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Study of Concrete Properties for Prestressed Concrete Reactor Vessels, Final Report, Part II: Creep and Strength Characteristics of Concrete at Elevated Temperatures

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STUDY OF CONCRETE PROPERTIES FOR PRESTRESSED CONCRETE REACTOR VESSELS

FINAL REPORT - PART II

CREEP AND STRENGTH CHARACTERISTICS OF CONCRETE AT ELEVATED TEMPERATURES

by

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REPORT TO
GENERAL ATOMIC COMPANY
SAN DIEGO, CALIFORNIA

APRIL 1976

COLLEGE OF ENGINEERING
UNIVERSITY OF CALIFORNIA
BERKELEY CALIFORNIA

Report

to

General Atomic Company

San Diego, California

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UC SESM 76-3

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April 1976

SUMMARY AND CONCLUSIONS

Presented in this Part II of the Final Report are results of Phase III, the final phase of a three-phase investigation on the properties of concrete for prestressed concrete reactor vessels (PCRV's). This test program was conducted at the University of California at Berkeley (UC) for the General Atomic Company (GA), in accordance with GA Specification 900670, Issue B, dated September 5, 1974. This third phase of the test program was concerned with the creep characteristics of high-strength concrete under long-term loads at temperatures up to 160 F and with the effects of thermal cycling and of elevated temperature on strength and mechanical properties of the concrete. Also determined were the thermal properties of the concrete, including adiabatic temperature rise. Results of Phase I and II of the test program, concerned with the evaluation of concrete-making materials and the development of concrete mixes used in Phase III, were presented in Part I of the Final Report, No. UC SESM 75-2, March 1975.

The two concrete mixes used in the creep studies contained either Berks (Mix G-19, 7.5 scy) or York (Mix G-26, 8.0 scy) crushed stone coarse aggregate of 1-1/2 in. maximum size, having 60-day compressive strengths of 7400 and 7620 psi, respectively. The same mixes were also used in other tests of Phase III with the exception of a York concrete (Mix G-25, 7.5 scy) having a 60-day strength of 7210 psi which was used in the thermal cycling phase of the test program. These strengths satisfy the requirement for PCRV concrete which has a specified strength of 6500 psi at age 60 days.

The creep study was made on Berks and York concretes at thirteen test conditions, identical for both concretes, which included loading sealed creep specimens to a 30 percent stress level at ages 28, 90, and 270 days at temperatures of 73, 110, and 160 F, and to a 45 and 60 percent stress level at age 90 days at temperatures of 73 and 160 F. Also tested at these test conditions were control specimens used for determining the autogenous volume change, drying shrinkage, and compressive strength of the concrete. The observed creep characteristics of the Berks and York concretes at the various test conditions were consistent with each other, with Berks concrete having somewhat higher total strains (elastic and creep strains).

The effect of temperature on the creep of concrete was to increase the total strain at the higher temperatures. Specimens under stress for one year

at 110 F at the 30 percent stress level had about 1.3 times the total strain of corresponding specimens tested at 73 F for all three ages of loading. At 160 F, the 30 percent stress level specimens loaded at 28 days had about 1.6 times and those loaded at 90 or 270 days had 2.1 times the total strain of the corresponding 73 F specimens after one year under load. Specimens loaded at 160 F to the 45 or 60 percent stress levels at age 90 days had a total strain about 2.2 times that of the corresponding specimens at 73 F.

The effect of the age at which specimens were loaded on the creep of concrete was the greatest for the early ages of loading and the 73 F temperature. The largest increase in total strain above that of the 270-day loaded specimens (about 1.3 times) occurred in concretes loaded at 28 days at 73 F. At 110 and 160 F, this average factor ranged from 1.0 to 1.1 for the 28 and 90-day ages of loading.

The effect of applying a greater level of stress on the concrete specimens was to increase the total strain per psi of applied stress. This total strain, after one year under stress at 73 F at the 45 and 60 percent stress levels, was about 1.05 and 1.2 times the strain of the 30 percent stress level specimens, respectively. At 160 F, the factor was 1.2 for the 45 percent and 1.3 for the 60 percent stress levels.

The actual applied stresses on the nominal 60 percent stress level specimens at 160 F were 4200 psi for Berks and 4250 psi for York concrete. These applied stresses, which were based on the 73 F strength, when expressed as a percentage of the concrete compressive strength at 160 F, corresponded to a 70 and 77 percent stress level for the Berks and York concrete, respectively. The concretes are satisfactorily sustaining these high constant stress values at 160 F after more than two years under load.

The effect of subjecting the concretes to one year of sustained stress at 73 or 110 F on their compressive strength and modulus of elasticity was negligible. Since the 160 F controls are still under observation, no comparison can be made of the 160 F creep specimen strengths with those of controls. However, the 160 F creep specimens tested to date had a somewhat lower strength and modulus of elasticity than the 73 or 110 F creep specimens.

The autogenous length change of both Berks and York concretes was about the same, being a contraction of the order of magnitude of 50 to 125 microstrains. Drying shrinkage strains of unsealed control specimens leveled off at the 400 to 600 micro-strain range, independent of the age at which the specimens were subjected to drying at the test temperatures of 73, 110, or 160 F. The compressive strength of these unsealed drying shrinkage control specimens was about 20 percent lower than that of the sealed controls at the end of the creep phase of testing.

Thermal cycling of sealed concretes from one to five 73-160-73 F temperature cycles commencing at age 90 days had no significant effect on their compressive strength, modulus of elasticity, splitting tensile strength, or Poisson's ratio. The linear coefficient of thermal expansion for the five cycles was 5.8 ($x 10^{-6}$ per °F) for Berks and 5.3 for York concrete.

The adiabatic temperature rise, determined only for Berks concrete, was 100 F during the 25 days of adiabatic curing. The initial temperature of the concrete was 48.6 F, and about 70 percent of the temperature rise occurred during the first 36 hours. The specific heat of the Berks and of the York concretes was about 0.25 Btu/lb/F, and the diffusivity was about 0.51 ft^2/hr.

The effect of testing at elevated temperature on compressive strength of sealed concretes was to yield strengths lower than those obtained when testing at 73 F. The strengths were from 3 to 11 percent lower at 110 F and from 11 to 22 percent lower at 160 F. Curing specimens at elevated temperature (up to 160 F) had the effect of increasing the compressive strength of the concrete with age.

In summary, the observed properties of both the Berks and York concretes can be considered satisfactory for use in a PCRV.

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GENERAL ATOMIC COMPANY

FINAL REPORT - PART II

on

PCRV Test Program - Phase III

CREEP AND STRENGTH CHARACTERISTICS OF CONCRETE AT ELEVATED TEMPERATURES

April, 1976

1. INTRODUCTION

Presented in this Final Report - Part II are the results of Phase III, the final phase of a three-phase investigation on the properties of concrete for prestressed concrete reactor vessels (PCRV's). Phase III primarily covered the creep characteristics of high strength concrete subjected to long-term sustained constant stress levels at elevated temperatures of up to 160 F, and the effects of thermal treatment on the properties of concrete. Results of Phases I and II, covering material evaluation and development of concrete mixes used in this Phase III, are given in Report No. UC SESM 75-2, entitled "Study of Concrete Properties for Prestressed Concrete Reactor Vessels, Final Report - Part I," March 1975. Final results for creep tests still in progress will be given approximately one year from now in an addendum to this Final Report. All tests in this investigation were carried out at the University of California at Berkeley (UC) for the General Atomic Company (GA) under PO 418058, following the test program given in GA Specification 900670, Issue B, dated September 5, 1974.

2. OBJECTIVE

The objective of this investigation was to develop concrete mixes having the strength and physical properties required by the design and construction specifications for PCRV's. Specifically, this investigation was to confirm the concrete properties used by GA in their design of the PCRV's for the Fulton Generating Station (Philadelphia Electric Company) and for the Summit Power Station (Delmarva Power and Light Company). Although both of these projects were cancelled in the Fall of 1975, GA decided to complete the test program and to apply these results to the design of future PCRV's.

3. TEST PROGRAM, TEST PROCEDURES AND RESULTS REPORTED

3.1 Test Program -- The test program for the investigation was divided into the following three phases:

Phase I - Materials' Selection and Evaluation

Phase II - Concrete Mix Development

Phase III - Concrete Long-Term Behavior

A complete description of the test program, summarizing the work done in all three phases, is given in Appendix A. In Phase I, the concrete making properties of three coarse aggregates, one fine aggregate, one portland cement, and three brands of water-reducing and retarding admixture were investigated. In Phase II, concrete mixes were developed using materials selected from Phase I tests to obtain the compressive strength specified in the design of PCRV's. Phase III testing included the determination of long-term creep characteristics of two concrete mixes developed in Phase II and the evaluation of the effect of thermal treatment on the properties of concrete. Creep characteristics were investigated at selected combinations of stress level, age at loading and temperature. The nominal stress levels were 30, 45 and 60 percent of ultimate strength, the ages at loading were 28, 90 and 270 days, and test temperatures were 73, 110 and 160 F. Thermal treatment included thermal cycling of specimens between 73 and 160 F for up to five cycles, adiabatic curing, prolonged curing at 160 F, and testing of specimens for compressive strength at 73, 110 and 160 F.

3.2 Test Procedures -- The test procedures used in this investigation are based on standard test methods which are described in Appendix B. Included are procedures used for material preparation, mixing concrete, determination of properties of fresh concrete, casting of specimens, preparation and storage conditions of sealed and moist-cured specimens, heating or cooling of specimens to test temperature and testing of specimens for compressive strength, modulus of elasticity, Poisson's ratio, splitting tensile strength, creep, autogenous length change, drying shrinkage, linear coefficient of thermal expansion and thermal properties. Also included as enclosures to Appendix B are UC methods of test for casting of creep specimens, calibration of Carlson strain meters, and testing for creep and thermal properties of concrete.

3.3 Results Reported -- The results reported in this Final Report - Part II include a description of the materials and mixes used to cast the Phase III specimens, the properties of hardened concrete including compressive strength, modulus of elasticity, creep, autogeneous length change, drying shrinkage and thermal properties, and the effect of thermal treatment and thermal cycling on mechanical properties of concrete.

4. CONCRETE MATERIALS AND PROPERTIES OF MIXES USED IN PHASE III

Three concrete mixes, designated Berks G-19, York G-25, and York G-26, were used to cast specimens in Phase III. The development of these mixes was done in Phase II and previously reported in Final Report - Part I. The concrete materials, mix proportions and properties of fresh and hardened concrete for these three mixes are summarized in Subsections 4.1 to 4.3.

4.1 Concrete Materials -- The following portland cement, fine aggregate, coarse aggregates and admixtures, identified by their brand name or source and the name of their producer, were used in Phase III of this test program:

Portland Cement: Medusa Type II, Low-alkali, Medusa Portland Cement Company, York, Pa.

Fine Aggregate: Belvedere quarry of Mason-Dixon Sand & Gravel, Perryville, Md., a Division of York Building Products, York, Pa.

Coarse Aggregates:
1) York quarry of York Stone & Supply Co, York, Pa.
2) Oley quarry of Berks Products Corp., Reading, Pa.

Admixtures:
1) Daratard 40, W. R. Grace & Co., Cambridge, Mass.
2) Pozzolith 300R, Master Builders, Cleveland, Ohio.

Numerous shipments of cement, aggregate and admixture were received over a two-year period as the test program progressed. To ensure uniformity and a sufficient quantity of concrete materials for making specimens throughout Phase III, several of these shipments of a given material were blended prior to the start of Phase III. A brief description of the properties of materials used in Phase III is given below. Material properties for each shipment received are given in Final Report - Part I.

4.1.1 Cement -- Two shipments of Medusa Type II cement, designated shipments "A" and "B", were batched in a 1:1 proportion to assure a uniform amount of each shipment in every concrete batch of Phase III. The chemical composition and physical properties for these two shipments are given in Table 1. Mill reports provided by the manufacturer are given in Appendix D. As reported in Final Report - Part I, the strength-gaining characteristics of shipment B cement were superior to those of shipment A, due primarily to a difference in chemical composition. UC recommended that a cement having similar characteristics to those of shipment B be used in the construction of the PCRV's; however, in order to obtain conservative test results, GA decided to use the 1:1 blend of the two shipments in this phase of the investigation.

4.1.2 <u>Fine Aggregate</u> -- A blend of three shipments of Mason-Dixon natural sand was used in all of the concrete mixes of Phase III. There were no significant differences in properties between the shipments. This blended sand had a fineness modulus of 2.87, a specific gravity of 2.63 and an absorption of 0.8 percent. The gradation of the sand complied with ASTM C 33 and is given in Table 2. Results of a petrographic examination, Appendix D, indicate that the sand is composed of angular particles of quartz and does not contain any deleteriously reactive substances.

4.1.3 <u>Coarse Aggregate</u> -- Two crushed stone coarse aggregates, Berks and York, were used in the concrete mixes of Phase III. The aggregates were batched in two sizes, ASTM C 33, size #67 (3/4 in. to No. 4) and ASTM C 33, size #4 (1 1/2 to 3/4 in.). The combined gradations of Berks and York aggregates, as used in Phase III, complied with ASTM C 33, size #467 and are given in Table 2. Both aggregates were a blend of three shipments and had similar properties. The specific gravity was 2.75 and the absorption was 0.5 percent. Results of the petrographic examination, Appendix D, indicate that both aggregates are composed of calcitic dolomites and dolomitic limestones suitable for PCRV construction but that the dolomite content and texture of both aggregates are similar to those known elsewhere to be potentially reactive with cement alkalies. A discussion by GA on the potential reactivity of these aggregates, in Appendix D, concludes that the aggregates will not cause deleterious expansions in the PCRV concrete.

4.1.4 <u>Admixtures</u> -- Two brands of Type D (ASTM C 494) water-reducing and retarding admixture, Daratard 40 and Pozzolith 300R, were used in Phase

III. The shipments of Daratard 40 and Pozzolith 300R are identified by their receipt dates, 4/27/73 and 4/9/73, respectively.

4.2 Mix Proportions and Properties of Fresh Concrete -- The specified compressive strength of the PCRV concrete was 6500 psi at age 60 days, and GA specified that the laboratory mix developed for use in the construction of the PCRV should attain a 60-day moist-cured cylinder strength of at least 7700 psi. As reported in Part I of the Final Report, mixes Berks G-19 and York G-25 met this requirement when shipment B cement was used (producing 60-day compressive strengths of 8190 and 7990 psi, respectively) and were thus initially selected for use in Phase III tests. However, when the blend of shipments A and B cement was used in the same mixes, the 60-day compressive strengths were only 7400 and 7210 psi, respectively.

After evaluation of the strength data, GA decided to use mix G-19 for all Berks specimens of Phase III, mix G-25 for York thermal cycling specimens of Phase III(c) and mix G-26 for all other York specimens of Phase III. Mix G-26 had produced a 60-day compressive strength of 8530 psi with shipment B cement and 7620 psi with the 1:1 blend of shipments A and B. It was felt that the use of these mixes was justified since concrete having compressive strength somewhat below 7700 psi would produce conservative test results with respect to long-term properties of PCRV concrete.

All three mixes, Berks G-19, York G-25, and York G-26, were proportioned to produce a concrete of good workability, having a 4 1/2 ± 1/4 in. slump. The concrete materials were cooled prior to mixing to obtain freshly mixed concrete having a temperature of 50 ± 3 F. The mix proportions and properties of fresh concrete used to cast the Phase III specimens are given in Table 3 for the Berks concrete and in Table 4 for the York concretes. A summary of the mix proportions and properties of fresh concretes for the three mixes is given in the tabulation on the following page. Prior to PCRV construction, these mixes should be verified and, if necessary, adjusted in the field using full batches and the equipment selected for production of PCRV concrete.

It should be mentioned that prior to casting of Phase III specimens, mix Berks G-19 was tested by GA for pumpability in a full-scale field test. The mix had good workability and pumped well with a slump as low as 2 1/2-in. through a 5-in. I.D. steel line.

MIX PROPORTIONS AND PROPERTIES OF SELECTED MIXES - PHASES II(c) AND III

	Berks G-19	York G-25	York G-26
I. Mix Proportions, lbs/cy			
Cement, Medusa Type II	706	703	756
Water (Incl. Admixture)	269	270	290
Sand, Mason-Dixon	1224	1210	1249
C.A., 3/4 in. to No. 4	887	1004	993
C.A., 1 1/2 to 3/4 in.	952	813	804
Total	4038	4000	4092
Admixture	Daratard 40 8.0 fl.oz./100 lbs	Daratard 40 8.0 fl.oz./100 lbs	Pozzolith 300R 3.5 fl.oz./100 lbs
II. Properties of Fresh Concrete			
Cement Content, scy	7.5	7.5	8.0
Water-Cement Ratio, by wt.	0.381	0.384	0.384
Slump, in.	4 1/2	4 3/4	4 1/4
Air Content, %	4.5	4.9	2.2
Temperature, F	50	50	50
Unit Weight, pcf	149.6	148.2	151.6
Sand Content, % by wt.	40	40	41

4.3 Properties of Hardened Concrete - Selected Mixes -- The properties of hardened concrete for mixes Berks G-19, York G-25, and York G-26 were determined in Phase II(c) of the test program and were reported in the Final Report - Part I. These test results will be referred to in this Final Report - Part II as those of the selected mixes. Phase II(c) selected mix values of compressive strength, modulus of elasticity, Poisson's ratio, splitting tensile strength and percentage of coarse aggregate fractured, for both sealed and moist-cured 6 by 12-in. concrete specimens cured and tested at 73 F, are given in Table 5 for Berks G-19 concrete and in Table 6 for York G-25 concrete. Compressive strength, modulus of elasticity and Poisson's ratio for York G-26 concrete are given in Table 7.

4.3.1 Compressive Strength -- The compressive strength of the three selected concretes are summarized in the tabulation on the following page. As already stated in Subsection 4.2, the moist-cured 60-day strengths are somewhat below the 7700 psi mix design strength desired for construction, but well above the specified strength of 6500 psi.

COMPRESSIVE STRENGTH OF SELECTED CONCRETE MIXES, PSI

Age, days	Sealed Specimens			Moist-Cured Specimens		
	Berks G-19*	York G-25	York G-26*	Berks G-19*	York G-25	York G-26*
	7.5 scy**		8 scy†	7.5 scy**		8 scy†
7	5230	4730	....	5230	4730	5060
28	6590	6280	6280	6560	6570	6660
60	7180	6820	6780	7400	7210	7620
90	7510	7180	7200	7960	7630	8030
180	7790	7600	....	8200	8190	....
270	8220	7730	8200	8430	8430	8900
365	8400	8080	....	8850	8680	9130
730	8930	8670	....	9650	9380	9500

*Selected mixes for casting of Phase III creep specimens.
**Daratard 40 admixture.
†Pozzolith 300R admixture.

Shown in Figures 1 and 2, for Berks G-19 and York G-26, respectively, are compressive strength curves for the sealed and moist-cured concrete specimens. A comparison of percent gain in compressive strength above the 60-day strength of Berks G-19, York G-25, and York G-26 concretes is given in the following tabulation:

PERCENT GAIN IN COMPRESSIVE STRENGTH OF CONCRETE AFTER AGE 60 DAYS

Age, days	Sealed Specimens			Moist-Cured Specimens		
	Berks G-19	York G-25	York G-26	Berks G-19	York G-25	York G-26
	7.5 scy*		8 scy**	7.5 scy*		8 scy**
60	7180 psi	6820 psi	6780 psi	7400 psi	7210 psi	7620 psi
90	5	5	6	8	6	5
180	8	11	..	11	14	..
270	14	13	21	14	17	17
365	17	18	..	20	20	20
730	24	27	..	30	30	25

*Daratard 40 admixture.
**Pozzolith 300R admixture.

The 730-day compressive strength of sealed concretes increased by about 25 percent over the 60-day strength while for moist-cured concretes this increase was about 28 percent.

4.3.2 Modulus of Elasticity -- The moduli of elasticity for the three selected concretes, obtained on moist-cured specimens, are summarized in the following tabulation:

MODULUS OF ELASTICITY OF SELECTED MOIST-CURED CONCRETES, E x 10^6 PSI

Age, days	Berks G-19	York G-25	York G-26
	7.5 scy		8 scy
28	6.3	6.0	6.0
60	6.3	6.0	6.1
90	6.4	6.2	6.4
270	6.5	6.1	6.3
730	6.5	6.4	6.5

It will be noted in Tables 5, 6, and 7 that the modulus of elasticity of sealed specimens was about 0.2 x 10^6 psi lower than the modulus of corresponding moist-cured specimens.

4.3.3 Splitting Tensile Strength -- The splitting tensile strength up to age 730 days for the Berks G-19 and York G-25 concretes are summarized in the following tabulation along with the tensile strength expressed as a percentage of the corresponding compressive strength.

SPLITTING TENSILE STRENGTH OF SELECTED CONCRETES, PSI

	Sealed Specimens, 7.5 scy				Moist-Cured Specimens, 7.5 scy			
	Berks G-19		York G-25		Berks G-19		York G-25	
Age, days	Tens. Str. psi	% of Compr. Str.	Tens. Str. psi	% of Compr. Str.	Tens. Str. psi	% of Compr. Str.	Tens. Str. psi	% of Compr. Str.
7	480	9	470	10	520	10	510	11
28	645	10	550	9	550	8	610	9
60	630	9	640	9	630	9	710	10
90	630	8	680	9	690	9	700	9
180	660	8	645	8	680	8	730	9
270	715	9	760	10	730	9	760	9
730	725	8	680	8	790	8	760	8

The tensile strength for moist-cured and sealed concretes cast from Berks G-19 and York G-25 mixes averaged to be about 9 percent of the compressive strength of corresponding specimens. The percentage of coarse aggregate fractured for both of the mixes averaged about 65 percent, with highest percentages observed for the 730-day tests.

5. CREEP CHARACTERISTICS OF CONCRETE - PHASES III(a) AND III(b)

Creep characteristics of concrete were determined using mixes Berks G-19 and York G-26. The test conditions, identical for both Berks and York concretes, included the determination of total strains of sealed concrete subjected to sustained constant stress, autogenous length changes of sealed concrete, drying shrinkage strains of unsealed concrete, and the compressive strength of concrete at loading ages and test temperatures corresponding to creep test conditions. This series of tests satisfies the test conditions described in Appendix A for Phases III(a) and III(b).

5.1 Test Conditions -- The creep of concrete was determined under thirteen combinations of temperature, applied stress level and age at loading. These test conditions, identical for both Berks and York concrete, are described in Appendix A and are summarized in the following tabulation:

CREEP TEST CONDITIONS

Temperature, F	Nominal Stress Level, % of Ult. Strength	Age at Loading, days
73	30	28, 90, 270
73	45, 60	90
110	30	28, 90, 270
160	30	28, 90, 270
160	45, 60	90

The specimens tested at 110 and 160 F were cured at 73 F, alongside specimens to be tested at 73 F, until five days prior to the age of loading. The specimens were then heated to test temperature at a rate of 24 F per day following the test procedure described in Appendix B. All creep specimens were at test temperature for a minimum of 24 hours prior to their loading and remained within ± 3 F of this temperature for the duration of the creep test phase.

5.2 Creep Specimens and Their Controls -- A total of 60 sealed 6 by 16-in. specimens were cast for each concrete, Berks G-19 and York G-26. Of these 60 specimens, 39 were used for creep tests and 21 were used as creep control specimens. Three creep specimens were subjected to a constant applied stress at each of the thirteen creep test conditions. Of the 21 control specimens, three were kept at 73 F and three each were heated to 110 or 160 F alongside corresponding creep specimens prior to the loading at 28, 90, or 270 days. After loading the corresponding creep specimens, one of the three controls was unsealed and used for determination of drying shrinkage strains. The remaining two controls were kept sealed and used for determination of autogenous length change. At 73 F, the two autogenous length change specimens were used as controls for all three ages of loading because the specimens were not subjected to a temperature change. The drying shrinkage specimen at 73 F was unsealed at age 28 days.

The creep and control specimens were each instrumented with one embedded 4-in. gage length Carlson strain meter. Butyl rubber was used to seal all specimens against moisture loss. The manufacturer's description of the strain meter is included in Appendix B.

Creep specimens are inventoried in Tables 8, 9, and 10 for specimens at 73, 110, and 160 F, respectively. The control specimens are inventoried in Table 11. Individual specimens are identified by their Carlson meter numbers and switching positions associated with the data acquisition system. This switching position is referred to as channel number.

5.3 Creep Companion Compression Specimens -- A total of 45 sealed 6 by 12-in. compressive strength specimens were cast alongside the creep specimens for each concrete, Berks G-19 and York G-26. These creep companion compression specimens were used to determine the compressive strength of the creep specimen concrete at age 7 days at 73 F and then at each age of loading and temperature specified for the creep specimens, with three companion specimens tested for each condition.

The creep specimens stressed to a nominal 30 percent of ultimate strength thus had a total of twelve sets of companion compression specimens cast for testing at 73, 110, or 160 F at age 7, 28, 90 and 270 days. Creep specimens stressed to 45 and 60 percent had a total of three sets of companion compression specimens cast, with two sets tested at 73 F (7 and 90 days) and one set tested at 160 F (90 days). The companion 6 by 12-in. specimens tested at 110 F and 160 F were heated to the test temperature alongside the creep specimens at a rate not exceeding 24 F per day.

The compressive strengths obtained for the Berks and York concrete are given in Tables 12 and 13, respectively. A discussion of the effect of test temperature on compressive strength of the concrete is given in Section 8 and shows that the compressive strength decreases with increase in test temperature.

5.4 Applied Stress Levels and Duration of Stress -- All creep specimens were stressed to a nominal 30, 45 or 60 percent of the 73 F ultimate strength of the concrete. The ultimate strength was determined at the loading age of the creep specimens, specifically at 28, 90, or 270 days. For specimens stressed to a nominal 30 percent of 73 F ultimate strength, two test pressures were used. These pressures were 2100 psi for specimens loaded at age 28 or 90 days and 2400 psi for specimens loaded at age 270 days. For specimens stressed to a nominal 45 or 60 percent stress level, the applied stresses were 3200 and 4200 psi for Berks concrete and 3190 and 4250 psi for York concrete, respectively. The test pressures were applied and maintained by hydraulic loading systems which are described in detail in Appendix B.

The effective stress level at a given age of loading and test temperature was determined from the compressive strength of creep companion compression specimens. The average compressive strength of these companion specimens is given in Tables 12 and 13. Because the compressive strength of the concretes tested at 110 and 160 F is lower than when tested at 73 F (see Section 8), the effective stress level applied to the concretes at these elevated temperatures is higher. The effective stress levels for each test condition are summarized in the following tabulation.

APPLIED STRESS LEVEL ON CREEP SPECIMENS
(Percent of 73 F Ultimate Strength)

Age at Loading	Applied Stress, psi	Test Temperature, F 73	110	160
I. 30 percent nominal stress level specimens				
28	2100	33, 34*	34, 36	38, 39
90	2100	29, 30	31, 33	36, 36
270	2400	30, 30	33, 33	39, 38
II. 45 percent nominal stress level specimens				
90	3220, 3190*	46, 45*	----	54, 58
III. 60 percent nominal stress level specimens				
90	4200, 4250*	60, 60*	----	70, 77

*The first value shown is for Berks G-19 specimens and the second value is for York G-26 specimens.

The effective stress level for specimens stressed to a nominal 30 percent of 73 F strength is increased by about 3 percentage points when the specimens are stressed at 110 F and by about 8 percentage points when stressed at 160 F. For specimens stressed to a nominal 45 and 60 percent of the 73 F strength, the effective stress level at temperature of 160 F is about 10 to 17 percentage points higher. The highest effective stress level was 77 percent for York specimens stressed at 160 F to 60 percent of the 73 F ultimate strength.

Of the twenty-six groups of creep specimens tested, nine groups are still under observation and seventeen groups have been unloaded with all subsequent testing completed. The specimens still under observation are scheduled for unloading after approximately 1000 days under stress. All unloaded specimens were under an applied stress for a minimum of 365 days. The durations of applied stress are shown in Table 16.

5.5 Computer Output of Test Data -- The test data for creep and their control specimens was recorded and reduced by means of a computerized data acquisition system described in Appendix B. The computer output of test data is presented in three basic forms; an individual output for each specimen, an averaging output for the three creep specimens at each test condition or for the two sealed control specimens (with data also shown for the unsealed control specimen at the same test condition) and a summarizing output of the averaged creep and sealed control specimen results for a given test condition. The averaging and summarizing outputs are given in Appendix C with only an example of an individual creep and control specimen output shown. The individual outputs for all specimens have been given to GA under separate cover. The information and data provided on each of the three basic outputs are summarized at the beginning of Appendix C. The outputs include all meter constants, description of test conditions, original data and the date they were taken, age and time under load at time data were taken, total micro-strains from time loading begins and from time after full load is applied, the total micro-strain values divided by the applied stress, creep strains, autogenous value strains, drying shrinkage strains, specific creep, and effective modulus of elasticity (applied stress divided by total micro-strain after full load).

5.6 Total Strains in Concrete Under Applied Constant Stress -- The strains discussed in this section are total strains in concrete subjected to constant compressive stress and include elastic and creep strains as well as autogenous length changes from the age of loading onward. All strains are shown in the computer output in Appendix C. The 0, 1, 10, 100 and 365-day total strains, from time of loading, are summarized in Table 14 for all 26 creep tests. The 0-day strains correspond to the loading strains. The total strains versus age of concrete are shown in Figures 3 to 8. The 40-year predictions (age 14,600 days) of total strain are given in Table 14 and were obtained by straight line extrapolation of the log-log curves of total strain per psi of applied stress versus time under stress, shown in Figures 9 to 15.

Three sealed 6 by 16-inch specimens were tested at each test condition. The consistency of strain readings between these three specimens is discussed in the next subsection. This is followed by a discussion of total strains and of total strains per psi of applied stress.

5.6.1 Consistency of Strain Readings -- The percent variation of each specimen's strain from the average of the three specimens' strains for a given test condition was calculated for all readings and used as a consistency check for the data reported. This percent variation was computed with the aid of a computer program. A sample output of the consistency check data is shown in Appendix C, and the average individual specimen's percent variation from the average is shown for all specimens in Tables 8, 9, and 10. The consistency between specimens was considered good if all individual specimens showed strains within 5 percent of the average. Of the 78 specimens under observation, 77 had strains within 5 percent of the average values reported and one specimen had a 7 percent variation. The good consistency between specimen strains can be attributed to the meter calibration checks performed at UC, the care taken in casting the specimens, and the determination of a specimen-meter factor prior to loading and after unloading as discussed in Appendix B. The specimen-meter factor is a calibration factor which correlates strains measured internally by the embedded meter with strains measured externally by a compressometer. A discussion of the Carlson meter performance is included in Appendix C. In general, the Carlson meter performed well at 73 and 110 F and fair at 160 F. Several failures of the meter occurred at 160 F well within the calibrated range of the meter. These failures were detected by an increase in meter resistance which thus indicated incorrect high temperatures for the meter. No readings are shown for meters after this increase in resistance occurred.

5.6.2 Total Strain in Concrete Loaded to the 30% Stress Level -- The total strains of the Berks and York concretes loaded at 28, 90, and 270 days to the nominal 30 percent stress level versus the age of concrete are shown in Figures 4, 5, and 6 for test temperatures of 73, 110, and 160 F, respectively. In general, the highest strains were obtained for concrete tested at the highest temperature (160 F) and at the earliest age of loading (28 days). The effect of temperature and of the age of loading on total strain in concrete are discussed in Sections 5.8 and 5.9.

At 73 F (Figure 4) and 110 F (Figure 5) Berks and York concretes had similar creep characteristics, with Berks concrete having slightly higher strains. Total strains for the two concretes and three ages of loading after 365 days under constant compressive stress ranged from 680 to 825 micro-strain at 73 F and from 918 to 1007 micro-strain at 110 F (Table 14). Forty-year predictions for total strain at 73 F and 110 F ranged from 1100 to 1400 micro-strain and 1600 to 1800 micro-strain, respectively. Included in these total strains are the elastic loading strains ranging from 340 to 404 micro-strain for the two concretes at the two test temperatures and three ages of loading.

At 160 F (Figure 6) Berks concrete had higher strains than the York concrete for all three ages of loading. After 365 days under stress, the total strain of Berks concrete was 1415 to 1558 micro-strain for the three ages of loading and that of York concrete 1230 to 1425. Forty-year predictions of total strain range from 3250 to 3600 for Berks and from 2650 to 3000 micro-strain for York concrete. The elastic loading strains were about the same for both concretes, ranging from 396 to 462 micro-strain.

5.6.3 Total Strains in Concrete Loaded at 90 days to the 30, 45, or 60% Stress Level -- The total strains in concrete loaded at 90 days to the nominal 30, 45, or 60 percent stress levels versus the age of concrete are shown in Figures 7 and 8. Figure 7 shows the total strains obtained at 73 F and Figure 8 the total strains at 160 F. It should be noted that the strains in Figure 8 are shown at half the scale to those of Figures 4 to 7. In general, the total strains in both concretes at the 45 and 60 percent stress levels were, respectively, about 1.6 to 1.9 and 2.4 to 2.8 times higher than those at the 30 percent stress level. The highest increase in strain above the 30 percent stress level strain occurred for York concrete loaded to the 45 and 60 percent stress levels at 160 F. Overall, Berks concrete had slightly higher strains than did York concrete at both test temperatures and all three stress levels. The effect of temperature and of stress level on total strains of concrete are discussed in Sections 5.8 and 5.10, respectively.

At 73 F (Figure 7) total strains obtained after 365 days under stress at the 30, 45, or 60 percent stress levels were 700, 1131, and 1654 micro-strain for Berks concrete and 680, 1071, and 1667 micro-strain for York concrete, respectively. The forty-year predictions of total strain in Berks and York concretes (Table 14) loaded to the 30, 45, or 60 percent stress levels at 73 F were 1100 to 1200, 1900, and 2600 to 2700 micro-strain, respectively.

At 160 F (Figure 8) total strains obtained after 365 days under stress at the 30, 45, or 60 percent stress levels were 1558, 2713, and 3868 micro-strain for Berks concrete and 1320, 2505, and 3757 micro-strain for York concrete, respectively. The forty-year predictions of total strain at 160 F were 3300, 6100, and 9550 for Berks concrete and 2700, 4750, and 7300 micro-strain for York concrete at the 30, 45, and 60 percent stress levels, respectively. The 9550 micro-strain prediction of total strain in Berks concrete loaded to the 60 percent stress level at 160 F appears high and could only be confirmed by tests over a longer period of time using instrumentation capable of measuring large strains.

5.7 Total Strain Per Unit of Applied Constant Stress -- The total strain per psi of applied constant stress was obtained by dividing the measured total strains discussed in Section 5.6 by the applicable applied stress given in Section 5.4. All total strains per psi are shown in the computer output in Appendix C. The 0, 1, 10, 100, and 365-day values are given in Table 15 for all 26 creep test conditions. The total strain per psi of applied stress of concrete versus age are shown in the log-log curves of Figures 9 to 15. The 0-day strains per psi correspond to the loading strains per psi in Table 15 and are shown as the 1-day (age zero plus one day to facilitate log plot) values in Figures 9 to 15. The discussion of total strain per psi of applied constant stress is included in the following sections on the effect of temperature, age of loading, and applied stress level on total strain in concrete.

The forty-year predictions (age 14,600 days) for total strain per psi are given in Table 14 and were obtained by straight line extrapolation of the curves in Figures 9 to 15. For Berks and York concretes loaded to the 30 percent stress level, these predicted total strains per psi at the three ages of loading ranged from 0.43 to 0.66 at 73 F, from 0.71 to 0.81 at 110 F, and from 1.25 to 1.56 at 160 F.

5.8 Effect of Temperature on Total Strain of Concrete -- The effect of temperature (73, 110, and 160 F) on total strain of concrete per psi of applied constant stress is shown in Figures 9, 10, and 11 for concrete loaded to a nominal 30 percent stress level at 28, 90, and 270 days, respectively, and in Figure 12 for concrete loaded to a nominal 30, 45, or 60 percent stress level at 90 days. As can be observed from the curves in these figures, the total strain per psi of applied stress increases with increase in temperature. This is true for all ages of loading and applied stress levels.

For concrete loaded to the nominal 30 percent stress level (Figures 9 to 11), the effect of temperature increase on total strain varied slightly for Berks and York concretes. The increase of strains at 110 and 160 F above the strains at 73 F are shown in the following tabulation for 10 and 365 days under stress.

EFFECT OF TEMPERATURE ON TOTAL STRAIN OF CONCRETE LOADED TO THE 30 PERCENT STRESS LEVEL

Days Under Stress	Age of Loading, days	Total Strain/psi 73 F		Strain Factors (based on 73 F)* 110 F		160 F	
		Berks	York	Berks	York	Berks	York
10	28	0.260	0.251	1.12	1.27	1.23	1.24
	90	0.219	0.218	1.25	1.31	1.57	1.50
	270	0.200	0.200	1.25	1.38	1.65	1.59
365	28	0.393	0.372	1.17	1.25	1.72	1.58
	90	0.333	0.324	1.32	1.35	2.23	1.94
	270	0.298	0.296	1.44	1.42	2.23	2.01

*Strain per psi at 110 or 160 F is obtained by multiplying the strain factor by the 73 F strain per psi.

At 110 F Berks concrete tended to have lower strain per psi factors than York concrete. At 160 F the strain per psi factor for Berks concrete increased at a faster rate than it did for the York concrete. On the average, the increase in strains at 110 F was about 1.3 times the strain at 73 F for both concretes. At 160 F greater differences were obtained dependent upon age of loading and time under stress. After ten days under stress, the increase in strains at 160 F was about 1.5 times the strain at 73 F and after 365 days under stress, ranged from 1.58 to 2.30 times the strain at 73 F. The effect of age of loading is discussed in Section 5.9.

For concretes loaded to the nominal 45 or 60 percent stress levels at age 90 days (Figure 12), the increase in total strains per psi at 160 F above the 73 F values are shown in the following tabulation for ages 10 and 365 days.

EFFECT OF TEMPERATURE ON TOTAL STRAIN OF CONCRETE LOADED TO THE 45 OR 60 PERCENT STRESS LEVEL AT 90 DAYS

Days Under Stress	Total Strain per psi 73 F, 45% Berks	73 F, 45% York	73 F, 60% Berks	73 F, 60% York	Strain Factors (based on 73 F)* 160 F, 45% Berks	160 F, 45% York	160 F, 60% Berks	160 F, 60% York
10	0.235	0.227	0.265	0.274	1.55	1.81	1.82	1.92
365	0.351	0.336	0.394	0.392	2.40	2.34	2.34	2.26

*Strain per psi at 110 or 160 F is obtained by multiplying the strain factor by the 73 F strain per psi.

At 160 F after 10 days under stress, Berks concrete had considerably lower strain per psi factors than did the York concrete, but after 365 days under stress, Berks concrete had the higher factors. A similar trend was also observed for concrete loaded to the 30 percent stress level. The effect of stress level on total strain per psi is discussed in Section 5.10.

5.9 Effect of Age of Loading on Total Strain of Concrete -- The effect of age of loading (28, 90, and 270 days) on total strain of concrete per psi applied constant stress is shown in Figures 13, 14, and 15 for concretes loaded at 73, 110, and 160 F, respectively. As can be observed from the curves in these figures, the age of loading has the greatest effect on total strain per psi at 73 F and considerably less effect at 110 and 160 F. Using the 270-day age of loading values as the basis for comparison, the increase in strains per psi for concretes loaded at 28 and 90 days is shown in the following tabulation for 10 and 365 days under stress.

EFFECT OF AGE OF LOADING ON STRAIN OF CONCRETE

Days Under Stress	Temp., F	Total Strain/psi 270-day Berks	270-day York	Strain Factors (based on 270 days)* 28-day Berks	28-day York	90-day Berks	90-day York
10	73	0.200	0.200	1.30	1.26	1.10	1.09
	110	0.250	0.275	1.17	1.16	1.10	1.04
	160	0.329	0.318	0.97	0.98	1.04	1.03
365	73	0.298	0.296	1.32	1.26	1.12	1.09
	110	0.429	0.420	1.07	1.11	1.03	1.04
	160	0.663	0.594	1.02	0.99	1.12	1.06

*Strain per psi at 28 or 90 days is obtained by multiplying the strain factor by the 270-day strain per psi.

The effect of the age of loading on total strain of concrete is minimized as the age of loading increases and as the temperature at which the stress is applied increases. The greatest increase in strain per psi above the 270-day loading values occurred in concretes loaded at 28 days at 73 F (average factor of 1.29). For concretes loaded at 28 days at 110 and 160 F, the average factors were 1.13 and 0.99, respectively. For concretes loaded at 90 days at 73, 110, or 160 F, the average factor was 1.07. When comparing the strain factors for 10 and for 365 days under stress, the period under load appears to have little effect on these factors.

5.10 Effect of Stress Level on Total Strain of Concrete -- The effect of stress level (30, 45, or 60 percent) on total strain of concrete per psi applied constant stress can be observed in Figure 12 for concretes loaded at 90 days at 73 or 160 F. Using the 30 percent stress level values as the basis for comparison, the increase in strain per psi for concretes stressed to the 45 and 60 percent stress levels is shown in the following tabulation for 10 and for 365 days under stress.

EFFECT OF STRESS LEVEL ON TOTAL STRAIN OF CONCRETE
LOADED AT AGE 90 DAYS

Days Under Stress	Temp., F	Total Strain/psi 30% Berks	Total Strain/psi 30% York	Strain Factors (based on 30% stress level)* 45% Berks	45% York	60% Berks	60% York
10	73	0.219	0.218	1.07	1.04	1.21	1.26
	160	0.343	0.326	1.06	1.26	1.40	1.62
365	73	0.333	0.324	1.05	1.04	1.18	1.21
	160	0.742	0.629	1.13	1.25	1.24	1.41

*Strain per psi for the 45 or 60% stress level is obtained by multiplying the strain factor by the 30% stress level values of strain per psi.

At 73 F the effect of applying an increased level of stress on total strain per psi was about the same for Berks and York concrete, with the period under load having no significant influence. The strains per psi factor were about 1.05 and 1.21 for the 45 and 60 percent stress levels, respectively.

At 160 F the effect of applying an increased level of stress was less for Berks concrete than for York concrete. For the 45 percent stress level, the strain per psi factors were about 1.09 for Berks and 1.26 for York concrete. For the 60 percent stress level, the strain per psi factors varied in the period under load, being higher during the early period under load, as shown in the above tabulation.

5.11 Effect of Heating on Strain of Concrete under Stress -- Berks concrete stressed at 73 F to the nominal 30 percent stress level at age 270 days was subjected to 110 F at age 544 days while the constant applied stress level of 2400 psi was continuously maintained. The concrete was thus under stress at 73 F for 273 days and then under stress at 110 F for 92 more days at which time it was unloaded (age 636 days). The total strains for this Berks concrete are shown in Figure 4 and the strains per psi are shown in Figures 11 and 13. A considerable increase in strains occurred due to this increase in temperature. Prior to subjecting the concrete to 110 F, the total strain after 273 days under stress at 73 F was 639 micro-strain (0.266 micro-strain per psi). Then after the 92 days of applied stress at 110 F (a total of 365 days under stress), the total strain was 889 micro-strain (0.370 micro-strain per psi). Although the time under stress at 110 F was only 92 days, it appears from Figure 11 that the strains per psi for this concrete heated to 110 F would have approached magnitudes of strain per psi similar to the concrete tested continuously at 110 F.

5.12 Effect of Reducing the Applied Stress Level -- Berks concrete loaded to the 45 percent stress level (3220 psi) at 160 F and York concrete loaded to the 60 percent stress level (4250 psi) at 73 F had their applied loads reduced to the 30 percent stress level (2100 psi) after 404 and 390 days, respectively. The resulting total strains are given in the computer output in Appendix C and are shown in Figure 8 for Berks concrete and in Figure 7 for York concrete. Berks concrete was subjected to the reduced stress level (from 3220 to 2100 psi) for 33 days, during which time the concrete had a creep recovery of about 40 micro-strains. York concrete was subjected to the reduced stress level (from 4250 to 2100 psi) for 28 days and had a net creep recovery of 54 micro-strains.

5.13 Strain Recovery After Unloading -- Strain recovery was observed for eleven of the seventeen groups of creep specimens unloaded at the time of this final report. Total strains during recovery are given on the computer outputs in Appendix C and are given for 0, 1, 10, and 90 days after unloading in Table 16. The 0 age total strain at recovery refers to the total strain at time of initial zero stress during unloading. Also included in Table 16 are the applied stresses, durations of stress in days, total number of days recovery was observed, and the total strain prior to unloading.

The strains during recovery are shown in Figures 3 to 8 with the strain recovery values summarized in the following tabulation.

STRAIN RECOVERY AFTER UNLOADING

Age at Loading, days	Applied Stress, psi	Recovery Temp., F	Duration of Stress, days	Strain, micro-strain Unload	Days of Recovery 1	10	90
I. Berks Concrete							
28	2100	110	487	315	37	63	93
90	2100	110	425	313	39	68	98
	2100	160	398	384	53	90	172
90	3220	73	404	467	71	110	163
90	4200	73	404	639	87	140	211
270	2400	(73),* 110	365	370	54	73	...
	2400	110	398	362	49	84	136
II. York Concrete							
28	2100	73	459	311	32	59	101
90	2100	110	378	311	38	65	99
90	(4250),**2100	73	418	347	60	97	..
270	2400	73	365	364	21	56	..

*Under stress 273 days at 73 F and 92 days at 110 F.
**Under 4250 psi for 390 days and 2100 psi for 28 days.

For the seven groups of specimens for which creep recovery at 73 or 110 F was observed for a period of 90 days, about 39 percent of the 90-day creep recovery occurred during the first day and 65 percent occurred within 10 days after unloading, independent of the previous applied stress level. At 160 F only one group's creep recovery was observed. This group had 31 and 52 percent of the 90-day creep recovery at 1 and 10 days, respectively, after unloading.

5.14 Autogenous Length Change -- Seven sets of three sealed creep control specimens were cast for Berks and for York concretes. The creep test conditions for which the controls were used and the listing of all individual controls are given in Table 11. Two of the three controls were kept sealed and used to measure autogenous length change. The third control was unsealed and used to determine the drying shrinkage of the concrete as discussed in Section 5.15.

The autogenous length changes, expressed in micro-strains, are given for each control specimen in the computer outputs in Appendix C and averaged for the two controls in Table 17 at times of 0, 10, 100, 200, and 365 days after the concrete reached test temperature. Also, the autogenous strains versus age of concrete are shown in Figures 16, 17, and 18 for concretes under observation at 73, 110, and 160 F, respectively.

As can be observed from the curves in these figures, both concretes had an autogenous contraction of about 50 to 125 micro-strains, except for the 175 micro-strain value obtained on the 110 F, Berks 90-day specimens, which may indicate some loss of moisture. After reaching test temperatures of 110 and 160 F, the concretes had an initial autogenous expansion of about 50 micro-strains after experiencing contraction while curing at 73 F. These autogenous length changes are assumed to be also present in the concrete under load and are thereby included in the total strains discussed in Section 5.7.

5.15 Drying Shrinkage of Unsealed Concrete -- Of the seven groups of three sealed creep control specimens cast for Berks and York concretes, one of the three controls was unsealed and used to determine the drying shrinkage strains from the age of unsealing. The test temperatures and the ages of unsealing corresponded to those of the creep tests (Table 18), except the Berks concrete specimen at 160 F and the York concrete specimen at 110 F, scheduled for unsealing at 90 days, were unsealed at 191 days. The relative humidity was maintained at 50 percent in the 73 F room and averaged about 10 percent in the 110 and 160 F rooms, where it was not controlled.

The drying shrinkage strains of the unsealed concretes are given in the computer outputs in Appendix C and are summarized in Table 18 for times 0, 1, 10, 100, 200, and 365 days after the removal of the sealing jacket. Also, the drying shrinkage strains versus the age of concrete are shown in Figures 16, 17, and 18 for concretes at 73, 110, and 160 F, respectively. In general, the drying shrinkage strains leveled off between 400 and 600 micro-strain for both concretes for all test conditions, with the higher drying shrinkage strains occurring at the higher temperatures.

At 73 F (Figure 16), the drying shrinkage strains and the rate of drying shrinkage were similar for both Berks and York concretes. The drying shrinkage leveled off at about 400 micro-strains around age 300 days. The concretes were unsealed at age 28 days. At 110 F (Figure 17) and 160 F (Figure 18), the drying shrinkage for both concretes leveled off at about 400 to 600 micro-strains.

6. THERMAL CYCLING OF BERKS AND YORK CONCRETES, PHASE III(c)

Berks G-19 and York G-25 concretes were thermally cycled from 73 to 160 to 73 F for up to five cycles. Both concretes were cast on the same day and thereby cycled together. The thermal cycling of the concretes was started at age 90 days with each of the 73 to 160 to 73 F cycles taking about 10 days to complete. The final cycle was completed at age 140 days. The heating and cooling procedures are given in Appendix B. The nominal temperature for a typical thermal cycle versus time in hours is given in Figure B2, Appendix B.

The compressive strength, splitting tensile strength and elastic properties of the thermally cycled concretes were determined on sealed 6 by 12-in. specimens at the end of each of the five thermal cycles. Results obtained for the Berks and York concretes are given in Tables 19 and 20, respectively. Strain and temperature measurements made during the five cycles on three Berks and three York instrumented 6 by 16-in. sealed specimens are given in Tables 21 and 22, respectively. The resulting linear coefficients of thermal expansion are given in Table 23, and the residual and cumulative thermal cycle strains are given in Table 24.

6.1 Thermal Cycle Temperatures -- The temperatures of eight constant-temperature hold periods were calculated for each cycle from the six instrumented specimens using their Carlson meter readings. The average measured temperatures for the five cycles are shown in the graphical representation of the nominal thermal cycles in Figure B2, Appendix B, and are compared to the nominal values in the following tabulation.

THERMAL CYCLE HOLD TEMPERATURES

Nominal Temperature, F:	73	95	110	135	160	135	110	95	73
Average Measured Temperature, F:	72	95	106	132	169	137	115	98	72
Time into cycle, hr:	0	24	46	71	126	151	174	196	230

6.2 Effect of Thermal Cycling on Compressive Strength and Elastic Properties -- Compressive strength, modulus of elasticity, and Poisson's ratio were determined on three Berks and three York thermal cycled specimens at the end of each cycle at 73 F. Sealed control specimens continuously cured at 73 F were tested at age 28 and 90 days and at the end of the second and fifth cycles. The average values of compressive strength and modulus of elasticity at the end of each cycle are given in Tables 19 and 20 and summarized in the following tabulation.

EFFECT OF THERMAL CYCLING ON COMPRESSIVE
STRENGTH AND MODULUS OF ELASTICITY

		Berks G-19		York G-25	
Completion of Thermal Cycle	Age, days	Control 73 F	Cycled 73-160-73 F	Control 73 F	Cycled 73-160-73 F
I. Compressive Strength, psi					
Prior to Cycling	90	7140	....	7350	....
Cycle 1	101	....	7040	....	7390
Cycle 2	110	7540	6990	7610	7360
Cycle 3	120	....	7270	....	7460
Cycle 4	129	....	7320	....	7450
Cycle 5	140	7520	7440	7770	7550
II. Modulus of Elasticity ($x10^6$), psi					
Prior to Cycling	90	6.2	...	6.1	...
Cycle 1	101	...	6.0	...	5.6
Cycle 2	110	6.3	6.1	6.1	5.8
Cycle 3	120	...	6.0	...	5.9
Cycle 4	129	...	6.0	...	5.9
Cycle 5	140	6.3	5.9	6.1	5.8

The results indicate that the compressive strength of both concretes was reduced about 5 percent after two thermal cycles and only about 2 percent after completion of five thermal cycles. The modulus of elasticity was reduced about 5 percent after the first cycle and remained stabilized at this reduced level for the subsequent four cycles. Poisson's ratio, given in Tables 21 and 22 for Berks and York concretes, respectively, was not affected by this thermal cycling.

6.3 Effect of Thermal Cycling on Splitting Tensile Strength -- Splitting tensile strength was determined on three Berks and three York specimens at the end of each cycle at 73 F. Sealed control specimens, continuously cured at 73 F, were tested at age 90 days and at the end of the second and fifth cycles. The resulting splitting tensile strength and percent of coarse aggregate fractured are given in Tables 21 and 22 for Berks and York concretes, respectively. Average values of splitting tensile strength are summarized in the following tabulation.

EFFECT OF THERMAL CYCLING ON SPLITTING
TENSILE STRENGTH, 73 - 160 - 73 F

		Berks G-19		York G-25	
Completion of Thermal Cycle	Age, days	Control 73 F	Cycled 73-160-73 F	Control 73 F	Cycled 73-160-73 F
Splitting Tensile Strength, psi					
Prior to Cycling	90	660	...	605	...
Cycle 1	101	...	535	...	590
Cycle 2	110	625	625	670	655
Cycle 3	120	...	630	...	625
Cycle 4	129	...	670	...	610
Cycle 5	140	710	690	640	670

Results indicate that the thermal cycling had no significant effect on the splitting tensile strength of these concretes.

6.4 Thermal Cycling Strains -- The strains and temperature measurements made on the instrumented specimens during the eight-hold periods of each of the five thermal cycles are given in Tables 21 and 22 for Berks and York concretes, respectively. These strain and temperature measurements were then used to compute the cumulative and residual strains and the linear coefficents of thermal expansion due to thermal cycling. Results reported are based on the average of three specimens, unless otherwise stated.

6.4.1 Cumulative and Residual Strains -- The average cumulative and residual strains for Berks and York concrete are given for each of the five thermal cycles in Table 23. The cumulative strains in this table were linearly normalized for the nominal temperature cycle using the temperatures and strains given in Tables 21 and 22. The results for the five cycles are summarized in the following tabulation along with the resulting cumulative linear coefficients of thermal expansion.

AVERAGE CUMULATIVE STRAINS AND COEFFICIENTS OF THERMAL EXPANSION
FOR CYCLES 1 TO 5

	Berks G-19		York G-25	
Temperature Range, F	Micro-Strains	Coeff. of Exp. per °F$\times10^{-6}$	Micro-Strains	Coeff. of Exp. per °F$\times10^{-6}$
73 to 95	125	5.7	115	5.3
73 to 110	205	5.5	185	5.0
73 to 135	340	5.5	310	5.0
73 to 160	520	6.0	500	5.7
73 to 160 to 135	360	5.8	330	5.3
73 to 160 to 110	220	5.9	200	5.4
73 to 160 to 95	130	5.9	125	5.7
Average		5.8		5.3

The average cumulative coefficients of thermal expansion for Berks and York concretes for five thermal cycles were 5.8 and 5.3 per °F x 10^{-6}, respectively.

Residual strains for Berks and York concretes are summarized in the following tabulation.

RESIDUAL MICRO-STRAINS PER THERMAL CYCLE

Cycle No.	Berks	York
1	55	45
2	25	40
3	-5	0
4	5	10
5	5	10
Total	85	105

For Berks concrete, 65 percent of the five cycle residual 85 micro-strain occurred by the end of the first cycle and 94 percent by the end of the second cycle. For York concrete, 43 percent of the five cycle residual 105 micro-strain occurred by the end of the first cycle and 81 percent by the end of the second cycle.

6.4.2 Linear Coefficient of Thermal Expansion -- Average values of the linear coefficients of thermal expansion for the Berks and York concretes were computed using values obtained in the five thermal cycles and are given in Table 24. A comparison of the values of coefficients of thermal expansion obtained for the different temperature ranges is given in the following tabulation.

LINEAR COEFFICIENTS OF THERMAL EXPANSION, per °F x 10^{-6}

Temperature Range, F	Coefficient of Thermal Expansion Average of Cycles 1 to 5 Berks G-19	York G-25
73 to 95	5.7	5.2
95 to 110	5.4	5.0
110 to 135	5.3	4.9
135 to 160	6.2*	5.5**
160 to 135	6.1*	5.4**
135 to 110	5.5	5.0
110 to 95	5.6	5.1
95 to 73	5.4	4.8

Averages based on results from three specimens, (*) indicates results from two specimens, (**) indicates results from one specimen.

In general the coefficients of thermal expansion for both concretes are consistent in the temperature range between 73 and 135 F, both during heating and cooling. There is a marked increase in the coefficient in the 135 to 160 F temperature range. It is in this range that some of the specimens were omitted from the average because of inconsistent results. Overall the Berks concrete has a linear coefficient of expansion which is about 0.5 x 10^{-6} higher than that of the York concrete at all temperature ranges used in the thermal cycling.

7. THERMAL PROPERTIES OF BERKS AND YORK CONCRETES, PHASE III(d)

The thermal properties of concrete determined included adiabatic temperature rise, specific heat, and diffusivity. The adiabatic temperature rise was determined only for Berks G-19 concrete. Specific heat and diffusivity were determined on Berks G-19 and York G-26 concretes. The methods of test used are described in Appendix B.

7.1 Adiabatic Temperature Rise -- The adiabatic temperature rise was determined on one 27 by 30-in. specimen. The resulting temperatures are given in Table 25 and plotted in Figure 19. The temperature and temperature rise at selected ages are given in the following tabulation.

ADIABATIC TEMPERATURE RISE OF BERKS G-19 CONCRETE

Time Elapsed, days	Temperature, F	Temperature Rise, F
0	48.6	0
0.5	61.6	13.0
1	101.3	52.7
1.5	118.5	69.9
3	134.6	86.0
7	142.4	93.8
14	146.1	97.5
25	148.7	100.1

The temperature rise of the adiabatically cured Berks concrete was about 100 F in 25 days. More than 50 percent of the temperature rise occurred in the first 24 hours and about 70 percent during the first 36 hours. This early age temperature rise is given at one-hour intervals in the following tabulation.

EARLY AGE ADIABATIC TEMPERATURE RISE OF BERKS G-19 CONCRETE

Time Elapsed, hrs.	Temp., F	Time Elapsed, hrs.	Temp., F	Time Elapsed, hrs.	Temp., F	Time Elapsed, hrs.	Temp., F
0	48.6	10	58.3	19	86.4	28	108.4
1	49.8	11	59.8	20	89.8	29	110.0
2	50.8	12	61.6	21	93.0	30	111.3
3	51.6	13	64.9	22	96.1	31	112.8
4	52.1	14	67.3	23	98.9	32	114.1
5	52.8	15	69.3	24	101.3	33	115.2
6	53.8	16	72.8	25	102.6	34	116.3
7	54.7	17	77.3	26	105.4	35	117.4
8	55.8	18	82.8	27	106.9	36	118.5
9	57.0						

7.2 Specific Heat and Diffusivity -- Specific heat of concrete, Btu/lb/F, is the amount of heat (Btu) required to raise the temperature of a unit mass (1 lb.) of the concrete one degree (F). It was determined at two ages in the temperature range of 70 to 100 F using one Berks and one York sealed 8 by 16-in. specimen.

The diffusivity of concrete is an index of the facility with which the concrete will undergo temperature change and is expressed as the rate at which heat will diffuse or disperse in all directions (ft^2/hr). It was determined at two ages in the temperature range of 120 to 42 F using one Berks and one York sealed 8-1/2 by 17-in. specimen.

Results of the specific heat and diffusivity tests for the Berks and York concretes are summarized in the following tabulation.

SPECIFIC HEAT AND DIFFUSIVITY OF BERKS AND YORK CONCRETES

	Berks G-19	York G-26
Specific Heat, Btu/lb/F	0.29* at 29 days	0.26 at 28 days
	0.25 at 147 days	0.25 at 104 days
Diffusivity, ft^2/hr	0.050 at 29 days	0.048 at 29 days
	0.055 at 97 days	0.050 at 97 days

*high value

On the average the specific heat of the concretes was about 0.25 and their diffusivity 0.051, which is within the range expected of a concrete mix containing this dolomitic limestone aggregate.

8. STRENGTH AND ELASTIC PROPERTIES OF PHASE III CONCRETES

The compressive strength and modulus of elasticity were determined for sealed Berks G-19 and York G-26 concretes subjected to various curing and test temperatures. The results, along with a discussion of the effects of curing and test temperatures, are given in the following sections.

8.1 Compressive Strength at Various Curing and Test Temperatures -- Compressive strength was determined on sealed 6 by 12-in. specimens subjected to the following curing and test temperatures: (a) creep companion specimens cured at 73 F and tested at 73, 110, or 160 F; (b) adiabatically cured specimens tested at 73 F; (c) specimens cured at 73 F and then subjected to from one to five thermal cycles between 73-160-73 F; and (d) specimens cured at 73 F and/or 160 F and then tested at 73, 110, or 160 F. Compressive strength of the 6 by 16-in. creep specimens and of their controls upon completion of creep testing (discussed in Section 8.4) were also determined.

8.1.1 Effect of Test Temperature on Compressive Strength of Creep Companion Specimens -- As discussed in Section 5, Berks and York sealed 6 by 12-in. creep companion specimens were tested for compressive strength at age 7 days and at each age of loading and test temperature used in the creep phase of the test program.

All specimens were cured at 73 F. Specimens tested at 110 or 160 F were heated to these test temperatures at a rate of not more than 24 F per day as described in Appendix B.

The compressive strengths obtained for the Berks concrete are given in Table 12 and Figure 1 and for the York concrete in Table 13 and Figure 2. A summary of average strengths obtained on specimens tested at 73, 110, and 160 F is given in the following tabulation.

COMPRESSIVE STRENGTH OF CREEP COMPANION SPECIMENS, PSI

	Age, days	Test Temperature, F 73	110	160
I. Berks G-19, 7.5 scy, Daratard 40				
	7	4930		
	28	6270	6100	5550
	90	7120	6710	5910
	270	7900	7310	6130
II. York G-26, 8.0 scy, Pozzolith 300R				
	7	4850		
	28	6160	5770	5420
	90	7070	6320	5650
	270	7980	7270	6350

The 7-day compressive strength at 73 F was used as an early age quality control check on concrete mixes used to cast the creep specimens and their controls. The compressive strengths at 28, 90, and 270 days were used to determine the stress level applied to the creep specimens.

The effect of test temperature on compressive strength can be observed from the curves of Figures 1 and 2 for Berks and York concretes, respectively. The influence of testing at 110 or 160 F on compressive strength is given in the following tabulation in which the results obtained at these temperatures are compared to those obtained at 73 F.

EFFECT OF TEST TEMPERATURES ON COMPRESSIVE STRENGTH

Age, days	Decrease in Compressive Strength as Compared to Specimens Tested at 73 F			
	Berks G-19		York G-26	
	110 F	160 F	110 F	160 F
28	3%	11%	6%	12%
90	6%	17%	11%	20%
270	7%	22%	9%	20%

The compressive strength of specimens tested at 110 F was reduced from 3 to 7 percent for Berks concrete and from 6 to 11 percent for York concrete in comparison to corresponding specimens tested at 73 F. There was an even greater reduction in compressive strength for the 160 F test temperature. At 160 F, Berks and York concrete had greater reductions which were on the average for both concretes about 11, 18, and 21 percent when tested at 28, 90, and 270 days, respectively.

8.1.2 Effect of Adiabatic-Curing on Compressive Strength -- Twelve sealed 6 by 12-in. specimens were cast with the adiabatic temperature rise specimen reported on in Section 7 using Berks G-19 concrete. Six of the specimens were cured adiabatically (48 to 146 F) for 14 days and then stored continuously at 110 F. The specimens were tested at 73 F after being cooled from 110 F in two days just prior to testing. The adiabatic temperature rise is shown in Figure 19 and individual temperature values are given in Table 25. The remaining six specimens were cured at 73 F. The compressive strengths at 28 and 60 days were then determined on three specimens from each of the two curing conditions. Results of these tests are given in Table 26 and the effect of adiabatic curing on compressive strength is summarized in the following tabulation.

EFFECT OF ADIABATIC CURING ON COMPRESSIVE STRENGTH

Age, days	Average Compressive Strength, psi Cured at 73 F	Adiabatic Cured	Increase in Strength of Adiabatic Over 73 F Curing
28	6360	7160	12%
60	6930	7470	8%

The adiabatic-curing resulted in a 12 percent increase in the 28-day compressive strength and an 8 percent increase in the 60-day strength in comparison to the strength of specimens cured continuously at 73 F.

8.1.3 Effect of Thermal Cycling on Compressive Strength -- The effects of thermal cycling on compressive strength were discussed in Section 6.2 for Berks G-19 and York G-25 concrete. After two 73-160-73 F thermal cycles (cycling commenced after 90 days curing at 73 F), a drop of about 5 percent in compressive strength was observed for both Berks and York concrete. At the end of five 73-160-73 F thermal cycles (age 140 days), a drop of 2 percent was observed.

8.1.4 Effect of Prolonged Curing at 160 F on Compressive Strength -- Fifteen sealed 6 by 12-in. specimens were cast using Berks G-19 concrete to determine what effect curing and then testing at 160 F had on compressive strength. All specimens were initially cured at 73 F for 85 days, and then nine of the specimens were heated to 160 F at a rate not exceeding 24 F per day, reaching the 160 F temperature level at age 89 days. The remaining six specimens were continuously cured at 73 F.

Of the nine specimens subsequently cured at 160 F, three specimens each were tested to determine their 90, 180, and 270-day compressive strengths at 160 F after 1, 91, and 181 days of curing at 160 F, respectively. Of the six specimens cured at 73 F, two specimens each were tested at 73 F at ages 90, 180, and 270 days. The compressive strength results are given in Table 26 and are summarized in the following tabulation.

EFFECT OF 160 F CURING ON COMPRESSIVE STRENGTH - BERKS G-19

160 F Curing History			Test	Compr. Strength, psi		Reduction in Strength
Temp., F	Age, days	Total days at 160 F	Age, days	Test Temperature 160 F	73 F*	at 160 F Compared to 73 F
73	0-85	...	..	....	....	...
73-135	86-88	...	..	....	....	...
160	89-90	1	90	5640	6990	19%
160	90-180	91	180	6520	7400	12%
160	180-270	181	270	6700	7820	14%

*73 F specimens cured and tested at 73 F

The 90-day test results indicated a 19 percent reduction in the compressive strength of specimens cured at 160 F for one day and then tested at 160 F in comparison to the strength of corresponding specimens cured and tested at 73 F. This result is consistent with the reduction in the 90-day compressive strength observed for the creep companion specimens tested at 160 F. After specimens were cured at 160 F for 91 and 181 days, their compressive strengths were only 12 to 14 percent lower than that of corresponding specimens cured and tested at 73 F. The compressive strength of the specimens cured at 160 F for 181 days, 6700 psi, was about 8 percent higher than the 6130 psi, 270-day compressive strength of creep companion specimens tested at 160 F (Section 8.1.1) which had only one day curing at 160 F. This increase in compressive strength was due to the increased rate of hydration at the elevated temperature. Similar increases in relative compressive strength after curing at elevated temperatures were observed for the adiabatically-cured specimens (Section 8.1.2) and for the thermal cycling specimens subsequent to the second cycle (Section 6.2).

8.1.5 Effect of Test Temperature on Compressive Strength After Curing at 73 or 160 F -- Fifteen sealed 6 by 12-in. specimens were cast using York G-26 concrete to determine the effect of curing at 73 F or 160 F and then testing at 73, 110, or 160 F on their 270-day compressive strength. All specimens were initially cured at 73 F for 85 days. Then six of the specimens remained at 73 F, while nine were heated to 160 F at a rate not exceeding 24 F per day, reaching the 160 F temperature level at age 89 days.

The six specimens at 73 F were cured at 73 F until age 265 days. Then from age 265 to 270 days, two of the six specimens were kept at 73 F, two were heated to 110 F, and two were heated to 160 F. The nine specimens heated to 160 F remained at 160 F for 176 days (age 265 days). From age 265 to 270 days, three specimens were kept at 160 F, three specimens were cooled to 110 F, and three were cooled to 73 F. At age 270 days all specimens were tested at their respective temperatures (73, 110, or 160 F). The 270-day compressive strengths are given in Table 27 and are summarized in the following tabulation.

270-DAY COMPRESSIVE STRENGTH OF CONCRETE TESTED AT 73, 110, and 160 F
AFTER CURING AT 73 and 160 F - YORK G-26

	Curing Condition		Compressive Strength, psi		
	Temp., F	Age, days	Test Temperature 73 F	110 F	160 F
73 F Cured	73	0-265			
	Heating	265-269			
	Test Temp.	270	8250	7270	6360
160 F Cured	73	0-85			
	73 to 135	86-88			
	160	89-265			
	Cooling	265-269			
	Test Temp.	270	7610	7550	6940

The specimens cured and tested at 160 F had a 7 percent higher compressive strength at 270 days (6940 psi) in comparison to specimens cured continuously at 73 F and then brought up to 160 F for testing (6360 psi). These results again indicate that specimens tested at 160 F show a gain in compressive strength if subjected to extended curing at 160 F and are consistent with the results obtained for the Berks specimens discussed in Section 8.1.4.

The effect of curing and testing temperature on compressive strength is shown in comparison to the compressive strength of specimens cured and tested at 73 F in the following tabulation.

EFFECT OF 73 and 160 F CURING ON 270-DAY COMPRESSIVE STRENGTH AT TEST TEMPERATURES OF 73, 110, and 160 F

	Compressive Strength at 73 F, psi	Reduction in Strength in Comparison to Specimens Cured and Tested at 73 F — Test Temperature 73 F	110 F	160 F
73 F Cured	8250	0%	12%	23%
160 F Cured	....	8%	8%	16%

Specimens cured and tested at 73 F, and thus not subjected to a temperature change, had the highest compressive strengths, while specimens cured at 73 F and tested at 110 or 160 F showed greater reductions in strength than specimens cured at 160 F and tested at 110 or 160 F.

The effect of test temperatures on compressive strength of the 73 and 160 F cured concretes is given in the following tabulation.

EFFECT OF TEST TEMPERATURES ON 270-DAY COMPRESSIVE STRENGTH OF 73 and 160 F CURED CONCRETE

	Compressive Strength at 73 F, psi	Reduction in Strength in Comparison to Specimens Tested at 73 F — Test Temperature 110 F	160 F
73 F Cured	8250	12%	23%
160 F Cured	7610	1%	9%

The specimens cured at 73 F and tested at 110 or 160 F showed a 12 and 23 percent reduction in compressive strength at 110 and 160 F, respectively, in comparison to specimens tested at 73 F. This observed reduction in the 270-day strength is consistent with the results obtained for creep companion specimens tested at 160 F, Section 8.1.1. For the 160 F cured specimens, the compressive strength at 110 and 160 F had a 1 and 9 percent strength reduction in comparison to the strength at 73 F. The reduction in strength is lower when specimens are cured at 160 F and then tested at 73 F in comparison to specimens cured at 73 F and then tested at 160 F.

8.2 Modulus of Elasticity of Creep Specimens During Loading and Unloading The moduli of elasticity of Berks and York concrete were determined from creep specimens during loading and unloading using measured strains obtained from the embedded Carlson meters at known applied stress levels. The rate of loading or unloading was 35 ± 5 psi per second. During loading, a nine-second hold at approximately half the full load level was made for specimens stressed to 30 and 45 percent of the concrete's compressive strength to allow for measurement of strain. For specimens loaded to the 60 percent stress level, two nine-second holds were made, one at the 22.5 and one at the 45 percent stress level. No holds were made during unloading. Strain readings were taken only just prior to and immediately after unloading.

If the strains at the high stress levels and temperatures exceeded the expected linear elastic range, the modulus of elasticity was computed from lower level stresses and strains obtained during loading, and the sustained modulus was computed for the full load. The stress levels and moduli of elasticity obtained for each of the creep specimens during loading and unloading are given in Tables 8, 9, and 10. A summary of the average modulus of elasticity obtained for each set of three creep specimens at each test condition is given in the following tabulation.

MODULUS OF ELASTICITY OF CONCRETE FROM CREEP SPECIMENS, Ex10^6 psi

	Test Temperature, F, and Applied Nominal Stress Level						
	73 F			110 F	160 F		
	30%	45%	60%	30%	30%	45%	60%
I. Berks G-19 Concrete							
28 days	6.0	...	...	5.8	5.3	...	...
90 days	6.2	6.1	6.1*(5.9)+	5.9	5.3	5.2	5.3*(4.9)
270 days	6.4	...	...	6.1	5.3	...	...
II. York G-26 Concrete							
28 days	5.8	...	...	5.5	5.3	...	...
90 days	6.1	6.1	6.1*(5.8)	5.8	5.3	5.3**(4.2)	5.4**(4.2)
270 days	6.3	...	...	5.9	5.2	...	...

*Modulus at 45% stress level.
**Modulus at 22.5% stress level.
+Values in ( ) are the sustained modulus at full stress level.

The modulus of elasticity at 73 F for Berks and York concrete is consistent with the values obtained from tests made on the 6 by 12-in. selected concretes, Section 4. At 110 F, the modulus of elasticity for both the Berks and York concretes was about 5 percent lower than at 73 F, and at 160 F, it was about 14 percent lower for Berks concrete and 11 percent lower for York concrete. At 160 F, the modulus of elasticity did not increase with the age of the concrete for the observed test ages.

8.3 Sustained Modulus of Creep Specimens Under Stress -- The sustained moduli of the Berks and York concretes were computed on the creep specimens for all creep strain readings subsequent to load application. It is given as an average value for the three specimens of each test condition in the summarizing computer output in Appendix C and shown plotted against time under stress in Figures 9 to 15.

The sustained modulus values (x 10^6 psi) for both Berks and York concrete stressed to the 30 percent stress level at 28 days reduced from about 6.1 at the time of loading to 2.5 after 365 days under stress at 73 F, from 5.8 to 2.1 at 110 F, and from 5.4 to 1.3 at 160 F. For concretes loaded at 90 and 270 days, the reductions were considerably less at 73 F and only slightly less at 110 F and 160 F, as may be observed from Figures 13 to 15. For concrete stressed to the 45 or 60 percent stress level at 90 days, the reductions were from about 6.1 to 2.9 (45%) and 6.1 to 2.5 (60%) at 73 F and from 4.6 to 1.2 (45% and 60%) at 160 F. The prediction of forty-year sustained modulus values can also be obtained from Figures 9 to 15.

8.4 Strength and Elastic Properties of Creep Specimens and their Controls at End of Creep Testing -- To date seventeen of the 26 groups of creep specimens have been unloaded. After completion of the creep recovery observations, two of the three specimens in each group were tested for compressive strength and modulus of elasticity along with one of the two sealed controls and the one unsealed control. The remaining creep and control specimens are scheduled for compressive strength testing at approximately age 1000 days.

All compression tests were made at 73 F, except for two 110 F creep groups which were tested at 110 F. The cooling to 73 F of the 110 F and 160 F creep specimens commenced at about one week prior to testing at a rate not exceeding 24 F per day. The ages of test, temperature of test, compressive strength, and modulus of elasticity for each specimen are given in Tables 8 to 11 and the results summarized in the following tabulation.

COMPRESSIVE STRENGTH AND MODULUS OF ELASTICITY
OF CREEP SPECIMENS AND THEIR CONTROLS

Test Condition			Compressive Strength and Modulus of Elasticity							
					Creep Specimens [a] Sealed		Control Specimens [b] Sealed		Control Specimens [b] Unsealed	
Temp., F	Age of Loading, days	Nominal Stress Level, %	Age of Concrete, days	Test Temp., F	Comp., psi	Ex10⁶ psi	Comp., psi	Ex10⁶ psi	Comp., psi	Ex10⁶ psi
I. Berks G-19, 7.5 scy with Daratard 40										
73	270	30	712	73	8680	6.8	....	...	....	...
73	90	45	585	73	8560	6.8	....	...	....	...
73	90	60	585	73	8560	6.8	....	...	....	...
110	28	30	606	73	8830	6.5	9190	6.5	7140	5.7
110	90	30	606	110	8350	6.4	8180	5.8	5730	5.9
110	270	30	759	110	8670	6.3	8250	6.0	6710	5.3
160	90	30	579	73	6700	5.7	....	...	....	...
160	90	45	545	73	7010	...	....	...	....	...
II. York G-26, 8.0 scy with Pozzolith 300R										
73	28	30	586	73	8940	6.9	....	...	....	...
73	270	30	704	73	9230	6.9	....	...	....	...
73	90	45	483	73	8240	6.7	....	...	....	...
73	90	60	565	73	8520	6.8	....	...	....	...
110	28	30	483	73	8700	6.4	9040	6.5	6890	5.3
110	90	30	559	73	9020	6.6	9760	6.8	8540	6.0
110	270	30	650	73	9240	6.4	9210	6.4	7450	5.5
160	90	30	503	73	7480	5.4	....	...	....	...
160	90	45	488	73	7060	5.3	....	...	....	...

(a) Average of two sealed 6 by 16-in. creep specimens.
(b) Data for one 6 by 16-in. control specimen.

The compressive strength and moduli of elasticity of the 73 and 110 F creep specimens are consistent with each other and with their sealed controls. For the 160 F creep specimens, the compressive strength and modulus of elasticity values obtained at 73 F were about 20 and 18 percent lower, respectively, than those for the 73 and 110 F creep specimens. Since all 160 F sealed and unsealed controls are still under observation, no comparison can be made of the 160 F creep specimen strengths to that of their controls at this time. After unloading the remaining 160 F creep specimens and their controls, they will be tested and results reported. The compressive strength and the modulus of elasticity of the unsealed controls were considerably lower than for the sealed controls, having on the average a 21 percent lower strength and 13 percent lower modulus.

In summary, subjecting the concretes to sustained stress at 73 F (at 30, 45, or 60% stress levels) or 110 F (at 30% stress level) had no significant effect on the compressive strength and modulus of elasticity. However, loss of moisture from concrete (unsealed specimens) caused a significant reduction in strength and the modulus of elasticity.

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TABLES 1 to 27

TABLE 1 -- CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF CEMENT

	Chemical Composition and Physical Properties	Medusa Type II Cement					GA Specification R0069-B
		Medusa Data		UC Data			
		"A" 9/31/72	"B" 2/8/73	"A" 9/31/72	"B" 2/8/73	"A+B" 1:1 Blend	
a.	Chemical Composition,%						
	C_3S	50.3	51.2	54.0	47.9	51.0*	40-50
	C_2S	22.8	22.7	19.7	27.1	23.4	...
	C_3A	5.0	6.1	4.6	2.0	3.3	0-6
	C_4AF	11.9	11.0	12.1	14.2	13.2	11-16
	Alkalies as Na_2O	0.60	0.55	0.65	0.45	0.55	0.60 max.
b.	Heat of Hydration,cal/gm						
	3-Day	...	...	66	...	...	...
	7-Day	...	...	72	67	69*	70 max.
	14-Day	...	...	77	...	...	...
	28-Day	...	...	82	76	79	...
c.	Blaine Fineness, sq. cm/gm	3690	3700	3810	3620	3720*	3000-3600
d.	Compressive Strength,psi (ASTM C 109)						
	3-Day	2800	2570	....	....	....	1000 min.
	7-Day	3530	3370	2920	2790	2890	1600 min.
	28-Day	5000	5230	4140	4370	4180	4000 min.
	60-Day	....	....	4440	5100	4660	....
e.	Air Content of Mortar,%	7.0	6.7	...	...	...	10 max.
f.	False Set, % final penetration	...	...	...	81	...	50 min.

* Numerical Average on Chemical Composition, Heat of Hydration and Blaine Fineness

TABLE 2 -- GRADATION AND PHYSICAL PROPERTIES OF FINE AND COARSE AGGREGATES

Fine Aggregate

Sieve Size	Mason-Dixon Sand(a)	Specification GA R0068-B and ASTM C 33
	Percent Passing	
3/8"	100	100
No. 4	97	95-100
8	80	80-100
16	64	50-85
30	46	25-60
50	21	10-30
100	5	2-10
200	1.1	0-3
Fineness Modulus	2.87	2.3-3.1
Specific Gravity	2.63	...
Absorption, %	0.8	...

Coarse Aggregate

Sieve Size	Berks Grad "B"(b)	York Grad "B"(c)	Specification ASTM C 33 # 467
	Percent Passing		
2"	100	...	100
1-1/2"	99	100	95-100
1"	77	92	...
3/4"	56	65	35-70
1/2"	30	23	...
3/8"	15	11	10-30
No. 4	2	2	0-5
Flat & Elong, %	6	3	15 max.*
Specific Gravity	2.76	2.73	...
Absorption, %	0.5	0.5	...

(a) Blend of Mason-Dixon Sand Shipments received 10/4/73, 3/2/73 and 11/16/72. (4:2:1)

(b) Berks Combined Gradation #467: 48.3% #67 (2/14/73, 9/20/73), 51.7% # 4 (2/14/73, 9/20/73)

(c) York Combined Gradation #467: 55.3% #67 (2/12/73, 2/12/73**, 11/7/73), 44.7% # 4 (2/12/73**, 5/11/73)

* GA Specification

** Separated at UC from size No. 467

TABLE 3 -- MIX PROPORTIONS AND PROPERTIES OF FRESH CONCRETE - PHASE III, BERKS G-19

	Selected Mix Phase II(c)		Creep Specimens and Controls				Thermal Cycling	Thermal Properties	Average Phase II(c) & III
			30%f'_c			45 or 60%f'_c			
	Comp.	Ten.	73F	110F	160F	73 or 160F			
I. Mix Proportions, pcy									
Cement	704	710	703	704	710	704	705	709	706
Water and Admixture	268	270	265	266	268	270	270	272	269
F.A. - Mason-Dixon sand	1221	1230	1220	1221	1231	1220	1221	1229	1224
C.A. - 3/4 in. to No. 4	885	891	885	884	892	884	885	891	887
C.A. - 1 1/2 to 3/4 in.	949	956	949	950	958	949	949	954	952
Total	4027	4057	4022	4025	4059	4027	4030	4055	4038
Admixture	Daratard 40, 8.0 fl. oz./100 lbs cement								
II. Properties of Fresh Concrete									
Cement Content, scy	7.49	7.55	7.48	7.49	7.55	7.49	7.50	7.54	7.51
Water-Cement Ratio, by wt.	0.381	0.380	0.377	0.378	0.377	0.384	0.383	0.384	0.381
Slump, in.	4 5/8	4 3/8	4 5/8	5	4 1/2	4 3/8	4 3/8	4 3/8	4 1/2
Air Content, %	4.7	4.2	4.7	4.3	4.3	4.5	4.7	4.4	4.5
Temperature, °F	50	51	52	50	50	50	50	49	50
Unit Weight, pcf	149.2	150.3	149.0	149.1	150.3	149.1	149.2	150.2	149.6
Sand Content, % by wt.	40	40	40	40	40	40	40	40	40

Notes: Mix proportions computed using measured unit weights

Admixture, Date Received	Daratard 40, 4/27/73
Time of Addition	Delayed Addition
Cement, Medusa Type II	Blend of Shipment "A" and "B"
F.A., Mason-Dixon sand	Blend of 11/16/72, 3/2/73, 10/4/73
C.A., Berks 1 1/2 in. to No. 4	Gradation "B"

TABLE 4 -- MIX PROPORTIONS AND PROPERTIES OF FRESH CONCRETE - PHASE III, YORK G-25 AND G-26

	York G-25			York G-26					
	Selected Mix Phase II (c)		Thermal Cycling	Selected Phase II(c)	Creep Specimens and Controls				Average Phase
					30% f'_c			45 or 60% f'_c	
	Comp.	Ten.		Comp	73F	110F	160F	73 or 160F	II(c) & III
I. Mix Proportions, pcy									
Cement	701	704	702	757	754	755	757	756	756
Water and Admixture	269	268	272	286	291	293	288	293	290
F.A.- Mason-Dixon sand	1207	1212	1212	1250	1247	1248	1251	1249	1249
C.A.- 3/4 in. to No. 4	1001	1005	1006	996	992	993	996	990	993
C.A.- 1-1/2 to 3/4 in.	812	813	814	805	803	804	805	804	804
Total	3990	4002	4006	4094	4087	4093	4097	4092	4092
Admixture	Daratard 40 8.0 fl. oz./100 lbs. cement			Pozzolith 300R 3.5 fl. oz./100 lbs. cement					
II. Properties of Fresh Concrete									
Cement Content, scy	7.46	7.49	7.47	8.05	8.02	8.03	8.05	8.04	8.04
Water-Cement Ratio, by wt.	0.384	0.381	0.387	0.378	0.386	0.388	0.380	0.388	0.384
Slump, in.	5	4-3/4	4-1/2	4	4-1/4	4-1/4	4-1/4	4-5/8	4-1/4
Air Content, %	4.9	4.9	4.9	2.2	2.3	2.1	2.2	2.3	2.2
Temperature, °F	50	51	50	50	50	51	49	48	50
Unit Weight, pcf	147.7	148.2	148.4	151.6	151.3	151.6	151.7	151.6	151.6
Sand Content, % by wt.	40	40	40	41	41	41	41	41	41

Notes: Mix proportions computed using measured unit weights.

	York G-25	York G-26
Admixture, Date Received	Daratard 40, 4/27/73	Pozzolith 300R, 4/9/73
Time of Addition	Delayed Addition	
Cement, Medusa Type II	Blend of Shipment "A" and "B"	
F.A., Mason-Dixon sand	Blend of 11/16/72, 3/2/73, 10/4/73	
C.A., York 1-1/2 to No. 4	Gradation "B"	

TABLE 5 -- STRENGTH AND ELASTIC PROPERTIES - PHASE II(c)
BERKS G-19 (7.5 scy)

		Compressive Strength, Modulus of Elasticity, and Poisson's Ratio						Splitting Tensile Strength and Percent C.A. Fractured			
		Sealed			Moist-Cured			Sealed		Moist-Cured	
Age, days	Spec. No.	Comp psi	Ex10[6] psi	μ	Comp psi	Ex10[6] psi	μ	Tens psi	Frac %	Tens psi	Frac %
7	1	5320	...	...	5020	...	...	510	60	530	60
	2	5020	...	...	5450	...	...	510	65	510	60
	3	5340	...	...	5210	...	...	420	50	525	55
	Average	5230	...	...	5230	...	...	480	60	520	60
28	1	6520	6.1	0.19	6660	6.3	0.19	640	70	525	60
	2	6790	6.4	0.20	6630	6.5	0.20	670	60	610	55
	3	6450	6.2	0.19	6390	6.2	0.20	620	70	515	50
	Average	6590	6.2	0.19	6560	6.3	0.20	645	65	550	55
60	1	7020	6.3	0.22	7380	6.3	0.22	700	60	625	60
	2	7250	6.3	0.21	7500	6.4	0.21	570	60	630	60
	3	7270	6.4	0.22	7320	6.3	0.21	625	55	630	60
	Average	7180	6.3	0.22	7400	6.3	0.21	630	60	630	60
90	1	7500	6.2	0.21	7820	6.4	0.22	680	50	700	65
	2	7550	6.4	0.23	8070	6.4	0.23	635	60	715	65
	3	7480	6.3	0.21	8000	6.3	0.22	575	50	655	70
	Average	7510	6.3	0.22	7960	6.4	0.22	630	55	690	65
120	1	7020	...	...	7610	...	...	...	..	...	..
	2	7590	...	...	7960	...	...	...	..	...	..
	3	6860	...	...	8020	...	...	...	..	...	..
	Average	7160	...	...	7860	...	...	...	..	...	..
180	1	7500	...	...	7980	...	...	625	75	705	60
	2	8000	...	...	8390	...	...	630	50	685	60
	3	7860	...	...	8230	...	...	730	65	680	60
	Average	7790	...	...	8200	...	...	660	65	680	60
270	1	7840	6.4	0.22	8180	6.4	0.21	660	55	770	75
	2	8390	6.4	0.22	8620	6.6	0.21	755	70	710	70
	3	8430	6.5	0.23	8480	6.6	0.21	730	60	730	70
	Average	8220	6.4	0.22	8430	6.5	0.21	715	60	730	70
365	1	8320	...	...	8750	...	...	...	..	...	..
	2	8550	...	...	9000	...	...	...	..	...	..
	3	8320	...	...	8800	...	...	...	..	...	..
	Average	8400	...	...	8850	...	...	...	..	...	..
730	1	8860	6.3	0.23	9500	6.5	0.22	700	75	805	80
	2	9210	6.6	0.21	9860	6.6	0.22	745	65	745	80
	3	8730	6.5	0.21	9590	6.5	0.22	735	80	825	75
	Average	8930	6.5	0.22	9650	6.5	0.22	725	75	790	80

Notes: Materials, mix proportions and properties of fresh concrete are given in Table 3

TABLE 6 -- STRENGTH AND ELASTIC PROPERTIES - PHASE II(c)
YORK G-25 (7.5 scy)

		Compressive Strength, Modulus of Elasticity, and Poisson's Ratio						Splitting Tensile Strength and Percent C.A. Fractured			
		Sealed			Moist-Cured			Sealed		Moist-Cured	
Age, days	Spec. No.	Comp psi	Ex10^6 psi	μ	Comp psi	Ex10^6 psi	μ	Tens psi	Frac %	Tens psi	Frac %
7	1	4830	...	...	4930	...	...	535	60	515	60
	2	4840	...	...	4700	...	...	340	65	525	60
	3	4520	...	...	4550	...	...	410	55	490	65
	Average	4730	...	...	4730	...	...	470	60	510	60
28	1	6540	5.9	0.22	6700	6.0	0.23	590	60	555	70
	2	6290	6.0	0.22	6610	6.0	0.22	495	55	665	70
	3	6020	5.8	0.22	6390	5.9	0.22	570	55	610	65
	Average	6280	5.9	0.22	6570	6.0	0.22	550	55	610	70
60	1	7110	6.1	0.23	7270	6.1	0.22	650	55	710	65
	2	6770	6.0	0.22	7320	6.0	0.21	585	60	710	70
	3	6570	6.0	0.22	7050	5.9	0.22	690	65	710	65
	Average	6820	6.0	0.22	7210	6.0	0.22	640	60	710	65
90	1	7370	6.2	0.21	7870	6.2	0.22	695	55	670	65
	2	7160	6.2	0.22	7550	6.1	0.23	685	65	705	65
	3	7020	6.1	0.22	7460	6.2	0.23	655	55	730	70
	Average	7180	6.2	0.22	7630	6.2	0.23	680	60	700	65
120	1	7660	...	...	7870	...	...	...	..	...	..
	2	7370	...	...	8110	...	...	...	..	...	..
	3	7000	...	...	7730	...	...	...	..	...	..
	Average	7340	...	...	7900	...	...	...	..	...	..
180	1	7870	...	...	8450	...	...	630	70	675	75
	2	7480	...	...	8160	...	...	675	60	805	75
	3	7460	...	...	7950	...	...	630	60	710	85
	Average	7600	...	...	8190	...	...	645	65	730	75
270	1	8070	6.0	0.22	8750	6.2	0.22	765	75	805	85
	2	7340	6.1	0.22	8370	6.2	0.22	760	75	675	80
	3	7770	5.9	0.22	8160	6.0	0.22	755	75	805	80
	Average	7730	6.0	0.22	8430	6.1	0.22	760	75	760	80
365	1	7710	...	...	8790	...	...	...	..	...	..
	2	8610	...	...	8390	...	...	...	..	...	..
	3	7930	...	...	8860	...	...	...	..	...	..
	Average	8080	...	...	8680	...	...	...	..	...	..
730	1	8700	6.3	0.21	9410	6.4	0.22	635	75	820	85
	2	8730	6.3	0.21	9320	6.3	0.22	770	80	790	80
	3	8570	6.1	0.22	9410	6.4	0.23	635	75	670	90
	Average	8670	6.2	0.21	9380	6.4	0.22	680	75	760	85

Notes: Materials, mix proportions and properties of fresh concrete are given in Table 4.

TABLE 7 -- STRENGTH AND ELASTIC PROPERTIES - PHASE II(c)
YORK G-26 (8 scy)

Compressive Strength, Modulus of Elasticity and Poisson's Ratio

		Sealed			Moist-Cured		
Age, days	Spec. No.	Comp. psi	$Ex10^6$ psi	μ	Comp psi	$Ex10^6$ psi	μ
7	1	....	...	....	5050	...	....
	2	....	...	....	5050	...	....
	3	....	...	....	5090	...	....
	Average	....	...	....	5060	...	....
28	1	6290	5.9	0.22	6910	6.1	0.22
	2	6230	5.8	0.22	6520	6.0	0.23
	3	6320	5.9	0.22	6540	5.9	0.23
	Average	6280	5.9	0.22	6660	6.0	0.23
60	1	6980	5.9	0.22	7610	6.1	0.23
	2	6680	6.0	0.22	7640	6.0	0.21
	3	6680	5.9	0.21	7620	6.2	0.23
	Average	6780	5.9	0.22	7620	6.1	0.22
90	1	7180	6.1	0.24	7980	6.3	0.24
	2	7340	6.2	0.23	8050	6.5	0.23
	3	7070	6.3	0.23	8050	6.4	0.23
	Average	7200	6.2	0.23	8030	6.4	0.23
270	1	8210	6.1	0.22	9000	6.2	0.23
	2	8390	6.3	0.22	8710	6.3	0.23
	3	8000	6.1	0.21	8980	6.3	0.23
	Average	8200	6.2	0.22	8900	6.3	0.23
365	1	....	...	....	9180	...	....
	2	....	...	....	9000	...	....
	3	....	...	....	9210	...	....
	Average	....	...	....	9130	...	....
730	1	....	...	....	9710	6.4	0.21
	2	....	...	....	8570*	6.5	0.22
	3	....	...	....	9290	6.6	0.22
	Average	....	...	....	9500	6.5	0.22

Notes: Materials, mix proportions and properties of fresh concrete are given in Table 4.

* Low value, not averaged.

TABLE 8 -- CREEP SPECIMENS TESTED AT 73 F

Age at Loading, days	Applied Stress Level psi	Percent of Strength Nominal	Percent of Strength Actual[a]	Days Under Stress	Age at Unload, days	Carlson Meter and Channel Number		Consistency of Strain Readings, %[b]	Modulus Ex10⁶, psi Load	Modulus Ex10⁶, psi Unload	Compression Test of Creep Specimens Age, days	Temp., F	Comp., psi	Ex10⁶, psi
I. Berks G-19 Concrete														
						245	73-00	+2	6.1					
28	2100	30	33.5	769[c]		251	73-01	+5	6.0					
						349	73-02	-7	6.0					
						343	73-12	+2	6.3					
90	2100	30	29.0	707[c]		252	73-13	-1	6.2					
						337	73-14	-2	6.0					
						359	73-18	-0	6.1	7.1				
90	3220	45	46.0	404	494	372	73-19	+2	6.1	6.9	585	73	8290	6.8
						358	73-20	-2	6.0	6.7	585	73	8840	6.9
						354	73-15	+0	6.2[f]	6.6				
90	4200	60	60.0	404	494	374	73-16	+3	6.2	6.7	585	73	8270	6.8
						360	73-17	-3	5.9	6.4	585	73	8860	6.9
						240	73-30	-2	6.3	6.4[d]	712	73	9140	6.9
270	2400	30	30.4	365[d]	636	255	73-31	+3	6.4	6.4	712	73	8230	6.7
						259	73-32	-1	6.4	6.6				
II. York G-26 Concrete														
						199	73-06	-0	5.8	6.8				
28	2100	30	34.1	459	487	197	73-07	+1	5.8	6.8	586	73	8890	6.8
						211	73-08	-1	5.8	6.6	586	73	9000	7.0
						198	73-21	-2	6.1					
90	2100	30	29.7	650[c]		200	73-22	0	6.1					
						205	73-23	+2	6.2					
						418	73-27	+0	6.1	6.7	483	73	8320	6.7
90	3190	45	45.1	376	466	401	73-28	+0	6.2	6.5	483	73	8160	6.7
						406	73-29	-0	6.1	6.9				
						400	73-24	+2	6.1[f]	6.2[e]				
90	4250	60	60.1	418[e]	508	414	73-25	+0	5.9	6.2	565	73	8340	6.7
						419	73-26	-2	6.0	5.8	565	73	8710	6.9
						204	73-33	-1	6.3	6.6	704	73	9110	6.9
270	2400	30	30.1	365	635	208	73-34	+1	6.3	6.6	704	73	9360	6.9
						209	73-35	+0	6.3	6.5				

(a) Actual applied stress level calculated as percentage of the compressive strength of creep companion specimen (Tables 12 and 13) at age of loading and test temperature.
(b) Percent variation of individual specimen's total strain reading from average of three specimens at given test condition.
(c) Specimens still under stress at time of this report.
(d) Specimens were moved to 110 F at age 544 days after stress applied at 73 F for 273 days. Specimens were unloaded at age 365 days, with unloading and creep recovery observed at 110 F.
(e) Specimens were unloaded to 2100 psi at age 480 days after 390 days under stress at 4250 psi. Unload modulus is for unloading from 2100 psi to zero stress.
(f) Modulus at loading calculated at 3220 psi loading stress.

TABLE 8

TABLE 9 -- CREEP SPECIMENS TESTED AT 110 F

Age at Loading, days	Applied Stress Level psi	Percent of Strength Nominal	Percent of Strength Actual(a)	Days Under Stress	Age at Unload, days	Carlson Meter and Channel Number		Consistency of Strain Readings, %(b)	Modulus $Ex10^6$, psi Load	Modulus $Ex10^6$, psi Unload	Compression Test of Creep Specimens Age, days	Temp., F	Comp., psi	$Ex10^6$, psi
I. Berks G-19 Concrete														
						364	11-00	+2	5.9	6.9				
28	2100	30	34.4	487	515	241	11-01	+1	5.8	6.8	606	73	8620	6.6
						338	11-02	-3	5.7	6.4	606	73	9050	6.5
						340	11-12	-3	5.8	6.6	606	110	8320	6.4
90	2100	30	31.3	425	515	342	11-13	+3	6.1	7.0	606	110	8390	6.5
						356	11-14	+0	5.9	6.5				
						248	11-61	+2	6.2	6.5				
270	2400	30	32.8	398	668	341	11-62	+3	6.1	6.7	759	110	8790	6.4
						365	11-63	-4	6.1	6.6	759	110	8550	6.1
II. York G-26 Concrete														
						396	11-30	-2	5.6	6.7	483	73	8610	6.5
28	2100	30	36.4	440	468	126	11-31	+1	5.5	6.6	483	73	8790	6.4
						228	11-32	+1	5.4	6.9				
						129	11-18	+1	5.8	6.8				
90	2100	30	33.2	378	468	212	11-19	-0	5.9	6.9	559	73	8930	6.7
						395	11-20	-0	5.6	6.6	559	73	9110	6.5
						391	11-78	-0	5.9	6.9				
270	2400	30	33.0	367	636	392	11-79	+1	5.9	7.1	650	73	9090	6.4
						409	11-80	-1	6.0	7.0	650	73	9390	6.3

(a) Actual applied stress level calculated as percentage of the compressive strength of creep companion specimen (Tables 12 and 13) at age of loading and test temperature.
(b) Percent variation of individual specimen's total strain reading from average of three specimens at given test condition.

TABLE 10 -- CREEP SPECIMENS TESTED AT 160 F

Age at Loading, days	Applied Stress Level psi	Percent of Strength Nominal	Percent of Strength Actual[a]	Days Under Stress	Age at Unload, days	Carlson Meter	Channel Number	Consistency of Strain Readings, %[b]	Modulus $Ex10^6$, psi Load	Modulus $Ex10^6$, psi Unload	Compression Test of Creep Specimens Age, days	Temp., F	Comp., psi	$Ex10^6$, psi
I. Berks G-19 Concrete														
						384	11-06	+2	5.2	...				
28	2100	30	38.2	740[c]		390	11-07	+3	5.3	...				
						380	11-08	-4	5.3	...				
						377	11-44	+3	5.4	5.5	579	73	6610	5.7
90	2100	30	36.0	398	488	378	11-45	-2	5.3	5.4	579	73	6800	5.8
						382	11-46	-1	5.1	...				
						376	11-36	+1	5.2	5.4				
90	3220	45	53.8	438[d]	529	370	11-37	-1	5.2	...	545	73	7370	...
						355	11-38	+1	5.2	...	545	73	6660	...
						373	11-41	+1	5.3[f]					
90	4200	60	70.2	684[c]		361	11-42	-2	5.1					
						362	11-43	+2	5.0					
						381	11-67	+3	5.4					
270	2400	30	39.2	498[c]		386	11-68	-5	5.2					
						363	11-69	+2	5.4					
II. York G-26 Concrete														
						222	11-24	+2	5.3					
28	2100	30	38.7	705[c]		207	11-25	+4	5.6					
						223	11-26	-3	5.1					
						225	11-47	-3	5.1	5.0	503	73	7360	5.5
90	2100	30	36.3	397	487	224	11-48	+1	5.3	5.8				
						218	11-49	+2	5.4	5.7	503	73	7610	5.4
						402	11-56	+1	5.1[e]	5.6				
90	3190	45	58.0	383	473	408	11-57	+2	5.5	5.9	488	73	7140	5.4
						415	11-58	-2	5.3	5.9	488	73	6980	5.3
						404	11-50	-1	5.3[e]					
90	4250	60	77.3	629[c]		397	11-51	-2	5.5					
						399	11-52	+3	5.4					
						213	11-72	-2	5.3					
270	2400	30	37.8	463[c]		220	11-73	+2	4.8					
						217	11-74	+0	5.5					

(a) Actual applied stress level calculated as percentage of the compressive strength of creep companion specimen (Tables 12 and 13) at age of loading and test temperature.
(b) Percent variation of individual specimen's total strain reading from average of three specimens at given test condition.
(c) Specimens still under stress at time of this report.
(d) Specimens were unloaded to 2100 psi at age 495 days after 404 days under stress at 3220 psi.
(e) Modulus at loading calculated at 1600 psi loading stress.
(f) Modulus at loading calculated at 3220 psi loading stress.

TABLE 11 -- CREEP CONTROL SPECIMENS AT 73, 110 AND 160 F

Controls for Creep Test Condition: Temperature, F(a)	Ages of Loading, days	Number of Days Observed	Moisture Condition (b)	Carlson Meter and Channel Number		Compression Test of Control Specimen: Age, days	Temp., F	Comp., psi	Ex10^6, psi
I. Berks G-19 Concrete									
73	28, 90, 270	797(c)	Sealed	242	73-03				
			Sealed	250	73-04				
			Unsealed(d)	336	73-05				
110	28	606	Sealed	423	11-04				
			Sealed	243	11-05	606	73	9190	6.5
			Unsealed	244	11-03	606	73	7140	5.7
110	90	606	Sealed	347	11-15	606	110	8180	5.8
			Sealed	339	11-16				
			Unsealed	346	11-17	606	110	5730	5.9
110	270	759	Sealed	246	11-64				
			Sealed	247	11-65	759	110	8250	6.0
			Unsealed	344	11-66	759	110	6710	5.3
160	28	768(c)	Sealed	383	11-09				
			Sealed	379	11-10				
			Unsealed	357	11-11				
160	90	414(e) 636(c)	Sealed	350	11-39				
			Sealed	375	11-40				
			Unsealed(f)	426	11-59				
160	270	768(c)	Sealed	425	11-60				
			Sealed	385	11-70				
			Unsealed	389	11-71				
II. York G-26 Concrete									
73	28, 90, 270	740(c)	Sealed	202	73-09				
			Sealed	201	73-10				
			Unsealed	206	73-11				
110	28	483	Sealed	221	11-33	483	73	9040	6.5
			Sealed	410	11-34				
			Unsealed	148	11-35	483	73	6890	5.3
110	90	636	Sealed	420	11-21				
			Sealed	421	11-22	706	73	9760	6.8
			Unsealed(f)	422	11-23	706	73	8540	6.0
110	270	651	Sealed	411	11-81	651	73	9210	6.4
			Sealed	424	11-83				
			Unsealed	412	11-82	650	73	7450	5.5
160	28	733(c)	Sealed	227	11-27				
			Sealed	203	11-28				
			Unsealed	226	11-29				
160	90	719(c)	Sealed	403	11-53				
			Sealed	413	11-54				
			Unsealed	398	11-55				
160	270	733(c)	Sealed	215	11-75				
			Sealed	216	11-76				
			Unsealed	214	11-77				

(a) All specimens were cured at 73F prior to being heated to test temperature. Heating to test temperature commenced five days prior to age of loading.
(b) All specimens were sealed in butyl rubber up to age of loading. One specimen was unsealed at age of loading.
(c) Still under observation at time of this report.
(d) Unsealed at age 28 days.
(e) Meters for sealed specimens malfunctioned after 414 days, specimens still at test condition.
(f) Unsealed at age 191 days.

TABLE 12 -- COMPRESSIVE STRENGTH OF CREEP COMPANION SPECIMENS, PSI - BERKS G-19

Age, days	Specimen No.	Selected Mix Phase II(c)		Creep Companion Specimens				
				Creep at 30% f'_c			Creep at 45 and 60% f'_c	
		73F Sealed	73F Moist	73F Sealed	110F Sealed	160F Sealed	73F Sealed	160F Sealed
Test Temperature:		73F	73F	73F	73F	73F	73F	
7	1	5320	5020	4930	5160	4750	5200	....
	2	5020	5450	4960	4980	4910	4910	....
	3	5340	5210	4960	4860	4980	4550	....
	Average	5230	5230	4950	5000	4880	4890	....
Test Temperature:		73F	73F	73F	110F	160F	73F	160F
28	1	6520	6660	6380	6300	5540	....	....
	2	6790	6630	6220	6210	5540	....	....
	3	6450	6390	6220	5800	5570	....	....
	Average	6590	6560	6270	6100	5550	....	....
90	1	7500	7820	7180	6890	6000	7390	5980
	2	7550	8070	7070	6710	5380	6710	6200
	3	7480	8000	7430	6540	6110	6890	5770
	Average	7510	7960	7230	6710	5830	7000	5980
270	1	7840	8180	7980	7230	5870	....	....
	2	8390	8620	7660	7550	6110	....	....
	3	8430	8480	8050	7140	6410	....	....
	Average	8220	8430	7900	7310	6130	....	....

Notes: Materials, mix proportions and properties of fresh concrete are given in Table 3.
Specimens: 6 by 12-in.

TABLE 13 -- COMPRESSIVE STRENGTH OF CREEP COMPANION SPECIMENS, PSI - YORK G-26

Age, days	Specimen No.	Selected Mix Phase II(c)		Creep Companion Specimens				
				Creep at 30% f'_c			Creep at 45 and 60% f'_c	
		73F Sealed	73F Moist	73F Sealed	110F Sealed	160F Sealed	73F Sealed	160F Sealed
Test Temperature:			73F	73F	73F	73F	73F	
7	1	....	5050	4800	4680	5050	4910	....
	2	....	5050	4820	4750	4860	4930	....
	3	....	5090	4710	4740	4980	4910	....
	Average	....	5060	4780	4740	4960	4920	....
Test Temperature:		73F	73F	73F	110F	160F	73F	160F
28	1	6290	6910	6120	3390*	5460	....	....
	2	6230	6520	6160	5770	5640	....	....
	3	6320	6540	6200	4160*	5160	....	....
	Average	6280	6660	6160	5770	5420	....	....
90	1	7180	7980	7110	6390	5800	7050	5500
	2	7340	8050	7040	6300	5660	7050	5530
	3	7070	8050	7050	6270	5910	7120	5460
	Average	7200	8030	7070	6320	5790	7070	5500
270	1	8210	9000	8040	....	6360	....	....
	2	8390	8710	7860	7460**	6200	....	....
	3	8000	8980	8020	7090**	6500	....	....
	Average	8200	8900	7980	7270	6350	....	....

Notes: Materials, mix proportions and properties of fresh concrete are given in Table 4.
Specimens: 6 by 12-in concrete cylinders.
* Failure of sulfur cap, capping procedures modified as described in Appendix B.
** Results of an additional test at 110F. Original companion specimen tested at 73F.

TABLE 14 -- TOTAL STRAIN IN CONCRETE SUBJECTED TO CONSTANT SUSTAINED COMPRESSIVE STRESS

Age at Loading, days	Applied Stress, psi	Test Temp, F	Total Strain, microstrain — Time under stress, days: 0	1	10	100	365	(Predict) 14,600
I. Berks G-19 Concrete								
28	2100	73	348	458	546	703	825	1400
		110	363	504	613	786	967	1700
		160	396	539	673	960	1415	3250
90	2100	73	340	403	459	593	700	1200
		110	352	468	574	753	924	1700
		160	398	555	720	1170	1558	3300
90	3220	73	528	657	756	961	1131	1900
		160	620	917	1171	1940	2713	6100
	4200	73	707	949	1113	1409	1654	2600 [a]
		160	861	1562	2022	3204	3868	9550
270	2400	73	376	433	479	583	715 [b]	1050 [a]
		110	392	526	600	775	1030	1800
		160	451	615	789	1223	1590	3600
II. York G-26 Concrete								
28	2100	73	361	449	528	673	782	1250
		110	382	547	670	819	976	1700
		160	395	531	653	980	1230	2650
90	2100	73	343	402	457	572	680	1100
		110	363	495	598	763	918	1600
		160	398	556	685	1038	1320	2700
90	3190	73	521	637	723	910	1071	1900
		160	756	1061	1316	1941	2505	4750
	4250	73	734	1005	1163	1440	1667	2700
		160	1005	1800	2242	3156	3757	7300
270	2400	73	380	435	481	583	707	1200
		110	404	536	660	848	1007	1700
		160	462	606	762	1112	1425	3000

(a) Values are low in comparison to those for York concrete at corresponding test condition.
(b) Specimens were moved to 110 F after stress applied at 73 F for 273 days. Value shown at 73 F was extrapolated from Figure 4.

TABLE 15 -- TOTAL STRAIN PER PSI OF APPLIED COMPRESSIVE STRESS

Age at Loading, days	Applied Stress, psi	Test Temp, F	Microstrain per psi, Time under stress, days: 0	1	10	100	365	(Predict) 14,600
I. Berks G-19 Concrete								
28	2100	73	.166	.218	.260	.335	.393	0.66
		110	.173	.240	.292	.374	.460	0.81
		160	.189	.257	.320	.457	.674	1.55
90	2100	73	.162	.192	.219	.282	.333	0.56
		110	.168	.223	.274	.359	.440	0.80
		160	.190	.264	.343	.557	.742	1.56
90	3220	73	.164	.204	.235	.298	.351	0.59
		160	.193	.285	.364	.602	.842	1.90
	4200	73	.168	.226	.265	.335	.394	0.62 (a)
		160	.205	.372	.482	.763	.921	2.27
270	2400	73	.157	.180	.200	.243	.298 (b)	0.43 (a)
		110	.163	.219	.250	.323	.429	0.74
		160	.188	.256	.329	.510	.663	1.49
II. York G-26 Concrete								
28	2100	73	.172	.214	.251	.320	.372	0.60
		110	.182	.261	.319	.390	.465	0.80
		160	.188	.253	.311	.467	.586	1.27
90	2100	73	.163	.192	.218	.273	.324	0.53
		110	.173	.236	.285	.363	.437	0.75
		160	.190	.265	.326	.494	.629	1.28
90	3190	73	.163	.200	.227	.285	.336	0.60
		160	.237	.332	.412	.608	.785	1.49
	4250	73	.173	.236	.274	.339	.392	0.64
		160	.236	.423	.527	.743	.884	1.72
270	2400	73	.158	.181	.200	.243	.296	0.50
		110	.168	.223	.275	.353	.420	0.71
		160	.193	.253	.318	.463	.594	1.25

(a) Values are low in comparison to those for York concrete at corresponding test condition.
(b) Specimens were moved to 110 F after stress applied at 73 F for 273 days. Value shown at 73 F was extrapolated from Figure 11.

TABLE 16 -- TOTAL STRAINS DURING RECOVERY AFTER UNLOADING

Age at Loading, days	Applied Stress, psi	Test Temp, F	Stress Duration, days	Days of Recov.	Strain Prior to Unload	Total strain, microstrain Time of recovery, days 0	1	10	90
I. Berks G-19 Concrete									
28	2100	73							
		110	487	91	1012	697	660	634	604
		160							
90	2100	73							
		110	425	91	951	638	599	570	540
		160	398	91	1589	1205	1152	1115	1033
90	3220	73	404	91	1145	678	607	568	515
		160	438[a]	8[a]	2575	2187	2125	--	--
	4200	73	404	91	1676	1037	950	897	826
		160							
270	2400	73	365[b]	76[b]	889	519	465	446	--
		110	398	91	1046	684	635	600	548
		160							
II. York G-26 Concrete									
28	2100	73	459	99	807	496	464	437	397
		110	440	15	1011	698	650	630	--
		160							
90	2100	73							
		110	378	91	924	613	575	548	514
		160	397	16	1349	963	912	870	--
90	3190	73	376	15	1080	605	550	513	--
		160	383[c]	15[c]	2523	1975	1880	1820	--
	4250	73	418[c]	56[c]	1341	994	934	897	--
		160							
270	2400	73	365	69	707	343	322	287	--
		110	367	14	1007	664	619	594	--
		160							

(a) Specimens at 3220 psi for 404 days and at 2100 psi from 404 to 438 days at which time they were fully unloaded. Recovery values shown are for final unloading to zero stress.
(b) Specimens at 73 F for 273 days and then at 110 F from 273 to 365 days. Recovery values are for unloading at 110 F.
(c) Specimens at 4250 psi for 390 days and at 2100 psi from 390 to 418 days at which time they were fully unloaded. Recovery values shown are for final unloading to zero stress.

TABLE 17 -- AUTOGENOUS LENGTH CHANGE OF CONCRETE

Temp., F	Age Specimens Reached Temp., days	Autogenous Strain,[a] microstrain Time at Temperature, days 0	10	100	200	365
I. Berks G-19 Concrete						
73	1	8	-24	-41	-47	-60
	28	-14	-8	-23	-42	-62
110	90	-64	-57	-81	-110(b)	-134(b)
	270	-55	-48	-65	-84	-108
	28	2	-12	-34	-60	-83
160	90	-40	8	-25	-44	-70
	270	-5	13	-73	-100(b)	--
II. York G-26 Concrete						
73	1	0	-28	-35	-37	-46
	28	-28	3	4	-20	-44
110	90	-33	-28	-40	-62	-96
	270	-49	-40	-56	-71	-97
	28	3	22	36	21	-7
160	90	-51	4	-20	-42	-66
	270	-30	0	-13	-38	--

(a) Negative values indicate contraction, positive values indicate expansion.

(b) High contraction strains indicate some loss of moisture.

TABLE 18 -- DRYING SHRINKAGE OF CONCRETE

Temp., F	Age Sealing Jacket Removed, days	Drying Shrinkage Strains, microstrain[a] Time after Sealing Jacket Removed, days 0	1	10	100	200	365
I. Berks G-19 Concrete							
73	28	32	34	105	292	365	395
	28	32	96	235	442	500	577
110	90	74	137	270	445	505	580
	270	56	120	223	385	432	460
	28	26	75	210	422	425	440
160	191	31	77	235	400	430	453
	270	40	104	255	410	421	440
II. York G-26 Concrete							
73	28	52	82	144	319	374	429
	28	22	86	214	383	455	501
110	191	41	77	142	288	338	404
	270	65	129	240	410	455	496
	28	6	64	194	503	514	522
160	90	26	105	235	465	469	480
	270	18	108	310	520	530	547

(a) At 73 F the relative humidity was maintained at 50%. At 110 and 160F the relative humidity was approximately 10%. Shrinkage values given are for one specimen for each test condition.

TABLE 19 -- EFFECT OF THERMAL CYCLING ON STRENGTH AND ELASTIC PROPERTIES OF CONCRETE - BERKS G-19

		Compressive Strength, Modulus of Elasticity, and Poisson's Ratio						Splitting Tensile Strength and Percent C. A. Fractured			
		73 F			73-160-73 F			73 F		73-160-73 F	
Age, days	Spec. No.	Comp psi	Ex10^6 psi	μ	Comp psi	Ex10^6 psi	μ	Tens psi	Frac %	Tens psi	Frac %
28	1	6500	6.0	0.20	....	...	...	...	..	...	..
	2	6090	6.1	0.19	....	...	...	...	..	...	..
	3	6270	6.1	0.20	....	...	...	...	..	...	..
	Average	6290	6.1	0.20	....	...	...	...	..	...	..
90	1	7210	6.2	0.21	....	...	...	685	70	...	..
	2	7000	6.1	0.22	....	...	...	705	70	...	..
	3	7210	6.2	0.22	....	...	...	585	45	...	..
	Average	7140	6.2	0.22	....	...	...	660	60	...	..
101 End of Cycle 1	1	....	...	....	7120	5.9	0.21	...	..	585	60
	2	....	...	....	6910	6.0	0.22	...	..	500	40
	3	....	...	....	7090	6.0	0.21	...	..	525	40
	Average	....	...	....	7040	6.0	0.21	...	..	535	45
110 End of Cycle 2	1	7780	6.3	0.22	7230	6.0	0.22	685	60	650	65
	2	7380	6.4	0.22	6520	6.2	0.21	590	60	595	65
	3	7470	6.3	0.22	7230	6.1	0.22	605	65	635	55
	Average	7540	6.3	0.22	6990	6.1	0.22	625	60	625	60
120 End of Cycle 3	1	....	...	....	7250	6.1	0.21	...	..	635	60
	2	....	...	....	7180	6.0	0.20	...	..	565	65
	3	....	...	....	7390	5.9	0.22	...	..	685	55
	Average	....	...	....	7270	6.0	0.21	...	..	630	60
129 End of Cycle 4	1	....	...	....	7370	6.1	0.22	...	..	690	55
	2	....	...	....	7270	5.9	0.22	...	..	670	55
	3	....	...	....	7320	6.1	0.22	...	..	655	55
	Average	....	...	....	7320	6.0	0.22	...	..	670	55
140 End of Cycle 5	1	7750	6.3	0.23	7320	5.8	0.22	735	55	650	60
	2	7520	6.3	0.21	7500	6.1	0.23	660	65	700	55
	3	7300	6.2	0.22	7500	5.9	0.21	730	65	715	55
	Average	7520	6.3	0.22	7440	5.9	0.22	710	60	690	55

Note: Materials, mix proportions and properties of fresh concrete are given in Table 3. Specimens: 6 by 12-in. concrete cylinders.

TABLE 20 -- EFFECT OF THERMAL CYCLING ON STRENGTH AND ELASTIC PROPERTIES OF CONCRETE - YORK G-25

		Compressive Strength, Modulus of Elasticity, and Poisson's Ratio						Splitting Tensile Strength and Percent C. A. Fractured			
		73 F			73-160-73 F			73 F		73-160-73 F	
Age, days	Spec. No.	Comp psi	$Ex10^6$ psi	μ	Comp psi	$Ex10^6$ psi	μ	Tens psi	Frac %	Tens psi	Frac %
28	1	6270	6.1	0.20	....	...	...	...	..	...	..
	2	6530	6.1	0.20	....	...	...	...	..	...	..
	3	6410	6.0	0.21	....	...	...	...	..	...	..
	Average	6400	6.1	0.20	....	...	...	...	..	...	..
90	1	7340	6.1	0.21	....	...	...	565	50	...	..
	2	7430	6.1	0.22	....	...	...	695	70	...	..
	3	7270	6.0	0.23	....	...	...	565	50	...	..
	Average	7350	6.1	0.22	....	...	...	605	55	...	..
101 End of Cycle 1	1	....	...	....	7430	5.6	0.22	...	..	525	60
	2	....	...	....	7450	5.6	0.20	...	..	595	65
	3	....	...	....	7300	5.7	0.22	...	..	645	70
	Average	....	...	....	7390	5.6	0.21	...	..	590	65
110 End of Cycle 2	1	7730	6.2	0.21	7160	5.9	0.21	715	75	660	65
	2	7730	6.1	0.23	7750	5.8	0.22	630	75	650	55
	3	7370	6.0	0.21	7180	5.8	0.22	660	70	655	70
	Average	7610	6.1	0.22	7360	5.8	0.22	670	75	655	65
120 End of Cycle 3	1	....	...	....	7540	5.8	0.21	...	..	565	60
	2	....	...	....	7540	6.0	0.20	...	..	675	55
	3	....	...	....	7310	5.9	0.22	...	..	630	55
	Average	....	...	....	7460	5.9	0.21	...	..	625	55
129 End of Cycle 4	1	....	...	....	7770	5.9	0.23	...	..	650	60
	2	....	...	....	7360	5.9	0.22	...	..	630	75
	3	....	...	....	7210	5.9	0.22	...	..	550	60
	Average	....	...	....	7450	5.9	0.22	...	..	610	65
140 End of Cycle 5	1	7750	6.2	0.22	7370	5.8	0.23	665	70	695	65
	2	7860	6.2	0.23	7750	5.9	0.22	695	65	675	75
	3	7710	6.0	0.22	7520	5.7	0.22	565	70	635	50
	Average	7770	6.1	0.22	7550	5.8	0.22	640	70	670	65

Note: Materials, mix proportions and properties of fresh concrete are given in Table 4. Specimens: 6 by 12-in. concrete cylinders.

TABLE 21 -- THERMAL CYCLING STRAINS - BERKS G-19

Temperature (F) and Strain (micro-strain) per Thermal Cycle

Cycle No. 1		Cycle No. 2		Cycle No. 3		Cycle No. 4		Cycle No. 5	
F	Strain	F	Strain	F	Strain	F	Strain	F	Strain
I. Specimen No. 1, 4-in. Carlson Meter No. M-189									
71.0	0	69.0	1	72.0	0	75.9	0	72.5	0
93.6	110	93.6	141	95.1	130	98.2	132	94.1	125
105.8	177	103.8	197	107.8	196	110.1	193	108.1	202
126.5	295	127.5	319	137.0	349	133.4	315	136.6	349
166.2	602	179.7	667	166.9	509	168.1	510	172.5	569
134.9	415	131.5	372	---	---	139.2	344	142.1	383
108.7	279	116.3	289	115.6	231	116.3	222	117.8	253
94.6	202	99.4	200	100.6	147	100.9	134	95.0	126
69.0	64	72.0	53	75.9	15	72.5	-15	70.9	4
II. Specimen No. 2, 10-in. Carlson Meter No. M-191									
71.0	0	68.9	0	71.6	0	75.7	0	72.3	0
93.4	111	93.1	142	96.3	142	98.2	133	94.5	130
105.7	178	102.7	193	109.0	211	110.8	201	109.4	212
126.5	290	126.0	316	136.5	354	134.2	323	138.4	364
170.5	586	179.2	655	166.5	524	168.5	529	170.6	569
133.5	369	132.2	368	---	---	140.9	359	143.2	392
107.2	224	116.5	278	116.4	242	112.4	201	119.6	264
94.2	158	99.4	139	101.1	155	101.2	138	95.7	123
68.9	25	71.6	32	75.7	14	72.3	-18	70.8	-23
III. Specimen No. 3, 10-in. Carlson Meter No. M-192									
71.0	0	69.1	0	72.0	0	76.1	0	72.7	0
93.7	114	93.3	141	96.9	144	98.5	132	95.1	131
106.1	183	103.6	196	109.6	214	111.1	202	110.0	215
127.4	302	127.3	323	135.5	353	134.8	331	139.1	374
168.3	638	178.8	706	164.8	563	169.6	589	172.1	630
134.9	402	130.2	368	---	---	140.4	367	143.7	406
108.5	261	116.1	287	116.9	252	117.3	238	119.0	266
94.8	186	99.0	192	101.4	164	101.4	146	95.7	135
69.1	64	72.0	44	76.1	23	72.7	-11	71.1	2

Note: Materials, mix proportions and properties of fresh concrete are given in Table 3.

Sealed 6 by 16-in. specimens, heated and cooled at the rate of 24 F per day, starting at age 90 days.

TABLE 22 -- THERMAL CYCLING STRAINS - YORK G-25

Temperature (F) and Strain (micro-strain) per Thermal Cycle

Cycle No. 1		Cycle No. 2		Cycle No. 3		Cycle No. 4		Cycle No. 5	
F	Strain	F	Strain	F	Strain	F	Strain	F	Strain
I. Specimen No. 1, 4-in. Carlson Meter No. M-187									
71.0	0	69.8	0	72.6	0	76.8	0	73.4	0
94.6	120	93.9	120	98.9	129	99.3	117	95.9	115
106.6	183	103.6	166	112.1	190	111.9	177	110.9	188
127.7	292	127.0	272	137.0	307	135.6	287	140.2	324
170.9	752	178.9	754	166.0	563	170.2	604	173.3	648
134.6	456	133.9	358	---	---	142.3	335	144.5	361
108.2	337	118.4	283	117.6	224	118.3	217	119.9	239
95.3	276	100.7	200	102.1	146	102.1	134	96.6	122
69.8	150	72.6	64	76.8	23	73.4	-1	71.8	10
II. Specimen No. 2, 10-in. Carlson Meter No. M-194									
71.0	0	69.3	0	71.9	0	76.1	0	72.5	0
95.4	111	93.7	134	93.3	118	98.3	123	94.0	120
107.0	170	103.9	184	104.7	172	110.7	186	108.0	192
127.8	279	127.4	301	135.5	330	134.4	306	135.9	334
169.2	620	180.4	683	165.9	539	169.1	549	172.8	597
135.1	385	125.5	326	---	---	139.4	334	142.1	369
108.4	251	112.5	254	116.1	231	115.4	211	117.8	241
94.8	182	96.8	172	101.2	151	100.5	128	94.7	119
69.3	54	71.9	45	76.1	21	72.5	-12	70.8	0
III. Specimen No. 3, 10-in. Carlson Meter No. M-196									
71.0	0	69.1	0	71.9	0	75.7	0	72.2	0
94.8	101	94.2	133	93.0	111	97.7	117	92.7	109
106.5	158	104.3	181	104.4	166	109.4	163	105.6	174
127.1	261	127.9	291	136.5	314	133.3	289	131.9	299
167.5	507	181.0	610	166.3	464	168.6	468	172.8	515
135.4	341	126.9	316	---	---	136.6	298	138.9	328
108.5	215	113.3	246	114.4	207	112.8	184	116.0	217
94.6	148	97.4	169	100.2	135	98.4	109	93.0	79
69.1	27	71.9	49	75.7	16	72.2	-12	70.5	-2

Note: Materials, mix proportions and properties of fresh concrete are given in Table 4.

Sealed 6 by 16-in. specimens, heated and cooled at the rate of 24 F per day, starting at age 90 days.

TABLE 23 -- CUMULATIVE AND RESIDUAL THERMAL STRAINS DUE TO THERMAL CYCLING - BERKS G-19 AND YORK G-25

Cycle No.	Thermal Strain per Cycle, microstrain: 73 to 95 F	73 to 110 F	73 to 135 F	73 to 160 F	73 to 160 to 135 F	73 to 160 to 110 F	73 to 160 to 90 F	Residual Microstrain 73 to 160 to 73 F
I. Berks G-19 Concrete								
1	110	190	330	545	385	255	170	55
2	130	210	340	535	370	220	130	25
3	125	210	340	490	---	200	120	-5
4	130	210	345	510	345	205	120	5
5	130	210	340	515	345	210	120	5
Ave 1 to 5	125	205	340	520	360	220	130	Σ = 85
Cumulative Coef. of Exp.	5.7	5.5	5.5	6.0	5.8	5.9	5.9	Ave = 5.8
II. York G-25 Concrete								
1	100	175	305	500*	350*	230*	150*	45*
2	115	190	310	510*	350	215	135	40
3	115	185	305	485	---	185	110	0
4	120	190	315	505	315	190	115	10
5	115	190	310	510	315	190	105	10
Ave 1 to 5	115	185	310	500	330	200	125	Σ = 105
Cumulative Coef. of Exp.	5.3	5.0	5.0	5.7	5.3	5.4	5.7	Ave = 5.3

Notes: Materials, mix proportions and properties of fresh concrete are given in Tables 3 and 4. Average of three 6 by 16-in. sealed specimens stored at 73 F for 90 days prior to thermal cycling. (*) indicates average of two specimens. Thermal strains shown above were normalized to nominal temperature range from measured strains and temperatures. The cumulative coefficients of thermal expansion were averaged from measured strains and temperatures.

TABLE 24 -- LINEAR COEFFICIENTS OF THERMAL EXPANSION - BERKS G-19 AND YORK G-25

Coefficients of Thermal Expansion, microstrain per F

Cycle No.	73 to 95 F(a)	95 to 110 F	110 to 135 F	135 to 160 F	160 to 135 F	135 to 110 F	110 to 95 F	95 to 73 F
I. Berks G-19 Concrete								
1	5.0	5.4	5.6	6.7**	6.0*	5.3	5.3	5.4
2	5.8	5.4	5.2	6.5*	6.1*	5.7	5.4*	5.4*
3	5.7	5.4	5.3	5.6*	---	---	5.7	5.5
4	5.9	5.3	5.3	5.8*	5.9	5.5	5.7	5.4
5	5.9	5.5	5.3	6.3*	6.3	5.5	5.7	5.4
Ave 1 to 5	5.7	5.4	5.3	6.2	6.1	5.5	5.6	5.4
II. York G-25 Concrete								
1	4.7	5.1	5.1	6.1**	5.2**	4.7	4.9	4.9
2	5.3	4.9	4.7	6.0**	5.5**	5.2	4.9	4.9
3	5.2	4.8	4.8	5.0**	---	---	5.2	5.0
4	5.3	4.9*	5.0	5.1**	5.3**	5.0	5.3	4.8
5	5.3	5.1	4.8	5.3**	5.5**	5.0	5.2	4.6
Ave 1 to 5	5.2	5.0	4.9	5.5	5.4	5.0	5.1	4.8

Notes: Materials, mix proportions and properties of fresh concrete are given in Tables 3 and 4. Average of three 6 by 16-in. sealed specimens stored at 73 F for 90 days prior to thermal cycling. (*) indicates average of two; (**) indicates one specimen.

(a) Nominal temperature range.

TABLE 25 -- THERMAL PROPERTIES OF CONCRETE - BERKS G-19 AND YORK G-26

I. Adiabatic Temperature Rise - Berks G-19

Age, days	Temperature, F	Age, days	Temperature, F	Age, days	Temperature, F
0	48.58	1.62	121.5	13.0	145.70
0.125	51.6]	1.75	123.8	14.0	146.05
0.248	53.8*	1.87	126.0	15.0	146.40
0.373	57.0	2.01	128.04	16.0	146.71
0.456	59.84	3.0	134.59	17.0	146.99
0.543	64.92	4.0	137.79	18.0	147.27
0.623	69.3	5.0	139.84	19.0	147.49
0.748	82.8	6.0	141.29	20.0	147.71
0.873	93.0	7.0	142.40	21.0	147.92
1.01	101.93	8.0	143.29	22.0	148.16
1.17	108.45	9.1	143.80	23.0	148.38
1.25	111.0	10.0	144.40	24.0	148.56
1.37	115.0	11.1	144.89	25.0	148.72
1.50	118.5	12.0	145.35	End of Test------	

*Note: Values given to one decimal place obtained from chart, all other values read using quartz thermometer.

	Berks G-19	York G-26
II. Specific Heat, Btu/lb/°F (70 ± 2 to 100 ± 2 °F)	0.293 at 29 days 0.250 at 147 days	0.256 at 28 days 0.254 at 104 days
III. Diffusivity, ft^2/hr. (120 ± 5 to $42 \pm .05$ °F)	0.0503 at 29 days 0.0552 at 97 days	0.0484 at 29 days 0.0503 at 97 days

TABLE 26 -- EFFECT OF CURING TEMPERATURE ON COMPRESSIVE STRENGTH OF SEALED CONCRETE - BERKS G-19

I. Effect of Adiabatic Curing

Age, days	Specimen No.	Compressive Strength, psi, Curing Condition: 14 Days Adiabatic and then 110 F (a)	Compressive Strength, psi, Curing Condition: Continuous 73 F
28	1	6930	6380
	2	7360	6320
	3	7200	6380
	Average	7160	6360
60	1	7590	6980
	2	7640	7020
	3	7180	6790
	Average	7470	6930

II. Effect of 160 F Curing

Test Age of Concrete, days	Days Curing at 160F for 160F Test Specimens (b)	Spec. No.	Compressive Strength, psi, Specimen's Test Temperature: 160F (b)	Compressive Strength, psi, Specimen's Test Temperature: 73 F (c)
90	1	1	5410	6870
		2	5860	7110
		3	5640	--
		Average	5640	6990
180	91	1	6210	7730
		2	6460	7070
		3	6880	--
		Average	6520	7400
270	181	1	6570	7680
		2	6540	7960
		3	7000	--
		Average	6700	7820

Notes: Materials, mix proportions and properties of fresh concrete are given in Table 3. Specimens: 6 by 12-in. sealed concrete cylinders.

(a) Two days prior to testing, specimens were cooled to and tested at 73 F.

(b) Specimens tested at 160 F were cured at 73 F from 0 to 85 days, 73 to 135 F from 85 to 89 days and then at 160 F from 89 days up to age of test.

(c) Specimens tested at 73 F were cured continuously at 73 F.

TABLE 27 -- EFFECT OF SPECIMEN'S TEST TEMPERATURE ON 270-DAY COMPRESSIVE STRENGTH OF SEALED CONCRETE - YORK G-26

Age, days	Spec. No.	Compressive Strength, psi Specimen's Test Temperature 73 F	110 F	160 F
I. Specimens Cured at 73 F[(a)]				
270	1	8210	7460	6450
	2	8300	7090	6270
	Average	8250	7270	6360
II. Specimens Cured at 73 F and then at 160 F from age 89 to 265 days (b)				
270	1	7570	7640	7130
	2	7700	7390	6820
	3	7550	7630	6860
	Average	7610	7550	6940

Notes: Materials, mix proportion and properties of fresh concrete are given in Table 4. Specimens: 6 by 12-in. sealed concrete cylinders.

(a) Specimens were cured at 73 F from 0 to 265 days and then kept at 73 F or heated to the 110 or 160 F test temperatures at a rate of 24 F per day.

(b) Specimens were cured at 73 F from 0 to 85 days, then heated to 135 F (24 F per day) and at age 89 days placed in a 160 F chamber where they were cured continuously for 176 days (age 265 days). Specimens were then kept at 160 F or cooled to the 110 or 73 F test temperatures at a rate of 24 F per day.

FIGURES 1 to 19

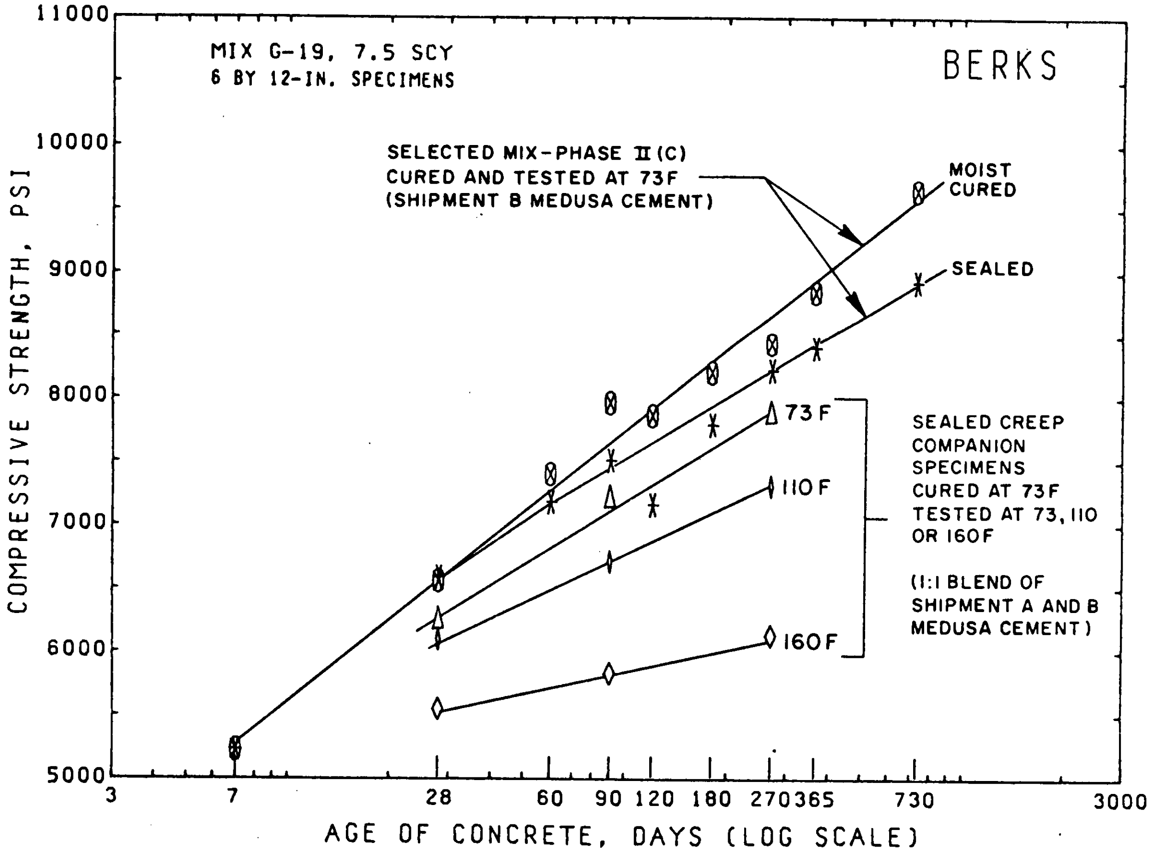


FIGURE 1 -- COMPRESSIVE STRENGTH OF BERKS CONCRETE

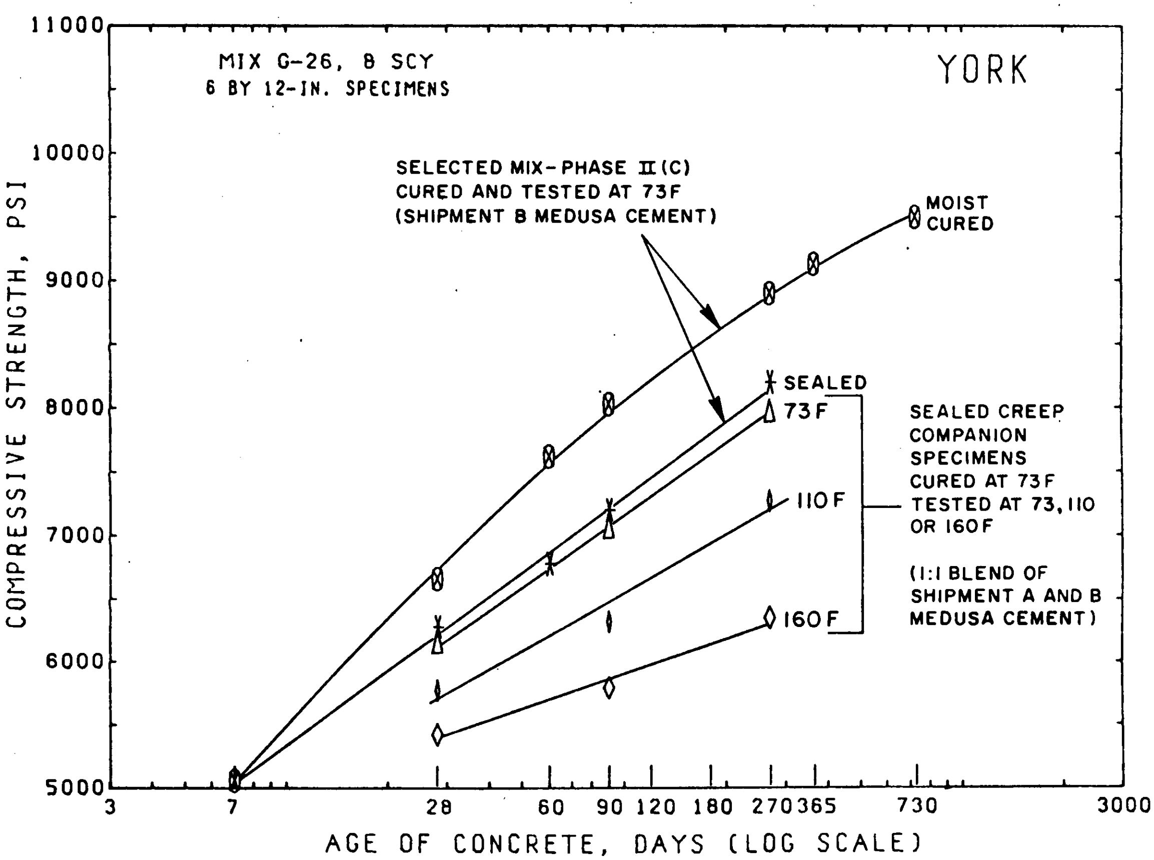
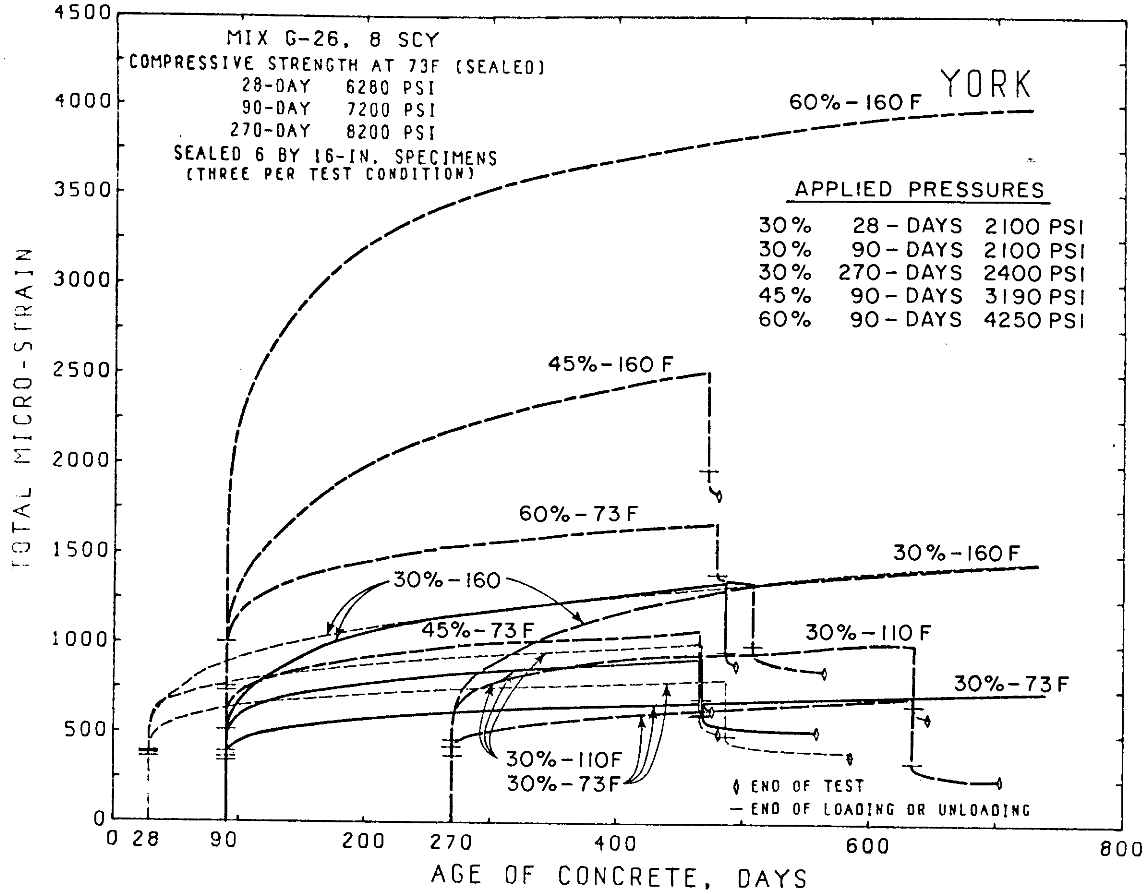


FIGURE 2 -- COMPRESSIVE STRENGTH OF YORK CONCRETE



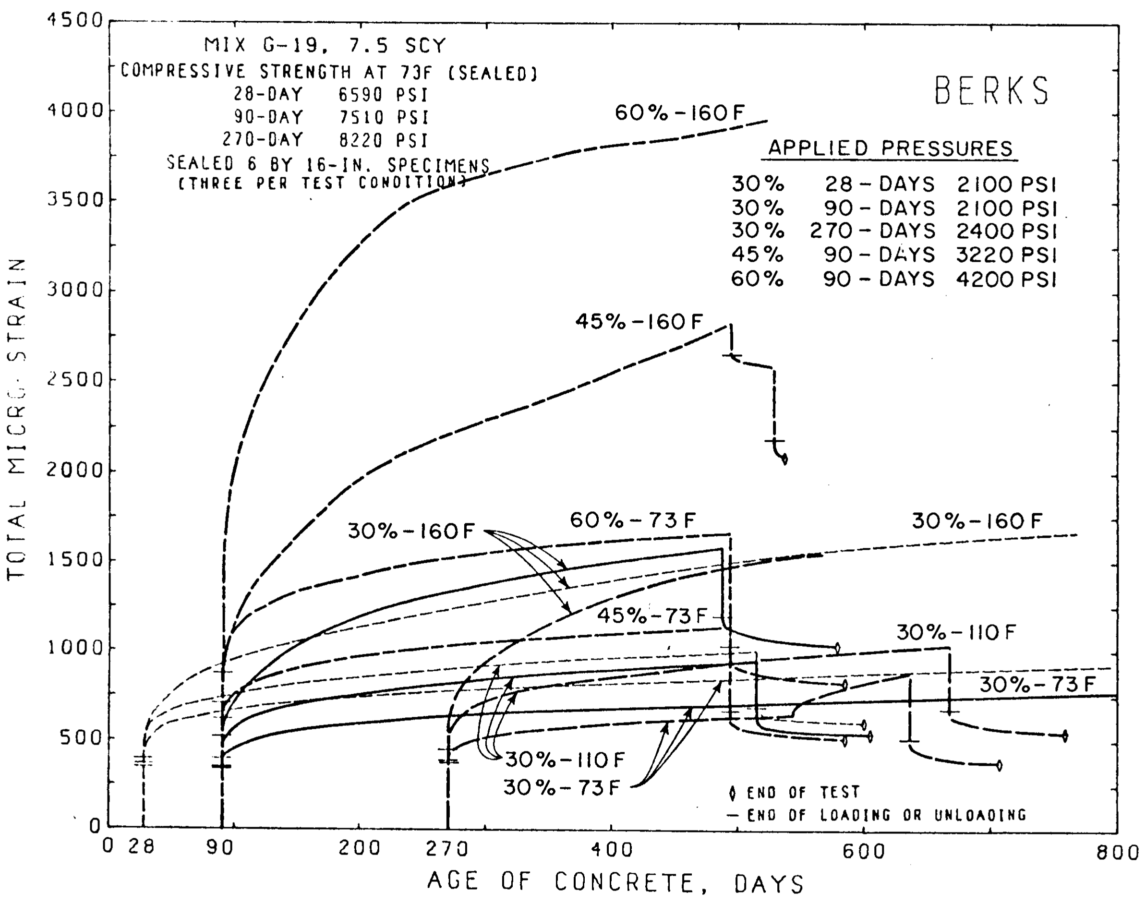
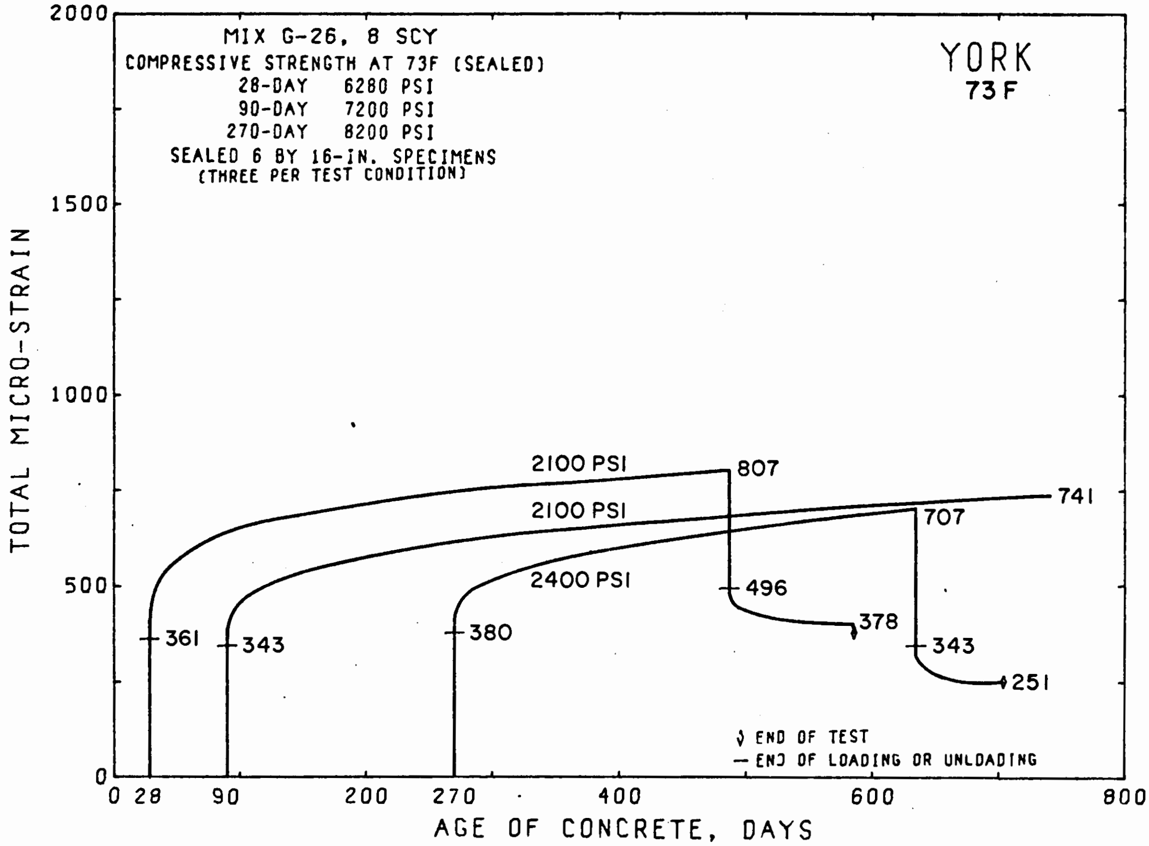


FIGURE 3 -- TOTAL STRAIN IN CONCRETE SHOWN FOR ALL TEST CONDITIONS

FIGURE 3



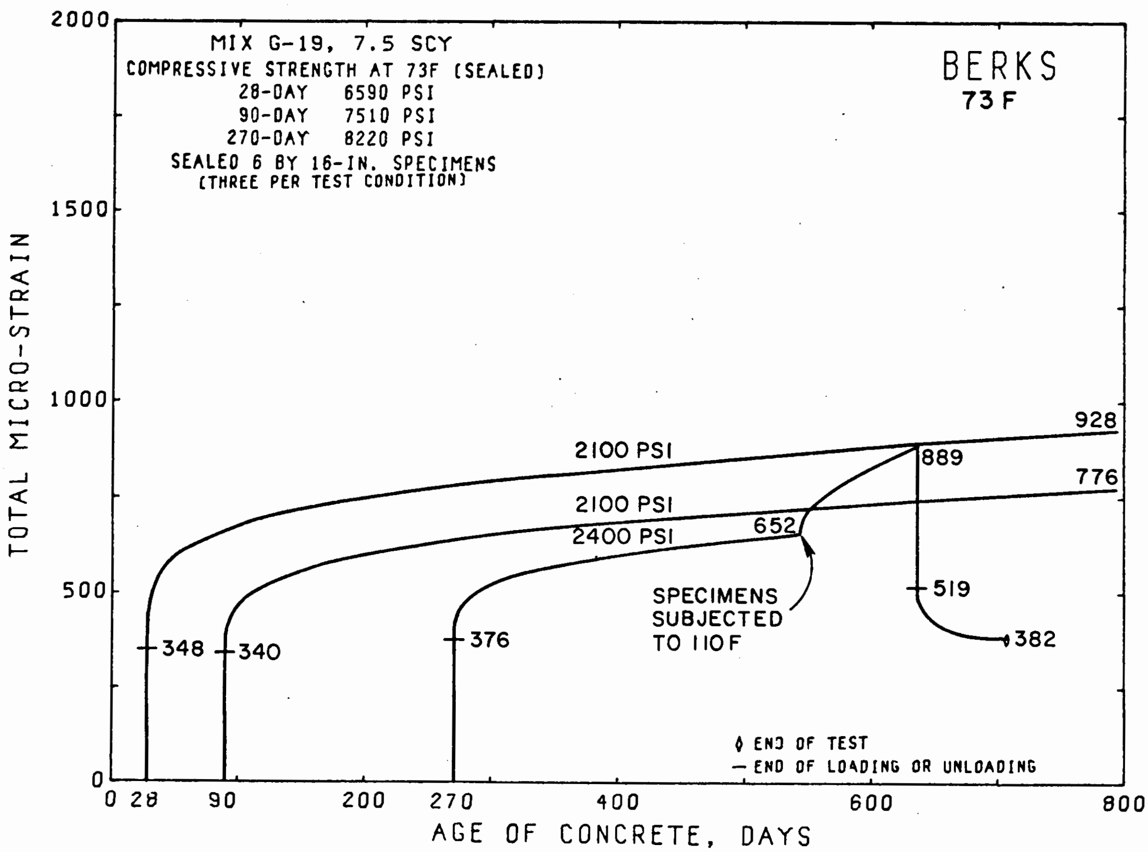


FIGURE 4 -- TOTAL STRAIN IN CONCRETE LOADED AT 73F TO A NOMINAL 30 PERCENT STRESS LEVEL.

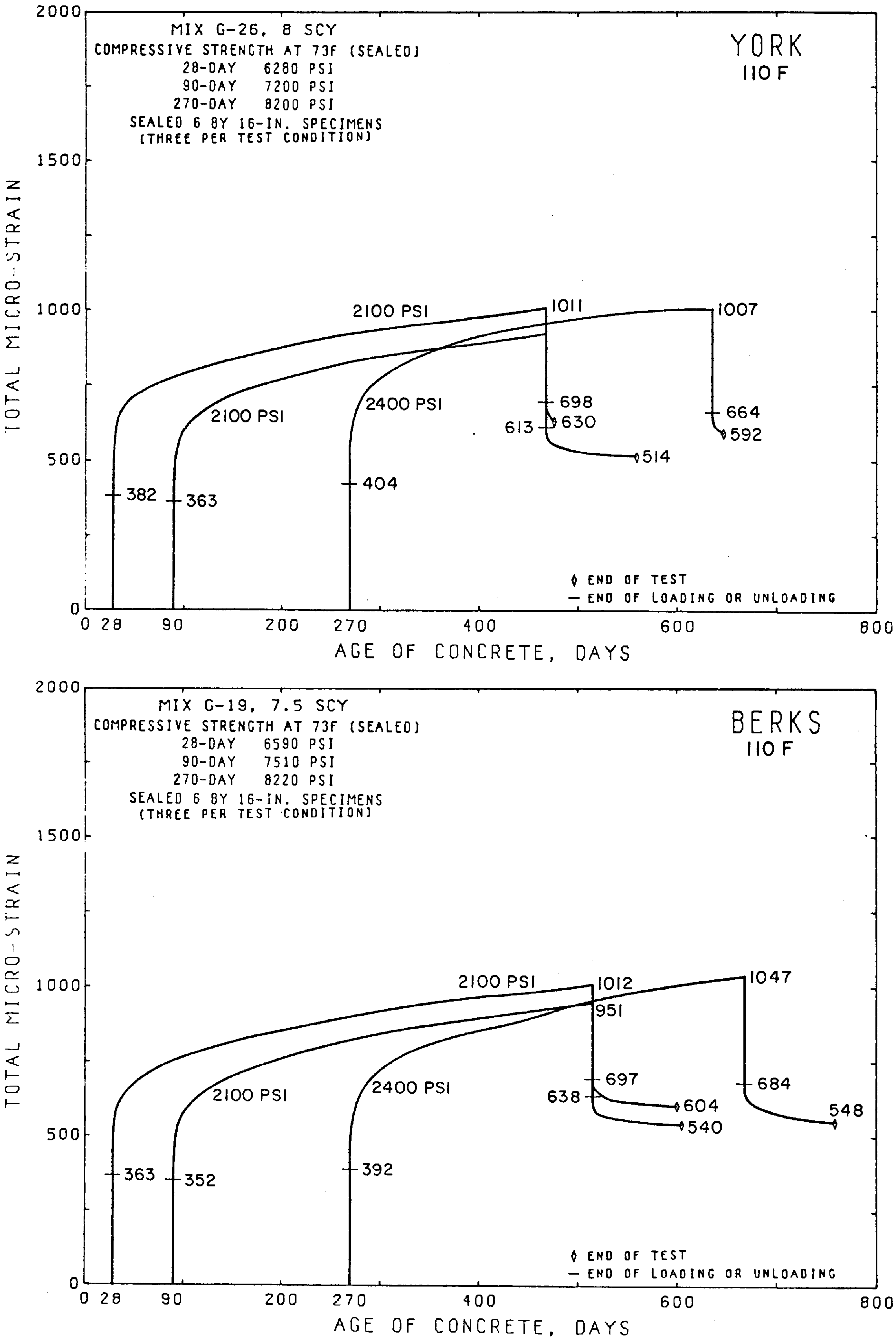
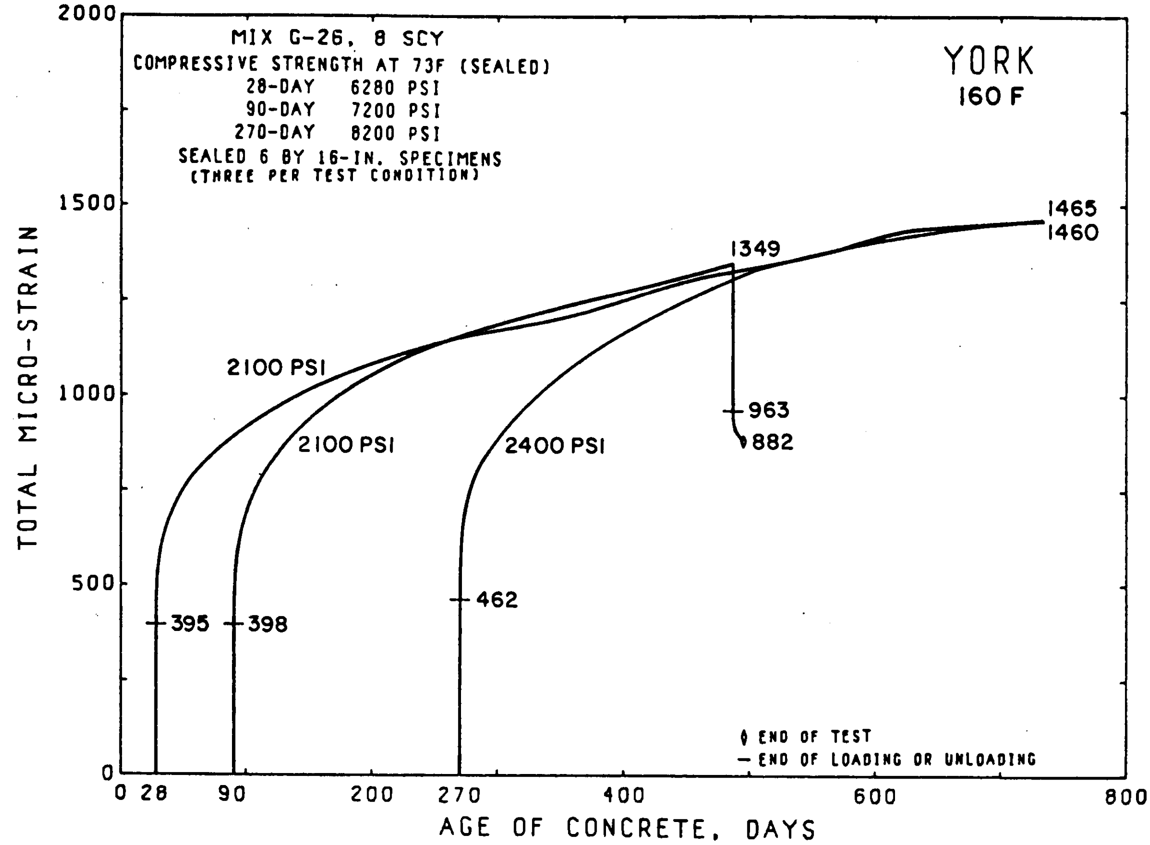


FIGURE 5 -- TOTAL STRAIN IN CONCRETE LOADED AT 110F TO A NOMINAL 30 PERCENT STRESS LEVEL

FIGURE 5



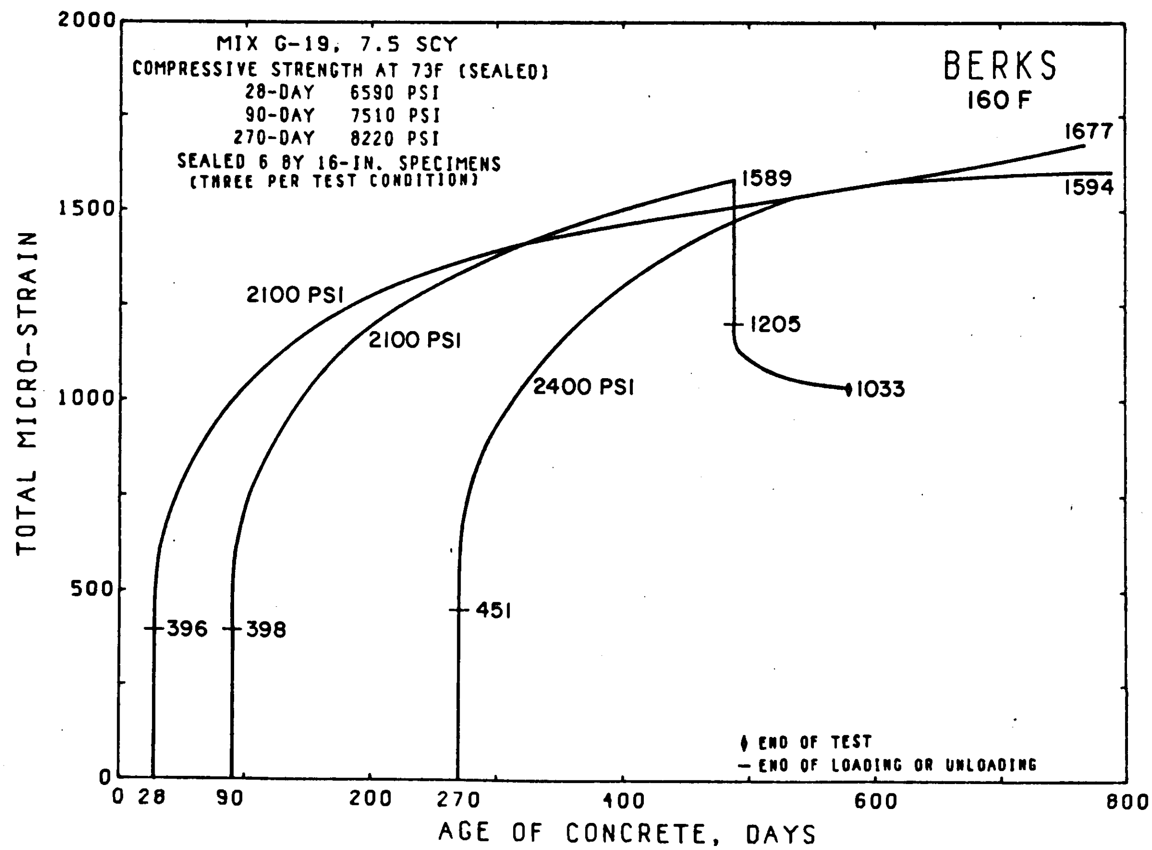
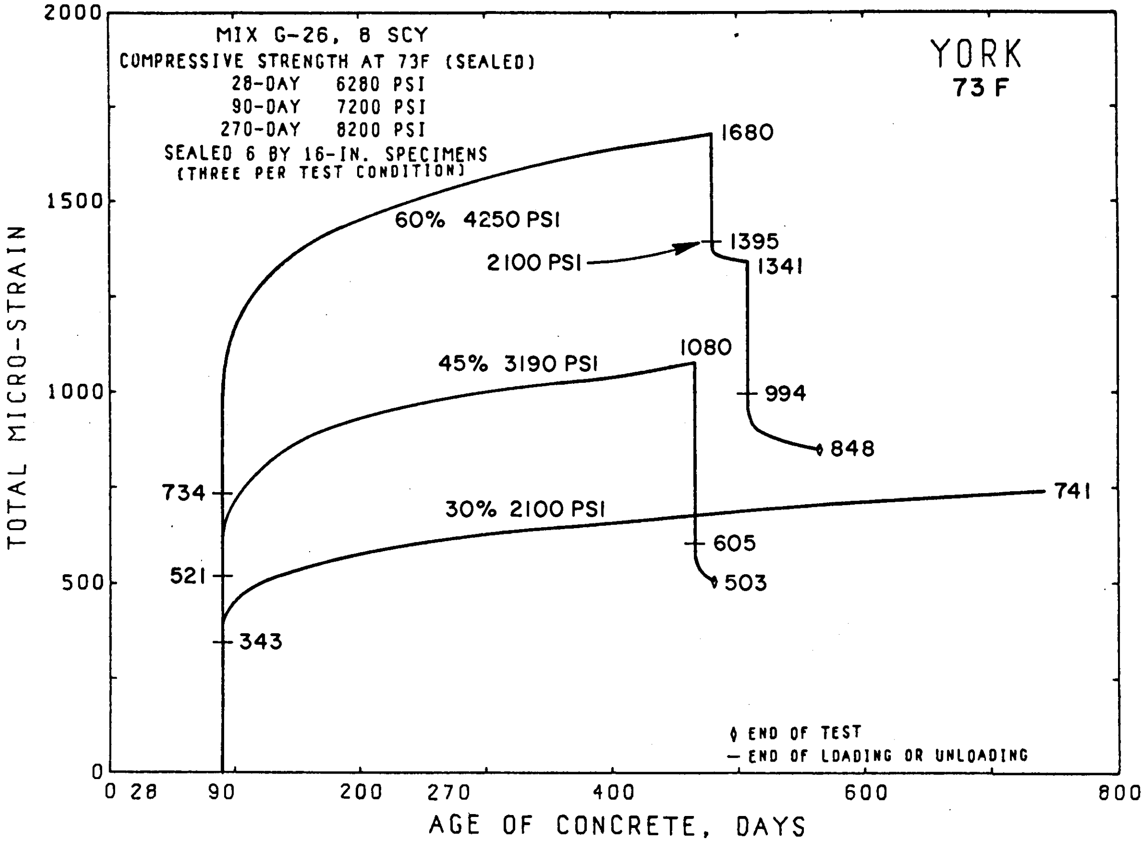


FIGURE 6 -- TOTAL STRAIN IN CONCRETE LOADED AT 160F TO A NOMINAL 30 PERCENT STRESS LEVEL.



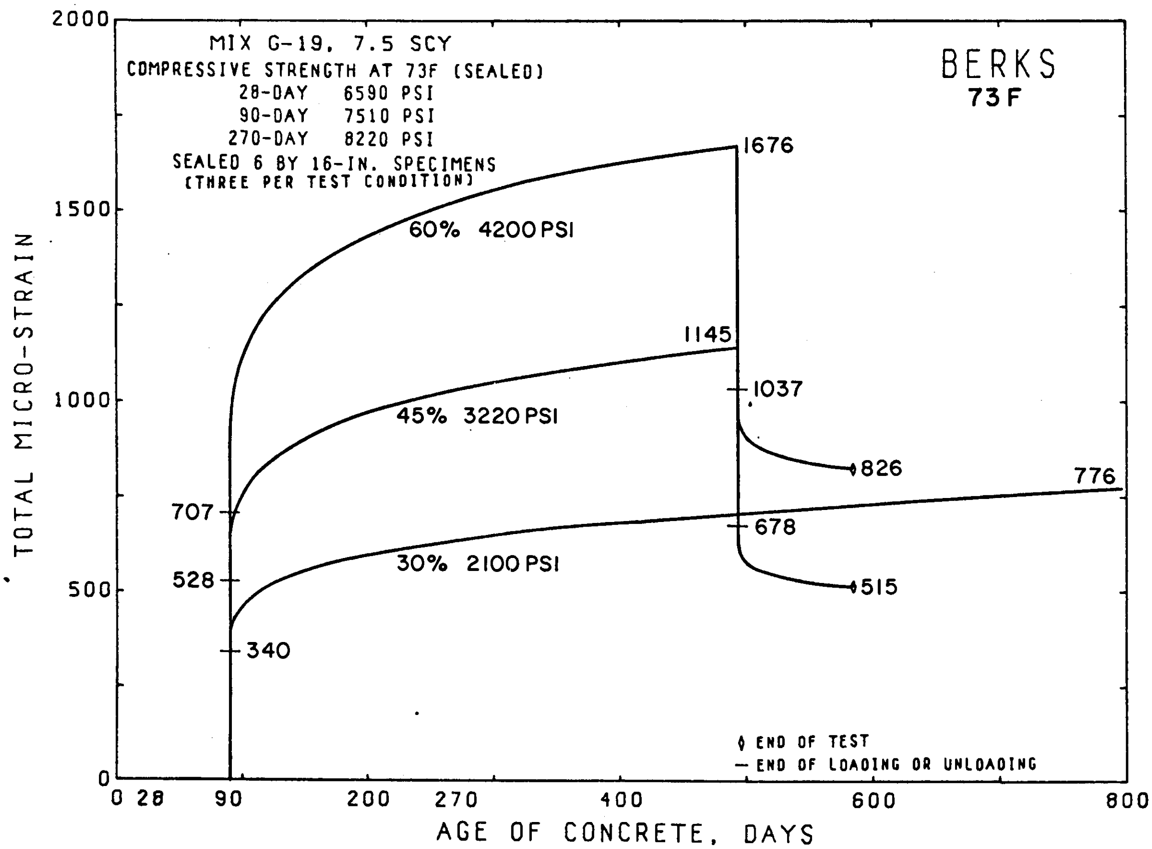
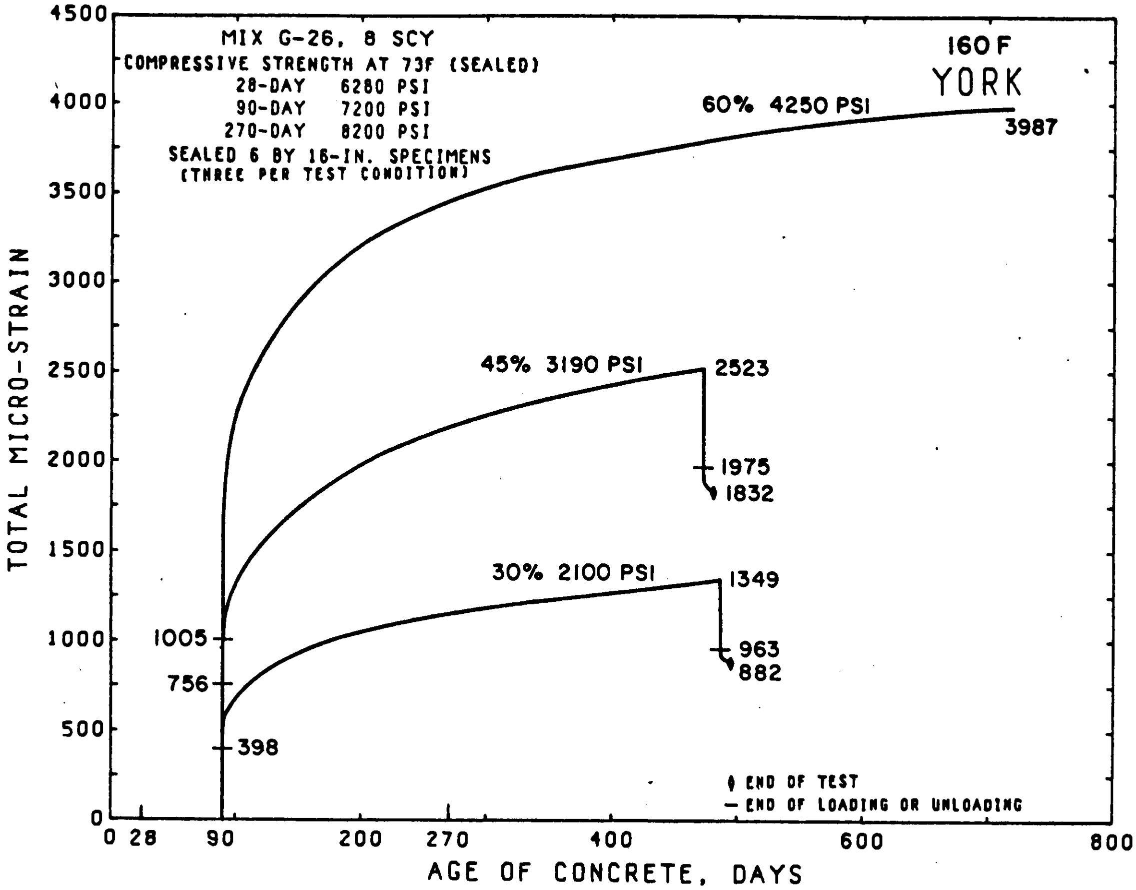


FIGURE 7 -- TOTAL STRAIN IN CONCRETE LOADED AT 73F TO A NOMINAL 30, 45, OR 60 PERCENT STRESS LEVEL.



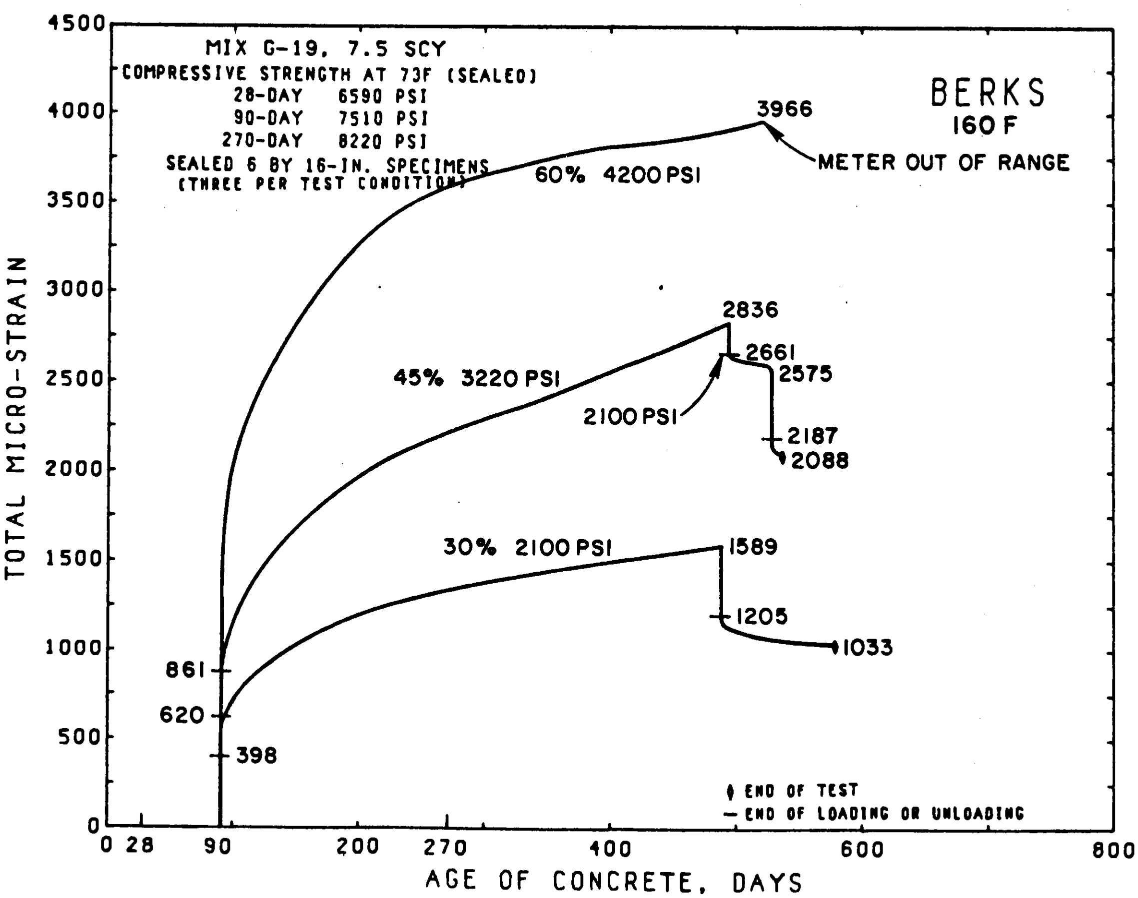


FIGURE 8 -- TOTAL STRAIN IN CONCRETE LOADED AT 160F TO A NOMINAL 30, 45, OR 60 PERCENT STRESS LEVEL.

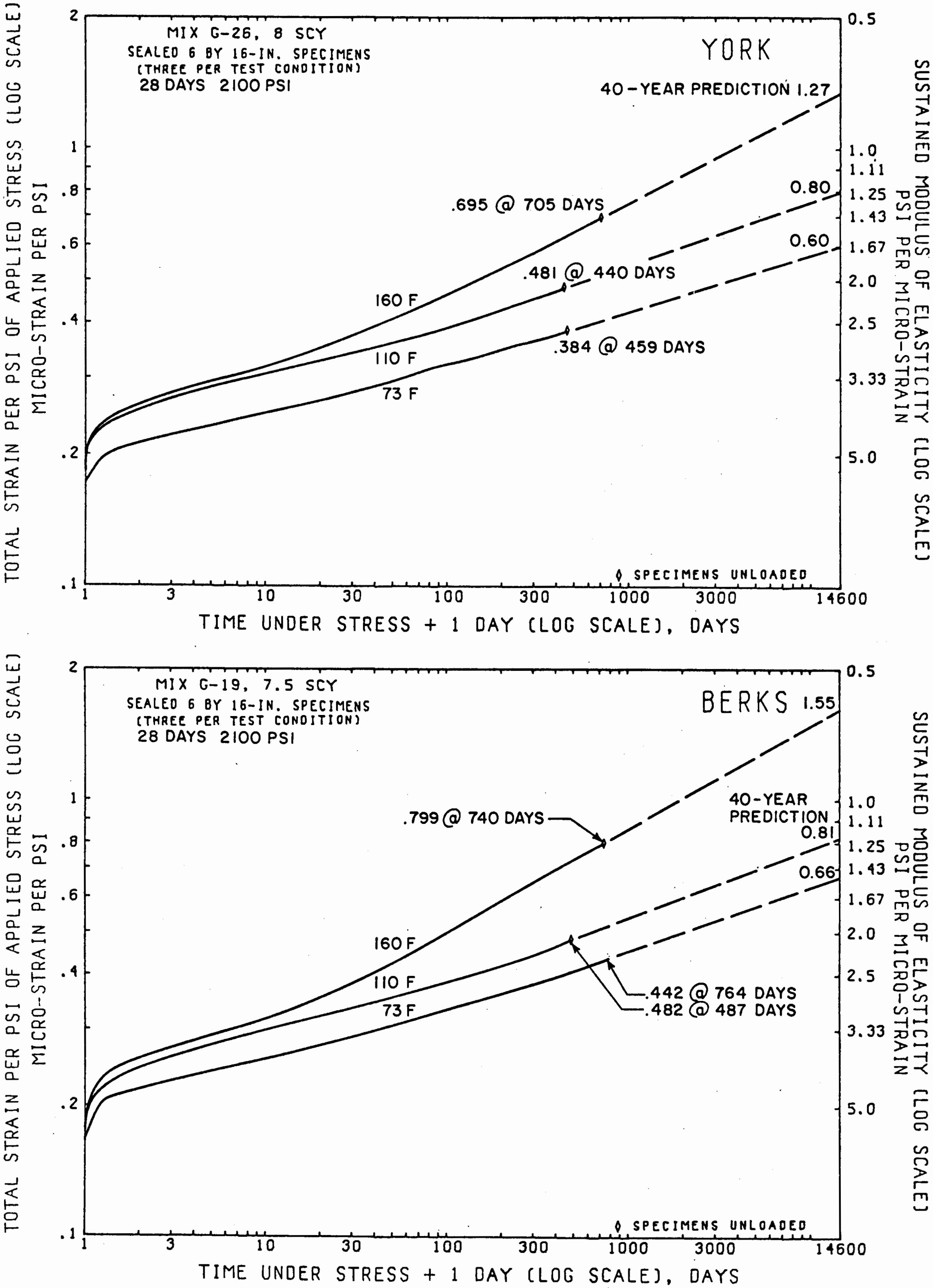
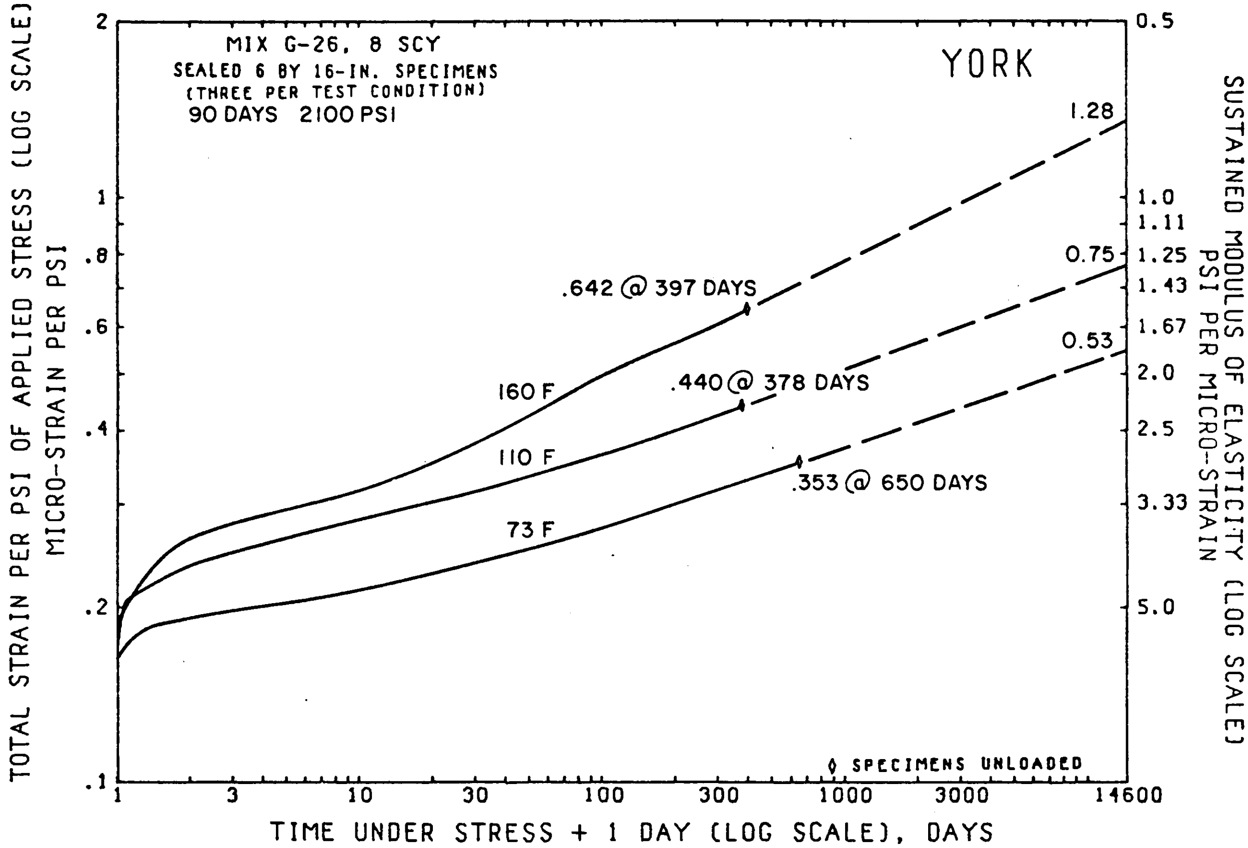


FIGURE 9 -- EFFECT OF TEMPERATURE ON TOTAL STRAIN OF CONCRETE LOADED AT 28 DAYS TO A NOMINAL 30 PERCENT STRESS LEVEL.

FIGURE 9



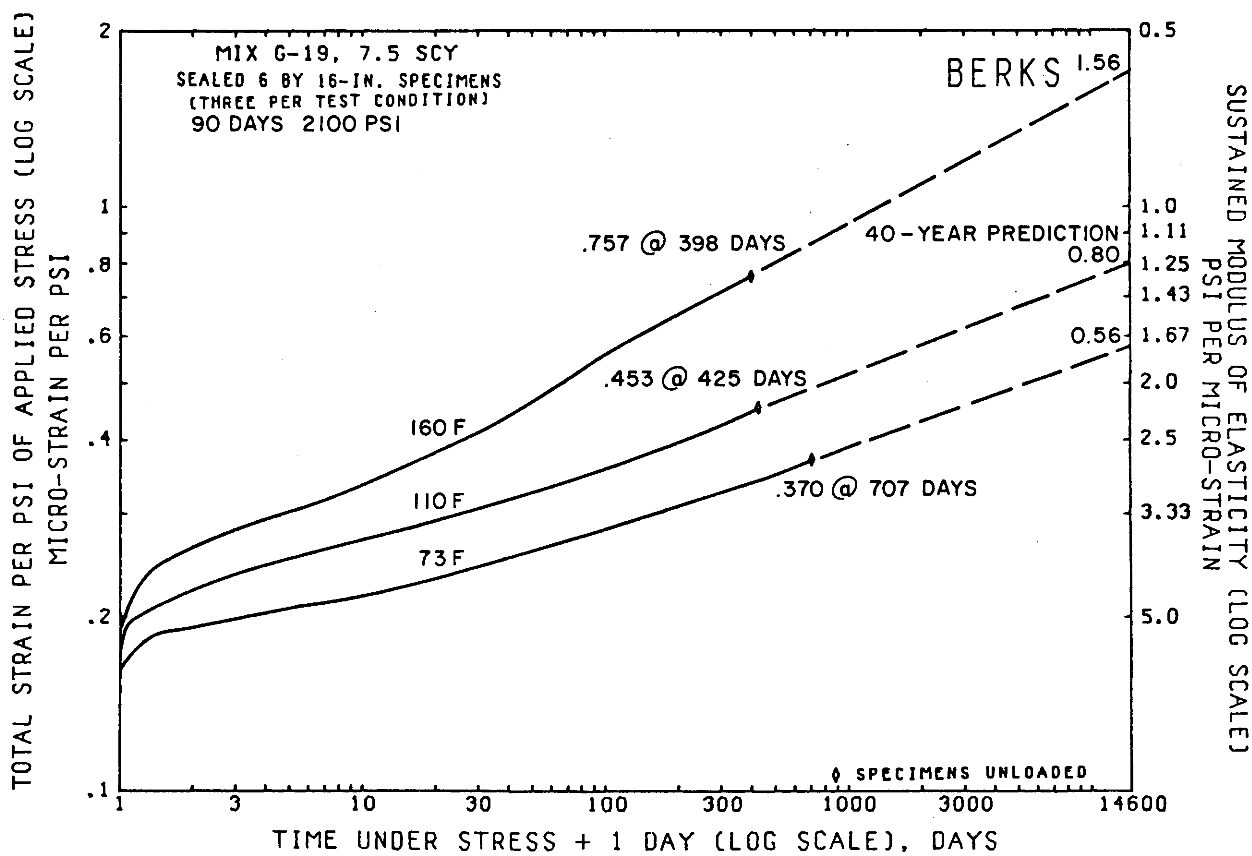


FIGURE 10 -- EFFECT OF TEMPERATURE ON TOTAL STRAIN OF CONCRETE LOADED AT 90 DAYS TO A NOMINAL 30 PERCENT STRESS LEVEL.

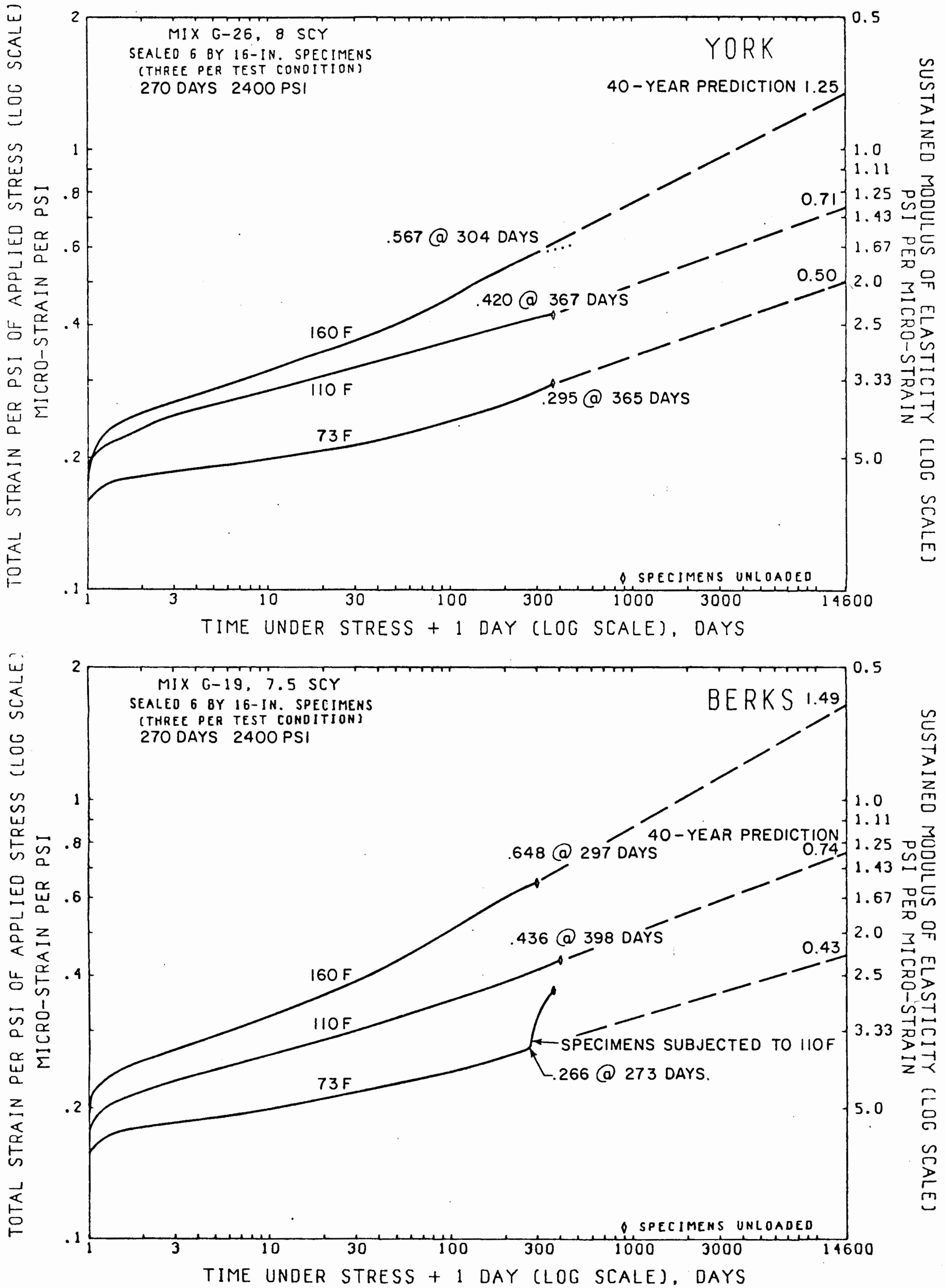


FIGURE 11 -- EFFECT OF TEMPERATURE ON TOTAL STRAIN OF CONCRETE LOADED AT 270 DAYS TO A NOMINAL 30 PERCENT STRESS LEVEL.

FIGURE 11

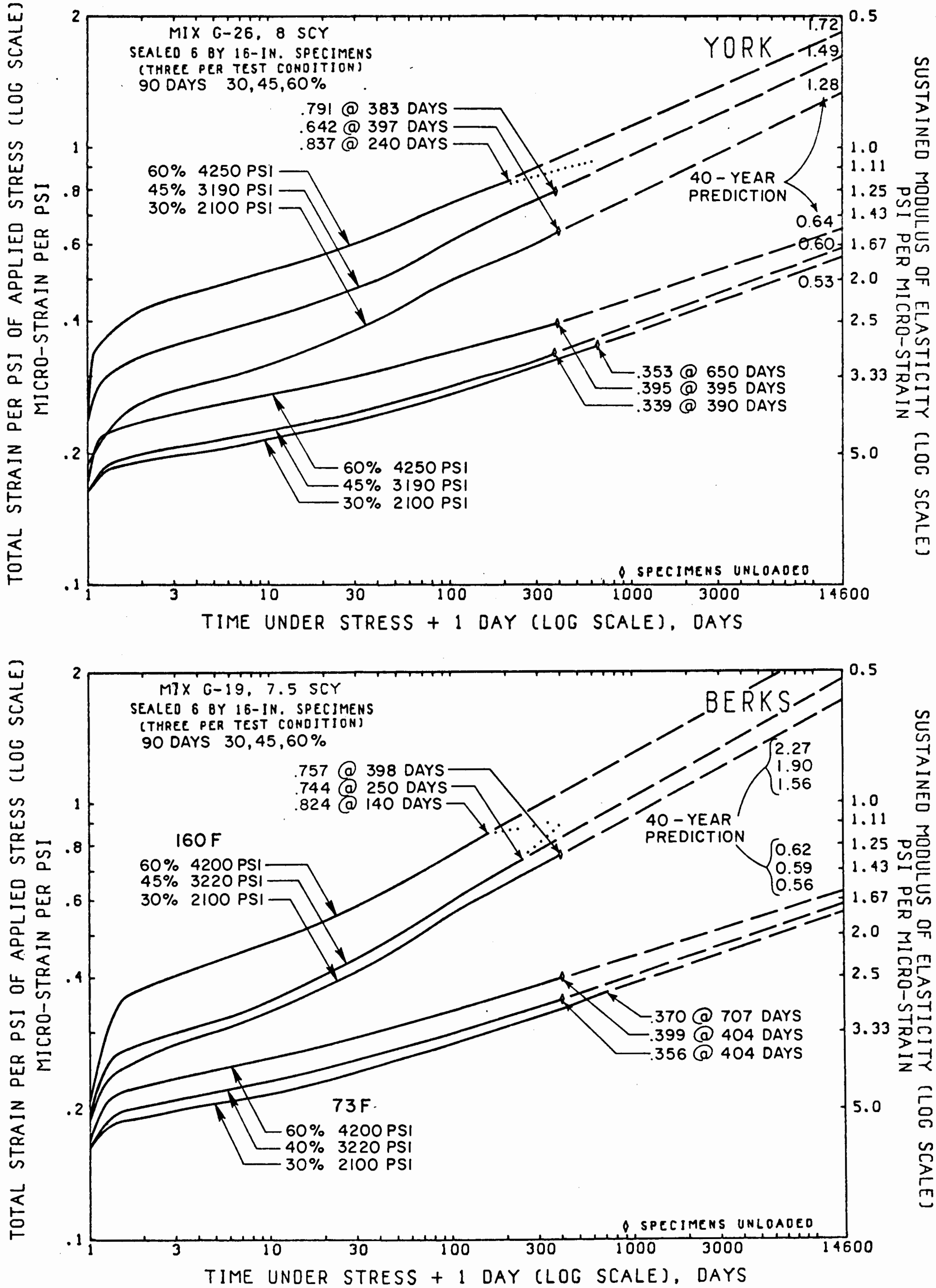
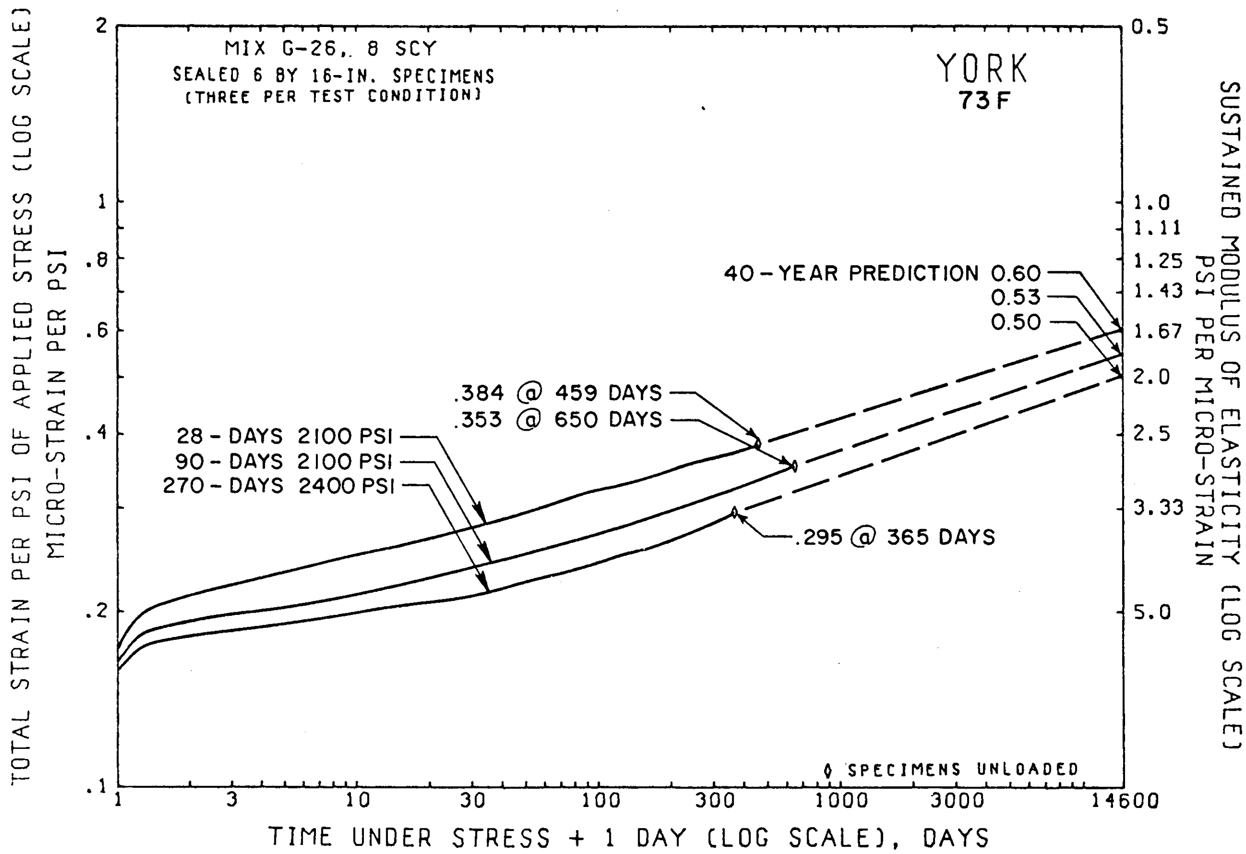


FIGURE 12 -- EFFECT OF TEMPERATURE ON TOTAL STRAIN OF CONCRETE LOADED AT 90 DAYS TO A NOMINAL 30, 45, OR 60 PERCENT STRESS LEVEL.



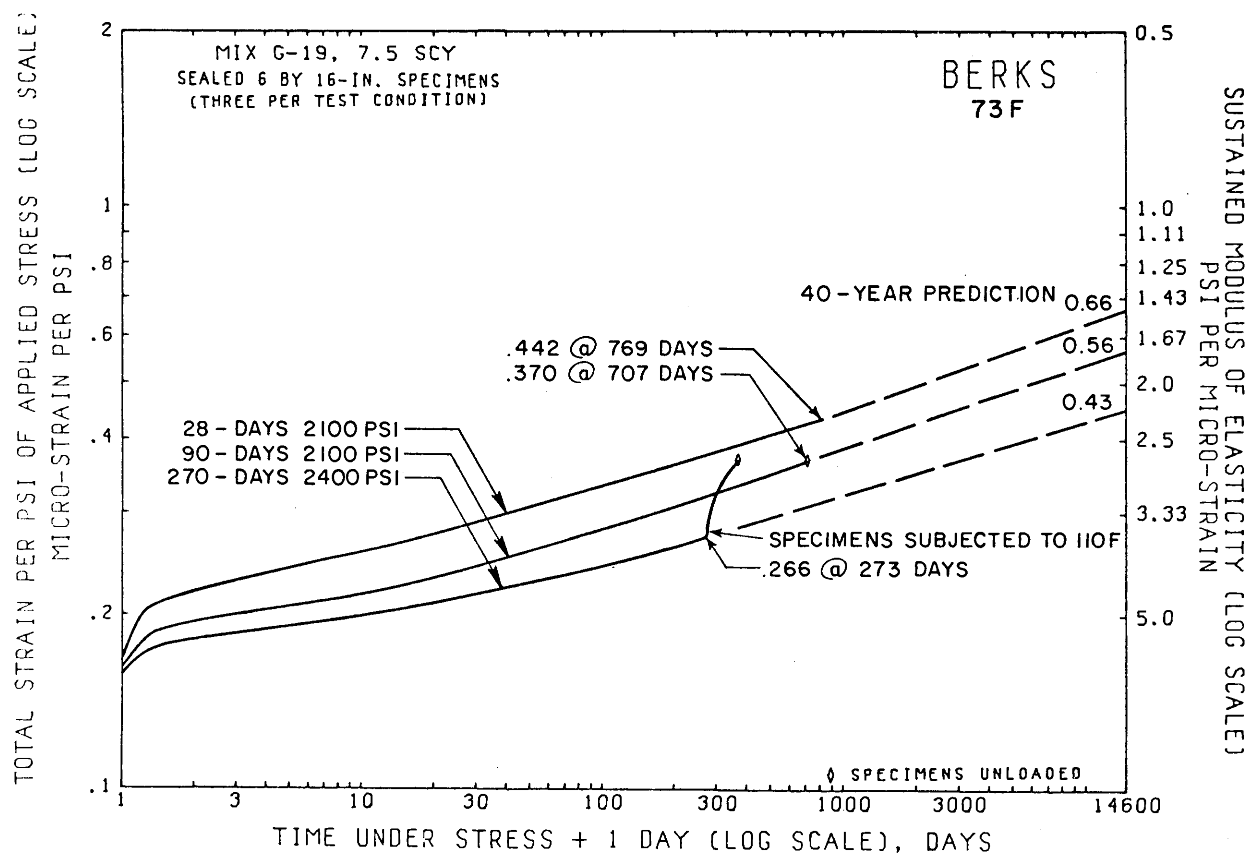
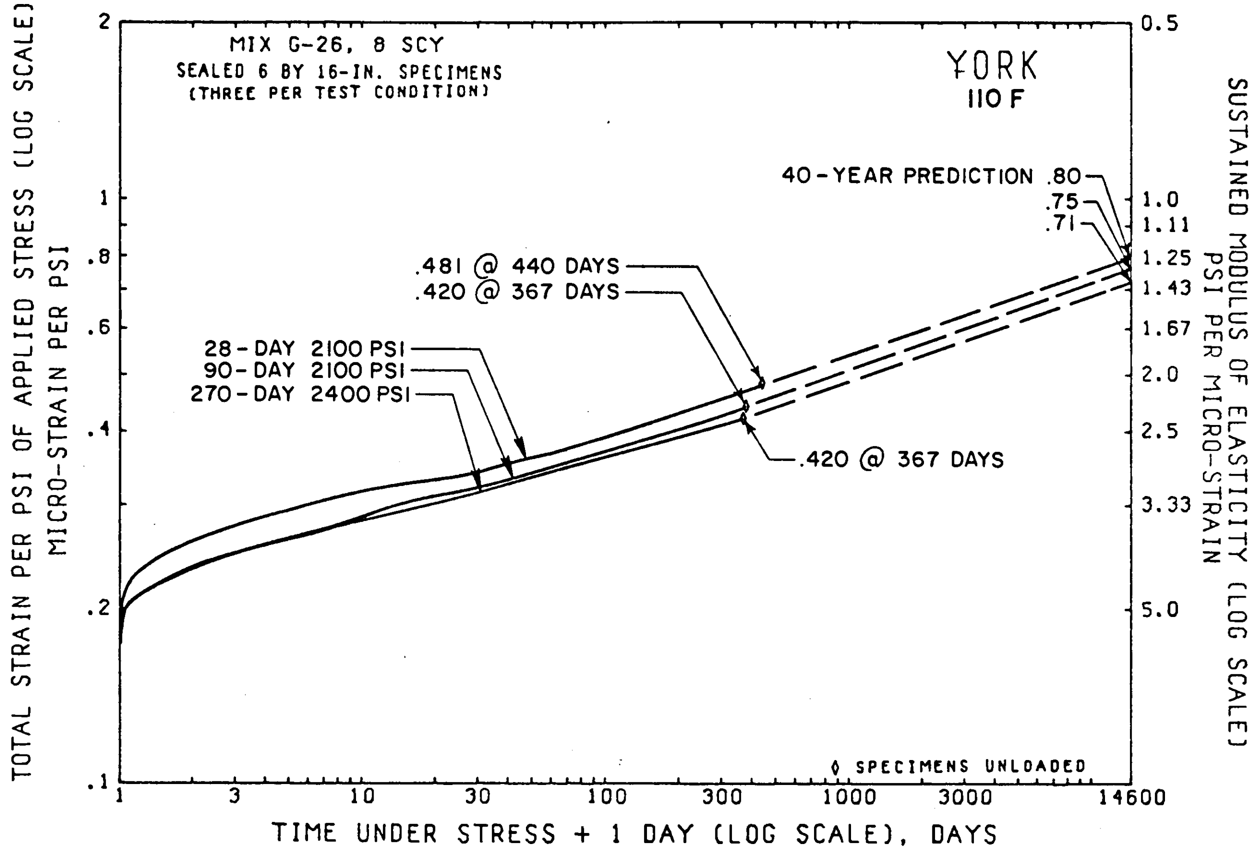


FIGURE 13 -- EFFECT OF AGE OF LOADING ON STRAIN OF CONCRETE LOADED AT 73F TO A NOMINAL 30 PERCENT STRESS LEVEL.



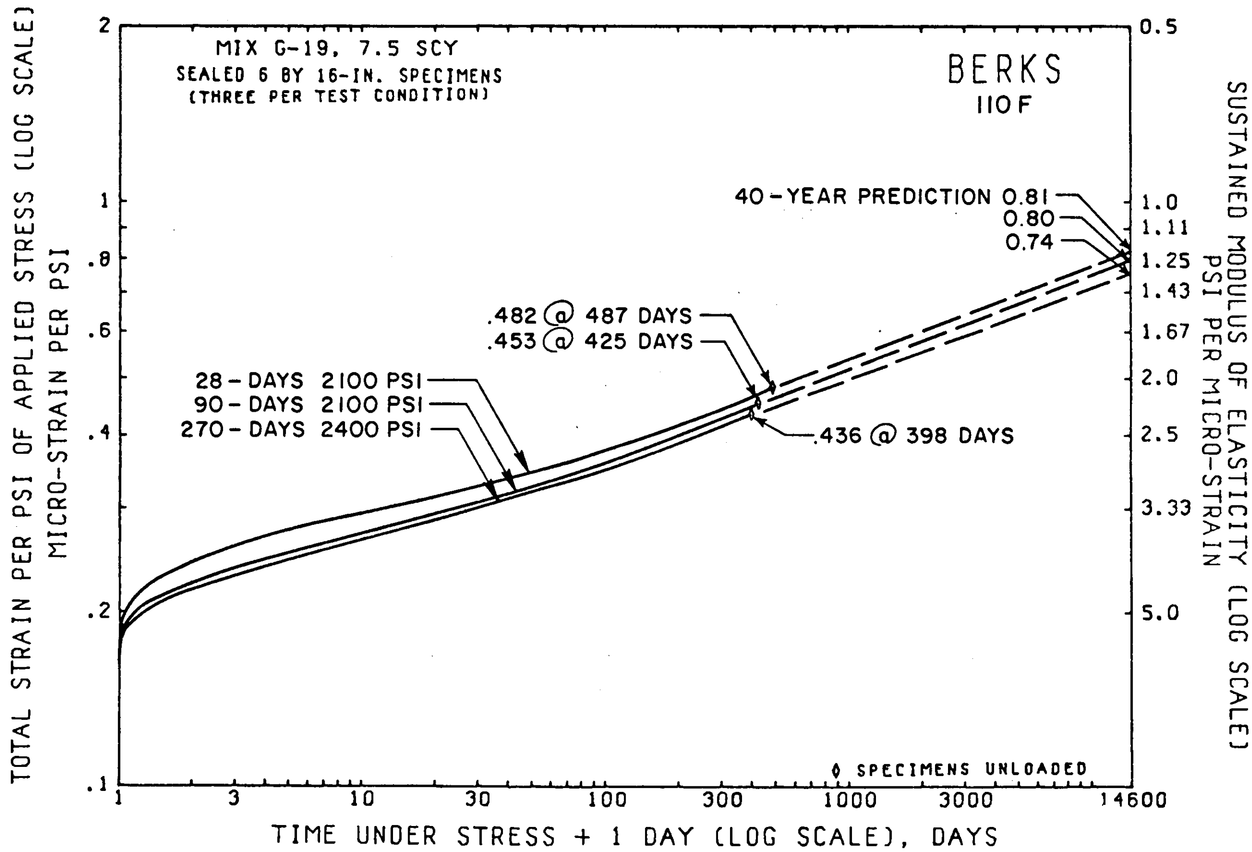
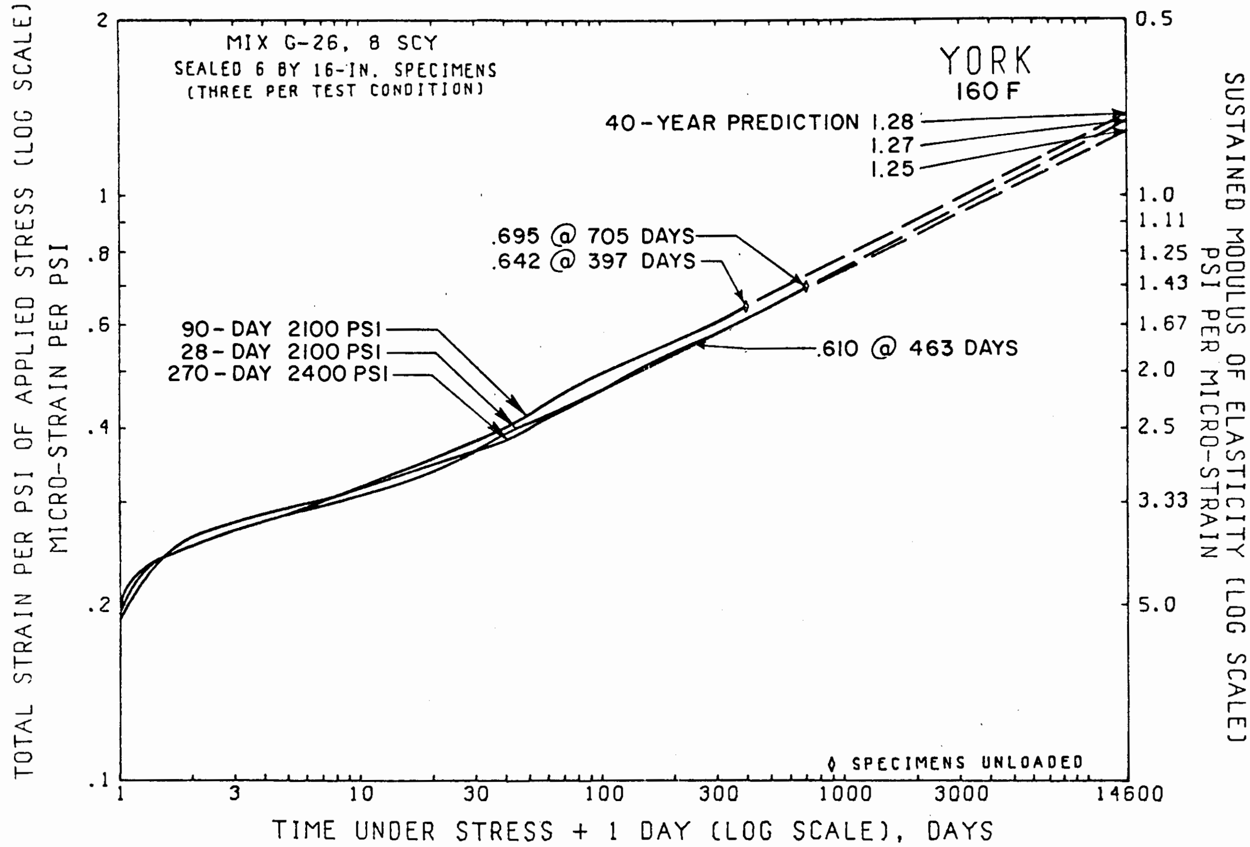


FIGURE 14 -- EFFECT OF AGE OF LOADING ON STRAIN OF CONCRETE LOADED AT 110F TO A NOMINAL 30 PERCENT STRESS LEVEL.



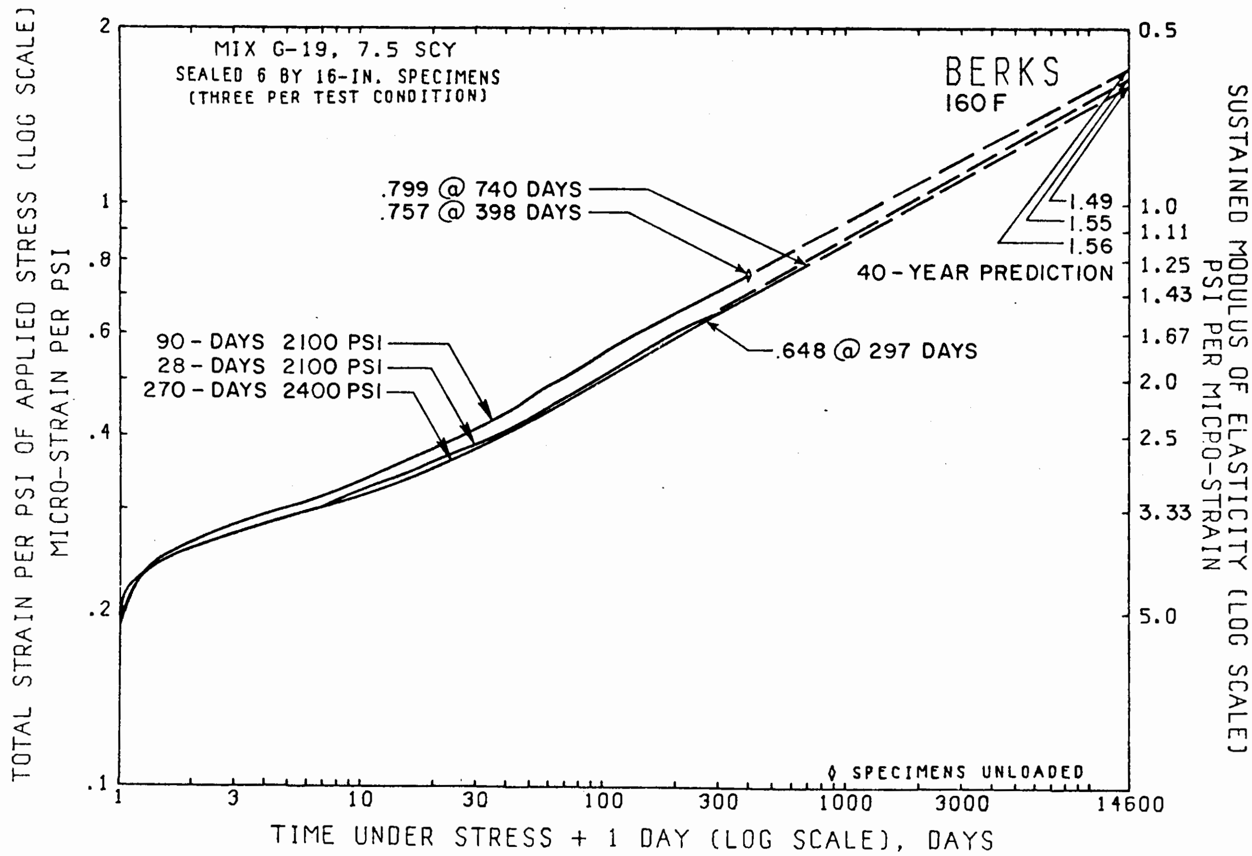


FIGURE 15 -- EFFECT OF AGE OF LOADING ON STRAIN OF CONCRETE LOADED AT 160F TO A NOMINAL 30 PERCENT STRESS LEVEL.

FIGURE 15

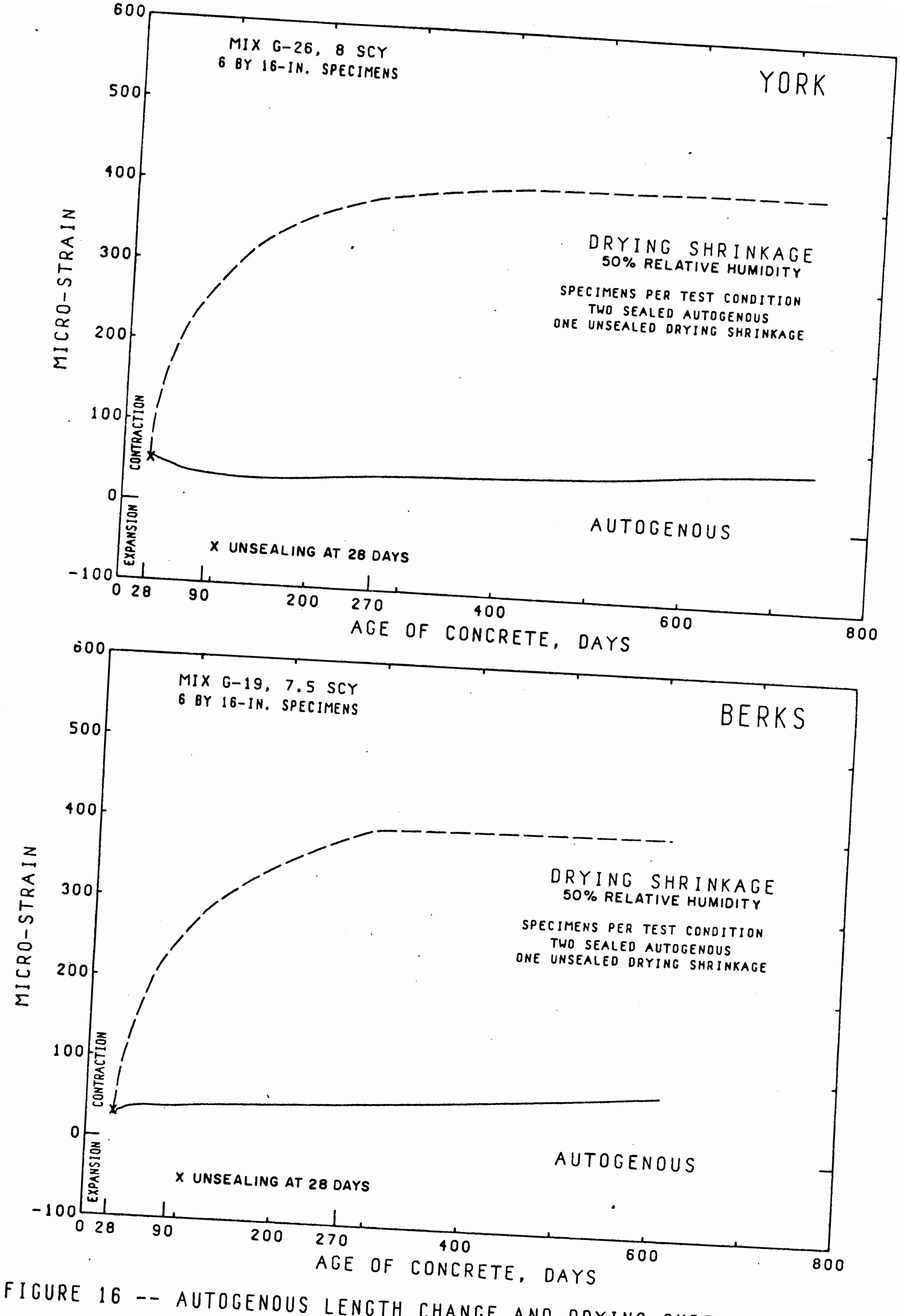
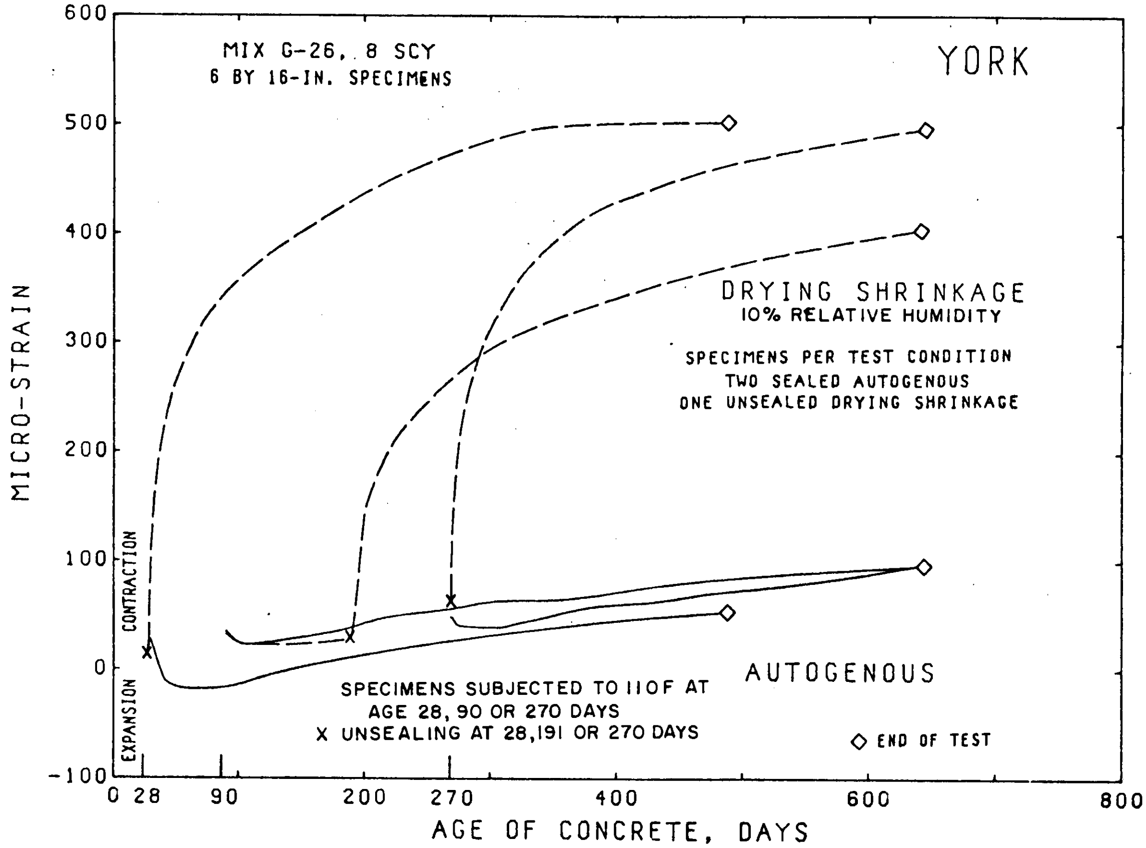


FIGURE 16 -- AUTOGENOUS LENGTH CHANGE AND DRYING SHRINKAGE OF CONCRETE AT 73F.



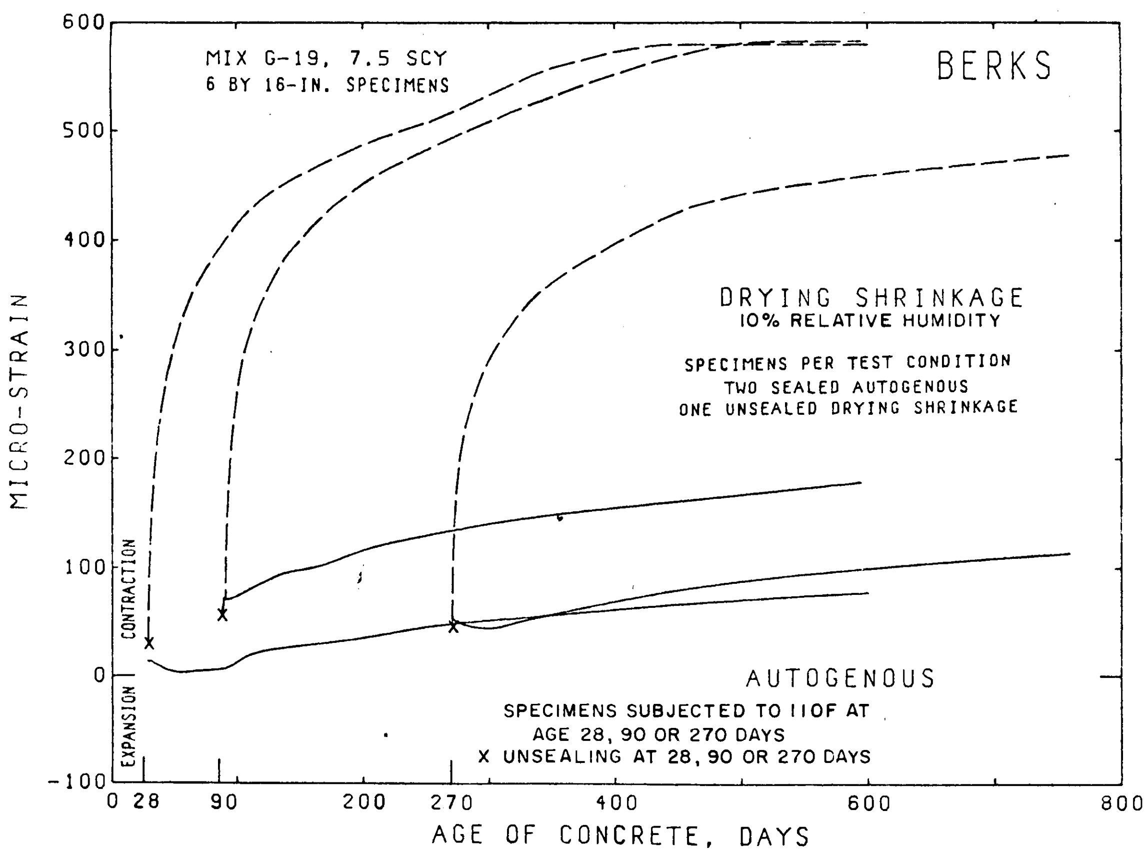
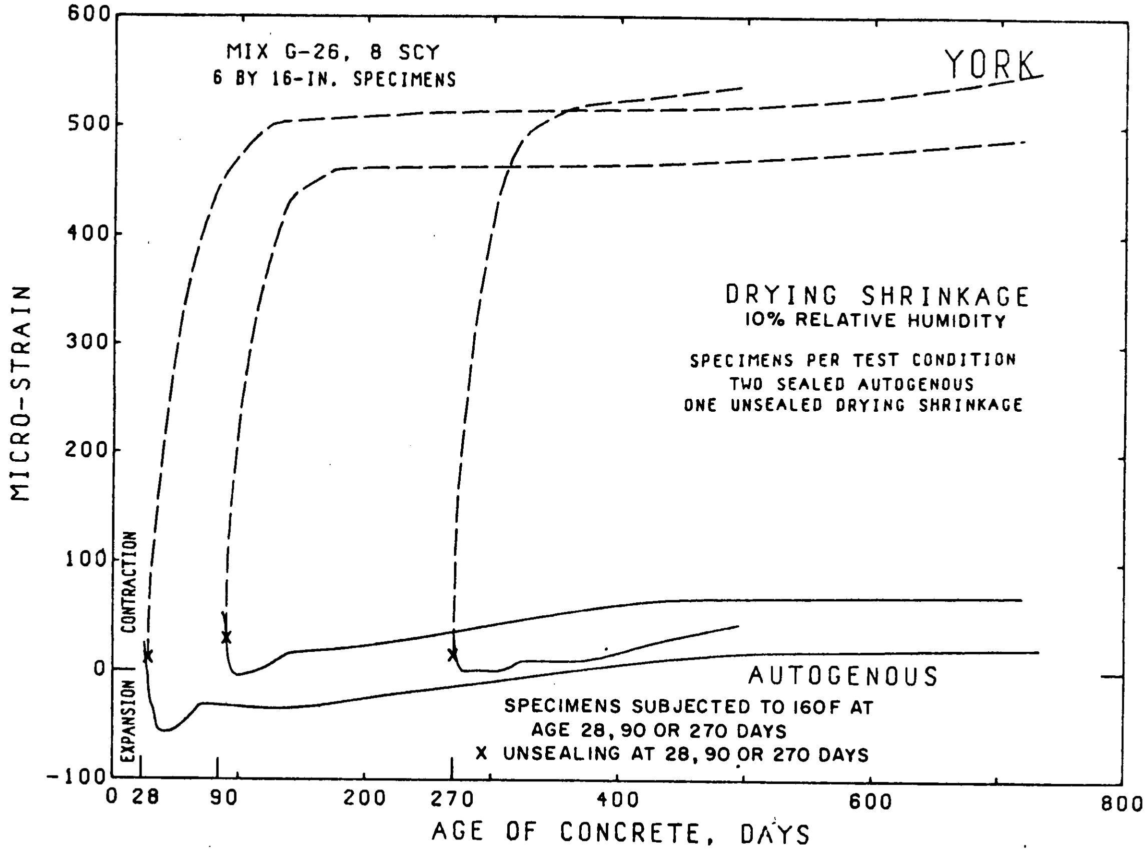


FIGURE 17 -- AUTOGENOUS LENGTH CHANGE AND DRYING SHRINKAGE OF CONCRETE AT 110F.

FIGURE 17



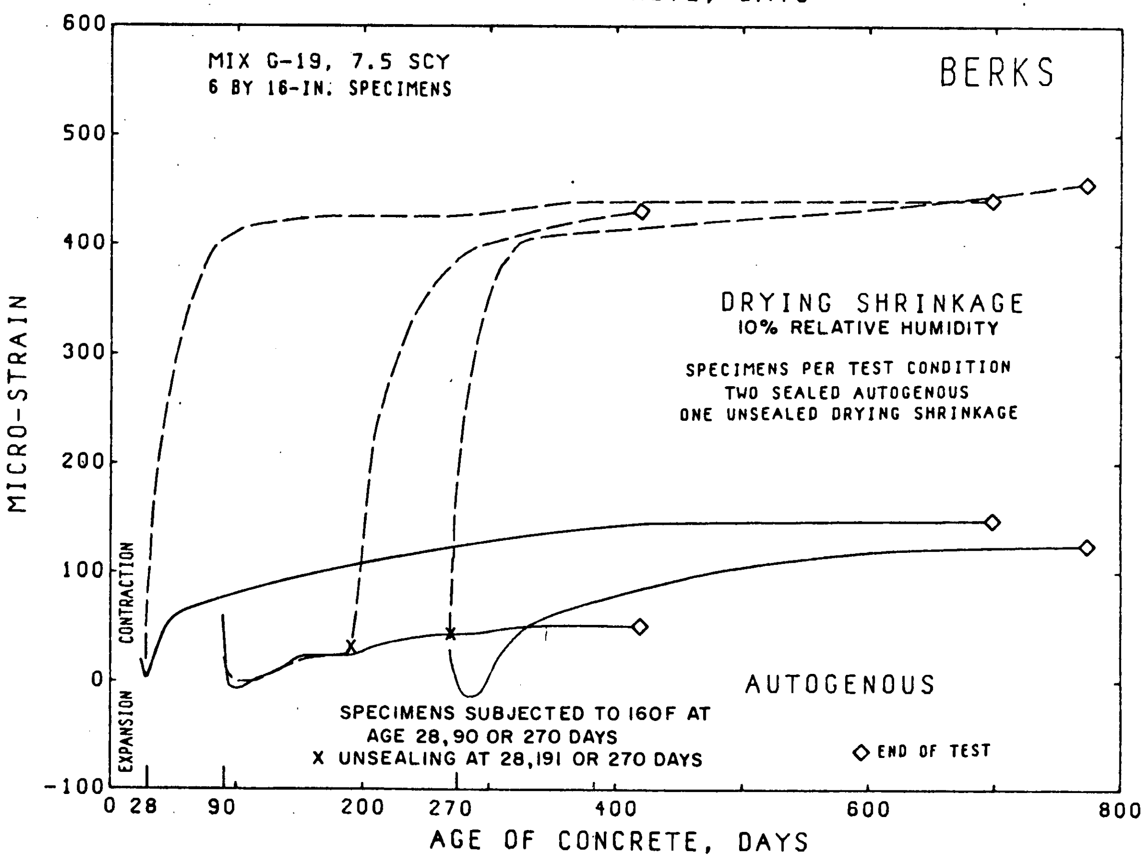


FIGURE 18 -- AUTOGENOUS LENGTH CHANGE AND DRYING SHRINKAGE OF CONCRETE AT 160F.

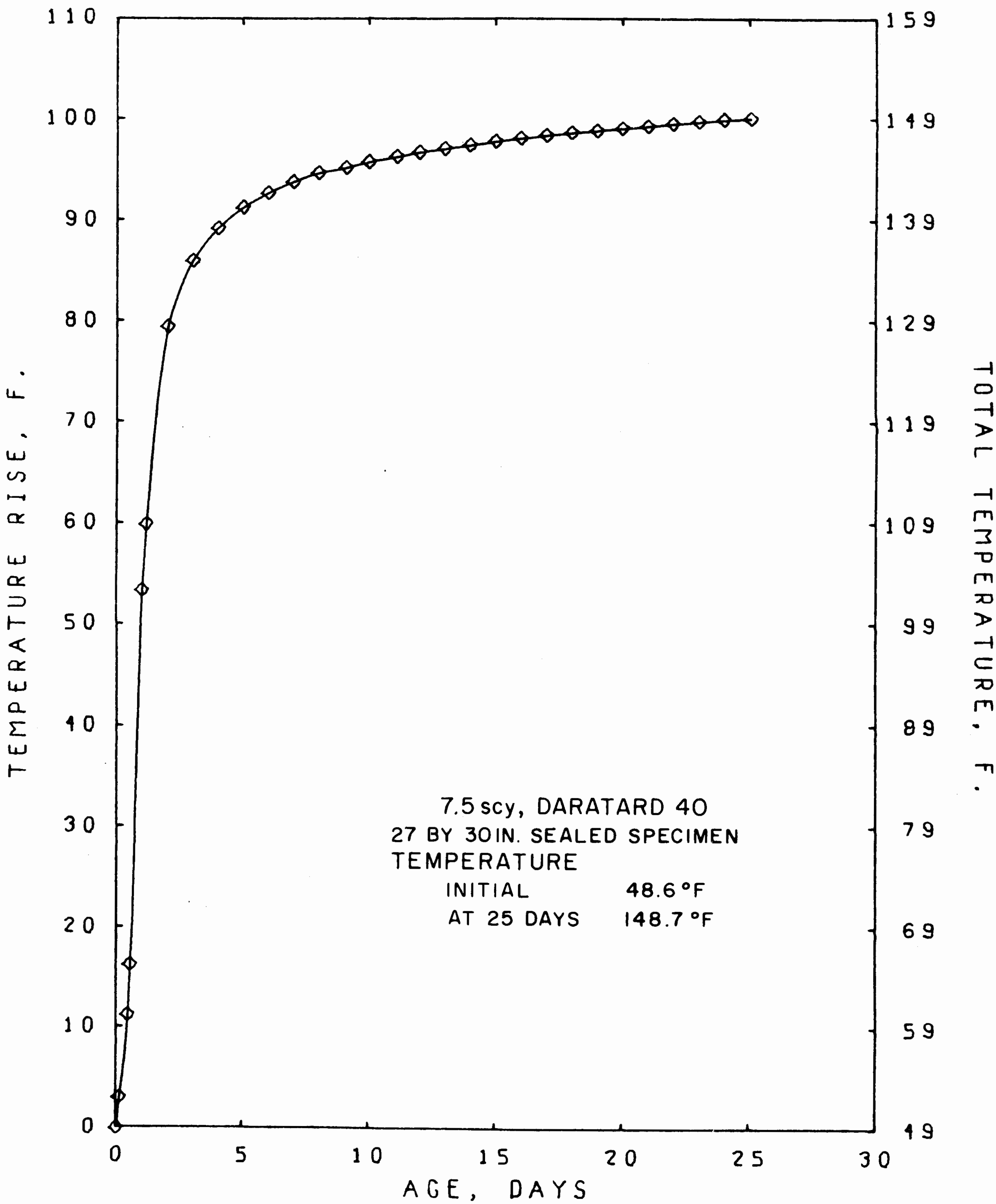


FIGURE 19 -- ADIABIATIC TEMPERATURE RISE OF BERKS G-19 CONCRETE.

FIG. 19

APPENDIX A -- TEST PROGRAM

APPENDIX A -- TEST PROGRAM

PCRV Test Program, Final Report - Part II,

April, 1976

APPENDIX A -- TEST PROGRAM

The test program of this investigation satisfied the General Atomic (GA) Specification 900670, Issue B, dated September 5, 1974. It consisted of the following three phases:

I. Materials' Selection and Evaluation
II. Concrete Mix Development
III. Concrete Long-Term Behavior

A description of all three phases is given in this Appendix A with emphasis on Phase III, results of which are presented in this Final Report - Part II. Results obtained in Phase I and Phase II were reported in Final Report - Part I. The size and number of specimens cast for each phase of the test program is summarized in Section 4 of this Appendix A.

1. PHASE I - MATERIALS' SELECTION AND EVALUATION

Phase I of the test program was concerned with the selection and evaluation of the concrete-making materials. In this evaluation of materials, various properties of the cement and aggregate were determined, including the chemical composition, heat of hydration and compressive strength of mortar cubes for the cement and the absorption, specific gravity and gradation of the aggregates. The concrete-making properties were then evaluated for three coarse aggregates and three admixtures. Tests made on the fresh concretes included slump, air content, unit weight, bleeding and time of setting. The properties determined on the hardened concretes included compressive strength up to age 60 days, elastic properties, linear coefficient of thermal expansion and drying shrinkage characteristics. The specific tests conducted in Phase I are described in the following four subsections.

1.1 Evaluation of Coarse Aggregates - Phase I(a) -- Three coarse aggregates, York, Berks, and Hempt, were evaluated using 1 mix design. Determined for each concrete were the 7, 28 and 60-day compressive strength and elastic properties, drying shrinkage up to 448 days, and the linear coefficient of thermal expansion.

1.2 Evaluation of Admixtures - Phase I(b) -- Three admixtures, Pozzolith 300R, Daratard 40 and Plastocrete-D, were evaluated using 1 mix design with the following six tests conducted on each mix: slump, bleeding, air content and time of setting on the fresh concrete, and the 7, 14, 28 and 60-day compressive strength, and drying shrinkage up to 448 days on the hardened concrete.

1.3 Preliminary Evaluation of Cement Content -- Ten concrete mixes, having a cement content of 7.5, 8 or 8.5 sacks per cubic yard (scy) and containing either 1 1/2 in. or 3/4 in. maximum size aggregate (MSA) and Daratard 40 or Pozzolith 300R admixture, were evaluated for properties of fresh concrete and for the 7, 14, 28 and 60-day compressive strength and elastic properties of the hardened concrete.

1.4 Evaluation of Sand Content -- Four mixes were tested to determine the effect of sand content on the properties of the fresh concrete and on the 7, 28 and 60-day compressive strength of the hardened concrete.

2. PHASE II - CONCRETE MIX DEVELOPMENT

Phase II of the test program was concerned with the development of test data needed to establish concrete mixes that would have the required strength and physical properties for the PCRV using the materials selected in Phase I. The specified strength of the PCRV concrete was 6,500 psi at 60 days and GA required that the laboratory mix attain a moist-cured cylinder strength of around 7,700 psi at 60 days.

Two coarse aggregates and two admixtures were evaluated in mixes of varying cement contents and a selected mix for each of the two aggregates containing a given admixture was established. Properties of fresh and hardened concrete were determined for all mixes. The properties of fresh concrete evaluated included workability, slump, air content, and unit weight. The properties of hardened concrete determined included compressive strength, tensile strength, and elastic properties up to age 2 years for both sealed and moist-cured specimens. The specific tests conducted in Phase II are described in the following two subsections.

2.1 Concrete Trial Mixes - Phases II(a) and II(b) -- A total of eighteen mixes, nine containing York aggregate and nine containing Berks aggregate, were evaluated. The mixes contained 1 1/2-in. or 3/4-in. MSA, Daratard 40 or Pozzolith 300R admixture and had cement contents of 7, 7.5, 8 or 8.5 scy. In Phase II(b) the 7, 14, 28, 60 and 120-day compressive strength and 28, 60 and 120-day elastic properties were determined on both sealed and moist-cured concrete specimens.

2.2 Selected Concrete Mixes - Phase II(c) -- The two concrete mixes selected for evaluation from the results obtained in Phases II(a) and II(b), mix Berks G-19 and mix York G-25, were tested in this Phase II(c) for compressive strength, tensile strength, modulus of elasticity and Poisson's ratio up to age 2 years, using both sealed and moist-cured specimens. The effect of slump on the 28 and 60-day compressive strength and elastic properties was determined using only moist-cured specimens. When the 28-day compressive strength of the selected concrete mixes was lower than desired, the selected mix for casting York concretes for Phase III was changed to mix York G-26, also developed in Phases II(a) and II(b). Additional specimens were cast for this York G-26 mix, with compressive strength and elastic properties determined on sealed and moist-cured specimens up to age 2 years.

3. PHASE III - CONCRETE LONG-TERM BEHAVIOR

Phase III of the test program, partially still in progress at the time Final Report - Part II was written, was concerned with establishing the behavior of the concretes developed in Phase II when subjected to exposure to long-term loads and elevated temperatures.

The creep test conditions, used in selected combinations, included: three temperatures (73, 110 and 160 F), three stress levels (30, 45 and 60% of the 73 F ultimate strength), and three ages of loading (28, 90 and 270 days). Also included in Phase III was an evaluation of the influence of thermal cycling on strength and elastic properties, and the determination of thermal properties of the concretes. The specific tests conducted in Phase III are described in the following five subsections.

3.1 <u>Creep Under 30% f'_c at 73, 110 and 160 F - Phase III(a)</u> -- A total of fifty-four 6 by 16-in. creep specimens were tested for determination of creep characteristics at a 30 percent f'_c stress level with the f'_c being the ultimate strength as determined at the age of loading at 73 F. Twenty-seven of the specimens were cast from mix Berks G-19 and 27 from York G-26. Of the 27 specimens for each aggregate type, nine specimens each were tested at 73, 110 and 160 F. Of the nine specimens at each temperature, three specimens each were loaded at ages of 28, 90 and 270 days.

A total of forty-two 6 by 16-in. creep control specimens were tested for autogenous volume change or drying shrinkage, with 21 specimens tested for each aggregate type as follows: three specimens were tested at 73 F, nine were tested at 110 F and nine were tested at 160 F. At 73 F, the three specimens were used as controls for all three ages of loading, that is 28, 90 and 270 days. At 110 and 160 F, three of the nine specimens were brought up to test temperature at each of the three ages of loading. Of the three sealed creep control specimens in each group, two were kept sealed and one was unsealed at the time of loading of the creep specimens.

In addition, each of the specimen groups at each temperature had twelve 6 by 12-in. sealed compressive strength control specimens designated as creep companion specimens. Three of these specimens were tested at age 7 days as a control on the concrete mix used, and three specimens were tested subsequently at each age of loading of the creep specimens (28, 90 and 270 days). The companion specimens were used to determine the magnitude of the applied stress level on the creep specimens which were stressed to a nominal 30 percent of the 73 F ultimate strength (f'_c).

Creep, autogenous volume change and drying shrinkage measurements were made for a minimum period of 365 after the age of loading, and are scheduled to be taken for up to 1000 days on selected groups of specimens.

Upon completion of creep testing, creep recovery was observed for up to 91 days at the creep test temperature and then selected creep and creep control specimens were tested for compressive strength at 73 or 110 F. One creep specimen and one sealed control specimen from each group of three creep or three control specimens is being kept at test temperature after the creep recovery phase for the duration of the test program.

3.2 Creep Under 45 and 60% f'_c at 73 and 160 F - Phase III(b) -- A total of twenty-four 6 by 16-in. creep specimens were tested for the determination of creep characteristics at a 45 or 60 percent f'_c stress level, with the f'_c being the ultimate strength as determined at the age of loading at 73 F. For each aggregate type (mix Berks G-19 and York G-26) twelve 6 by 16-in. creep specimens were cast, six for each stress level, with three tested at 73 F and three at 160 F. All creep specimens were loaded at age 90 days. There were no creep control specimens cast with these specimens since the controls cast for the 30 percent stress level specimens at 73 and 160 F in Phase III(a) also served as controls for these higher stress level creep specimens. Nine 6 by 12-in. compressive strength controls were cast for each aggregate type. Three of these were tested at age 7 days as a control on the concrete mix used, and three specimens each were tested at 90 days at 73 F and at 160 F.

Creep measurements were made for a minimum period of 376 days after the age of loading. Specimens tested at 160 F at the 60 percent of ultimate strength level are scheduled to be under stress for 1000 days.

Creep recovery and testing of creep specimens and their controls for compressive strength was conducted following the test program described for the creep specimens stressed to 30 percent of ultimate strength, subsection 3.1.

3.3 Thermal Cycling - Phase III(c) -- A total of ninety-six 6 by 12-in. and six instrumented 6 by 16-in. specimens were tested for the effect of thermal cycling on compressive and splitting tensile strength and for the determination of linear coefficient of thermal expansion. For each aggregate a total of forty-eight 6 by 12-in. specimens and three instrumented 6 by 16-in. specimens were cycled beginning at age 90 days for up to five temperature cycles of 73-160-73 F. All specimens remained sealed during curing and cycling. At the end of every cycle, three specimens were tested in compression and three in splitting tension. The three instrumented 6 by 16-in. specimens were used to monitor thermal expansion and contraction during the thermal cycling. Eighteen of the 6 by 12-in. specimens were used as controls at 73 F, with three being tested in compression and three in splitting tension at the start of cycling, after the second cycle, and at the end of cycling. Modulus of elasticity and Poisson's ratio were determined on all compression specimens.

3.4 Thermal Properties -- Adiabatic temperature rise up to age 25 days was determined for Berks G-19 concrete. In addition to the adiabatic temperature rise specimen, there were twelve 6 by 12-in. sealed compression controls. Six of these control specimens were cured adiabatically with the 27 by 30-in. adiabatic specimen for 14 days and, subsequently, at 110 F until age of test. Six 6 by 12-in. specimens were cured at 73 F. Three specimens from each group were tested at ages 28 and 60 days.

Specific heat and diffusivity were determined for both the Berks G-19 and York G-26 concretes, at ages of 29 and 147, and 29 and 97 days, respectively.

3.5 Thermal Treatment of Sealed Concrete -- A total of fifteen 6 by 12-in. sealed Berks G-19 concrete specimens were tested to evaluate the effect of prolonged curing at 160 F on 90, 180 and 270-day compressive strength. All specimens were initially cured at 73 F to age 85 days. Nine specimens were then heated to 160 F with three specimens each tested in compression at 160 F after 1, 91 or 181 days curing at 160 F. The remaining six specimens were continuously cured at 73 F with two specimens tested at each test age.

A total of fifteen 6 by 12-in. sealed York G-26 specimens were tested to determine the effect of curing at 160 F and the effect of specimen test temperature on the 270-day compressive strength. All specimens were initially cured at 73 F for 85 days. Nine specimens were then heated to 160 F, cured at this temperature for 176 days, and tested in compression at 160, 110 or 73 F, with three specimens tested at each temperature. The remaining six specimens were continuously cured at 73 F and then tested in compression at 73, 110 or 160 F, with two specimens tested at each temperature.

4. SUMMARY OF TEST PROGRAM

The following is a summary of the test program as performed at the University of California (UC) and as specified by General Atomic (GA) in its Specification 900670, Issue B, dated 9/5/74. The size and number of specimens used in the three phases of the test program are given in the following tabulation:

SIZE AND NUMBER OF SPECIMENS USED IN THE TEST PROGRAM

Test Program		Used in UC Tests	GA Spec. 900670 Issue B
1. PHASE I - MATERIALS' SELECTION AND EVALUATION			
1.1 Evaluation of Coarse Aggregates - Phase I(a)			
Compression	6x12-in.	27	27
Drying Shrinkage	4x4x11-in.	9	9
Coefficient of Thermal Expansion	6x16-in.	9	9
1.2 Evaluation of Admixtures - Phase I(b)			
Compression	6x12-in.	48	48
Drying Shrinkage	4x4x11-in.	16	12
1.3 Preliminary Evaluation of Cement Content			
Trial Mixes (a)	6x12-in.	36	...
Trial Mixes (b)	6x12-in.	36	...
Trial Mixes (c)	6x12-in.	24	...
1.4 Evaluation of Sand Content	6x12-in.	24	...
Total Phase I		229	105
2. PHASE II - CONCRETE MIX DEVELOPMENT			
2.1 Concrete Trial Mixes - Phases II(a) and II(b)			
Compression	6x12-in.	672	504 (252)*
2.2 Selected Concrete Mixes - Phase II(c)			
Compression and Tension	6x12-in.	249	144 (72)
3. PHASE III - CONCRETE LONG-TERM BEHAVIOR			
3.1 Creep Under 30% f'_c at 73,110 and 160 F - Phase III(a)			
Creep and Creep Controls	6x16-in.	96	96 (48)
Compression	6x12-in.	72	...
3.2 Creep Under 45 and 60% f'_c at 73 and 160 F - Phase III(b)			
Creep	6x16-in.	24	24 (12)
Compression	6x12-in.	18	...
3.3 Thermal Cycling - Phase III(c)			
Instrumented	6x16-in.	6	6 (3)
Compression	6x12-in.	30	30 (15)
Tension	6x12-in.	30	30 (15)
Controls	6x12-in.	36	...

SIZE AND NUMBER OF SPECIMENS USED IN THE TEST PROGRAM (cont'd)

Test Program		Used in UC Tests	GA Spec. 900670 Issue B
3.4 Thermal Properties			
Adiabatic	27x30-in.	1	...
Compression	6x12-in.	24	...
Specific Heat	8x16-in.	2	...
Diffusivity	8 1/2 x17-in.	2	...
3.5 Thermal Treatment of Sealed Concrete			
Compression	6x12-in.	30	...
Total Phases II and III		1292	834 (417)*
Total Phase I		229	105 (105)
Total for Test Program		1521	939 (522)

*The value in ( ) represents the number of specimens for one aggregate as specified for Phases II and III in GA Specification 900670 Issue B. In this test program, two aggregates were evaluated.

APPENDIX B -- SUMMARY OF TEST PROCEDURES

APPENDIX B -- SUMMARY OF TEST PROCEDURES

Page

APPENDIX B -- SUMMARY OF TEST PROCEDURES (cont'd)

FIGURES

ENCLOSURES

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APPENDIX B -- SUMMARY OF TEST PROCEDURES

The test procedures used in Phases II(c) and III of the test program are summarized in this Appendix, which includes a description of material preparation and testing, mixing of concrete, tests for properties of fresh concrete, casting procedures, preparation and storage conditions of sealed and moist-cured specimens, and testing of concretes for compressive strength, modulus of elasticity, Poisson's ratio, splitting tensile strength, creep, autogenous and drying shrinkage, adiabatic temperature rise, specific heat, thermal diffusivity and effect of thermal cycling and thermal treatment on properties of concrete.

1. MATERIAL PREPARATION

Aggregates, cement and admixtures were prepared in accordance with ASTM C 192 "Making and Curing Concrete Test Specimens in the Laboratory." A description of the specific preparation of the aggregates and of the cement is given in the following two subsections.

1.1 Aggregates -- To assure a uniform gradation and moisture content of the aggregates used in the concretes of this test program, each shipment of aggregate type was blended and brought to a moisture content close to a saturated surface dry (SSD) condition. The aggregate was then stored in labeled and numbered sealed 55-gallon steel drums. Each drum was labeled with the aggregate name, size, date of receipt, date of blending, and research project name and identification number.

Prior to batching the aggregate from any particular drum, the aggregate within that drum was reblended to assure a uniform moisture content. After reblending, the moisture content of the aggregate was determined in accordance with ASTM C 566 "Total Moisture Content of Aggregate by Drying." The coarse and fine aggregates were then batched for each mix from these reblended aggregate drums. As the material inside the drums diminished to a point where there was not enough material for a complete casting, the material in that drum was set aside and used later in the preparation of additional drums of aggregates. This blending procedure gave a good aggregate moisture control for the several batches usually required for any given casting.

Blending of different shipments of each aggregate type was accomplished by consolidating the material from the different shipments into one stockpile and then blending the entire stockpile to assure uniform gradation and moisture content. The aggregate was then again stored in sealed 55-gallon steel drums.

1.2 Cement -- The cement was blended as soon as it was received in the laboratory. Blending of the cement was accomplished by placing one scoopful at a time from each bag received into each one of the 55-gallon capacity steel drums used for storage of the cement. The drums were then sealed with a sheet of plastic and a steel lid and stored in a 73 F controlled room until required for use. Cement was batched from one drum at a time until it was emptied.

When two shipments of cement were used in a given casting, equal weights of shipments "A" and "B" were batched to yield the total weight of cement required by the mix design. This assured that all batches had the same proportions of cement from each shipment.

2. MATERIAL TESTING

Material testing at the University of California, Berkeley (UC) was limited to determining the properties and gradation of the aggregate needed for development of a good mix design and to check the properties and chemical analysis of the Medusa Type II cement shipments "A" and "B" when it became apparent that the two shipments of cement had different strength gain characteristics. All procedures followed were in accordance with the standard test methods listed below.

2.1 Aggregates -- The testing of the aggregates was performed in accordance with the following standard specifications and test methods.

ASTM C 33	Specification for Concrete Aggregates
ASTM C 117	Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
ASTM C 127	Specific Gravity and Absorption of Coarse Aggregate

ASTM C 128	Specific Gravity and Absorption of Fine Aggregate
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 566	Total Moisture Content of Aggregate by Drying
CRD-C 119	Corps of Engineers Method of Test for Flat and Elongated Particles in Coarse Aggregate

2.2 Cement -- The testing of the cement was performed in accordance with the following standard specifications and test methods.

ASTM C 109	Compressive Strength of Hydraulic Cement Mortars
ASTM C 114	Chemical Analysis of Hydraulic Cement
ASTM C 150	Specification for Portland Cement
ASTM C 186	Heat of Hydration of Hydraulic Cement

3. MIXING AND PROPERTIES OF FRESH CONCRETE

Basic mixing procedures and test methods used for determining the properties of fresh concrete were in accordance with ASTM C 192. A description of the number of batches used to cast each group of specimens in this test program, the specific procedures used for cooling of materials and mixing of the concrete, and the properties determined on each batch of fresh concrete is given in the following four subsections.

3.1 Number of Batches Used -- A 2 cu. ft. capacity "Lancaster" or a 5 cu. ft. capacity "Cumflow" pan type mixer was used to mix the concrete for all specimens. For good laboratory control, with limited materials on hand, it was advantageous to cast a group of specimens from several smaller batches rather than one large batch. A summary of the number and size of batches mixed for each test phase is given in the following tabulation:

BATCHES USED FOR CASTING PHASE II(c) AND PHASE III SPECIMENS

Specimen Group	No. of Batches	Size of Batches, cu. ft.
Phase II(c) - Selected Mixes		
Berks Concrete Mix G-19		
Compression	6	1.9
Tension	6	1.45
York Concrete Mix G-25		
Compression	6	1.9
Tension	6	1.45

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BATCHES USED FOR CASTING PHASE II(c) AND PHASE III SPECIMENS (cont'd)

Specimen Group	No. of Batches	Size of Batches, cu. ft.
York Concrete Mix G-26		
Compression	1	3.5*
Phase III(a) - Creep at 30% f'_c		
Berks Concrete Mix G-19		
73 F Specimens	3	1.95
110 F Specimens	6	1.25
160 F Specimens	6	1.25
York Concrete Mix G-26		
73 F Specimens	2	2.9*
110 F Specimens	2	3.3*
160 F Specimens	2	4*
Phase III(b) - Creep at 45 and 60% f'_c		
Berks Concrete Mix G-19		
73 F and 160 F Specimens	5	1.25
York Concrete Mix G-26		
73 F and 160 F Specimens	1	3.0*
	1	4.0*
Phase III(c) - Thermal Cycling		
Berks Concrete Mix G-19	6	2.0
York Concrete Mix G-25	6	2.0
Thermal Properties		
Berks Concrete Mix G-19		
Adiabatic	2	5.0*
Specific Heat, Diffusivity and Compression	2	1.8
York Concrete Mix G-26		
Specific Heat and Diffusivity	Same batches as Phase III(b)	
Thermal Treatment of Sealed Concrete		
Berks Concrete Mix G-19	1	4.3*
York Concrete Mix G-26	1	4.6*

*5 cu. ft. capacity mixer

3.2 Cooling of Materials -- To produce concrete with a temperature of 50 ± 3 F at the end of mixing, the materials were cooled by storing cement and aggregate at 40 F for 24 hours prior to mixing, and by replacing a portion of mixing water with ice-cold water.

3.3 Mixing Procedure -- A pan-type mixer having a capacity of 2 cu. ft. or 5 cu. ft. was used. The mixing room temperature was maintained at 73 F. The following is a step by step procedure used in mixing each of the concrete batches.

1) Prime mixer with a throw away batch to coat the mixing pan and blades with mortar and thus prevent loss of mortar from batches used for casting of specimens.
2) Add coarse aggregate to mixer.
3) Add approximately one-half of the mixing water and let the aggregate soak for two minutes.
4) Start mixer, add sand and blend with coarse aggregate for one minute. When the 5 cu. ft. capacity mixer is used, add the sand to the mixer at the same time as the coarse aggregate.
5) Add remaining mixing water and cement simultaneously over a time period of twenty seconds. Mixing time begins after all cement and water is in the mixer.
6) After twenty seconds of mixing add admixtures (referred to as delayed addition of admixture).
7) Stop mixer after 3 minutes of mixing.
8) Let concrete rest for 3 minutes, with the mixer being covered by a plastic sheet to prevent loss of moisture.
9) Re-start mixer and mix for 2 additional minutes. During this final mixing period slight adjustments in water can be made if needed to obtain the desired slump.

To insure a more efficient distribution of the admixtures in the concrete, they were diluted with a small amount of mixing water prior to being added to the batch.

3.4 Properties of Fresh Concrete -- The procedures used in determining the unit weight, slump and air content of fresh concrete were in accordance with the following standard methods of test:

ASTM C 138	Unit Weight Yield and Air Content of Concrete
ASTM C 143	Slump of Portland Cement Concrete
ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method

The concrete used in the slump and unit weight tests was reblended by hand with the remaining concrete in the mixer and was used in casting of the specimens. The top layer of the concrete used in the air content test was discarded, with the remaining concrete used as necessary.

Immediately after mixing each batch, the temperature of the concrete was measured and a slump test was performed. All slump tests were completed within an elapsed time of 2 1/2 minutes after completion of mixing. When the 2 cu. ft. capacity mixer was used, the slump test was started immediately after the end of mixing with concrete taken directly from the mixer. When the 5 cu. ft. capacity mixer was used, the slump test was started one minute after the end of mixing to allow for emptying the mixer and for reblending the concrete prior to making the slump test.

The unit weight and air content of the concrete were determined on the batches of concrete as described in the following two subsections.

3.4.1 One, Two, or Three-Batch Castings -- When one, two or three batches of concrete were used to cast a group of specimens of a given mix, the unit weight (using a 0.5 cu. ft. container) and air content tests were performed on each one of the batches. The container size for the air content apparatus was 0.20 cu. ft.

3.4.2 Five or Six-Batch Castings -- When five or six batches of concrete were used to cast a group of specimens of a given mix, the unit weight was determined (using a 0.5 cu. ft. container) on the first, third and fifth batches. The air content and the unit weight (using the 0.2 cu. ft. air meter container) were determined on the second and fourth batches, and also on the sixth batch for six-batch concrete castings.

4. CASTING OF SPECIMENS

All concrete specimens were cast in accordance with ASTM C 192. The number of layers used in casting the specimens is given in subsections 4.1 to 4.3. A description of the distribution of the various size concrete batches used for each layer is given in subsection 4.4.

4.1 <u>6 by 12-in. Specimens</u> -- The 6 by 12-in. specimens were cast in three layers of approximately equal volume of concrete, each being compacted by rodding. The individual layers were composed of concrete from one or two batches as described in subsection 4.4.

4.2 <u>6 by 16-in. Specimens</u> -- The 6 by 16-in. instrumented concrete specimens were cast in three layers of approximately equal volume, in accordance with University of California method of test for "Setting Up, Casting, Sealing and Storage of 6 by 16-in. Internally Instrumented Concrete Specimens," given as Enclosure 1 to this Appendix. The individual layers were composed of concrete from one or two batches, as described in subsection 4.4.

4.3 <u>Thermal Properties Specimens</u> -- The 8 1/2 by 17-in. diffusivity specimens and the 8 by 16-in. specific heat specimens were cast in four layers of approximately equal volume. Each layer was rodded 50 times. The 27 by 30-in. adiabatic specimen was cast in four layers, with compaction of each layer accomplished by internal vibration. The individual layers were composed of concrete from one or two batches as described in subsection 4.4.

4.4 <u>Distribution of Concrete from Batches</u> -- One, two, three, five or six batches of concrete were used to cast a group of specimens, as previously described in subsection 3.1. To assure that each batch of concrete was represented within a test group of specimens at each test condition, procedures were established for distributing the concrete between the group of specimens cast. These procedures were based on the number of batches cast and are described in the following five subsections.

4.4.1 <u>One-Batch Castings</u> -- For castings with one batch, all specimens were cast at the same time from the single batch.

4.4.2 <u>Two-Batch Castings</u> -- For castings with two batches, all specimens were cast at the same time with half the volume of the specimens cast using the first batch and the remaining volume cast using the second batch. The average time between batches was approximately 15 to 20 minutes. For specimens cast with three layers, the No. 1 batch was used to cast the first layer and half of the second layer. The first layer was consolidated by rodding prior to the placement of the subsequent half-layer.

The specimens were covered with a plastic sheet to prevent the loss of moisture while the No. 2 batch was mixed. The placement of the second layer of concrete was then completed with the No. 2 batch and this second layer was consolidated by rodding. The third layer was cast using the remainder of the No. 2 batch.

4.4.3 Three-Batch Castings -- For castings with three batches, the specimens were divided into three equal groups with each batch used to cast one of these groups. For each test condition, one specimen from each of the three groups was used.

4.4.4 Five-Batch Castings -- A five-batch casting was used only for the Berks Phase III(b) specimens. The 6 by 16-in. creep specimens, their controls and companion 6 by 12-in. specimens were cast in three equal groups. The first group of 6 by 16-in. specimens was cast with enough concrete from the No. 1 batch to fill two-thirds of their volume, thus covering the meter, and was finished with concrete from the No. 2 batch. The remaining concrete from the No. 2 batch was used to cast about one-third the volume of the second group of specimens, to within one inch below the meter. The casting of the second group of specimens was completed with the third batch. The third group of specimens was cast in a manner similar to the first group, except that batches No. 4 and No. 5 were used. For each test condition, one specimen from each of the three gorups was used.

The companion 6 by 12-in. specimens were cast and selected for testing in a similar manner, except that some adjustment was made in the volumes cast from each batch to accommodate the casting of the 6 by 16-in. instrumented specimens.

4.4.5 Six-Batch Castings -- The specimens cast from six batches were divided into three equal groups. Two batches of concrete were used to cast each one of the three groups, using the procedures for two-batch mixes given in subsection 4.4.2. For each test condition, one specimen from each of the three groups was used.

5. SEALING OR MOIST-CURING OF SPECIMENS

5.1 Sealed Specimens -- The sealing of the concrete specimens was accomplished after 20 hours and within 48 hours after casting. The procedures used are described below.

5.1.1 6 by 12-in. Specimens -- Prior to casting, the bottom and side seams of the standard sheet metal molds conforming to ASTM C 470, "Specification for Molds for Forming Concrete Test Cylinders Vertically," were soldered and painted with a light-colored anti-rust paint. This assured moisture tightness of the mold and enabled easy inspection of the seams. After casting, the top lids were placed on the molds and each specimen was covered with a plastic bag to minimize water evaporation.

After 20 hours and within 48 hours after casting, the top lids were removed and the top edge of the mold was cleaned with steel wool. A bead of silicone rubber sealant/adhesive was placed around the outside top perimeter of the mold and the top lid was pressed down over the sheet metal mold, distributing the silicone rubber between the lid and mold. Another bead of silicone rubber was then placed around the joining surface of the lid and mold. The specimens were then placed inside a plastic bag and stored at 73 F.

The effectiveness of this sealing method was checked by filling a soldered mold two-thirds full of water and then sealing the top with silicone rubber in the manner described above. The water vapor developed inside this water-filled test mold imposes a more critical condition for sealing than if the mold were filled with concrete. After 3 years of storage the weight of the mold plus water has remained stable indicating no loss of moisture.

During storage, the sealed specimens were periodically inspected by checking the painted soldered joints for discoloration or signs of water vapor inside the plastic bags. A final inspection was given prior to stripping of the molds. Also, after demolding, the surface moisture condition of the specimens was visually inspected. To date, no signs of leakage have been detected for any of the sealed specimens.

5.1.2 6 by 16-in. Specimens -- The 6 by 16-in. specimens were sealed using steel end plates and butyl rubber jackets as described in Enclosure 1 to this Appendix. As an additional precaution against loss of moisture, specimens tested at 110 F and 160 F had a two-inch wide strip of Tuck waterproof tape placed over the seams of the butyl rubber lap splice. The specimens tested at 160 F also had a double layer of Tuck tape wrapped over the entire butyl rubber jacket.

This butyl rubber sealing method has been found to be very effective. It has been used at UC for sealing 73 F creep specimens for over 15 years with no indication of moisture loss, as determined from strain measurements on the specimens. The effectiveness of using butyl rubber for sealing at elevated temperature (110 and 160 F) was evaluated prior to its selection for use in this test program. Three butyl rubber sealed specimens were exposed to a temperature of 160 $\pm$ 5 F for six months. During this time the internal strain measurements indicated no detectable loss of moisture from the concrete.

Although the sealing method employed provides an excellent moisture seal, an occasional specimen may exhibit some moisture loss due to a defect in the sealing material or the installation of the jacket. This would be true whether the concrete specimen were sealed with a butyl rubber or a soldered copper jacket. Such moisture loss would then have to be detected by comparing the measured strains of a group of creep specimens and their controls. In this test program, a moisture loss was observed in only three of the 109 sealed 6 by 16-in. specimens, as was discussed in Section 5 of this Final Report - Part II.

5.1.3 Thermal Properties Specimens -- The thermal properties specimens are described in UC method of test for "Thermal Properties of Concrete," given as Enclosure 5 to this Appendix. The adiabatic specimen mold was made of 24-gage sheet metal with soldered side and bottom seams. The lid was soldered on immediately after casting and then tested for air tightness. The specific heat and diffusivity molds were made of copper with soldered joints. The lids were sealed to the mold with silicone rubber within 20 to 30 hours after casting, using the sealing method described in subsection 5.1.1.

5.2 Moist-Cured Specimens -- The moist-cured 6 by 12-in. specimens were cast in standard sheet metal molds conforming to ASTM C 470. After casting of the specimens the top lids were placed on the molds to assure a circular cross-section of the concrete cylinder and to prevent evaporation of water. After 20 hours and within 30 hours after casting, the molds were stripped and the specimens were stored in the fog room, maintained at 100 percent relative humidity and at 73 F, in accordance with ASTM C 511, "Specification for Moist Cabinets and Rooms Used in the Testing of Hydraulic Cements and Concrete."

The specimens were stored three deep on shelves, with ample space between the specimens, to allow adequate moisture to reach their surface. During the first three days of curing in the fog room, the specimens were wetted down periodically with water from a hose to assure that free water was maintained on their surfaces at all times, as specified in ASTM C-192. The specimens were also periodically relocated on the shelves according to a regular shcedule in order to provide the same moisture exposure conditions to all of the specimens. Daily inspections were made to check that the fog room was operating properly and that all specimen surfaces were moist.

6. HEATING OR COOLING OF SPECIMENS TO TEST TEMPERATURE

All specimens were cast in the laboratory at ambient temperature of approximately 73 F with 50 $\pm$ 3 F concrete and were cured at 73 F immediately after casting, except that the adiabatically cured specimens were cast in the adiabatic calorimeter chamber operating at 47 F as described in Enclosure 5 to this Appendix. Subsequent curing and testing of all specimens was accomplished in the nominal temperature range of 73 to 160 F in rooms maintained within $\pm$ 3 F at 73, 95, 110 or 160 F, or in a variable temperature room operating between 73 and 135 F.

Specimens subjected to temperatures higher than 73 F were heated and, when required, were cooled at a rate not exceeding 24 F per day unless specified otherwise, using one or more constant temperature rooms or the variable temperature room. The variable temperature room was programmed for temperature changes to occur automatically at the rate of 2 F per hour with minimum hold times of 12 hours at the nominal temperatures of 73, 95, 110 and 135 F.

When specimens were transferred from one temperature room to another, the specimens were wrapped with fiberglass insulation. All transfers between rooms were accomplished within an elapsed time of two minutes. The fiberglass insulation was kept around the specimens until they were within ± 5 F of the ambient temperature. The heating and cooling procedures of the specific groups of test specimens are described in the following four subsections.

6.1 Creep Specimens and Their Controls -- Creep specimens, creep control specimens and the 6 by 12-in. creep companion specimens were tested at 73, 110 or 160 F. Heating to test temperature of 110 and 160 F was accomplished over a five-day period in accordance with UC method of test for "Creep of Concrete," given as Enclosure 4 to this Appendix.

After the completion of creep and creep recovery testing, the 110 and 160 F creep and control specimens were cooled to 73 F, when required. The cooling of the specimens was commenced one week before they were to be tested for compressive strength. Specimens which had been at 160 F, were cooled by being subjected to nominal temperatures of 135, 110, 95 and 73 F, in succession. Specimens at 110 F were first cooled to a temperature of 95 F and then to 73 F. Specimens were kept at each temperature for a minimum of 24 hours. The variable temperature room was used for the 135 F level and constant temperature rooms were used for all other temperature levels.

6.2 Thermal Cycling Specimens -- The thermal cycling, up to five cycles, from 73 to 160 to 73 F, was accomplished in the variable temperature room, operating between 73 and 135 F, and in the 160 F chamber.

For the heating phase of each cycle, the temperature of the variable temperature room was raised at the programmed rate from 73 to 135 F. At the end of the 12-hour hold period at 135 F, the specimens were wrapped in fiberglass insulation and transferred directly into the 160 F chamber, where they remained for a minimum of 48 hours, completing the heating phase of one thermal cycle.

For the cooling phase, specimens were transferred from the 160 F chamber back into the variable temperature room operating at 135 F. At the end of the 135 F hold period, the fiberglass insulation was loosened and the cooling to 73 F was continued at the programmed rate, completing one thermal cycle.

Figure B1 shows the nominal temperatures for the programmed thermal cycle and shows the average length of time in hours that the specimens were at each temperature for each of the five cycles.

6.3 Adiabatic Companion Specimens -- The sealed 6 by 12-in. adiabatic companion strength specimens were cured with the adiabatic temperature rise specimen until age 14 days. The specimens were then transferred directly to the 110 F room where they were cured until two days prior to testing at 73 F. Specimens were cooled from 110 to 95 to 73 F, using cooling procedures described for the creep specimens, subsection 6.1.

6.4 Thermal Treatment Specimens -- Thermal treatment specimens were tested at 73, 110 or 160 F after curing at 73 F or 73 and 160 F. Procedure used for heating specimens to curing or test temperature was similar to that used for heating the creep specimens, subsection 6.1.

The cooling of specimens from 160 to 73 F followed the procedure similar to that used for the creep specimens, except cooling commenced five days prior to compressive strength testing. Specimens which were cooled from 160 to 110 F were cooled alongside those cooled to 73 F until the temperature of 110 F was reached.

7. TESTING OF SPECIMENS

The following is a brief description of the test methods used in determining properties of concrete, including compressive strength, modulus of elasticity, Poisson's ratio, splitting tensile strength, creep strains, autogenous strains, drying shrinkage strains, thermal properties and the linear coefficient of thermal expansion.

7.1 Compressive Strength -- The compressive strength tests on all of the 6 by 12-in. and 6 by 16-in. concrete specimens were performed on a 400-kip Baldwin hydraulic testing machine in accordance with ASTM C 39 "Compressive Strength of Cylindrical Concrete Specimens." The rate of loading was 60,000 pounds per minute or approximately 35 psi per second. No adjustment in controls was made immediately before failure when the specimen was yielding rapidly. Additional procedures used for determining the compressive strength of specimens tested at 110 or 160 F are given in subsection 7.1.3. The tests were conducted in a room maintained at approximately 73 F.

7.1.1 Capping -- The specimens were capped either with sulfur capping compound or with steel plate caps as discussed in the following two subsections.

7.1.1.1 Sulfur Caps -- Sulfur caps conforming to ASTM C 617, "Capping Cylindrical Concrete Specimens," were employed on all compressive strength specimens tested at 73 F, including the selected mix specimens, thermal cycling specimens, creep companion 6 by 12-in. specimens tested at 73 F, thermal treatment specimens tested at 73 F and thermal properties companion 6 by 12-in. specimens. For all specimens tested at 73 F, the type of fracture was of the usual conical shape.

Sulfur caps were also employed on the 6 by 12-in. creep companion specimens tested at 110 and 160 F until low compressive strengths and cap failures were observed on two of the three York 28-day specimens tested at 110 F. For these two specimens the strengths were about half of the expected value, the fractures occurred at the ends of the specimens and the caps were severely cracked. Further examination indicated that the caps, although within ASTM C 617 limits, were about 1 1/2 times thicker than usual and were poorly bonded to the concrete.

Prior to these sulfur cap failures, Berks 28-day 160 F creep companion specimens had already been capped with sulfur and tested for compressive strength. Although their strengths were somewhat lower than expected, subsequent tests showed that these strengths were not influenced by the sulfur caps.

An inspection of Berks 90-day 160 F creep companion specimens which had been sulfur capped at the same time as the York 28-day 110 F specimens and which were scheduled for testing in compression on the day following the York tests, revealed that the caps were poorly bonded to the concrete cylinders. All three specimens were recapped with sulfur caps while their temperature of 160 F was maintained by fiberglass insulation. After the first Berks 90-day companion specimen tested at 160 F failed at what was thought to be a low compressive strength, it was decided to recap the remaining two Berks specimens with 2-in. thick steel plates bonded to the specimens with neat cement paste. These two specimens were then tested at age 93 days. Their compressive strength was similar to that of the first specimen tested. It was then decided to further evaluate capping procedures for tests at elevated temperatures.

First, the capping procedure was changed to reduce the thickness of the sulfur caps to about 1/8 in. Then, a set of corresponding specimens was capped with either sulfur caps or steel plates and tested at 160 F to determine if the type of cap used had an influence on the compressive strength. The results obtained are shown in the following tabulation:

EFFECT OF TYPE OF CAP ON 90-DAY COMPRESSIVE STRENGTH AT 160 F, PSI
York Companion Sealed 6 by 12-in. Cylinders

Specimen	Steel Capped	Sulfur Capped
1	5730	5800
2	5790	5660
3	5820	5910
Average	5780	5790

By minimizing the thickness of the sulfur caps, the strengths obtained were consistent with those of specimens capped with steel plates. However, because of the elevated temperatures and of the high stress levels required to fail the specimens it was felt that the sulfur capping compound might be at the limit of its reliability. Therefore, it was decided to employ steel plate caps on all subsequent specimens tested at 160 F and to employ sulfur caps, having a thickness of about 1/8 in., for all subsequent specimens tested at 73 and 110 F.

All observed fractures of the 6 by 12-in. cylinders capped with sulfur and tested at 73, 110, or 160 F, with the exception of the two cap failures of York 28-day 110 F creep companion specimens, were of the usual conical shape and the compressive strengths were consistent within the group of specimens tested. The procedures for capping with steel plates is given in the following subsection.

7.1.1.2 <u>Steel Plate Caps</u> -- Steel plate caps were employed on 6 by 12-in. specimens tested in compression at 160 F after the failure of sulfur caps described in subsection 7.1.1.1. The steel plate caps were bonded to the specimens with neat cement paste. The paste had good consistency and workability and was used to cap the specimens after its bleeding had ceased. The ends of the concrete specimens were roughened by chipping and then were thoroughly cleaned. The specimens were placed in a squared capping rig, the top end was slightly dampened and the neat cement paste was placed on this moistened end in the shape of a flat cone. The 2-in. thick end plate was then placed on top of the paste and worked down until the paste was spread uniformly in a thin layer between the plate and the specimen. Excess paste squeezed out along the edge was removed and the squareness of the plate in relation to the specimen was checked and adjusted to within ASTM C 39 specifications. The end plate was then taped along its circumference to the concrete specimen. Capping of the opposite end of the cylinder was accomplished in a similar manner, except that the specimen was now placed on a rectangular steel plate equipped with handles. This allowed the specimen to be moved without breaking bond between the bottom steel end plate and the specimen. The rectangular steel plate was machined flat to allow the specimens to be tested on this plate.

All observed failures of the 6 by 12-in. concrete cylinders tested at 160 F with steel caps were of the typical conical shape and the compressive strengths were consistent within the group of specimens tested. Inspection of the caps, when the steel end plates were removed, showed that the bonding and distribution of neat cement paste were good.

All 6 by 16-in. creep specimens and their controls, were capped with steel end plates, as described in Enclosure 1 to this Appendix and were tested in compression with no additional capping. These steel end plates were anchored to the concrete by means of three concrete nails in the top plate and two eye bolts in the bottom plate. Initial testing indicated that no damaging stress concentrations are created by the nails and eye bolts. All 6 by 16-in. specimens tested in compression had the usual conical failures occurring in the middle third of the specimen. The ends of the specimen near the steel plates remained intact.

7.1.2 Capping Schedule and Storage Conditions Prior to Testing -- The capping schedule and storage conditions of specimens before they were tested for compressive strength are described in the following five subsection.

7.1.2.1 6 by 12-in. Specimens Cured and Tested at 73 F -- A schedule for capping all specimens cured and tested at 73 F was established to assure that the sulfur capping compound had adequate strength at the time of the compression test. Specimens to be tested at age 7 and 14 days were capped a minimum of two hours prior to the time of test. Specimens to be tested at age 28 and 60 days were capped two days prior to testing, and all the later age specimens were capped three days prior to testing.

The moist-cured specimens were removed from the fog room, capped and placed back in the fog room where they remained until time of test. Just prior to the compression test, the specimens were removed from the fog room and wrapped with moisture-proof plastic film to prevent the loss of moisture during testing.

The sealed specimens were demolded, immediately wrapped in the plastic film and capped, sealing the ends of the moisture-proof plastic film with the sulfur capping compound. The specimens were then placed into two plastic bags, to insure that no moisture would be lost prior to testing, and were stored at 73 F until time of test. The specimens were removed from the bags just prior to testing.

7.1.2.2 Creep Companion Specimens Tested at 110 or 160 F -- The 6 by 12-in. sealed creep companion specimens, scheduled for testing at 110 or 160 F were normally stripped, sealed and capped prior to being heated to test temperature. The specimens were sealed with five layers of moisture-proof plastic wrap and were then capped. The joint between the plastic wrap and the cap and the vertical overlap portion of the plastic wrap were sealed with a strip of waterproof tape to protect the specimens against loss of moisture. The specimens were then placed into two plastic bags from which they were removed just prior to testing. All creep companion specimens were capped prior to the start of the heating phase with the exceptions of Berks 90-day 160 F specimens which were recapped at 160 F with steel plates as described in subsection 7.1.1.1 and of the York

90-day 160 F specimens which were capped with steel plates when the specimens were at 135 F.

7.1.2.3 Thermal Cycling Specimens -- The 6 by 12-in. thermal cycling specimens tested in compression at the end of a completed temperature cycle of 73 to 160 to 73 F were stripped from their sealed molds when the temperature of the cooling phase had reached 73 F. They were immediately wrapped with a moisture proof plastic film and capped with sulfur, sealing the ends of the plastic film with the capping compound. The specimens were then stored at 73 F for two days prior to testing.

7.1.2.4 Adiabatic Companion Specimens -- Procedures for sealing with plastic wrap and for capping the 6 by 12-in. adiabatic companion strength specimens were the same as described in subsection 7.1.2.1, except that the specimens were capped at 73 F one day prior to testing.

7.1.2.5 Thermal Treatment Specimens -- The thermal treatment specimens cured and tested at 73 F were stripped, sealed and capped following the procedures described in subsection 7.1.2.1.

Specimens cured at 73 F but tested at 110 or 160 F were stripped, sealed and capped per subsection 7.1.2.2.

Specimens cured at 160 F for 1, 91, or 181 days were stripped of their mold and wrapped in multiple layers of moisture-proof plastic with the seams taped with water-proof tape, just before they were heated to 160 F. The specimens tested at 160 F were steel capped at 160 F, three days prior to testing. Specimens tested at 110 and 73 F were sulfur capped at the test temperature one day prior to testing.

7.1.3 Testing at 110 or 160 F -- All specimens tested in compression at 110 or 160 F were maintained at test temperature for a minimum of 24 hours prior to testing. To maintain its temperature during testing, each specimen was wrapped with a layer of fiberglass insulation. The specimens were then transported one at a time from the elevated temperature room to the testing machine on a cart covered with an additional layer of fiberglass insulation and tested in compression with the fiberglass wrapped around the specimen. Heat loss due to contact of the specimen with the testing machine was minimized by heating two steel bearing plates, normally employed in the compression test, to test temperature prior to testing the first specimen. Then, upon completion of each test, the tested specimen was kept in the machine while the next specimen was being transported for testing.

The effectiveness of this method of testing at elevated temperature was established by monitoring the surface temperature of a sulfur capped 6 by 12-in. specimen while it was tested at 160 F and by monitoring the internal temperatures of eight steel capped 6 by 16-in. specimens while they were tested at 110 F. The specimen's temperature did not drop significantly from the time the specimen was removed from the 110 or 160 F room to the completion of the compression test. A surface temperature drop of about 4 F occurred for the specimen tested at 160 F and an average internal temperature drop of less than 0.5 occurred for the specimens tested at 110 F. The concrete surface temperature was measured at a distance of one inch below the cap using two quartz thermometers. The internal temperatures were measured using the 4-in. gage length Carlson strain meters embedded at the centroid of each specimen.

7.2 Modulus of Elasticity and Poisson's Ratio -- Procedures for measuring the modulus of elasticity and Poisson's ratio were based on ASTM C 469, "Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression," and are further described below. The longitudinal and lateral deformations were determined with a compressometer equipped with four linear variable differential transformers (LVDT's).

The longitudinal deformations of a specimen were measured by two LVDT's mounted vertically, parallel to the axis of the specimen and diametrically opposite each other. The effective gage length of each LVDT was eight inches. The compressometer was centered at midheight of the specimen and was rigidly attached to it by set screws.

The lateral deformations of a specimen were measured by two LVDT's mounted horizontally on a ring located at midheight of the compressometer and suspended by four springs from the top ring of the compressometer. The springs were designed with a sufficient stiffness to minimize the weight of this ring, with the lateral LVDT's mounted, to insure that the ring remained at midheight of the compressometer after the spacer bars were removed. The ring itself was also attached to the specimen by spring loaded set screws. The horizontal LVDT's were mounted on the compressometer perpendicular to the axis of the specimen, diametrically opposite each other and rotated 90° from the LVDT's used to measure longitudinal deformations. The effective gage length of each of these two LVDT's on a six-inch diameter specimen was three inches. Prior to testing, the moisture-proof plastic film used to wrap the specimen was removed from the immediate area of the contact tip of the LVDT's and the tip was allowed to make direct contact with the surface of the concrete specimen.

Prior to each day's testing, the longitudinal and lateral LVDT's were calibrated in pairs by setting off known displacements, using a supermicrometer having a least reading of 10 microinches (.00001 inches). An XYY' recorder was calibrated simultaneously to record directly the average strain from the known LVDT displacements.

The stress calibration of the XYY' recorder was performed by applying a known load to a specimen with the testing machine and adjusting the load scale of the XYY' recorder to record the corresponding stress for a 5.97-in. diameter (28.0-sq. in. area) specimen. The load applied to the specimen was taken directly off the testing machine by means of an electric pressure transducer and was recorded as stress on the XYY' chart.

In Phase II(c), an additional calibration step was added to the procedure. After the calibrations for strain and stress were performed, and prior to testing the concrete specimens, the calibration was checked by placing the compressometer on a calibrated steel cylinder. The steel cylinder was then loaded and the resulting strain and stress levels were compared with known calibration values.

To obtain the modulus of elasticity and Poisson's ratio for a given specimen, the specimen was loaded to 40 percent of its estimated ultimate strength three consecutive times. The loading rate was 60,000 lbs per minute or approximately 35 psi per second. During the loadings, stress versus longitudinal strain and lateral strain versus longitudinal strain curves were plotted with the XYY' recorder. The elastic modulus was computed from the first curve and the Poisson's ratio from the second. The values given in this report represent the average of the second and

and third loadings. The lateral LVDT's were then disconnected from the compressometer and the specimen was tested for compressive strength.

On selected specimens a time ramp generator, calibrated to record time, was connected to the XYY' recorder in place of the input from the lateral LVDT's prior to loading the specimen to failure. During the loading, stress versus longitudinal strain and time versus longitudinal strain curves were obtained. The first curve provided the stress-strain relation of concrete. The second provided a check on the loading rate. The loading rate was in all cases within the limits of ASTM C 469. A typical XYY' plot is shown in reduced size in Figure B2, the actual size being 10 by 15 inches.

7.2.1 Sustained Modulus of 6 by 16-in. Creep Specimens -- The sustained modulus of elasticity of the creep specimens, defined as the total strain divided by the applied stress, was determined during loading and unloading. The specimens were loaded and unloaded in accordance with GA specifications and as described in Enclosure 4 to this Appendix.

The strain readings during loading were taken as follows. For creep specimens stressed to a nominal stress level corresponding to 30 or 45 percent of their 73 F ultimate strength, the Carlson strain meters were read 15 seconds prior to start of loading (zero stress), then, during a nine second period while the applied stress was held constant at a level equal to about one half the full stress, and finally immediately after reaching the full stress. For creep specimens stressed to 60 percent of their 73 F ultimate strength, the strain readings were taken at stress levels of 0, 22.5, 45 and 60 percent. The creep specimens were stressed at a rate of 35 ± 5 psi per second, except when the stress was held constant during the nine second hold periods required to read strains at given stress levels.

The sustained modulus during loading was computed for all specimens using the strain measured at the full stress level. The intermediate strain readings taken during loading were used to check the linearity of loading and to determine the modulus of elasticity of the concrete when the full stress level was greater than 40 to 45 percent of its ultimate strength at the given test temperature.

The specimens were unloaded at a rate of 35 ± 5 psi per second. During unloading, the sustained modulus was computed from the strains determined immediately prior to unloading and immediately after unloading.

7.3 Splitting Tensile Strength -- The splitting tensile strength tests on all of the 6 by 12-in. concrete specimens were performed on a 120 or on a 400-kip Baldwin hydraulic testing machine in accordance with ASTM C 496 "Splitting Tensile Strength of Cylindrical Concrete Specimens." The rate of loading was 16,000 lbs per minute or approximately 140 psi per second. Specimens were tested in a self-aligning splitting tensile strength testing rig, designed and built at UC, which has alignment marks that are coordinated with alignment marks on the testing machine platform, assuring proper alignment of test specimen in the machine.

Splitting tensile strength specimens were stripped from their molds at the same time as the corresponding compressive strength specimens, subsection 7.1. Moist-cured specimens were sealed with moisture proof plastic film immediately after removal of the specimens from the fog room. Sealed specimens were wrapped with the plastic film immediately upon stripping and placed in two plastic bags. The plastic film was removed from both the moist-cured and sealed specimens just prior to the testing of an individual specimen.

The percentage of coarse aggregate fractured during the splitting tensile strength test was determined by counting the number of fractured and not fractured pieces of aggregate on a representative section of concrete, equal to at least half of the fractured surface of the 6 by 12-in. cylinder.

7.4 Creep, Autogenous and Drying Shrinkage Strains -- Creep, autogenous and drying shrinkage strains of concrete were determined on 6 by 16-in. specimens, each internally instrumented with one 4-in. Carlson strain meter. In addition, eight of the creep specimens were also instrumented with Whittemore points as a quality control check on the Carlson instrumentation. The specimens were prepared and sealed in accordance with the procedures described in this Appendix and in Enclosure 1 to this Appendix. The creep specimens were loaded and tested in accordance with ASTM C 512, "Test for Creep of Concrete in Compression," as described in Enclosure 4 to this Appendix.

A description of the instrumentation and of the calibration checks performed at UC are given in subsections 7.4.1 and 7.4.2. Strain data were collected using computer oriented data acquisition system described in Enclosure 4 to this Appendix. The computer output of the creep, autogenous length change and drying shrinkage data is presented in Appendix C of this report, along with sample calculations showing determination of temperature, strain and specific creep.

7.4.1 Carlson Meter Instrumentation -- A 4-in. gage length A-4 Carlson strain meter was used in each of the 6 by 16-in. creep and creep control specimens. The manufacturer's description of the meter, entitled "Carlson Elastic Wire Strain Meter" is given as Enclosure 2 to this Appendix. Calibration constants for determining strain and temperature were supplied by the manufacturer. These meter calibration constants were checked at UC prior to using the meters. After the specimens were cast, a proof-loading was performed and the internal strains determined with the Carlson meter were compared to the external strains determined with a compressometer equipped with LVDT's. The percent difference between the external and the internal strains is referred to as the specimen-meter factor (SMF). The UC calibration checks for strain, temperature and specimen-meter factor are described in the following three subsections.

7.4.1.1 Strain Calibration -- The strain calibration constants supplied by the manufacturer were checked as described in UC method of test for "Calibration of Carlson Strain Meters," given as Enclosure 3 of this Appendix.

Prior to selection of the Carlson strain meter for this test program, it was also established that the strain calibration constant for this type of meter does not vary with temperature within the range of 73 to 160 F. This check was performed per Enclosure 3 to this Appendix except that the known displacements were applied with a high temperature calibration unit and were measured with three LVDT's instead of the dial gage. The high temperature calibration unit, designed and built at UC, contains a temperature controlled oil bath. In this calibration check, a Carlson meter was submerged into the oil bath and was subjected to known displacements at oil temperatures in the range of 73 to 160 F. Prior to the calibration, the oil bath was maintained within ± 0.3 F of the test temperature for a minimum of 12 hours. The LVDT's used for measuring displacements were calibrated using a super-micrometer, having a least reading of 0.00001 in. and a digital voltmeter reading to 0.0001 volt.

7.4.1.2 Temperature Calibration -- Prior to the use of Carlson meters, their temperature calibration constants were checked at UC. This calibration check was accomplished by storing a group of Carlson strain meters in an insulated container in the 73 F room. The temperature inside the container was measured by means of a quartz thermometer calibrated to ± 0.01 F. The resistance of each Carlson strain meter was measured using the Carlson test set and/or the SESM test set. This procedure was then repeated in the 110 F room and then again in the 73 F room, taking resistance readings for each Carlson meter at each temperature level. The temperature calibration constants (T.C.) were then determined for each meter, using the following basic equation:

$$\text{Temperature Calibration Constant, T.C.} = \Delta_t/\Delta_R, \text{ F/ohm}$$

where:

Δ_t = Change in temperature, F

Δ_R = Change in resistance, ohms

Example: T.C. for Carlson Meter No. 363

Temperature, F	Resistance, ohms
70.00	55.41
108.10	58.98
Δ_t = 38.10	Δ_R = 3.57

$$\text{T.C.} = 38.10/3.57 = 10.67 \text{ F/ohm}$$

The temperature calibration was also checked for one set of 12 Carlson meters at 160 F. The results were found to be consistent with the calibrations performed in the temperature range of 73 to 110 F. Thus, within the temperature range of 73 to 160 F, the Carlson meter resistance versus temperature curve can be assumed to be a straight line.

7.4.1.3 <u>Determination of Specimen-Meter Calibration Factor</u> -- The specimen-meter calibration factor (SMF) is a calibration constant which correlates the strain readings obtained from a Carlson meter embedded in a concrete specimen to the actual strains in the concrete. Due to several factors, a primary one being the void created in the concrete by the embedded meter itself, the meter registers higher strains when the concrete is subjected to an externally applied load. The theoretical increase in strain readings for a 4-in. Carlson meter due to the void alone has been computed to be about 12 percent. Experimentally, this increase in strain readings, including all causes, was found to average about 16 percent for 4-in. Carlson meters, with extreme values ranging from as low as 0 to as high as 30 percent.

The SMF was generally determined by proof loading the instrumented 6 by 16-in. specimens to 1500 psi in a testing machine about two weeks prior to the creep tests. External strains were determined by the use of a compressometer instrumented with two LVDT's for measuring longitudinal strains which were recorded on an XY plot, following procedures similar to those described in subsection 7.2. Simultaneously, the internal strains were obtained from the Carlson meter. The SMF and strain in concrete were then determined using the following calculations:

$$\text{SMF} = \frac{(\text{External Strain})-(\text{Carlson Strain})}{\text{External Strain}} \times 100, \text{ percent}$$

Strain in Concrete = Strain from Carlson Meter X (100-SMF)

When the concrete was not loaded but was subjected to autogenous, thermal and drying shrinkage strains, the theoretical SMF, equal to 0, was used.

After completion of creep testing, the specimen-meter factor was checked again for specimens tested for compressive strength. Just prior to the compression test, specimens were stressed to 2500 psi with Carlson meter strains recorded at every 500 psi interval. Simultaneously, external strains were recorded on an XY plot following procedure similar to that described above. On the average, the SMF value checked within ± 3 percentage points of the SMF value obtained prior to the creep loading. The final SMF used for a given specimen was the average of the two values.

7.4.2 Whittemore Instrumentation -- As a quality control check on Carlson strain meter instrumentation, the strains of eight creep specimens at 73 F were also measured with a Whittemore gage. Three pairs of Whittemore gage points, set to a 10-in. gage length, were epoxied on the surface of each of the eight creep specimens at third points around the circumference and equidistant from the ends of the specimen, three days prior to loading.

The Whittemore gage points were drilled on the surface of small stainless steel plates machined to 1/4 by 3/4 by 1/16 in. with a 3-in. radius of curvature in the 3/4 in. dimension. The butyl rubber sealing jackets were cut at the location of the gage points to allow the plates to be epoxied directly to the concrete surface. A butyl rubber cover patch, having a central opening was aligned over the Whittemore point in the plate, and was epoxied directly on the plate and original jacket, making a complete seal.

Strain readings were taken with a 10-in. Whittemore gage instrumented with a dial having a least reading of 0.0001-in. The external strains, $\pm$ 5 microstrains, from the three pairs of Whittemore points were averaged and compared to the internal strain readings from the Carlson meter.

The external strains were in general consistent with the internal strains. A summary of specimens instrumented with Whittemore points and the percent variation of the external Whittemore strains from the internal Carlson meter strains is given in the following tabulation:

CONSISTENCY OF WHITTEMORE-CARLSON READINGS

Concrete Group	Stress Level	Meter Number	Percent Variation of Whittemore from Carlson
Berks	45%	359	-3
		372	-3
Berks	60%	354	-7
		374	-3
York	45%	418	+7
		401	+7
York	60%	400	-1
		414	+1

7.5 Linear Coefficient of Thermal Expansion -- The linear coefficient of thermal expansion was determined for Berks and York concrete using the set of three 6 by 16-in. internally instrumented thermal cycling specimens for each concrete. In each set of three specimens, two were instrumented with 10-in. gage length A-10 Carlson strain meters and one was instrumented with a 4-in. gage length A-4 Carlson strain meter. The manufacturer's description of the meters is given in Enclosure 2 to this Appendix.

The specimens were subjected to five temperature cycles of 73 to 160 to 73 F, as described in subsection 6.2. Strain gage readings, using a Carlson test set, were taken at 73, 90, 110, 135, 160, 135, 110, and 73 F during each cycle just prior to increasing or decreasing the temperature to the next level, and the linear coefficient of thermal expansion was determined for each step for all five cycles.

Reduction of data was made using the strain meter constants supplied by the manufacturer. A set of sample calculations for computing the linear coefficient of thermal expansion for one meter and one change in temperature is given in Final Report - Part I, Appendix B, p. 118.

7.6 Thermal Properties -- The adiabatic temperature rise, specific heat and thermal diffusivity of concrete were determined in accordance with Enclosure 5 to this Appendix.

The UC test procedure for determining adiabatic temperature rise is similar to Corps of Engineers test method CRD-C 38 which is based on the procedures developed and established at UC. The UC test procedure for specific heat is based on the US Bureau of Reclamation test method described in the Boulder Canyon Project Final Report, Bulletin 1, entitled, "Thermal Properties of Concrete." The UC test procedure for thermal diffusivity is similar to the Corps of Engineers method CRD-C 36.

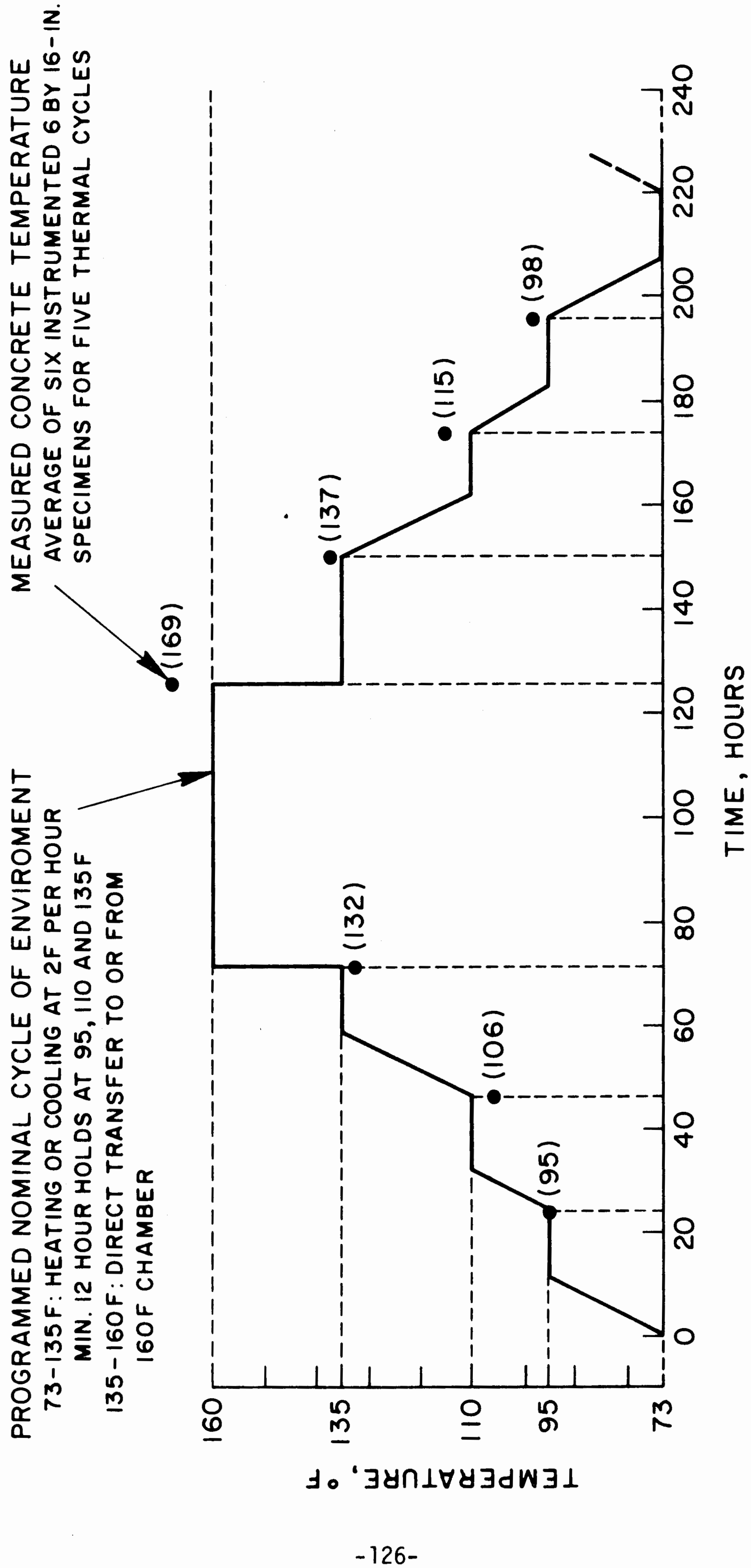
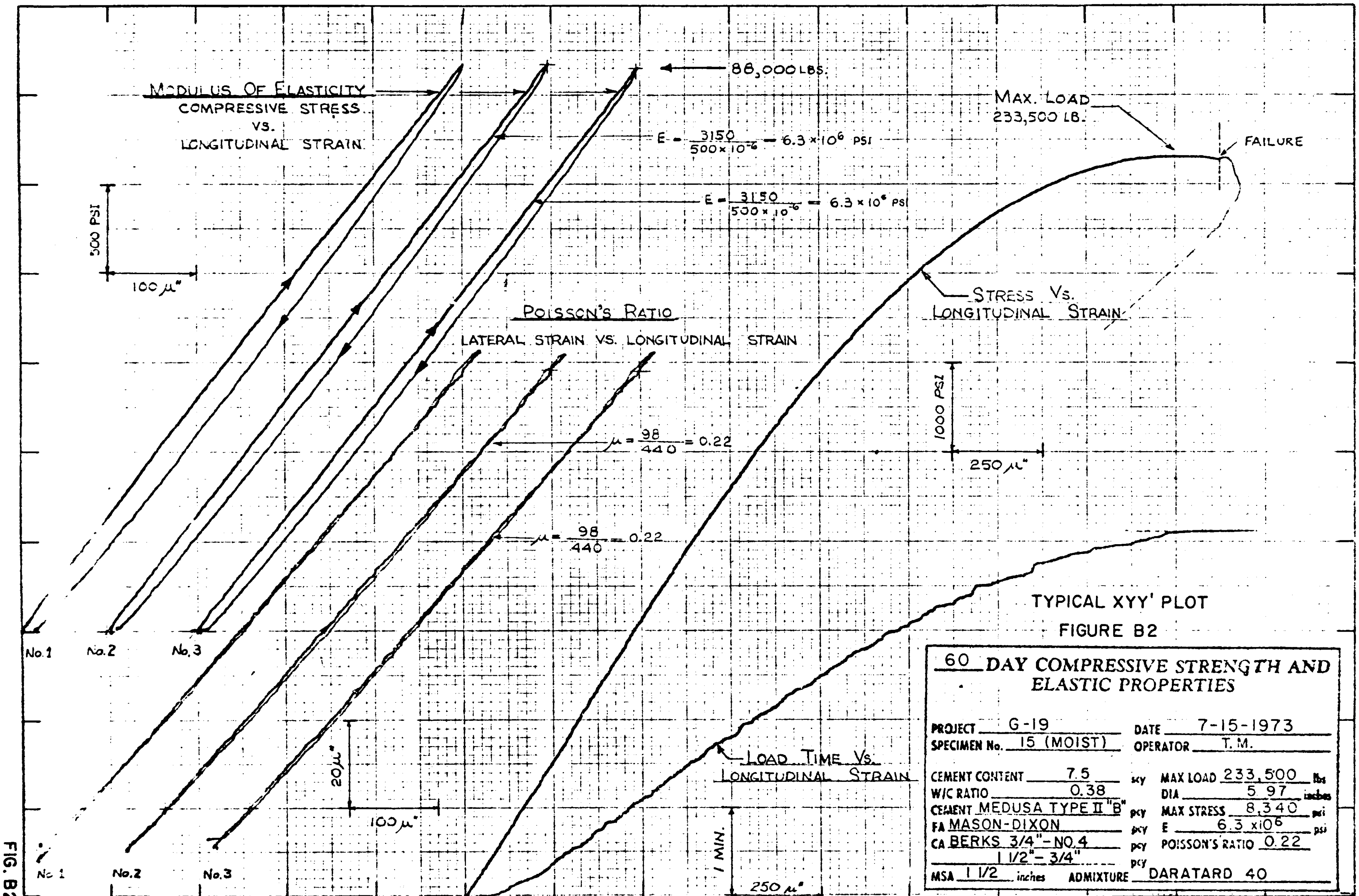


FIGURE B1--AVERAGE THERMAL CYCLE, BERKS G-19 AND YORK G-25 CONCRETE



88,000 LBS.
MODULUS OF ELASTICITY
COMPRESSIVE STRESS
VS.
LONGITUDINAL STRAIN
E = 3150 / 500×10^-6 = 6.3×10^6 PSI
E = 3150 / 500×10^-6 = 6.3×10^6 PSI
500 PSI
100 μ"
MAX. LOAD
233,500 LB.
FAILURE
STRESS VS.
LONGITUDINAL STRAIN
POISSON'S RATIO
LATERAL STRAIN VS. LONGITUDINAL STRAIN
μ = 98/440 = 0.22
μ = 98/440 = 0.22
1000 PSI
250 μ"
No. 1
No. 2
No. 3
20 μ"
100 μ"
LOAD TIME VS.
LONGITUDINAL STRAIN
1 MIN.
250 μ"
No. 1
No. 2
No. 3
TYPICAL XYY' PLOT
FIGURE B2
60 DAY COMPRESSIVE STRENGTH AND ELASTIC PROPERTIES
PROJECT G-19
DATE 7-15-1973
SPECIMEN No. 15 (MOIST)
OPERATOR T.M.
CEMENT CONTENT 7.5 scy
MAX LOAD 233,500 lbs
W/C RATIO 0.38
DIA 5.97 inches
CEMENT MEDUSA TYPE II "B" pcy
MAX STRESS 8,340 psi
FA MASON-DIXON pcy
E 6.3 x10^6 psi
CA BERKS 3/4"-NO.4 pcy
POISSON'S RATIO 0.22
1 1/2"-3/4" pcy
MSA 1 1/2 inches
ADMIXTURE DARATARD 40

FIG. B2

Test Method for GA Research Program
University of California, Berkeley
Issue A, March, 1975
Rev. No. 1, January 25, 1976

Method of Test for

SETTING-UP, CASTING, SEALING AND STORAGE OF 6 BY 16-IN. INTERNALLY INSTRUMENTED CONCRETE SPECIMENS

1. SCOPE

This method covers procedures for setting up molds for 6 by 16-in. internally instrumented concrete specimens, casting of these specimens, sealing the specimens and storage of specimens until time of test.

2. APPARATUS (FOR EACH SPECIMEN)

2.1 Molds -- Cast iron 6 by 18-in. cylindrical molds. Note: These molds were manufactured by casting the mold in two halves, their edges milled parallel, and then with the two halves bolted together, their inside diameter machined to 6 $\pm$ .001 inches.

2.2 End Plates -- Two (2) 6-in. dia. steel end plates, one 2-in. thick and the other 1 1/2-in. thick. The 2-in. thick end plate has a hole and slot for instrument lead wire. The 1 1/2-in. end plate is solid. Both end plates have eye hooks or concrete nails to prevent end plates from being sheared off specimen.

2.3 Strain Gage -- A Carlson or a Microdot strain gage for embedment in concrete.

2.4 Alignment Rig -- Strain gage alignment and tensioning rig with soft wire for securing and aligning instrument in cast iron mold and to maintain its alignment during casting.

2.5 Sealing Jacket -- Butyl rubber sheet, 1/16 in. thick, cut to size 18 by 23 in., with one of its 18-in. sides beveled by sanding. The side is beveled to prevent bulging of rubber at 4-in. lap splice.

2.6 Leveling Plate -- Leveling plate especially manufactured for leveling the top steel plate on creep specimens.

3. PROCEDURE

3.1 Setting Up Molds -- Setting up of the 6 by 18-in. molds and installation of the strain gage includes the following:

a) Inspect molds for cleanliness and oil lightly.

b) Check strain gage to be installed for defects and make certain the strain gage can be read.

c) Inspect rubber gasket on mold base plate for defects and cleanliness. Thread lead wire through hole in the 2-in. end plate and fit "O-ring" washer and nut.

d) Use soft wire to position strain gage axially in mold. Loop wire around bottom flange once and secure to eye bolts in 2-in. end plate. Strain gage should be positioned so that distance between bottom of strain gage's lower flange and top surface of 2-in. bottom end plate is according to size of strain gage used as follows:

4-in. strain gage: 6 ± 1/4 in.	8-in. strain gage: 4 ± 1/4 in.
6-in. strain gage: 5 ± 1/4 in.	10-in. strain gage: 3 ± 1/4 in.

e) Tighten nut with "O-ring" to assure seal of lead wire opening. Grease edge of the 2-in. end plate and position it in the one side of the 6 by 18-in. mold.

f) Loop soft wire around top flange of strain gage and through strain gage alignment and tensioning rig resting on top edge of mold. Align strain gage and tension top wire as little as possible to maintain strain gage in vertical position.

g) Check position of strain gage from bottom end plate again. Take reading on strain gage. Make sure strain gage is positioned correctly and can be read. Check strain gage identification number and show this number on lead wire tag. Grease edges of mold and tighten mold halves together.

h) Place instrumented mold in storage area and cover to prevent dirt from entering mold.

3.2 Casting Instrumented Specimens -- The instrumented specimens are cast as follows:

a) Place instrumented molds on cart and cast molds on cart if feasible to prevent having to lift molds after casting. Inspect molds for cleanliness.

b) Check strain gages to make certain they can be read.

c) Specimens are to be cast vertically according to ASTM C 192 "Making and Curing Concrete Test Specimens in the Laboratory," modified to include the following:

(1) Cast the concrete in layers, consolidating each layer by rodding 25 times. Extreme caution must be taken to prevent damage to instrument during rodding. A smaller diameter rod may be used to consolidate the concrete in the immediate proximity of the strain gage.

(2) The layer of concrete from 1 in. below to 1 in. above the strain gage should be cast from the same batch if possible, and in as short a time span as feasible. Maintain alignment of instrument during casting. Concrete above and below the strain gage level is cast using standard practice.

(3) Place concrete with a scoop gently into mold. Care must be taken to prevent dropping concrete directly on the strain gage. Alternate placing of concrete from one side of the strain gage alignment rig to the other, keeping concrete evenly distributed in the mold.

d) After completion of casting, cover specimens with plastic film and move on cart to place of storage. Remove cover, cut wires, remove alignment rig and cover specimen again with plastic film secured to mold with rubber bands. Vibrate specimens slightly to assure meter settles with concrete.

3.3 Sealing of Specimens -- Specimens are sealed against moisture loss as follows:

a) Before placing top end plate, allow approximately 5 hours time after casting so that no more bleeding water rises to the surface. Then form a conical-shaped layer of mortar on top of each cylinder. This mortar is obtained from the original mix, or prepared separately at time of casting, to allow time for bleeding to cease prior to its use. Work the 1 1/2-in. top plate back and forth into position on each specimen until the mortar appears to be spread uniformly between the plate and the specimen. Use the leveling plate to assure top plate is normal to the axis of the specimen. Move specimens to 73 F room.

b) Strip cast iron molds from specimens not earlier than 24 hours but no later than 48 hours after casting. Just prior to stripping molds off specimen prepare the sealing jacket by applying rubber cement to the 1/16-in. thick butyl rubber sheet at surfaces of the lap splice joint, and on 2-in. wide strips along each edge of 23-in. side. Then within 3 minutes after removing cast iron mold the following operations shall be performed:

(1) Clean end plates.

(2) Coat edges of end plates and adjacent 1-in. strip of concrete specimen, as well as 2-in. vertical strip on specimen for attaching of rubber sheet.

(3) Wrap the 1/16-in. thick butyl rubber sheet around the concrete (beveled edge outward) bonding the top and bottom edge of the rubber to the steel end plates.

(4) Inspect bonding of the 4-in. lap splice. Tighten the 6-in. dia. hose clamps over the butyl rubber and steel end plates to assure specimen will be thoroughly sealed.

3.4 Storage of Specimens -- After sealing, specimens are to be stored in 73 F room until time of test. They are to be stored vertically with lead wire coming out at the top of specimen (opposite to position of casting).

3.5 Labeling of Specimens -- Prior to sealing the specimen will be identified by instrument number and concrete mix from which it was cast.

After sealing each specimen is to have the following information tagged to it.

a) Meter No.: ______, Ratio range: ______, Channel: ______.

b) Concrete: Mix No.: ______, Batch No.: ______,
Date cast: __________.

c) Temperature (to be loaded at): ______, Loading level: ______%.

d) Age of loading: _____days, Date to be loaded: __________.

e) Heating to begin: __________.

f) Date unloaded: __________.

3.6 Carlson Strain Gage Readings -- Carlson strain gage readings prior to casting can be taken with either the Carlson or the SESM test set. The initial reading on the strain gage after casting of the specimen must be taken with both test sets. Subsequent readings will be taken with the SESM test set, except that periodically readings with both test sets must be taken as a double check on strain gage readings.

a) The following is a summary of required strain gage readings:

(1) Check of strain gage prior to use.

(2) Check of strain gage after setting up mold.

(3) Check of strain gage prior to casting specimen.

(4) Check of strain gage after casting.

(5) Initial readings 24 hours after casting.

(6) Subsequent readings at intervals depending on type of test being performed.

CARLSON ELASTIC WIRE STRAIN METER*

July 1, 1972

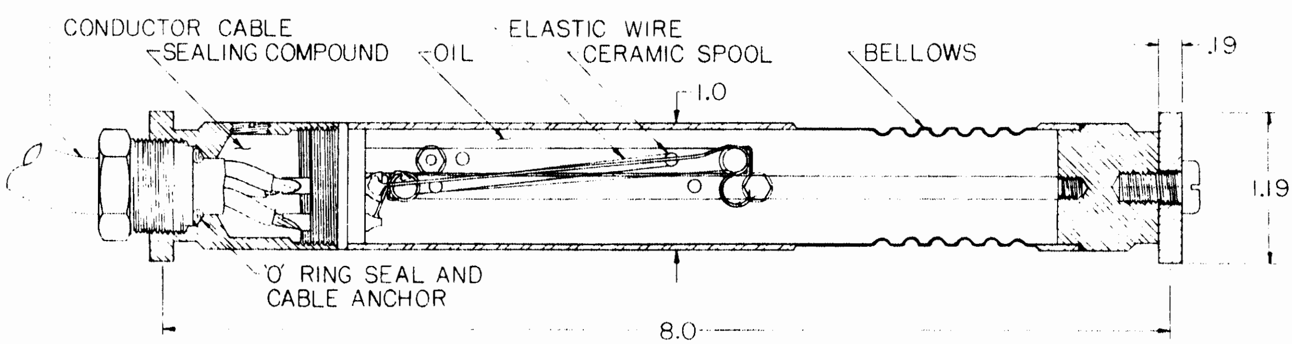
The standard strain meter can be embedded in concrete or it can be attached to a surface with saddle mounts. It measures change in length (strain) and temperature with the help of a simple Wheatstone-bridge type testing set (James Biddle Model 72-4010). The meter contains two coils of highly elastic steel wire, one of which increases in length and electrical resistance when a strain occurs, while the other decreases. The ratio of the two resistances is independent of temperature (except for thermal expansion) and therefore the change in resistance ratio is a measure of strain. The total resistance on the other hand is indepandent of strain since one coil increases the same amount as the other decreases due to a change in length of the meter. Thus, the total resistance is a measure of temperature. The improved strain meter is a better thermometer than the earlier ones, which had one coil within the other and therefore of different lengths.

The strain meter is furnished in three different lengths, from 8 inches to 20 inches, but all with the identical sensing element. The end away from the cable has a tapped hole (1/4-28 UNF) to permit attachment to a spider for mass concrete embedment, or for adding an extender to increase the length and sensitivity. The body is covered with cotton sleeving to break the bond with the concrete.

The conductor cable most commonly used is neoprene rubber-covered, portable cord with either three or four conductors. The four-conductor cable permits the testing set to make automatic subtraction of cable resistance for the determination of temperature only. If the user does not specify cable length, the meter is supplied with 30 inches of 16/3 SO cord. However, it is often preferred to attach the cable at the job site in the full length to be needed. In this case, the user must specify the diameter of the cable to be used so that the sealing chamber can be made to order and supplied separately with the meters. Instructions for attaching the cables and sealing chambers are supplied to the user. It is recommended that no greater than 600 ft. of 16 AWG cable be used. Larger wire should be used with longer lengths.

The strain meter frame is all steel, thus reducing the temperature correction (for thermal expansion of the frame) from the former value of 7.5 micro-strain per degree. The improved strain meter is more nearly compensating for thermal expansion than before, because the 6.7 value is more nearly the same as the thermal expansion of concrete. This is advantageous in that not much of the range of the meter is lost because of temperature change.

*See page entitled "Improved Sensing Element for Carlson Instruments"



SPECIFICATIONS - A SERIES

Former Model Number	S1-8	SL-10	...	SA-20
Current **Model Number**	**A8**	**A10**	**A105****	**A20**
Range (micro-strain)*	2600	2100	2100	1050
Least reading (micro-strain)	3.9	3.1	3.1	1.6
Least reading, temperature (°F)	0.1	0.1	0.1	0.1
Gauge length (inches)	8	10	10	20
Weight (lbs)	.8	1.3	1.3	3.5

*Normally set at factory for 2/3 of range in compression. Within limits, other settings may be specified.

**Saddle mount. Mounting diameter is 1-1/16 inches.

IMPROVED SENSING ELEMENT FOR CARLSON INSTRUMENTS

Carlson strain meters, stress meters and pore pressure cells all use an elastic-wire electrical resistance device as the sensing element. The device is both a strain meter and a thermometer. It consists of two coils of fine steel wire, wound on ceramic spools. One of the coils increases in length and resistance with strain while the other decreases. The change in resistance is due mainly to stress and not to change in dimensions; when the length of a coil is increased by 1 per cent the electrical resistance is increased 3.6 per cent. The ratio of electrical resistance of the two coils is directly proportional to change in gauge length, while the total resistance of the two coils is directly related to temperature. Electrical resistances and ratios can be measured accurately with a Wheatstone bridge type testing set to 0.01 ohm and 0.01 per cent, respectively.

The improvement of the sensing element has come about through a simplification largely by eliminating internal screws. A new design of ceramic spool permits it to be mounted without screws, and similarly, the flat-spring guides are now attached without screws. These innovations permit the sensing element to be slender enought to be suitable for miniature strain meters and yet fully satisfactory for larger instruments. Thus, the new sensing element can be used with only minor modification for all Carlson meters except thermometers and joint and foundation meters.

The improved sensing element is a more precise thermometer than before. In the past it has been necessary to mount one coil of elastic wire within the other to insure that they would be of equal temperature, and thus one coil had to be shorter than the other. In the new and more slender sensing element, the coils are mounted close enough to each other that they can be of equal length and yet of substantially equal temperature. There is no longer any effect of strain on the determination of temperature.

The sensing element for the miniature strain meters is necessarily shorter than for other meters. Its electrical resistance is only about 55 ohms at room temperature. For stress and pore cells, resistance of the two internal coils is 70 ohms. For standard strain meters the resistance is 90 ohms.

All of the Carlson Instruments using this type of sensing element are sold as 5% instruments, that is, the accuracy of any measurement is within ±5% of full range. The linearity is within ±2% of full range of a line joining the end points. The average meter will be much better than specified, however, to tighten the specifications would increase the cost considerably.

DR. ROY W. CARLSON
1203 DELL AVENUE - CAMPBELL, CALIF. 95008

Test Method for GA Research Program
University of California, Berkeley
Issue B - January 27, 1976

Method of Test for

CALIBRATION OF CARLSON STRAIN METERS

1. SCOPE

This method describes the calibration of Carlson strain meters which are used to measure strain inside 6 by 16-inch concrete cylinders.

2. APPARATUS

The apparatus required to calibrate the Carlson meter includes a Carlson and a SESM test set, which are used for reading the Carlson meter, and a calibration unit, which is used for subjecting the Carlson meter to known displacements. The requirements for accuracy and calibration of these apparatuses are described in Sections 2.1 to 2.3.

2.1 Carlson Test Set -- The Carlson test set used for calibration shall have the following accuracy:

Resistance Ratio ± .005%
Resistance ± .01 ohms

A calibration check of the Carlson test set should be made prior to each set of Carlson meters calibrated. The calibration check consists of reading the ratio for two standard resistors, both direct and with leads reversed. The product of the ratio read-direct when multiplied by the ratio read-reverse should equal 1.00000 ± .00005.

2.2 SESM Test Set -- The SESM test set, designed and built at the University of California at Berkeley (UC), contains a digital voltmeter for measuring the unbalance of voltage across a Wheatstone bridge. The SESM test set shall have the following accuracy for calibrating Carlson meters:

Mode 3 (for strain) -- ± 5 microvolts
Mode 4 (for temperature) -- ± 5 microvolts

A calibration check of the SESM test set shall be made prior to each calibration of a Carlson meter. The calibration check consists of reading Mode 0 and Mode 1, built-in calibration controls for the SESM test set. These readings should be:

Mode 0 -- ± 40 microvolts
Mode 1 -- ± 1390 ± 20 microvolts

The applied voltage supplied by the SESM test set shall be 2 volts as read on Mode 2 of the test set. This voltage reading should be:

Mode 2 -- 2 ± .003 volts

2.3 Calibration Unit -- The calibration unit, designed and built at UC, shall contain a dial gage having a least reading of .0001 inch. A check of the calibration unit shall be made at least once a year. The calibration unit check shall be performed by aligning the calibration unit in a super-micrometer having a least reading of ± .00001 inch. Displacements shall be marked off in even steps not greater than 0.002 inch, as read on the calibration unit dial gage. For each step marked off, super-micrometer readings shall be recorded and compared with the calibration unit dial gage. The super-micrometer readings shall agree within ± 0.00002 inch of the dial gage readings.

3. CALIBRATION PROCEDURE

This calibration procedure can be used for calibrating or for verifying the calibration of Carlson strain meters. The calibration consists of the following steps:

(a) Set-up Carlson test set, SESM test set, and a switching unit to allow a meter to be read using both test sets in sequence at a given displacement.

(b) Record Carlson meter number, date, and names of persons doing calibration.

(c) Measure and record Carlson meter gage length. The gage length shall be determined from outside to outside of flanges and measured to ± .01 inch.

(d) Position meter in calibration unit and fasten flange clamps securely.

(e) Starting at meter reading just above high ratio range, begin to mark off displacements in even steps not greater than 0.0020 inch as indicated on the calibration dial gage. Take readings using both test sets at each displacement step. Continue marking off displacements until lower ratio range is reached. The displacement dial shall be turned in one direction only throughout the calibration range to avoid backlash in the displacement dial.

(f) Calculate (Section 4) and compare calibration constants between each displacement step marked off. The calibration constant used for the meter shall be the average value of the constants obtained for each step marked off, excluding the first and last step values.

(g) If a verification of the meter constant to within ± 1 percent cannot be obtained with the constant supplied by the manufacturer, check the calibration of the meter again starting with step (c) of this procedure. Make certain the meter is fastened securely in the calibration unit. If the recalibration of the meter checks within ± 1 percent of the preceding UC calibration, use this UC calibration constant for the meter. If a calibration check cannot be obtained, return meter to the manufacturer.

4. CALCULATION OF CALIBRATION CONSTANTS

Calibration constants for the meter shall be computed as follows:

4.1 Calibration Constant (C_s) for Carlson Test Set

$$\text{Carlson } C_s = \frac{\Delta \text{ Displacement}}{\Delta \text{ Ratio}} \times \frac{1}{\text{Gage Length}}$$

$$\text{Strain} = \Delta \text{ Ratio} \times C_s$$

4.2 Calibration Constant (C_s) for SESM Test Set (per volt)

$$\text{SESM } C_s = \frac{\Delta \text{ Microvolts}}{\text{Mode 2 voltage}} \times \frac{\text{Gage Length}}{\Delta \text{ Displacements}}$$

$$\text{Strain} = \frac{\Delta \text{ Microvolts}}{\text{Mode 2 voltage}} \times \frac{1}{C_s}$$

5. CALIBRATION OF CARLSON METERS FOR PCRV TEST PROGRAM

The above calibration procedure was used to calibrate all Carlson meters used in this PCRV test program. Calibrated Carlson meters were received from the manufacturer prior to his filling them with oil. After meters were recalibrated at U.C. Berkeley, the meters were returned to the manufacturer. The manufacturer then set the initial meter ratios, filled the meters with oil, sealed them, and returned the meters for use in the specimens.

The data reduction of the Carlson meter constants was facilitated by using a Nova 2 computer for all required data reduction. A sample output is given in Table 1.

TABLE 1

SAMPLE COMPUTER DATA REDUCTION OF CARLSON METER CALIBRATION

CARLSON METER NO. 422

MODE 2 VOLTAGE = 2.0012 GAGE LENGTH=4.15 IN.

DIAL GAGE	*** CARLSON TEST SET ***			***** SESM TEST SET *****		
	RATIO	CHANGE IN RATIO	CAL. CONSTANT	MODE 3	CHANGE IN M-VOLTS	CAL. CONSTANT
.1	104.86			23370		
		.943	5.11		4563	4.73
.098	103.917			18807		
		.925	5.21		4527	4.69
.096	102.992			14280		
		.929	5.19		4593	4.76
.094	102.063			9687		
		.888	5.43		4427	4.59
.092	101.175			5260		
		.892	5.4		4490	4.66
.09	100.283			770		
		.902	5.34		4597	4.77
.088	99.381			-3827		
		.9	5.35		4610	4.78
.086	98.481			-8437		
		.877	5.5		4533	4.7
.084	97.604			-12970		
		-7.237	5.33		-36262	4.7
.1	104.841			23292		
AVERAGE EXCLUDING FIRST AND LAST C.C. =			5.32			4.71

Test Method for GA Research Program
University of California, Berkeley
Issue A January 22, 1974
Rev. No. 1 January 21, 1976

Method of Test for

CREEP OF CONCRETE

1. SCOPE

This method covers procedures for determining creep on 6 by 16-in. specimens and complies with ASTM C-512, "Test of Creep of Concrete in Compression." A description of the loading system used at the University of California (UC), Berkeley, is given, including the specific arrangement of loading system components and test specimens for the PCRV test program, the test procedures used, and the data acquisition procedures.

2. LOADING SYSTEM

2.1 Development -- The loading system used at U.C. Berkeley to apply and maintain constant sustained high levels of stress on creep specimens was developed in the early 1950's by Professors C. H. Best, D. Pirtz, and M. Polivka and is described in their paper, "A Loading System for Creep Studies of Concrete," ASTM Bulletin, No. 224, Sept. 1957, pp. 44-47. This reliable creep loading method has been evaluated and modified through the years in numerous creep studies, under the supervision of D. Pirtz, into a flexible system useful for creep studies at elevated temperatures.

2.2 Basic Components of the Loading System -- The loading system is made up of two types of basic components. These are:

a) the loading frame and hydraulic load cell; and,
b) the pressure supply and control unit.

By varying the size, capacity, and number of these basic components, different sizes and numbers of specimens can be tested for creep over a wide range of stress levels.

2.2.1 Loading Frame and Hydraulic Load Cell -- Loading frame size is classified according to the diameter of the hydraulic load cell used with the load frame. For example, a load frame with a 6-inch diameter hydraulic load cell, which is used for applying and maintaining a uniform stress on specimens having up to a 6-inch maximum diameter, is referred to as a 6-inch loading frame. At U.C. Berkeley loading frames with 6, 10, 16 and 30-inch diameter hydraulic load cells have been designed, manufactured and used to meet a wide range of test requirements.

The 6-inch hydraulic load cells are manufactured independent of the loading frame while the larger diameter hydraulic load cells are incorporated into the design of the loading frame's top or bottom end plates. The principle on which the load cell works is similar for all sizes of load cells, with some modification in design for the larger diameter load cells.

2.2.1.1 Loading Frame--The loading frame used in conjunction with the hydraulic loading cell, is designed to assure a uniform distribution of stress over the entire cross-section area of the stressed specimens. It consists of a top and bottom steel end plate of sufficient stiffness to prevent significant end plate distortions at the applied stress levels. High strength steel bolts threaded at each end are positioned between the end plates with the threaded portions passing through holes in the top and bottom end plates. While not under load, the end plates are positioned and supported by a secondary support system independent of the loading system.

The specimens and the hydraulic load cell are aligned between the load frame end plates. When the stress is applied by means of the hydraulic load cell, bolts with hex-nuts restrain the movement of the end plates placing the bolts in tension and the specimens in compression.

By increasing the length of the high strength bolts, it is practical to stress simultaneously up to three 6 by 16-inch creep specimens, aligned on top of one another, with a single hydraulic load cell.

2.2.1.2 Hydraulic Load Cell--The hydraulic load cell is positioned between the specimens at either the top or bottom of the load frame. It consists of a shallow steel cylinder containing a molded rubber piston cup supporting a steel plate. The load cell is pressurized by introducing oil (SAE 10) into the steel cylinder under the rubber piston cup. With constant pressure maintained behind the rubber piston cup, constant pressure is maintained on the specimens aligned with the hydraulic load cell.

The hydraulic load cell is calibrated for the pressure to be applied. In addition, the applied stress is measured by a calibrated pressure cell placed between the specimens and the load frame at the opposite end from the hydraulic load cell. This eliminates questions as to actual pressures applied to the concrete test specimens.

A typical arrangement of specimens, hydraulic load cell and pressure cell within the load frame is:

1. Load frame end plate.
2. Hydraulic load cell.
3. Specimens - aligned up to three specimens high.
4. Pressure cell.
5. Load frame end plate.

Because the 6-inch diameter load cells are manufactured independent of the load frame end plates, it is feasible to design and build loading frames with end plate size and bar arrangement to accommodate more than one 6-inch diameter hydraulic load cell. Load frames capable of accommodating from one to four groups of three high specimens are used at U.C. Berkeley. Each group can be loaded at any age desired and at as many different constant test pressures as there are hydraulic pressure and control units available.

All loading frames and hydraulic pressure cells have been designed, machined or manufactured at U.C. Berkeley. The rubber piston cups are Johns-Manville-Type "A" piston cups.

2.2.2 Pressure Supply and Control System--Applied hydraulic test pressures are maintained by either a (a) manual or (b) automatic pressure control system or a combination of both systems.

All tubing used in the pressure supply system is 1/4-in. O.D. copper tubing, with high quality connections and valves used throughout the system.

2.2.2.1 Manual Control of Test Pressures--In the manually controlled pressure supply system, the desired test pressure in the hydraulic load cell is developed by means of a hand operated hydraulic pump and it is maintained with the aid of a one-gallon capacity accumulator incorporated into the system. The accumulator helps to minimize pressure losses due to leakage of oil out of the system and also serves as a surge tank while hand pumping. It is made-up of two compartments separated by a diaphragm. One compartment is pressurized with gas to approximately 77 ± 5 percent of the test pressure. The other side is connected to the hydraulic load cell oil pressure line and brought up to the required test pressure. Test pressures are read on an hydraulic pressure gauge calibrated to within one percent of the applied load using a dead weight tester. With a one-gallon accumulator and moderately light leakage in the hydraulic system, test pressures can be maintained within the ASTM C-512 allowable limits of ±2 percent from the correct pressure value for one week without the need to pump up pressure in the system.

2.2.2.2 Automatic Control of Test Pressure-- An automatic pressure controller consists of an American Bosch diesel-fuel injection pump powered by a 1/20 HP ratio motor capable of developing 21 in.-lbs. of torque at 57 rpm. Oil is supplied to the pump from a reservoir of sufficient capacity to assure adequate oil supplies and a minimum amount of monitoring. The fuel-injection pump is used because of its low displacement and high pressure capacity. The pump delivers one drop of oil per stroke and is capable of developing required pressures for creep loadings. The pump pressure line has a 1-pint accumulator which acts as a surge tank for the pump.

The pump motor is activated with a Minneapolis Honeywell vane type electronic pressure regulator sensitive to small decreases in line pressure. The pressure regulator is calibrated to desired test pressure and in conjunction with the pump will maintain the pressure within 0.1 percent.

In case of failure of the controller, the pump is shut off automatically. To prevent significant loss of pressure due to controller or power failure, a 1-quart capacity accumulator is included in the system. Each automatic pressure controller is designed to accommodate numerous pressure lines from different loading frames maintained at the same pressure. Each pressure line has its own accumulator and check valve.

3. ARRANGEMENT OF LOADING SYSTEM COMPONENTS AS USED IN THIS PCRV TEST PROGRAM

A description of the arrangement of loading frames and pressure control systems used in this PCRV test program, including safeguards in the system, is given in the following sections. This Method of Test "CREEP OF CONCRETE," Revision No. 1, January 21, 1976, reflects the final arrangements and procedures used in the test program.

3.1 Load Frames for Creep Specimens--Load frames with 6 and 10-inch diameter hydraulic load cells were used for this test program. All creep specimens were 6 by 16-inch sealed concrete cylinders stressed three high in the test frames.

Load frames with 6-inch diameter hydraulic load cells were used to stress all Berks and York creep specimens to 30 percent of ultimate load at ages of 28, 90 or 270 days at temperatures of 73, 110 or 160 F.

The load frames with 10-inch diameter hydraulic load cells were used to load the high stress level specimens for both the Berks and York aggregate concretes. These specimens were stressed to 45 or 60 percent of ultimate strength at age 90 days at temperatures of 73 F and 160 F (Reference Appendix A for creep specimen test conditions).

3.2 Pressure Control Systems for Creep Specimens--For creep specimens stressed in test frames with 6-inch diameter hydraulic load cells, two test pressure levels were used and maintained by two automatic pressure control units described previously in Section 2.2.2.2. All specimens stressed at 28 and 90 days had the same level of stress applied, and all the specimens stressed at 270 days had a second, different, level of stress applied.

Each load frame with 10-inch diameter hydraulic load cell had its own manually controlled pressure system described previously in Section 2.2.2.1. Therefore, specimens stressed to 45 or 60 percent of ultimate strength were maintained at their own specified stress level.

All loading frame systems were designed to accommodate connecting them to either the manual or the automatic pressure control system.

3.3 Safeguards in Loading Systems

3.3.1 Accumulators--All pressure lines had an accumulator of sufficient capacity to minimize pressure drops due to leakage in the system.

3.3.2 Check Valves--All hydraulic load cells had a check valve which allows flow of oil into the load cell but prevents flow of oil out of the load cell. Had a pressure line break occurred, the check valve would have prevented any significant drop in the pressure in the hydraulic load cell supplied by the pressure line in question.

3.3.3 Pressure Cell--A pressure cell was placed between specimens and load frame at the opposite end from the hydraulic load cell. This pressure cell gave a direct indication of the test pressure applied on the specimens. These pressure cells were similar in design to the load cell of a Carlson stress meter. Pressure cells capable of measuring pressures up to 2500 or 4500 psi were designed and built specially for use in this PCRV test program.

3.3.4 Auxiliary Power Supply--In the event of a power failure, test temperatures of 110 and 160 F can be maintained by an auxiliary power supply utilizing a gasoline powered generator specifically set-up for this purpose. No auxiliary power is required to maintain a temperature of 73 F or for maintaining of applied loads on creep specimens.

3.4 Summary of Load Systems by Specimen Test Conditions

LOAD SYSTEMS USED IN PCRV TEST PROGRAM

Nominal Stress Level, % of Ult. Strength	Temp. of Loading, F	Age of Loading, days	Size of Load Cell, inches	Pressure Control System Used
		28	6	Automatic "A"
30	73	90	6	Automatic "A"
		270	6	Automatic "B"
		28	6	Automatic "A"
30	110	90	6	Automatic "A"
		270	6	Automatic "B"
		28	6	Automatic "A"
30	160	90	6	Automatic "A"
		270	6	Automatic "B"
45	73	90	10	Manual 1&2 & Auto."C"
	160	90	10	Manual 3&4
60	73	90	10	Manual 5&6 & Auto."D"
	160	90	10	Manual 7&8

3.5 Summary of Load Systems by Temperature Rooms

3.5.1 73 F Room -- Room 360 A in Davis Hall is a constant temperature room with temperatures maintained at 73 ± 3 F and was used for specimens stressed at this temperature. For this PCRV test program, the following load frames were set-up at 73 F: one load frame with four 6-inch diameter hydraulic load cells; two load frames with one 6-inch diameter hydraulic load cell each and four load frames with 10-inch diameter hydraulic load cells.

All automatic pressure controllers were operated from the 73 F room. Two hydraulic lines, one connected to pressure controller No. A and one to No. B, led from the 73 F room to the loading frames in the 110 and 160 F rooms.

3.5.2 110 F Room -- Room 353 in Davis Hall is a variable temperature room which was operated at a constant temperature of 110 ± 3 F for the duration of the test. It had two load frames set-up in it, each with three 6-inch diameter hydraulic load cells.

3.5.3 <u>160 F Room</u> -- The 160 F room is a specially built chamber within the 110 F room. It is built from 4-inch thick styrofoam insulated walls and has its own heating and fan circulating system. In the 160 F room, two load frames each with three 6-inch diameter hydraulic load cells and four load frames with 10-inch diameter hydraulic load cells were set-up.

All gauges and manual pressure control systems were placed on the wall in the 110 F room, except the gauges for monitoring pressure cells. This minimized the need to open and enter the 160 F room.

4. TEST PROCEDURES

All test procedures used in the creep study were in accordance with GA Specification 900670, Issue B, "Concrete Properties Test Program," dated September 5, 1974. The following is a description of basic test procedures related to the loading of creep specimens.

4.1 <u>Heating Specimens to Test Temperature</u> -- After casting the 6 by 16-in. specimens at 50 ± 3 F, specimens were stored in Room 360A and maintained at a constant 73 ± 3 F until 5 days prior to age of loading. After that time, the heating phase for bringing specimens up to test temperature commenced. The heating phases for specimens stressed at 73, 110, and 160 F are described below. All temperatures were maintained within ± 3 F.

4.1.1 <u>Heating Phase for 73 F</u> -- No heating phase was required since specimens were stored continuously at 73 F within one hour after casting.

4.1.2 <u>Heating Phase for 110 and 160 F</u> -- Heating of specimens was performed in Room 352, Davis Hall, a variable temperature room which was programmed for the thermal cycling of specimens. Temperature rises (and drops) were programmed to occur at about 2 F per hour with at least a minimum 12-hour hold period at 95, 110, and 135 F. Above 135 F, specimens which were heated to 160 F had to be transferred to the 160 F chamber located inside Room 353. The transfer to Room 353 and the 160 F chamber was accomplished by pushing the specimen cart with specimens wrapped in fiberglass insulation from one room to the other. All specimens were heated at the same rate with heating beginning 5 days prior to loading. Specimens heated to 110 F were removed and transferred to Room 353, operating at 110 F after the 12-hour hold period at 110 F. All specimens were at testing temperature 24 hours prior to loading.

4.2 Applied Test Pressures -- For specimens stressed to a nominal 30 percent stress level, two test pressures were used. These pressures were 2100 psi for Berks and York specimens loaded at ages 28 or 90 days and 2400 psi for specimens loaded at age 270 days. For specimens stressed to a nominal 45 or 60 percent stress level, the applied stresses were 3220 and 4200 psi for Berks concrete and 3190 and 4250 psi for York concrete, respectively.

4.3 Applying Test Pressure to Creep Specimens -- After specimens were aligned in the load frame, stressing to test pressure was accomplished by use of a double-acting hydraulic hand pump and a stop watch. The stress was applied at the rate of 35 ± 5 psi per second, following the pressure-time table shown in Table 1 of this test method. Note that the effective stress on a 6-inch diameter specimen at any time is the same as the pressure values shown for the 6-inch hydraulic load cell pressures in Table 1.

A strain reading on each specimen was required by the specifications during the loading phase. This was taken while maintaining pressure for nine seconds at a constant level equal to about one-half the full applied stress level. The hold time was required to read all three specimens being stressed simultaneously. After the hold, the loading proceeded at the loading rate schedule shown in Table 1.

4.4 Maintaining Specimens at Test Pressure -- Immediately after specimens reached test pressure the hydraulic load cell was connected by opening one valve to the pressure control system already operating at test pressure. Daily checks were made of the test pressures and environmental room temperatures.

4.5 Unloading Creep Specimens -- Unloading of creep specimens proceeded at a rate of 35 ± 5 psi per second following the pressure-time table shown in Table 1. A strain reading was taken immediately prior to unloading and then again when specimens were fully unloaded. The rate of pressure drop was controlled by relieving the pressure through the double-acting hydraulic hand pump.

4.6 Cooling Specimens to Test Temperature -- After creep testing, specimens remained at test temperature until one week prior to their compressive strength testing. At that time, specimens were cooled to test temperature at a rate not exceeding 24 F per day.

5. DATA ACQUISITION PROCEDURES

5.1 Heating and Cooling Phase -- Readings for strain and temperature were taken with both the Carlson and SESM test set during the heating phase and only the SESM test set during the cooling phase. For specimens stressed at 110 F, readings were taken at 73, 95, and 110 F. For specimens stressed at 160 F, readings were taken at 73, 95, 110, 135, and 160 F.

5.2 Stressing Phase -- After specimens were placed in the loading frame and prior to loading, readings were taken with both test sets. During loading, only readings were taken with the SESM test while the stress was held constant. After the applied test stress level was reached, readings for strain and temperature were taken for all specimens.

5.3 Creep Phase -- After specimens were fully stressed, all required readings were taken using the SESM test set. These SESM test set readings were periodically checked with the Carlson test set. Temperature and pressure were always checked prior to taking readings.

5.4 Description of Data -- When Carlson meter data was taken with the Carlson test set, it was manually recorded in a field book. Information in the field book included:

1. Date, time
2. Room temperature
3. Specimen identification
4. Meter and channel number
5. Resistance ratio
6. Resistance

When Carlson meter data was taken using the SESM test set, a Nova 2 computer was also used. The Nova 2 computer was programmed to generate a format for taking the data and for giving simultaneously a primary reduction of the Carlson meter readings into strains and temperatures. A teletype was used for recording the data and for making a computer tape. The tape was used as input into a computer program and punched computer cards were obtained, one card per specimen per data reading. The computer cards were then sorted by specimen number and used as input into a computer program which reduced and presented the data in the form of the computer outputs given in Appendix C.

Method of Test for Creep of Concrete

Table 1 - Rate of Loading Creep Specimens

Loading rate used: 35 ± 5 psi per second

Time, Min.-Sec.	Pressure Applied to System, Psi	
	6" Pressure Cell	10" Pressure Cell
5	175	65
10	350	125
15	525	190
20	700	250
25	875	315
30	1050	380
35	1225	440
40	1400	505
45	1575	565
50	1750	630
55	1925	695
1-00	2100	755
1-05	2275	820
1-10	2450	880
1-15	2625	945
1-20	2800	1010
1-25	2975	1070
1-30	3150	1135
1-35	3325	1195
1-40	3500	1260
1-45	3675	1325
1-50	3850	1385
1-55	4025	1450
2-00	4200	1510
2-05	4375	1575
2-10	4550	1640
2-15	4725	1700

Test Method for GA Research Program
University of California, Berkeley
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Method of Test for

THERMAL PROPERTIES OF CONCRETE

1. SCOPE

Described herein are the methods of test used in determining thermal properties of concrete, including 1) adiabatic temperature rise, 2) specific heat and 3) diffusivity. The test methods described are being used in the materials laboratory of the Department of Civil Engineering, University of California, Berkeley.

2. ADIABATIC TEMPERATURE RISE

The purpose of this test is to determine the temperature-rise history of a sealed concrete specimen which is maintained under an adiabatic temperature condition, namely with no heat loss or heat gain from outside source. This is accomplished by placing the concrete specimen immediately after casting into an adiabatic calorimeter chamber whose temperature follows the rising temperature of the concrete specimen caused by hydration of the cement.

2.1 Test Specimen and Instrumentation -- The concrete test specimen used is a 27-in. diameter and 30-in. high cylinder instrumented with five embedded resistance thermometers readable to the nearest 0.01 F, located along its diameter at mid-height of the specimen. In addition a quartz thermometer readable to the nearest 0.001 F is embedded near the center of the specimen.

The container used for the concrete is made of 24-gage sheet metal whose side and bottom seams are soldered to prevent moisture loss. Immediately after casting, a lid is attached by soldering it to the top of the cylinder. This lid is provided with O-ring seals for the thermometers placed within the concrete to prevent moisture loss during the test.

After casting and sealing, the specimen is moved into the inner calorimeter chamber and insulated by a 2-in. layer of expanded vermiculite. Two thermometers are located on the outside of the specimen between the insulation and the specimen, and two additional thermometers are located outside the insulation.

2.2 <u>Calorimeter and Test Procedure</u> -- The calorimeter used for the adiabatic temperature rise test is an improved version of that developed at this laboratory for the Oroville Dam concrete studies, which is described in the paper by Professor David Pirtz, "Improved Adiabatic Calorimeter for Concrete," Materials Research and Standards, ASTM, Vol. 2, No. 1, January 1962. The calorimeter consists essentially of a small chamber located inside a large chamber.

The small chamber which houses the test specimen is instrumented with a fast-acting resistance thermometer and a quartz thermometer. Heat is provided in this inner chamber by electric heaters and fans are used for air circulation. These heaters automatically control the temperature of the inner chamber to within ± 0.02 F. The temperature of the outer large chamber is controlled automatically to ± 1 F and is at all times maintained 2 to 5 F below the temperature of the inner chamber so that any small excess of heat in the inner chamber flows to the outer chamber.

2.3 <u>Calibration of Thermometers</u> -- Prior to testing, all thermometers are calibrated against a platinum thermometer previously calibrated by the U.S. Bureau of Standards. This platinum thermometer is also used during the adiabatic temperature rise test and is located on the top of the concrete specimen under the insulation.

2.4 <u>Test Data</u> -- The temperature rise of the air in the inner chamber is plotted by a recorder on a strip chart and the temperature rise of the concrete is read manually with higher precision (± 0.01 F) on a Mueller bridge. In addition, as a check of the operation of the system, a strip chart record is obtained for the temperature difference between the concrete specimen and the inner chamber as well as of the air temperature in the inner room.

The test is carried out for a period of up to 28 days, depending on the rate of heat generation of the concrete under test.

3. SPECIFIC HEAT

The specific heat of concrete is a measure of the heat required to raise the temperature of concrete and is usually expressed in units of Btu/lb/°F, which is the heat needed in Btu to increase the temperature of one pound of concrete by one degree F.

3.1 Test Specimen -- The concrete test specimen used for the determination of specific heat is cast in an 8 by 16-in. copper cylindrical mold having an axial brass tube which is 16 in. long and of 1 1/2-in. inside diameter and is soldered through a hole in the bottom of the mold.

After casting of the specimen it is sealed by a friction lid with a central hole placed on top of the specimen and the joints sealed with silicon sealer. The specimen is then stored in a 73 F room until age of test. After completion of the curing period, usually 28 days, the concrete specimen is tested for specific heat.

3.2 Calorimeter and Test Procedure -- The calorimeter used for the specific heat test consists essentially of an inner and outer chamber. The outer chamber is of double-wall construction having about 2 1/2 inches of insulation. The inner chamber, centrally positioned inside the outer chamber, consists of two galvanized-iron cans separated from one another by a 1-inch dead air space.

About 1 hour prior to commencing the test, the specimen is removed from the curing environment and placed centrally in the inner of the two concentric galvanized-iron containers. Water at specimen temperature is poured into this container to completely submerge the specimen, and the weight of the water used is recorded. A heater-stirrer assembly is then inserted in the hollow central portion of the specimen. The stirrer shaft, which projects above the cover of the outer calorimeter chamber, is attached to a motor which causes the stirrer to propel the water down the central passage in the specimen, thus maintaining a uniform temperature distribution. An electric heater, pans of ice, and a fan in the annular space between the inner and outer chambers are used to maintain adiabatic conditions between the inner and outer chambers.

The temperature of the water and of the air in the outer calorimeter chamber are monitored to ± 0.1 F by means of a thermopile consisting of four thermocouples. A Dewar flask filled with melting ice (32 F) is used as the cold junction for these thermocouples which are read on a precision digital voltmeter.

After approximately one hour for temperature equilibrium to be assured, the heater immersed in the hollow central part of the specimen is energized and the power supplied is measured on a sensitive watt-hour meter. As the water temperature increases, the heat input to the air in the outer chamber is proportionally increased so that no temperature difference will exist between the water and the air. After 2 1/2 hours, the current to the water heater is shut off, and the test is complete when the water temperature is stabilized. By this time the concrete specimen and the water will be at the same temperature.

3.3 Test Data -- The observed difference between the initial and final watt-hour meter reading gives the electrical energy supplied to the water heater during the test period. The specific heat of the concrete is then computed in units of Btu/hr/°F.

4. THERMAL DIFFUSIVITY

Thermal diffusivity of concrete expresses the facility with which the concrete will undergo temperature change upon being heated or cooled and is usually expressed as a rate of temperature change in units of sq. ft./hr.

4.1 Test Specimen -- The concrete test specimen used for the thermal diffusivity test is cast in an 8 1/2 by 17-in. soldered copper cylindrical can. A brass rod covered with rubber tubing is positioned axially from mid-height of the specimen and extended above the specimen to provide a central hole of approximately 3/8-in. diameter. After casting of the specimen a lid having a central hole for a hollow rubber stopper is placed on the can and the seam sealed with waterproof tape. The brass rod extends through the rubber stopper thus providing a moisture seal. The specimen is then stored at 73 F. After one day the lid is sealed to the can using silicone sealer, the brass rod withdrawn and the lid sealed with a solid rubber stopper to provide for a completely sealed specimen. The sealed specimen is cured at 73 F usually to age 26 days.

4.2 Test Procedure -- Two days before testing, the specimen is stored at 120 F in a water bath and tested for diffusivity. The test procedure used consists of transferring the 120 F sealed concrete specimen into a room maintained at 40 F, immersing it in 40 F water, and reading the temperature by means of quartz thermometers at the center of the specimen and in the water to the nearest 0.01 F at about 5-minute intervals until the temperature has dropped to about 2 F above the water bath temperature, which is maintained by addition of chipped ice at 40 ± 0.05 F, throughout the test.

4.3 Test Data -- Reduction of the test data consists of calculating, for the various time intervals, the ratio of temperature difference existing between the specimen and the bath as the initial temperature difference.

Then entering Table 12, U.S. Bureau of Reclamation, Boulder Canyon Project Final Report, Bulletin 1, entitled "Thermal Properties of Concrete," with these values of the original temperature difference remaining gives a value for h^2t/D^2. Knowing the elapsed time (t) in hours and the specimen diameter (D) in feet, the equation is solved for the thermal diffusivity (h^2) in feet squared per hour. The average of the best 5 diffusivity values where equilibrium was obtained and where the part of the original temperature remaining has declined to the smallest value is reported as the thermal diffusivity of the concrete.

APPENDIX C -- COMPUTER OUTPUTS OF CREEP TEST DATA

APPENDIX C - COMPUTER OUTPUTS OF CREEP TEST DATA

CONTENTS

COMPUTER OUTPUT INVENTORY FOR BERKS CONCRETE CREEP TEST DATA

Age at Loading, days	Nominal Stress Level,%	Carlson Meter and Channel Number		Page Number Computer Output Averaging	Summary
1. Creep Specimens Tested at 73 F					
28	30	245 251 349	73-00 73-01 73-02	C21	C22
90	30	343 252 337	73-12 73-13 73-14	C23	C24
90	45	372 358 359	73-19 73-20 73-18	C25	C26
90	60	374 360 354	73-16 73-17 73-15	C27	C28
270	30	240 255 259	73-30 73-31 73-32	C29	C30
2. Creep Specimens Tested at 110 F					
28	30	241 338 364	11-01 11-02 11-00	C31	C32
90	30	340 342 356	11-12 11-13 11-14	C33	C34
270	30	341 365 248	11-62 11-63 11-61	C35	C36
3. Creep Specimens Tested at 160 F					
28	30	390 380 384	11-07 11-08 11-06	C37	C38
90	30	378 377 382	11-45 11-44 11-46	C39	C40
90	45	376 370 355	11-36 11-37 11-38	C41	C42
90	60	373 361 362	11-41 11-42 11-43	C43	C44
270	30	386 363 381	11-68 11-69 11-67	C45	C46

COMPUTER OUTPUT INVENTORY FOR YORK CONCRETE CREEP TEST DATA

Age at Loading, days	Nominal Stress Level,%	Carlson Meter and Channel Number		Page Number Computer Output Averaging	Summary
1. Creep Specimens Tested at 73 F					
28	30	197 211 199	73-07 73-08 73-06	C47	C48
90	30	198 200 205	73-21 73-22 73-23	C49	C50
90	45	418 401 406	73-27 73-28 73-29	C51	C52
90	60	414 419 400	73-25 73-26 73-24	C53	C54
270	30	204 208 209	73-33 73-34 73-35	C55	C56
2. Creep Specimens Tested at 110 F					
28	30	396 126 228	11-30 11-31 11-32	C57	C58
90	30	212 395 129	11-19 11-20 11-18	C59	C60
270	30	392 409 391	11-79 11-80 11-78	C61	C62
3. Creep Specimens Tested at 160 F					
28	30	222 223 207	11-24 11-26 11-25	C63	C64
90	30	218 225 224	11-49 11-47 11-48	C65	C66
90	45	408 415 402	11-57 11-58 11-56	C67	C68
90	60	399 397 404	11-52 11-51 11-50	C69	C70
270	30	220 217 213	11-73 11-74 11-72	C71	C72

COMPUTER OUTPUT FOR CONTROL SPECIMENS

Controls for Creep Test Condition: Temperature, F	Controls for Creep Test Condition: Ages of Loading, days	Moisture Condition	Carlson Meter and Channel Number		Page Number Computer Output Averaging*
I. Berks G-19 Concrete					
		Sealed	242	73-03	
73	28, 90, 270	Sealed	250	73-04	C73
		Unsealed	336	73-05	
		Sealed	423	11-04	
110	28	Sealed	243	11-05	C75
		Unsealed	244	11-03	
		Sealed	347	11-15	
110	90	Sealed	339	11-16	C77
		Unsealed	346	11-17	
		Sealed	246	11-64	
110	270	Sealed	247	11-65	C79
		Unsealed	344	11-66	
		Sealed	383	11-09	
160	28	Sealed	379	11-10	C81
		Unsealed	357	11-11	
		Sealed	350	11-39	
160	90	Sealed	375	11-40	C83
		Unsealed	426	11-59	
		Sealed	425	11-60	
160	270	Sealed	385	11-70	C85
		Unsealed	389	11-71	
II. York G-26 Concrete					
		Sealed	202	73-09	
73	28, 90, 270	Sealed	201	73-10	C74
		Unsealed	206	73-11	
		Sealed	221	11-33	
110	28	Sealed	410	11-34	C76
		Unsealed	148	11-35	
		Sealed	420	11-21	
110	90	Sealed	421	11-22	C78
		Unsealed	422	11-23	
		Sealed	411	11-81	
110	270	Sealed	424	11-83	C80
		Unsealed	412	11-82	
		Sealed	227	11-27	
160	28	Sealed	203	11-28	C82
		Unsealed	226	11-29	
		Sealed	403	11-53	
160	90	Sealed	413	11-54	C84
		Unsealed	398	11-55	
		Sealed	215	11-75	
160	270	Sealed	216	11-76	C86
		Unsealed	214	11-77	

*Only averaged strains of sealed control specimens, subsequent to age of loading, shown in averaging output.

SUMMARY OF INFORMATION AND DATA PROVIDED ON COMPUTER OUTPUTS*

Information	Individual Creep	Individual Control	Averaging Creep	Averaging Control	Summary
1--Heading	x	x	x	x	x
2--Specimen Meter and Channel Number	x	x	x	x	x
3--Specimen Group	x	x	x	x	x
4--Age of Loading	x	x	x	x	x
5--Test Temperature	x	x	x	x	x
6--Ultimate Strength - Selected Mix	x	x	x	x	x
7--Ultimate Strength - Companion	x	x	x	x	x
8--Applied Test Stress	x	x	x	x	x
9--Per. Ult. Str. Applied (Selected Mix)	x	---	x	---	x
10-Per. Ult. Str. Applied (Companion Mix)	x	---	x	---	x
11-Calibration Constants of Carlson Meter	x	x	---	---	---
12-Time & Age of Change in Condition	x	x	x	x	x
13-Modulus of Elasticity or Sustained Modulus					
13.1-Loading	x	---	x	---	---
13.2-Unloading	x	---	---	---	---
13.3-Compression Test	x	x	---	---	---
14-Compressive Strength	x	x	---	---	---
15-Notes	x	x	x	x	---
Data					
16-Date & Time Data in Given Row Taken	x	x	x	x	---
17-Age of Concrete at Time Data Taken	x	x	x	x	x
18-Days Under Stress at Time Data Taken	x	---	x	---	x
19-Mode 4, Primary Temp. Data	x	x	---	---	---
20-Resistance of Carlson Meter	x	x	---	---	---
21-Temperature of Specimen	x	x	---	---	---
21.2-Average Temperature	---	---	x	x	---
22-Mode 3, Primary Strain Data	x	x	---	---	---
23-Change in Mode 3 From Day One	x	x	---	---	---
24-Micro-Strain					
24.1-With Temperature Strains	x	x	---	---	---
24.2-Independent of Temp. Strain	x	x	---	x	---
25-Elastic & Creep Strain (including Autogenous)	x	---	x	---	---

Summary (cont'd)

	Individual Creep	Individual Control	Averaging Creep	Averaging Control	Summary
25.1-Average for Three Specimens . .	---	---	x	---	x
26-Creep Strain (including Autogenous) .	x	---	x	---	---
26.1-Average for Three Specimens . .	---	---	x	---	x
27-Autogenous Strain	---	x	---	x	---
27.1-Average of Two Controls	---	---	---	x	x
28-Drying Shrinkage	---	x	---	x	---
29-Creep Strain	---	---	---	---	x
30-Total Strain Divided by Applied Stress	---	---	x	---	x
31-Creep Plus Autogenous Strain Divided by Applied Stress	x	---	---	---	---
32-Specific Creep	---	---	---	---	x
33-Sustained Modulus	---	---	---	---	x

Data Calculated - Computer Output Not Shown

34-Percent Variation of Individual Specimen Strain Data From Average

*Numbers in Summary correspond with numbers in sections entitled "Explanation and Cross Reference of Information and Data Provided on Computer Outputs" and "Sample Computer Outputs."

EXPLANATION AND CROSS REFERENCE OF INFORMATION AND DATA PROVIDED ON COMPUTER OUTPUTS

1. Heading -- Identifies the type of data given on the computer output and indicates the type of aggregate used, nominal test temperature, age of loading, nominal stress level or control specimen information, and a description of the specimen. Computer output was presented in the following three basic forms (1.1, 1.2, and 1.3) with one additional form (1.4) used at the University of California as a quality control check of the data.

1.1 Individual Specimen Data -- Each specimen's test data is presented in an individual computer output. There are three types of individual computer outputs, all of which begin with the heading "Elastic and Creep Strains." They are:

1.1.1 Creep Specimen -- (elastic, creep and autogenous strains)

1.1.2 Control Specimen, Sealed -- (autogenous strains)

1.1.3 Control Specimen, Unsealed -- (autogenous and then drying shrinkage strains)

1.2 Averaged Data -- The resulting strains obtained from individual specimens at a given test condition are averaged. There are two types of averaging computer outputs, which are:

1.2.1 Creep Specimens -- The computer heading begins with "Average Elastic Plus Creep Strains." The elastic and creep strains of the three individual creep specimens at a given test condition are averaged.

1.2.2 Control Specimens -- The computer heading begins with "Average Autogenous and Drying Strains." The autogenous strains for two sealed control creep specimens are averaged and the strains from the one unsealed control is included for comparison.

1.3 Summary Data -- The resulting average elastic and creep strains of three creep specimens and the average autogenous strains of two sealed controls, subsequent to the age of loading, are given for each test condition. The computer heading begins with "Average Elastic, Creep and Autogenous Strains."

1.4 Quality Control Check of Data -- The percent variations of an individual creep specimen's elastic and creep strains from the average values obtained from all three creep specimens at the given test condition are calculated for all strain readings. Only a sample computer output is shown. The average percent variation of an individual specimen's elastjc and creep strains from the average is given for each specimen in Tables 8, 9, or 10 of the Final Report - Part II.

2. Carlson Meter and Channel Number -- Individual specimen's Carlson meter identification and channel number associated with switching position used in data acquisition. Channel numbers begin with 73 or 11 for specimens tested at 73 F or elevated temperatures (110 F or 160 F), respectively.

3. Specimen Group -- Group casting identification number and mix used. A Berks 3 (Mix G-19) identification for a specimen signifies it was cast during the third casting using Berks G-19 concrete. In addition, Group 3 (Berks 3 and York 3) specimens were tested at 73 F, Group 4 at 110 F, and Group 5 at 160 F, with the creep specimens in these three groups all tested at the 30 percent stress level. Group 6 (Berks 6 and York 6) specimens were tested at 73 F or 160 F, with the creep specimens tested at the 45 or 60 percent stress level.

4. Age of Loading -- Age of concrete when specimens were first subjected to test temperature (5) and applied test stress (8).

5. Test Temperature -- Temperature of 73, 110, or 160 F for age of loading (4) and applied test stress (8).

6. Ultimate Strength - Selected Mix -- Compressive strength of sealed 6 by 12-in. selected mix specimens at age corresponding to age of loading (4). (Medusa Shipment B cement was used in the selected mix concrete, while a 1:1 blend of Medusa Shipments A and B was used in casting the creep, control, and companion specimens).

7. Ultimate Strength - Companion -- Compressive strength of sealed 6 by 12-in. specimens of specimen group (3) tested on day of loading (4) at test temperature (5) after being heated to the test temperature from 73 F alongside creep specimens.

8. Applied Test Stress -- Magnitude of constant sustained stress applied on specimen.

9. Percent Ultimate Strength Applied - Selected Mix -- Applied test stress (8) expressed as a percentage of compressive strength of selected mix (6) at 73 F.

10. Percent Ultimate Strength Applied - Companion -- Applied test stress (8) expressed as a percentage of ultimate strength of companion specimen (7) at test temperature (5).

11. Calibration Constants -- All Carlson meter (2) calibration constants used in data reduction.

11.1 Meter Resistance at 0.0 Degrees F (R_o) -- Constant used to reduce temperature data (21).

11.2 Temperature Calibration Constant (T.C.) -- Constant used to reduce temperature data (21).

11.3 Strain Calibration Constant -- Constant used to reduce strain data (24).

11.4 Calibrated Range -- Range Carlson meter calibration was checked at the University of California (UC).

11.5 Meter Coefficient of Thermal Expansion (α_m) -- Constant used to reduce strain data (24).

11.6 Concrete Coefficient of Thermal Expansion (α_c) -- Constant used to reduce strain data (24.2). The values for coefficient of thermal expansion of Berks, 5.7, and York, 5.2, concrete were obtained at UC during thermal cycling tests and represent the average cumulative coefficient value (Cycles 2 to 5).

11.7 Specimen-Meter Factor (SMF) -- This constant, used to reduce strain data (24), was determined at UC during proof loading of creep specimens. It correlates internally measured strains (Carlson meter) to externally measured strains (compressometer).

12. Time and Age of Change in Condition -- Month, Day, Year, Time and Age.

12.1 Date Specimens Cast -- Casting of specimens completed.

12.2 Loading Begins -- Loading of specimens from 0 to the applied stress level (8) begins. Minus days under stress (18) indicate time at which loading stress was held constant at the levels given (12.2) for a nine-second period to allow strain readings to be taken.

12.3 Specimens Fully Loaded -- Specimens fully loaded at the applied test stress (8).

12.4 Applied Stress Changed -- Applied test stress (8) changed to the reduced constant stress level given (12.4) for duration of test (12.5).

12.5 Specimens Fully Unloaded -- Specimens fully unloaded to zero stress from applied test stress (8 or 12.4). Days of creep recovery are given in column entitled "Days Under Stress" (18) for all subsequent ages.

12.6 Control Unsealed -- Control specimen's sealing jacket removed.

12.7 End of Test -- No further strain readings required to be taken. Some specimens tested to failure in compression.

13. Modulus of Elasticity or Sustained Modulus --

13.1 Loading -- Applied stress (8) divided by initial full load strain (12.3, 25) obtained from Carlson meter.

13.2 Unloading -- Applied stress (8 or 12.4) divided by change in strain (25), obtained from Carlson meter readings, just prior to and immediately after unloading (12.5)

13.3 Compression Test -- For specimens tested at 73 F, the modulus was determined using externally mounted compressometer and LVDT's following Standard ASTM C-469 and UC test procedures. For specimens tested at 110 F, the modulus was determined using Carlson meter readings obtained during the compression test.

14. Compressive Strength -- Compressive strength of specimen was determined using Standard ASTM C-39 and UC test procedures.

15. Note -- Additional information or discrepancies in data are noted.

16. Date and Time -- Month, Day, Year, and Time data in given row is taken.

17. Age, Days -- Age of concrete at time data taken (16) from date specimens cast (12.1).

18. Days Under Stress -- Days under stress at time data taken (16) from time specimen fully loaded (12.3).

19. Mode 4, Volts -- Primary data for determining temperature inside specimen instrumented with Carlson meter using SESM test set. (Applied voltage: 2.0000 volts)

20. Resistance, OHMS -- Resistance of Carlson meter calculated from Mode 4 (19).

$$\text{Resistance} = [\ 120(1 + \text{Mode 4})/(1 - \text{Mode 4})\ ] + 0.06$$

21. Temperature, Degrees F -- Temperature inside specimen from Carlson meter using resistance (2) and calibration constants R_o (11.1) and T.C. (11.2).

$$\text{Temperature} = (\text{Resistance} - R_o) \times \text{T.C.}$$

21.1 Average Temperature -- The temperatures of each individual specimen (21) at a given test condition (1.1) are averaged and given in the averaging computer output (1.2).

22. Mode 3, Microvolts -- Primary data for determining strains inside specimen instrumented with Carlson meter using SESM test set. (Applied voltage: 2.0000 volts)

23. Change, Microvolts -- Change in Mode 3 (22) in reference to Mode 3 at age of one day (17, 22).

24. Micro-Strain -- Micro-strain, in reference to day one Mode 3 reading (17, 22), is calculated using the change in microvolts (23) (applied voltage 2.0000), the strain calibration constant per volt applied voltage, C_s (11.3), and the specimen meter factor, SMF (11.7). This micro-strain value includes autogenous length change (1.1.2) and the effect of change in temperature between readings.

$$\text{Micro-Strain} = \frac{\text{Change in Microvolts}}{\text{Applied Voltage}} / [C_s \times (1 + \text{SMF})]$$

24.1 Micro-Strain, Total with Temperature -- Micro-strain reading (24) is corrected for meter expansion, α_m (11.5), due to change in temperature at reading and day one, Temp. (21) - Temp._1 (21) = ΔTemp., but includes thermal expansion of concrete, α_c (11.6).

$$\text{Micro-Strain, Total with Temp.} = \text{Micro-Strain} + (\Delta\text{Temp.} \times \alpha_m)$$

24.2 Micro-Strain, From Day One -- Micro-strain reading (24) is corrected for meter, α_m (11.5), and concrete, α_c (11.6), expansion due to change in temperature at reading and day one, Temp. (21) - Temp._1 (21) = ΔTemp.

$$\text{Micro-Strain, From Day One} = \text{Micro-Strain} + [(\alpha_m - \alpha_c) \times \Delta\text{Temp.}]$$

25. Elastic and Creep Strains (including Autogenous) -- The elastic, creep, and autogenous strain, referred to as total strain, is given from the time loading begins (12.2). It is obtained by subtracting the temperature corrected micro-strain value at the first negative day under stress (18, 24.2) from the micro-strain value of the subsequent readings (24.2).

25.1 Average Elastic, Creep, and Autogenous Strains -- The total strains (25) of the three creep specimens at a given test condition (1.1.1) are averaged and given in the averaging (1.2.1) and summary (1.3) computer outputs.

26. Creep Strains (including Autogenous) -- The creep and autogenous strain is given from the time the specimens are fully loaded (12.3). It is obtained by subtracting the total strain (25) value at .0000 days under stress (18, 25) from the total strain values of the subsequent readings (25).

26.1 Average Creep and Autogenous Strain -- The creep and autogenous strains (26) of the three creep specimens at a given test condition (1.1.1) are averaged and given in the averaging (1.2.1) and summary (1.3) computer outputs.

27. Autogenous Strains -- The micro-strain from day one (24.2) of sealed creep control specimens (1.1.2) is a measure of the autogenous strains in concrete.

27.1 Average Autogenous Strains -- The autogenous strains (27) of two sealed control specimens (1.1.2) are averaged and given from day one in the averaging (1.2.2) computer output.

27.2 Average Autogenous Strains After Creep Specimens Fully Loaded -- The average autogenous strains (27) of two sealed control specimens (1.1.2) occurring at age subsequent to time corresponding creep specimens are fully loaded (12.3) are given in the summary (1.3) computer output. They are obtained by subtracting the autogenous strain (27) at the time corresponding creep specimens are fully loaded (12.3) from the autogenous values of the subsequent readings (27).

28. Drying Shrinkage -- The micro-strain from day one (24.2) of a sealed control specimen after the specimen is unsealed (1.1.3, 12.6) is a measure of the micro-strain in concrete during drying shrinkage.

29. Creep Strain -- The average autogenous strains of two sealed control specimens (27.2) are subtracted from the average creep and autogenous strains (26.1) of three sealed creep specimens at corresponding test conditions (4,5) and ages (17).

30. Total Strain Divided by Applied Stress -- The total strain (25) is divided by the applied test stress (8).

31. Creep Plus Autogenous Strain Divided by Applied Stress -- The creep and autogenous strain (26) is divided by the applied test stress (8).

32. Specific Creep -- The creep strain, corrected for autogenous strain (29), is divided by the applied test stress (8).

33. Sustained Modulus -- The sustained modulus is obtained by dividing the applied test stress (8) by the total strain (25), 10^6 psi (MPSI).

34. Percent Variation from Average -- The percent variation of an individual creep specimen's strain from the average value obtained for all three creep specimens at the given test condition was computed for the following strains.

34.1 Total Strain -- The percent variation from the average (25.1) of each specimen's strain from day one (24.2) prior to loading (12.2) and the of total strains (25) after loading begins (12.2).

34.2 Total Strain (Full Load) -- The percent variation from the average (26.1) of each specimen's creep and autogenous strain (26) after specimens are fully loaded (12.3).

1.1.1 SAMPLE COMPUTER OUTPUT - INDIVIDUAL CREEP SPECIMEN

1.1.1 ELASTIC AND CREEP STRAINS **YORK ** 73F, 90 DAY, 60 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

11 CALIBRATION CONSTANTS:
11.1 METER RESISTANCE AT 0.0 DEGREES F. = 48.78 OHMS
11.2 TEMP. CALIBRATION CONSTANT = 10.87 F/OHM CHANGE IN RESIST.
11.3 STRAIN CALIBRATION CONSTANT = 4.68 MICROVOLTS PER VOLT PER STRAIN
11.4 CALIBRATED RANGE = 14600 TO -21500 MICROVOLTS
11.5 METER COEFF. OF THERMAL EXPANSION = 6.4 MICROSTRAIN PER DEGREE F.
11.6 CONCRETE COEFF. OF THERMAL EXPANSION= 5.2 MICROSTRAIN PER DEGREE F.
11.7 SPECIMEN-METER FACTOR = 15 PERCENT

2 STRAIN METER NO. : 414 73 25
3 SPECIMEN GROUP : YORK 6 (MIX G-26)
4 AGE OF LOADING : 90 DAYS
5 TEST TEMPERATURE : 73 DEG. F.
6 ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
7 ULT. STR.:COMPANION : 7070. PSI AT 73.F.
8 APPLIED TEST STRESS : 4250. PSI
9 PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
10 60.1 PERCENT (COMPANION)

	DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	MODE 4 VOLTS	RESIST. OHMS	TEMP. DEGREE F.	MODE 3 MICRO-VOLTS	CHANGE MICRO-VOLTS	MICROSTRAIN (INCLUDING AUTOGENOUS): TOTAL WITH TEMP.	TEMPERATURE CORRECTED: FROM DAY ONE	ELASTIC +CREEP	CREEP	SPECIFIC CREEP
12.1 *	3 -7-74	1430	0	SPECIMEN CAST										
	3 -8-74	1430	1.0		-.36896	55.38	71.7	11504	0	0	0			
	3-11-74	930	3.8		-.36900	55.37	71.6	11392	-112	-13	-11			
12.2 *	6 -5-74	1517	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0, 1590, AND 3190 PSI (PLUS OR MINUS 30), RESPECTIVELY										
	6 -5-74	1517	90.0	-.0021	-.36884	55.39	71.9	10857	-647	-68	-59	0		
	6 -5-74	1518	90.0	-.0014	-.36887	55.39	71.8	8353	-3151	-292	-292	-233		
	6 -5-74	1519	90.0	-.0007	-.36889	55.38	71.8	5255	-6249	-580	-579	-520		
12.3 *	6 -5-74	1520	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 4250 PSI										
	6 -5-74	1520	90.0	0.	-.36904	55.37	71.6	2934	-8570	-798	-795	-736	0	0.
	6 -5-74	1522	90.0	.0014	-.36901	55.37	71.6	2641	-8863	-825	-822	-763	-27	-.00635
	6 -5-74	1525	90.0	.0035	-.36901	55.37	71.6	2364	-9140	-850	-848	-789	-53	-.01247
	6 -5-74	1530	90.0	.0069	-.36901	55.37	71.6	2176	-9328	-868	-866	-807	-71	-.01671
	6 -5-74	1535	90.0	.0104	-.36904	55.37	71.6	2059	-9445	-879	-877	-818	-82	-.01929
	6 -5-74	1555	90.1	.0243	-.36904	55.37	71.6	1849	-9655	-898	-896	-837	-101	-.02376
	6 -5-74	1620	90.1	.0417	-.36907	55.36	71.5	1586	-9918	-923	-921	-862	-126	-.02965
	6 -5-74	1720	90.1	.0833	-.36907	55.36	71.5	1316	-10188	-948	-946	-887	-151	-.03553
	6 -5-74	2105	90.3	.2396	-.36917	55.35	71.4	857	-10647	-992	-989	-929	-193	-.04541
	6 -6-74	840	90.8	.7222	-.36934	55.33	71.2	270	-11234	-1048	-1043	-984	-248	-.05835
	6 -6-74	1403	91.0	.9465	-.36937	55.32	71.1	122	-11382	-1062	-1057	-998	-262	-.06165
	6 -7-74	1445	92.0	1.9757	-.36948	55.31	71.0	-364	-11868	-1109	-1102	-1043	-307	-.07224
	6 -8-74	1450	93.0	3.0	-.36944	55.31	71.0	-646	-12150	-1134	-1129	-1070	-334	-.07859
	6 -9-74	1240	93.9	3.9	-.36976	55.27	70.6	-821	-12325	-1154	-1145	-1086	-350	-.08235
	6-10-74	1512	95.0	5.0	-.36984	55.26	70.5	-1036	-12540	-1175	-1165	-1106	-370	-.08706
	6-11-74	923	95.8	5.8	-.37013	55.23	70.1	-1149	-12653	-1188	-1176	-1117	-381	-.08965
	6-12-74	1145	96.9	6.9	-.37016	55.22	70.0	-1296	-12800	-1202	-1190	-1131	-395	-.09294
	6-14-74	845	98.8	8.7	-.37015	55.22	70.0	-1474	-12978	-1219	-1207	-1148	-412	-.09694
	6-17-74	1600	102.1	12.0	-.37011	55.23	70.1	-1799	-13303	-1249	-1237	-1178	-442	-.10400
	6-20-74	1340	105.0	14.9	-.36985	55.26	70.5	-1983	-13487	-1263	-1253	-1194	-458	-.10776
	6-26-74	1140	110.9	20.8	-.37009	55.23	70.1	-2368	-13872	-1301	-1290	-1231	-495	-.11647
	6-30-74	940	114.8	24.8	-.37003	55.24	70.2	-2588	-14092	-1321	-1310	-1251	-515	-.12118
	7 -9-74	930	123.8	33.8	-.37008	55.23	70.1	-2971	-14475	-1357	-1346	-1287	-551	-.12965
	7-10-74	1630	125.1	35.0	-.36984	55.26	70.5	-3013	-14517	-1359	-1349	-1290	-554	-.13035
	7-15-74	1300	129.9	39.9	-.36949	55.31	71.0	-3185	-14689	-1371	-1365	-1306	-570	-.13412
	7-24-74	1600	139.1	49.0	-.36950	55.31	70.9	-3499	-15003	-1400	-1394	-1335	-599	-.14094
	7-31-74	1715	146.1	56.1	-.36964	55.29	70.8	-3699	-15203	-1420	-1413	-1354	-618	-.14541
	8 -8-74	1200	153.9	63.9	-.36965	55.29	70.7	-3953	-15457	-1444	-1436	-1377	-641	-.15082
	8-15-74	1115	160.9	70.8	-.36991	55.25	70.4	-4063	-15567	-1457	-1447	-1388	-652	-.15341
	8-29-74	1135	174.9	84.8	-.36979	55.27	70.5	-4332	-15836	-1481	-1472	-1413	-677	-.15929
	9-11-74	1315	187.9	97.9	-.36946	55.31	71.0	-4575	-16079	-1508	-1494	-1435	-699	-.16447
	9-25-74	1600	202.1	112.0	-.37003	55.24	70.2	-4787	-16291	-1525	-1514	-1455	-719	-.16918
	10 -9-74	1600	216.1	126.0	-.36935	55.33	71.2	-5044	-16548	-1542	-1537	-1478	-742	-.17459
	10-23-74	1420	230.0	140.0	-.36957	55.30	70.8	-5239	-16743	-1562	-1555	-1496	-760	-.17882
	11-21-74	1000	258.8	168.8	-.36964	55.29	70.8	-5597	-17101	-1596	-1589	-1530	-794	-.18682
	12-17-74	1430	285.0	195.0	-.36989	55.26	70.4	-5902	-17406	-1627	-1618	-1559	-823	-.19365
	1-15-75	1330	314.0	223.9	-.36917	55.35	71.4	-6089	-17593	-1637	-1634	-1575	-839	-.19741
	2-18-75	1430	348.0	258.0	-.37005	55.24	70.2	-6452	-17956	-1680	-1669	-1610	-874	-.20565
	3-14-75	1100	371.9	281.8	-.37002	55.24	70.2	-6629	-18133	-1696	-1685	-1626	-890	-.20941
	4-12-75	1200	400.9	310.9	-.36984	55.26	70.5	-6796	-18300	-1710	-1701	-1642	-906	-.21318
	5-16-75	1130	434.9	344.8	-.36915	55.35	71.4	-7047	-18551	-1726	-1723	-1664	-928	-.21835
	6-16-75	1230	465.9	375.9	-.36928	55.33	71.3	-7227	-18731	-1744	-1740	-1681	-945	-.22235
	6-30-75	1429	480.0	390.0	-.36932	55.33	71.2	-7306	-18810	-1752	-1747	-1688	-952	-.22400
12.4 *	6-30-75	1430	480.0	APPLIED TEST STRESS CHANGED TO 2100 PSI										
	6-30-75	1430	480.0	390.0	-.36939	55.32	71.1	-4229	-15733	-1467	-1461	-1402	-666	
	6-30-75	1445	480.0	390.0	-.36935	55.33	71.2	-4057	-15561	-1450	-1445	-1386	-650	
	6-30-75	1500	480.0	390.0	-.37019	55.22	70.0	-4084	-15588	-1461	-1449	-1390	-654	
	6-30-75	1700	480.1	390.1	-.36978	55.27	70.5	-4040	-15544	-1453	-1444	-1385	-649	
	7 -1-75	1545	481.1	391.0	-.36876	55.40	72.0	-3945	-15449	-1434	-1434	-1375	-639	
	7 -7-75	1425	487.0	397.0	-.36895	55.38	71.7	-3847	-15351	-1427	-1425	-1366	-630	
	7-15-75	1400	495.0	404.9	-.36898	55.37	71.7	-3715	-15219	-1415	-1413	-1354	-618	
	7-28-75	1220	507.9	417.9	-.36875	55.40	72.0	-3677	-15181	-1409	-1409	-1350	-614	
12.5 *	7-28-75	1221	507.9	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
	7-28-75	1221	507.9	.0000	-.36875	55.40	72.0	-21	-11525	-1069	-1069	-1010	-274	
	7-28-75	1222	507.9	.0007	-.36875	55.40	72.0	32	-11472	-1064	-1064	-1005	-269	
	7-28-75	1226	507.9	.0035	-.36878	55.40	71.9	112	-11392	-1057	-1057	-998	-262	
	7-28-75	1236	507.9	.0104	-.36874	55.40	72.0	197	-11307	-1049	-1049	-990	-254	
	7-28-75	1600	508.1	.1521	-.36874	55.40	72.0	395	-11109	-1030	-1031	-972	-236	
	7-29-75	1210	508.9	.9924	-.36885	55.39	71.8	574	-10930	-1015	-1014	-955	-219	
	7-31-75	1550	511.1	3.1	-.36885	55.39	71.8	749	-10755	-999	-993	-939	-203	
	8 -5-75	1630	516.1	8.2	-.36886	55.39	71.8	982	-10522	-980	-979	-920	-184	
	8-22-75	1315	532.9	25.0	-.36904	55.37	71.6	1245	-10259	-955	-952	-893	-157	
	9-16-75	1640	558.1	50.2	-.36900	55.37	71.6	1479	-10025	-932	-930	-871	-135	
	9-22-75	915	563.8	55.9	-.36926	55.34	71.3	1497	-10007	-933	-929	-870	-134	
12.7 *	9-23-75	1300	564.9	END OF TEST, SPECIMEN TESTED TO FAILURE IN COMPRESSION										
	16		17	18	19	20	21	22	23	24.1	24.2	25	26	31

13.1 MODULUS: LOADING E= 5.8 AT 73.F., AGE 90 DAYS (STRESS LEVEL 0 TO 4250 PSI)
13.2 UNLOADING E= 6.2 AT 73.F., AGE 508 DAYS (STRESS LEVEL 2100 TO 0 PSI)
13.3 COMPRESSION TEST E= 6.7 AT 73.F., AGE 565 DAYS (STRESS LEVEL 0 TO 2500 PSI)

14 COMPRESSIVE STRENGTH: 8340 PSI AT 73.F., AGE 565 DAYS

15 NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

C14

1.1.2 SAMPLE COMPUTER OUTPUT – SEALED CONTROL SPECIMEN

1.1.2 ELASTIC AND CREEP STRAINS **YORK ** 73F, 28 DAY CONTROL
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

11 CALIBRATION CONSTANTS:

11.1 METER RESISTANCE AT 0.0 DEGREES F. = 48.90 OHMS
11.2 TEMP. CALIBRATION CONSTANT = 10.84 F/OHM CHANGE IN RESIST.
11.3 STRAIN CALIBRATION CONSTANT = 4.61 MICROVOLTS PER VOLT PER STRAIN
11.4 CALIBRATED RANGE = 19100 TO -16550 MICROVOLTS
11.5 METER COEFF. OF THERMAL EXPANSION = 6.4 MICROSTRAIN PER DEGREE F.
11.6 CONCRETE COEFF. OF THERMAL EXPANSION= 5.2 MICROSTRAIN PER DEGREE F.
11.7 SPECIMEN-METER FACTOR = 0 PERCENT

2 STRAIN METER NO. : 202 73 09
3 SPECIMEN GROUP : YORK 3 (MIX G-26)
4 AGE OF LOADING : 28 DAYS
5 TEST TEMPERATURE : 73 DEG. F.
6 ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
7 ULT. STR.:COMPANION : 6160. PSI AT 73.F.
8 APPLIED TEST STRESS : 0. PSI
9 PER. ULT. STR. APPLIED: 0. PERCENT (SELECTED MIX)
10 0. PERCENT (COMPANION)

	DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	MODE 4 VOLTS	RESIST. OHMS	TEMP. DEGREE F.	MODE 3 MICRO-VOLTS	CHANGE MICRO-VOLTS	MICROSTRAIN (INCLUDING AUTOGENOUS): TOTAL WITH TEMP.	TEMPERATURE CORRECTED: FROM DAY ONE	ELASTIC +CREEP	CREEP	SPECIFIC CREEP
12.1	2-14-74	1400	0	SPECIMEN CAST										
	2-15-74	1400	1.0		-.36790	55.51	71.7	12054	0	0	0			
	2-20-74	1630	6.1		-.36790	55.51	71.7	11872	-182	-20	-19			
	3-14-74	1535	28.1		-.36858	55.42	70.7	11569	-485	-60	-53			
	3-14-74	1625	28.1		-.36852	55.43	70.8	11571	-483	-60	-52			
	3-15-74	1035	28.9		-.36792	55.51	71.6	11558	-496	-55	-53			
	3-16-74	1500	30.0		-.36784	55.52	71.7	11571	-483	-52	-51			
	3-18-74	1610	32.1		-.36790	55.51	71.7	11579	-475	-52	-51			
	3-19-74	2045	33.3		-.36792	55.51	71.6	11584	-470	-52	-50			
	3-20-74	1018	33.8		-.36826	55.47	71.2	11602	-452	-53	-49			
	3-21-74	1140	34.9		-.36820	55.47	71.2	11604	-450	-53	-48			
	3-24-74	1440	38.0		-.36860	55.42	70.7	11609	-445	-56	-48			
	3-25-74	1200	38.9		-.36847	55.44	70.9	11610	-444	-55	-48			
	3-27-74	1715	41.1		-.36834	55.46	71.1	11623	-431	-52	-46			
	4 -1-74	1215	45.9		-.36843	55.44	70.9	11652	-402	-50	-43			
	4 -4-74	1430	49.0		-.36850	55.43	70.8	11662	-392	-49	-43			
	4-11-74	1705	56.1		-.36828	55.46	71.1	11679	-375	-45	-40			
	4-18-74	1340	63.0		-.36843	55.44	70.9	11699	-355	-45	-38			
	4-23-74	1530	68.1		-.36840	55.45	71.0	11711	-343	-43	-37			
	4-30-74	1435	75.0		-.36774	55.53	71.9	11662	-392	-41	-41			
	5 -3-74	1400	78.0		-.36787	55.51	71.7	11666	-388	-42	-41			
	5-13-74	1330	88.0		-.36822	55.47	71.2	11674	-380	-45	-41			
	5-21-74	855	95.8		-.36832	55.46	71.1	11679	-375	-46	-40			
	5-31-74	1440	106.0		-.36738	55.58	72.4	11651	-403	-39	-42			
	6-10-74	1512	116.0		-.36781	55.52	71.8	11660	-394	-42	-42			
	6-26-74	1140	131.9		-.36796	55.50	71.6	11657	-397	-44	-42			
	7-31-74	1715	167.1		-.36747	55.57	72.3	11614	-440	-44	-46			
	8-15-74	1115	181.9		-.36773	55.53	71.9	11617	-437	-46	-46			
	9-11-74	1315	209.0		-.36756	55.56	72.1	11580	-474	-48	-50			
	10-23-74	1420	251.0		-.36734	55.58	72.4	11543	-511	-50	-53			
	11-21-74	1000	279.8		-.36749	55.56	72.2	11513	-541	-55	-57			
	12-30-74	840	318.8		-.36828	55.46	71.1	11519	-535	-63	-58			
	1-15-75	1330	335.0		-.36742	55.57	72.3	11502	-552	-55	-58			
	2-18-75	1430	369.0		-.36797	55.50	71.6	11485	-569	-63	-61			
	3-14-75	1100	392.9		-.36785	55.52	71.7	11477	-577	-63	-61			
	4-12-75	1200	421.9		-.36787	55.52	71.7	11454	-600	-65	-64			
	5-16-75	1130	455.9		-.36713	55.61	72.7	11410	-644	-62	-68			
	6-16-75	830	486.8		-.36733	55.58	72.5	11407	-647	-65	-68			
	7-15-75	1400	516.0		-.36698	55.63	73.0	11389	-665	-63	-70			
	8-22-75	1315	554.0		-.36707	55.62	72.8	11358	-696	-67	-73			
	9-16-75	1640	579.1		-.36703	55.62	72.9	11340	-714	-69	-75			
	10-20-75	1530	613.1		-.36692	55.64	73.0	11309	-745	-71	-78			
	11-11-75	911	634.8		-.36737	55.58	72.4	11266	-788	-80	-84			
	12-24-75	920	677.8		-.36772	55.53	71.9	11237	-817	-87	-87			
	2-24-76	930	739.8		-.36767	55.54	72.0	11190	-864	-92	-92			
	16		17		19	20	21	22	23	24.1	24.2, 27			

1.1.3 SAMPLE COMPUTER OUTPUT - UNSEALED CONTROL SPECIMEN

1.1.3 ELASTIC AND CREEP STRAINS **YORK ** 73F, 28 DAY UNSEALED
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

2 STRAIN METER NO. : 206 73 11
3 SPECIMEN GROUP : YORK 3 (MIX G-26)
4 AGE OF LOADING : 28 DAYS
5 TEST TEMPERATURE : 73 DEG. F.

11 CALIBRATION CONSTANTS:
11.1 METER RESISTANCE AT 0.0 DEGREES F. = 49.25 OHMS
11.2 TEMP. CALIBRATION CONSTANT = 10.77 F/OHM CHANGE IN RESIST.
11.3 STRAIN CALIBRATION CONSTANT = 4.52 MICROVOLTS PER VOLT PER STRAIN
11.4 CALIBRATED RANGE = 14850 TO -19700 MICROVOLTS
11.5 METER COEFF. OF THERMAL EXPANSION = 6.4 MICROSTRAIN PER DEGREE F.
11.6 CONCRETE COEFF. OF THERMAL EXPANSION= 5.2 MICROSTRAIN PER DEGREE F.
11.7 SPECIMEN-METER FACTOR = 0 PERCENT

6 ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
7 ULT. STR.:COMPANION : 6160. PSI AT 73.F.
8 APPLIED TEST STRESS : 0. PSI
9 PER. ULT. STR. APPLIED: 0. PERCENT (SELECTED MIX)
10 0. PERCENT (COMPANION)

	DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	MODE 4 VOLTS	RESIST. OHMS	TEMP. DEGREE F.	MODE 3 MICRO-VOLTS	CHANGE MICRO-VOLTS	MICROSTRAIN (INCLUDING AUTOGENOUS): TOTAL WITH TEMP.	TEMPERATURE CORRECTED: FROM DAY ONE	ELASTIC +CREEP	CREEP	SPECIFIC CREEP
12.1	* 2-14-74	1400	0	SPECIMEN CAST										
	2-15-74	1400	1.0		-.36520	55.86	71.2	9023	0	0	0			
	2-20-74	1630	6.1		-.36520	55.86	71.2	8840	-183	-21	-19			
	3-14-74	1535	28.1		-.36536	55.84	70.9	8542	-481	-56	-52			
12.6	* 3-14-74	1541	28.1	SPECIMEN UNSEALED, START OF DRYING SHRINKAGE										
	3-14-74	1545	28.1		-.36512	55.87	71.3	8529	-494	-55	-54			
	3-14-74	1555	28.1		-.36523	55.85	71.1	8499	-524	-60	-57			
	3-14-74	1625	28.1		-.36576	55.79	70.4	8490	-533	-66	-59			
	3-14-74	1936	28.2		-.36535	55.84	71.0	8443	-580	-67	-63			
	3-14-74	2220	28.3		-.36481	55.91	71.7	8402	-621	-66	-67			
	3-15-74	1035	28.9		-.36507	55.87	71.3	8298	-725	-80	-79			
	3-15-74	1700	29.1		-.36468	55.93	71.9	8261	-762	-80	-82			
	3-16-74	1500	30.0		-.36492	55.89	71.6	8169	-854	-93	-93			
	3-17-74	1505	31.0		-.36502	55.88	71.4	8084	-939	-103	-103			
	3-18-74	1610	32.1		-.36503	55.88	71.4	8004	-1019	-112	-111			
	3-20-74	1018	33.8		-.36526	55.85	71.1	7925	-1098	-123	-121			
	3-21-74	1140	34.9		-.36521	55.86	71.2	7871	-1152	-129	-126			
	3-22-74	1345	36.0		-.36533	55.84	71.0	7800	-1223	-138	-134			
	3-24-74	1440	38.0		-.36555	55.81	70.7	7718	-1305	-149	-144			
	3-25-74	1200	38.9		-.36547	55.82	70.8	7680	-1343	-153	-148			
	3-27-74	1715	41.1		-.36509	55.87	71.3	7596	-1427	-158	-157			
	3-29-74	1130	42.9		-.36525	55.85	71.1	7557	-1466	-164	-161			
	4 -3-74	1200	47.9		-.36532	55.84	71.0	7368	-1655	-186	-182			
	4 -8-74	1640	53.1		-.36525	55.85	71.1	7250	-1773	-198	-195			
	4-11-74	1705	56.1		-.36531	55.84	71.0	7145	-1878	-210	-207			
	4-18-74	1340	63.0		-.36528	55.85	71.1	7011	-2012	-225	-222			
	4-23-74	1530	68.1		-.36533	55.84	71.0	6976	-2047	-229	-226			
	4-30-74	1435	75.0		-.36468	55.93	71.9	6803	-2220	-241	-244			
	5 -6-74	1335	81.0		-.36583	55.78	70.3	6708	-2315	-264	-256			
	5-13-74	1330	88.0		-.36518	55.86	71.2	6606	-2417	-268	-266			
	5-16-74	1500	91.0		-.36482	55.91	71.7	6560	-2463	-270	-271			
	5-24-74	955	98.8		-.36481	55.91	71.7	6476	-2547	-279	-280			
	5-28-74	1140	102.9		-.36479	55.91	71.7	6420	-2603	-285	-286			
	6 -4-74	1935	110.2		-.36474	55.92	71.8	6355	-2668	-291	-293			
	6-10-74	1512	116.0		-.36485	55.90	71.7	6279	-2744	-301	-302			
	6-26-74	1140	131.9		-.36491	55.90	71.6	6117	-2906	-320	-320			
	7-17-74	1500	153.0		-.36428	55.98	72.5	5963	-3060	-330	-336			
	8-15-74	1115	181.9		-.36468	55.93	71.9	5786	-3237	-354	-356			
	9-11-74	1315	209.0		-.36451	55.95	72.1	5639	-3384	-368	-372			
	10 -9-74	1600	237.1		-.36412	56.00	72.7	5587	-3436	-370	-377			
	11 -7-74	1100	265.9		-.36428	55.98	72.5	5436	-3587	-388	-394			
	12-10-74	1230	298.9		-.36461	55.93	72.0	5450	-3573	-390	-393			
	12-17-74	1430	306.0		-.36464	55.93	71.9	5350	-3673	-402	-404			
	1-15-75	1330	335.0		-.36422	55.98	72.5	5280	-3743	-405	-411			
	2-18-75	1430	369.0		-.36490	55.90	71.6	5177	-3846	-423	-424			
	3-14-75	1100	392.9		-.36477	55.91	71.8	5130	-3893	-427	-429			
	4 -1-75	1100	410.9		-.36418	55.99	72.6	5192	-3831	-414	-421			
	4-12-75	1200	421.9		-.36482	55.91	71.7	5319	-3704	-407	-408			
	5-16-75	1130	455.9		-.36400	56.01	72.8	5327	-3696	-397	-406			
	6-16-75	1038	486.9		-.36416	55.99	72.6	5324	-3699	-399	-406			
	7-15-75	1400	516.0		-.36393	56.02	72.9	5291	-3732	-401	-410			
	8-22-75	1315	554.0		-.36399	56.01	72.8	5333	-3690	-397	-405			
	9-16-75	1640	579.1		-.36393	56.02	72.9	5327	-3696	-397	-406			
	10 -3-75	1055	595.9		-.36400	56.01	72.8	5262	-3761	-405	-413			
	11-11-75	911	634.8		-.36434	55.97	72.4	5264	-3759	-408	-413			
	12-11-75	840	664.8		-.36449	55.95	72.2	5293	-3730	-406	-410			
	2-24-76	930	739.8		-.36472	55.92	71.8	5347	-3676	-403	-405			
	16	16	17		19	20	21	22	23	24.1	24.2, 28			

1.2.1 SAMPLE COMPUTER OUTPUT – AVERAGING FOR CREEP SPECIMENS

1.2.1 AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 90 DAY, 60 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 4250 PSI)
NO.1	414	73 25	15	5.8
NO.2	419	73 26	10	5.7
NO.3	400	73 24	24	5.9
	2		11.7	13.1

3 SPECIMEN GROUP : YORK 6 (MIX G-26)
4 AGE OF LOADING : 90 DAYS
5 TEST TEMPERATURE : 73 DEG. F.
6 ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
7 ULT. STR.:COMPANION : 7070. PSI AT 73.F.
8 APPLIED TEST STRESS : 4250. PSI
9 PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
10 60.1 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

	DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 4250 PSI
12.1 *	3 -7-74	1430	0	SPECIMENS CAST										
12.2 *	6 -5-74	1517	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0, 1590, AND 3190 PSI (PLUS OR MINUS 30), RESPECTIVELY										
	6 -5-74	1517	90.0	-.0021	71.7 **	0	0	0	0 **	0	0	0	0 **	0.
	6 -5-74	1518	90.0	-.0014	71.7 **	-233	-240	-230	-234 **	0	0	0	0 **	-.05506
	6 -5-74	1519	90.0	-.0007	71.7 **	-520	-525	-512	-519 **	0	0	0	0 **	-.12212
12.3 *	6 -5-74	1520	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 4250 PSI										
	6 -5-74	1520	90.0	0.	71.6 **	-736	-751	-715	-734 **	0	0	0	0 **	-.17271
	6 -5-74	1522	90.0	.0014	71.6 **	-763	-778	-752	-764 **	-27	-27	-37	-30 **	-.17976
	6 -5-74	1525	90.0	.0035	71.6 **	-789	-806	-778	-791 **	-53	-55	-63	-57 **	-.18612
	6 -5-74	1530	90.0	.0069	71.6 **	-807	-822	-798	-809 **	-71	-71	-83	-75 **	-.19035
	6 -5-74	1535	90.0	.0104	71.6 **	-818	-832	-809	-819 **	-82	-81	-94	-85 **	-.19271
	6 -5-74	1555	90.1	.0243	71.6 **	-837	-850	-831	-839 **	-101	-99	-116	-105 **	-.19741
	6 -5-74	1620	90.1	.0417	71.6 **	-862	-873	-858	-864 **	-126	-122	-143	-130 **	-.20329
	6 -5-74	1720	90.1	.0833	71.5 **	-887	-896	-886	-889 **	-151	-145	-171	-155 **	-.20918
	6 -5-74	2105	90.3	.2396	71.4 **	-929	-937	-932	-932 **	-193	-186	-217	-198 **	-.21929
	6 -6-74	840	90.8	.7222	71.2 **	-984	-990	-989	-987 **	-248	-239	-274	-253 **	-.23224
	6 -6-74	1403	91.0	.9465	71.2 **	-998	-1004	-1004	-1002 **	-262	-253	-289	-268 **	-.23576
	6 -7-74	1445	92.0	1.9757	71.0 **	-1043	-1049	-1051	-1047 **	-307	-298	-336	-313 **	-.24635
	6 -8-74	1450	93.0	3.0	71.1 **	-1070	-1074	-1079	-1074 **	-334	-323	-364	-340 **	-.25271
	6 -9-74	1240	93.9	3.9	70.7 **	-1086	-1091	-1096	-1091 **	-350	-340	-381	-357 **	-.25671
	6-10-74	1512	95.0	5.0	70.6 **	-1106	-1111	-1116	-1111 **	-370	-360	-401	-377 **	-.26141
	6-11-74	923	95.8	5.8	70.2 **	-1117	-1122	-1127	-1122 **	-381	-371	-412	-388 **	-.26400
	6-12-74	1145	96.9	6.9	70.3 **	-1131	-1135	-1141	-1135 **	-395	-384	-426	-401 **	-.26706
	6-14-74	845	98.8	8.7	70.2 **	-1148	-1151	-1158	-1152 **	-412	-400	-443	-418 **	-.27106
	6-17-74	1600	102.1	12.0	70.2 **	-1178	-1181	-1186	-1181 **	-442	-430	-471	-447 **	-.27788
	6-20-74	1340	105.0	14.9	70.8 **	-1194	-1205	-1204	-1201 **	-458	-454	-489	-467 **	-.28259
	6-26-74	1140	110.9	20.8	70.2 **	-1231	-1233	-1240	-1234 **	-495	-482	-525	-500 **	-.29035
	6-30-74	940	114.8	24.8	70.3 **	-1251	-1254	-1260	-1255 **	-515	-503	-545	-521 **	-.29529
	7 -9-74	930	123.8	33.8	70.2 **	-1287	-1290	-1295	-1290 **	-551	-539	-580	-556 **	-.30353
	7-10-74	1630	125.1	35.0	70.6 **	-1290	-1294	-1299	-1294 **	-554	-543	-584	-560 **	-.30447
	7-15-74	1300	129.9	39.9	71.1 **	-1306	-1309	-1313	-1309 **	-570	-558	-598	-575 **	-.30800
	7-24-74	1600	139.1	49.0	71.1 **	-1335	-1339	-1343	-1339 **	-599	-588	-628	-605 **	-.31506
	7-31-74	1715	146.1	56.1	70.9 **	-1354	-1358	-1361	-1357 **	-618	-607	-646	-623 **	-.31929
	8 -8-74	1200	153.9	63.9	70.9 **	-1377	-1383	-1384	-1381 **	-641	-632	-669	-647 **	-.32494
	8-15-74	1115	160.9	70.8	70.5 **	-1388	-1393	-1395	-1392 **	-652	-642	-680	-658 **	-.32753
	8-29-74	1135	174.9	84.8	70.7 **	-1413	-1417	-1419	-1416 **	-677	-666	-704	-682 **	-.33318
	9-11-74	1315	187.9	97.9	71.1 **	-1435	-1438	-1440	-1437 **	-699	-687	-725	-703 **	-.33812
	9-25-74	1600	202.1	112.0	70.3 **	-1455	-1458	-1460	-1457 **	-719	-707	-745	-723 **	-.34282
	10 -9-74	1600	216.1	126.0	71.3 **	-1478	-1482	-1482	-1480 **	-742	-731	-767	-746 **	-.34824
	10-23-74	1420	230.0	140.0	71.0 **	-1496	-1500	-1501	-1499 **	-760	-749	-786	-765 **	-.35271
	11-21-74	1000	258.8	168.8	70.9 **	-1530	-1532	-1534	-1532 **	-794	-781	-819	-798 **	-.36047
	12-17-74	1430	285.0	195.0	70.5 **	-1559	-1558	-1561	-1559 **	-823	-807	-846	-825 **	-.36682
	1-15-75	1330	314.0	223.9	71.5 **	-1575	-1574	-1574	-1574 **	-839	-823	-859	-840 **	-.37035
	2-18-75	1430	348.0	258.0	70.3 **	-1610	-1605	-1607	-1607 **	-874	-854	-892	-873 **	-.37812
	3-14-75	1100	371.9	281.8	70.3 **	-1626	-1620	-1620	-1622 **	-890	-869	-905	-888 **	-.38165
	4-12-75	1200	400.9	310.9	70.6 **	-1642	-1633	-1636	-1637 **	-906	-882	-921	-903 **	-.38518
	5-16-75	1130	434.9	344.8	71.6 **	-1664	-1653	-1656	-1657 **	-928	-902	-941	-923 **	-.38988
	6-16-75	1230	465.9	375.9	71.4 **	-1681	-1668	-1670	-1673 **	-945	-917	-955	-939 **	-.39365
	6-30-75	1429	480.0	390.0	70.6 **	-1688	-1676	-1678	-1680 **	-952	-925	-963	-946 **	-.39529
12.4 *	6-30-75	1430	480.0	APPLIED TEST STRESS CHANGED TO 2100 PSI										
	6-30-75	1430	480.0	390.0	70.9 **	-1402	-1386	-1398	-1395 **	-666	-635	-683	-661 **	
	6-30-75	1445	480.0	390.0	70.4 **	-1386	-1369	-1383	-1379 **	-650	-618	-668	-645 **	
	6-30-75	1500	480.0	390.0	70.1 **	-1390	-1370	-1386	-1382 **	-654	-619	-671	-648 **	
	6-30-75	1700	480.1	390.1	70.7 **	-1385	-1364	-1381	-1376 **	-649	-613	-666	-642 **	
	7 -1-75	1545	481.1	391.0	72.1 **	-1375	-1355	-1370	-1366 **	-639	-604	-655	-632 **	
	7 -7-75	1425	487.0	397.0	71.8 **	-1366	-1345	-1358	-1356 **	-630	-594	-643	-622 **	
	7-15-75	1400	495.0	404.9	71.7 **	-1354	-1334	-1348	-1345 **	-618	-583	-633	-611 **	
	7-28-75	1220	507.9	417.9	72.0 **	-1350	-1330	-1344	-1341 **	-614	-579	-629	-607 **	
12.5 *	7-28-75	1221	507.9	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
	7-28-75	1221	507.9	.0000	72.0 **	-1010	-968	-1005	-994 **	-274	-217	-290	-260 **	
	7-28-75	1222	507.9	.0007	72.0 **	-1005	-963	-997	-988 **	-269	-212	-282	-254 **	
	7-28-75	1226	507.9	.0035	72.0 **	-998	-954	-989	-980 **	-262	-203	-274	-246 **	
	7-28-75	1236	507.9	.0104	72.1 **	-990	-946	-980	-972 **	-254	-195	-265	-238 **	
	7-28-75	1600	508.1	.1521	72.1 **	-972	-926	-961	-953 **	-236	-175	-246	-219 **	
	7-29-75	1210	508.9	.9924	71.9 **	-955	-908	-943	-935 **	-219	-157	-228	-201 **	
	7-31-75	1550	511.1	3.1	71.9 **	-939	-892	-927	-919 **	-203	-141	-212	-185 **	
	8 -5-75	1630	516.1	8.2	71.8 **	-920	-872	-908	-900 **	-184	-121	-193	-166 **	
	8-22-75	1315	532.9	25.0	71.6 **	-893	-844	-880	-872 **	-157	-93	-165	-138 **	
	9-16-75	1640	558.1	50.2	71.6 **	-871	-821	-857	-849 **	-135	-70	-142	-115 **	
	9-22-75	915	563.8	55.9	71.3 **	-870	-819	-856	-848 **	-134	-68	-141	-114 **	
12.7 *	9-23-75	1200	564.9	END OF TEST										
	16		17	18	21.1	25			25.1	26			26.1	

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
15

1.2.2 SAMPLE COMPUTER OUTPUT - AVERAGING FOR CONTROL SPECIMENS

1.2.2 AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 73F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

3 SPECIMEN GROUP : YORK 3 (MIX G-26)
4 AGE OF LOADING : 28 DAYS
5 TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	202	73 09	0
NO.2	201	73 10	0
NO.3	206	73 11	0

2 11.7

6 ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
7 ULT. STR.:COMPANION : 6160. PSI AT 73.F.
8 APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
12.1 * 2-14-74	1400	0	SPECIMENS CAST					
2-15-74	1400	1.0		71.9	0	0	0	0
2-20-74	1630	6.1		71.9	-19	-19	-19	-19
3-14-74	1535	28.1		70.8	-53	-59	-56	-52
3-14-74	1625	28.1		70.9	-52	-58	-55	-59
3-15-74	1035	28.9		71.7	-53	-58	-55	-79
3-16-74	1500	30.0		71.8	-51	-57	-54	-93
3-18-74	1610	32.1		71.7	-51	-57	-54	-111
3-19-74	2045	33.3		71.7	-50	-57	-53	-117
3-20-74	1018	33.8		71.2	-49	-56	-52	-121
3-21-74	1140	34.9		71.3	-48	-56	-52	-126
3-24-74	1440	38.0		70.8	-48	-56	-52	-144
3-25-74	1200	38.9		70.9	-48	-55	-51	-148
3-27-74	1715	41.1		71.2	-46	-53	-49	-157
4 -1-74	1215	45.9		71.0	-43	-51	-47	-173
4 -4-74	1430	49.0		71.0	-43	-50	-46	-184
4-11-74	1705	56.1		71.2	-40	-47	-43	-207
4-18-74	1340	63.0		71.1	-38	-43	-40	-222
4-23-74	1530	68.1		71.0	-37	-39	-38	-226
4-30-74	1435	75.0		72.0	-41	-38	-39	-244
5 -3-74	1400	78.0		71.8	-41	-37	-39	-249
5-13-74	1330	88.0		71.3	-41	-32	-36	-266
5-21-74	855	95.8		71.2	-40	-30	-35	-275
5-31-74	1440	106.0		72.5	-42	-28	-35	-288
6-10-74	1512	116.0		71.8	-42	-27	-34	-302
6-26-74	1140	131.9		71.7	-42	-25	-33	-320
7-31-74	1715	167.1		72.4	-46	-25	-35	-345
8-15-74	1115	181.9		72.0	-46	-25	-35	-356
9-11-74	1315	209.0		72.2	-50	-26	-38	-372
10-23-74	1420	251.0		72.6	-53	-29	-41	-384
11-21-74	1000	279.8		72.3	-57	-31	-44	-393
12-30-74	840	318.8		71.3	-58	-31	-44	-406
1-15-75	1330	335.0		72.5	-58	-30	-44	-411
2-18-75	1430	369.0		71.7	-61	-32	-46	-424
3-14-75	1100	392.9		71.9	-61	-34	-47	-429
4-12-75	1200	421.9		71.8	-64	-34	-49	-408
5-16-75	1130	455.9		72.9	-68	-37	-52	-406
6-16-75	830	486.8		72.6	-68	-36	-52	-405
7-15-75	1400	516.0		73.0	-70	-38	-54	-410
8-22-75	1315	554.0		72.9	-73	-39	-56	-405
9-16-75	1640	579.1		73.0	-75	-41	-58	-406
10-20-75	1530	613.1		73.1	-78	-44	-61	-412
11-11-75	911	634.8		72.5	-84	-47	-65	-413
12-24-75	920	677.8		72.0	-87	-47	-67	-408
2-24-76	930	739.8		72.0	-92	-50	-71	-405

16 17 21.1 27 27.1 28

1.3 SAMPLE COMPUTER OUTPUT - SUMMARY FOR CREEP AND SEALED CONTROL SPECIMENS

1.3 AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 73F, 90 DAY, 60 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

3 SPECIMEN GROUP : YORK 6 (MIX G-26)
4 AGE OF LOADING : 90 DAYS
5 TEST TEMPERATURE : 73 DEG. F.
6 ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
7 ULT. STR.:COMPANION : 7070. PSI AT 73.F.
8 APPLIED TEST STRESS : 4250. PSI
9 PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
10 60.1 PERCENT (COMPANION)

STRAIN METER NUMBERS (2)
AUTOGENOUS: 202 73 09
201 73 10
CREEP : 414 73 25
419 73 26
400 73 24

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 4250 PSI (MICROSTRAIN PER PSI)
12.2 **LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0021		0	0	0	0		
90	-.0014		-234	0	0	0		
90	-.0007		-519	0	0	0		
12.3 **SPECIMENS FULLY LOADED, APPLIED TEST STRESS 4250 PSI								
90	0.	5.79	-734	0	0	0	0.	-.1727
90	.0014	5.56	-764	-30	0	-30	-.0071	-.1798
90	.0035	5.37	-791	-57	0	-57	-.0134	-.1861
90	.0069	5.25	-809	-75	0	-75	-.0176	-.1904
90	.0104	5.19	-819	-85	0	-85	-.0200	-.1927
90	.0243	5.07	-839	-105	0	-105	-.0247	-.1974
90	.0417	4.92	-864	-130	0	-130	-.0306	-.2033
90	.0833	4.78	-889	-155	0	-155	-.0365	-.2092
90	.2396	4.56	-932	-198	0	-198	-.0466	-.2193
91	.7222	4.31	-987	-253	0	-253	-.0595	-.2322
91	.9465	4.24	-1002	-268	0	-268	-.0631	-.2358
92	2.0	4.06	-1047	-313	1	-314	-.0739	-.2464
93	3.0	3.96	-1074	-340	1	-341	-.0802	-.2527
94	3.9	3.90	-1091	-357	1	-358	-.0842	-.2567
95	5.0	3.83	-1111	-377	1	-378	-.0889	-.2614
96	5.8	3.79	-1122	-388	0	-388	-.0913	-.2640
97	6.9	3.74	-1135	-401	1	-402	-.0946	-.2671
99	8.7	3.69	-1152	-418	1	-419	-.0986	-.2711
102	12.0	3.60	-1181	-447	1	-448	-.1054	-.2779
105	14.9	3.54	-1201	-467	1	-468	-.1101	-.2826
111	20.8	3.44	-1234	-500	1	-501	-.1179	-.2904
115	24.8	3.39	-1258	-521	2	-523	-.1231	-.2953
124	33.8	3.29	-1290	-556	2	-558	-.1313	-.3035
125	35.0	3.28	-1294	-560	3	-563	-.1325	-.3045
130	39.9	3.25	-1309	-575	3	-578	-.1360	-.3080
139	49.0	3.17	-1339	-605	3	-608	-.1431	-.3151
146	56.1	3.13	-1357	-623	2	-625	-.1471	-.3193
154	63.9	3.08	-1381	-647	2	-649	-.1527	-.3249
161	70.8	3.05	-1392	-658	1	-659	-.1551	-.3275
176	84.8	3.00	-1416	-682	1	-683	-.1607	-.3332
188	97.9	2.96	-1437	-703	0	-703	-.1654	-.3381
202	112.0	2.92	-1457	-723	-1	-722	-.1699	-.3428
216	126.0	2.87	-1480	-746	-3	-743	-.1748	-.3482
230	140.0	2.84	-1499	-765	-4	-761	-.1791	-.3527
259	168.8	2.77	-1532	-798	-6	-792	-.1864	-.3605
285	195.0	2.73	-1559	-825	-8	-817	-.1922	-.3668
314	223.9	2.70	-1574	-840	-8	-832	-.1958	-.3704
348	258.0	2.64	-1607	-873	-9	-864	-.2033	-.3781
372	281.8	2.62	-1622	-888	-10	-878	-.2066	-.3816
401	310.9	2.60	-1637	-903	-12	-891	-.2096	-.3852
435	344.8	2.56	-1657	-923	-14	-909	-.2139	-.3899
466	375.9	2.54	-1673	-939	-16	-923	-.2172	-.3936
480	390.0	2.53	-1680	-946	-16	-930	-.2188	-.3953
12.4 **APPLIED TEST STRESS CHANGED TO 2100 PSI								
480	390.0		-1395	-661	-16	-645		
480	390.0		-1379	-645	-16	-629		
480	390.0		-1382	-648	-16	-632		
480	390.1		-1376	-642	-16	-626		
481	391.0		-1366	-632	-16	-616		
487	397.0		-1356	-622	-17	-605		
495	404.9		-1345	-611	-17	-594		
508	417.9		-1341	-607	-17	-590		
12.5 **SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
508	.0000		-994	-260	-17	-243		
508	.0007		-988	-254	-17	-237		
508	.0035		-980	-246	-17	-229		
508	.0104		-972	-238	-17	-221		
508	.1521		-953	-219	-17	-202		
509	.9924		-935	-201	-18	-183		
511	3.1		-919	-185	-18	-167		
516	8.2		-900	-166	-19	-147		
533	25.0		-872	-138	-19	-119		
558	50.2		-849	-115	-20	-95		
564	55.9		-848	-114	-21	-93		
12.7 **END OF TEST								
17	18	33	25.1	26.1	27.2	29	32	30

1.4 SAMPLE COMPUTER OUTPUT - QUALITY CONTROL CHECK FOR CREEP SPECIMEN DATA

1.4 AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 90 DAY, 60 PERCENT
(3 SPECIMENS: SEALED 6 BY 15 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN				
NO.1	414	73 25	15	5.8
NO.2	419	73 26	10	5.7
NO.3	400	73 24	24	5.9
	2		11.7	13.1

6 ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
7 ULT. STR.:COMPANION : 7070. PSI AT 73.F.
8 APPLIED TEST STRESS : 4250. PSI
9 PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
10 60.1 PERCENT (COMPANION)

---SPECIMEN'S MICRO-STRAIN AND PERCENT VARIATION FROM AVERAGE - TEMPERATURE CORRECTED---

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	TEMPERATURE NO.1	NO.2	NO.3	TOTAL STRAIN NO.1	NO.2	NO.3	AVG.	PERCENT VAR. NO.1	NO.2	NO.3	TOTAL STRAIN (FULL LOAD) NO.1	NO.2	NO.3	AVG.	PERCENT VAR. NO.1	NO.2	NO.3
12.1 3-7-74	1430	C	SPECIMENS CAST																	
3-9-74	1430	1.0	0.	72.	71.	72.	0	0	0	0	0.	0.	0.	0	0	0	0	0.	0.	0.
3-11-74	930	3.8	0.	72.	71.	71.	-11	-11	-12	-11	0.	0.	-9.1	0	0	0	0	0.	0.	0.
6-5-74	1517	90.0	-.0	72.	71.	72.	0	0	0	0	0.	0.	0.	0	0	0	0	0.	0.	0.
6-5-74	1518	90.0	-.0	72.	71.	72.	-233	-240	-230	-234	.4	-2.6	1.7	0	0	0	0	0.	0.	0.
6-5-74	1519	90.0	-.0	72.	71.	72.	-520	-525	-512	-519	-.2	-1.2	1.3	0	0	0	C	0.	0.	0.
6-5-74	1520	90.0	0.	72.	71.	72.	-736	-751	-715	-734	-.3	-2.3	2.6	0	0	0	0	0.	0.	0.
6-5-74	1522	90.0	.0	72.	71.	72.	-763	-778	-752	-764	.1	-1.8	1.6	-27	-27	-37	-30	10.0	10.0	-23.3
6-5-74	1525	90.0	.0	72.	71.	72.	-789	-806	-778	-791	.3	-1.9	1.6	-53	-55	-63	-57	7.0	3.5	-10.5
6-5-74	1530	90.0	.0	72.	71.	72.	-807	-822	-798	-809	.2	-1.6	1.4	-71	-71	-83	-75	5.3	5.3	-10.7
6-5-74	1535	90.0	.0	72.	71.	72.	-819	-832	-809	-819	.1	-1.6	1.2	-82	-81	-94	-85	3.5	4.7	-10.6
6-5-74	1555	90.1	.0	72.	71.	72.	-837	-850	-831	-839	.2	-1.3	1.0	-101	-99	-116	-105	3.8	5.7	-10.5
6-5-74	1620	90.1	.0	72.	71.	72.	-862	-873	-858	-864	.2	-1.0	.7	-126	-122	-143	-130	3.1	6.2	-10.0
6-5-74	1720	90.1	.1	72.	71.	72.	-887	-896	-886	-889	.2	-.8	.3	-151	-145	-171	-155	2.6	6.5	-10.3
6-5-74	2105	90.3	.2	71.	71.	71.	-929	-937	-932	-932	.3	-.5	0.	-193	-186	-217	-198	2.5	6.1	-9.6
6-6-74	840	90.8	.7	71.	71.	71.	-984	-990	-989	-987	.3	-.3	-.2	-248	-239	-274	-253	2.0	5.5	-8.3
6-6-74	1403	91.0	.9	71.	71.	71.	-998	-1004	-1004	-1002	.4	-.2	-.2	-262	-253	-289	-268	2.2	5.6	-7.8
6-7-74	1445	92.0	2.0	71.	71.	71.	-1043	-1049	-1051	-1047	.4	-.2	-.4	-307	-298	-336	-313	1.9	4.8	-7.3
6-8-74	1450	93.0	3.0	71.	71.	71.	-1070	-1074	-1079	-1074	.4	0.	-.5	-334	-323	-364	-340	1.8	5.0	-7.1
6-9-74	1240	93.9	3.9	71.	71.	71.	-1086	-1091	-1096	-1091	.5	0.	-.5	-350	-340	-381	-357	2.0	4.8	-6.7
6-10-74	1512	95.0	5.0	70.	71.	70.	-1106	-1111	-1116	-1111	.5	0.	-.5	-370	-360	-401	-377	1.9	4.5	-6.4
6-11-74	923	95.8	5.8	70.	70.	70.	-1117	-1122	-1127	-1122	.4	0.	-.4	-381	-371	-412	-388	1.8	4.4	-6.2
6-12-74	1145	96.9	6.9	70.	71.	70.	-1131	-1135	-1141	-1135	.4	0.	-.5	-395	-384	-426	-401	1.5	4.2	-6.2
6-14-74	845	98.8	8.7	70.	70.	70.	-1148	-1151	-1158	-1152	.3	.1	-.5	-412	-400	-443	-418	1.4	4.3	-6.0
6-17-74	1600	102.1	12.0	70.	70.	70.	-1178	-1181	-1186	-1181	.3	0.	-.4	-442	-430	-471	-447	1.1	3.8	-5.4
6-20-74	1740	105.0	14.9	70.	71.	71.	-1194	-1205	-1204	-1201	.6	-.3	-.2	-458	-454	-489	-467	1.9	2.8	-4.7
6-26-74	1140	110.9	20.8	70.	70.	70.	-1231	-1233	-1240	-1234	.2	.1	-.5	-495	-482	-525	-500	1.0	3.6	-5.0
6-30-74	940	114.8	24.8	70.	70.	70.	-1251	-1254	-1260	-1255	.3	.1	-.4	-515	-503	-545	-521	1.2	3.5	-4.6
7-9-74	930	123.8	33.8	70.	70.	70.	-1287	-1290	-1295	-1290	.2	0.	-.4	-551	-539	-580	-556	.9	3.1	-4.3
7-10-74	1630	125.1	35.0	70.	71.	71.	-1290	-1294	-1299	-1294	.3	0.	-.4	-554	-543	-584	-560	1.1	3.0	-4.3
7-15-74	1700	129.9	39.9	71.	71.	71.	-1306	-1309	-1313	-1309	.2	0.	-.3	-570	-558	-598	-575	.9	3.0	-4.0
7-24-74	1600	139.1	49.0	71.	71.	71.	-1335	-1339	-1343	-1339	.3	0.	-.3	-599	-588	-628	-605	1.0	2.8	-3.8
7-31-74	1715	146.1	56.1	71.	71.	71.	-1354	-1358	-1361	-1357	.2	-.1	-.3	-618	-607	-646	-623	.8	2.6	-3.7
8-9-74	1200	153.9	63.9	71.	71.	71.	-1377	-1383	-1384	-1381	.3	-.1	-.2	-641	-632	-669	-647	.9	2.3	-3.4
8-15-74	1115	160.9	70.8	70.	71.	70.	-1388	-1393	-1395	-1392	.3	-.1	-.2	-652	-642	-680	-658	.9	2.4	-3.3
8-29-74	1135	174.9	84.8	71.	71.	71.	-1413	-1417	-1419	-1416	.2	-.1	-.2	-677	-666	-704	-682	.7	2.3	-3.2
9-11-74	1315	187.9	97.9	71.	71.	71.	-1435	-1438	-1440	-1437	.1	-.1	-.2	-699	-687	-725	-703	.6	2.3	-3.1
9-25-74	1600	202.1	112.0	70.	70.	70.	-1455	-1458	-1460	-1457	.1	-.1	-.2	-719	-707	-746	-723	.6	2.2	-3.0
10-9-74	1500	216.1	126.0	71.	71.	71.	-1478	-1482	-1482	-1480	.1	-.1	-.1	-742	-731	-767	-746	.5	2.8	-2.8
10-23-74	1420	230.0	140.0	71.	71.	71.	-1496	-1500	-1501	-1499	.2	-.1	-.1	-760	-749	-786	-766	.7	2.1	-2.7
11-21-74	1000	258.8	168.8	71.	71.	71.	-1530	-1532	-1534	[illegible]	.1	0.	-.1	-798	-781	-819	-798	.5	2.1	-2.6
12-17-74	1430	285.0	195.0	70.	70.	71.	-1559	-1558	-1561	[illegible]	0.	.1	-.1	-823	-807	-846	-825	.2	2.2	-2.5
1-15-75	1330	314.0	223.9	71.	71.	72.	-1575	-1574	-1574	-1574	-.1	0.	0.	-839	-823	-859	-840	.1	2.0	-2.3
2-18-75	1430	348.0	258.0	70.	70.	71.	-1610	-1605	-1607	-1607	-.2	.1	0.	-874	-854	-892	-873	-.1	2.2	-2.2
3-14-75	1100	371.9	281.8	70.	70.	71.	-1626	-1620	-1620	-1622	-.2	.1	.1	-890	-869	-905	-888	-.2	2.1	-1.9
4-12-75	1200	400.9	310.9	70.	70.	71.	-1642	-1633	-1636	-1637	-.3	.2	.1	-906	-882	-921	-903	-.3	2.3	-2.0
5-16-75	1130	434.9	344.8	71.	71.	72.	-1664	-1653	-1656	-1657	-.4	.2	.1	-928	-902	-941	-923	-.5	2.3	-2.0
6-16-75	1230	465.9	375.9	71.	71.	72.	-1681	-1668	-1670	-1673	-.5	.3	.2	-945	-917	-955	-939	-.6	2.3	-1.7
6-30-75	1429	480.0	390.0	71.	70.	70.	-1685	-1676	-1678	-1680	-.5	.2	.1	-952	-925	-963	-946	-.6	2.2	-1.8
6-30-75	1470	480.0	390.0	71.	70.	71.	-1402	-1386	-1398	-1395	-.5	.6	-.2	-666	-635	-683	-661	-.8	3.9	-3.3
6-30-75	1445	480.0	390.0	71.	70.	70.	-1386	-1369	-1383	-1379	-.5	.7	-.3	-650	-618	-668	-645	-.8	4.2	-3.6
6-30-75	1500	480.0	390.0	70.	70.	70.	-1390	-1370	-1386	-1382	-.6	.9	-.3	-654	-619	-671	-648	-.9	4.5	-3.5
6-30-75	1700	480.1	390.1	71.	71.	71.	-1385	-1364	-1381	-1376	-.7	.9	-.4	-649	-613	-666	-642	-1.1	4.5	-3.7
7-1-75	1545	481.1	391.0	72.	72.	72.	-1375	-1355	-1370	-1366	-.7	.8	-.3	-639	-604	-655	-632	-1.1	4.4	-3.6
7-7-75	1425	487.0	397.0	72.	72.	72.	-1366	-1345	-1358	-1356	-.7	.8	-.1	-630	-594	-643	-622	-1.3	4.5	-3.4
7-15-75	1400	495.0	404.9	72.	72.	72.	-1354	-1334	-1348	-1345	-.7	.8	-.2	-618	-583	-633	-611	-1.1	4.6	-3.6
7-28-75	1220	507.9	417.9	72.	72.	72.	-1350	-1330	-1344	-1341	-.7	.8	-.2	-614	-579	-629	-607	-1.2	4.6	-3.6
7-28-75	1221	507.9	417.9	72.	72.	72.	-1010	-968	-1005	-994	-1.6	2.6	-1.1	-274	-217	-290	-260	-5.4	16.5	-11.5
7-28-75	1222	507.9	417.9	72.	72.	72.	-1005	-963	-997	-988	-1.7	2.5	-.9	-269	-212	-282	-254	-5.9	16.5	-11.0
7-28-75	1226	507.9	417.9	72.	72.	72.	-998	-954	-989	-980	-1.8	2.7	-.9	-262	-203	-274	-246	-6.5	17.5	-11.4
7-28-75	1236	507.9	417.9	72.	72.	72.	-990	-946	-980	-972	-1.9	2.7	-.8	-254	-195	-265	-238	-6.7	18.1	-11.3
7-29-75	1600	509.1	418.0	72.	72.	72.	-972	-926	-961	-953	-2.0	2.8	-.8	-236	-175	-246	-219	-7.8	20.1	-12.3
7-29-75	1210	508.9	418.9	72.	72.	72.	-955	-908	-943	-935	-2.1	2.9	-.9	-219	-157	-228	-201	-9.0	21.9	-13.4
7-31-75	1550	511.1	421.0	72.	72.	72.	-939	-892	-927	-919	-2.2	2.9	-.9	-203	-141	-212	-185	-9.7	23.8	-14.6
8-5-75	1630	516.1	426.0	72.	72.	72.	-920	-872	-908	-900	-2.2	3.1	-.9	-184	-121	-193	-166	-10.8	27.1	-16.3
8-22-75	1315	532.9	442.9	72.	72.	72.	-893	-844	-880	-872	-2.4	3.2	-.9	-157	-93	-165	-138	-13.8	32.6	-19.6
9-15-75	1640	558.1	468.1	72.	72.	72.	-871	-821	-857	-849	-2.6	3.3	-.9	-135	-70	-142	-115	-17.4	39.1	-23.5
9-22-75	915	567.8	473.7	71.	71.	71.	-870	-819	-856	-848	-2.6	3.4	-.9	-134	-68	-141	-114	-17.5	40.4	-23.7
16		17	18	21			25			25.1	34.1			26			26.1	34.2		

DISCUSSION OF CARLSON METER PERFORMANCE

A 4-inch gauge length A-4 Carlson strain meter was used in each of the 120 6 by 16-in. creep and creep control specimens to obtain strain and temperature data. The 72 meters in specimens tested at 73 and 110 F performed well during the test period, with some specimens under load for almost 800 days. However, at 160 F unexpected malfunctions of some of the meters began to occur after the creep and creep control specimens were subjected to the 160 F test temperature for about one year. Of the 30 creep and 18 control specimens tested at 160 F, 11 of the creep and 8 of the control specimen meters malfunctioned prior to the end of the test. (Malfunctioning creep meter channel numbers are 11-6, 7, 8, 25, 38, 44, 46, 67, 69, 72, and 74 and control meter channel numbers are 11-27, 39, 40, 53, 54, 75, and 76.) The malfunctioning of a meter was generally indicated by a progressive increase in coil wire resistance, which thus yielded higher specimen temperature than that of the environmental test temperature. After this increase in meter resistance occurred, the strain data from the meter was disregarded. Subsequent strain readings are given as zeros on the computer outputs in Appendix C. It should be noted that for meters at 73 and 110 F the zero values do not indicate malfunctioning but show that strain data was not taken for the one specimen maintained at test temperature just prior to the end of the test. Reasons as to why the meter resistance increased after the specimens were subjected to 160 F for over a year are being investigated.

The strain meter calibration range was exceeded for the three Berks (11-41, 42, 43) and three York (11-50, 51, 52) creep specimens tested at the nominal 60 percent stress level at 160 F and for two of the three Berks specimens (11-36, 37) tested at the nominal 45 percent stress level at 160 F due to the high strain levels encountered. However, the main purpose of testing the concrete at such high stress levels at 160 F was to determine if the concrete could sustain a high constant stress without failure and not necessarily to develop creep data. High strains were also developed at 160 F because the effective applied stress level was higher due to the decrease in strength at 160 F than the nominal stress level which was established on the basis of the 73 F compressive strength of the concrete. The effective stress levels for Berks and York concrete at the nominal 60 percent stress level were 70 and 77 percent at 160 F, respectively.

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 73F, 28 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	245	73 00	12	6.1
NO.2	251	73 01	20	6.0
NO.3	349	73 02	0	6.0

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 6270. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 31.9 PERCENT (SELECTED MIX)
33.5 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
*12-19-73	1000	0	SPECIMENS CAST										
* 1-16-74	1551	28.2	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
1-16-74	1551	28.2	-.0007	71.6	0	0	0	0	0	0	0	0	0.
1-16-74	1551	28.2	-.0003	71.6	-167	-171	-170	-169	0	0	0	0	-.08048
* 1-16-74	1552	28.2	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
1-16-74	1552	28.2	.0000	71.6	-344	-349	-351	-348	0	0	0	0	-.16571
1-16-74	1559	28.2	.0049	70.8	-382	-387	-390	-386	-38	-38	-39	-38	-.18381
1-16-74	1605	28.3	.0090	70.9	-384	-390	-393	-389	-40	-41	-42	-41	-.18524
1-16-74	1625	28.3	.0229	70.9	-393	-398	-401	-397	-49	-49	-50	-49	-.18905
1-16-74	1655	28.3	.0438	71.0	-402	-408	-410	-406	-58	-59	-59	-58	-.19333
1-16-74	1855	28.4	.1271	70.8	-417	-423	-423	-421	-73	-74	-72	-73	-.20048
1-16-74	2155	28.5	.2521	70.8	-427	-433	-433	-431	-83	-84	-82	-83	-.20524
1-17-74	1100	29.0	.7972	70.3	-449	-456	-453	-452	-105	-107	-102	-104	-.21524
1-17-74	1555	29.2	1.0021	70.5	-455	-461	-458	-458	-111	-112	-107	-110	-.21810
1-18-74	2130	30.5	2.2	70.4	-479	-486	-480	-481	-135	-137	-129	-133	-.22905
1-19-74	1510	31.2	3.0	70.6	-491	-498	-491	-493	-147	-149	-140	-145	-.23476
1-20-74	1550	32.2	4.0	71.3	-504	-510	-504	-506	-160	-161	-153	-158	-.24095
1-21-74	1600	33.3	5.0	71.0	-512	-519	-510	-513	-168	-170	-159	-165	-.24429
1-23-74	1550	35.2	7.0	71.1	-530	-536	-525	-530	-186	-187	-174	-182	-.25238
1-25-74	1430	37.2	8.9	71.1	-541	-547	-534	-540	-197	-198	-183	-192	-.25714
1-27-74	1545	39.2	11.0	70.9	-553	-559	-542	-551	-209	-210	-191	-203	-.26238
1-31-74	1310	43.1	14.9	70.7	-582	-589	-564	-578	-238	-240	-213	-230	-.27524
2 -5-74	1550	48.2	20.0	70.5	-594	-600	-569	-587	-250	-251	-218	-239	-.27952
2-12-74	1635	55.3	27.0	70.8	-614	-620	-575	-603	-270	-271	-224	-255	-.28714
2-21-74	1200	64.1	35.8	71.4	-632	-640	-586	-619	-288	-291	-235	-271	-.29476
2-25-74	1520	68.2	40.0	71.2	-643	-653	-592	-629	-299	-304	-241	-281	-.29952
3 -1-74	1020	72.0	43.8	70.9	-650	-661	-597	-636	-306	-312	-246	-288	-.30286
3 -4-74	1040	75.0	46.8	71.4	-656	-668	-600	-641	-312	-319	-249	-293	-.30524
3-11-74	1630	82.3	54.0	71.2	-667	-680	-606	-651	-323	-331	-255	-303	-.31000
3-16-74	915	87.0	58.7	71.8	-679	-687	-608	-658	-335	-338	-257	-310	-.31333
3-18-74	1610	89.3	61.0	71.5	-685	-694	-615	-664	-341	-345	-264	-316	-.31619
3-25-74	1200	96.1	67.8	71.0	-687	-699	-619	-668	-343	-350	-268	-320	-.31810
4 -1-74	1215	103.1	74.8	71.0	-694	-708	-626	-676	-350	-359	-275	-328	-.32190
4-15-74	1015	117.0	88.8	71.7	-711	-725	-640	-692	-367	-376	-289	-344	-.32952
4-30-74	1435	132.2	103.9	72.1	-726	-740	-655	-707	-382	-391	-304	-359	-.33667
5-31-74	1440	163.2	134.9	72.8	-751	-765	-677	-731	-407	-416	-326	-383	-.34810
6-26-74	1140	189.1	160.8	71.6	-762	-777	-686	-741	-418	-428	-338	-393	-.35286
7-17-74	1500	210.2	182.0	72.7	-773	-789	-697	-753	-429	-440	-346	-405	-.35857
8-29-74	1135	253.1	224.8	72.0	-794	-813	-716	-774	-450	-464	-365	-426	-.36857
9-25-74	1600	280.2	252.0	71.7	-805	-826	-727	-784	-461	-477	-376	-438	-.37429
10-23-74	1420	308.2	279.9	72.4	-816	-838	-737	-797	-472	-489	-386	-449	-.37952
11-21-74	1000	337.0	308.8	72.2	-827	-855	-750	-810	-483	-506	-399	-462	-.38571
12-30-74	840	375.9	347.7	71.6	-834	-864	-755	-817	-490	-515	-404	-469	-.38905
1-31-75	830	407.9	379.7	71.5	-848	-878	-768	-831	-504	-529	-417	-483	-.39571
2-28-75	1000	436.0	407.8	72.3	-852	-884	-772	-836	-508	-535	-421	-488	-.39810
3-14-75	1100	450.0	421.8	72.0	-859	-887	-775	-840	-515	-538	-424	-492	-.40000
4-12-75	1200	479.1	450.8	72.1	-862	-897	-780	-846	-518	-548	-429	-498	-.40286
5-16-75	1130	513.1	484.8	73.1	-876	-910	-792	-859	-532	-561	-441	-511	-.40905
6-16-75	1230	544.1	515.9	72.9	-887	-929	-808	-874	-543	-580	-457	-526	-.41619
7-15-75	1400	573.2	544.9	73.2	-889	-933	-811	-877	-545	-584	-460	-529	-.41762
8-22-75	1315	611.1	582.9	72.9	-898	-945	-820	-887	-554	-596	-469	-539	-.42238
9-16-75	1640	636.3	608.0	73.1	-903	-952	-824	-893	-559	-603	-473	-545	-.42524
10-20-75	1530	670.2	642.0	73.2	-911	-961	-834	-902	-567	-612	-483	-554	-.42952
12-24-75	920	735.0	706.7	72.1	-921	-975	-847	-914	-577	-626	-496	-566	-.43524
2-24-76	930	797.0	768.7	72.2	-933	-991	-862	-928	-589	-642	-511	-580	-.44190

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.3; STRAINS ARE 7 PERCENT BELOW AVERAGE

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 73F, 28 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 6270. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 31.9 PERCENT (SELECTED MIX)
33.5 PERCENT (COMPANION)

STRAIN METER NUMBERS
AUTOGENOUS: 242 73 03
250 73 04
CREEP : 245 73 00
251 73 01
349 73 02

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
28	-.0007		0	0	0	0		
28	-.0003		-169	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
28	.0000	6.03	-348	0	0	0	0.	-.1657
28	.0049	5.44	-386	-38	0	-38	-.0181	-.1838
28	.0090	5.40	-389	-41	0	-41	-.0195	-.1852
28	.0229	5.29	-397	-49	0	-49	-.0233	-.1890
28	.0438	5.17	-406	-58	0	-58	-.0276	-.1933
28	.1271	4.99	-421	-73	0	-73	-.0348	-.2005
28	.2521	4.87	-431	-83	0	-83	-.0395	-.2052
29	.7972	4.65	-452	-104	2	-106	-.0505	-.2152
29	1.0021	4.59	-458	-110	2	-112	-.0533	-.2181
30	2.2	4.37	-481	-133	1	-134	-.0638	-.2290
31	3.0	4.26	-493	-145	-2	-143	-.0681	-.2348
32	4.0	4.15	-506	-158	-2	-156	-.0743	-.2410
33	5.0	4.09	-513	-165	-4	-161	-.0767	-.2443
35	7.0	3.96	-530	-182	-6	-176	-.0838	-.2524
37	8.9	3.89	-540	-192	-6	-186	-.0886	-.2571
39	11.0	3.81	-551	-203	-6	-197	-.0938	-.2624
43	14.9	3.63	-578	-230	-9	-221	-.1052	-.2752
48	20.0	3.58	-587	-239	-10	-229	-.1090	-.2795
55	27.0	3.48	-603	-255	-10	-245	-.1167	-.2871
64	35.8	3.39	-619	-271	-11	-260	-.1238	-.2948
68	40.0	3.34	-629	-281	-12	-269	-.1281	-.2995
72	43.8	3.30	-636	-288	-12	-276	-.1314	-.3029
75	46.8	3.28	-641	-293	-11	-282	-.1343	-.3052
82	54.0	3.23	-651	-303	-12	-291	-.1386	-.3100
87	58.7	3.19	-658	-310	-13	-297	-.1414	-.3133
89	61.0	3.16	-664	-316	-12	-304	-.1448	-.3162
96	67.8	3.14	-668	-320	-12	-308	-.1467	-.3181
103	74.8	3.11	-676	-328	-13	-315	-.1500	-.3219
117	88.8	3.03	-692	-344	-15	-329	-.1567	-.3295
132	103.9	2.97	-707	-359	-15	-344	-.1638	-.3367
163	134.9	2.87	-731	-383	-19	-364	-.1733	-.3481
189	160.8	2.83	-741	-393	-18	-375	-.1786	-.3529
210	182.0	2.79	-753	-405	-20	-385	-.1833	-.3586
253	224.8	2.71	-774	-426	-23	-403	-.1919	-.3686
280	252.0	2.67	-786	-438	-25	-413	-.1967	-.3743
308	279.9	2.63	-797	-449	-28	-421	-.2005	-.3795
337	308.8	2.59	-810	-462	-29	-433	-.2062	-.3857
376	347.7	2.57	-817	-469	-32	-437	-.2081	-.3890
408	379.7	2.53	-831	-483	-35	-448	-.2133	-.3957
436	407.8	2.51	-836	-488	-38	-450	-.2143	-.3981
450	421.8	2.50	-840	-492	-40	-452	-.2152	-.4000
479	450.8	2.48	-846	-498	-40	-458	-.2181	-.4029
513	484.8	2.44	-859	-511	-41	-470	-.2238	-.4090
544	515.9	2.40	-874	-526	-48	-478	-.2276	-.4162
573	544.9	2.39	-877	-529	-48	-481	-.2290	-.4176
611	582.9	2.37	-887	-539	-50	-489	-.2329	-.4224
636	608.0	2.35	-893	-545	-52	-493	-.2348	-.4252
670	642.0	2.33	-902	-554	-55	-499	-.2376	-.4295
735	706.7	2.30	-914	-566	-59	-507	-.2414	-.4352
797	768.7	2.26	-928	-580	-62	-518	-.2467	-.4419

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 73F, 90 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	343	73 12	21	6.3
NO.2	252	73 13	14	6.2
NO.3	337	73 14	8	6.0

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 7230. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 28.0 PERCENT (SELECTED MIX)
29.0 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
*12-19-73	1000	0	SPECIMENS CAST										
* 3-19-74	1017	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
3-19-74	1017	90.0	-.0007	71.6	0	0	0	0	0	0	0	0	0.
3-19-74	1017	90.0	-.0003	71.6	-161	-163	-168	-164	0	0	0	0	-.07810
* 3-19-74	1018	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
3-19-74	1018	90.0	.0C00	71.6	-333	-339	-348	-340	0	0	0	0	-.16190
3-19-74	1020	90.0	.0014	71.6	-343	-348	-355	-348	-10	-9	-7	-8	-.16571
3-19-74	1023	90.0	.0035	71.5	-348	-353	-360	-353	-15	-14	-12	-13	-.16810
3-19-74	1033	90.0	.0104	71.5	-355	-359	-364	-359	-22	-20	-16	-19	-.17095
3-19-74	1118	90.1	.0417	71.6	-363	-368	-372	-367	-30	-29	-24	-27	-.17476
3-19-74	1218	90.1	.0833	71.6	-369	-373	-376	-372	-36	-34	-28	-32	-.17714
3-19-74	1318	90.1	.1250	71.6	-375	-379	-382	-378	-42	-40	-34	-38	-.18000
3-19-74	2045	90.4	.4354	71.6	-390	-393	-395	-392	-57	-54	-47	-52	-.18667
3-20-74	1018	91.0	1.0000	71.2	-401	-404	-405	-403	-68	-65	-57	-63	-.19190
3-21-74	1140	92.1	2.1	71.3	-417	-419	-420	-418	-84	-80	-72	-78	-.19905
3-22-74	1345	93.2	3.1	71.2	-429	-430	-430	-429	-96	-91	-82	-89	-.20429
3-24-74	1440	95.2	5.2	70.9	-442	-442	-442	-442	-109	-103	-94	-102	-.21048
3-25-74	1200	96.1	6.1	71.1	-445	-445	-445	-445	-112	-106	-97	-105	-.21190
3-27-74	1715	98.3	8.3	71.4	-456	-456	-455	-455	-123	-117	-107	-115	-.21667
3-29-74	1130	100.1	10.1	71.2	-460	-460	-458	-459	-127	-121	-110	-119	-.21857
4 -1-74	1215	103.1	13.1	70.9	-473	-472	-471	-472	-140	-133	-123	-132	-.22476
4 -3-74	1200	105.1	15.1	71.1	-478	-479	-478	-478	-145	-140	-130	-138	-.22762
4 -4-74	1430	106.2	16.2	71.2	-483	-481	-480	-481	-150	-142	-132	-141	-.22905
4 -8-74	1640	110.3	20.3	71.1	-493	-491	-490	-491	-160	-152	-142	-151	-.23381
4-11-74	1705	113.3	23.3	71.4	-503	-500	-501	-501	-170	-161	-153	-161	-.23857
4-15-74	1015	117.0	27.0	71.7	-510	-508	-508	-508	-177	-169	-160	-168	-.24190
4-18-74	1340	120.2	30.1	70.9	-517	-514	-515	-515	-184	-175	-167	-175	-.24524
4-23-74	1530	125.2	35.2	71.1	-524	-522	-521	-522	-191	-183	-173	-182	-.24857
4-30-74	1435	132.2	42.2	72.0	-539	-535	-536	-536	-206	-196	-188	-196	-.25524
5 -6-74	1335	138.1	48.1	70.5	-550	-546	-545	-547	-217	-207	-197	-207	-.26048
5-13-74	1330	145.1	55.1	71.2	-556	-551	-550	-552	-223	-212	-202	-212	-.26286
5-21-74	855	153.0	62.9	71.1	-565	-561	-558	-561	-232	-222	-210	-221	-.26714
5-31-74	1440	163.2	73.2	72.8	-579	-574	-571	-574	-246	-235	-223	-234	-.27333
6-14-74	845	176.9	86.9	70.9	-589	-584	-579	-584	-256	-245	-231	-244	-.27810
6-26-74	1140	189.1	99.1	71.6	-597	-592	-587	-592	-264	-253	-239	-252	-.28190
7-24-74	1600	217.2	127.2	72.3	-615	-609	-603	-609	-282	-270	-255	-269	-.29000
8-21-74	1435	245.2	155.2	72.2	-634	-626	-621	-627	-301	-287	-273	-287	-.29857
9-18-74	900	273.0	182.9	71.7	-648	-640	-634	-640	-315	-301	-286	-300	-.30476
10 -9-74	1600	294.2	204.2	72.7	-656	-649	-642	-649	-323	-310	-294	-309	-.30905
11 -7-74	1100	323.0	233.0	72.4	-673	-665	-659	-665	-340	-326	-311	-325	-.31667
12-17-74	1430	363.2	273.2	72.1	-688	-678	-672	-679	-355	-339	-324	-339	-.32333
1-15-75	1330	392.1	302.1	73.1	-691	-682	-675	-682	-358	-343	-327	-342	-.32476
2-18-75	1430	426.2	336.2	72.2	-701	-690	-682	-691	-368	-351	-334	-351	-.32905
3-14-75	1100	450.0	360.0	72.2	-709	-698	-690	-699	-376	-359	-342	-359	-.33286
4-12-75	1200	479.1	389.1	72.3	-716	-705	-696	-705	-383	-366	-348	-365	-.33571
5-16-75	1130	513.1	423.0	73.2	-728	-717	-708	-717	-395	-378	-360	-377	-.34143
6-16-75	1230	544.1	454.1	73.0	-737	-724	-716	-725	-404	-385	-368	-385	-.34524
7-15-75	1400	573.2	483.2	73.3	-743	-728	-720	-730	-410	-389	-372	-390	-.34762
8-22-75	1315	611.1	521.1	72.9	-751	-736	-728	-738	-418	-397	-380	-398	-.35143
9-16-75	1640	636.3	546.3	73.1	-758	-743	-734	-745	-425	-404	-386	-405	-.35476
10-20-75	1530	670.2	580.2	73.2	-765	-748	-740	-751	-432	-409	-392	-411	-.35762
11-26-75	1450	707.2	617.2	73.0	-779	-762	-755	-765	-446	-423	-407	-425	-.36429
12-24-75	920	735.0	645.0	72.2	-778	-761	-752	-763	-445	-422	-404	-423	-.36333
2-24-76	930	797.0	707.0	72.2	-791	-773	-764	-776	-458	-434	-416	-436	-.36952

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 73F, 90 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 7230. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 28.0 PERCENT (SELECTED MIX)
29.0 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 242 73 03
250 73 04

CREEP : 343 73 12
252 73 13
337 73 14

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0007		0	0	0	0		
90	-.0003		-164	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
90	.0000	6.18	-340	0	0	0	0.	-.1619
90	.0014	6.03	-348	-8	0	-8	-.0038	-.1657
90	.0035	5.95	-353	-13	0	-13	-.0062	-.1681
90	.0104	5.85	-359	-19	0	-19	-.0090	-.1710
90	.0417	5.72	-367	-27	0	-27	-.0129	-.1748
90	.0833	5.65	-372	-32	0	-32	-.0152	-.1771
90	.1250	5.56	-378	-38	0	-38	-.0181	-.1800
90	.4354	5.36	-392	-52	0	-52	-.0248	-.1867
91	1.0000	5.21	-403	-63	0	-63	-.0300	-.1919
92	2.1	5.02	-418	-78	-1	-77	-.0367	-.1990
93	3.1	4.90	-429	-89	0	-89	-.0424	-.2043
95	5.2	4.75	-442	-102	-2	-100	-.0476	-.2105
96	6.1	4.72	-445	-105	-1	-104	-.0495	-.2119
98	8.3	4.62	-455	-115	-2	-113	-.0538	-.2167
100	10.1	4.58	-459	-119	-1	-118	-.0562	-.2186
103	13.1	4.45	-472	-132	-2	-130	-.0619	-.2248
105	15.1	4.39	-478	-138	-2	-136	-.0648	-.2276
106	16.2	4.37	-481	-141	-3	-138	-.0657	-.2290
110	20.3	4.28	-491	-151	-2	-149	-.0710	-.2338
113	23.3	4.19	-501	-161	-3	-158	-.0752	-.2386
117	27.0	4.13	-508	-168	-4	-164	-.0781	-.2419
120	30.1	4.08	-515	-175	-3	-172	-.0819	-.2452
125	35.2	4.02	-522	-182	-4	-178	-.0848	-.2486
132	42.2	3.92	-536	-196	-4	-192	-.0914	-.2552
138	48.1	3.84	-547	-207	-6	-201	-.0957	-.2605
145	55.1	3.80	-552	-212	-5	-207	-.0986	-.2629
153	62.9	3.74	-561	-221	-6	-215	-.1024	-.2671
163	73.2	3.66	-574	-234	-8	-226	-.1076	-.2733
177	86.9	3.60	-584	-244	-6	-238	-.1133	-.2781
189	99.1	3.55	-592	-252	-7	-245	-.1167	-.2819
217	127.2	3.45	-609	-269	-8	-261	-.1243	-.2900
245	155.2	3.35	-627	-287	-10	-277	-.1319	-.2986
273	182.9	3.28	-640	-300	-12	-288	-.1371	-.3048
294	204.2	3.24	-649	-309	-14	-295	-.1405	-.3090
323	233.0	3.16	-665	-325	-17	-308	-.1467	-.3167
363	273.2	3.09	-679	-339	-20	-319	-.1519	-.3233
392	302.1	3.08	-682	-342	-24	-318	-.1514	-.3248
426	336.2	3.04	-691	-351	-27	-324	-.1543	-.3290
450	360.0	3.00	-699	-359	-29	-330	-.1571	-.3329
479	389.1	2.98	-705	-365	-29	-336	-.1600	-.3357
513	423.0	2.93	-717	-377	-30	-347	-.1652	-.3414
544	454.1	2.90	-725	-385	-37	-348	-.1657	-.3452
573	483.2	2.88	-730	-390	-37	-353	-.1681	-.3476
611	521.1	2.85	-738	-398	-39	-359	-.1710	-.3514
636	546.3	2.82	-745	-405	-41	-364	-.1733	-.3548
670	580.2	2.80	-751	-411	-44	-367	-.1748	-.3576
707	617.2	2.75	-765	-425	-47	-378	-.1800	-.3643
735	645.0	2.75	-763	-423	-48	-375	-.1786	-.3633
797	707.0	2.71	-776	-436	-51	-385	-.1833	-.3695

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 73F, 90 DAY, 45 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 3220 PSI)
NO.1	372	73 19	17	6.1
NO.2	358	73 20	12	6.0
NO.3	359	73 18	15	6.1

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 7000. PSI AT 73.F.
APPLIED TEST STRESS : 3220. PSI
PER. ULT. STR. APPLIED: 42.9 PERCENT (SELECTED MIX)
46.0 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 3220 PSI
* 1-10-74	1500	0	SPECIMENS CAST										
* 4-10-74	1328	89.9	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1610 PSI (PLUS OR MINUS 30), RESPECTIVELY										
4-10-74	1328	89.9	-.0014	71.3	0	0	0	0	0	0	0	0	0.
4-10-74	1329	89.9	-.0007	71.3	-237	-245	-245	-242	0	0	0	0	-.07516
* 4-10-74	1330	89.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 3220 PSI										
4-10-74	1330	89.9	0.	71.3	-524	-534	-527	-528	0	0	0	0	-.16398
4-10-74	1333	89.9	.0021	71.4	-547	-548	-532	-542	-23	-14	-5	-14	-.16832
4-10-74	1335	89.9	.0035	71.4	-552	-553	-555	-553	-28	-19	-28	-25	-.17174
4-10-74	1345	89.9	.0104	71.1	-566	-564	-568	-566	-42	-30	-41	-37	-.17578
4-10-74	1400	90.0	.0208	71.1	-577	-572	-579	-576	-53	-38	-52	-47	-.17888
4-10-74	1430	90.0	.0417	71.6	-587	-581	-588	-585	-63	-47	-61	-57	-.18168
4-10-74	1630	90.1	.1250	71.7	-609	-600	-609	-606	-85	-66	-82	-77	-.18820
4-10-74	1720	90.1	.1597	71.5	-614	-604	-613	-610	-90	-70	-86	-82	-.18944
4-10-74	2200	90.3	.3542	70.9	-633	-621	-631	-628	-109	-87	-104	-100	-.19503
4-11-74	815	90.7	.7813	71.4	-654	-640	-652	-648	-130	-106	-125	-120	-.20124
4-11-74	1325	90.9	.9965	71.5	-663	-648	-660	-657	-139	-114	-133	-128	-.20404
4-12-74	1410	92.0	2.0	71.6	-686	-670	-682	-679	-162	-136	-155	-151	-.21087
4-13-74	1115	92.8	2.9	71.7	-700	-682	-696	-692	-176	-148	-169	-164	-.21491
4-14-74	1520	94.0	4.1	71.6	-714	-695	-709	-706	-190	-161	-182	-177	-.21925
4-15-74	1015	94.8	4.9	71.6	-724	-705	-719	-716	-200	-171	-192	-187	-.22236
4-16-74	1625	96.1	6.1	71.6	-737	-717	-732	-728	-213	-183	-205	-200	-.22609
4-18-74	1340	97.9	8.0	71.2	-750	-729	-744	-741	-226	-195	-217	-212	-.23012
4-19-74	1420	99.0	9.0	70.7	-756	-734	-749	-746	-232	-200	-222	-218	-.23168
4-20-74	1115	99.8	9.9	70.9	-764	-743	-758	-755	-240	-209	-231	-226	-.23447
4-23-74	1530	103.0	13.1	71.2	-781	-758	-774	-771	-257	-224	-247	-242	-.23944
4-25-74	1515	105.0	15.1	71.2	-791	-767	-783	-780	-267	-233	-256	-252	-.24224
4-30-74	1435	110.0	20.0	72.1	-817	-792	-808	-805	-293	-258	-281	-277	-.25000
5 -6-74	1335	115.9	26.0	70.7	-838	-813	-829	-826	-314	-279	-302	-298	-.25652
5-13-74	1330	122.9	33.0	71.4	-858	-833	-849	-846	-334	-299	-322	-318	-.26273
5-16-74	1500	126.0	36.1	71.9	-865	-839	-855	-853	-341	-305	-328	-324	-.26491
5-21-74	855	130.7	40.8	71.3	-867	-840	-857	-854	-343	-306	-330	-326	-.26522
5-28-74	1140	137.9	47.9	72.0	-893	-865	-881	-879	-369	-331	-354	-351	-.27298
6 -4-74	1935	145.2	55.3	72.1	-910	-879	-895	-894	-386	-345	-368	-366	-.27764
6-10-74	1512	151.0	61.1	71.9	-922	-892	-908	-907	-398	-358	-381	-379	-.28168
6-20-74	1340	160.9	71.0	71.2	-941	-905	-922	-922	-417	-371	-395	-394	-.28634
6-26-74	1140	166.9	76.9	71.7	-947	-915	-930	-930	-423	-381	-403	-402	-.28882
7-17-74	1500	188.0	98.1	72.7	-978	-942	-957	-959	-454	-408	-430	-430	-.29783
7-31-74	1715	202.1	112.2	72.4	-995	-959	-973	-975	-471	-425	-446	-447	-.30280
8 -8-74	1200	209.9	119.9	72.3	-1005	-969	-983	-986	-481	-435	-456	-457	-.30590
9-11-74	1315	243.9	154.0	72.5	-1034	-997	-1010	-1013	-510	-463	-483	-485	-.31460
10 -9-74	1600	272.0	182.1	72.7	-1051	-1012	-1026	-1029	-527	-478	-499	-501	-.31957
10-23-74	1420	286.0	196.0	72.6	-1069	-1028	-1042	-1046	-545	-494	-515	-518	-.32484
11-21-74	1000	314.8	224.9	72.4	-1086	-1046	-1058	-1063	-562	-512	-531	-535	-.33012
12-17-74	1430	341.0	251.0	72.0	-1105	-1070	-1077	-1084	-581	-536	-550	-555	-.33665
1-15-75	1330	369.9	280.0	73.1	-1116	-1074	-1085	-1091	-592	-540	-558	-563	-.33882
2-18-75	1430	404.0	314.0	72.2	-1136	-1089	-1104	-1109	-612	-555	-577	-581	-.34441
3-14-75	1100	427.8	337.9	72.3	-1149	-1102	-1117	-1122	-625	-568	-590	-594	-.34845
4-12-75	1200	456.9	366.9	72.3	-1160	-1110	-1126	-1132	-636	-576	-599	-603	-.35155
5-19-75	905	493.8	403.8	72.7	-1174	-1122	-1139	-1145	-650	-588	-612	-616	-.35559
* 5-19-75	906	493.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
5-19-75	906	493.8	0.	72.7	-708	-642	-685	-678	-184	-108	-158	-150	
5-19-75	908	493.8	.0014	72.7	-691	-625	-657	-657	-167	-91	-130	-129	
5-19-75	922	493.8	.0111	72.7	-677	-613	-642	-644	-153	-79	-115	-115	
5-19-75	1007	493.8	.0424	72.8	-669	-605	-633	-635	-145	-71	-106	-107	
5-19-75	1055	493.8	.0757	72.6	-664	-601	-629	-631	-140	-67	-102	-103	
5-20-75	1105	494.8	1.0826	73.5	-639	-576	-604	-606	-115	-42	-77	-78	
5-21-75	935	495.8	2.0	72.7	-630	-570	-596	-598	-106	-36	-69	-70	
5-22-75	1400	497.0	3.2	72.9	-623	-562	-588	-591	-99	-28	-61	-62	
5-26-75	900	500.7	7.0	73.0	-607	-544	-572	-574	-83	-10	-45	-46	
6 -2-75	1100	507.8	14.1	72.9	-594	-532	-559	-561	-70	2	-32	-33	
6-16-75	1230	521.9	28.1	72.8	-577	-516	-543	-545	-53	18	-16	-17	
7 -1-75	1545	537.0	43.3	73.0	-566	-503	-533	-534	-42	31	-6	-5	
7-15-75	1400	551.0	57.2	73.1	-558	-494	-525	-525	-34	40	2	2	
7-31-75	1550	567.0	73.3	73.2	-552	-488	-519	-519	-28	46	8	8	
8-18-75	1630	585.1	91.3	70.8	-520	-456	0	-488	4	78	0	41	
* 8-18-75	1700	585.1	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 73F, 90 DAY, 45 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 7000. PSI AT 73.F.
APPLIED TEST STRESS : 3220. PSI
PER. ULT. STR. APPLIED: 42.9 PERCENT (SELECTED MIX)
46.0 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 242 73 03
250 73 04

CREEP : 372 73 19
358 73 20
359 73 18

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 3220 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0014		0	0	0	0		
90	-.0007		-242	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 3220 PSI								
90	0.	6.10	-528	0	0	0	0.	-.1640
90	.0021	5.94	-542	-14	0	-14	-.0043	-.1683
90	.0035	5.82	-553	-25	0	-25	-.0078	-.1717
90	.0104	5.69	-566	-37	0	-37	-.0115	-.1758
90	.0208	5.59	-576	-47	0	-47	-.0146	-.1789
90	.0417	5.50	-585	-57	0	-57	-.0177	-.1817
90	.1250	5.31	-606	-77	0	-77	-.0239	-.1882
90	.1597	5.28	-610	-82	0	-82	-.0255	-.1894
90	.3542	5.13	-628	-100	0	-100	-.0311	-.1950
91	.7813	4.97	-648	-120	0	-120	-.0373	-.2012
91	.9965	4.90	-657	-128	0	-128	-.0398	-.2040
92	2.0	4.74	-679	-151	-1	-150	-.0466	-.2109
93	2.9	4.65	-692	-164	0	-164	-.0509	-.2149
94	4.1	4.56	-706	-177	-1	-176	-.0547	-.2193
95	4.9	4.50	-716	-187	-2	-185	-.0575	-.2224
96	6.1	4.42	-728	-200	-1	-199	-.0618	-.2261
98	8.0	4.35	-741	-212	-2	-210	-.0652	-.2301
99	9.0	4.32	-746	-218	-1	-217	-.0674	-.2317
100	9.9	4.26	-755	-226	-1	-225	-.0699	-.2345
103	13.1	4.18	-771	-242	-2	-240	-.0745	-.2394
105	15.1	4.13	-780	-252	-2	-250	-.0776	-.2422
110	20.0	4.00	-805	-277	-2	-275	-.0854	-.2500
116	26.0	3.90	-826	-298	-3	-295	-.0916	-.2565
123	33.0	3.81	-846	-318	-4	-314	-.0975	-.2627
126	36.1	3.77	-853	-324	-4	-320	-.0994	-.2649
131	40.8	3.77	-854	-326	-4	-322	-.1000	-.2652
138	47.9	3.66	-879	-351	-6	-345	-.1071	-.2730
145	55.3	3.60	-894	-366	-5	-361	-.1121	-.2776
151	61.1	3.55	-907	-379	-5	-374	-.1161	-.2817
161	71.8	3.49	-922	-394	-7	-387	-.1202	-.2863
167	76.9	3.46	-930	-402	-7	-395	-.1227	-.2888
188	98.1	3.36	-959	-430	-7	-423	-.1314	-.2978
202	112.2	3.30	-976	-447	-8	-439	-.1363	-.3028
210	119.9	3.27	-985	-457	-9	-448	-.1391	-.3059
244	154.0	3.18	-1013	-485	-10	-475	-.1475	-.3146
272	182.1	3.13	-1029	-501	-12	-489	-.1519	-.3196
286	196.0	3.08	-1046	-518	-13	-505	-.1568	-.3248
315	224.9	3.03	-1063	-535	-16	-519	-.1612	-.3301
341	251.0	2.97	-1084	-555	-18	-537	-.1668	-.3366
370	280.0	2.95	-1091	-563	-20	-543	-.1686	-.3388
404	314.0	2.90	-1109	-581	-24	-557	-.1730	-.3444
428	337.9	2.87	-1122	-594	-26	-568	-.1764	-.3484
457	366.9	2.84	-1132	-603	-28	-575	-.1786	-.3516
494	403.8	2.81	-1145	-616	-29	-587	-.1823	-.3556
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
494	0.		-678	-150	-29	-121		
494	.0014		-657	-129	-29	-100		
494	.0111		-644	-115	-29	-86		
494	.0424		-635	-107	-29	-78		
494	.0757		-631	-103	-29	-74		
495	1.0826		-606	-78	-29	-49		
496	2.0		-598	-70	-29	-41		
497	3.2		-591	-62	-29	-33		
501	7.0		-574	-46	-29	-17		
508	14.1		-561	-33	-30	-3		
522	28.1		-545	-17	-30	13		
537	43.3		-534	-5	-33	28		
551	57.2		-525	2	-36	38		
567	73.3		-519	8	-37	45		
585	91.3		-488	41	-38	79		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 73F, 90 DAY, 60 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 4200 PSI)
NO.1	374	73 16	29	6.0
NO.2	360	73 17	10	6.0
NO.3	354	73 15	14	5.8

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 7000. PSI AT 73.F.
APPLIED TEST STRESS : 4200. PSI
PER. ULT. STR. APPLIED: 55.9 PERCENT (SELECTED MIX)
60.0 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 4200 PSI
* 1-10-74	1500	0	SPECIMENS CAST										
* 4-10-74	1417	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0, 1610, AND 3220 PSI (PLUS OR MINUS 30), RESPECTIVELY										
4-10-74	1417	90.0	-.0021	71.4	0	0	0	0	0	0	0	0	0.
4-10-74	1418	90.0	-.0014	71.4	-225	-228	-237	-230	0	0	0	0	-.05476
4-10-74	1419	90.0	-.0007	71.4	-499	-503	-527	-509	0	0	0	0	-.12119
* 4-10-74	1420	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 4200 PSI										
4-10-74	1420	90.0	0.	71.4	-701	-695	-726	-707	0	0	0	0	-.16833
4-10-74	1422	90.0	.0014	71.5	-722	-711	-746	-726	-21	-16	-20	-19	-.17286
4-10-74	1423	90.0	.0021	71.5	-730	-717	-753	-733	-29	-22	-27	-26	-.17452
4-10-74	1425	90.0	.0035	71.5	-739	-724	-761	-741	-38	-29	-35	-34	-.17643
4-10-74	1430	90.0	.0069	71.4	-757	-738	-776	-757	-56	-43	-50	-49	-.18024
4-10-74	1435	90.0	.0104	71.4	-769	-748	-787	-768	-68	-53	-61	-60	-.18286
4-10-74	1450	90.0	.0208	71.3	-792	-766	-806	-788	-91	-71	-80	-80	-.18762
4-10-74	1523	90.0	.0438	71.4	-819	-789	-831	-813	-118	-94	-105	-105	-.19357
4-10-74	1630	90.1	.0903	71.5	-848	-812	-855	-838	-147	-117	-129	-131	-.19952
4-10-74	1720	90.1	.1250	71.5	-860	-823	-866	-849	-159	-128	-140	-142	-.20214
4-10-74	2200	90.3	.3194	70.9	-907	-861	-906	-891	-206	-166	-180	-184	-.21214
4-11-74	815	90.7	.7465	71.3	-952	-900	-945	-932	-251	-205	-219	-225	-.22190
4-11-74	1325	90.9	.9618	71.4	-968	-914	-960	-947	-267	-219	-234	-240	-.22548
4-11-74	2215	91.3	1.3299	71.4	-987	-930	-975	-964	-286	-235	-249	-256	-.22952
4-12-74	1410	92.0	1.9931	71.7	-1015	-954	-999	-989	-314	-259	-273	-282	-.23548
4-13-74	1115	92.8	2.9	71.8	-1040	-977	-1021	-1012	-339	-282	-295	-305	-.24095
4-14-74	1520	94.0	4.0	71.8	-1065	-998	-1043	-1035	-364	-303	-317	-328	-.24643
4-15-74	1015	94.8	4.8	71.7	-1082	-1014	-1059	-1051	-381	-319	-333	-344	-.25024
4-16-74	1625	96.1	6.1	71.7	-1104	-1034	-1080	-1072	-403	-339	-354	-365	-.25524
4-18-74	1340	97.9	8.0	71.0	-1126	-1053	-1097	-1092	-425	-358	-371	-384	-.26000
4-19-74	1420	99.0	9.0	70.6	-1135	-1062	-1105	-1100	-434	-367	-379	-393	-.26190
4-20-74	1115	99.8	9.9	70.9	-1147	-1073	-1117	-1112	-446	-378	-391	-405	-.26476
4-23-74	1530	103.0	13.0	71.1	-1175	-1099	-1142	-1138	-474	-404	-416	-431	-.27095
4-25-74	1515	105.0	15.0	71.1	-1188	-1111	-1154	-1151	-487	-416	-428	-443	-.27405
4-30-74	1435	110.0	20.0	72.2	-1226	-1147	-1191	-1188	-525	-452	-465	-480	-.28286
5 -6-74	1335	115.9	26.0	70.6	-1259	-1176	-1220	-1218	-558	-481	-494	-511	-.29000
5-13-74	1330	122.9	33.0	71.4	-1289	-1205	-1248	-1247	-588	-510	-522	-540	-.29690
5-16-74	1500	126.0	36.0	71.9	-1301	-1215	-1259	-1258	-600	-520	-533	-551	-.29952
5-21-74	855	130.7	40.8	71.2	-1307	-1220	-1263	-1263	-606	-525	-537	-556	-.30071
5-28-74	1140	137.9	47.9	72.2	-1343	-1284	-1299	-1298	-642	-559	-573	-591	-.30905
6 -4-74	1935	145.2	55.2	72.3	-1366	-1276	-1320	-1320	-665	-581	-594	-613	-.31429
6-10-74	1512	151.0	61.0	72.1	-1383	-1293	-1336	-1337	-682	-598	-610	-630	-.31833
6-20-74	1340	160.9	71.0	71.3	-1407	-1318	-1361	-1362	-706	-623	-635	-654	-.32429
6-26-74	1140	166.9	76.9	71.7	-1419	-1327	-1369	-1371	-718	-632	-643	-664	-.32643
7-17-74	1500	188.0	98.0	72.8	-1454	-1359	-1402	-1405	-753	-664	-676	-697	-.33452
7-31-74	1715	202.1	112.1	72.5	-1480	-1384	-1426	-1430	-779	-689	-700	-722	-.34048
8 -8-74	1200	209.9	119.9	72.4	-1502	-1405	-1446	-1451	-801	-710	-720	-743	-.34548
9-11-74	1315	243.9	154.0	72.7	-1550	-1449	-1492	-1497	-849	-754	-766	-789	-.35643
10 -9-74	1600	272.0	182.1	72.9	-1585	-1480	-1524	-1529	-884	-785	-798	-822	-.36405
11 -7-74	1100	300.8	210.9	72.5	-1614	-1509	-1554	-1559	-913	-814	-828	-851	-.37119
12-10-74	1230	333.9	243.9	72.0	-1644	-1536	-1581	-1587	-943	-841	-855	-879	-.37786
1-15-75	1330	369.9	280.0	73.0	-1663	-1552	-1599	-1604	-962	-857	-873	-897	-.38190
2-18-75	1430	404.0	314.0	72.0	-1690	-1577	-1625	-1630	-989	-882	-899	-923	-.38810
3-14-75	1100	427.8	337.9	72.0	-1703	-1588	-1638	-1643	-1002	-893	-912	-935	-.39119
4-12-75	1200	456.9	366.9	72.2	-1717	-1599	-1651	-1655	-1016	-904	-925	-948	-.39405
5-19-75	1038	493.8	403.8	72.7	-1738	-1618	-1672	-1676	-1037	-923	-946	-968	-.39905
* 5-19-75	1040	493.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
5-19-75	1040	493.8	0.	72.7	-1110	-964	-1037	-1037	-409	-269	-311	-329	
5-19-75	1042	493.8	.0014	73.0	-1092	-950	-1014	-1018	-391	-255	-288	-311	
5-19-75	1045	493.8	.0035	72.8	-1087	-944	-1009	-1013	-386	-249	-283	-306	
5-19-75	1055	493.8	.0104	72.4	-1078	-936	-1001	-1005	-377	-241	-275	-297	
5-20-75	1105	494.8	1.0174	73.5	-1021	-880	-949	-950	-320	-185	-223	-242	
5-21-75	935	495.8	2.0	72.6	-1009	-868	-935	-937	-308	-173	-209	-230	
5-22-75	1400	497.0	3.1	72.9	-999	-857	-925	-927	-298	-162	-199	-219	
5-26-75	900	500.7	6.9	72.9	-976	-834	-904	-904	-275	-139	-178	-197	
6 -2-75	1100	507.8	14.0	72.9	-959	-817	-886	-887	-258	-122	-160	-180	
6-16-75	1230	521.9	28.1	72.8	-937	-794	-866	-865	-236	-99	-140	-158	
7 -1-75	1545	537.0	43.2	72.8	-921	-778	-850	-849	-220	-83	-124	-142	
7-15-75	1400	551.0	57.1	73.1	-911	-767	-841	-839	-210	-72	-115	-132	
7-31-75	1550	567.0	73.2	73.1	-902	-759	-832	-831	-201	-64	-106	-123	
8-18-75	1430	585.0	91.2	71.4	-869	-724	0	-796	-168	-29	0	-98	
* 8-18-75	1600	585.0	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 73F, 90 DAY, 60 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 7000. PSI AT 73.F.
APPLIED TEST STRESS : 4200. PSI
PER. ULT. STR. APPLIED: 55.9 PERCENT (SELECTED MIX)
60.0 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 242 73 03
250 73 04

CREEP : 374 73 16
360 73 17
354 73 15

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 4200 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0021		0	0	0	0		
90	-.0014		-230	0	0	0		
90	-.0007		-509	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 4200 PSI								
90	0.	5.94	-707	0	0	0	0.	-.1683
90	.0014	5.79	-726	-19	0	-19	-.0045	-.1729
90	.0021	5.73	-733	-26	0	-26	-.0062	-.1745
90	.0035	5.67	-741	-34	0	-34	-.0081	-.1764
90	.0069	5.55	-757	-49	0	-49	-.0117	-.1802
90	.0104	5.47	-768	-60	0	-60	-.0143	-.1829
90	.0208	5.33	-788	-80	0	-80	-.0190	-.1876
90	.0438	5.17	-813	-105	0	-105	-.0250	-.1936
90	.0903	5.01	-838	-131	0	-131	-.0312	-.1995
90	.1250	4.95	-849	-142	0	-142	-.0338	-.2021
90	.3194	4.71	-891	-184	0	-184	-.0438	-.2121
91	.7465	4.51	-932	-225	0	-225	-.0536	-.2219
91	.9618	4.44	-947	-240	0	-240	-.0571	-.2255
91	1.3299	4.36	-964	-256	0	-256	-.0610	-.2295
92	2.0	4.25	-989	-282	-1	-281	-.0669	-.2355
93	2.9	4.15	-1012	-305	0	-305	-.0726	-.2410
94	4.0	4.06	-1035	-328	-1	-327	-.0779	-.2464
95	4.8	4.00	-1051	-344	-2	-342	-.0814	-.2502
96	6.1	3.92	-1072	-365	-1	-364	-.0867	-.2552
98	8.0	3.85	-1092	-384	-2	-382	-.0910	-.2600
99	9.0	3.82	-1100	-393	-1	-392	-.0933	-.2619
100	9.9	3.78	-1112	-405	-1	-404	-.0962	-.2648
103	13.0	3.69	-1138	-431	-2	-429	-.1021	-.2710
105	15.0	3.65	-1151	-443	-2	-441	-.1050	-.2740
110	20.0	3.54	-1188	-480	-2	-478	-.1138	-.2829
116	26.0	3.45	-1218	-511	-3	-508	-.1210	-.2900
123	33.0	3.37	-1247	-540	-4	-536	-.1276	-.2969
126	36.0	3.34	-1258	-551	-4	-547	-.1302	-.2995
131	40.8	3.33	-1263	-556	-4	-552	-.1314	-.3007
138	47.9	3.24	-1298	-591	-6	-585	-.1393	-.3090
145	55.2	3.18	-1320	-613	-5	-608	-.1448	-.3143
151	61.0	3.14	-1337	-630	-5	-625	-.1488	-.3183
161	71.0	3.08	-1362	-654	-7	-647	-.1540	-.3243
167	76.9	3.06	-1371	-664	-7	-657	-.1564	-.3264
188	98.0	2.99	-1405	-697	-7	-690	-.1643	-.3345
202	112.1	2.94	-1430	-722	-8	-714	-.1700	-.3405
210	119.9	2.89	-1451	-743	-9	-734	-.1748	-.3455
244	154.0	2.81	-1497	-789	-10	-779	-.1855	-.3564
272	182.1	2.75	-1529	-822	-12	-810	-.1929	-.3640
301	210.9	2.69	-1559	-851	-14	-837	-.1993	-.3712
334	243.9	2.65	-1587	-879	-18	-861	-.2050	-.3779
370	280.0	2.62	-1604	-897	-20	-877	-.2088	-.3819
404	314.0	2.58	-1630	-923	-24	-899	-.2140	-.3881
428	337.9	2.56	-1643	-935	-26	-909	-.2164	-.3912
457	366.9	2.54	-1655	-948	-28	-920	-.2190	-.3940
494	403.8	2.51	-1676	-968	-29	-939	-.2236	-.3990
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
494	0.		-1037	-329	-29	-300		
494	.0014		-1018	-311	-29	-282		
494	.0035		-1013	-306	-29	-277		
494	.0104		-1005	-297	-29	-268		
495	1.0174		-950	-242	-29	-213		
496	2.0		-937	-230	-29	-201		
497	3.1		-927	-219	-29	-190		
501	6.9		-904	-197	-29	-168		
508	14.0		-887	-180	-30	-150		
522	28.1		-865	-158	-30	-128		
537	43.2		-849	-142	-33	-109		
551	57.1		-839	-132	-36	-96		
567	73.2		-831	-123	-37	-86		
585	91.2		-796	-98	-38	-60		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 73F, 270 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2400 PSI)
NO.1	240	73 30	15	6.3
NO.2	255	73 31	21	6.4
NO.3	259	73 32	15	6.4

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 7900. PSI AT 73.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
30.4 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/2400 PSI
*12-19-73	1000	0	SPECIMENS CAST										
* 9-16-74	1009	271.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1200 PSI (PLUS OR MINUS 30), RESPECTIVELY										
9-16-74	1009	271.0	-.0007	71.4	0	0	0	0	0	0	0	0	0.
9-16-74	1009	271.0	-.0003	71.6	-176	-178	-176	-176	0	0	0	0	-.07333
* 9-16-74	1010	271.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2400 PSI										
9-16-74	1010	271.0	0.	71.6	-379	-376	-374	-376	0	0	0	0	-.15667
9-16-74	1011	271.0	.0007	71.5	-384	-383	-380	-382	-5	-7	-6	-6	-.15917
9-16-74	1015	271.0	.0035	71.3	-392	-391	-389	-390	-13	-15	-15	-14	-.16250
9-16-74	1025	271.0	.0104	71.4	-399	-400	-397	-398	-20	-24	-23	-22	-.16583
9-16-74	1110	271.0	.0417	71.5	-400	-402	-399	-400	-21	-26	-25	-24	-.16667
9-16-74	1430	271.2	.1806	71.6	-412	-415	-411	-412	-33	-39	-37	-36	-.17167
9-16-74	1610	271.3	.2500	71.7	-415	-419	-415	-416	-36	-43	-41	-40	-.17333
9-17-74	840	271.9	.9375	71.6	-431	-436	-431	-432	-52	-60	-57	-56	-.18000
9-18-74	900	273.0	1.9514	71.3	-441	-447	-441	-443	-62	-71	-67	-66	-.18458
9-19-74	950	274.0	3.0	71.3	-448	-454	-448	-450	-69	-78	-74	-73	-.18750
9-20-74	1100	275.0	4.0	71.5	-454	-461	-455	-456	-75	-85	-81	-80	-.19000
9-23-74	1105	278.0	7.0	71.4	-466	-474	-467	-469	-87	-98	-93	-92	-.19542
9-25-74	1600	280.2	9.2	71.3	-473	-482	-474	-476	-94	-106	-100	-100	-.19833
9-27-74	1130	282.1	11.1	71.1	-480	-489	-481	-483	-101	-113	-107	-107	-.20125
10 -2-74	1315	287.1	16.1	72.0	-494	-503	-495	-497	-115	-127	-121	-121	-.20708
10 -9-74	1600	294.2	23.2	72.5	-504	-514	-505	-507	-125	-138	-131	-131	-.21125
10-22-74	1200	307.1	36.1	72.1	-529	-540	-529	-532	-150	-164	-155	-156	-.22167
10-28-74	1330	313.1	42.1	72.2	-535	-546	-535	-538	-156	-170	-161	-162	-.22417
11 -7-74	1100	323.0	52.0	72.3	-546	-558	-547	-550	-167	-182	-173	-174	-.22917
11-18-74	810	333.9	62.9	71.5	-551	-565	-554	-556	-172	-189	-180	-180	-.23167
12 -4-74	1350	350.2	79.2	71.8	-560	-574	-562	-565	-181	-198	-188	-189	-.23542
12-10-74	1230	356.1	85.1	71.9	-565	-579	-567	-570	-186	-203	-193	-194	-.23750
12-17-74	1430	363.2	92.2	72.0	-575	-590	-578	-581	-196	-214	-204	-204	-.24208
12-30-74	840	375.9	104.9	71.3	-579	-594	-581	-584	-200	-218	-207	-208	-.24333
1-31-75	830	407.9	136.9	71.3	-600	-617	-604	-607	-221	-241	-230	-230	-.25292
2-28-75	1000	436.0	165.0	72.3	-610	-627	-614	-617	-231	-251	-240	-240	-.25708
3-14-75	1100	450.0	179.0	72.0	-619	-635	-623	-625	-240	-259	-249	-249	-.26042
4-12-75	1200	479.1	208.1	72.1	-627	-643	-633	-634	-248	-267	-259	-258	-.26417
5-16-75	1130	513.1	242.1	72.8	-646	-659	-653	-652	-267	-283	-279	-276	-.27167
6-16-75	1148	544.1	273.1	72.1	-629	-647	-641	-639	-250	-271	-267	-262	-.26625
6-16-75	1200	544.1	273.1	71.6	-611	-635	-617	-621	-232	-259	-243	-244	-.25875
6-16-75	1600	544.2	273.2	98.0	-634	-656	-641	-643	-255	-280	-267	-267	-.26792
6-17-75	1130	545.1	274.1	110.1	-683	-704	-686	-691	-304	-328	-312	-314	-.28792
6-25-75	830	552.9	281.9	110.4	-707	-733	-713	-717	-328	-357	-339	-341	-.29875
6-27-75	1500	555.2	284.2	110.8	-718	-742	-723	-726	-336	-366	-349	-350	-.30250
7-15-75	1330	573.1	302.1	110.9	-767	-797	-776	-780	-388	-421	-402	-403	-.32500
9-16-75	1420	636.2	365.2	110.4	-873	-908	-888	-889	-494	-532	-514	-513	-.37042
* 9-16-75	1421	636.2	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
9-16-75	1421	636.2	0.	110.5	-498	-535	-524	-519	-119	-159	-150	-142	
9-16-75	1426	636.2	.0035	110.5	-493	-528	-516	-512	-114	-152	-142	-136	
9-16-75	1436	636.2	.0104	110.3	-487	-522	-510	-506	-108	-146	-136	-130	
9-16-75	1557	636.2	.0667	110.3	-473	-509	-497	-493	-94	-133	-123	-116	
9-17-75	1700	637.3	1.1104	110.1	-444	-478	-468	-463	-65	-102	-94	-87	
10-22-75	1045	672.0	35.8	110.2	-368	-406	-397	-390	11	-30	-23	-14	
11-25-75	1545	706.2	70.1	109.3	-360	-399	-391	-383	19	-23	-17	-7	
11-26-75	1500	707.2	71.0	97.5	-361	-403	0	-382	18	-27	0	-4	
12 -1-75	1315	712.1	76.0	71.0	-363	-410	0	-386	16	-34	0	-9	
*12 -1-75	1345	712.2	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMENS SUBJECTED TO 110F, 6-16-75 1200

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 73F, 270 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 7900. PSI AT 73.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
30.4 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 242 73 03
250 73 04

CREEP : 240 73 30
255 73 31
259 73 32

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	MICROSTRAIN: ELASTIC, CREEP PLUS AUTOGENOUS	MICROSTRAIN: CREEP PLUS AUTOGENOUS	MICROSTRAIN: AUTOGENOUS	MICROSTRAIN: CREEP	MICROSTRAIN PER PSI: SPECIFIC CREEP	MICROSTRAIN PER PSI: TOTAL STRAIN DIVIDED BY 2400 PSI
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
271	-.0007		0	0	0	0		
271	-.0003		-176	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2400 PSI								
271	0.	6.38	-376	0	0	0	0.	-.1567
271	.0007	6.28	-382	-6	0	-6	-.0025	-.1592
271	.0035	6.15	-390	-14	0	-14	-.0058	-.1625
271	.0104	6.03	-398	-22	0	-22	-.0092	-.1658
271	.0417	6.00	-400	-24	0	-24	-.0100	-.1667
271	.1806	5.83	-412	-36	0	-36	-.0150	-.1717
271	.2500	5.77	-416	-40	0	-40	-.0167	-.1733
272	.9375	5.56	-432	-56	0	-56	-.0233	-.1800
273	2.0	5.42	-443	-66	0	-66	-.0275	-.1846
274	3.0	5.33	-450	-73	-1	-72	-.0300	-.1875
275	4.0	5.26	-456	-80	-1	-79	-.0329	-.1900
278	7.0	5.12	-469	-92	-1	-91	-.0379	-.1954
280	9.2	5.04	-476	-100	-2	-98	-.0408	-.1983
282	11.1	4.97	-483	-107	-1	-106	-.0442	-.2012
287	16.1	4.83	-497	-121	-1	-120	-.0500	-.2071
294	23.2	4.73	-507	-131	-2	-129	-.0537	-.2112
307	36.1	4.51	-532	-156	-4	-152	-.0633	-.2217
313	42.1	4.46	-538	-162	-4	-158	-.0658	-.2242
323	52.0	4.36	-550	-174	-5	-169	-.0704	-.2292
334	62.9	4.32	-556	-180	-6	-174	-.0725	-.2317
350	79.2	4.25	-565	-189	-8	-181	-.0754	-.2354
356	85.1	4.21	-570	-194	-7	-187	-.0779	-.2375
363	92.2	4.13	-581	-204	-8	-196	-.0817	-.2421
376	104.9	4.11	-584	-208	-9	-199	-.0829	-.2433
408	136.9	3.95	-607	-230	-12	-218	-.0908	-.2529
436	165.0	3.89	-617	-240	-15	-225	-.0938	-.2571
450	179.0	3.84	-625	-249	-17	-232	-.0967	-.2604
479	208.1	3.79	-634	-258	-17	-241	-.1004	-.2642
513	242.1	3.68	-652	-276	-18	-258	-.1075	-.2717
544	273.1	3.76	-639	-262	-25	-237	-.0987	-.2662
544	273.1	3.86	-621	-244	-25	-219	-.0912	-.2587
544	273.2	3.73	-643	-267	-25	-242	-.1008	-.2679
545	274.1	3.47	-691	-314	-24	-290	-.1208	-.2879
553	281.9	3.35	-717	-341	-25	-316	-.1317	-.2987
555	284.2	3.31	-726	-350	-25	-325	-.1354	-.3025
573	302.1	3.08	-780	-403	-25	-378	-.1575	-.3250
636	365.2	2.70	-889	-513	-29	-484	-.2017	-.3704
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
636	0.		-519	-142	-29	-113		
636	.0035		-512	-136	-29	-107		
636	.0104		-506	-130	-29	-101		
636	.0667		-493	-116	-29	-87		
637	1.1104		-463	-87	-28	-59		
672	35.8		-390	-14	-31	17		
706	70.1		-383	-7	-35	28		
707	71.0		-382	-4	-35	31		
712	76.0		-386	-9	-35	26		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 110F, 28 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	241	11 01	15	5.8
NO.2	338	11 02	14	5.7
NO.3	364	11 00	25	5.9

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 6100. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 31.9 PERCENT (SELECTED MIX)
34.4 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
*12-21-73	1000	0	SPECIMENS CAST										
* 1-18-74	1407	28.2	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
1-18-74	1407	28.2	-.0007	109.6	0	0	0	0	0	0	0	0	0.
1-18-74	1407	28.2	-.0003	109.6	-167	-210	-166	-181	0	0	0	0	-.08619
* 1-18-74	1408	28.2	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
1-18-74	1408	28.2	.0000	109.6	-360	-371	-358	-363	0	0	0	0	-.17286
1-18-74	1409	28.2	.0007	109.8	-368	-379	-368	-371	-8	-8	-10	-8	-.17667
1-18-74	1418	28.2	.0069	109.5	-386	-395	-387	-389	-26	-24	-29	-26	-.18524
1-18-74	1423	28.2	.0104	109.6	-390	-399	-391	-393	-30	-28	-33	-30	-.18714
1-18-74	1438	28.2	.0208	109.6	-396	-404	-397	-399	-36	-33	-39	-36	-.19000
1-18-74	1508	28.2	.0417	109.7	-407	-414	-410	-410	-47	-43	-52	-47	-.19524
1-18-74	1703	28.3	.1215	109.7	-427	-433	-434	-431	-67	-62	-76	-68	-.20524
1-18-74	2000	28.4	.2444	109.6	-447	-450	-457	-451	-87	-79	-99	-88	-.21476
1-19-74	1515	29.2	1.0465	109.5	-503	-500	-516	-506	-143	-129	-158	-143	-.24095
1-20-74	1545	30.2	2.1	109.5	-534	-531	-548	-537	-174	-160	-190	-174	-.25571
1-21-74	1545	31.2	3.1	109.8	-555	-551	-570	-558	-195	-180	-212	-195	-.26571
1-22-74	1555	32.2	4.1	109.0	-568	-566	-585	-573	-208	-195	-227	-210	-.27286
1-23-74	1600	33.3	5.1	108.7	-577	-576	-593	-582	-217	-205	-235	-219	-.27714
1-25-74	1455	35.2	7.0	108.5	-593	-591	-612	-598	-233	-220	-254	-235	-.28476
1-27-74	1230	37.1	8.9	108.3	-594	-602	-626	-607	-234	-231	-268	-244	-.28905
1-29-74	1300	39.1	11.0	108.5	-604	-613	-640	-619	-244	-242	-282	-256	-.29476
2 -3-74	1220	44.1	15.9	109.7	-608	-641	-664	-637	-248	-270	-306	-274	-.30333
2 -6-74	1727	47.3	19.1	110.7	-584	-653	-675	-637	-224	-282	-317	-274	-.30333
2-12-74	1540	53.2	25.1	109.2	-614	-686	-706	-668	-254	-315	-348	-305	-.31810
2-18-74	1615	59.3	31.1	109.6	-634	-693	-715	-680	-274	-322	-357	-317	-.32381
2-22-74	1645	63.3	35.1	107.4	-676	-696	-722	-698	-316	-325	-364	-335	-.33238
3 -1-74	1120	70.1	41.9	109.6	-680	-708	-736	-708	-320	-337	-378	-345	-.33714
3 -4-74	1055	73.0	44.9	109.9	-680	-713	-743	-712	-320	-342	-385	-349	-.33905
3-11-74	1600	80.3	52.1	109.1	-698	-724	-754	-725	-338	-353	-396	-362	-.34524
3-16-74	930	85.0	56.8	108.8	-688	-731	-762	-727	-328	-360	-404	-364	-.34619
3-21-74	1645	90.3	62.1	108.6	-699	-736	-770	-735	-339	-365	-412	-372	-.35000
4 -4-74	1445	104.2	76.0	110.3	-741	-751	-787	-759	-381	-380	-429	-396	-.36143
4-18-74	1315	118.1	90.0	110.9	-751	-767	-806	-774	-391	-396	-448	-411	-.36857
4-30-74	1455	130.2	102.0	110.0	-767	-780	-819	-788	-407	-409	-461	-425	-.37524
5-16-74	1525	146.2	118.1	109.0	-785	-797	-836	-806	-425	-426	-478	-443	-.38381
6-14-74	915	175.0	146.8	110.0	-800	-817	-857	-824	-440	-446	-499	-461	-.39238
7-17-74	1620	208.3	180.1	111.0	-826	-840	-883	-849	-466	-469	-525	-486	-.40429
8-29-74	1120	251.1	222.9	110.2	-894	-869	-910	-891	-534	-498	-552	-528	-.42429
9-25-74	1630	278.3	250.1	110.7	-907	-902	-926	-911	-547	-531	-568	-548	-.43381
10-24-74	830	306.9	278.8	110.0	-927	-917	-938	-927	-567	-546	-580	-564	-.44143
11-21-74	915	335.0	306.8	110.5	-948	-932	-951	-943	-588	-561	-593	-580	-.44905
12-17-74	1630	361.3	333.1	110.7	-962	-940	-963	-955	-602	-569	-605	-592	-.45476
1-15-75	1340	390.2	362.0	111.0	-973	-953	-973	-966	-613	-582	-615	-603	-.46000
2-18-75	1515	424.2	396.0	110.0	-984	-962	-982	-976	-624	-591	-624	-613	-.46476
3-14-75	1235	448.1	419.9	110.6	-994	-969	-990	-984	-634	-598	-632	-621	-.46857
4-12-75	1215	477.1	448.9	110.4	-1007	-979	-1000	-995	-647	-608	-642	-632	-.47381
5-16-75	1215	511.1	482.9	110.8	-1027	-991	-1013	-1010	-667	-620	-655	-647	-.48095
5-20-75	1319	515.1	487.0	110.4	-1029	-993	-1014	-1012	-669	-622	-656	-649	-.48190
* 5-20-75	1320	515.1	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
5-20-75	1320	515.1	0.	110.4	-718	-666	-709	-697	-358	-295	-351	-334	
5-20-75	1325	515.1	.0035	110.0	-712	-661	-703	-692	-352	-290	-345	-329	
5-20-75	1335	515.1	.0104	109.9	-708	-656	-699	-687	-348	-285	-341	-324	
5-20-75	1422	515.2	.0431	109.7	-702	-649	-692	-681	-342	-278	-334	-318	
5-20-75	1623	515.3	.1271	110.1	-696	-643	-687	-675	-336	-272	-329	-312	
5-21-75	1350	516.2	1.0208	110.9	-681	-626	-672	-659	-321	-255	-314	-296	
5-23-75	1310	518.1	3.0	111.0	-670	-615	-661	-648	-310	-244	-303	-285	
5-27-75	1045	522.0	6.9	111.0	-660	-604	-650	-638	-300	-233	-292	-275	
6 -3-75	845	528.9	13.8	109.3	-653	-595	-641	-629	-293	-224	-283	-266	
6-16-75	1500	542.2	27.1	108.5	-646	-586	-632	-621	-286	-215	-274	-258	
7 -1-75	1620	557.3	42.1	110.1	-638	-579	-627	-614	-278	-208	-269	-251	
7-15-75	1440	571.2	56.1	109.8	-635	-575	-620	-610	-275	-204	-262	-247	
8 -7-75	1600	594.2	79.1	109.3	-630	-570	-613	-604	-270	-199	-255	-241	
8-13-75	1335	600.1	85.0	109.5	-629	-565	-612	-602	-269	-194	-254	-239	
8-14-75	1340	601.2	86.0	95.9	-625	-565	0	-595	-265	-194	0	-229	
8-19-75	900	606.0	90.8	70.3	-616	-557	0	-586	-256	-186	0	-221	
* 8-19-75	900	606.0	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.1: ERRATIC LOW READINGS 2-6-74 TO 2-18-74

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 110F, 28 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 6100. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 31.9 PERCENT (SELECTED MIX)
34.4 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 243 11 05
423 11 04

CREEP : 241 11 01
338 11 02
364 11 00

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
28	-.0007		0	0	0	0		
28	-.0003		-181	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
28	.0000	5.79	-363	0	0	0	0.	-.1729
28	.0007	5.66	-371	-8	0	-8	-.0038	-.1767
28	.0069	5.40	-389	-26	0	-26	-.0124	-.1852
28	.0104	5.34	-393	-30	0	-30	-.0143	-.1871
28	.0208	5.26	-399	-36	0	-36	-.0171	-.1900
28	.0417	5.12	-410	-47	0	-47	-.0224	-.1952
28	.1215	4.87	-431	-68	0	-68	-.0324	-.2052
28	.2444	4.66	-451	-88	0	-88	-.0419	-.2148
29	1.0465	4.15	-506	-143	1	-144	-.0686	-.2410
30	2.1	3.91	-537	-174	0	-174	-.0829	-.2557
31	3.1	3.76	-558	-195	2	-197	-.0938	-.2657
32	4.1	3.66	-573	-210	3	-213	-.1014	-.2729
33	5.1	3.61	-582	-219	3	-222	-.1057	-.2771
35	7.0	3.51	-598	-235	2	-237	-.1129	-.2848
37	8.9	3.46	-607	-244	5	-249	-.1186	-.2890
39	11.0	3.39	-619	-256	7	-263	-.1252	-.2948
44	15.9	3.30	-637	-274	9	-283	-.1348	-.3033
47	19.1	3.30	-637	-274	11	-285	-.1357	-.3033
53	25.1	3.14	-668	-305	11	-316	-.1505	-.3181
59	31.1	3.09	-680	-317	11	-328	-.1562	-.3238
63	35.1	3.01	-698	-335	10	-345	-.1643	-.3324
70	41.9	2.97	-708	-345	9	-354	-.1686	-.3371
73	44.9	2.95	-712	-349	8	-357	-.1700	-.3390
80	52.1	2.90	-725	-362	9	-371	-.1767	-.3452
85	56.8	2.89	-727	-364	8	-372	-.1771	-.3462
90	62.1	2.86	-735	-372	7	-379	-.1805	-.3500
104	76.0	2.77	-759	-396	-3	-393	-.1871	-.3614
118	90.0	2.71	-774	-411	-6	-405	-.1929	-.3686
130	102.0	2.66	-788	-425	-9	-416	-.1981	-.3752
146	118.1	2.61	-806	-443	-9	-434	-.2067	-.3838
175	146.8	2.55	-824	-461	-15	-446	-.2124	-.3924
208	180.1	2.47	-849	-486	-23	-463	-.2205	-.4043
251	222.9	2.36	-891	-528	-32	-496	-.2362	-.4243
278	250.1	2.31	-911	-548	-34	-514	-.2448	-.4338
307	278.8	2.27	-927	-564	-39	-525	-.2500	-.4414
335	306.8	2.23	-943	-580	-41	-539	-.2567	-.4490
361	333.1	2.20	-955	-592	-44	-548	-.2610	-.4548
390	362.0	2.17	-966	-603	-48	-555	-.2643	-.4600
424	396.0	2.15	-976	-613	-50	-563	-.2681	-.4648
448	419.9	2.13	-984	-621	-53	-568	-.2705	-.4686
477	448.9	2.11	-995	-632	-54	-578	-.2752	-.4738
511	482.9	2.08	-1010	-647	-57	-590	-.2810	-.4810
515	487.0	2.08	-1012	-649	-58	-591	-.2814	-.4819
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
515	0.		-697	-334	-58	-276		
515	.0035		-692	-329	-58	-271		
515	.0104		-687	-324	-58	-266		
515	.0431		-681	-318	-58	-260		
515	.1271		-675	-312	-58	-254		
516	1.0208		-659	-296	-57	-239		
518	3.0		-648	-285	-57	-228		
522	6.9		-638	-275	-57	-218		
529	13.8		-629	-266	-57	-209		
542	27.1		-621	-258	-57	-201		
557	42.1		-614	-251	-60	-191		
571	56.1		-610	-247	-61	-186		
594	79.1		-604	-241	-62	-179		
600	85.0		-602	-239	-64	-175		
601	86.0		-595	-229	-64	-165		
606	90.8		-586	-221	-67	-154		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 110F, 90 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	340	11 12	11	5.8
NO.2	342	11 13	23	6.1
NO.3	356	11 14	16	5.9

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 6710. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 28.0 PERCENT (SELECTED MIX)
31.3 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
*12-21-73	1000	0	SPECIMENS CAST										
* 3-21-74	1014	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
3-21-74	1014	90.0	-.0007	109.7	0	0	0	0	0	0	0	0	0.
3-21-74	1014	90.0	-.0003	109.7	-169	-156	-158	-161	0	0	0	0	-.07667
* 3-21-74	1015	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
3-21-74	1015	90.0	.0000	109.7	-362	-342	-353	-352	0	0	0	0	-.16762
3-21-74	1017	90.0	.0014	109.7	-375	-355	-364	-364	-13	-13	-11	-12	-.17333
3-21-74	1020	90.0	.0035	109.9	-382	-362	-373	-372	-20	-20	-20	-20	-.17714
3-21-74	1030	90.0	.0104	109.5	-392	-375	-383	-383	-30	-33	-30	-31	-.18238
3-21-74	1119	90.1	.0444	109.3	-407	-390	-399	-398	-45	-48	-46	-46	-.18952
3-21-74	1415	90.2	.1667	109.1	-430	-413	-423	-422	-68	-71	-70	-69	-.20095
3-21-74	1615	90.3	.2500	109.0	-437	-421	-430	-429	-75	-79	-77	-77	-.20429
3-21-74	2210	90.5	.4965	109.3	-455	-440	-450	-448	-93	-98	-97	-96	-.21333
3-22-74	1200	91.1	1.0729	109.6	-478	-463	-473	-471	-116	-121	-120	-119	-.22429
3-23-74	1250	92.1	2.1	109.8	-507	-493	-501	-500	-145	-151	-148	-148	-.23810
3-24-74	1430	93.2	3.2	109.7	-525	-511	-518	-518	-163	-169	-165	-165	-.24667
3-25-74	1315	94.1	4.1	109.0	-535	-523	-527	-528	-173	-181	-174	-176	-.25143
3-26-74	1500	95.2	5.2	109.6	-546	-536	-541	-541	-184	-194	-188	-188	-.25762
3-29-74	1230	98.1	8.1	109.4	-569	-561	-561	-563	-207	-219	-208	-211	-.26810
4 -1-74	1240	101.1	11.1	109.5	-586	-580	-578	-581	-224	-238	-225	-229	-.27667
4 -3-74	1130	103.1	13.1	109.4	-595	-590	-586	-590	-233	-248	-233	-238	-.28095
4 -4-74	1445	104.2	14.2	109.9	-601	-596	-591	-596	-239	-254	-238	-243	-.28381
4 -8-74	1535	108.2	18.2	110.4	-616	-613	-606	-611	-254	-271	-253	-259	-.29095
4-11-74	1405	111.2	21.2	109.9	-626	-625	-616	-622	-264	-283	-263	-270	-.29619
4-15-74	1135	115.1	25.1	110.3	-636	-637	-626	-633	-274	-295	-273	-280	-.30143
4-18-74	1315	118.1	28.1	110.9	-644	-647	-634	-641	-282	-305	-281	-289	-.30524
4-25-74	1530	125.2	35.2	110.1	-659	-667	-650	-658	-297	-325	-297	-306	-.31333
4-30-74	1455	130.2	40.2	110.0	-668	-679	-661	-669	-306	-337	-308	-317	-.31857
5-13-74	1420	143.2	53.2	109.9	-689	-706	-683	-692	-327	-364	-330	-340	-.32952
5-21-74	1440	151.2	61.2	110.3	-701	-72'	-695	-705	-339	-379	-342	-353	-.33571
6 -4-74	1630	165.3	75.3	111.0	-717	-739	-711	-722	-355	-397	-358	-370	-.34381
6-14-74	915	175.0	85.0	109.9	-728	-755	-723	-735	-366	-413	-370	-383	-.35000
6-26-74	1150	187.1	97.1	110.1	-742	-772	-737	-750	-380	-430	-384	-398	-.35714
7-24-74	1615	215.3	125.2	110.7	-768	-803	-764	-778	-406	-461	-411	-426	-.37048
8-21-74	1450	243.2	153.2	110.5	-791	-831	-789	-803	-429	-489	-436	-451	-.38238
9-20-74	1105	273.0	183.0	115.3	-818	-856	-812	-828	-456	-514	-459	-476	-.39429
10-24-74	830	306.9	216.9	110.0	-841	-881	-836	-852	-479	-539	-483	-500	-.40571
11 -8-74	1315	322.1	232.1	110.5	-848	-890	-843	-860	-486	-548	-490	-508	-.40952
11-21-74	915	335.0	245.0	110.5	-856	-900	-851	-869	-494	-558	-498	-516	-.41381
12-17-74	1630	361.3	271.3	110.6	-875	-928	-878	-893	-513	-586	-523	-540	-.42524
1-15-75	1340	390.2	300.1	111.0	-882	-933	-878	-897	-520	-591	-525	-545	-.42714
2-18-75	1515	424.2	334.2	110.0	-894	-948	-892	-911	-532	-606	-539	-559	-.43381
3-14-75	1235	448.1	358.1	110.6	-903	-959	-902	-921	-541	-617	-549	-569	-.43857
4-12-75	1215	477.1	387.1	110.5	-914	-972	-914	-933	-552	-630	-561	-581	-.44429
5-16-75	1215	511.1	421.1	110.8	-927	-989	-929	-948	-565	-647	-576	-596	-.45143
5-20-75	1319	515.1	425.1	110.2	-930	-991	-933	-951	-568	-649	-580	-599	-.45286
* 5-20-75	1320	515.1	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
5-20-75	1320	515.1	0.	110.2	-611	-691	-612	-638	-249	-349	-259	-285	
5-20-75	1325	515.1	.0035	110.0	-604	-683	-604	-630	-242	-341	-251	-278	
5-20-75	1335	515.1	.0104	109.9	-599	-679	-599	-625	-237	-337	-246	-273	
5-20-75	1422	515.2	.0431	109.8	-593	-673	-592	-619	-231	-331	-239	-267	
5-20-75	1623	515.3	.1271	110.2	-587	-666	-586	-613	-225	-324	-233	-260	
5-21-75	1350	516.2	1.0208	111.0	-572	-652	-570	-598	-210	-310	-217	-245	
5-23-75	1310	518.1	3.0	111.0	-559	-640	-557	-585	-197	-298	-204	-233	
5-27-75	1045	522.0	6.9	111.0	-548	-630	-545	-574	-186	-288	-192	-222	
6 -3-75	845	528.9	13.8	109.3	-539	-623	-536	-565	-177	-281	-183	-213	
6-16-75	1500	542.2	27.1	108.6	-530	-617	-527	-553	-168	-275	-174	-205	
7-15-75	1440	571.2	56.1	109.8	-516	-609	-512	-545	-154	-267	-159	-193	
8-18-75	910	605.0	89.8	109.8	-508	-609	-504	-540	-146	-267	-151	-188	
8-19-75	1400	606.2	91.0	110.0	-504	-605	0	-554	-142	-263	0	-202	
* 8-19-75	1400	606.2	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 110F, 90 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 6710. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 28.0 PERCENT (SELECTED MIX)
31.3 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 347 11 15
339 11 16

CREEP : 340 11 12
342 11 13
355 11 14

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0007		0	0	0	0		
90	-.0003		-161	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
90	.0000	5.97	-352	0	0	0	0.	-.1676
90	.0014	5.77	-364	-12	0	-12	-.0057	-.1733
90	.0035	5.65	-372	-20	0	-20	-.0095	-.1771
90	.0104	5.48	-383	-31	0	-31	-.0148	-.1824
90	.0444	5.28	-398	-46	0	-46	-.0219	-.1895
90	.1667	4.98	-422	-69	0	-69	-.0329	-.2010
90	.2500	4.90	-429	-77	0	-77	-.0367	-.2043
91	.4965	4.69	-448	-96	1	-97	-.0462	-.2133
91	1.0729	4.46	-471	-119	1	-120	-.0571	-.2243
92	2.1	4.20	-500	-148	0	-148	-.0705	-.2381
93	3.2	4.05	-518	-165	1	-166	-.0790	-.2467
94	4.1	3.98	-528	-176	3	-179	-.0852	-.2514
95	5.2	3.88	-541	-188	0	-188	-.0895	-.2576
98	8.1	3.73	-563	-211	-1	-210	-.1000	-.2681
101	11.1	3.61	-581	-229	-3	-226	-.1076	-.2767
103	13.1	3.56	-590	-238	-4	-234	-.1114	-.2810
104	14.2	3.52	-596	-243	-5	-238	-.1133	-.2838
108	18.2	3.44	-611	-259	-8	-251	-.1195	-.2910
111	21.2	3.38	-622	-270	-11	-259	-.1233	-.2962
115	25.1	3.32	-633	-280	-12	-268	-.1276	-.3014
118	28.1	3.28	-641	-289	-15	-274	-.1305	-.3052
125	35.2	3.19	-658	-306	-18	-288	-.1371	-.3133
130	40.2	3.14	-669	-317	-20	-297	-.1414	-.3186
143	53.2	3.03	-692	-340	-23	-317	-.1510	-.3295
151	61.2	2.98	-705	-353	-28	-325	-.1548	-.3357
165	75.3	2.91	-722	-370	-30	-340	-.1619	-.3438
175	85.0	2.86	-735	-383	-36	-347	-.1652	-.3500
187	97.1	2.80	-750	-398	-41	-357	-.1700	-.3571
215	125.2	2.70	-778	-426	-50	-376	-.1790	-.3705
243	153.2	2.62	-803	-451	-58	-393	-.1871	-.3824
273	183.0	2.54	-828	-476	-64	-412	-.1962	-.3943
307	216.9	2.46	-852	-500	-72	-428	-.2038	-.4057
322	232.1	2.44	-860	-508	-73	-435	-.2071	-.4095
335	245.0	2.42	-869	-516	-76	-440	-.2095	-.4138
361	271.3	2.35	-893	-540	-80	-460	-.2190	-.4252
390	300.1	2.34	-897	-545	-87	-458	-.2181	-.4271
424	334.2	2.31	-911	-559	-90	-469	-.2233	-.4338
448	358.1	2.28	-921	-569	-92	-477	-.2271	-.4386
477	387.1	2.26	-933	-581	-95	-486	-.2314	-.4443
511	421.1	2.22	-948	-596	-97	-499	-.2376	-.4514
515	425.1	2.21	-951	-599	-103	-496	-.2362	-.4529
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
515	0.		-638	-285	-103	-182		
515	.0035		-630	-278	-103	-175		
515	.0104		-625	-273	-103	-170		
515	.0431		-619	-267	-103	-164		
515	.1271		-613	-260	-103	-157		
516	1.0208		-598	-245	-96	-149		
519	3.0		-585	-233	-97	-136		
522	7.0		-574	-222	-98	-124		
529	13.8		-566	-213	-100	-113		
542	27.1		-558	-205	-104	-101		
571	56.1		-545	-193	-105	-68		
605	89.9		-540	-188	-131	-57		
606	91.0		-554	-202	-135	-67		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 110F, 270 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2400 PSI)
NO.1	341	11 62	15	6.1
NO.2	365	11 63	22	6.1
NO.3	248	11 61	12	6.2

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 7310. PSI AT 110.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
32.8 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2400 PSI
*12-21-73	1000	0	SPECIMENS CAST										
* 9-17-74	1054	270.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1200 PSI (PLUS OR MINUS 30), RESPECTIVELY										
9-17-74	1054	270.0	-.0007	109.9	0	0	0	0	0	0	0	0	0.
9-17-74	1054	270.0	-.0003	109.4	-190	-186	-172	-182	0	0	0	0	-.07583
* 9-17-74	1055	270.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2400 PSI										
9-17-74	1055	270.0	0.	109.4	-393	-395	-389	-392	0	0	0	0	-.16333
9-17-74	1100	270.0	.0035	110.0	-416	-421	-411	-416	-23	-26	-22	-23	-.17333
9-17-74	1110	270.0	.0104	109.8	-429	-435	-422	-428	-36	-40	-33	-36	-.17833
9-17-74	1155	270.1	.0417	109.9	-447	-454	-440	-447	-54	-59	-51	-54	-.18625
9-17-74	1355	270.2	.1250	110.4	-466	-475	-459	-466	-73	-80	-70	-74	-.19417
9-17-74	1655	270.3	.2500	110.8	-482	-493	-476	-483	-89	-98	-87	-91	-.20125
9-18-74	845	270.9	.9097	111.1	-520	-535	-515	-523	-127	-140	-126	-131	-.21792
9-19-74	1000	272.0	1.9618	111.3	-551	-568	-546	-555	-158	-173	-157	-162	-.23125
9-20-74	1105	273.0	3.0	111.3	-572	-586	-568	-575	-179	-191	-179	-183	-.23958
9-23-74	1135	276.1	6.0	111.4	-611	-556	-607	-591	-218	-161	-218	-199	-.24625
9-24-74	1650	277.3	7.2	111.5	-621	-528	-618	-589	-228	-133	-229	-196	-.24542
9-26-74	1030	279.0	9.0	111.0	-635	-514	-633	-594	-242	-119	-244	-201	-.24750
10 -2-74	1330	285.1	15.1	111.1	-672	-540	-671	-627	-279	-145	-282	-235	-.26125
10 -9-74	1430	292.2	22.1	111.0	-698	-622	-698	-672	-305	-227	-309	-280	-.28000
10-15-74	810	297.9	27.9	111.0	-717	-671	-719	-702	-324	-276	-330	-310	-.29250
10-22-74	1140	305.1	35.0	111.1	-737	-678	-740	-718	-344	-283	-351	-326	-.29917
10-28-74	1325	311.1	41.1	110.5	-750	-699	-753	-734	-357	-304	-364	-341	-.30583
11 -8-74	1315	322.1	52.1	111.0	-771	-714	-774	-753	-378	-319	-385	-360	-.31375
11-21-74	915	335.0	64.9	111.0	-789	-733	-795	-772	-396	-338	-406	-380	-.32167
12 -4-74	1420	348.2	78.1	110.8	-806	-738	-814	-786	-413	-343	-425	-393	-.32750
12-20-74	935	364.0	94.0	111.1	-370	-342	-363	-358	23	53	26	34	-.14917
12-20-74	958	364.0	94.0	111.1	-737	-723	-730	-730	-344	-328	-341	-337	-.30417
12-20-74	1021	364.0	94.0	111.0	-741	-731	-732	-734	-348	-336	-343	-342	-.30583
12-21-74	1630	365.3	95.2	111.1	-775	-718	-765	-752	-382	-323	-376	-360	-.31333
12-24-74	1200	368.1	98.0	111.0	-795	-733	-785	-771	-402	-338	-396	-378	-.32125
1 -3-75	1645	378.3	108.2	111.1	-820	-746	-811	-792	-427	-351	-422	-400	-.33000
1 -6-75	830	380.9	110.9	111.2	-826	-753	-817	-798	-433	-358	-428	-406	-.33250
1-10-75	1530	385.2	115.2	111.2	-834	-764	-825	-807	-441	-369	-436	-415	-.33625
1-20-75	835	394.9	124.9	111.2	-849	-776	-840	-821	-456	-381	-451	-429	-.34208
2-18-75	1530	424.2	154.2	110.5	-879	-805	-871	-851	-486	-410	-482	-459	-.35458
3-14-75	1235	448.1	178.1	111.3	-902	-824	-892	-872	-509	-429	-503	-480	-.36333
4-12-75	1230	477.1	207.1	110.9	-925	-853	-914	-897	-532	-458	-525	-505	-.37375
5-16-75	1215	511.1	241.1	111.6	-950	-983	-939	-957	-557	-588	-550	-565	-.39875
6-16-75	1540	542.2	272.2	109.4	-966	-1005	-977	-982	-573	-610	-588	-590	-.40917
7-15-75	1450	571.2	301.2	110.5	-980	-1021	-995	-998	-597	-626	-606	-606	-.41583
8-22-75	1340	609.2	339.1	110.9	-997	-1042	-1016	-1018	-604	-647	-627	-626	-.42417
9-18-75	1625	636.3	366.2	110.5	-1007	-1054	-1029	-1030	-614	-659	-640	-637	-.42917
10-20-75	914	668.0	397.9	110.1	-1022	-1071	-1046	-1046	-629	-676	-657	-654	-.43583
*10-20-75	913	668.0	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
10-20-75	915	668.0	0.	110.1	-665	-710	-677	-684	-272	-315	-288	-291	
10-20-75	920	668.0	.0035	110.1	-654	-700	-664	-672	-261	-305	-275	-280	
10-20-75	930	668.0	.0104	110.0	-650	-695	-660	-668	-257	-300	-271	-276	
10-20-75	1015	668.0	.0417	110.0	-641	-687	-651	-659	-248	-292	-262	-267	
10-20-75	1320	668.1	.1701	110.1	-632	-677	-642	-650	-239	-282	-253	-258	
10-22-75	1040	670.0	2.1	110.1	-610	-653	-619	-627	-217	-258	-230	-235	
10-24-75	845	671.9	4.0	109.7	-616	-658	-625	-633	-223	-263	-236	-240	
10-27-75	1145	675.1	7.1	110.0	-590	-633	-600	-607	-197	-238	-211	-215	
11 -6-75	840	684.9	17.0	109.8	-575	-617	-586	-592	-182	-222	-197	-200	
11-14-75	1600	693.2	25.3	109.4	-569	-610	-581	-586	-176	-215	-192	-194	
12-24-75	900	733.0	65.0	109.2	-551	-590	-563	-568	-158	-195	-174	-175	
1-19-76	1315	759.1	91.2	109.6	-537	-558	-549	-548	-144	-163	-160	-155	
* 1-19-76	1600	759.2	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.2: LOW READINGS FROM 9-23-74 TO 4-12-75, APPLIED PRESSURE DROP ON 12-20-74

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 110F, 270 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 7310. PSI AT 110.F.
APPLIED TEST STRESS : 2400. PSI
PTP. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
32.8 PERCENT (COMPANION)

STRAIN METER NUMBERS
AUTOGENOUS: 246 11 64
247 11 65
CREEP : 341 11 62
365 11 63
248 11 61

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2400 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
270	-.0007		0	0	0	0		
270	-.0003		-182	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2400 PSI								
270	0.	6.12	-392	0	0	0	0.	-.1633
270	.0035	5.77	-416	-23	0	-23	-.0096	-.1733
270	.0104	5.61	-428	-36	0	-36	-.0150	-.1783
270	.0417	5.37	-447	-54	0	-54	-.0225	-.1862
270	.1250	5.15	-466	-74	0	-74	-.0308	-.1942
270	.2500	4.97	-483	-91	0	-91	-.0379	-.2012
271	.9097	4.59	-523	-131	5	-136	-.0567	-.2179
272	2.0	4.32	-555	-162	5	-167	-.0696	-.2312
273	3.0	4.17	-575	-183	5	-188	-.0783	-.2396
276	6.0	4.06	-591	-199	7	-206	-.0858	-.2462
277	7.2	4.07	-589	-196	9	-205	-.0854	-.2454
279	9.0	4.04	-594	-201	9	-210	-.0875	-.2475
285	15.1	3.83	-627	-235	11	-246	-.1025	-.2612
292	22.1	3.57	-672	-280	11	-291	-.1212	-.2800
298	27.9	3.42	-702	-310	13	-323	-.1346	-.2925
305	35.0	3.34	-718	-326	11	-337	-.1404	-.2992
311	41.1	3.27	-734	-341	8	-349	-.1454	-.3058
322	52.1	3.19	-753	-360	7	-367	-.1529	-.3137
335	64.9	3.11	-772	-380	5	-385	-.1604	-.3217
348	78.1	3.05	-786	-393	1	-394	-.1642	-.3275
364	94.0	6.70	-358	34	-5	39	.0162	-.1492
364	94.0	3.29	-730	-337	-5	-332	-.1383	-.3042
364	94.0	3.27	-734	-342	-5	-337	-.1404	-.3058
365	95.2	3.19	-752	-360	-5	-355	-.1479	-.3133
368	98.0	3.11	-771	-378	-6	-372	-.1550	-.3212
378	108.2	3.03	-792	-400	-10	-390	-.1625	-.3300
381	110.9	3.01	-798	-406	-10	-396	-.1650	-.3325
385	115.2	2.97	-807	-415	-11	-404	-.1683	-.3362
395	124.9	2.92	-821	-429	-13	-416	-.1733	-.3421
424	154.2	2.82	-851	-459	-18	-441	-.1837	-.3546
448	178.1	2.75	-872	-480	-23	-457	-.1904	-.3633
477	207.1	2.68	-897	-505	-28	-477	-.1987	-.3737
511	241.1	2.51	-957	-565	-31	-534	-.2225	-.3987
542	272.2	2.44	-982	-590	-39	-551	-.2296	-.4092
571	301.2	2.40	-998	-606	-42	-564	-.2350	-.4158
609	339.1	2.36	-1018	-626	-47	-579	-.2412	-.4242
636	365.2	2.33	-1030	-637	-50	-587	-.2446	-.4292
668	397.9	2.29	-1046	-654	-55	-599	-.2496	-.4358
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
668	0.		-684	-291	-55	-236		
668	.0035		-672	-280	-55	-225		
668	.0104		-668	-276	-55	-221		
668	.0417		-659	-267	-55	-212		
668	.1701		-650	-258	-55	-203		
670	2.1		-627	-235	-54	-181		
672	4.0		-633	-240	-54	-186		
675	7.1		-607	-215	-55	-160		
685	17.0		-592	-200	-57	-143		
693	25.3		-586	-194	-57	-137		
733	65.0		-568	-175	-65	-110		
759	91.2		-548	-155	-57	-98		

**END OF TEST

C37

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 160F, 28 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	390	11 07	15	5.3
NO.2	380	11 08	10	5.3
NO.3	384	11 06	10	5.2

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 31.9 PERCENT (SELECTED MIX)
38.2 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 1-17-74	1500	0	SPECIMENS CAST										
* 2-14-74	1052	27.8	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
2-14-74	1052	27.8	-.0014	159.1	0	0	0	0	0	0	0	0	0.
2-14-74	1053	27.8	-.0007	159.1	-185	-186	-187	-186	0	0	0	0	-.08857
* 2-14-74	1054	27.8	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
2-14-74	1054	27.8	.0000	159.1	-396	-393	-401	-396	0	0	0	0	-.18857
2-14-74	1115	27.8	.0146	159.1	-432	-424	-438	-431	-36	-31	-37	-34	-.20524
2-14-74	1155	27.9	.0424	159.3	-445	-437	-451	-444	-49	-44	-50	-47	-.21143
2-14-74	1255	27.9	.0840	160.3	-458	-446	-462	-455	-62	-53	-61	-58	-.21667
2-14-74	1500	28.0	.1708	161.7	-473	-459	-475	-469	-77	-66	-74	-72	-.22333
2-14-74	1940	28.2	.3653	160.8	-503	-485	-502	-496	-107	-92	-101	-100	-.23619
2-15-74	125	28.4	.6049	159.5	-527	-509	-526	-520	-131	-116	-125	-124	-.24762
2-15-74	1230	28.9	1.0667	158.9	-549	-530	-546	-541	-153	-137	-145	-145	-.25762
2-16-74	1115	29.8	2.0	158.7	-570	-532	-567	-556	-174	-139	-166	-159	-.26476
2-17-74	2110	31.3	3.4	158.6	-608	-571	-605	-594	-212	-178	-204	-198	-.28286
2-18-74	1520	32.0	4.2	160.5	-631	-592	-626	-616	-235	-199	-225	-219	-.29333
2-19-74	1615	33.1	5.2	160.6	-644	-604	-639	-629	-248	-211	-238	-232	-.29952
2-21-74	1245	34.9	7.1	161.0	-664	-621	-657	-647	-268	-228	-256	-250	-.30810
2-22-74	1650	36.1	8.2	160.8	-674	-632	-668	-658	-278	-239	-267	-261	-.31333
2-25-74	1530	39.0	11.2	161.9	-698	-655	-697	-683	-302	-262	-296	-286	-.32524
3 -1-74	1120	42.8	15.0	162.1	-722	-679	-721	-707	-326	-286	-320	-310	-.33667
3 -4-74	1055	45.8	18.0	161.9	-736	-685	-734	-718	-340	-292	-333	-321	-.34190
3-11-74	1600	53.0	25.2	159.1	-805	-748	-793	-782	-409	-355	-392	-385	-.37238
3-16-74	930	57.8	29.9	160.4	-831	-772	-830	-811	-435	-379	-429	-414	-.38619
3-21-74	1645	63.1	35.2	159.5	-851	-595	-854	-766	-455	-202	-453	-370	-.36476
3-26-74	1500	68.0	40.2	160.4	-876	-617	-878	-790	-480	-224	-477	-393	-.37619
4 -1-74	1240	73.9	46.1	161.6	-903	-621	-900	-808	-507	-228	-499	-411	-.38476
4 -8-74	1535	81.0	53.2	161.9	-934	-599	-928	-820	-538	-206	-527	-423	-.39048
4-15-74	1135	87.9	60.0	161.2	-953	-623	-947	-841	-557	-230	-546	-444	-.40048
4-22-74	1315	94.9	67.1	160.8	-993	-691	-975	-886	-597	-298	-574	-489	-.42190
4-30-74	1455	103.0	75.2	158.8	-1025	-746	-1004	-925	-629	-353	-603	-528	-.44048
5-10-74	1340	112.9	85.1	160.0	-1054	-758	-1026	-946	-658	-365	-625	-549	-.45048
5-16-74	1525	119.0	91.2	157.3	-1069	-726	-1037	-944	-673	-333	-636	-547	-.44952
5-21-74	1440	124.0	96.2	159.1	-1087	-711	-1051	-949	-691	-318	-650	-553	-.45190
5-28-74	1200	130.9	103.0	160.0	-1111	-755	-1063	-976	-715	-362	-662	-579	-.46476
5-31-74	1600	134.0	106.2	158.6	-1129	-835	-1076	-1013	-733	-442	-675	-616	-.48238
6-14-74	915	147.8	119.9	159.0	-1175	-883	-1104	-1054	-779	-490	-703	-657	-.50190
7-17-74	1620	181.1	153.2	161.8	-1229	-802	-1145	-1058	-833	-409	-744	-662	-.50381
8-29-74	1120	223.8	196.0	158.7	-1312	-1234	-1212	-1252	-916	-841	-811	-856	-.59619
9-25-74	1630	251.1	223.2	158.6	-1340	-1247	-1242	-1276	-944	-854	-841	-879	-.60762
10-24-74	830	279.7	251.9	158.7	-1374	-1301	-1271	-1315	-978	-908	-870	-918	-.62619
11-21-74	915	307.8	279.9	158.8	-1404	-1348	-1295	-1349	-1008	-955	-894	-952	-.64238
12-17-74	1630	334.1	306.2	158.7	-1425	-1367	-1314	-1368	-1029	-974	-913	-972	-.65143
1-15-75	1340	362.9	335.1	155.1	-1441	-1379	-1331	-1383	-1045	-986	-930	-987	-.65857
2-18-75	1515	397.0	369.2	155.8	-1463	-1403	-1346	-1404	-1067	-1010	-945	-1007	-.66857
2-28-75	1200	406.9	379.0	154.1	-1471	-1414	-1351	-1412	-1075	-1021	-950	-1015	-.67238
3-14-75	1235	420.9	393.1	151.7	-1478	-1423	0	-1450	-1082	-1030	0	-1056	-.69048
4-12-75	1215	449.9	422.1	154.5	-1489	-1435	0	-1462	-1093	-1042	0	-1067	-.69619
5-16-75	1215	483.9	456.1	161.4	-1508	-1465	0	-1486	-1112	-1072	0	-1092	-.70762
6-16-75	1500	515.0	487.2	159.6	-1526	-1492	0	-1509	-1130	-1099	0	-1114	-.71857
7-15-75	1440	544.0	516.2	159.1	-1541	-1523	0	-1532	-1145	-1130	0	-1137	-.72952
8 -7-75	1600	567.0	539.2	159.6	-1549	-1542	0	-1545	-1153	-1149	0	-1151	-.73571
9-18-75	1620	609.1	581.2	162.1	-1564	-1560	0	-1562	-1168	-1167	0	-1167	-.74381
10-20-75	1310	640.9	613.1	162.2	-1602	-1590	0	-1596	-1206	-1197	0	-1201	-.76000
11-14-75	1600	666.0	638.2	161.4	-1647	-1632	0	-1639	-1251	-1239	0	-1245	-.78048
12-24-75	900	705.7	677.9	162.8	-1657	-1648	0	-1652	-1261	-1255	0	-1258	-.78667
2-24-76	945	767.8	740.0	164.6	-1721	-1634	0	-1677	-1325	-1241	0	-1283	-.79857

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.2: ERRATIC LOW READINGS 3-21-74 TO 7-17-74

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 160F, 28 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 31.9 PERCENT (SELECTED MIX)
38.2 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 383 11 09
379 11 10

CREEP : 390 11 07
380 11 08
384 11 06

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
28	-.0014		0	0	0	0		
28	-.0007		-186	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
28	.0000	5.30	-396	0	0	0	0.	-.1886
28	.0146	4.87	-431	-34	0	-34	-.0162	-.2052
28	.0424	4.73	-444	-47	0	-47	-.0224	-.2114
28	.0840	4.62	-455	-58	0	-58	-.0276	-.2167
28	.1708	4.48	-469	-72	0	-72	-.0343	-.2233
28	.3653	4.23	-496	-100	0	-100	-.0476	-.2362
28	.6049	4.04	-520	-124	0	-124	-.0590	-.2476
29	1.0667	3.88	-541	-145	6	-151	-.0719	-.2576
30	2.0	3.78	-556	-159	18	-177	-.0843	-.2648
31	3.4	3.54	-594	-198	-1	-197	-.0938	-.2829
32	4.2	3.41	-616	-219	-9	-210	-.1000	-.2933
33	5.2	3.34	-629	-232	-9	-223	-.1062	-.2995
35	7.1	3.25	-647	-250	-7	-243	-.1157	-.3081
36	8.2	3.19	-658	-261	-7	-254	-.1210	-.3133
39	11.2	3.07	-683	-286	-5	-281	-.1338	-.3252
43	15.0	2.97	-707	-310	-3	-307	-.1462	-.3367
46	18.0	2.92	-718	-321	4	-325	-.1548	-.3419
53	25.2	2.69	-782	-385	-18	-367	-.1748	-.3724
58	29.9	2.59	-811	-414	-15	-399	-.1900	-.3862
63	35.2	2.74	-766	-370	-13	-357	-.1700	-.3648
68	40.2	2.66	-790	-393	-18	-375	-.1786	-.3762
74	46.1	2.60	-808	-411	-22	-389	-.1852	-.3848
81	53.2	2.56	-820	-423	-20	-403	-.1919	-.3905
88	60.0	2.50	-841	-444	-17	-427	-.2033	-.4005
95	67.1	2.37	-886	-489	-23	-466	-.2219	-.4219
103	75.2	2.27	-925	-528	-31	-497	-.2367	-.4405
113	85.1	2.22	-946	-549	-34	-515	-.2452	-.4505
119	91.2	2.22	-944	-547	-26	-521	-.2481	-.4495
124	96.2	2.21	-949	-553	-28	-525	-.2500	-.4519
131	103.0	2.15	-976	-579	-28	-551	-.2624	-.4648
134	106.2	2.07	-1013	-616	-35	-581	-.2767	-.4824
148	119.9	1.99	-1054	-657	-38	-619	-.2948	-.5019
181	153.2	1.98	-1058	-662	-41	-621	-.2957	-.5038
224	196.0	1.68	-1252	-856	-52	-804	-.3829	-.5962
251	223.2	1.65	-1276	-879	-59	-820	-.3905	-.6076
280	251.9	1.60	-1315	-918	-113	-805	-.3833	-.6262
308	279.9	1.56	-1349	-952	-128	-824	-.3924	-.6424
334	306.2	1.54	-1368	-972	-137	-835	-.3976	-.6514
363	335.1	1.52	-1383	-987	-138	-849	-.4043	-.6586
397	369.2	1.50	-1404	-1007	-138	-869	-.4138	-.6686
407	379.0	1.49	-1412	-1015	-138	-877	-.4176	-.6724
421	393.1	1.45	-1450	-1056	-138	-918	-.4371	-.6905
450	422.1	1.44	-1462	-1067	-138	-929	-.4424	-.6962
484	456.1	1.41	-1486	-1092	-138	-954	-.4543	-.7076
515	487.2	1.39	-1509	-1114	-138	-976	-.4648	-.7186
544	516.2	1.37	-1532	-1137	-138	-999	-.4757	-.7295
567	539.2	1.36	-1545	-1151	-138	-1013	-.4824	-.7357
609	581.2	1.34	-1562	-1167	-138	-1029	-.4900	-.7438
641	613.1	1.32	-1596	-1201	-138	-1063	-.5062	-.7600
666	638.2	1.28	-1639	-1245	-138	-1107	-.5271	-.7805
706	677.9	1.27	-1652	-1258	-138	-1120	-.5333	-.7867
768	740.0	1.25	-1677	-1283	-138	-1145	-.5452	-.7986

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS** 160F, 90 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	378	11 45	8	6.3
NO.2	377	11 44	12	5.4
NO.3	382	11 46	16	5.1

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5830. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 28.0 PERCENT (SELECTED MIX)
36.0 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 1-17-74	1500	0	SPECIMENS CAST										
* 4-17-74	1349	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
4-17-74	1349	90.0	-.0007	162.9	0	0	0	0	0	0	0	0	0.
4-17-74	1349	90.0	-.0003	162.9	-181	-180	-187	-182	0	0	0	0	-.08667
* 4-17-74	1350	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
4-17-74	1350	90.0	0.	162.9	-398	-390	-408	-398	0	0	0	0	-.18952
4-17-74	1352	90.0	.0014	162.8	-410	-403	-419	-410	-12	-13	-11	-12	-.19524
4-17-74	1355	90.0	.0035	162.8	-423	-416	-432	-423	-25	-26	-24	-25	-.20143
4-17-74	1405	90.0	.0104	162.6	-435	-426	-441	-434	-37	-36	-33	-35	-.20667
4-17-74	1450	90.0	.0417	162.9	-454	-445	-461	-453	-56	-55	-53	-54	-.21571
4-17-74	1710	90.1	.1389	163.0	-481	-471	-491	-481	-83	-81	-83	-82	-.22905
4-17-74	1950	90.2	.2500	163.0	-498	-488	-510	-498	-100	-98	-102	-100	-.23714
4-18-74	913	90.8	.8076	163.0	-544	-533	-563	-545	-146	-143	-152	-147	-.25952
4-18-74	1350	91.0	1.0000	162.9	-553	-542	-570	-555	-155	-152	-162	-156	-.26429
4-19-74	1430	92.0	2.0	163.0	-590	-579	-607	-592	-192	-189	-199	-193	-.28190
4-20-74	1130	92.9	2.9	159.3	-625	-614	-617	-618	-227	-224	-209	-220	-.29429
4-22-74	1315	94.9	5.0	159.5	-660	-651	-650	-653	-262	-261	-242	-255	-.31095
4-25-74	1530	98.0	8.1	159.6	-701	-696	-695	-697	-303	-306	-287	-298	-.33190
4-30-74	1455	103.0	13.0	157.1	-762	-763	-743	-756	-364	-373	-335	-357	-.36000
5 -3-74	1335	105.9	16.0	154.8	-789	-802	-773	-788	-391	-412	-365	-389	-.37524
5 -6-74	1355	109.0	19.0	157.7	-807	-817	-791	-805	-409	-427	-383	-406	-.38333
5-10-74	1340	112.9	23.0	158.2	-833	-850	-818	-833	-435	-460	-410	-435	-.39667
5-13-74	1420	116.0	26.0	158.1	-854	-871	-838	-854	-456	-481	-430	-455	-.40667
5-17-74	1130	119.9	29.9	158.6	-875	-896	-861	-877	-477	-506	-453	-478	-.41762
5-21-74	1440	124.0	34.0	158.8	-895	-923	-884	-900	-497	-533	-476	-502	-.42857
5-24-74	1330	126.9	37.0	159.0	-911	-941	-899	-917	-513	-551	-491	-518	-.43667
5-28-74	1200	130.9	40.9	159.1	-928	-964	-915	-935	-530	-574	-507	-537	-.44524
5-31-74	1600	134.0	44.1	157.5	-954	-993	-942	-963	-556	-603	-534	-564	-.45857
6 -4-74	1630	138.1	48.1	157.7	-976	-1024	-958	-986	-578	-634	-550	-587	-.46952
6-10-74	1135	143.9	53.9	157.9	-1000	-1052	-984	-1012	-602	-662	-576	-613	-.48190
6-14-74	915	147.8	57.8	157.6	-1015	-1069	-1001	-1028	-617	-679	-593	-629	-.48952
6-21-74	1220	154.9	64.9	157.6	-1039	-1099	-1028	-1055	-641	-709	-620	-656	-.50238
6-26-74	1150	159.9	69.9	158.1	-1055	-1121	-1046	-1074	-657	-731	-638	-675	-.51143
7-10-74	1650	174.1	84.1	159.3	-1097	-1170	-1093	-1120	-699	-780	-685	-721	-.53333
7-24-74	1615	188.1	98.1	159.8	-1138	-1216	-1138	-1164	-740	-826	-730	-765	-.55429
8 -6-74	1239	200.9	111.0	157.0	-1187	-1249	-1176	-1202	-789	-859	-762	-803	-.57238
8-15-74	1050	209.8	119.9	157.4	-1264	-1270	-1192	-1222	-806	-880	-784	-823	-.58190
9-20-74	1105	245.8	155.9	157.5	-1278	-1344	[illegible]	-1294	-880	-954	-854	-896	-.61619
10 -2-74	1330	257.9	168.0	157.3	-1299	-1364	-1284	-1316	-901	-974	-876	-917	-.62619
10-24-74	830	279.7	189.8	159.7	-1335	-1398	-1342	-1358	-937	-1008	-934	-959	-.64667
11-21-74	915	307.8	217.8	160.0	-1372	-1434	-1385	-1397	-974	-1044	-977	-998	-.66524
12-17-74	1640	334.1	244.1	155.9	-1408	-1467	-1421	-1432	-1010	-1077	-1013	-1033	-.68190
1-15-75	1350	363.0	273.0	158.1	-1431	-1500	-1463	-1464	-1033	-1110	-1055	-1066	-.69714
2-18-75	1530	397.0	307.1	157.8	-1470	-1531	-1473	-1491	-1072	-1141	-1065	-1092	-.71000
3-14-75	1235	420.9	330.9	157.8	-1497	-1552	-1452	-1500	-1099	-1162	-1044	-1101	-.71429
4-12-75	1230	449.9	359.9	158.1	-1526	-1581	0	-1553	-1128	-1191	0	-1159	-.73952
5-16-75	1215	483.9	393.9	159.0	-1565	-1611	0	-1588	-1167	-1221	0	-1194	-.75619
5-20-75	1348	487.9	398.0	162.2	-1569	-1610	0	-1589	-1171	-1220	0	-1195	-.75667
* 5-20-75	1349	488.0	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
5-20-75	1349	488.0	0.	162.2	-1183	-1227	0	-1205	-785	-837	0	-811	
5-20-75	1354	488.0	.0035	159.0	-1176	-1219	0	-1197	-778	-829	0	-803	
5-20-75	1400	488.0	.0076	158.8	-1172	-1215	0	-1193	-774	-825	0	-799	
5-20-75	1450	488.0	.0424	158.3	-1163	-1201	0	-1182	-765	-811	0	-788	
5-20-75	1650	488.1	.1257	159.3	-1155	-1192	0	-1173	-757	-802	0	-779	
5-21-75	1350	489.0	1.0007	159.8	-1133	-1171	0	-1152	-735	-781	0	-758	
5-23-75	1310	490.9	3.0	159.7	-1121	-1156	0	-1138	-723	-766	0	-744	
5-27-75	1045	494.8	6.9	160.1	-1110	-1140	0	-1125	-712	-750	0	-731	
6 -3-75	900	501.7	13.8	158.8	-1100	-1114	0	-1107	-702	-724	0	-713	
6-16-75	1540	515.0	27.1	159.6	-1091	-1066	0	-1078	-693	-676	0	-684	
7 -1-75	1630	530.1	42.1	159.5	-1085	-1007	0	-1046	-687	-617	0	-652	
7-15-75	1450	544.0	56.0	160.1	-1080	-954	0	-1017	-682	-564	0	-623	
8 -7-75	1600	567.0	79.1	159.0	-1058	0	0	-1058	-660	0	0	-660	
8-12-75	1100	571.8	83.9	159.2	-1053	0	0	-1053	-655	0	0	-655	
8-14-75	1340	573.9	86.0	95.8	-1048	0	0	-1048	-650	0	0	-650	
8-19-75	1130	578.9	90.9	70.4	-1033	0	0	-1033	-635	0	0	-635	
* 8-19-75	1200	578.9	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS** 160F, 90 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5830. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 28.0 PERCENT (SELECTED MIX)
36.0 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 350 11 39
375 11 40

CREEP : 378 11 45
377 11 44
382 11 46

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0007		0	0	0	0		
90	-.0003		-182	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
90	0.	5.28	-398	0	0	0	0.	-.1895
90	.0014	5.12	-410	-12	0	-12	-.0057	-.1952
90	.0035	4.96	-423	-25	0	-25	-.0119	-.2014
90	.0104	4.84	-434	-35	0	-35	-.0167	-.2067
90	.0417	4.64	-453	-54	0	-54	-.0257	-.2157
90	.1389	4.37	-481	-82	0	-82	-.0390	-.2290
90	.2500	4.22	-498	-100	0	-100	-.0476	-.2371
91	.8076	3.85	-545	-147	13	-160	-.0762	-.2595
91	1.0000	3.78	-555	-156	13	-169	-.0805	-.2643
92	2.0	3.55	-592	-193	28	-221	-.1052	-.2819
93	2.9	3.40	-618	-220	35	-255	-.1214	-.2943
95	5.0	3.22	-653	-255	43	-298	-.1419	-.3110
98	8.1	3.01	-697	-298	49	-347	-.1652	-.3319
103	13.0	2.78	-756	-357	45	-402	-.1914	-.3600
106	16.0	2.66	-788	-389	43	-432	-.2057	-.3752
109	19.0	2.61	-805	-406	39	-445	-.2119	-.3833
113	23.0	2.52	-833	-435	37	-472	-.2248	-.3967
116	26.0	2.46	-854	-455	35	-490	-.2333	-.4067
120	29.9	2.39	-877	-478	35	-513	-.2443	-.4176
124	34.0	2.33	-900	-502	34	-536	-.2552	-.4286
127	37.0	2.29	-917	-518	33	-551	-.2624	-.4367
131	40.9	2.25	-935	-537	29	-566	-.2695	-.4452
134	44.1	2.18	-963	-564	27	-591	-.2814	-.4586
138	48.1	2.13	-986	-587	23	-610	-.2905	-.4695
144	53.9	2.08	-1012	-613	20	-633	-.3014	-.4819
148	57.8	2.04	-1028	-629	19	-648	-.3086	-.4895
155	64.9	1.99	-1055	-656	14	-670	-.3190	-.5024
160	69.9	1.96	-1074	-675	15	-690	-.3286	-.5114
174	84.1	1.88	-1120	-721	14	-735	-.3500	-.5333
188	98.1	1.80	-1164	-765	14	-779	-.3710	-.5543
201	111.0	1.75	-1202	-803	10	-813	-.3871	-.5724
210	119.9	1.72	-1222	-823	6	-829	-.3948	-.5819
246	155.9	1.62	-1294	-896	-2	-894	-.4257	-.6162
258	168.0	1.60	-1315	-917	-5	-912	-.4343	-.6262
280	189.8	1.55	-1358	-959	-5	-954	-.4543	-.6467
308	217.6	1.50	-1397	-998	-8	-990	-.4714	-.6652
334	244.1	1.47	-1432	-1033	-12	-1021	-.4862	-.6819
363	273.0	1.43	-1464	-1066	-15	-1051	-.5005	-.6971
397	307.1	1.41	-1491	-1092	6	-1098	-.5229	-.7100
421	330.9	1.40	-1500	-1101	6	-1107	-.5271	-.7143
450	359.9	1.35	-1553	-1159	6	-1165	-.5548	-.7395
484	393.9	1.32	-1588	-1194	6	-1200	-.5714	-.7562
488	398.0	1.32	-1589	-1195	6	-1201	-.5719	-.7567
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
488	0.		-1205	-811	6	-817		
488	.0035		-1197	-803	6	-809		
488	.0076		-1193	-799	6	-805		
488	.0424		-1182	-788	6	-794		
488	.1257		-1173	-779	6	-785		
489	1.0007		-1152	-758	6	-764		
491	3.0		-1138	-744	6	-750		
495	6.9		-1125	-731	6	-737		
502	13.8		-1107	-713	6	-719		
515	27.1		-1078	-684	6	-690		
530	42.1		-1046	-652	6	-658		
544	56.0		-1017	-623	6	-629		
567	79.1		-1058	-660	6	-666		
572	83.9		-1053	-655	6	-661		
574	86.0		-1048	-650	6	-656		
579	90.9		-1033	-635	6	-641		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS** 160F, 90 DAY, 45 PERCENT
(3 SPECIMENS; SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 3220 PSI)
NO.1	376	11 36	27	5.2
NO.2	370	11 37	25	5.2
NO.3	355	11 38	19	5.2

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5980. PSI AT 160.F.
APPLIED TEST STRESS : 3220. PSI
PER. ULT. STR. APPLIED: 42.9 PERCENT (SELECTED MIX)
53.8 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 3220 PSI
* 1-10-74	1500	0	SPECIMENS CAST										
* 4-11-74	1203	90.9	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1610 PSI (PLUS OR MINUS 30), RESPECTIVELY										
4-11-74	1203	90.9	-.0014	162.1	0	0	0	0	0	0	0	0	0.
4-11-74	1204	90.9	-.0007	162.1	-261	-258	-265	-261	0	0	0	0	-.08106
* 4-11-74	1205	90.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 3220 PSI										
4-11-74	1205	90.9	0.	162.1	-619	-616	-625	-620	0	0	0	0	-.19255
4-11-74	1210	90.9	.0035	161.9	-672	-660	-667	-666	-53	-44	-42	-46	-.20683
4-11-74	1215	90.9	.0069	160.8	-691	-675	-682	-682	-72	-59	-57	-62	-.21180
4-11-74	1220	90.9	.0104	162.0	-700	-685	-692	-692	-81	-69	-67	-72	-.21491
4-11-74	1235	90.9	.0208	161.9	-723	-706	-712	-713	-104	-90	-87	-93	-.22143
4-11-74	1305	90.9	.0417	161.5	-751	-729	-735	-738	-132	-113	-110	-118	-.22919
4-11-74	1345	90.9	.0694	162.2	-776	-752	-758	-762	-157	-136	-133	-142	-.23665
4-11-74	1450	91.0	.1146	162.3	-799	-774	-779	-784	-180	-158	-154	-164	-.24348
4-11-74	1600	91.0	.1632	162.0	-818	-791	-796	-801	-199	-175	-171	-181	-.24876
4-11-74	1800	91.1	.2465	162.1	-841	-813	-817	-823	-222	-197	-192	-203	-.25559
4-11-74	2220	91.3	.4271	161.9	-877	-847	-850	-858	-258	-231	-225	-238	-.26646
4-12-74	1110	91.8	.9618	162.0	-930	-907	-908	-915	-311	-291	-283	-295	-.28416
4-13-74	1135	92.9	1.9792	162.2	-950	-971	-972	-964	-331	-355	-347	-344	-.29938
4-14-74	1500	94.0	3.1	162.3	-963	-1018	-1018	-999	-344	-402	-393	-379	-.31025
4-15-74	1135	94.9	4.0	162.7	-973	-1053	-1048	-1024	-354	-437	-423	-404	-.31801
4-16-74	1720	96.1	5.2	162.7	-996	-1088	-1076	-1053	-377	-472	-451	-433	-.32702
4-18-74	1315	97.9	7.0	162.0	-1050	-1136	-1125	-1103	-431	-520	-500	-483	-.34255
4-20-74	1130	99.9	9.0	160.1	-1120	-1172	-1163	-1151	-501	-556	-538	-531	-.35745
4-22-74	1315	101.9	11.0	160.1	-1173	-1206	-1194	-1191	-554	-590	-569	-571	-.36988
4-25-74	1530	105.0	14.1	160.7	-1226	-1249	-1237	-1237	-607	-633	-612	-617	-.38416
4-30-74	1455	110.0	19.1	158.5	-1317	-1311	-1300	-1309	-698	-695	-675	-689	-.40652
5 -3-74	1335	112.9	22.1	159.7	-1362	-1340	-1331	-1344	-743	-724	-706	-724	-.41739
5 -6-74	1355	116.0	25.1	159.8	-1388	-1365	-1361	-1371	-769	-749	-736	-751	-.42578
5-10-74	1340	119.9	29.1	157.8	-1427	-1404	-1401	-1410	-808	-788	-776	-790	-.43789
5-13-74	1420	123.0	32.1	159.9	-1449	-1425	-1422	-1432	-830	-809	-797	-812	-.44472
5-17-74	1130	126.9	36.0	160.1	-1483	-1457	-1455	-1465	-864	-841	-830	-845	-.45497
5-21-74	1440	131.0	40.1	160.1	-1504	-1488	-1485	-1492	-885	-872	-860	-872	-.46335
5-28-74	1200	137.9	47.0	160.4	-1575	-1537	-1534	-1548	-956	-921	-909	-928	-.48075
6 -4-74	1630	145.1	54.2	158.3	-1642	-1595	-1596	-1611	-1023	-979	-971	-991	-.50031
6 -7-74	1152	147.9	57.0	159.1	-1665	-1615	-1614	-1631	-1046	-999	-989	-1011	-.50652
6-14-74	915	154.8	63.9	159.8	-1716	-1658	-1664	-1679	-1097	-1043	-1039	-1059	-.52143
6-21-74	1820	161.9	71.0	159.6	-1767	-1713	-1717	-1732	-1148	-1097	-1092	-1112	-.53789
6-26-74	1150	166.9	76.0	160.4	-1805	-1779	-1756	-1736	-1186	-1123	-1129	-1146	-.54845
7-17-74	1620	188.1	97.2	161.4	-1948	-1871	-1894	-1902	-1323	-1255	-1269	-1282	-.59068
7-31-74	1630	202.1	111.2	159.9	-2019	-1946	-1977	-1980	-1400	-1330	-1352	-1360	-.61491
8-29-74	1120	230.8	140.0	157.7	-2143	-2058	-2100	-2100	-1524	-1442	-1475	-1480	-.65217
9-25-74	1630	258.1	167.2	157.8	-2219	-2139	-2190	-2182	-1600	-1523	-1565	-1562	-.67764
10-24-74	830	286.7	195.9	158.2	-2299	-2209	-2278	-2262	-1680	-1593	-1653	-1642	-.70248
11-21-74	915	314.8	223.9	158.8	-2369	-2287	-2354	-2336	-1750	-1671	-1729	-1716	-.72547
12-17-74	1630	341.1	250.2	157.6	-2433	-2351	-2401	-2395	-1814	-1735	-1776	-1775	-.74379
1-15-75	1340	369.9	279.1	159.0	-2494	-2435	-2440	-2456	-1875	-1819	-1815	-1836	-.76273
2-18-75	1515	404.0	313.1	158.7	-2601	-2546	0	-2573	-1982	-1930	0	-1956	-.79907
3-14-75	1235	427.9	337.0	160.8	-2660	-2629	0	-2644	-2041	-2013	0	-2027	-.82112
4-12-75	1215	456.9	366.0	160.1	-2703	-2728	0	-2715	-2084	-2112	0	-2098	-.84317
5-16-75	1215	490.9	400.0	165.5	-2753	-2888	0	-2820	-2134	-2272	0	-2203	-.87578
5-20-75	1120	494.8	404.0	165.0	-2764	-2909	0	-2836	-2145	-2293	0	-2219	-.88075
* 5-20-75	1121	494.8	APPLIED TEST STRESS CHANGED TO 2100 PSI										
5-20-75	1121	494.8	404.0	165.0	-2595	-2727	0	-2661	-1976	-2111	0	-2043	
5-20-75	1126	494.9	404.0	165.7	-2586	-2718	0	-2652	-1967	-2102	0	-2034	
5-20-75	1422	495.0	404.1	165.2	-2579	-2710	0	-2644	-1960	-2094	0	-2027	
6 -3-75	845	508.7	417.9	170.5	-2554	0	0	-2554	-1935	0	0	-1935	
6-23-75	919	528.8	437.9	172.8	-2575	0	0	-2575	-1956	0	0	-1956	
* 6-23-75	921	528.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
6-23-75	921	528.8	0.	172.8	-2187	0	0	-2187	-1568	0	0	-1568	
6-23-75	1110	528.8	.0757	172.2	-2153	0	0	-2153	-1534	0	0	-1534	
6-24-75	1700	530.1	1.3188	174.0	-2120	0	0	-2120	-1501	0	0	-1501	
7 -1-75	1620	537.1	8.3	175.4	-2088	0	0	-2088	-1469	0	0	-1469	
* 7 -9-75	930	544.8	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.1 AND NO.2: CALIBRATED RANGE EXCEEDED ON 3-14-75 AND 5-2-75, RESPECTIVELY

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS** 160F, 90 DAY, 45 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 6 (MIX G-1))
AGE OF LOADING : 90 . DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5980. PSI AT 160.F.
APPLIED TEST STRESS : 3220. PSI
PER. ULT. STR. APPLIED: 42.9 PERCENT (SELECTED MIX)
53.8 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 350 11 39
375 11 40

CREEP : 376 11 36
370 11 37
355 11 38

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 3220 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
91	-.0014		0	0	0	0		
91	-.0007		-261	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 3220 PSI								
91	0.	5.19	-620	0	0	0	0.	-.1925
91	.0035	4.83	-666	-46	0	-46	-.0143	-.2068
91	.0069	4.72	-682	-62	0	-62	-.0193	-.2118
91	.0104	4.65	-692	-72	0	-72	-.0224	-.2149
91	.0208	4.52	-713	-93	0	-93	-.0289	-.2214
91	.0417	4.36	-738	-118	0	-118	-.0366	-.2292
91	.0694	4.23	-762	-142	0	-142	-.0441	-.2366
91	.1146	4.11	-784	-164	0	-164	-.0509	-.2435
91	.1632	4.02	-801	-181	0	-181	-.0562	-.2488
91	.2465	3.91	-823	-203	0	-203	-.0630	-.2556
91	.4271	3.75	-858	-238	0	-238	-.0739	-.2665
92	.9618	3.52	-915	-295	15	-310	-.0963	-.2842
93	2.0	3.34	-964	-344	22	-366	-.1137	-.2994
94	3.1	3.22	-999	-379	29	-408	-.1267	-.3102
95	4.0	3.14	-1024	-404	30	-434	-.1348	-.3180
96	5.2	3.06	-1053	-433	36	-469	-.1457	-.3270
98	7.0	2.92	-1103	-483	36	-519	-.1612	-.3425
100	9.0	2.80	-1151	-531	32	-563	-.1748	-.3575
102	11.0	2.70	-1191	-571	33	-604	-.1876	-.3699
105	14.1	2.60	-1237	-617	31	-648	-.2012	-.3842
110	19.1	2.46	-1309	-689	25	-714	-.2217	-.4065
113	22.1	2.40	-1344	-724	24	-748	-.2323	-.4174
116	25.1	2.35	-1371	-751	22	-773	-.2401	-.4258
120	29.1	2.28	-1410	-790	22	-812	-.2522	-.4379
123	32.1	2.25	-1432	-812	21	-833	-.2587	-.4447
127	36.0	2.20	-1465	-845	20	-865	-.2686	-.4550
131	40.1	2.16	-1492	-872	16	-888	-.2758	-.4634
138	47.0	2.08	-1548	-928	10	-938	-.2913	-.4807
145	54.2	2.00	-1611	-991	7	-998	-.3099	-.5003
148	57.0	1.97	-1631	-1011	6	-1017	-.3158	-.5065
155	63.9	1.92	-1679	-1059	1	-1060	-.3292	-.5214
162	71.0	1.86	-1732	-1112	1	-1113	-.3457	-.5379
167	76.0	1.82	-1766	-1146	0	-1146	-.3559	-.5484
188	97.2	1.69	-1902	-1282	1	-1283	-.3984	-.5907
202	111.2	1.63	-1980	-1360	-3	-1357	-.4214	-.6149
231	140.0	1.53	-2100	-1480	-12	-1468	-.4559	-.6522
258	167.2	1.43	-2182	-1562	-18	-1544	-.4795	-.6776
287	195.9	1.42	-2262	-1642	-19	-1623	-.5040	-.7025
315	223.9	1.38	-2336	-1716	-24	-1692	-.5255	-.7255
341	250.2	1.34	-2395	-1775	-30	-1745	-.5419	-.7438
370	279.1	1.31	-2456	-1836	-33	-1803	-.5599	-.7627
404	313.1	1.25	-2573	-1956	-10	-1946	-.6043	-.7991
428	337.0	1.22	-2644	-2027	-10	-2017	-.6264	-.8211
457	365.0	1.19	-2715	-2098	-10	-2088	-.6484	-.8432
491	400.0	1.14	-2820	-2203	-10	-2193	-.6811	-.8758
495	404.0	1.14	-2836	-2219	-10	-2209	-.6860	-.8807
**APPLIED TEST STRESS CHANGED TO 2100 PSI								
495	404.0		-2661	-2043	-10	-2033		
495	404.0		-2652	-2034	-10	-2024		
495	404.1		-2644	-2027	-10	-2017		
509	417.9		-2554	-1935	-10	-1925		
529	437.9		-2575	-1956	-10	-1946		
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
529	0.		-2187	-1568	-10	-1558		
529	.0757		-2153	-1534	-10	-1524		
530	1.3188		-2120	-1501	-10	-1491		
537	8.3		-2088	-1469	-10	-1459		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS** 160F, 90 DAY, 60 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 4200 PSI)
NO.1	373	11 41	20	5.1
NO.2	361	11 42	17	4.8
NO.3	362	11 43	19	4.7

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5980. PSI AT 160.F.
APPLIED TEST STRESS : 4200. PSI
PER. ULT. STR. APPLIED: 55.9 PERCENT (SELECTED MIX)
70.2 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 4200 PSI
* 1-10-74	1500	0	SPECIMENS CAST										
* 4-11-74	942	90.7	SPECIMEN(S) LOADING BEGINS, READINGS AT 0, 1610, AND 3220 PSI (PLUS OR MINUS 30), RESPECTIVELY										
4-11-74	842	90.7	-.0021	162.6	0	0	0	0	0	0	0	0	0.
4-11-74	843	90.7	-.0014	162.5	-256	-273	-265	-264	0	0	0	0	-.06286
4-11-74	844	90.7	-.0007	162.6	-558	-605	-604	-589	0	0	0	0	-.14024
* 4-11-74	845	90.7	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 4200 PSI										
4-11-74	845	90.7	0.	162.6	-822	-872	-889	-861	0	0	0	0	-.20500
4-11-74	850	90.7	.0035	162.4	-1026	-1009	-990	-1008	-204	-137	-101	-147	-.24000
4-11-74	852	90.7	.0049	162.2	-1057	-1029	-1006	-1030	-235	-157	-117	-169	-.24524
4-11-74	855	90.7	.0069	161.9	-1096	-1055	-1027	-1059	-274	-183	-138	-198	-.25214
4-11-74	900	90.7	.0104	162.0	-1140	-1087	-1056	-1094	-318	-215	-167	-233	-.26048
4-11-74	905	90.8	.0139	162.2	-1165	-1105	-1073	-1114	-343	-233	-184	-253	-.26524
4-11-74	915	90.8	.0208	162.1	-1203	-1136	-1103	-1147	-381	-264	-214	-286	-.27310
4-11-74	925	90.8	.0278	162.0	-1230	-1159	-1124	-1171	-408	-287	-235	-310	-.27881
4-11-74	945	90.8	.0417	160.4	-1282	-1204	-1168	-1218	-460	-332	-279	-357	-.29000
4-11-74	1045	90.8	.0833	161.7	-1356	-1266	-1232	-1284	-534	-394	-343	-423	-.30571
4-11-74	1145	90.9	.1250	161.0	-1380	-1292	-1258	-1310	-558	-420	-369	-449	-.31190
4-11-74	1245	90.9	.1667	161.4	-1419	-1324	-1291	-1344	-597	-452	-402	-483	-.32000
4-11-74	1405	91.0	.2222	161.9	-1455	-1358	-1326	-1379	-633	-486	-437	-518	-.32833
4-11-74	1450	91.0	.2535	162.0	-1470	-1373	-1341	-1394	-648	-501	-452	-533	-.33190
4-11-74	1800	91.1	.3854	162.1	-1517	-1421	-1390	-1442	-695	-549	-501	-581	-.34333
4-11-74	2220	91.3	.5660	161.6	-1567	-1471	-1440	-1492	-745	-599	-551	-631	-.35524
4-12-74	845	91.7	1.0000	161.5	-1636	-1541	-1510	-1562	-814	-669	-621	-701	-.37190
4-13-74	1135	92.9	2.1	162.7	-1744	-1660	-1630	-1678	-922	-788	-741	-817	-.39952
4-14-74	1500	94.0	3.3	162.8	-1798	-1721	-1692	-1737	-976	-849	-803	-876	-.41357
4-15-74	1135	94.9	4.1	162.8	-1861	-1788	-1758	-1802	-1039	-916	-869	-941	-.42905
4-16-74	1720	96.1	5.4	162.6	-1924	-1856	-1827	-1869	-1102	-984	-938	-1008	-.44500
4-18-74	1315	97.9	7.2	162.7	-1987	-1931	-1902	-1940	-1165	-1059	-1013	-1079	-.46190
4-20-74	1130	99.9	9.1	160.4	-2051	-1986	-1958	-1998	-1229	-1114	-1069	-1137	-.47571
4-22-74	1315	101.9	11.2	160.7	-2104	-2043	-2015	-2054	-1282	-1171	-1126	-1193	-.48905
4-25-74	1530	105.0	14.3	160.9	-2168	-2114	-2085	-2122	-1346	-1242	-1196	-1261	-.50524
4-30-74	1455	110.0	19.3	158.5	-2280	-2226	-2193	-2233	-1458	-1354	-1304	-1372	-.53167
5 -3-74	1335	112.9	22.2	159.2	-2321	-2274	-2241	-2278	-1499	-1402	-1352	-1417	-.54238
5 -6-74	1355	116.0	25.2	158.7	-2347	-2305	-2270	-2307	-1525	-1433	-1381	-1446	-.54929
5-10-74	1340	119.9	29.2	157.8	-2400	-2364	-2330	-2364	-1578	-1492	-1441	-1503	-.56286
5-13-74	1420	123.0	32.2	159.3	-2428	-2399	-2368	-2397	-1606	-1527	-1477	-1536	-.57071
5-17-74	1130	126.9	36.1	159.9	-2467	-2447	-2416	-2443	-1645	-1575	-1527	-1582	-.58167
5-21-74	1440	131.0	40.2	159.5	-2518	-2503	-2477	-2499	-1696	-1631	-1588	-1638	-.59500
5-24-74	1330	133.9	43.2	160.0	-2541	-2529	-2514	-2528	-1719	-1657	-1625	-1667	-.60190
5-28-74	1200	137.9	47.1	160.2	-2593	-2586	-2582	-2587	-1771	-1714	-1693	-1726	-.61595
5-31-74	1600	141.0	50.3	158.6	-2650	-2642	-2648	-2646	-1828	-1770	-1759	-1785	-.63000
6 -4-74	1630	145.1	54.3	157.4	-2704	-2684	-2713	-2700	-1882	-1812	-1824	-1839	-.64286
6 -7-74	1152	147.9	57.1	159.6	-2728	-2719	-2753	-2733	-1906	-1847	-1864	-1872	-.65071
6-11-74	843	151.7	61.0	159.2	-2774	-2760	-2811	-2781	-1952	-1888	-1922	-1920	-.66214
6-14-74	915	154.8	64.0	159.1	-2808	-2797	-2856	-2820	-1986	-1925	-1967	-1959	-.67143
6-21-74	1220	161.9	71.1	159.8	-2885	-2874	-2956	-2905	-2063	-2002	-2067	-2044	-.69167
6-26-74	1150	166.9	76.1	160.3	-2933	-2927	-3027	-2962	-2111	-2055	-2138	-2101	-.70524
7-17-74	1620	188.1	97.3	161.9	-3118	-3123	-3300	-3180	-2296	-2251	-2411	-2319	-.75714
7-31-74	1630	202.1	111.3	159.8	-3258	-3223	-3439	-3306	-2436	-2351	-2550	-2445	-.78714
8-29-74	1120	230.8	140.1	158.5	-3402	-3366	-3618	-3462	-2580	-2494	-2729	-2601	-.82429
9-11-74	1345	243.9	153.2	159.3	-3455	-3414	-3675	-3514	-2633	-2542	-2786	-2653	-.83667
9-25-74	1630	258.1	167.3	159.1	-3505	-3460	0	-3482	-2683	-2588	0	-2635	-.82905
10 -9-74	1430	272.0	181.2	159.5	-3556	-3504	0	-3530	-2734	-2632	0	-2683	-.84048
10-24-74	830	286.7	196.0	158.9	-3593	-3531	0	-3562	-2771	-2659	0	-2715	-.84810
11-21-74	915	314.8	224.0	158.4	-3657	-3602	0	-3629	-2835	-2730	0	-2782	-.86405
12-17-74	1640	341.1	250.3	160.1	-3704	-3668	0	-3686	-2882	-2796	0	-2839	-.87762
1-15-75	1350	370.0	279.2	161.9	-3755	-3765	0	-3760	-2933	-2893	0	-2913	-.89524
1-31-75	1430	386.0	295.2	162.1	-3783	-3829	0	-3806	-2961	-2957	0	-2959	-.90619
2-18-75	1530	404.0	313.3	160.8	-3802	0	0	-3802	-2980	0	0	-2980	-.90524
2-28-75	1200	413.9	323.1	157.8	-3823	0	0	-3823	-3001	0	0	-3001	-.91024
3-14-75	1215	427.9	337.2	158.1	-3839	0	0	-3839	-3017	0	0	-3017	-.91405
4-12-75	1230	456.9	366.2	160.1	-3869	0	0	-3869	-3047	0	0	-3047	-.92119
5-16-75	1215	490.9	400.1	160.9	-3911	0	0	-3911	-3089	0	0	-3089	-.93119
6-16-75	1540	522.0	431.3	159.1	-3966	0	0	-3966	-3144	0	0	-3144	-.94429
7-15-75	1450	551.0	460.3	160.9	-4032	0	0	-4032	-3210	0	0	-3210	-.96000
8-22-75	1340	588.9	498.2	163.4	-4150	0	0	-4150	-3328	0	0	-3328	-.98810
9-13-75	1625	616.1	525.3	165.5	-4259	0	0	-4259	-3437	0	0	-3437	-1.01405
10 -3-75	935	630.8	540.0	165.6	-4344	0	0	-4344	-3522	0	0	-3522	-1.03429

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.1,NO.2, AND NO.3: CALIBRATED RANGE EXCEEDED ON 8-29-74, 6-26-74 AND 7-17-74, RESPECTIVELY

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS** 160F, 90 DAY, 60 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5980. PSI AT 160.F.
APPLIED TEST STRESS : 4200. PSI
PER. ULT. STR. APPLIED: 55.9 PERCENT (SELECTED MIX)
70.2 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 350 11 39
375 11 40

CREEP : 373 11 41
361 11 42
362 11 43

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 4200 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
91	-.0021		0	0	0	0		
91	-.0014		-264	0	0	0		
91	-.0007		-589	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 4200 PSI								
91	0.	4.88	-861	0	0	0	0.	-.2050
91	.0035	4.17	-1008	-147	0	-147	-.0350	-.2400
91	.0049	4.08	-1030	-169	0	-169	-.0402	-.2452
91	.0069	3.97	-1059	-198	0	-198	-.0471	-.2521
91	.0104	3.84	-1094	-233	0	-233	-.0555	-.2605
91	.0139	3.77	-1114	-253	0	-253	-.0602	-.2652
91	.0208	3.66	-1147	-286	0	-286	-.0681	-.2731
91	.0278	3.59	-1171	-310	0	-310	-.0738	-.2788
91	.0417	3.45	-1218	-357	0	-357	-.0850	-.2900
91	.0833	3.27	-1284	-423	0	-423	-.1007	-.3057
91	.1250	3.21	-1310	-449	0	-449	-.1069	-.3119
91	.1667	3.13	-1344	-483	0	-483	-.1150	-.3200
91	.2222	3.05	-1379	-518	0	-518	-.1233	-.3283
91	.2535	3.01	-1394	-533	0	-533	-.1269	-.3319
91	.3854	2.91	-1442	-581	0	-581	-.1383	-.3433
91	.5660	2.82	-1492	-631	0	-631	-.1502	-.3552
92	1.0000	2.69	-1562	-701	15	-716	-.1705	-.3719
93	2.1	2.50	-1678	-817	22	-839	-.1998	-.3995
94	3.3	2.42	-1737	-876	29	-905	-.2155	-.4136
95	4.1	2.33	-1802	-941	30	-971	-.2312	-.4290
96	5.4	2.25	-1869	-1008	36	-1044	-.2486	-.4450
98	7.2	2.16	-1940	-1079	36	-1115	-.2655	-.4619
100	9.1	2.10	-1998	-1137	32	-1169	-.2783	-.4757
102	11.2	2.04	-2054	-1193	33	-1226	-.2919	-.4890
105	14.3	1.98	-2122	-1261	31	-1292	-.3076	-.5052
110	19.3	1.88	-2233	-1372	25	-1397	-.3326	-.5317
113	22.2	1.84	-2278	-1417	24	-1441	-.3431	-.5424
116	25.2	1.82	-2307	-1446	22	-1468	-.3495	-.5493
120	29.2	1.78	-2364	-1503	22	-1525	-.3631	-.5629
123	32.2	1.75	-2397	-1536	21	-1557	-.3707	-.5707
127	36.1	1.72	-2443	-1582	20	-1602	-.3814	-.5817
131	40.2	1.68	-2499	-1638	16	-1654	-.3938	-.5950
134	43.2	1.66	-2528	-1667	14	-1681	-.4002	-.6019
138	47.1	1.62	-2587	-1726	10	-1736	-.4133	-.6160
141	50.3	1.59	-2646	-1785	6	-1791	-.4264	-.6300
145	54.3	1.56	-2700	-1839	7	-1846	-.4395	-.6429
148	57.1	1.54	-2733	-1872	6	-1878	-.4471	-.6507
152	61.0	1.51	-2781	-1920	4	-1924	-.4581	-.6621
155	64.0	1.49	-2820	-1959	1	-1960	-.4667	-.6714
162	71.1	1.45	-2905	-2044	1	-2045	-.4869	-.6917
167	76.1	1.42	-2962	-2101	0	-2101	-.5002	-.7052
188	97.3	1.32	-3180	-2319	1	-2320	-.5524	-.7571
202	111.3	1.27	-3306	-2445	-3	-2442	-.5814	-.7871
231	140.1	1.21	-3462	-2601	-12	-2589	-.6164	-.8243
244	153.2	1.20	-3514	-2653	-16	-2637	-.6279	-.8367
258	167.3	1.21	-3482	-2635	-18	-2617	-.6231	-.8290
272	181.2	1.19	-3530	-2683	-17	-2666	-.6348	-.8405
287	196.0	1.18	-3562	-2715	-19	-2696	-.6419	-.8481
315	224.0	1.16	-3629	-2782	-24	-2758	-.6567	-.8640
341	250.3	1.14	-3686	-2839	-30	-2809	-.6688	-.8776
370	279.2	1.12	-3760	-2913	-33	-2880	-.6857	-.8952
386	295.2	1.10	-3806	-2959	-6	-2953	-.7031	-.9062
404	313.3	1.10	-3802	-2980	-10	-2970	-.7071	-.9052
414	323.1	1.10	-3823	-3001	-26	-2975	-.7083	-.9102
428	337.2	1.09	-3839	-3017	-26	-2991	-.7121	-.9140
457	366.2	1.09	-3869	-3047	-26	-3021	-.7193	-.9212
491	400.1	1.07	-3911	-3089	-26	-3063	-.7293	-.9312
522	431.3	1.06	-3966	-3144	-26	-3118	-.7424	-.9443
551	460.3	1.04	-4032	-3210	-26	-3184	-.7581	-.9600
589	498.2	1.01	-4150	-3328	-26	-3302	-.7862	-.9881
616	525.3	.99	-4259	-3437	-26	-3411	-.8121	-1.0140
631	540.0	.97	-4344	-3522	-26	-3496	-.8324	-1.0343

AVERAGE ELASTIC PLUS CREEP STRAINS **BERKS ** 160F, 270 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2400 PSI)
NO.1	386	11 63	0	5.2
NO.2	363	11 69	22	5.4
NO.3	381	11 67	18	5.4

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 6130. PSI AT 160.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
39.2 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2400 PSI
* 1-17-74	1500	0	SPECIMENS CAST										
*10-14-74	921	269.8	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1200 PSI (PLUS OR MINUS 30), RESPECTIVELY										
10-14-74	921	269.8	-.0007	158.8	0	0	0	0	0	0	0	0	0.
10-14-74	921	269.8	-.0003	158.8	-212	-206	-199	-205	0	0	0	0	-.08542
*10-14-74	922	269.8	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2400 PSI										
10-14-74	922	269.8	0.	158.8	-464	-446	-443	-451	0	0	0	0	-.18792
10-14-74	925	269.8	.0021	158.7	-480	-459	-463	-467	-16	-13	-20	-16	-.19458
10-14-74	927	269.8	.0035	158.7	-489	-470	-474	-477	-25	-24	-31	-26	-.19875
10-14-74	938	269.8	.0111	158.6	-502	-483	-489	-491	-38	-37	-46	-40	-.20458
10-14-74	945	269.8	.0160	158.5	-508	-489	-495	-497	-44	-43	-52	-46	-.20708
10-14-74	1022	269.8	.0417	158.5	-524	-506	-513	-514	-60	-60	-70	-63	-.21417
10-14-74	1200	269.9	.1097	158.7	-544	-527	-536	-535	-80	-81	-93	-84	-.22292
10-14-74	1327	269.9	.1701	158.8	-554	-539	-548	-547	-90	-93	-105	-96	-.22792
10-14-74	1700	270.1	.3181	158.8	-571	-560	-569	-566	-107	-114	-126	-115	-.23583
10-15-74	810	270.7	.9500	158.7	-613	-606	-616	-611	-149	-160	-173	-160	-.25458
10-15-74	1530	271.0	1.2556	158.8	-628	-621	-633	-627	-164	-175	-190	-176	-.26125
10-16-74	1630	272.1	2.3	157.9	-666	-656	-669	-663	-202	-210	-226	-212	-.27625
10-20-74	1100	275.8	6.1	158.1	-732	-732	-731	-731	-268	-286	-288	-280	-.30458
10-21-74	1400	277.0	7.2	158.1	-751	-750	-753	-751	-297	-304	-310	-300	-.31292
10-22-74	1140	277.9	8.1	158.0	-763	-761	-742	-755	-299	-315	-299	-304	-.31458
10-24-74	830	279.7	10.0	158.3	-788	-786	-793	-789	-324	-340	-350	-338	-.32875
10-28-74	1325	283.9	14.2	158.9	-817	-826	-840	-827	-353	-380	-397	-376	-.34458
10-31-74	1429	287.0	17.2	159.3	-840	-854	-872	-855	-376	-408	-429	-404	-.35625
11 -4-74	1020	290.8	21.0	159.2	-865	-886	-907	-886	-401	-440	-464	-435	-.36917
11 -8-74	1315	294.9	25.2	159.3	-886	-915	-937	-912	-422	-469	-494	-461	-.38000
11-14-74	930	300.8	31.0	159.8	-909	-943	-971	-941	-445	-497	-528	-490	-.39208
11-21-74	915	307.8	38.0	158.8	-942	-980	-1013	-978	-478	-534	-570	-527	-.40750
11-25-74	1450	312.0	42.2	158.3	-962	-1002	-1037	-1000	-498	-556	-594	-549	-.41667
12 -4-74	1420	321.0	51.2	158.2	-999	-1046	-1084	-1043	-535	-600	-641	-592	-.43458
12 -7-74	1445	324.0	54.2	158.3	-1005	-1054	-1092	-1050	-541	-608	-649	-599	-.43750
12-20-74	1100	336.8	67.1	158.4	-1043	-1103	-1142	-1096	-579	-657	-699	-645	-.45667
12-24-74	1200	340.9	71.1	158.4	-1065	-1133	-1174	-1124	-601	-687	-731	-673	-.46833
1 -3-75	1645	351.1	81.3	160.2	-1087	-1176	-1213	-1158	-623	-730	-770	-707	-.48250
1-10-75	1530	358.0	88.3	159.7	-1104	-1202	-1243	-1183	-640	-756	-800	-732	-.49292
1-20-75	935	367.7	98.0	160.4	-1128	-1242	-1284	-1218	-664	-796	-841	-767	-.50750
1-31-75	1430	379.0	109.2	160.3	-1157	-1280	-1302	-1246	-693	-834	-859	-795	-.51917
2-18-75	1530	397.0	127.3	159.4	-1203	-1340	-1355	-1299	-739	-894	-912	-848	-.54125
3-14-75	1235	420.9	151.1	159.5	-1250	-1395	-1406	-1350	-786	-949	-963	-899	-.56250
4-12-75	1230	449.9	180.1	159.4	-1298	-1450	-1464	-1404	-834	-1004	-1021	-953	-.58500
5-16-75	1215	483.9	214.1	160.2	-1355	-1515	-1545	-1471	-891	-1069	-1102	-1020	-.61292
6-16-75	1540	515.0	245.3	160.4	-1384	-1561	-1595	-1513	-920	-1115	-1152	-1062	-.63042
7-15-75	1450	544.0	274.2	159.4	-1421	-1602	-1611	-1544	-957	-1156	-1168	-1093	-.64333
8-22-75	1340	581.9	312.2	160.8	-1452	-1643	0	-1547	-988	-1197	0	-1092	-.64458
9-18-75	1625	609.1	339.3	159.6	-1471	0	0	-1471	-1007	0	0	-1007	-.61292
10-20-75	1320	640.9	371.2	159.4	-1496	0	0	-1496	-1032	0	0	-1032	-.62333
11 -6-75	840	657.7	388.0	159.8	-1508	0	0	-1508	-1044	0	0	-1044	-.62833
11-14-75	1600	666.0	396.3	157.9	-1538	0	0	-1538	-1074	0	0	-1074	-.64083
12-24-75	900	705.7	436.0	159.7	-1548	0	0	-1548	-1084	0	0	-1084	-.64500
2-24-76	945	767.8	498.0	162.3	-1594	0	0	-1594	-1130	0	0	-1130	-.66417

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.1: STRAINS 7 PERCENT LOWER THAN AVERAGE FROM 1-3-75 ON

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** BERKS ** 160F, 270 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 6130. PSI AT 160.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
39.2 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 423 11 60
385 11 70

CREEP : 386 11 68
363 11 69
381 11 67

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2400 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
270	-.0007		0	0	0	0		
270	-.0003		-205	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2400 PSI								
270	0.	5.32	-451	0	0	0	0.	-.1879
270	.0021	5.14	-467	-16	0	-16	-.0067	-.1946
270	.0035	5.03	-477	-26	0	-26	-.0108	-.1987
270	.0111	4.89	-491	-40	0	-40	-.0167	-.2046
270	.0160	4.83	-497	-46	0	-46	-.0192	-.2071
270	.0417	4.67	-514	-63	0	-63	-.0262	-.2142
270	.1097	4.49	-535	-84	1	-85	-.0354	-.2229
270	.1701	4.39	-547	-96	1	-97	-.0404	-.2279
270	.3181	4.24	-566	-115	2	-117	-.0487	-.2358
271	.9500	3.93	-611	-160	7	-167	-.0696	-.2546
271	1.2556	3.83	-627	-176	7	-183	-.0762	-.2612
272	2.3	3.62	-663	-212	10	-222	-.0925	-.2762
276	6.1	3.28	-731	-280	17	-297	-.1237	-.3046
277	7.2	3.20	-751	-300	17	-317	-.1321	-.3129
278	8.1	3.18	-755	-304	17	-321	-.1337	-.3146
280	10.0	3.04	-789	-338	16	-354	-.1475	-.3287
284	14.2	2.90	-827	-376	16	-392	-.1633	-.3446
287	17.2	2.81	-855	-404	15	-419	-.1746	-.3562
291	21.0	2.71	-886	-435	13	-448	-.1867	-.3692
295	25.2	2.63	-912	-461	9	-470	-.1958	-.3800
301	31.0	2.55	-941	-490	5	-495	-.2062	-.3921
308	38.0	2.45	-978	-527	-2	-525	-.2188	-.4075
312	42.2	2.40	-1000	-549	-4	-545	-.2271	-.4167
321	51.2	2.30	-1043	-592	-10	-582	-.2425	-.4346
324	54.2	2.29	-1050	-599	-11	-588	-.2450	-.4375
337	67.1	2.19	-1096	-645	-17	-628	-.2617	-.4567
341	71.1	2.14	-1124	-673	-19	-654	-.2725	-.4683
351	81.3	2.07	-1159	-707	-22	-685	-.2854	-.4825
358	88.3	2.03	-1183	-732	-22	-710	-.2958	-.4929
368	98.0	1.97	-1218	-767	-22	-745	-.3104	-.5075
379	109.2	1.93	-1246	-795	-22	-773	-.3221	-.5192
397	127.3	1.85	-1299	-848	-22	-826	-.3442	-.5412
421	151.1	1.78	-1350	-899	-22	-877	-.3654	-.5625
450	180.1	1.71	-1404	-953	-22	-931	-.3879	-.5850
484	214.1	1.63	-1471	-1020	-22	-998	-.4158	-.6129
515	245.3	1.59	-1513	-1062	-22	-1040	-.4333	-.6304
544	274.2	1.55	-1544	-1093	-22	-1071	-.4462	-.6433
582	312.2	1.55	-1547	-1092	-22	-1070	-.4458	-.6446
609	339.3	1.63	-1471	-1007	-22	-985	-.4104	-.6129
641	371.2	1.60	-1496	-1032	-22	-1010	-.4208	-.6233
658	388.0	1.59	-1508	-1044	-22	-1022	-.4258	-.6283
666	396.3	1.56	-1538	-1074	-22	-1052	-.4383	-.6408
706	436.0	1.55	-1548	-1084	-22	-1062	-.4425	-.6450
708	438.0	1.51	-1594	-1130	-22	-1108	-.4617	-.6642

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 28 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	197	73 07	18	5.8
NO.2	211	73 08	18	5.8
NO.3	199	73 06	13	5.8

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 6160. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 33.4 PERCENT (SELECTED MIX)
34.1 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 2-14-74	1400	0	SPECIMENS CAST										
* 3-14-74	1540	28.1	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
3-14-74	1540	28.1	-.0007	71.6	0	0	0	0	0	0	0	0	0.
3-14-74	1540	28.1	-.0003	71.5	-166	-164	-161	-163	0	0	0	0	-.07762
* 3-14-74	1541	28.1	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
3-14-74	1541	28.1	.0000	71.6	-363	-359	-361	-361	0	0	0	0	-.17190
3-14-74	1542	28.1	.0007	71.6	-369	-365	-366	-366	-6	-6	-5	-5	-.17429
3-14-74	1545	28.1	.0028	71.6	-377	-373	-374	-374	-14	-14	-13	-13	-.17810
3-14-74	1555	28.1	.0097	71.5	-388	-384	-385	-385	-25	-25	-24	-24	-.18333
3-14-74	1625	28.1	.0306	71.3	-398	-395	-394	-395	-35	-36	-33	-34	-.18810
3-14-74	1936	28.2	.1632	72.1	-413	-410	-410	-411	-50	-51	-49	-50	-.19571
3-14-74	2220	28.3	.2771	72.8	-421	-417	-420	-419	-58	-58	-59	-58	-.19952
3-15-74	1035	28.9	.7875	72.0	-446	-441	-446	-444	-83	-82	-85	-83	-.21143
3-15-74	1700	29.1	1.0549	72.6	-452	-448	-451	-450	-89	-89	-90	-89	-.21429
3-16-74	1500	30.0	1.9715	71.7	-468	-464	-467	-466	-105	-105	-106	-105	-.22190
3-17-74	1505	31.0	3.0	71.6	-484	-482	-482	-482	-121	-123	-121	-121	-.22952
3-18-74	1610	32.1	4.0	71.4	-492	-489	-490	-490	-129	-130	-129	-129	-.23333
3-21-74	1140	34.9	6.8	71.2	-514	-510	-510	-511	-151	-151	-149	-150	-.24333
3-22-74	1345	36.0	7.9	71.0	-521	-518	-518	-519	-158	-159	-157	-158	-.24714
3-24-74	1440	38.0	10.0	70.6	-530	-527	-527	-528	-167	-168	-166	-167	-.25143
3-25-74	1200	38.9	10.8	70.9	-534	-531	-530	-531	-171	-172	-169	-170	-.25286
3-27-74	1715	41.1	13.1	71.2	-543	-540	-539	-540	-180	-181	-178	-179	-.25714
3-29-74	1130	42.9	14.8	71.0	-550	-547	-543	-546	-187	-188	-182	-185	-.26000
4 -3-74	1200	47.9	19.8	71.0	-567	-563	-560	-563	-204	-204	-199	-202	-.26810
4 -8-74	1640	53.1	25.0	71.1	-581	-577	-571	-576	-218	-218	-210	-215	-.27429
4-11-74	1705	56.1	28.1	71.1	-590	-585	-579	-584	-227	-226	-218	-223	-.27810
4-18-74	1340	63.0	34.9	70.9	-604	-599	-590	-597	-241	-240	-229	-236	-.28429
4-23-74	1530	68.1	40.0	71.1	-612	-607	-597	-605	-249	-248	-236	-244	-.28810
4-30-74	1435	75.0	47.0	72.0	-625	-620	-610	-618	-262	-261	-249	-257	-.29429
5 -6-74	1335	81.0	52.9	70.6	-639	-634	-622	-631	-276	-275	-261	-270	-.30048
5-16-74	1500	91.0	63.0	71.7	-648	-644	-631	-641	-285	-285	-270	-280	-.30524
5-28-74	1140	102.9	74.8	71.7	-660	-656	-644	-653	-297	-297	-283	-292	-.31095
6-10-74	1512	116.0	88.0	71.7	-675	-671	-658	-668	-312	-312	-297	-307	-.31810
6-26-74	1140	131.9	103.8	71.6	-685	-679	-667	-677	-322	-320	-306	-316	-.32238
7-17-74	1500	153.0	125.0	72.6	-698	-692	-681	-690	-335	-333	-320	-329	-.32857
8-15-74	1115	181.9	153.8	71.8	-714	-709	-698	-707	-351	-350	-337	-346	-.33667
9-11-74	1315	209.0	180.9	72.1	-730	-723	-714	-722	-367	-364	-353	-361	-.34381
10 -9-74	1600	237.1	209.0	72.5	-743	-736	-726	-735	-380	-377	-365	-374	-.35000
11 -7-74	1100	265.9	237.8	72.2	-763	-753	-742	-752	-400	-394	-381	-391	-.35810
12-10-74	1230	298.9	270.9	71.9	-767	-757	-750	-758	-404	-398	-389	-397	-.36095
1-15-75	1330	335.0	306.9	72.9	-773	-763	-759	-765	-410	-404	-398	-404	-.36429
2-18-75	1430	369.0	341.0	71.9	-782	-771	-770	-774	-419	-412	-409	-413	-.36857
3-14-75	1100	392.9	364.8	71.9	-790	-778	-778	-782	-427	-419	-417	-421	-.37238
4-12-75	1200	421.9	393.8	72.0	-796	-781	-784	-787	-433	-422	-423	-426	-.37476
5-16-75	1130	455.9	427.8	72.9	-806	-789	-796	-797	-443	-430	-435	-436	-.37952
6-16-75	1032	486.9	458.8	72.6	-816	-801	-806	-807	-453	-442	-445	-446	-.38429
* 6-16-75	1033	486.9	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
6-16-75	1033	486.9	.0000	72.6	-507	-485	-498	-496	-144	-126	-137	-135	
6-16-75	1038	486.9	.0035	72.7	-500	-479	-488	-489	-137	-120	-127	-128	
6-16-75	1153	486.9	.0556	72.9	-491	-469	-479	-479	-128	-110	-118	-118	
6-16-75	1230	486.9	.0813	72.9	-490	-469	-478	-479	-127	-110	-117	-118	
6-16-75	1333	487.0	.1250	72.9	-488	-466	-477	-477	-125	-107	-116	-116	
6-17-75	1115	487.9	1.0292	72.5	-477	-454	-465	-465	-114	-95	-104	-104	
6-19-75	1550	490.1	3.2	72.9	-465	-441	-452	-452	-102	-82	-91	-91	
6-24-75	1710	495.1	8.3	72.9	-453	-428	-440	-440	-90	-69	-79	-79	
7 -1-75	1545	502.1	15.2	73.4	-444	-420	-430	-431	-81	-61	-69	-70	
7-15-75	1400	516.0	29.1	73.2	-432	-402	-418	-417	-69	-43	-57	-56	
8-22-75	1315	554.0	67.1	72.9	-418	-392	-404	-404	-55	-33	-43	-43	
9-22-75	915	584.8	97.9	72.5	-412	-381	-399	-397	-49	-22	-38	-36	
9-23-75	945	585.8	99.0	70.6	-387	-370	0	-378	-24	-11	0	-17	
* 9-23-75	1000	585.8	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 73F, 28 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 6160. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 33.4 PERCENT (SELECTED MIX)
34.1 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 202 73 09
201 73 10

CREEP : 197 73 07
211 73 08
199 73 06

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
28	-.0007		0	0	0	0		
28	-.0003		-163	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
28	.0000	5.82	-361	0	0	0	0.	-.1719
28	.0007	5.74	-366	-5	0	-5	-.0024	-.1743
28	.0028	5.61	-374	-13	0	-13	-.0062	-.1781
28	.0097	5.45	-385	-24	0	-24	-.0114	-.1833
28	.0306	5.32	-395	-34	0	-34	-.0162	-.1881
28	.1632	5.11	-411	-50	0	-50	-.0238	-.1957
28	.2771	5.01	-419	-58	0	-58	-.0276	-.1995
29	.7875	4.73	-444	-83	1	-84	-.0400	-.2114
29	1.0549	4.67	-450	-89	1	-90	-.0429	-.2143
30	2.0	4.51	-466	-105	2	-107	-.0510	-.2219
31	3.0	4.36	-482	-121	3	-124	-.0590	-.2295
32	4.0	4.29	-490	-129	2	-131	-.0624	-.2333
35	6.8	4.11	-511	-150	4	-154	-.0733	-.2433
36	7.9	4.05	-519	-158	5	-163	-.0776	-.2471
38	10.0	3.98	-528	-167	4	-171	-.0814	-.2514
39	10.8	3.95	-531	-170	5	-175	-.0833	-.2529
41	13.1	3.89	-540	-179	7	-186	-.0886	-.2571
43	14.8	3.85	-546	-185	9	-194	-.0924	-.2600
48	19.8	3.73	-563	-202	11	-213	-.1014	-.2681
53	25.0	3.65	-576	-215	13	-228	-.1086	-.2743
56	28.1	3.60	-584	-223	13	-236	-.1124	-.2781
63	34.9	3.52	-597	-236	16	-252	-.1200	-.2843
68	40.0	3.47	-605	-244	18	-262	-.1248	-.2881
75	47.0	3.40	-618	-257	17	-274	-.1305	-.2943
81	52.9	3.33	-631	-270	19	-289	-.1376	-.3005
91	63.0	3.28	-641	-280	21	-301	-.1433	-.3052
103	74.8	3.22	-653	-292	22	-314	-.1495	-.3110
116	88.0	3.14	-668	-307	22	-329	-.1567	-.3181
132	103.8	3.10	-677	-316	23	-339	-.1614	-.3224
153	125.0	3.04	-690	-329	23	-352	-.1676	-.3286
182	153.8	2.97	-707	-346	21	-367	-.1748	-.3367
209	180.9	2.91	-722	-361	18	-379	-.1805	-.3438
237	209.0	2.86	-735	-374	17	-391	-.1862	-.3500
266	237.8	2.79	-752	-391	14	-405	-.1929	-.3581
299	270.9	2.77	-758	-397	13	-410	-.1952	-.3610
335	306.9	2.75	-765	-404	12	-416	-.1981	-.3643
369	341.0	2.71	-774	-413	10	-423	-.2014	-.3686
393	364.8	2.69	-782	-421	9	-430	-.2048	-.3724
422	393.8	2.67	-787	-426	7	-433	-.2062	-.3748
456	427.8	2.63	-797	-436	4	-440	-.2095	-.3795
487	458.8	2.60	-807	-446	4	-450	-.2143	-.3843
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
487	.0000		-496	-135	4	-139		
487	.0035		-489	-128	4	-132		
487	.0556		-479	-118	4	-122		
487	.0813		-479	-118	4	-122		
487	.1250		-477	-116	4	-120		
488	1.0292		-465	-104	5	-109		
490	3.2		-452	-91	5	-96		
495	8.3		-440	-79	4	-83		
502	15.2		-431	-70	4	-74		
516	29.1		-417	-56	2	-58		
554	67.1		-404	-43	0	-43		
585	97.9		-397	-36	-2	-34		
586	99.0		-378	-17	-2	-15		

**END OF TEST

C49

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 90 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	198	73 21	14	6.1
NO.2	200	73 22	14	6.1
NO.3	205	73 23	22	6.2

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 7070. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
29.7 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 2-14-74	1400	0	SPECIMENS CAST										
* 5-15-74	1400	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
5-15-74	1400	90.0	-.0007	70.8	0	0	0	0	0	0	0	0	0.
5-15-74	1400	90.0	-.0003	70.9	-163	-162	-161	-162	0	0	0	0	-.07714
* 5-15-74	1401	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
5-15-74	1401	90.0	.0000	70.8	-346	-343	-340	-343	0	0	0	0	-.16333
5-15-74	1406	90.0	.0035	70.9	-358	-354	-352	-354	-12	-11	-12	-11	-.16857
5-15-74	1416	90.0	.0104	71.0	-364	-361	-359	-361	-18	-18	-19	-18	-.17190
5-15-74	1501	90.0	.0417	71.2	-372	-369	-368	-369	-26	-26	-28	-26	-.17571
5-15-74	1701	90.1	.1250	71.5	-381	-379	-378	-379	-35	-36	-38	-36	-.18048
5-15-74	2001	90.3	.2500	71.5	-388	-386	-385	-386	-42	-43	-45	-43	-.18381
5-16-74	910	90.8	.7979	71.3	-402	-400	-400	-400	-56	-57	-60	-57	-.19048
5-16-74	1500	91.0	1.0410	71.5	-405	-403	-403	-403	-59	-60	-63	-60	-.19190
5-21-74	855	95.8	5.8	70.7	-439	-437	-439	-438	-93	-94	-99	-95	-.20857
5-22-74	1155	96.9	6.9	71.1	-444	-441	-444	-443	-98	-98	-104	-100	-.21095
5-24-74	955	98.8	8.8	71.4	-453	-449	-453	-451	-107	-106	-113	-108	-.21476
5-25-74	1155	99.9	9.9	71.4	-459	-454	-459	-457	-113	-111	-119	-114	-.21762
5-26-74	1445	101.0	11.0	71.5	-461	-457	-462	-460	-115	-114	-122	-117	-.21905
5-28-74	1140	102.9	12.9	71.4	-467	-461	-467	-465	-121	-118	-127	-122	-.22143
5-31-74	1440	106.0	16.0	72.3	-479	-474	-480	-477	-133	-131	-140	-134	-.22714
6 -4-74	1935	110.2	20.2	71.6	-485	-480	-486	-483	-139	-137	-146	-140	-.23000
6 -7-74	850	112.8	22.8	71.5	-490	-485	-491	-488	-144	-142	-151	-145	-.23238
6-10-74	1512	116.0	26.0	71.4	-498	-493	-500	-497	-152	-150	-160	-154	-.23667
6-14-74	845	119.8	29.8	70.6	-502	-498	-504	-501	-156	-155	-164	-158	-.23857
6-20-74	1340	126.0	36.0	70.9	-512	-507	-514	-511	-166	-164	-174	-168	-.24333
6-26-74	1140	131.9	41.9	71.2	-518	-515	-522	-518	-172	-172	-182	-175	-.24667
7 -3-74	915	138.8	48.8	71.9	-524	-522	-529	-525	-178	-179	-189	-182	-.25000
7-10-74	1630	146.1	56.1	72.1	-533	-531	-538	-534	-187	-188	-198	-191	-.25429
7-17-74	1500	153.0	63.0	72.6	-540	-537	-546	-541	-194	-194	-206	-198	-.25762
7-24-74	1600	160.1	70.1	71.9	-548	-545	-553	-548	-202	-202	-213	-205	-.26095
8 -6-74	1230	172.9	82.9	71.4	-559	-556	-565	-560	-213	-213	-225	-217	-.26667
8-15-74	1115	181.9	91.9	71.4	-565	-563	-572	-566	-219	-220	-232	-223	-.26952
8-21-74	1435	188.0	98.0	71.8	-570	-567	-578	-571	-224	-224	-238	-228	-.27190
8-30-74	1320	197.0	107.0	71.6	-575	-573	-584	-577	-229	-230	-244	-234	-.27476
9-18-74	900	215.8	125.8	71.3	-589	-585	-598	-590	-243	-242	-258	-247	-.28095
10 -9-74	1600	237.1	147.1	72.3	-598	-595	-606	-600	-252	-252	-268	-257	-.28571
11 -7-74	1100	265.9	175.9	72.1	-622	-621	-634	-626	-276	-278	-294	-282	-.29762
12-10-74	1230	298.9	208.9	72.0	-627	-626	-642	-631	-281	-283	-302	-288	-.30048
1-15-75	1330	335.0	245.0	72.9	-638	-637	-652	-642	-292	-294	-312	-299	-.30571
2-18-75	1430	369.0	279.0	71.8	-645	-647	-661	-651	-299	-304	-321	-308	-.31000
3-14-75	1100	392.9	302.9	71.9	-656	-657	-670	-661	-310	-314	-330	-318	-.31476
4-12-75	1200	421.9	331.9	71.9	-661	-663	-677	-667	-315	-320	-337	-324	-.31762
5-16-75	1130	455.9	365.9	72.8	-673	-677	-691	-680	-327	-334	-351	-337	-.32381
6-16-75	1230	486.9	396.9	72.6	-681	-686	-699	-688	-335	-343	-359	-345	-.32762
7-15-75	1400	516.0	426.0	72.9	-685	-692	-704	-693	-339	-349	-364	-350	-.33000
8-22-75	1315	554.0	464.0	72.6	-694	-702	-714	-703	-348	-359	-374	-360	-.33476
9-16-75	1640	579.1	489.1	72.7	-700	-708	-721	-709	-354	-365	-381	-366	-.33762
10-20-75	1530	613.1	523.1	72.9	-706	-716	-728	-716	-360	-373	-388	-373	-.34095
11-26-75	1450	650.0	560.0	72.6	-719	-730	-742	-730	-373	-387	-402	-387	-.34762
12-24-75	920	677.8	587.8	71.8	-718	-730	-741	-729	-372	-387	-401	-386	-.34714
2-24-75	930	739.8	649.8	71.8	-727	-743	-754	-741	-381	-400	-414	-398	-.35286

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 73F, 90 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 7070. PSI AT 73.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
29.7 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 202 73 09
201 73 10

CREEP : 198 73 21
200 73 22
205 73 23

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0007		0	0	0	0		
90	-.0003		-162	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
90	.0000	6.12	-343	0	0	0	0.	-.1633
90	.0035	5.93	-354	-11	0	-11	-.0052	-.1686
90	.0104	5.82	-361	-18	0	-18	-.0086	-.1719
90	.0417	5.69	-369	-26	0	-26	-.0124	-.1757
90	.1250	5.54	-379	-36	0	-36	-.0171	-.1805
90	.2500	5.44	-386	-43	0	-43	-.0205	-.1838
91	.7979	5.25	-400	-57	0	-57	-.0271	-.1905
91	1.0410	5.21	-403	-60	0	-60	-.0286	-.1919
96	5.8	4.79	-438	-95	0	-95	-.0452	-.2086
97	6.9	4.74	-443	-100	1	-101	-.0481	-.2110
99	8.8	4.66	-451	-108	1	-109	-.0519	-.2148
100	9.9	4.60	-457	-114	1	-115	-.0548	-.2176
101	11.0	4.57	-460	-117	1	-118	-.0562	-.2190
103	12.9	4.52	-465	-122	1	-123	-.0586	-.2214
106	16.0	4.40	-477	-134	0	-134	-.0638	-.2271
110	20.2	4.35	-483	-140	1	-141	-.0671	-.2300
113	22.8	4.30	-488	-145	2	-147	-.0700	-.2324
116	26.0	4.23	-497	-154	1	-155	-.0738	-.2367
120	29.8	4.19	-501	-158	2	-160	-.0762	-.2386
126	36.0	4.11	-511	-168	3	-171	-.0814	-.2433
132	41.9	4.05	-518	-175	2	-177	-.0843	-.2467
139	48.8	4.00	-525	-182	3	-185	-.0881	-.2500
146	56.1	3.93	-534	-191	2	-193	-.0919	-.2543
153	63.0	3.88	-541	-198	2	-200	-.0952	-.2576
160	70.1	3.83	-548	-205	1	-206	-.0981	-.2610
173	82.9	3.75	-560	-217	1	-218	-.1038	-.2667
182	91.9	3.71	-566	-223	0	-223	-.1062	-.2695
188	98.0	3.68	-571	-228	0	-228	-.1086	-.2719
197	107.0	3.64	-577	-234	-1	-233	-.1110	-.2748
216	125.8	3.56	-590	-247	-2	-245	-.1167	-.2810
237	147.1	3.50	-600	-257	-4	-253	-.1205	-.2857
266	175.9	3.36	-625	-282	-7	-275	-.1310	-.2976
299	208.9	3.33	-631	-288	-8	-280	-.1333	-.3005
335	245.0	3.27	-642	-299	-9	-290	-.1381	-.3057
369	279.0	3.23	-651	-308	-11	-297	-.1414	-.3100
393	302.9	3.18	-661	-318	-12	-306	-.1457	-.3148
422	331.9	3.15	-667	-324	-14	-310	-.1476	-.3176
456	365.9	3.09	-680	-337	-17	-320	-.1524	-.3238
487	396.9	3.05	-688	-345	-17	-328	-.1562	-.3276
516	426.0	3.03	-693	-350	-19	-331	-.1576	-.3300
554	464.0	2.99	-703	-360	-21	-339	-.1614	-.3348
579	489.1	2.96	-709	-366	-23	-343	-.1633	-.3376
613	523.1	2.93	-716	-373	-26	-347	-.1652	-.3410
650	560.0	2.88	-730	-387	-30	-357	-.1700	-.3476
678	587.8	2.88	-729	-386	-32	-354	-.1686	-.3471
740	649.8	2.83	-741	-398	-36	-362	-.1724	-.3529

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AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 90 DAY, 45 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 3190 PSI)
NO.1	418	73 27	21	6.1
NO.2	401	73 28	14	6.2
NO.3	406	73 29	15	6.1

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 7070. PSI AT 73.F.
APPLIED TEST STRESS : 3190. PSI
PER. ULT. STR. APPLIED: 44.3 PERCENT (SELECTED MIX)
45.1 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

	DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.		ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.		CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.		(ELASTIC +CREEP)/ 3190 PSI
*	3 -7-74	1430	0	SPECIMENS CAST													
*	6 -5-74	1418	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1590 PSI (PLUS OR MINUS 30), RESPECTIVELY													
	6 -5-74	1418	90.0	-.0014	71.4	**	0	0	0	0	**	0	0	0	0	**	0.
	6 -5-74	1419	90.0	-.0007	71.4	**	-240	-236	-233	-236	**	0	0	0	0	**	-.07398
*	6 -5-74	1420	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 3190 PSI													
	6 -5-74	1420	90.0	0.	71.3	**	-525	-517	-523	-521	**	0	0	0	0	**	-.16332
	6 -5-74	1421	90.0	.0007	71.3	**	-533	-529	-535	-532	**	-8	-12	-12	-10	**	-.16677
	6 -5-74	1425	90.0	.0035	71.3	**	-547	-540	-547	-544	**	-22	-23	-24	-23	**	-.17053
	6 -5-74	1435	90.0	.0104	71.3	**	-557	-551	-558	-555	**	-32	-34	-35	-33	**	-.17398
	6 -5-74	1450	90.0	.0208	71.3	**	-567	-561	-568	-565	**	-42	-44	-45	-43	**	-.17712
	6 -5-74	1525	90.0	.0451	71.4	**	-576	-571	-578	-575	**	-51	-54	-55	-53	**	-.18025
	6 -5-74	1720	90.1	.1250	71.3	**	-592	-587	-595	-591	**	-67	-70	-72	-69	**	-.18527
	6 -5-74	2105	90.3	.2813	71.2	**	-604	-599	-607	-603	**	-79	-82	-84	-81	**	-.18903
	6 -6-74	840	90.8	.7639	71.0	**	-629	-625	-632	-628	**	-104	-108	-109	-107	**	-.19687
	6 -6-74	1403	91.0	.9882	71.0	**	-637	-633	-641	-637	**	-112	-116	-118	-115	**	-.19969
	6 -7-74	1445	92.0	2.0	70.9	**	-658	-655	-662	-658	**	-133	-138	-139	-136	**	-.20627
	6 -8-74	1450	93.0	3.0	70.9	**	-672	-669	-676	-672	**	-147	-152	-153	-150	**	-.21066
	6 -9-74	1240	93.9	3.9	70.5	**	-681	-678	-685	-681	**	-156	-161	-162	-159	**	-.21348
	6-10-74	1512	95.0	5.0	70.5	**	-694	-692	-698	-694	**	-169	-175	-175	-173	**	-.21755
	6-11-74	923	95.8	5.8	70.1	**	-699	-697	-703	-699	**	-174	-180	-180	-178	**	-.21912
	6-12-74	1145	96.9	6.9	70.2	**	-708	-706	-711	-708	**	-183	-189	-188	-186	**	-.22194
	6-14-74	845	98.8	8.8	70.0	**	-716	-714	-720	-716	**	-191	-197	-197	-195	**	-.22445
	6-17-74	1600	102.1	12.1	70.2	**	-734	-733	-738	-735	**	-209	-216	-215	-213	**	-.23041
	6-20-74	1340	105.0	15.0	70.9	**	-754	-753	-756	-754	**	-229	-236	-233	-232	**	-.23636
	6-26-74	1140	110.9	20.9	70.2	**	-768	-768	-772	-769	**	-243	-251	-249	-247	**	-.24107
	6-30-74	940	114.8	24.8	70.2	**	-778	-778	-782	-779	**	-253	-261	-259	-257	**	-.24420
	7 -9-74	930	123.8	33.8	70.3	**	-804	-804	-809	-805	**	-279	-287	-286	-284	**	-.25235
	7-10-74	1630	125.1	35.1	70.6	**	-806	-806	-811	-807	**	-281	-289	-288	-286	**	-.25298
	7-15-74	1300	129.9	39.9	71.0	**	-824	-824	-829	-825	**	-299	-307	-306	-304	**	-.25862
	7-24-74	1600	139.1	49.1	71.0	**	-836	-836	-841	-837	**	-311	-319	-318	-316	**	-.26238
	7-31-74	1715	146.1	56.1	70.9	**	-851	-853	-856	-853	**	-326	-336	-333	-331	**	-.26740
	8 -8-74	1200	153.9	63.9	70.8	**	-864	-866	-869	-866	**	-339	-349	-346	-344	**	-.27147
	8-15-74	1115	160.9	70.9	70.5	**	-874	-877	-879	-876	**	-349	-360	-356	-355	**	-.27461
	8-29-74	1135	174.9	84.9	70.7	**	-885	-888	-889	-887	**	-360	-371	-366	-365	**	-.27806
	9-11-74	1315	187.9	98.0	71.0	**	-906	-910	-910	-908	**	-381	-393	-387	-387	**	-.28464
	9-25-74	1600	202.1	112.1	70.3	**	-920	-925	-924	-923	**	-398	-408	-401	-401	**	-.28934
	10-23-74	1420	230.0	140.0	71.0	**	-946	-952	-949	-949	**	-421	-435	-426	-427	**	-.29749
	11-21-74	1000	258.8	168.8	70.9	**	-972	-978	-972	-974	**	-447	-461	-449	-452	**	-.30533
	12-17-74	1430	285.0	195.0	70.6	**	-997	-1004	-996	-999	**	-472	-487	-473	-477	**	-.31317
	1-15-75	1330	314.0	224.0	71.6	**	-1005	-1010	-1002	-1005	**	-480	-493	-479	-484	**	-.31505
	2-18-75	1430	348.0	258.0	70.5	**	-1025	-1021	-1020	-1022	**	-500	-504	-497	-500	**	-.32038
	3-14-75	1100	371.9	281.9	70.6	**	-1043	-1024	-1034	-1033	**	-518	-507	-511	-512	**	-.32382
	4-12-75	1200	400.9	310.9	70.6	**	-1054	-1029	-1044	-1042	**	-529	-512	-521	-520	**	-.32665
	5-16-75	1130	434.9	344.9	71.6	**	-1073	-1035	-1058	-1055	**	-548	-518	-535	-533	**	-.33072
	6-16-75	1128	465.9	375.9	71.5	**	-1085	-1089	-1068	-1080	**	-560	-572	-545	-559	**	-.33856
*	6-16-75	1130	465.9	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*													
	6-16-75	1130	465.9	0.	71.5	**	-608	-601	-606	-605	**	-83	-84	-83	-83	**	
	6-16-75	1145	465.9	.0104	71.4	**	-587	-582	-589	-586	**	-62	-65	-66	-64	**	
	6-16-75	1230	465.9	.0417	71.4	**	-580	-575	-582	-579	**	-55	-58	-59	-57	**	
	6-16-75	1425	466.0	.1215	71.5	**	-571	-565	-574	-570	**	-46	-48	-51	-48	**	
	6-17-75	1115	466.9	.9896	71.1	**	-552	-546	-555	-551	**	-27	-29	-32	-29	**	
	6-19-75	1550	469.1	3.2	71.4	**	-536	-530	-540	-535	**	-11	-13	-17	-13	**	
	6-24-75	1710	474.1	8.2	71.4	**	-520	-511	-522	-517	**	5	6	1	4	**	
	7 -1-75	1545	481.1	15.2	72.2	**	-506	-496	-508	-503	**	19	21	15	18	**	
*	7 -3-75	1630	483.1	END OF TEST													

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 73F, 90 DAY, 45 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 7070. PSI AT 73.F.
APPLIED TEST STRESS : 3190. PSI
PER. ULT. STR. APPLIED: 44.3 PERCENT (SELECTED MIX)
45.1 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 202 73 09
201 73 10

CREEP : 418 73 27
401 73 28
406 73 29

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 3190 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0014		0	0	0	0		
90	-.0007		-236	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 3190 PSI								
90	0.	6.12	-521	0	0	0	0.	-.1633
90	.0007	6.00	-532	-10	0	-10	-.0031	-.1668
90	.0035	5.86	-544	-23	0	-23	-.0072	-.1705
90	.0104	5.75	-555	-33	0	-33	-.0103	-.1740
90	.0208	5.65	-565	-43	0	-43	-.0135	-.1771
90	.0451	5.55	-575	-53	0	-53	-.0166	-.1803
90	.1250	5.40	-591	-69	0	-69	-.0216	-.1853
90	.2813	5.29	-603	-81	0	-81	-.0254	-.1890
91	.7639	5.08	-628	-107	0	-107	-.0335	-.1969
91	.9882	5.01	-637	-115	0	-115	-.0361	-.1997
92	2.0	4.85	-658	-136	1	-137	-.0429	-.2063
93	3.0	4.75	-672	-150	1	-151	-.0473	-.2107
94	3.9	4.68	-681	-159	1	-160	-.0502	-.2135
95	5.0	4.60	-694	-173	1	-174	-.0545	-.2176
96	5.8	4.56	-699	-178	0	-178	-.0558	-.2191
97	6.9	4.51	-708	-186	1	-187	-.0586	-.2219
99	8.8	4.46	-716	-195	1	-196	-.0614	-.2245
102	12.1	4.34	-735	-213	1	-214	-.0671	-.2304
105	15.0	4.23	-754	-232	1	-233	-.0730	-.2364
111	20.9	4.15	-769	-247	1	-248	-.0777	-.2411
115	24.8	4.09	-779	-257	2	-259	-.0812	-.2442
124	33.8	3.96	-805	-284	2	-286	-.0897	-.2524
125	35.1	3.95	-807	-286	3	-289	-.0906	-.2530
130	39.9	3.87	-825	-304	3	-307	-.0962	-.2586
139	49.1	3.81	-837	-316	3	-319	-.1000	-.2624
146	56.1	3.74	-853	-331	2	-333	-.1044	-.2674
154	63.9	3.68	-866	-344	2	-346	-.1085	-.2715
161	70.9	3.64	-876	-355	1	-356	-.1116	-.2746
175	84.9	3.60	-887	-365	1	-366	-.1147	-.2781
188	98.0	3.51	-908	-387	0	-387	-.1213	-.2846
202	112.1	3.46	-923	-401	-1	-400	-.1254	-.2893
230	140.0	3.36	-949	-427	-4	-423	-.1326	-.2975
259	168.8	3.28	-974	-452	-6	-446	-.1398	-.3053
285	195.0	3.19	-999	-477	-8	-469	-.1470	-.3132
314	224.0	3.17	-1005	-484	-8	-476	-.1492	-.3150
348	258.0	3.12	-1022	-500	-9	-491	-.1539	-.3204
372	281.9	3.09	-1033	-512	-10	-502	-.1574	-.3238
401	310.9	3.06	-1042	-520	-12	-508	-.1592	-.3266
435	344.9	3.02	-1055	-533	-14	-519	-.1627	-.3307
466	375.9	2.95	-1080	-559	-16	-543	-.1702	-.3386
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
466	0.		-605	-83	-16	-67		
466	.0104		-586	-64	-16	-48		
466	.0417		-579	-57	-16	-41		
466	.1215		-570	-48	-16	-32		
467	.9896		-551	-29	-16	-13		
469	3.2		-535	-13	-16	3		
474	8.2		-517	4	-16	20		
481	15.2		-503	18	-16	34		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 90 DAY, 60 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 4250 PSI)
NO.1	414	73 25	15	5.8
NO.2	419	73 26	10	5.7
NO.3	400	73 24	24	5.2

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 7070. PSI AT 73.F.
APPLIED TEST STRESS : 4250. PSI
PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
60.1 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

	DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	ELASTIC PLUS CREEP SPECIMEN NO.2	ELASTIC PLUS CREEP SPECIMEN NO.3	ELASTIC PLUS CREEP AVG.	CREEP SPECIMEN NO.1	CREEP SPECIMEN NO.2	CREEP SPECIMEN NO.3	CREEP AVG.	(ELASTIC +CREEP)/ 4250 PSI
*	3-7-74	1430	0	SPECIMENS CAST										
*	6-5-74	1517	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0, 1590, AND 3190 PSI (PLUS OR MINUS 30), RESPECTIVELY										
	6-5-74	1517	90.0	-.0021	71.7	0	0	0	0	0	0	0	0	0.
	6-5-74	1518	90.0	-.0014	71.7	-233	-240	-230	-234	0	0	0	0	-.05506
	6-5-74	1519	90.0	-.0007	71.7	-520	-525	-512	-519	0	0	0	0	-.12212
*	6-5-74	1520	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 4250 PSI										
	6-5-74	1520	90.0	0.	71.6	-736	-751	-715	-734	0	0	0	0	-.17271
	6-5-74	1522	90.0	.0014	71.6	-763	-778	-752	-764	-27	-27	-37	-30	-.17976
	6-5-74	1525	90.0	.0035	71.6	-789	-806	-778	-791	-53	-55	-63	-57	-.18612
	6-5-74	1530	90.0	.0069	71.6	-807	-822	-798	-809	-71	-71	-83	-75	-.19035
	6-5-74	1535	90.0	.0104	71.6	-818	-832	-809	-819	-82	-81	-94	-85	-.19271
	6-5-74	1555	90.1	.0243	71.6	-837	-850	-831	-839	-101	-99	-116	-105	-.19741
	6-5-74	1620	90.1	.0417	71.6	-862	-873	-858	-864	-126	-122	-143	-130	-.20329
	6-5-74	1720	90.1	.0833	71.5	-887	-896	-886	-889	-151	-145	-171	-155	-.20918
	6-5-74	2105	90.3	.2396	71.4	-929	-937	-932	-932	-193	-186	-217	-198	-.21929
	6-6-74	840	90.8	.7222	71.2	-984	-990	-989	-987	-248	-239	-274	-253	-.23224
	6-6-74	1403	91.0	.9465	71.2	-998	-1004	-1004	-1002	-262	-253	-289	-268	-.23576
	6-7-74	1445	92.0	1.9757	71.0	-1043	-1049	-1051	-1047	-307	-298	-336	-313	-.24635
	6-8-74	1450	93.0	3.0	71.1	-1070	-1074	-1079	-1074	-334	-323	-364	-340	-.25271
	6-9-74	1240	93.9	3.9	70.7	-1086	-1091	-1096	-1091	-350	-340	-381	-357	-.25671
	6-10-74	1512	95.0	5.0	70.6	-1106	-1111	-1116	-1111	-370	-360	-401	-377	-.26141
	6-11-74	923	95.8	5.8	70.2	-1117	-1122	-1127	-1122	-381	-371	-412	-388	-.26400
	6-12-74	1145	96.9	6.9	70.3	-1131	-1135	-1141	-1135	-395	-384	-426	-401	-.26706
	6-14-74	845	98.8	8.7	70.2	-1148	-1151	-1158	-1152	-412	-400	-443	-418	-.27106
	6-17-74	1600	102.1	12.0	70.2	-1178	-1181	-1186	-1181	-442	-430	-471	-447	-.27788
	6-20-74	1340	105.0	14.9	70.8	-1194	-1205	-1204	-1201	-458	-454	-489	-467	-.28259
	6-26-74	1140	110.9	20.9	70.2	-1231	-1233	-1240	-1234	-495	-482	-525	-500	-.29035
	6-30-74	940	114.8	24.8	70.3	-1251	-1254	-1260	-1255	-515	-503	-545	-521	-.29529
	7-9-74	930	123.8	33.8	70.2	-1287	-1290	-1295	-1290	-551	-539	-580	-556	-.30353
	7-10-74	1630	125.1	35.0	70.6	-1290	-1294	-1299	-1294	-554	-543	-584	-560	-.30447
	7-15-74	1300	129.9	39.9	71.1	-1306	-1309	-1313	-1309	-570	-558	-598	-575	-.30800
	7-24-74	1600	139.1	49.0	71.1	-1335	-1339	-1343	-1339	-599	-588	-628	-605	-.31506
	7-31-74	1715	146.1	56.1	70.9	-1354	-1358	-1361	-1357	-618	-607	-646	-623	-.31929
	8-8-74	1200	153.9	63.9	70.9	-1377	-1383	-1384	-1381	-641	-632	-669	-647	-.32494
	8-15-74	1115	160.9	70.8	70.5	-1388	-1393	-1395	-1392	-652	-642	-680	-658	-.32753
	8-29-74	1135	174.9	84.8	70.7	-1413	-1417	-1419	-1416	-677	-666	-704	-682	-.33318
	9-11-74	1315	187.9	97.9	71.1	-1435	-1438	-1440	-1437	-699	-687	-725	-703	-.33812
	9-25-74	1600	202.1	112.0	70.3	-1455	-1458	-1460	-1457	-719	-707	-745	-723	-.34282
	10-9-74	1600	216.1	126.0	71.3	-1478	-1482	-1482	-1480	-742	-731	-767	-746	-.34824
	10-23-74	1420	230.0	140.0	71.0	-1496	-1500	-1501	-1499	-760	-749	-786	-765	-.35271
	11-21-74	1000	258.8	168.8	70.9	-1530	-1532	-1534	-1532	-794	-781	-819	-798	-.36047
	12-17-74	1430	285.0	195.0	70.5	-1559	-1558	-1561	-1559	-823	-807	-846	-825	-.36682
	1-15-75	1330	314.0	223.9	71.5	-1575	-1574	-1574	-1574	-839	-823	-859	-840	-.37035
	2-18-75	1430	348.0	258.0	70.3	-1610	-1605	-1607	-1607	-874	-854	-892	-873	-.37812
	3-14-75	1100	371.9	281.8	70.3	-1626	-1620	-1620	-1622	-890	-869	-905	-888	-.38165
	4-12-75	1200	400.9	310.9	70.6	-1642	-1633	-1636	-1637	-906	-882	-921	-903	-.38518
	5-16-75	1130	434.9	344.8	71.6	-1664	-1653	-1656	-1657	-928	-902	-941	-923	-.38988
	6-16-75	1230	465.9	375.9	71.4	-1681	-1668	-1670	-1673	-945	-917	-955	-939	-.39365
	6-30-75	1429	480.0	390.0	70.6	-1688	-1676	-1678	-1680	-952	-925	-963	-946	-.39529
*	6-30-75	1430	480.0	APPLIED TEST STRESS CHANGED TO 2100 PSI										
	6-30-75	1430	480.0	390.0	70.9	-1402	-1386	-1398	-1395	-666	-635	-683	-661	
	6-30-75	1445	480.0	390.0	70.4	-1386	-1369	-1383	-1379	-650	-618	-668	-645	
	6-30-75	1500	480.0	390.0	70.1	-1390	-1370	-1396	-1382	-654	-619	-671	-648	
	6-30-75	1700	480.1	390.1	70.7	-1385	-1364	-1381	-1376	-649	-613	-666	-642	
	7-1-75	1345	481.1	391.0	72.1	-1375	-1355	-1370	-1366	-639	-604	-655	-632	
	7-7-75	1425	487.0	397.0	71.8	-1366	-1345	-1358	-1356	-630	-594	-643	-622	
	7-15-75	1400	495.0	404.9	71.7	-1354	-1334	-1348	-1345	-618	-583	-633	-611	
	7-28-75	1220	507.9	417.9	72.0	-1350	-1330	-1344	-1341	-614	-579	-629	-607	
*	7-28-75	1221	507.9	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
	7-28-75	1221	507.9	.0000	72.0	-1010	-968	-1005	-994	-274	-217	-290	-260	
	7-28-75	1222	507.9	.0007	72.0	-1005	-963	-997	-988	-269	-212	-282	-254	
	7-28-75	1226	507.9	.0035	72.0	-998	-954	-989	-980	-262	-203	-274	-246	
	7-28-75	1236	507.9	.0104	72.1	-990	-946	-980	-972	-254	-195	-265	-238	
	7-28-75	1600	508.1	.1521	72.1	-972	-926	-961	-953	-236	-175	-246	-219	
	7-29-75	1210	508.9	.9924	71.9	-955	-908	-943	-935	-219	-157	-228	-201	
	7-31-75	1550	511.1	3.1	71.9	-939	-892	-927	-919	-203	-141	-212	-185	
	8-5-75	1630	516.1	8.2	71.8	-920	-872	-908	-900	-184	-121	-193	-166	
	8-22-75	1315	532.9	25.0	71.6	-893	-844	-880	-872	-157	-93	-165	-138	
	9-16-75	1640	558.1	50.2	71.6	-871	-821	-857	-849	-135	-70	-142	-115	
	9-22-75	915	563.8	55.9	71.3	-870	-819	-856	-848	-134	-68	-141	-114	
*	9-23-75	1200	564.9	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 73F, 90 DAY, 60 PERCENT
(SPECIMEN: SEALED 6 BY 15 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 7070. PSI AT 73.F.
APPLIED TEST STRESS : 4250. PSI
PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
60.1 PERCENT (COMPANION)

STRAIN METER NUMBERS
AUTOGENOUS: 202 73 09
201 73 10
CREEP : 414 73 25
419 73 26
400 73 24

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 4250 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0021		0	0	0	0		
90	-.0014		-234	0	0	0		
90	-.0007		-519	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 4250 PSI								
90	0.	5.79	-734	0	0	0	0.	-.1727
90	.0014	5.56	-764	-30	0	-30	-.0071	-.1798
90	.0035	5.37	-791	-57	0	-57	-.0134	-.1861
90	.0069	5.25	-809	-75	0	-75	-.0176	-.1904
90	.0104	5.19	-819	-85	0	-85	-.0200	-.1927
90	.0243	5.07	-839	-105	0	-105	-.0247	-.1974
90	.0417	4.92	-864	-130	0	-130	-.0306	-.2033
90	.0833	4.78	-889	-155	0	-155	-.0365	-.2092
90	.2396	4.56	-932	-198	0	-198	-.0466	-.2193
91	.7222	4.31	-987	-253	0	-253	-.0595	-.2322
91	.9465	4.24	-1002	-268	0	-268	-.0631	-.2358
92	2.0	4.06	-1047	-313	1	-314	-.0739	-.2464
93	3.0	3.96	-1074	-340	1	-341	-.0802	-.2527
94	3.9	3.90	-1091	-357	1	-358	-.0842	-.2567
95	5.0	3.83	-1111	-377	1	-378	-.0889	-.2614
96	5.8	3.79	-1122	-388	0	-388	-.0913	-.2640
97	6.9	3.74	-1135	-401	1	-402	-.0946	-.2671
99	8.7	3.69	-1152	-418	1	-419	-.0986	-.2711
102	12.0	3.60	-1181	-447	1	-448	-.1054	-.2779
105	14.9	3.54	-1201	-467	1	-468	-.1101	-.2826
111	20.8	3.44	-1234	-500	1	-501	-.1179	-.2904
115	24.8	3.39	-1255	-521	2	-523	-.1231	-.2953
124	33.8	3.29	-1290	-556	2	-558	-.1313	-.3035
125	35.0	3.28	-1294	-560	3	-563	-.1325	-.3045
130	39.9	3.25	-1309	-575	3	-578	-.1360	-.3080
139	49.0	3.17	-1339	-605	3	-608	-.1431	-.3151
146	56.1	3.13	-1357	-623	2	-625	-.1471	-.3193
154	63.9	3.08	-1381	-647	2	-649	-.1527	-.3249
161	70.8	3.05	-1392	-658	1	-659	-.1551	-.3275
175	84.8	3.00	-1416	-682	1	-683	-.1607	-.3332
188	97.9	2.96	-1437	-703	0	-703	-.1654	-.3381
202	112.0	2.92	-1457	-723	-1	-722	-.1699	-.3428
216	126.0	2.87	-1480	-746	-3	-743	-.1748	-.3482
230	140.0	2.84	-1499	-765	-4	-761	-.1791	-.3527
259	168.8	2.77	-1532	-798	-6	-792	-.1864	-.3605
285	195.0	2.73	-1559	-825	-8	-817	-.1922	-.3668
314	223.9	2.70	-1574	-840	-8	-832	-.1958	-.3704
348	258.0	2.64	-1607	-873	-9	-864	-.2033	-.3781
372	281.8	2.62	-1622	-888	-10	-878	-.2066	-.3816
401	310.9	2.60	-1637	-903	-12	-891	-.2096	-.3852
435	344.8	2.56	-1657	-923	-14	-909	-.2139	-.3899
466	375.9	2.54	-1673	-939	-16	-923	-.2172	-.3936
480	390.0	2.53	-1680	-946	-16	-930	-.2188	-.3953
**APPLIED TEST STRESS CHANGED TO 2100 PSI								
480	390.0		-1395	-661	-16	-645		
480	390.0		-1379	-645	-16	-629		
480	390.0		-1382	-648	-16	-632		
480	390.1		-1376	-642	-16	-626		
481	391.0		-1366	-632	-16	-616		
487	397.0		-1356	-622	-17	-605		
495	404.9		-1345	-611	-17	-594		
508	417.9		-1341	-607	-17	-590		
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
508	.0000		-994	-260	-17	-243		
508	.0007		-988	-254	-17	-237		
508	.0035		-980	-246	-17	-229		
508	.0104		-972	-238	-17	-221		
508	.1521		-953	-219	-17	-202		
509	.9924		-935	-201	-18	-183		
511	3.1		-919	-185	-18	-167		
516	8.2		-900	-166	-19	-147		
533	25.0		-872	-138	-19	-119		
558	50.2		-849	-115	-20	-95		
564	55.9		-848	-114	-21	-93		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 73F, 270 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2400 PSI)
NO.1	204	73 33	11	6.3
NO.2	208	73 34	16	6.3
NO.3	209	73 35	9	6.3

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 7980. PSI AT 73.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.3 PERCENT (SELECTED MIX)
30.1 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2400 PSI
* 2-14-74	1400	0	SPECIMENS CAST										
*11-11-74	916	269.8	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1200 PSI (PLUS OR MINUS 30), RESPECTIVELY										
11-11-74	916	269.8	-.0007	72.4	0	0	0	0	0	0	0	0	0.
11-11-74	916	269.8	-.0003	72.4	-186	-191	-196	-191	0	0	0	0	-.07958
*11-11-74	917	269.8	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2400 PSI										
11-11-74	917	269.8	0.	72.4	-381	-380	-379	-380	0	0	0	0	-.15833
11-11-74	923	269.8	.0042	72.5	-394	-394	-393	-393	-13	-14	-14	-13	-.16375
11-11-74	932	269.8	.0104	72.6	-398	-398	-397	-397	-17	-18	-18	-17	-.16542
11-11-74	1022	269.8	.0451	72.6	-407	-407	-406	-406	-26	-27	-27	-26	-.16917
11-11-74	1222	269.9	.1285	72.8	-413	-414	-413	-413	-32	-34	-34	-33	-.17208
11-11-74	1612	270.1	.2882	73.0	-420	-421	-419	-420	-39	-41	-40	-40	-.17500
11-12-74	922	270.8	1.0035	72.9	-435	-437	-435	-435	-54	-57	-56	-55	-.18125
11-14-74	1020	272.8	3.0	72.9	-453	-457	-454	-454	-72	-77	-75	-74	-.18917
11-15-74	1130	273.9	4.1	72.9	-459	-462	-459	-460	-78	-82	-80	-80	-.19167
11-16-74	1150	274.9	5.1	72.7	-464	-463	-464	-463	-83	-83	-85	-83	-.19292
11-18-74	810	276.8	7.0	72.1	-470	-474	-471	-471	-89	-94	-92	-91	-.19625
11-21-74	1000	279.8	10.0	72.8	-479	-484	-480	-481	-98	-104	-101	-101	-.20042
11-22-74	1130	280.9	11.1	72.7	-482	-487	-483	-484	-101	-107	-104	-104	-.20167
12 -4-74	1350	293.0	23.2	72.6	-500	-508	-502	-503	-119	-128	-123	-123	-.20958
12-10-74	1230	298.9	29.1	72.6	-510	-518	-512	-513	-129	-138	-133	-133	-.21375
12-13-74	1500	302.0	32.2	72.2	-518	-525	-520	-521	-137	-145	-141	-141	-.21708
12-17-74	1430	306.0	36.2	72.8	-529	-535	-531	-531	-148	-155	-152	-151	-.22125
12-20-74	1200	308.9	39.1	72.4	-532	-540	-536	-536	-151	-160	-157	-156	-.22333
12-30-74	840	318.8	49.0	72.0	-536	-545	-540	-540	-155	-165	-161	-160	-.22500
1 -7-75	855	326.8	57.0	72.7	-544	-554	-548	-548	-163	-174	-169	-168	-.22833
1-15-75	1330	335.0	65.2	74.2	-552	-562	-556	-556	-171	-182	-177	-176	-.23167
1-20-75	810	339.8	70.0	73.1	-559	-570	-564	-564	-178	-190	-185	-184	-.23500
1-31-75	830	350.8	81.0	72.0	-567	-579	-573	-573	-186	-199	-194	-193	-.23875
2-18-75	1430	369.0	99.2	72.6	-575	-589	-582	-582	-194	-209	-203	-202	-.24250
2-28-75	1000	378.8	109.0	73.1	-583	-596	-589	-589	-202	-216	-210	-209	-.24542
3-14-75	1100	392.9	123.1	72.9	-593	-608	-600	-600	-212	-228	-221	-220	-.25000
4-12-75	1200	421.9	152.1	72.9	-605	-621	-613	-613	-224	-241	-234	-233	-.25542
5-16-75	1130	455.9	186.1	73.7	-627	-643	-636	-635	-246	-263	-257	-255	-.26458
6-16-75	1230	486.9	217.1	73.5	-635	-654	-647	-645	-254	-274	-268	-265	-.26875
7-15-75	1400	516.0	246.2	73.8	-649	-668	-661	-659	-268	-288	-282	-279	-.27458
8-22-75	1315	554.0	284.2	73.3	-658	-679	-671	-669	-277	-299	-292	-289	-.27875
9-16-75	1640	579.1	309.3	73.5	-674	-693	-686	-684	-293	-313	-307	-304	-.28500
10-20-75	1530	613.1	343.3	73.8	-685	-705	-699	-696	-304	-325	-320	-316	-.29000
11-11-75	905	634.8	365.0	72.6	-697	-716	-710	-707	-316	-336	-331	-327	-.29458
*11-11-75	906	634.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
11-11-75	906	634.8	0.	72.6	-333	-354	-342	-343	48	26	37	37	
11-11-75	911	634.8	.0035	73.0	-324	-345	-335	-334	57	35	44	45	
11-11-75	921	634.8	.0104	72.7	-321	-342	-331	-331	60	38	48	48	
11-11-75	1005	634.8	.0410	72.8	-314	-335	-326	-325	67	45	53	55	
11-11-75	1550	635.1	.2806	72.8	-305	-325	-316	-315	76	55	63	64	
11-14-75	840	637.8	3.0	73.8	-291	-310	-301	-300	90	70	78	79	
11-26-75	1450	650.0	15.2	73.1	-268	-288	-280	-278	113	92	99	101	
12-11-75	840	664.8	30.0	72.5	-253	-273	-265	-263	128	107	114	116	
12-24-75	920	677.8	43.0	72.2	-237	-258	-250	-248	144	122	129	131	
1-19-76	1145	703.9	69.1	72.3	-240	-260	-253	-251	141	120	126	129	
* 1-19-76	1430	704.0	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 73F, 270 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 73 DEG. F.

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 7980. PSI AT 73.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.3 PERCENT (SELECTED MIX)
30.1 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 202 73 09
201 73 10

CREEP : 204 73 33
208 73 34
209 73 35

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2400 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
270	-.0007		0	0	0	0		
270	-.0003		-191	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2400 PSI								
270	0.	6.32	-380	0	0	0	0.	-.1583
270	.0042	6.11	-393	-13	0	-13	-.0054	-.1637
270	.0104	6.05	-397	-17	0	-17	-.0071	-.1654
270	.0451	5.91	-406	-26	0	-26	-.0108	-.1692
270	.1285	5.81	-413	-33	0	-33	-.0137	-.1721
270	.2882	5.71	-420	-40	0	-40	-.0167	-.1750
271	1.0035	5.52	-435	-55	0	-55	-.0229	-.1812
273	3.0	5.29	-454	-74	0	-74	-.0308	-.1892
274	4.1	5.22	-460	-80	0	-80	-.0333	-.1917
275	5.1	5.18	-463	-83	0	-83	-.0346	-.1929
277	7.0	5.10	-471	-91	-1	-90	-.0375	-.1962
280	10.0	4.99	-481	-101	-2	-99	-.0412	-.2004
281	11.1	4.96	-484	-104	-1	-103	-.0429	-.2017
293	23.2	4.77	-503	-123	-1	-122	-.0508	-.2096
299	29.1	4.68	-513	-133	-1	-132	-.0550	-.2137
302	32.2	4.61	-521	-141	-1	-140	-.0583	-.2171
306	36.2	4.52	-531	-151	-1	-150	-.0625	-.2212
309	39.1	4.48	-536	-156	-1	-155	-.0646	-.2233
319	49.0	4.44	-540	-160	-2	-158	-.0658	-.2250
327	57.0	4.38	-548	-168	-1	-167	-.0696	-.2283
335	65.2	4.32	-556	-176	-2	-174	-.0725	-.2317
340	70.0	4.26	-564	-184	-1	-183	-.0762	-.2350
351	81.0	4.19	-573	-193	-2	-191	-.0796	-.2387
369	99.2	4.12	-582	-202	-4	-198	-.0825	-.2425
379	109.0	4.07	-589	-209	-3	-206	-.0858	-.2454
393	123.1	4.00	-600	-220	-5	-215	-.0896	-.2500
422	152.1	3.92	-613	-233	-7	-226	-.0942	-.2554
456	186.1	3.78	-635	-255	-10	-245	-.1021	-.2646
487	217.1	3.72	-645	-265	-10	-255	-.1062	-.2687
516	246.2	3.64	-659	-279	-12	-267	-.1112	-.2746
554	284.2	3.59	-669	-289	-14	-275	-.1146	-.2787
579	309.3	3.51	-684	-304	-16	-288	-.1200	-.2850
613	343.3	3.45	-696	-316	-19	-297	-.1237	-.2900
635	365.3	3.39	-707	-327	-23	-304	-.1267	-.2946
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
635	0.		-343	37	-23	60		
635	.0035		-334	45	-23	68		
635	.0104		-331	48	-23	71		
635	.0410		-325	55	-23	78		
635	.2806		-316	64	-23	87		
638	3.0		-300	79	-22	101		
650	15.2		-278	101	-23	124		
665	30.0		-263	116	-23	139		
678	43.0		-248	131	-25	156		
704	69.1		-251	129	-26	155		

**END OF TEST

C57

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 110F, 28 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	396	11 30	15	5.6
NO.2	126	11 31	25	5.5
NO.3	228	11 32	25	5.4

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 5770. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 33.4 PERCENT (SELECTED MIX)
36.4 PERCENT (COMPANION)

------MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE---

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 3-12-74	1400	0	SPECIMENS CAST										
* 4 -9-74	1059	27.9	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
4 -9-74	1059	27.9	-.0007	109.1	0	0	0	0	0	0	0	0	0.
4 -9-74	1059	27.9	-.0003	109.1	-175	-179	-177	-177	0	0	0	0	-.08429
* 4 -9-74	1100	27.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
4 -9-74	1100	27.9	.0000	109.1	-376	-382	-388	-382	0	0	0	0	-.18190
4 -9-74	1102	27.9	.0014	108.7	-396	-402	-406	-401	-20	-20	-18	-19	-.19095
4 -9-74	1105	27.9	.0035	108.7	-406	-412	-417	-411	-30	-30	-29	-29	-.19571
4 -9-74	1115	27.9	.0104	108.9	-418	-424	-429	-423	-42	-42	-41	-41	-.20143
4 -9-74	1130	27.9	.0208	109.0	-427	-434	-439	-433	-51	-52	-51	-51	-.20619
4 -9-74	1200	27.9	.0417	109.2	-439	-446	-451	-445	-63	-64	-63	-63	-.21190
4 -9-74	1300	28.0	.0833	109.6	-456	-463	-468	-462	-80	-81	-80	-80	-.22000
4 -9-74	1400	28.0	.1250	109.6	-467	-474	-479	-473	-91	-92	-91	-91	-.22524
4 -9-74	1700	28.1	.2500	110.3	-485	-493	-499	-492	-109	-111	-111	-110	-.23429
4 -9-74	2115	28.3	.4271	110.3	-506	-513	-519	-512	-130	-131	-131	-130	-.24381
4-10-74	1050	28.9	.9931	109.9	-540	-549	-554	-547	-164	-167	-166	-165	-.26048
4-11-74	1405	30.0	2.1	110.0	-577	-587	-590	-584	-201	-205	-202	-202	-.27810
4-12-74	1110	30.9	3.0	110.0	-594	-606	-608	-602	-218	-224	-220	-220	-.28667
4-13-74	1135	31.9	4.0	110.4	-610	-623	-624	-619	-234	-241	-236	-237	-.29476
4-14-74	1500	33.0	5.2	110.2	-623	-637	-637	-632	-247	-255	-249	-250	-.30095
4-16-74	1720	35.1	7.3	110.4	-642	-657	-657	-652	-266	-275	-269	-270	-.31048
4-18-74	1315	37.0	9.1	110.1	-657	-670	-670	-665	-281	-288	-282	-283	-.31667
4-20-74	1130	38.9	11.0	110.0	-667	-682	-681	-676	-291	-300	-293	-294	-.32190
4-22-74	1315	41.0	13.1	109.9	-676	-691	-691	-686	-300	-309	-303	-304	-.32667
4-25-74	1530	44.1	16.2	109.9	-687	-702	-702	-697	-311	-320	-314	-315	-.33190
4-30-74	1455	49.0	21.2	109.6	-703	-718	-718	-713	-327	-336	-330	-331	-.33952
5 -3-74	1235	52.0	24.1	109.4	-706	-720	-723	-716	-330	-338	-335	-334	-.34095
5-10-74	1340	59.0	31.1	108.3	-707	-723	-729	-719	-331	-341	-341	-337	-.34238
5-13-74	1420	62.0	34.1	109.5	-716	-732	-737	-728	-340	-350	-349	-346	-.34667
5-17-74	1130	65.9	38.0	109.5	-726	-741	-746	-737	-350	-359	-358	-355	-.35095
5-21-74	1440	70.0	42.2	110.1	-733	-749	-754	-745	-357	-367	-366	-363	-.35476
5-28-74	1200	76.9	49.0	109.8	-745	-759	-765	-756	-369	-377	-377	-374	-.36000
6 -4-74	1630	84.1	56.2	110.9	-755	-770	-777	-767	-379	-388	-389	-385	-.36524
6-11-74	843	90.8	62.9	110.1	-765	-783	-782	-776	-389	-401	-394	-394	-.36952
6-21-74	1220	100.9	73.1	109.7	-778	-800	-798	-792	-402	-418	-410	-410	-.37714
6-26-74	1150	105.9	78.0	[illegible]	-783	[illegible]	-803	-797	-407	-423	-415	-415	-.37952
7-17-74	1620	127.1	99.2	110.5	-803	[illegible]	[illegible]	-818	-427	-444	-438	-436	-.38952
7-31-74	1630	141.1	113.2	109.9	-817	-863	-843	-834	-441	-461	-455	-452	-.39714
8-29-74	1120	169.9	142.0	109.9	-837	-868	-866	-857	-461	-486	-478	-475	-.40810
9-25-74	1630	197.1	169.2	110.6	-854	-892	-890	-878	-478	-510	-502	-496	-.41810
10-24-74	830	225.8	197.9	109.7	-874	-915	-913	-900	-498	-533	-525	-518	-.42857
11-21-74	915	253.8	225.9	110.4	-886	-933	-931	-916	-510	-551	-543	-534	-.43619
12-17-74	1630	280.1	252.2	110.8	-899	-944	-946	-929	-523	-562	-558	-547	-.44238
1-15-75	1340	309.0	281.1	111.0	-911	-959	-959	-943	-535	-577	-571	-561	-.44905
2-18-75	1515	343.1	315.2	110.1	-923	-973	-973	-956	-547	-591	-585	-574	-.45524
3-14-75	1235	366.9	339.1	110.5	-932	-984	-982	-966	-556	-602	-594	-584	-.46000
4-12-75	1215	395.9	368.1	110.4	-942	-996	-993	-977	-566	-614	-605	-595	-.46524
5-16-75	1215	429.9	402.1	110.7	-956	-1010	-1007	-991	-580	-628	-619	-609	-.47190
6-16-75	1500	461.0	433.2	108.6	-975	-1027	-1023	-1008	-599	-645	-635	-626	-.48000
6-23-75	739	467.7	439.9	109.2	-978	-1030	-1026	-1011	-602	-648	-638	-629	-.48143
* 6-23-75	800	467.7	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
6-23-75	800	467.7	0.	109.2	-663	-710	-721	-698	-287	-328	-333	-316	
6-23-75	910	467.8	.0486	108.9	-639	-690	-702	-677	-263	-308	-314	-295	
7 -1-75	1620	476.1	8.3	109.5	-593	-642	-656	-630	-217	-260	-268	-248	
7 -8-75	1500	483.0	15.3	70.3	-580	-637	0	-608	-204	-255	0	-229	
* 7 -8-75	1600	483.1	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 110F, 28 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 5770. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 33.4 PERCENT (SELECTED MIX)
36.4 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 221 11 33
410 11 34

CREEP : 396 11 30
126 11 31
228 11 32

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
28	-.0007		0	0	0	0		
28	-.0003 .		-177	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
28	.0000	5.50	-382	0	0	0	0.	-.1819
28	.0014	5.24	-401	-19	0	-19	-.0090	-.1910
28	.0035	5.11	-411	-29	0	-29	-.0138	-.1957
28	.0104	4.96	-423	-41	0	-41	-.0195	-.2014
28	.0208	4.85	-433	-51	0	-51	-.0243	-.2062
28	.0417	4.72	-445	-63	0	-63	-.0300	-.2119
28	.0833	4.55	-462	-80	0	-80	-.0381	-.2200
28	.1250	4.44	-473	-91	0	-91	-.0433	-.2252
28	.2500	4.27	-492	-110	0	-110	-.0524	-.2343
28	.4271	4.10	-512	-130	0	-130	-.0619	-.2438
29	.9931	3.84	-547	-165	1	-166	-.0790	-.2605
30	2.1	3.60	-584	-202	3	-205	-.0976	-.2781
31	3.0	3.49	-602	-220	7	-227	-.1081	-.2867
32	4.0	3.39	-619	-237	10	-247	-.1176	-.2948
33	5.2	3.32	-632	-250	16	-266	-.1267	-.3010
35	7.3	3.22	-652	-270	23	-293	-.1395	-.3105
37	9.1	3.16	-665	-283	28	-311	-.1481	-.3167
39	11.0	3.11	-676	-294	34	-328	-.1562	-.3219
41	13.1	3.06	-686	-304	39	-343	-.1633	-.3267
44	16.2	3.01	-697	-315	42	-357	-.1700	-.3319
49	21.2	2.95	-713	-331	44	-375	-.1786	-.3395
52	24.1	2.93	-716	-334	46	-380	-.1810	-.3410
59	31.1	2.92	-719	-337	46	-383	-.1824	-.3424
62	34.1	2.88	-728	-346	50	-396	-.1886	-.3467
66	38.0	2.85	-737	-355	46	-401	-.1910	-.3510
70	42.2	2.82	-745	-363	46	-409	-.1948	-.3548
77	49.0	2.78	-756	-374	51	-425	-.2024	-.3600
84	56.2	2.74	-767	-385	50	-435	-.2071	-.3652
91	62.9	2.71	-776	-394	44	-438	-.2086	-.3695
101	73.1	2.65	-792	-410	40	-450	-.2143	-.3771
106	78.0	2.63	-797	-415	38	-453	-.2157	-.3795
127	99.2	2.57	-818	-436	32	-468	-.2229	-.3895
141	113.2	2.52	-834	-452	28	-480	-.2286	-.3971
170	142.0	2.45	-857	-475	21	-496	-.2362	-.4081
197	169.2	2.39	-878	-496	16	-512	-.2438	-.4181
226	197.9	2.33	-900	-518	9	-527	-.2510	-.4286
254	225.9	2.29	-916	-534	6	-540	-.2571	-.4362
280	252.2	2.26	-929	-547	-2	-545	-.2595	-.4424
309	281.1	2.23	-943	-561	-9	-552	-.2629	-.4490
343	315.2	2.20	-956	-574	-10	-564	-.2686	-.4552
367	339.1	2.17	-966	-584	-14	-570	-.2714	-.4600
396	368.1	2.15	-977	-595	-17	-578	-.2752	-.4652
430	402.1	2.12	-991	-609	-18	-591	-.2814	-.4719
461	433.2	2.08	-1008	-626	-25	-601	-.2862	-.4800
468	439.9	2.03	-1011	-629	-26	-603	-.2871	-.4814
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
468	0.		-698	-316	-26	-290		
468	.0486		-677	-295	-26	-269		
476	8.3		-630	-248	-26	-222		
483	15.3		-608	-229	-25	-204		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 110F, 90 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	212	11 19	16	5.9
NO.2	395	11 20	14	5.6
NO.3	129	11 18	13	5.8

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 6320. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
33.2 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 3-12-74	1400	0	SPECIMENS CAST										
* 6-10-74	929	89.8	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
6-10-74	929	89.8	-.0007	109.9	0	0	0	0	0	0	0	0	0.
6-10-74	929	89.8	-.0003	109.9	-166	-177	-165	-169	0	0	0	0	-.08048
* 6-10-74	930	89.8	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
6-10-74	930	89.8	0.	110.0	-356	-372	-362	-363	0	0	0	0	-.17286
6-10-74	932	89.9	.0014	109.9	-371	-382	-380	-377	-15	-10	-18	-14	-.17952
6-10-74	935	89.8	.0035	109.9	-381	-392	-391	-388	-25	-20	-29	-24	-.18476
6-10-74	945	89.8	.0104	110.0	-391	-401	-401	-397	-35	-29	-39	-34	-.18905
6-10-74	1030	89.9	.0417	110.3	-410	-420	-420	-416	-54	-48	-58	-53	-.19810
6-10-74	1135	89.9	.0868	110.6	-423	-433	-434	-430	-67	-61	-72	-66	-.20476
6-10-74	1742	90.2	.3417	111.2	-448	-458	-460	-455	-92	-86	-98	-92	-.21667
6-11-74	843	90.8	.9674	111.5	-487	-496	-499	-494	-131	-124	-137	-130	-.23524
6-12-74	1152	91.9	2.1	111.3	-517	-526	-528	-523	-161	-154	-166	-160	-.24905
6-13-74	830	92.8	3.0	110.8	-527	-536	-536	-533	-171	-164	-174	-169	-.25381
6-14-74	915	93.8	4.0	111.1	-544	-553	-553	-550	-188	-181	-191	-186	-.26190
6-17-74	1600	97.1	7.3	111.8	-577	-585	-586	-582	-221	-213	-224	-219	-.27714
6-21-74	1220	100.9	11.1	111.2	-599	-607	-606	-604	-243	-235	-244	-240	-.28762
6-26-74	1150	105.9	16.1	111.2	-620	-629	-626	-625	-264	-257	-264	-261	-.29762
6-30-74	950	109.8	20.0	111.1	-633	-641	-638	-637	-277	-269	-276	-274	-.30333
7-10-74	1650	120.1	30.3	111.9	-661	-668	-664	-664	-305	-296	-302	-301	-.31619
7-15-74	1310	125.0	35.2	111.6	-677	-683	-679	-679	-321	-311	-317	-316	-.32333
7-22-74	1420	132.0	42.2	111.6	-688	-693	-689	-690	-332	-321	-327	-326	-.32857
7-31-74	1630	141.1	51.3	111.4	-706	-712	-705	-707	-350	-340	-343	-344	-.33667
8-6-74	1239	146.9	57.1	111.5	-714	-724	-714	-717	-358	-352	-352	-354	-.34143
8-21-74	1430	162.0	72.2	111.5	-735	-740	-733	-736	-379	-368	-371	-372	-.35048
9-11-74	1345	183.0	93.2	111.8	-757	-762	-754	-757	-401	-390	-392	-394	-.36048
9-25-74	1630	197.1	107.3	111.9	-770	-775	-766	-770	-414	-403	-404	-407	-.36667
10-24-74	830	225.8	136.0	111.1	-796	-800	-791	-795	-440	-428	-429	-432	-.37857
11-21-74	915	253.8	164.0	111.8	-816	-820	-811	-815	-460	-448	-449	-452	-.38810
12-17-74	1630	280.1	190.3	112.1	-837	-841	-839	-839	-481	-469	-477	-475	-.39952
1-15-75	1340	309.0	219.2	112.4	-855	-857	-855	-855	-499	-485	-493	-492	-.40714
2-18-75	1515	343.1	253.2	111.7	-869	-871	-868	-869	-513	-499	-506	-506	-.41381
3-14-75	1235	366.9	277.1	111.9	-880	-881	-878	-879	-524	-509	-516	-516	-.41857
4-12-75	1215	395.9	306.1	111.8	-892	-893	-890	-891	-536	-521	-528	-528	-.42429
5-16-75	1215	429.9	340.1	112.1	-908	-907	-904	-906	-552	-535	-542	-543	-.43143
6-16-75	1500	461.0	371.2	109.9	-923	-923	-919	-921	-567	-551	-557	-558	-.43857
6-23-75	809	467.8	377.9	110.5	-925	-925	-922	-924	-569	-553	-560	-560	-.44000
* 6-23-75	810	467.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
6-23-75	810	467.8	.0000	110.5	-622	-608	-611	-613	-266	-236	-249	-250	
6-23-75	815	467.8	.0035	110.4	-614	-600	-603	-605	-258	-228	-241	-242	
6-23-75	825	467.8	.0104	110.4	-611	-596	-599	-602	-255	-224	-237	-238	
6-23-75	910	467.8	.0417	110.3	-604	-590	-593	-595	-248	-218	-231	-232	
6-23-75	1110	467.9	.1250	110.4	-598	-584	-587	-589	-242	-212	-225	-226	
6-24-75	1700	469.1	1.3681	111.0	-582	-566	-570	-572	-226	-194	-208	-209	
6-27-75	1455	472.0	4.3	110.9	-569	-552	-557	-559	-213	-180	-195	-196	
7-1-75	1620	476.1	8.3	111.3	-560	-543	-547	-550	-204	-171	-185	-186	
7-15-75	1440	490.0	22.3	110.9	-545	-527	-532	-534	-189	-155	-170	-171	
8-7-75	1600	513.1	45.3	110.3	-533	-514	-521	-522	-177	-142	-159	-159	
9-8-75	1600	545.1	77.3	110.8	-521	-501	-510	-510	-165	-129	-148	-147	
9-18-75	1610	555.1	87.3	111.3	-518	-502	-501	-507	-162	-130	-139	-143	
9-19-75	1610	556.1	88.3	95.4	-523	-505	0	-514	-167	-133	0	-150	
9-22-75	1500	559.0	91.3	71.4	-527	-502	0	-514	-171	-130	0	-150	
* 9-22-75	1415	559.0	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 110F, 90 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 6320. PSI AT 110.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
33.2 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 420 11 21
421 11 22

CREEP : 212 11 19
395 11 20
129 11 18

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0007		0	0	0	0		
90	-.0003		-169	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
90	0.	5.79	-363	0	0	0	0.	-.1729
90	.0014	5.57	-377	-14	0	-14	-.0067	-.1795
90	.0035	5.41	-388	-24	0	-24	-.0114	-.1848
90	.0104	5.29	-397	-34	0	-34	-.0162	-.1890
90	.0417	5.05	-416	-53	0	-53	-.0252	-.1981
90	.0868	4.88	-430	-66	0	-66	-.0314	-.2048
90	.3417	4.62	-455	-92	0	-92	-.0438	-.2167
91	.9674	4.25	-494	-130	1	-131	-.0624	-.2352
92	2.1	4.02	-523	-160	1	-161	-.0767	-.2490
93	3.0	3.94	-533	-169	3	-172	-.0819	-.2538
94	4.0	3.82	-550	-186	3	-189	-.0900	-.2619
97	7.3	3.61	-582	-219	6	-225	-.1071	-.2771
101	11.1	3.48	-604	-240	8	-248	-.1181	-.2876
106	15.1	3.36	-625	-261	11	-272	-.1295	-.2976
110	20.0	3.30	-637	-274	11	-285	-.1357	-.3033
120	30.3	3.16	-664	-301	9	-310	-.1476	-.3162
125	35.2	3.09	-679	-316	9	-325	-.1548	-.3233
132	42.2	3.04	-690	-326	7	-333	-.1586	-.3286
141	51.3	2.97	-707	-344	5	-349	-.1662	-.3367
147	57.1	2.93	-717	-354	4	-358	-.1705	-.3414
162	72.2	2.85	-736	-372	-1	-371	-.1767	-.3505
183	93.2	2.77	-757	-394	-4	-390	-.1857	-.3605
197	107.3	2.73	-770	-407	-8	-399	-.1900	-.3667
226	136.0	2.64	-795	-432	-17	-415	-.1976	-.3786
254	164.0	2.58	-815	-452	-21	-431	-.2052	-.3881
280	190.3	2.50	-839	-475	-25	-450	-.2143	-.3995
309	219.2	2.46	-855	-492	-30	-462	-.2200	-.4071
343	253.2	2.42	-869	-506	-29	-477	-.2271	-.4138
367	277.1	2.39	-879	-516	-35	-481	-.2290	-.4186
396	306.1	2.36	-891	-528	-40	-488	-.2324	-.4243
430	340.1	2.32	-906	-543	-44	-499	-.2376	-.4314
461	371.2	2.28	-921	-558	-49	-509	-.2424	-.4386
468	377.9	2.27	-924	-560	-48	-512	-.2438	-.4400
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
468	.0000		-613	-250	-48	-202		
468	.0035		-605	-242	-48	-194		
468	.0104		-602	-238	-48	-190		
468	.0417		-595	-232	-48	-184		
468	.1250		-589	-226	-48	-178		
469	1.3681		-572	-209	-49	-160		
472	4.3		-559	-196	-49	-147		
476	8.3		-550	-186	-49	-137		
490	22.3		-534	-171	-50	-121		
513	45.3		-522	-159	-52	-107		
545	77.3		-510	-147	-56	-91		
555	87.3		-507	-143	-57	-86		
556	88.3		-514	-150	-57	-93		
559	91.3		-514	-150	-58	-92		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 110F, 270 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2400 PSI)
NO.1	392	11 79	24	5.9
NO.2	409	11 80	20	6.0
NO.3	391	11 78	20	5.9

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 7270. PSI AT 110.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.3 PERCENT (SELECTED MIX)
33.0 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2400 PSI
* 3-12-74	1400	0	SPECIMENS CAST										
*12 -6-74	1129	268.9	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1200 PSI (PLUS OR MINUS 30), RESPECTIVELY										
12 -6-74	1129	268.9	-.0007	110.3	0	0	0	0	0	0	0	0	0.
12 -6-74	1129	268.9	-.0003	110.3	-189	-189	-178	-185	0	0	0	0	-.07708
*12 -6-74	1130	268.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2400 PSI										
12 -6-74	1130	268.9	0.	110.3	-407	-400	-405	-404	0	0	0	0	-.16833
12 -6-74	1135	268.9	.0035	110.3	-429	-421	-417	-422	-22	-21	-12	-18	-.17583
12 -6-74	1145	268.9	.0104	110.3	-441	-431	-427	-433	-34	-31	-22	-29	-.18042
12 -6-74	1200	268.9	.0208	110.4	-451	-439	-437	-442	-44	-39	-32	-38	-.18417
12 -6-74	1230	268.9	.0417	110.3	-464	-450	-450	-454	-57	-50	-45	-50	-.18917
12 -6-74	1430	269.0	.1250	110.5	-485	-470	-472	-475	-78	-70	-67	-71	-.19792
12 -6-74	2310	269.4	.4861	110.8	-523	-506	-510	-513	-116	-106	-105	-109	-.21375
12 -7-74	1445	270.0	1.1354	110.9	-553	-535	-541	-543	-146	-135	-136	-139	-.22625
12 -8-74	1640	271.1	2.2	110.9	-587	-567	-575	-576	-180	-167	-170	-172	-.24000
12-10-74	1115	272.9	4.0	110.7	-617	-597	-605	-606	-210	-197	-200	-202	-.25250
12-11-74	1330	274.0	5.1	110.4	-631	-610	-619	-620	-224	-210	-214	-216	-.25833
12-12-74	1330	275.0	6.1	110.4	-640	-620	-628	-629	-233	-220	-223	-225	-.26208
12-13-74	1500	276.0	7.1	110.5	-650	-629	-638	-639	-243	-229	-233	-235	-.26625
12-17-74	1640	280.1	11.2	111.2	-679	-658	-657	-668	-272	-258	-262	-264	-.27833
12-20-74	1100	282.9	14.0	110.9	-706	-684	-693	-694	-299	-284	-288	-290	-.28917
12-24-74	1200	286.9	18.0	110.9	-717	-695	-704	-705	-310	-295	-299	-301	-.29375
1 -3-75	1645	297.1	28.2	111.0	-744	-724	-731	-733	-337	-324	-326	-329	-.30542
1 -6-75	830	299.8	30.9	110.9	-752	-733	-739	-741	-345	-333	-334	-337	-.30875
1-10-75	1530	304.1	35.2	111.0	-762	-743	-749	-751	-355	-343	-344	-347	-.31292
1-15-75	1350	309.0	40.1	111.1	-772	-753	-760	-761	-365	-353	-355	-357	-.31708
1-31-75	1430	325.0	56.1	110.8	-802	-783	-788	-791	-395	-383	-383	-387	-.32958
2-18-75	1530	343.1	74.2	110.7	-830	-812	-814	-818	-423	-412	-409	-414	-.34083
2-28-75	1200	352.9	84.0	110.9	-841	-823	-825	-829	-434	-423	-420	-425	-.34542
3-14-75	1235	366.9	98.0	111.1	-858	-840	-842	-846	-451	-440	-437	-442	-.35250
4 -1-75	1130	384.9	116.0	110.6	-876	-859	-860	-865	-469	-459	-455	-461	-.36042
4-12-75	1230	395.9	127.0	110.8	-885	-869	-869	-874	-478	-469	-464	-470	-.36417
5-16-75	1215	429.9	161.0	111.2	-913	-897	-895	-901	-506	-497	-490	-497	-.37542
6-16-75	1540	461.1	192.2	109.0	-934	-919	-916	-923	-527	-519	-511	-519	-.38458
7-15-75	1450	490.0	221.1	109.9	-954	-940	-939	-944	-547	-540	-534	-540	-.39333
8-22-75	1340	528.0	259.1	109.8	-970	-957	-956	-961	-563	-557	-551	-557	-.40042
9-18-75	1625	555.1	286.2	110.0	-980	-969	-968	-972	-573	-569	-563	-568	-.40500
10-20-75	1320	587.0	318.1	109.6	-993	-983	-983	-988	-586	-583	-578	-582	-.41083
11-14-75	1600	612.1	343.2	109.0	-1015	-1005	-1008	-1009	-608	-606	-603	-605	-.42042
12 -8-75	944	635.8	366.9	109.2	-1013	-1004	-1006	-1007	-606	-604	-601	-603	-.41958
*12 -8-75	945	635.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
12 -8-75	945	635.8	0.	109.0	-673	-662	-659	-664	-266	-262	-254	-260	
12 -8-75	950	635.8	.0035	109.1	-664	-655	-649	-656	-257	-255	-244	-252	
12 -8-75	1000	635.8	.0104	109.2	-660	-651	-645	-652	-253	-251	-240	-248	
12 -8-75	1045	635.9	.0417	109.2	-653	-644	-638	-645	-246	-244	-233	-241	
12 -8-75	1215	635.9	.1042	109.4	-648	-639	-633	-640	-241	-239	-228	-236	
12-11-75	815	638.8	2.9	109.2	-618	-609	-602	-609	-211	-209	-197	-205	
12-16-75	1055	643.9	8.0	108.8	-605	-598	-590	-597	-198	-198	-185	-193	
12-19-75	930	646.8	11.0	109.0	-600	-592	-584	-592	-193	-192	-179	-188	
12-22-75	1300	650.0	14.1	70.2	-606	-609	0	-607	-199	-209	0	-204	
*12-22-75	1000	649.8	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 110F, 270 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 4 (MIX 3-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 110 DEG. F.

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 7270. PSI AT 110.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.3 PERCENT (SELECTED MIX)
33.0 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 411 11 81
424 11 83

CREEP : 392 11 79
409 11 80
391 11 78

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2400 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
269	-.0007		0	0	0	0		
269	-.0003		-185	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2400 PSI								
269	0.	5.94	-404	0	0	0	0.	-.1683
269	.0035	5.69	-422	-18	0	-18	-.0075	-.1758
269	.0104	5.54	-433	-29	0	-29	-.0121	-.1804
269	.0208	5.43	-442	-38	0	-38	-.0158	-.1842
269	.0417	5.29	-454	-50	0	-50	-.0208	-.1892
269	.1250	5.05	-475	-71	0	-71	-.0296	-.1979
269	.4861	4.68	-513	-109	0	-109	-.0454	-.2137
270	1.1354	4.42	-543	-139	1	-140	-.0583	-.2262
271	2.2	4.17	-576	-172	5	-177	-.0737	-.2400
273	4.0	3.96	-606	-202	7	-209	-.0871	-.2525
274	5.1	3.87	-620	-216	7	-223	-.0929	-.2583
275	6.1	3.82	-629	-225	8	-233	-.0971	-.2621
276	7.1	3.76	-639	-235	8	-243	-.1012	-.2662
280	11.2	3.59	-668	-264	9	-273	-.1137	-.2783
283	14.0	3.46	-694	-290	10	-300	-.1250	-.2892
287	18.0	3.40	-705	-301	9	-310	-.1292	-.2937
297	28.2	3.27	-733	-329	10	-339	-.1412	-.3054
300	30.9	3.24	-741	-337	10	-347	-.1446	-.3087
304	35.2	3.20	-751	-347	10	-357	-.1487	-.3129
309	40.1	3.15	-761	-357	10	-367	-.1529	-.3171
325	56.1	3.03	-791	-387	5	-392	-.1633	-.3296
343	74.2	2.93	-818	-414	0	-414	-.1725	-.3408
353	84.0	2.90	-829	-425	-2	-423	-.1762	-.3454
367	98.0	2.84	-846	-442	-6	-436	-.1817	-.3525
385	116.0	2.77	-865	-461	-10	-451	-.1879	-.3604
396	127.0	2.75	-874	-470	-10	-460	-.1917	-.3642
430	161.0	2.66	-901	-497	-14	-483	-.2012	-.3754
461	192.2	2.60	-923	-519	-21	-498	-.2075	-.3846
490	221.1	2.54	-944	-540	-23	-517	-.2154	-.3933
528	259.1	2.50	-961	-557	-30	-527	-.2196	-.4004
555	286.2	2.47	-972	-568	-33	-535	-.2229	-.4050
587	318.1	2.43	-986	-582	-45	-537	-.2237	-.4108
612	343.2	2.38	-1009	-605	-46	-559	-.2329	-.4204
636	366.9	2.38	-1007	-603	-47	-556	-.2317	-.4196
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
636	0.		-664	-260	-47	-213		
636	.0035		-656	-252	-47	-205		
636	.0104		-652	-248	-47	-201		
636	.0417		-645	-241	-47	-194		
636	.1042		-640	-236	-47	-189		
639	2.9		-609	-205	-48	-157		
644	8.0		-597	-193	-50	-143		
647	11.0		-592	-188	-51	-137		
650	14.1		-607	-204	-71	-133		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 160F, 28 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	222	11 24	7	5.3
NO.2	223	11 26	11	5.1
NO.3	207	11 25	22	5.6

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 5420. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 33.4 PERCENT (SELECTED MIX)
38.7 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 2-21-74	1500	0	SPECIMENS CAST										
* 3-21-74	1159	27.9	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
3-21-74	1159	27.9	-.0007	160.5	0	0	0	0	0	0	0	0	0.
3-21-74	1159	27.9	-.0003	160.5	-171	-176	-164	-170	0	0	0	0	-.08095
* 3-21-74	1200	27.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
3-21-74	1200	27.9	0.	160.5	-400	-411	-376	-395	0	0	0	0	-.18810
3-21-74	1205	27.9	.0033	160.0	-414	-427	-393	-411	-14	-16	-17	-15	-.19571
3-21-74	1215	27.9	.0104	159.8	-428	-442	-407	-425	-28	-31	-31	-30	-.20238
3-21-74	1300	27.9	.0417	160.0	-445	-460	-427	-444	-45	-49	-51	-48	-.21143
3-21-74	1500	28.0	.1250	160.1	-467	-483	-450	-466	-67	-72	-74	-71	-.22190
3-21-74	1700	28.1	.2083	160.7	-480	-497	-466	-481	-80	-86	-90	-85	-.22905
3-21-74	2210	28.3	.4236	160.9	-500	-518	-488	-502	-100	-107	-112	-106	-.23905
3-22-74	1200	28.9	1.0000	161.0	-528	-547	-520	-531	-128	-136	-144	-136	-.25286
3-23-74	1250	29.9	2.0	161.1	-561	-582	-558	-567	-151	-171	-182	-171	-.27000
3-24-74	1430	31.0	3.1	160.6	-580	-602	-580	-587	-180	-191	-204	-191	-.27952
3-25-74	1315	31.9	4.1	158.7	-593	-613	-601	-602	-193	-202	-225	-206	-.28667
3-26-74	1500	33.0	5.1	161.6	-602	-625	-612	-613	-202	-214	-236	-217	-.29190
3-29-74	1230	35.9	8.0	162.1	-632	-628	-646	-635	-232	-217	-270	-239	-.30238
4-1-74	1240	38.9	11.0	162.0	-662	-653	-673	-662	-262	-242	-297	-267	-.31524
4-3-74	1130	40.9	13.0	161.4	-679	-665	-691	-678	-279	-254	-315	-282	-.32286
4-4-74	1445	42.0	14.1	161.9	-688	-677	-700	-688	-288	-266	-324	-292	-.32762
4-8-74	1535	46.0	18.1	162.7	-713	-693	-730	-712	-313	-282	-354	-316	-.33905
4-11-74	1405	49.0	21.1	162.9	-726	-705	-747	-726	-326	-294	-371	-330	-.34571
4-15-74	1135	52.9	25.0	163.0	-744	-726	-768	-746	-344	-315	-392	-350	-.35524
4-18-74	1315	55.9	28.1	163.2	-758	-744	-785	-762	-358	-333	-409	-366	-.36286
4-20-74	1130	57.9	30.0	162.5	-778	-764	-793	-778	-378	-353	-417	-382	-.37048
4-22-74	1315	59.9	32.1	162.5	-788	-774	-802	-788	-388	-363	-426	-392	-.37524
4-25-74	1530	63.0	35.1	162.4	-800	-786	-814	-800	-400	-375	-438	-404	-.38095
4-30-74	1455	68.0	40.1	160.4	-822	-811	-843	-825	-422	-400	-467	-429	-.39286
5-6-74	1355	74.0	46.1	161.2	-842	-830	-866	-846	-442	-419	-490	-450	-.40286
5-13-74	1420	81.0	53.1	161.6	-862	-851	-890	-867	-462	-440	-514	-472	-.41286
5-21-74	1440	89.0	61.1	162.2	-884	-874	-918	-892	-434	-463	-542	-496	-.42476
5-28-74	1200	95.9	68.0	162.3	-929	-889	-928	-915	-529	-478	-552	-519	-.43571
6-7-74	1152	105.9	78.0	161.6	-963	-917	-948	-942	-563	-506	-572	-547	-.44857
6-26-74	1150	124.9	97.0	162.2	-994	-933	-987	-971	-594	-522	-611	-575	-.46238
7-10-74	1650	139.1	111.2	163.0	-1015	-755	-1014	-928	-615	-344	-638	-532	-.44190
8-21-74	1450	181.0	153.1	159.0	-1099	-880	-1080	-1019	-699	-469	-704	-624	-.48524
9-20-74	1105	210.8	183.0	159.2	-1127	-1082	-1103	-1097	-727	-651	-727	-701	-.52238
10-24-74	830	244.7	216.9	158.8	-1163	-1099	-1140	-1134	-763	-688	-764	-738	-.54000
11-21-74	915	272.8	244.9	159.4	-1185	-1146	-1180	-1170	-785	-735	-804	-774	-.55714
12-17-74	1630	299.1	271.2	159.0	-1208	-1012	-1197	-1139	-808	-601	-821	-743	-.54238
1-15-75	1540	327.9	300.1	160.2	-1226	-1117	-1211	-1184	-826	-706	-835	-789	-.56381
2-18-75	1515	362.0	334.1	159.1	-1250	-1161	-1232	-1214	-850	-750	-856	-818	-.57810
3-14-75	1235	385.9	358.0	161.0	-1256	-1176	-1242	-1224	-856	-765	-866	-829	-.58286
4-12-75	1215	414.9	387.0	160.4	-1271	-1213	-1263	-1249	-871	-802	-887	-853	-.59476
5-16-75	1215	448.9	421.0	160.9	-1291	-1325	-1291	-1302	-891	-914	-915	-906	-.62000
6-16-75	1500	480.0	452.1	160.5	-1312	-1349	-1330	-1330	-912	-938	-954	-934	-.63333
7-15-75	1440	509.0	481.1	160.6	-1318	-1378	-1380	-1358	-918	-967	-1004	-963	-.64667
8-7-75	1600	532.0	504.2	160.2	-1327	-1392	0	-1359	-927	-981	0	-954	-.64714
8-22-75	1340	546.9	519.1	160.4	-1336	-1400	0	-1368	-936	-989	0	-962	-.65143
9-18-75	1620	574.1	546.2	161.4	-1343	-1417	0	-1380	-943	-1006	0	-974	-.65714
10-20-75	1510	605.9	578.0	161.0	-1358	-1443	0	-1400	-958	-1032	0	-995	-.66667
11-14-75	1600	631.0	603.2	159.8	-1389	-1490	0	-1439	-989	-1079	0	-1034	-.68524
12-24-75	900	670.7	642.9	161.6	-1384	-1499	0	-1441	-984	-1088	0	-1035	-.68619
2-24-76	945	732.8	704.9	164.3	-1401	-1520	0	-1460	-1001	-1109	0	-1055	-.69524

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.2: ERRATIC LOW READINGS 7-10-74,8-21-74,12-17-74 AND 1-15-75

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 160F, 28 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 5420. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 33.4 PERCENT (SELECTED MIX)
38.7 PERCENT (COMPANION)

STRAIN METER NUMBERS
AUTOGENOUS: 203 11 28
227 11 27
CREEP : 222 11 24
223 11 26
207 11 25.

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
28	-.0007		0	0	0	0		
28	-.0003		-170	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
28	0.	5.32	-395	0	0	0	0.	-.1881
28	.0035	5.11	-411	-15	0	-15	-.0071	-.1957
28	.0104	4.94	-425	-30	0	-30	-.0143	-.2024
28	.0417	4.73	-444	-48	0	-48	-.0229	-.2114
28	.1250	4.51	-466	-71	0	-71	-.0338	-.2219
28	.2083	4.37	-481	-85	0	-85	-.0405	-.2290
28	.4236	4.18	-502	-106	0	-106	-.0505	-.2390
29	1.0000	3.95	-531	-136	19	-155	-.0738	-.2529
30	2.0	3.70	-567	-171	27	-198	-.0943	-.2700
31	3.1	3.53	-587	-191	26	-217	-.1033	-.2795
32	4.1	3.49	-602	-206	32	-238	-.1133	-.2867
33	5.1	3.43	-613	-217	44	-261	-.1243	-.2919
36	8.0	3.31	-635	-239	52	-291	-.1386	-.3024
39	11.0	3.17	-662	-267	54	-321	-.1529	-.3152
41	13.0	3.10	-678	-282	54	-336	-.1600	-.3229
42	14.1	3.05	-688	-292	54	-346	-.1648	-.3276
46	18.1	2.95	-712	-316	53	-369	-.1757	-.3390
49	21.1	2.89	-726	-330	50	-380	-.1810	-.3457
53	25.0	2.82	-746	-350	48	-398	-.1895	-.3552
56	28.1	2.76	-762	-366	47	-413	-.1967	-.3629
58	30.0	2.70	-778	-382	41	-423	-.2014	-.3705
60	32.1	2.66	-788	-392	39	-431	-.2052	-.3752
63	35.1	2.63	-800	-404	37	-441	-.2100	-.3810
68	40.1	2.55	-825	-429	29	-458	-.2181	-.3929
74	46.1	2.48	-846	-450	29	-479	-.2281	-.4029
81	53.1	2.42	-867	-472	31	-503	-.2395	-.4129
89	61.1	2.35	-892	-496	30	-526	-.2505	-.4248
96	68.0	2.30	-915	-519	32	-551	-.2624	-.4357
106	78.0	2.23	-942	-547	31	-578	-.2752	-.4486
125	97.0	2.16	-971	-575	32	-607	-.2890	-.4624
139	111.2	2.26	-928	-532	34	-566	-.2695	-.4419
181	153.1	2.06	-1019	-624	24	-648	-.3086	-.4852
211	183.0	1.91	-1097	-701	20	-721	-.3433	-.5224
245	216.9	1.85	-1134	-738	13	-751	-.3576	-.5400
273	244.9	1.79	-1170	-774	12	-786	-.3743	-.5571
299	271.2	1.84	-1139	-743	5	-748	-.3562	-.5424
328	300.1	1.77	-1184	-789	-2	-787	-.3748	-.5638
362	334.1	1.73	-1214	-818	-4	-814	-.3876	-.5781
386	358.0	1.72	-1224	-829	-9	-820	-.3905	-.5829
415	387.0	1.68	-1249	-853	-12	-841	-.4005	-.5948
449	421.0	1.61	-1302	-906	-18	-888	-.4229	-.6200
480	452.1	1.58	-1330	-934	-22	-912	-.4343	-.6333
509	481.1	1.55	-1358	-963	-21	-942	-.4486	-.6467
532	504.2	1.55	-1359	-954	-21	-933	-.4443	-.6471
547	519.1	1.54	-1368	-962	-20	-942	-.4486	-.6514
574	546.2	1.52	-1380	-974	-22	-952	-.4533	-.6571
606	578.0	1.50	-1400	-995	-23	-972	-.4629	-.6667
631	603.2	1.46	-1439	-1034	-23	-1011	-.4814	-.6852
671	642.9	1.46	-1441	-1036	-24	-1012	-.4819	-.6862
733	704.0	1.44	-1460	-1055	-34	-1021	-.4862	-.6952

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 160F, 90 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2100 PSI)
NO.1	218	11 49	12	5.4
NO.2	225	11 47	1	5.1
NO.3	224	11 48	16	5.3

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5790. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
36.3 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2100 PSI
* 2-21-74	1400	0	SPECIMENS CAST										
* 5-22-74	1444	90.0	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1050 PSI (PLUS OR MINUS 30), RESPECTIVELY										
5-22-74	1444	90.0	-.0007	160.0	0	0	0	0	0	0	0	0	0.
5-22-74	1444	90.0	-.0003	160.0	-169	-177	-169	-171	0	0	0	0	-.08143
* 5-22-74	1445	90.0	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2100 PSI										
5-22-74	1445	90.0	0.	160.0	-389	-412	-395	-398	0	0	0	0	-.18952
5-22-74	1447	90.0	.0014	159.8	-403	-429	-411	-414	-14	-17	-16	-15	-.19714
5-22-74	1450	90.0	.0035	159.9	-413	-440	-422	-425	-24	-28	-27	-26	-.20238
5-22-74	1500	90.0	.0104	159.8	-424	-452	-435	-437	-35	-40	-40	-38	-.20810
5-22-74	1515	90.1	.0208	159.9	-433	-465	-448	-448	-44	-53	-53	-50	-.21333
5-22-74	1545	90.1	.0417	160.3	-440	-475	-457	-457	-51	-63	-62	-58	-.21762
5-22-74	1745	90.2	.1250	161.4	-461	-501	-485	-482	-72	-89	-90	-83	-.22952
5-22-74	2045	90.3	.2500	161.9	-480	-522	-506	-502	-91	-110	-111	-104	-.23905
5-23-74	900	90.8	.7604	162.4	-522	-559	-547	-542	-133	-147	-152	-144	-.25810
5-23-74	1355	91.0	.9653	162.0	-541	-569	-557	-555	-152	-157	-162	-157	-.26429
5-24-74	1330	92.0	1.9479	162.1	-577	-595	-589	-587	-188	-183	-194	-188	-.27952
5-25-74	1200	92.9	2.9	161.7	-599	-611	-609	-606	-210	-199	-214	-207	-.28857
5-26-74	1700	94.1	4.1	162.2	-616	-628	-627	-623	-227	-216	-232	-225	-.29667
5-27-74	1115	94.9	4.9	162.1	-626	-635	-637	-632	-237	-223	-242	-234	-.30095
5-28-74	1200	95.9	5.9	161.9	-638	-645	-647	-643	-249	-233	-252	-244	-.30619
5-30-74	1500	98.0	8.0	162.7	-656	-664	-666	-662	-267	-252	-271	-263	-.31524
5-31-74	1600	99.1	9.1	160.9	-672	-677	-679	-676	-283	-265	-284	-277	-.32190
6 -4-74	1630	103.1	13.1	158.5	-712	-715	-718	-715	-323	-303	-323	-316	-.34048
6 -7-74	1152	105.9	15.9	161.4	-732	-727	-716	-725	-343	-315	-321	-326	-.34524
6-11-74	843	109.8	19.7	161.2	-762	-760	-748	-756	-373	-348	-353	-358	-.36000
6-14-74	915	112.8	22.8	160.9	-780	-776	-774	-776	-391	-364	-379	-378	-.36952
6-21-74	1220	119.9	29.9	161.6	-813	-807	-813	-811	-424	-395	-418	-412	-.38619
6-26-74	1150	124.9	34.9	161.9	-833	-821	-836	-830	-444	-409	-441	-431	-.39524
6-30-74	950	128.8	38.8	162.2	-848	-833	-855	-845	-459	-421	-460	-446	-.40238
7 -9-74	1045	137.9	47.8	162.9	-881	-860	-892	-877	-492	-448	-497	-479	-.41762
7-17-74	1620	146.1	56.1	163.0	-910	-887	-925	-907	-521	-475	-530	-508	-.43190
7-24-74	1015	153.1	63.1	152.6	-933	-911	-949	-931	-544	-499	-554	-532	-.44333
8 -9-74	1430	169.0	79.0	158.6	-1005	-975	-991	-990	-616	-563	-596	-591	-.47143
8-15-74	1050	174.9	84.8	159.6	-1014	-988	-1007	-1003	-625	-576	-612	-604	-.47762
8-29-74	1120	188.9	98.9	159.3	-1046	-1023	-1039	-1036	-657	-611	-644	-637	-.49333
9-11-74	1345	202.0	112.0	159.0	-1069	-1049	-1063	-1060	-680	-637	-668	-661	-.50476
9-25-74	1630	216.1	126.1	159.1	-1091	-1073	-1089	-1084	-702	-661	-694	-685	-.51619
10-24-74	830	244.8	154.7	158.8	-1133	-1115	-1130	-1126	-744	-703	-735	-727	-.53619
11-21-74	915	272.8	182.8	159.2	-1176	-1157	-1168	-1167	-787	-745	-773	-768	-.55571
12-17-74	1640	299.1	209.1	158.8	-1211	-1192	-1203	-1202	-822	-780	-808	-803	-.57238
1-15-75	1350	328.0	238.0	160.1	-1227	-1210	-1223	-1220	-838	-798	-828	-821	-.58095
2-18-75	1530	362.1	272.0	158.7	-1260	-1215	-1257	-1244	-871	-803	-862	-845	-.59238
3-14-75	1235	385.9	295.9	161.3	-1265	-1237	-1272	-1258	-876	-825	-877	-859	-.59905
4-12-75	1230	414.9	324.9	159.5	-1289	-1269	-1300	-1286	-900	-857	-905	-887	-.61238
5-16-75	1215	448.9	358.9	159.8	-1321	-1298	-1331	-1316	-932	-886	-936	-918	-.62667
6-16-75	1540	480.1	390.0	160.4	-1341	-1319	-1351	-1337	-952	-907	-956	-938	-.63667
6-23-75	1012	486.8	396.8	159.2	-1355	-1330	-1362	-1349	-966	-918	-967	-950	-.64238
* 6-23-75	1013	486.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*										
6-23-75	1013	486.8	.0000	159.2	-986	-908	-997	-963	-597	-496	-602	-565	
6-23-75	1110	486.9	.0396	158.9	-991	-873	-968	-944	-602	-461	-573	-545	
6-24-75	1700	488.1	1.2826	160.8	-956	-833	-936	-908	-567	-421	-541	-509	
7 -1-75	1630	495.1	8.3	161 0	-932	-804	-912	-882	-543	-392	-517	-484	
7 -9-75	1000	502.8	16.0	70.8	-910	-775	0	-842	-521	-363	0	-442	
* 7 -9-75	1100	502.9	END OF TEST										

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTUGENOUS STRAINS ** YORK ** 160F, 90 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5790. PSI AT 160.F.
APPLIED TEST STRESS : 2100. PSI
PER. ULT. STR. APPLIED: 29.2 PERCENT (SELECTED MIX)
36.3 PERCENT (COMPANION)

STRAIN METER NUMBERS
AUTOGENOUS: 403 11 53
413 11 54
CREEP : 218 11 49
225 11 47
224 11 48

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	CREEP PLUS AUTOG-ENOUS (MICROSTRAIN)	AUTOG-ENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2100 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0007		0	0	0	0		
90	-.0003		-171	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2100 PSI								
90	0.	5.28	-398	0	0	0	0.	-.1895
90	.0014	5.07	-414	-15	0	-15	-.0071	-.1971
90	.0035	4.94	-425	-26	0	-26	-.0124	-.2024
90	.0104	4.81	-437	-38	0	-38	-.0181	-.2081
90	.0208	4.69	-448	-50	0	-50	-.0238	-.2133
90	.0417	4.60	-457	-58	0	-58	-.0276	-.2176
90	.1250	4.36	-482	-83	0	-83	-.0395	-.2295
90	.2500	4.18	-502	-104	0	-104	-.0495	-.2390
91	.7604	3.87	-542	-144	11	-155	-.0738	-.2581
91	.9653	3.78	-555	-157	11	-168	-.0800	-.2643
92	1.9	3.58	-587	-188	20	-208	-.0990	-.2795
93	2.9	3.47	-606	-207	25	-232	-.1105	-.2886
94	4.1	3.37	-623	-225	28	-253	-.1205	-.2967
95	4.9	3.32	-632	-234	31	-265	-.1262	-.3010
96	5.9	3.27	-643	-244	31	-275	-.1310	-.3062
98	8.0	3.17	-662	-263	33	-296	-.1410	-.3152
99	9.1	3.11	-676	-277	33	-310	-.1476	-.3219
103	13.1	2.94	-715	-316	32	-348	-.1657	-.3405
106	15.9	2.90	-725	-326	31	-357	-.1700	-.3452
110	19.7	2.78	-756	-358	29	-387	-.1843	-.3600
113	22.8	2.71	-776	-378	29	-407	-.1938	-.3695
120	29.9	2.59	-811	-412	26	-438	-.2086	-.3862
125	34.9	2.53	-830	-431	22	-453	-.2157	-.3952
129	38.8	2.49	-845	-446	21	-467	-.2224	-.4024
138	47.8	2.39	-877	-479	14	-493	-.2348	-.4176
146	56.1	2.32	-907	-508	12	-520	-.2476	-.4319
153	63.1	2.26	-931	-532	11	-543	-.2586	-.4433
169	79.0	2.12	-990	-591	10	-601	-.2862	-.4714
175	84.8	2.09	-1003	-604	8	-612	-.2914	-.4776
189	98.9	2.03	-1036	-637	11	-648	-.3086	-.4933
202	112.0	1.98	-1060	-661	6	-667	-.3176	-.5048
216	126.1	1.94	-1084	-685	4	-689	-.3281	-.5162
245	154.7	1.87	-1126	-727	-3	-724	-.3448	-.5362
273	182.8	1.80	-1167	-768	-8	-760	-.3619	-.5557
299	209.1	1.75	-1202	-803	-13	-790	-.3762	-.5724
328	238.0	1.72	-1220	-821	-16	-805	-.3833	-.5810
362	272.0	1.69	-1244	-845	-24	-821	-.3910	-.5924
386	295.9	1.67	-1258	-859	-28	-831	-.3957	-.5990
415	324.9	1.63	-1286	-887	-32	-855	-.4071	-.6124
449	358.9	1.60	-1316	-918	-28	-890	-.4238	-.6267
480	390.0	1.57	-1337	-938	-18	-920	-.4381	-.6367
487	396.8	1.56	-1349	-950	-19	-931	-.4433	-.6424
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
487	.0000		-963	-565	-19	-546		
487	.0396		-944	-545	-19	-526		
488	1.2826		-908	-509	-19	-490		
495	8.3		-882	-484	-21	-463		
503	16.0		-842	-442	-16	-426		

**END OF TEST

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 160F, 90 DAY, 45 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 3190 PSI)
NO.1	408	11 57	27	4.3
NO.2	415	11 58	25	4.2
NO.3	402	11 56	28	4.2

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 3190. PSI
PER. ULT. STR. APPLIED: 44.3 PERCENT (SELECTED MIX)
58.0 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.		ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.		CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.		(ELASTIC +CREEP)/ 3190 PSI
* 3 -7-74	1430	0	SPECIMENS CAST													
* 6 -5-74	1233	89.9	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1590 PSI (PLUS OR MINUS 30), RESPECTIVELY													
6 -5-74	1233	89.9	-.0014	160.8	**	0	0	0	0	**	0	0	0	0	**	0.
6 -5-74	1234	89.9	-.0007	160.8	**	-288	-297	-309	-298	**	0	0	0	0	**	-.09342
* 6 -5-74	1235	89.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 3190 PSI													
6 -5-74	1235	89.9	.0000	160.8	**	-750	-755	-763	-756	**	0	0	0	0	**	-.23699
6 -5-74	1240	89.9	.0035	160.4	**	-753	-760	-776	-763	**	-3	-5	-13	-7	**	-.23918
6 -5-74	1245	89.9	.0069	160.4	**	-769	-770	-794	-777	**	-19	-15	-31	-21	**	-.24357
6 -5-74	1250	89.9	.0104	160.4	**	-783	-784	-808	-791	**	-33	-29	-45	-35	**	-.24796
6 -5-74	1255	89.9	.0139	160.4	**	-795	-795	-820	-803	**	-45	-40	-57	-47	**	-.25172
6 -5-74	1305	89.9	.0208	160.4	**	-808	-807	-833	-816	**	-58	-52	-70	-60	**	-.25580
6 -5-74	1320	90.0	.0313	160.5	**	-824	-823	-852	-833	**	-74	-68	-89	-77	**	-.26113
6 -5-74	1335	90.0	.0417	160.6	**	-838	-837	-867	-847	**	-88	-82	-104	-91	**	-.26552
6 -5-74	1405	90.0	.0625	160.5	**	-859	-856	-886	-867	**	-109	-101	-123	-111	**	-.27179
6 -5-74	1440	90.0	.0868	160.5	**	-875	-872	-903	-883	**	-125	-117	-140	-127	**	-.27680
6 -5-74	1538	90.0	.1271	160.8	**	-900	-895	-923	-907	**	-150	-140	-165	-151	**	-.28433
6 -5-74	1735	90.1	.2083	160.9	**	-932	-926	-954	-937	**	-182	-171	-191	-181	**	-.29373
6 -5-74	2112	90.3	.3590	161.6	**	-974	-964	-987	-975	**	-224	-209	-224	-219	**	-.30564
6 -6-74	1225	90.9	.9931	161.6	**	-1063	-1049	-1069	-1060	**	-313	-294	-306	-304	**	-.33229
6 -7-74	1152	91.9	1.9701	161.3	**	-1130	-1114	-1131	-1125	**	-380	-359	-368	-369	**	-.35266
6 -8-74	1215	92.9	3.0	160.5	**	-1173	-1157	-1172	-1167	**	-423	-402	-409	-411	**	-.36583
6 -9-74	1300	93.9	4.0	160.4	**	-1207	-1189	-1205	-1200	**	-457	-434	-442	-444	**	-.37618
6-10-74	1135	94.9	5.0	160.5	**	-1232	-1213	-1229	-1224	**	-482	-458	-466	-468	**	-.38370
6-11-74	843	95.8	5.8	160.8	**	-1253	-1233	-1247	-1244	**	-503	-478	-484	-488	**	-.38997
6-12-74	1152	96.9	7.0	160.4	**	-1277	-1256	-1269	-1267	**	-527	-501	-506	-511	**	-.39718
6-14-74	915	98.8	8.9	160.7	**	-1310	-1287	-1301	-1299	**	-560	-532	-538	-543	**	-.40721
6-17-74	1600	102.1	12.1	160.7	**	-1360	-1336	-1345	-1347	**	-610	-581	-582	-591	**	-.42226
6-21-74	1220	105.9	16.0	161.1	**	-1408	-1380	-1390	-1392	**	-658	-625	-627	-636	**	-.43636
6-26-74	1150	110.9	21.0	161.5	**	-1466	-1434	-1446	-1448	**	-716	-679	-683	-692	**	-.45392
6-30-74	950	114.8	24.9	161.7	**	-1503	-1469	-1482	-1484	**	-753	-714	-719	-728	**	-.46520
7 -9-74	1045	123.8	33.9	162.6	**	-1577	-1537	-1553	-1555	**	-827	-782	-790	-799	**	-.48746
7-10-74	1650	125.1	35.2	162.5	**	-1586	-1545	-1559	-1563	**	-836	-790	-796	-807	**	-.48997
7-15-74	1310	129.9	40.0	163.1	**	-1621	-1575	-1591	-1595	**	-871	-820	-828	-839	**	-.50000
7-24-74	1615	139.1	49.2	163.2	**	-1688	-1637	-1651	-1658	**	-938	-882	-888	-902	**	-.51975
7-31-74	1630	146.1	56.2	157.3	**	-1742	-1715	-1702	-1719	**	-992	-960	-939	-963	**	-.53887
8 -6-74	1239	151.9	62.0	158.3	**	-1783	-1748	-1742	-1757	**	-1033	-993	-979	-1001	**	-.55078
8-15-74	1050	160.8	70.9	160.5	**	-1831	-1789	-1786	-1802	**	-1081	-1034	-1023	-1046	**	-.56489
8-29-74	1120	174.9	84.9	158.9	**	-1901	-1864	-1857	-1874	**	-1151	-1109	-1094	-1118	**	-.58746
9-11-74	1345	188.0	98.0	159.0	**	-1965	-1920	-1916	-1933	**	-1215	-1165	-1153	-1177	**	-.60596
9-25-74	1630	202.1	112.2	158.8	**	-2024	-1974	-1974	-1990	**	-1274	-1219	-1211	-1234	**	-.62382
10 -9-74	1430	216.0	126.1	159.3	**	-2081	-2018	-2027	-2042	**	-1331	-1263	-1264	-1286	**	-.64013
10-24-74	830	230.7	140.8	158.5	**	-2130	-2055	-2068	-2084	**	-1380	-1300	-1305	-1328	**	-.65329
11 -8-74	1315	245.9	156.0	159.7	**	-2185	-2096	-2120	-2133	**	-1435	-1341	-1357	-1377	**	-.66865
11-21-74	915	258.8	168.9	158.1	**	-2217	-2127	-2149	-2164	**	-1467	-1372	-1386	-1408	**	-.67837
12-17-74	1640	285.1	195.2	159.4	**	-2287	-2175	-2220	-2227	**	-1537	-1420	-1457	-1471	**	-.69812
1-15-75	1350	314.0	224.1	163.5	**	-2355	-2225	-2284	-2288	**	-1605	-1470	-1521	-1532	**	-.71724
2-18-75	1530	348.0	258.1	160.4	**	-2419	-2284	-2353	-2352	**	-1669	-1529	-1590	-1596	**	-.73730
3-14-75	1235	371.9	282.0	157.8	**	-2450	-2320	-2385	-2385	**	-1700	-1565	-1622	-1629	**	-.74765
4-12-75	1230	400.9	311.0	159.2	**	-2486	-2346	-2426	-2419	**	-1736	-1591	-1663	-1663	**	-.75831
5-16-75	1215	434.9	345.0	159.6	**	-2553	-2404	-2499	-2485	**	-1803	-1649	-1736	-1729	**	-.77900
6-16-75	1540	466.0	376.1	158.4	**	-2590	-2433	-2527	-2516	**	-1840	-1678	-1764	-1760	**	-.78871
6-23-75	940	472.8	382.9	159.6	**	-2597	-2442	-2531	-2523	**	-1847	-1687	-1768	-1767	**	-.79091
* 6-23-75	942	472.8	SPECIMEN(S) FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *DAYS UNDER STRESS*													
6-23-75	942	472.8	.0000	159.6	**	-2058	-1903	-1965	-1975	**	-1308	-1148	-1202	-1219	**	
6-23-75	1110	472.9	.0611	157.4	**	-2003	-1847	-1914	-1921	**	-1253	-1092	-1151	-1165	**	
6-24-75	1700	474.1	1.3042	158.5	**	-1954	-1796	-1866	-1872	**	-1204	-1041	-1103	-1116	**	
7 -1-75	1630	481.1	8.3	158.6	**	-1915	-1756	-1827	-1832	**	-1165	-1001	-1064	-1076	**	
7 -8-75	1330	488.0	15.2	71.3	**	-1850	-1749	0	-1799	**	-1100	-994	0	-1047	**	
* 7 -8-75	1430	488.0	END OF TEST													

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 160F, 90 DAY, 45 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 3190. PSI
PER. ULT. STR. APPLIED: 44.3 PERCENT (SELECTED MIX)
58.0 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 403 11 53
413 11 54

CREEP : 408 11 57
415 11 58
402 11 56

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 3190 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0014		0	0	0	0		
90	-.0007		-298	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 3190 PSI								
90	.0000	4.22	-756	0	0	0	0.	-.2370
90	.0035	4.18	-763	-7	0	-7	-.0022	-.2392
90	.0069	4.11	-777	-21	0	-21	-.0066	-.2436
90	.0104	4.03	-791	-35	0	-35	-.0110	-.2480
90	.0139	3.97	-803	-47	0	-47	-.0147	-.2517
90	.0208	3.91	-816	-60	0	-60	-.0188	-.2558
90	.0313	3.83	-833	-77	0	-77	-.0241	-.2611
90	.0417	3.77	-847	-91	0	-91	-.0285	-.2655
90	.0625	3.68	-867	-111	0	-111	-.0348	-.2718
90	.0368	3.61	-883	-127	0	-127	-.0398	-.2768
90	.1271	3.52	-907	-151	0	-151	-.0473	-.2843
90	.2083	3.40	-937	-181	0	-181	-.0567	-.2937
90	.3590	3.27	-975	-219	0	-219	-.0687	-.3056
91	.9931	3.01	-1060	-304	11	-315	-.0987	-.3323
92	2.0	2.84	-1125	-369	20	-389	-.1219	-.3527
93	3.0	2.73	-1167	-411	25	-436	-.1367	-.3658
94	4.0	2.66	-1200	-444	28	-472	-.1480	-.3762
95	5.0	2.61	-1224	-468	31	-499	-.1564	-.3837
96	5.8	2.56	-1244	-488	31	-519	-.1627	-.3900
97	7.0	2.52	-1267	-511	33	-544	-.1705	-.3972
99	8.9	2.46	-1299	-543	33	-576	-.1806	-.4072
102	12.1	2.37	-1347	-591	32	-623	-.1953	-.4223
106	16.0	2.29	-1392	-636	31	-667	-.2091	-.4364
111	21.0	2.20	-1448	-692	29	-721	-.2260	-.4539
115	24.9	2.15	-1484	-728	28	-756	-.2370	-.4652
124	33.9	2.05	-1555	-799	23	-822	-.2577	-.4875
125	35.2	2.04	-1563	-807	22	-829	-.2599	-.4900
130	40.0	2.00	-1595	-839	19	-858	-.2690	-.5000
139	49.2	1.92	-1658	-902	12	-914	-.2865	-.5197
146	56.2	1.86	-1719	-963	12	-975	-.3056	-.5389
152	62.0	1.82	-1757	-1001	12	-1013	-.3176	-.5508
161	70.9	1.77	-1802	-1046	11	-1057	-.3313	-.5649
175	84.9	1.70	-1874	-1118	8	-1126	-.3530	-.5875
188	98.0	1.65	-1933	-1177	10	-1187	-.3721	-.6060
202	112.2	1.60	-1990	-1234	6	-1240	-.3887	-.6238
216	126.1	1.56	-2042	-1286	4	-1290	-.4044	-.6401
231	140.8	1.53	-2084	-1328	1	-1329	-.4166	-.6533
246	156.0	1.50	-2133	-1377	-4	-1373	-.4304	-.6687
259	168.9	1.47	-2164	-1408	-5	-1403	-.4398	-.6784
285	195.2	1.43	-2227	-1471	-14	-1457	-.4567	-.6981
314	224.1	1.39	-2288	-1532	-15	-1517	-.4755	-.7172
348	258.1	1.36	-2352	-1596	-20	-1576	-.4940	-.7373
372	282.0	1.34	-2385	-1629	-28	-1601	-.5019	-.7476
401	311.0	1.32	-2419	-1663	-31	-1632	-.5116	-.7583
435	345.0	1.28	-2485	-1729	-38	-1691	-.5301	-.7790
466	376.1	1.27	-2516	-1760	-18	-1742	-.5461	-.7887
473	382.9	1.26	-2523	-1767	-21	-1746	-.5473	-.7909
**SPECIMENS FULLY UNLOADED, DAYS RECOVERY GIVEN NOW IN COLUMN *TIME UNDER STRESS*								
473	.0000		-1975	-1219	-21	-1198		
473	.0611		-1921	-1165	-21	-1144		
474	1.3042		-1872	-1116	-20	-1096		
481	8.3		-1832	-1076	-19	-1057		
498	15.2		-1799	-1047	-19	-1028		
**END OF TEST								

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 160F, 90 DAY, 60 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 4250 PSI)
NO.1	399	11 52	15	4.2
NO.2	397	11 51	16	4.2
NO.3	404	11 50	30	4.3

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 4250. PSI
PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
77.3 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 4250 PSI
* 3 -7-74	1430	0	SPECIMENS CAST										
* 6 -5-74	1052	89.8	SPECIMEN(S) LOADING BEGINS, READINGS AT 0, 1590, AND 3190 PSI (PLUS OR MINUS 30), RESPECTIVELY										
6 -5-74	1052	89.8	-.0021	160.2	0	0	0	0	0	0	0	0	0.
6 -5-74	1053	89.8	-.0014	160.2	-298	-281	-291	-290	0	0	0	0	-.06824
6 -5-74	1054	89.9	-.0007	160.2	-579	-652	-652	-661	0	0	0	0	-.15553
* 6 -5-74	1055	89.9	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 4250 PSI										
6 -5-74	1055	89.9	.0000	160.2	-1017	-1005	-995	-1005	0	0	0	0	-.23647
6 -5-74	1100	89.9	.0035	160.0	-1152	-1167	-1170	-1163	-135	-162	-175	-157	-.27365
6 -5-74	1103	89.9	.0056	160.1	-1172	-1189	-1194	-1185	-155	-184	-199	-179	-.27882
6 -5-74	1105	89.9	.0069	160.1	-1184	-1204	-1210	-1199	-167	-199	-215	-193	-.28212
6 -5-74	1112	89.9	.0118	160.1	-1217	-1241	-1250	-1236	-200	-236	-255	-230	-.29082
6 -5-74	1115	89.9	.0139	160.1	-1237	-1263	-1273	-1257	-220	-258	-278	-252	-.29576
6 -5-74	1125	89.9	.0208	160.1	-1267	-1297	-1309	-1291	-250	-292	-314	-285	-.30376
6 -5-74	1140	89.9	.0313	160.2	-1303	-1337	-1352	-1330	-286	-332	-357	-325	-.31294
6 -5-74	1155	89.9	.0417	160.3	-1328	-1365	-1382	-1358	-311	-360	-387	-352	-.31953
6 -5-74	1255	89.9	.0833	160.2	-1404	-1449	-1471	-1441	-387	-444	-476	-435	-.33906
6 -5-74	1405	90.0	.1319	159.9	-1457	-1507	-1532	-1498	-440	-502	-537	-493	-.35247
6 -5-74	1538	90.0	.1965	160.1	-1506	-1561	-1589	-1552	-489	-556	-594	-546	-.36518
6 -5-74	1655	90.1	.2500	160.2	-1538	-1595	-1624	-1585	-521	-590	-629	-580	-.37294
6 -5-74	2112	90.3	.4285	161.0	-1619	-1679	-1713	-1670	-602	-674	-718	-664	-.39294
6 -6-74	850	90.8	.9132	161.1	-1733	-1798	-1835	-1788	-716	-793	-840	-783	-.42071
6 -7-74	1152	91.9	2.0	161.0	-1862	-1928	-1967	-1919	-845	-923	-972	-913	-.45153
6 -8-74	1215	92.9	3.1	162.1	-1935	-2000	-2040	-1991	-918	-995	-1045	-986	-.46847
6 -9-74	1300	93.9	4.1	162.0	-1993	-2057	-2097	-2049	-976	-1052	-1102	-1043	-.48212
6-10-74	1135	94.9	5.0	161.0	-2035	-2099	-2137	-2090	-1018	-1094	-1142	-1084	-.49176
6-11-74	843	95.8	5.9	161.4	-2068	-2131	-2168	-2122	-1051	-1126	-1173	-1116	-.49929
6-12-74	1152	96.9	7.0	161.1	-2108	-2170	-2207	-2161	-1091	-1165	-1212	-1156	-.50847
6-14-74	915	98.8	8.9	161.3	-2164	-2223	-2260	-2215	-1147	-1218	-1265	-1210	-.52118
6-17-74	1600	102.1	12.2	161.0	-2245	-2301	-2339	-2295	-1228	-1296	-1344	-1289	-.54000
6-21-74	1220	105.9	16.1	161.7	-2319	-2374	-2414	-2369	-1302	-1369	-1419	-1363	-.55741
6-26-74	1150	110.9	21.0	162.2	-2408	-2458	-2501	-2455	-1391	-1453	-1506	-1450	-.57765
6-30-74	950	114.8	25.0	162.4	-2467	-2514	-2557	-2512	-1450	-1509	-1562	-1507	-.59106
7 -9-74	1045	123.8	34.0	163.2	-2578	-2617	-2665	-2620	-1561	-1612	-1670	-1614	-.61647
7-15-74	1310	129.9	40.1	163.2	-2642	-2676	-2729	-2682	-1625	-1671	-1734	-1676	-.63106
7-24-74	1615	139.1	49.2	163.0	-2746	-2773	-2843	-2787	-1729	-1768	-1848	-1781	-.65576
7-31-74	1630	146.1	56.2	157.2	-2834	-2849	-2939	-2874	-1817	-1844	-1944	-1868	-.67624
8 -6-74	1239	151.9	62.1	159.2	-2909	-2903	-3026	-2946	-1892	-1898	-2031	-1940	-.69318
8-15-74	1050	160.8	71.0	160.3	-2993	-2967	-3100	-3020	-1976	-1962	-2105	-2014	-.71059
8-29-74	1120	174.9	85.0	159.4	-3102	-3056	-3247	-3135	-2085	-2051	-2252	-2129	-.73765
9-11-74	1345	188.0	98.1	158.6	-3179	-3114	0	-3146	-2162	-2109	0	-2135	-.74024
9-25-74	1630	202.1	112.2	159.0	-3253	-3183	0	-3218	-2236	-2178	0	-2207	-.75718
10 -9-74	1430	216.0	126.1	161.1	-3314	-3236	0	-3275	-2297	-2231	0	-2264	-.77059
10-24-74	830	230.7	140.9	161.5	-3372	-3291	0	-3331	-2355	-2286	0	-2320	-.78376
11 -8-74	1315	245.9	156.1	162.9	-3432	-3342	0	-3387	-2415	-2337	0	-2376	-.79694
11-21-74	915	258.8	168.9	162.4	-3472	-3380	0	-3426	-2455	-2375	0	-2415	-.80612
12 -4-74	1420	272.0	182.1	161.2	-3507	-3411	0	-3459	-2490	-2406	0	-2448	-.81388
12-17-74	1640	285.1	195.2	161.1	-3543	-3450	0	-3496	-2526	-2445	0	-2485	-.82259
1-15-75	1350	314.0	224.1	162.6	-3599	-3519	0	-3559	-2582	-2514	0	-2548	-.83741
2-18-75	1530	348.0	258.2	160.4	-3663	-3582	0	-3622	-2646	-2577	0	-2611	-.85224
3-14-75	1235	371.9	282.1	162.0	-3700	-3619	0	-3659	-2683	-2614	0	-2648	-.86094
4-12-75	1230	400.9	311.1	162.5	-3737	-3655	0	-3696	-2720	-2650	0	-2685	-.86965
5-16-75	1215	434.9	345.1	163.2	-3775	-3695	0	-3735	-2758	-2690	0	-2724	-.87882
6-16-75	1540	466.0	376.2	161.6	-3808	-3730	0	-3769	-2791	-2725	0	-2758	-.88682
7-15-75	1450	495.0	405.2	163.0	-3867	-3769	0	-3818	-2850	-2764	0	-2807	-.89835
8 -7-75	1600	518.1	428.2	163.7	-3884	-3789	0	-3836	-2857	-2784	0	-2825	-.90259
9-18-75	1625	560.1	470.2	166.6	-3894	-3819	0	-3856	-2877	-2814	0	-2845	-.90729
10-20-75	1320	592.0	502.1	165.2	-3915	0	0	-3915	-2898	0	0	-2898	-.92118
11-14-75	1600	617.1	527.2	163.7	-3949	0	0	-3949	-2932	0	0	-2932	-.92918
12-24-75	900	656.8	566.9	164.8	-3959	0	0	-3959	-2942	0	0	-2942	-.93153
2-24-76	945	718.8	629.0	167.6	-3987	0	0	-3987	-2970	0	0	-2970	-.93812

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD
SPECIMEN NO.1,NO.2, AND NO.3: CALIBRATED RANGE EXCEEDED ON 7-24-74,8-29-74 AND 7-9-74, RESPECTIVELY

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 160F, 90 DAY, 60 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 4250. PSI
PER. ULT. STR. APPLIED: 59.0 PERCENT (SELECTED MIX)
77.3 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 403 11 53
413 11 54

CREEP : 399 11 52
397 11 51
404 11 50

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 4250 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
90	-.0021		0	0	0	0		
90	-.0014		-290	0	0	0		
90	-.0007		-661	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 4250 PSI								
90	.0000	4.23	-1005	0	0	0	0.	-.2365
90	.0035	3.65	-1163	-157	0	-157	-.0369	-.2736
90	.0056	3.59	-1185	-179	0	-179	-.0421	-.2788
90	.0069	3.54	-1199	-193	0	-193	-.0454	-.2821
90	.0118	3.44	-1236	-230	0	-230	-.0541	-.2908
90	.0139	3.38	-1257	-252	0	-252	-.0593	-.2958
90	.0208	3.29	-1291	-285	0	-285	-.0671	-.3038
90	.0313	3.20	-1330	-325	0	-325	-.0765	-.3129
90	.0417	3.13	-1358	-352	0	-352	-.0828	-.3195
90	.0833	2.95	-1441	-435	0	-435	-.1024	-.3391
90	.1319	2.84	-1498	-493	0	-493	-.1160	-.3525
90	.1965	2.74	-1552	-546	0	-546	-.1285	-.3652
90	.2500	2.68	-1585	-580	0	-580	-.1365	-.3729
90	.4285	2.54	-1670	-664	0	-664	-.1562	-.3929
91	.9132	2.38	-1788	-783	11	-794	-.1868	-.4207
92	2.0	2.21	-1919	-913	20	-933	-.2195	-.4515
93	3.1	2.13	-1991	-986	25	-1011	-.2379	-.4685
94	4.1	2.07	-2049	-1043	28	-1071	-.2520	-.4821
95	5.0	2.03	-2090	-1084	31	-1115	-.2624	-.4918
96	5.9	2.00	-2122	-1116	31	-1147	-.2699	-.4993
97	7.0	1.97	-2161	-1156	33	-1189	-.2798	-.5085
99	8.9	1.92	-2215	-1210	33	-1243	-.2925	-.5212
102	12.2	1.85	-2295	-1289	32	-1321	-.3108	-.5400
106	16.1	1.79	-2369	-1363	31	-1394	-.3280	-.5574
111	21.0	1.73	-2455	-1450	29	-1479	-.3480	-.5776
115	25.0	1.69	-2512	-1507	28	-1535	-.3612	-.5911
124	34.0	1.62	-2620	-1614	23	-1637	-.3852	-.6165
130	40.1	1.58	-2682	-1676	19	-1695	-.3988	-.6311
139	49.2	1.52	-2787	-1781	12	-1793	-.4219	-.6558
146	56.2	1.48	-2874	-1868	12	-1880	-.4424	-.6762
152	62.1	1.44	-2946	-1940	12	-1952	-.4593	-.6932
161	71.0	1.41	-3020	-2014	11	-2025	-.4765	-.7106
175	85.0	1.36	-3135	-2129	8	-2137	-.5028	-.7376
188	98.1	1.35	-3146	-2135	10	-2145	-.5047	-.7402
202	112.2	1.32	-3218	-2207	6	-2213	-.5207	-.7572
216	126.1	1.30	-3275	-2264	4	-2268	-.5336	-.7706
231	140.9	1.28	-3331	-2320	1	-2321	-.5461	-.7838
246	156.1	1.25	-3387	-2376	-4	-2372	-.5581	-.7969
259	168.9	1.24	-3426	-2415	-5	-2410	-.5671	-.8061
272	182.1	1.23	-3459	-2448	-9	-2439	-.5739	-.8139
285	195.2	1.22	-3496	-2485	-14	-2471	-.5814	-.8226
314	224.1	1.19	-3559	-2548	-15	-2533	-.5960	-.8374
348	258.2	1.17	-3622	-2611	-20	-2591	-.6096	-.8522
372	282.1	1.16	-3659	-2648	-28	-2620	-.6165	-.8609
401	311.1	1.15	-3696	-2685	-31	-2654	-.6245	-.8696
435	345.1	1.14	-3735	-2724	-38	-2686	-.6320	-.8788
466	376.2	1.13	-3769	-2758	-18	-2740	-.6447	-.8868
495	405.2	1.11	-3818	-2807	-21	-2786	-.6555	-.8984
518	428.2	1.11	-3836	-2825	-9	-2816	-.6626	-.9026
560	470.2	1.10	-3856	-2845	-9	-2836	-.6673	-.9073
592	502.1	1.09	-3915	-2898	-9	-2889	-.6798	-.9212
617	527.2	1.08	-3949	-2932	-9	-2923	-.6878	-.9292
657	566.9	1.07	-3959	-2942	-9	-2933	-.6901	-.9315
719	629.0	1.07	-3987	-2970	-9	-2961	-.6967	-.9381

AVERAGE ELASTIC PLUS CREEP STRAINS **YORK ** 160F, 270 DAY, 30 PERCENT
(3 SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(NOT CORRECTED FOR AUTOGENOUS STRAINS)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR	MODULUS (0 TO 2400 PSI)
NO.1	220	11 73	12	4.8
NO.2	217	11 74	25	5.5
NO.3	213	11 72	17	5.3

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 6350. PSI AT 160.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.3 PERCENT (SELECTED MIX)
37.8 PERCENT (COMPANION)

MICROSTRAIN (INCLUDING AUTOGENOUS)--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	ELASTIC PLUS CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	CREEP SPECIMEN NO.1	NO.2	NO.3	AVG.	(ELASTIC +CREEP)/ 2400 PSI
* 2-21-74	1500	0	SPECIMENS CAST										
*11-18-74	1037	269.8	SPECIMEN(S) LOADING BEGINS, READINGS AT 0 AND 1200 PSI (PLUS OR MINUS 30), RESPECTIVELY										
11-18-74	1037	269.8	-.0007	161.2	0	0	0	0	0	0	0	0	0.
11-18-74	1037	269.8	-.0003	161.2	-230	-201	-212	-214	0	0	0	0	-.08917
*11-18-74	1038	269.8	SPECIMEN(S) FULLY LOADED, APPLIED TEST STRESS 2400 PSI										
11-18-74	1038	269.8	0.	161.3	-498	-435	-455	-462	0	0	0	0	-.19250
11-18-74	1042	269.8	.0028	161.0	-523	-464	-484	-490	-25	-29	-29	-27	-.20417
11-18-74	1047	269.8	.0063	161.0	-526	-468	-489	-494	-28	-33	-34	-31	-.20583
11-18-74	1053	269.8	.0104	161.0	-528	-472	-493	-497	-30	-37	-38	-35	-.20708
11-18-74	1138	269.9	.0417	161.4	-546	-490	-510	-515	-48	-55	-55	-52	-.21458
11-18-74	1443	270.0	.1701	162.3	-573	-516	-544	-544	-75	-81	-89	-81	-.22667
11-18-74	1638	270.1	.2500	162.5	-583	-527	-555	-555	-85	-92	-100	-92	-.23125
11-19-74	1040	270.8	1.0014	162.8	-632	-583	-604	-606	-134	-148	-149	-143	-.25250
11-20-74	1300	271.9	2.1	162.3	-671	-632	-638	-647	-173	-197	-183	-184	-.26958
11-21-74	915	272.8	2.9	162.6	-690	-657	-651	-666	-192	-222	-196	-203	-.27750
11-22-74	1135	273.9	4.0	162.6	-708	-682	-674	-688	-210	-247	-219	-225	-.28667
11-25-74	1450	277.0	7.2	161.7	-752	-742	-718	-737	-254	-307	-263	-274	-.30708
12 -4-74	1420	286.0	16.2	161.9	-820	-831	-803	-818	-322	-396	-348	-355	-.34083
12 -6-74	1430	288.0	18.2	161.6	-831	-843	-817	-830	-333	-408	-362	-367	-.34583
12 -7-74	1445	289.0	19.2	161.9	-809	-826	-798	-811	-311	-391	-343	-348	-.33792
12-10-74	1115	291.8	22.0	162.1	-755	-783	-751	-763	-257	-348	-296	-300	-.31792
12-11-74	1330	292.9	23.1	161.9	-732	-765	-732	-743	-234	-330	-277	-280	-.30958
12-20-74	1100	301.8	32.0	161.7	-836	-872	-838	-848	-338	-437	-383	-386	-.35333
12-24-74	1200	305.9	36.1	161.9	-881	-918	-886	-895	-383	-483	-431	-432	-.37292
1 -3-75	1645	316.1	46.3	162.6	-927	-966	-936	-943	-429	-531	-481	-480	-.39292
1-10-75	1530	323.0	53.2	162.6	-955	-995	-967	-972	-457	-560	-512	-509	-.40500
1-20-75	835	332.7	62.9	162.1	-1004	-1015	-1010	-1009	-506	-580	-555	-547	-.42042
1-31-75	1430	344.0	74.2	161.4	-1037	-1043	-1046	-1042	-539	-608	-591	-579	-.43417
2-18-75	1530	362.0	92.2	159.9	-1092	-1103	-1114	-1103	-594	-668	-659	-640	-.45958
2-28-75	1200	371.9	102.1	162.3	-1100	-1126	-1117	-1114	-602	-691	-662	-651	-.46417
3-14-75	1235	385.9	116.1	162.4	-1127	-1158	-1152	-1145	-629	-723	-697	-683	-.47708
4-12-75	1230	414.9	145.1	160.7	-1184	-1214	-1217	-1205	-686	-779	-762	-742	-.50208
5-16-75	1215	448.9	179.1	162.5	-1228	-1289	-1271	-1262	-730	-854	-816	-800	-.52583
6-16-75	1540	480.0	210.2	163.0	-1268	-1332	-1305	-1301	-770	-897	-850	-839	-.54208
7 -1-75	1630	495.1	225.2	163.0	-1291	-1353	-1319	-1321	-793	-918	-864	-858	-.55042
7-15-75	1450	509.0	239.2	81.2	-1308	0	0	-654	-810	0	0	-810	-.27250
8-22-75	1340	546.9	277.1	162.7	-1341	0	0	-1341	-843	0	0	-843	-.55875
9 -2-75	1155	557.9	288.1	162.5	-1350	0	0	-1350	-852	0	0	-852	-.56250
9-18-75	1625	574.1	304.2	163.8	-1360	0	0	-1360	-862	0	0	-862	-.56667
10-20-75	1320	605.9	336.1	163.2	-1387	0	0	-1387	-889	0	0	-889	-.57792
11-14-75	1600	631.0	361.2	161.6	-1425	0	0	-1425	-927	0	0	-927	-.59375
12-11-75	815	657.7	387.9	162.1	-1424	0	0	-1424	-926	0	0	-926	-.59333
12-24-75	900	670.7	400.9	162.8	-1431	0	0	-1431	-933	0	0	-933	-.59625
2-24-76	945	732.8	463.0	165.2	-1465	0	0	-1465	-967	0	0	-967	-.61042

NOTE: MINUS DAYS UNDER LOAD INDICATES SPECIMEN LOADING TIME PRIOR TO FULL LOAD

AVERAGE ELASTIC, CREEP AND AUTOGENOUS STRAINS ** YORK ** 160F, 270 DAY, 30 PERCENT
(SPECIMEN: SEALED 6 BY 16 IN. CONCRETE CYL.)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 160 DEG. F.

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 6350. PSI AT 160.F.
APPLIED TEST STRESS : 2400. PSI
PER. ULT. STR. APPLIED: 29.3 PERCENT (SELECTED MIX)
37.8 PERCENT (COMPANION)

STRAIN METER NUMBERS

AUTOGENOUS: 215 11 75
216 11 76

CREEP : 220 11 73
217 11 74
213 11 72

AGE, DAYS	TIME UNDER STRESS, DAYS	SUSTAINED MODULUS OF ELASTICITY MPSI	ELASTIC, CREEP PLUS AUTOGENOUS (MICROSTRAIN)	CREEP PLUS AUTOGENOUS (MICROSTRAIN)	AUTOGENOUS (MICROSTRAIN)	CREEP (MICROSTRAIN)	SPECIFIC CREEP (MICROSTRAIN PER PSI)	TOTAL STRAIN DIVIDED BY 2400 PSI (MICROSTRAIN PER PSI)
**LOADING OF SPECIMENS BEGINS (MINUS TIME IS TIME PRIOR TO FULL LOAD)								
270	-.0007		0	0	0	0		
270	-.0003		-214	0	0	0		
**SPECIMENS FULLY LOADED, APPLIED TEST STRESS 2400 PSI								
270	0.	5.19	-462	0	0	0	0.	-.1925
270	.0028	4.90	-490	-27	0	-27	-.0112	-.2042
270	.0063	4.86	-494	-31	0	-31	-.0129	-.2058
270	.0104	4.83	-497	-35	0	-35	-.0146	-.2071
270	.0417	4.66	-515	-52	0	-52	-.0217	-.2146
270	.1701	4.41	-544	-81	0	-81	-.0337	-.2267
270	.2500	4.32	-555	-92	0	-92	-.0383	-.2312
271	1.0014	3.96	-606	-143	11	-154	-.0642	-.2525
272	2.1	3.71	-647	-184	19	-203	-.0846	-.2696
273	2.9	3.60	-666	-203	23	-226	-.0942	-.2775
274	4.0	3.49	-688	-225	26	-251	-.1046	-.2867
277	7.2	3.26	-737	-274	30	-304	-.1267	-.3071
286	16.2	2.93	-818	-355	30	-385	-.1604	-.3408
288	18.2	2.89	-830	-367	29	-396	-.1650	-.3458
289	19.2	2.96	-811	-348	30	-378	-.1575	-.3379
292	22.0	3.15	-763	-300	30	-330	-.1375	-.3179
293	23.1	3.23	-743	-280	29	-309	-.1287	-.3096
302	32.0	2.83	-848	-386	30	-416	-.1733	-.3533
306	36.1	2.68	-895	-432	29	-461	-.1921	-.3729
316	46.3	2.55	-943	-480	25	-505	-.2104	-.3929
323	53.2	2.47	-972	-509	20	-529	-.2204	-.4050
333	62.9	2.38	-1009	-547	7	-554	-.2308	-.4204
344	74.2	2.30	-1042	-579	-10	-569	-.2371	-.4342
362	92.2	2.18	-1103	-640	-35	-605	-.2521	-.4596
372	102.1	2.15	-1114	-651	-34	-617	-.2571	-.4642
386	116.1	2.10	-1145	-683	-42	-641	-.2671	-.4771
415	145.1	1.99	-1205	-742	-54	-688	-.2867	-.5021
449	179.1	1.90	-1262	-800	-63	-737	-.3071	-.5258
480	210.2	1.84	-1301	-839	-72	-767	-.3196	-.5421
495	225.2	1.82	-1321	-858	-73	-785	-.3271	-.5504
509	239.2	3.67	-654	-810	-73	-737	-.3071	-.2725
547	277.1	1.79	-1341	-843	-73	-770	-.3208	-.5587
558	288.1	1.78	-1350	-852	-73	-779	-.3246	-.5625
574	304.2	1.76	-1360	-862	-73	-789	-.3287	-.5667
606	336.1	1.73	-1387	-889	-73	-816	-.3400	-.5779
631	361.2	1.68	-1425	-927	-73	-854	-.3558	-.5938
658	387.9	1.69	-1424	-926	-73	-853	-.3554	-.5933
671	400.9	1.68	-1431	-933	-73	-860	-.3583	-.5962
733	463.0	1.64	-1465	-967	-73	-894	-.3725	-.6104

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS ** 73F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 3 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	242	73 03	0
NO.2	250	73 04	0
NO.3	336	73 05	0

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 6270. PSI AT 73.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
*12-19-73	1000	0	SPECIMENS CAST					
12-20-73	1000	1.0		71.2	0	0	0	0
12-22-73	1220	3.1		71.4	6	10	8	-2
12-26-73	1600	7.3		71.8	-5	-7	-6	-7
12-28-73	1145	9.1		71.4	-16	-30	-23	-9
1 -2-74	1630	14.3		71.1	-20	-28	-24	-15
1-14-74	1215	26.1		71.0	-24	-28	-26	-29
1-16-74	1535	28.2		71.7	-29	-28	-28	-32
1-16-74	1625	28.3		70.9	-27	-24	-25	-32
1-17-74	1555	29.2		70.5	-28	-25	-26	-35
1-18-74	2130	30.5		70.4	-29	-26	-27	-47
1-19-74	1510	31.2		70.6	-32	-28	-30	-55
1-21-74	1600	33.3		71.0	-34	-31	-32	-75
1-23-74	1550	35.2		71.1	-36	-32	-34	-92
1-25-74	1430	37.2		71.1	-36	-33	-34	-101
1-27-74	1545	39.2		70.9	-36	-33	-34	-110
1-31-74	1310	43.1		70.7	-37	-38	-37	-127
2 -5-74	1550	48.2		70.5	-39	-38	-38	-149
2-18-74	1619	61.3		71.3	-38	-42	-40	-188
2-25-74	1520	68.2		71.2	-37	-44	-40	-207
3 -1-74	1020	72.0		71.0	-36	-44	-40	-217
3-11-74	1630	82.3		71.4	-35	-45	-40	-232
3-16-74	915	87.0		71.9	-36	-47	-41	-239
3-21-74	1140	92.1		71.2	-35	-46	-40	-246
3-24-74	1440	95.2		70.8	-35	-48	-41	-252
3-27-74	1715	98.3		71.0	-35	-47	-41	-257
4 -1-74	1215	103.1		70.8	-36	-47	-41	-265
4 -4-74	1430	106.2		70.9	-36	-48	-42	-269
4-15-74	1015	117.0		71.4	-37	-50	-43	-282
5 -6-74	1335	138.1		70.6	-39	-51	-45	-297
5-21-74	855	153.0		71.0	-39	-52	-45	-315
5-31-74	1440	163.2		72.4	-41	-53	-47	-329
6-10-74	1512	173.2		71.8	-40	-52	-46	-337
7-17-74	1500	210.2		72.6	-42	-54	-48	-353
8-15-74	1115	239.1		72.0	-44	-56	-50	-373
8-29-74	1135	253.1		72.1	-45	-57	-51	-382
9-11-74	1315	266.1		72.2	-46	-59	-52	-386
9-26-74	1600	280.2		71.8	-47	-60	-53	-392
10 -9-74	1600	294.2		72.6	-47	-59	-53	-393
10-23-74	1420	308.2		72.4	-50	-62	-56	-398
12 -4-74	1350	350.2		72.1	-53	-66	-59	-382
12-30-74	840	375.9		71.2	-54	-67	-60	-386
1-15-75	1330	392.1		72.4	-57	-69	-63	-387
2-18-75	1430	426.2		71.6	-60	-73	-66	-391
3-14-75	1100	450.0		71.7	-61	-75	-68	-390
4 -1-75	1100	468.0		72.5	-61	-74	-67	-389
4-12-75	1200	479.1		71.7	-62	-75	-68	-391
5 -2-75	900	499.0		72.3	-63	-75	-69	-397
6 -2-75	1100	530.0		72.7	-65	-78	-71	-398
6-16-75	1230	544.1		72.7	-71	-82	-76	-399
7 -1-75	1545	559.2		72.8	-71	-84	-77	-400
7-31-75	1550	589.2		73.0	-72	-84	-78	-399
8-22-75	1315	611.1		72.8	-72	-85	-78	-399
9-16-75	1640	636.3		72.9	-74	-87	-80	-398

NOTE: SPECIMEN NO.3; CAST 5-29-74, STRAINS HAVE BEEN INTERPOLATED FOR AGES SHOWN

Individual data for Specimen #3 not available after 9-16-75; specimen still under observation.

AVERAGE AUTOGENUUS AND DRYING SHRINKAGE STRAINS ** YORK ** 73F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 3 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 73 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	202	73 09	0
NO.2	201	73 10	0
NO.3	206	73 11	0

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 6160. PSI AT 73.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
2-14-74	1400	0	SPECIMENS CAST					
2-15-74	1400	1.0		71.9	0	0	0	0
2-20-74	1630	6.1		71.9	-19	-19	-19	-19
3-14-74	1535	28.1		70.9	-53	-59	-56	-52
3-14-74	1625	28.1		70.9	-52	-58	-55	-59
3-15-74	1035	28.9		71.7	-53	-58	-55	-79
3-16-74	1500	30.0		71.8	-51	-57	-54	-93
3-18-74	1610	32.1		71.7	-51	-57	-54	-111
3-19-74	2045	33.3		71.7	-50	-57	-53	-117
3-20-74	1018	33.8		71.2	-49	-56	-52	-121
3-21-74	1140	34.9		71.3	-48	-56	-52	-126
3-24-74	1440	38.0		70.8	-48	-56	-52	-144
3-25-74	1200	38.9		70.9	-48	-55	-51	-148
3-27-74	1715	41.1		71.2	-46	-53	-49	-157
4 -1-74	1215	45.9		71.0	-43	-51	-47	-173
4 -4-74	1430	49.0		71.0	-43	-50	-46	-184
4-11-74	1705	56.1		71.2	-40	-47	-43	-207
4-18-74	1340	63.0		71.1	-38	-43	-40	-222
4-23-74	1530	68.1		71.0	-37	-39	-38	-226
4-30-74	1435	75.0		72.0	-41	-38	-39	-244
5 -3-74	1400	78.0		71.8	-41	-37	-39	-249
5-13-74	1330	88.0		71.3	-41	-32	-36	-266
5-21-74	855	95.8		71.2	-40	-30	-35	-275
5-31-74	1440	106.0		72.5	-42	-28	-35	-288
6-10-74	1512	116.0		71.8	-42	-27	-34	-302
6-26-74	1140	131.9		71.7	-42	-25	-33	-320
7-31-74	1715	167.1		72.4	-46	-25	-35	-345
8-15-74	1115	181.9		72.0	-46	-25	-35	-356
9-11-74	1315	209.0		72.2	-50	-26	-38	-372
10-23-74	1420	251.0		72.6	-53	-29	-41	-384
11-21-74	1000	279.8		72.3	-57	-31	-44	-393
12-30-74	840	318.8		71.3	-59	-31	-44	-406
1-15-75	1330	335.0		72.5	-58	-30	-44	-411
2-18-75	1430	369.0		71.7	-61	-32	-46	-424
3-14-75	1100	392.9		71.9	-61	-34	-47	-429
4-12-75	1200	421.9		71.8	-64	-34	-49	-408
5-16-75	1130	455.9		72.9	-68	-37	-52	-406
6-16-75	830	486.8		72.6	-68	-36	-52	-405
7-15-75	1400	516.0		73.0	-70	-38	-54	-410
8-22-75	1315	554.0		72.9	-73	-39	-56	-405
9-16-75	1640	579.1		73.0	-75	-41	-58	-406
10-20-75	1530	613.1		73.1	-78	-44	-61	-412
11-10-75	911	634.8		72.5	-84	-47	-65	-413
12-24-75	920	677.8		72.0	-87	-47	-67	-408
2-24-76	930	739.8		72.0	-92	-50	-71	-405

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS ** 110F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	243	11 05	0
NO.2	423	11 04	0
NO.3	244	11 03	0

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 6100. PSI AT 110.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
*12-21-73	1000	0	SPECIMENS CAST					
12-22-73	1000	1.0		71.9	0	0	0	0
12-26-73	1200	5.1		71.2	-12	-4	-8	-17
12-28-73	1145	7.1		71.1	-36	-7	-21	-37
1 -2-74	1630	12.3		90.6	-39	-8	-23	-43
1-14-74	1220	24.1		90.1	-45	-7	-26	-48
1-15-74	945	25.0		90.6	-45	-7	-26	-50
1-15-74	1750	25.3		95.4	-38	-7	-22	-45
1-16-74	800	25.9		106.8	-23	-7	-15	-33
1-18-74	1418	28.2		109.6	-22	-6	-14	-31
1-18-74	1508	28.2		109.5	-21	-6	-13	-32
1-18-74	1703	28.3		109.5	-21	-6	-13	-41
1-18-74	2000	28.4		109.4	-21	-6	-13	-52
1-19-74	1515	29.2		109.4	-20	-6	-13	-96
1-20-74	1545	30.2		109.7	-23	-6	-14	-130
1-23-74	1600	33.3		109.1	-17	-6	-11	-187
1-25-74	1455	35.2		110.0	-18	-6	-12	-212
1-27-74	1230	37.1		110.2	-13	-5	-9	-229
1-29-74	1300	39.1		110.1	-11	-4	-7	-245
2 -3-74	1220	44.1		110.2	-8	-3	-5	-279
2-12-74	1540	53.2		110.0	-4	-3	-3	-320
2-18-74	1615	59.3		110.6	-1	-5	-3	-339
2-22-74	1645	63.3		109.7	-1	-7	-4	-350
3 -1-74	1120	70.1		110.4	-2	-9	-5	-365
3 -4-74	1055	73.0		110.4	-3	-10	-6	-374
3-16-74	930	85.0		109.5	0	-13	-6	-388
3-21-74	1645	90.3		109.8	-1	-14	-7	-400
3-26-74	1500	95.2		110.4	-4	-19	-11	-406
4 -1-74	1240	101.1		110.5	-7	-27	-17	-413
4 -8-74	1535	108.2		110.8	-9	-30	-19	-425
4-18-74	1315	118.1		110.9	-15	-25	-20	-437
4-30-74	1455	130.2		110.4	-19	-28	-23	-445
5 -3-74	1335	133.1		110.2	-21	-29	-25	-450
5-16-74	1525	146.2		109.8	-21	-25	-23	-459
6 -4-74	1630	165.3		110.9	-26	-26	-26	-468
6-14-74	915	175.0		110.9	-30	-28	-29	-475
7-17-74	1620	208.3		111.4	-39	-36	-37	-491
8-29-74	1120	251.1		109.8	-50	-43	-46	-508
10 -9-74	1430	292.2		110.5	-53	-48	-50	-525
10-24-74	830	306.9		110.3	-56	-49	-53	-532
11-21-74	915	335.0		110.8	-61	-50	-55	-547
12-17-74	1630	361.3		110.2	-64	-52	-58	-562
1-15-75	1340	390.2		110.6	-70	-55	-62	-577
3-14-75	1235	448.1		110.4	-74	-61	-67	-580
4-12-75	1215	477.1		110.1	-77	-60	-68	-585
5-20-75	1325	515.1		110.6	-81	-63	-72	-583
5-27-75	1045	522.0		110.4	-78	-64	-71	-581
6 -3-75	845	528.9		110.8	-78	-65	-71	-577
7 -1-75	1620	557.3		110.4	-80	-69	-74	-573
7-15-75	1440	571.2		110.9	-81	-70	-75	-568
8-13-75	1335	600.1		108.9	-83	-74	-78	-564
8-19-75	900	606.0		89.0	-87	-75	-81	-533
* 8-19-75	1100	606.0	END OF TEST					

NOTE: SPECIMEN NO.2: CAST 5-29-74, STRAINS MATCHED FOR AGES SHOWN

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 110F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	221	11 33	0
NO.2	410	11 34	0
NO.3	148	11 35	0

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 5770. PSI AT 110.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 3-12-74	1400	0	SPECIMENS CAST					
3-13-74	1400	1.0		71.2	0	0	0	0
4 -6-74	1150	24.9		71.2	-32	-32	-32	-32
4 -8-74	1610	27.1		105.4	-13	-18	-15	-19
4 -9-74	1055	27.9		108.6	-27	-30	-28	-21
4 -9-74	1102	27.9		108.5	-27	-30	-28	-22
4 -9-74	1700	28.1		110.2	-27	-30	-28	-54
4-10-74	1050	28.9		110.0	-25	-29	-27	-86
4-11-74	830	29.8		110.0	-23	-27	-25	-113
4-11-74	1405	30.0		110.2	-23	-27	-25	-119
4-12-74	1110	30.9		110.0	-19	-23	-21	-135
4-13-74	1135	31.9		110.5	-14	-22	-18	-152
4-14-74	1500	33.0		110.4	-5	-19	-12	-166
4-15-74	1135	33.9		110.4	1	-18	-8	-177
4-16-74	1720	35.1		110.8	6	-17	-5	-185
4-18-74	1315	37.0		110.5	17	-17	0	-203
4-20-74	1130	38.9		110.1	29	-16	6	-216
4-22-74	1315	41.0		110.1	38	-15	11	-227
4-25-74	1530	44.1		110.0	43	-14	14	-242
4-30-74	1455	49.0		109.8	44	-11	16	-262
5 -3-74	1335	52.0		109.8	44	-7	18	-272
5-10-74	1340	59.0		107.5	43	-6	18	-290
5-13-74	1420	62.0		109.8	47	-2	22	-295
5-17-74	1130	65.9		109.7	43	-6	18	-308
5-21-74	1440	70.0		110.4	42	-6	18	-316
5-28-74	1200	76.9		110.1	47	-1	23	-325
6 -4-74	1630	84.1		111.4	47	-2	22	-335
6-11-74	842	90.8		110.1	40	-7	16	-347
6-21-74	1220	100.9		109.8	35	-10	12	-358
6-26-74	1150	105.9		109.9	33	-12	10	-365
7-17-74	1620	127.1		110.6	26	-17	4	-383
7-31-74	1630	141.1		110.1	20	-21	-0	-394
8-29-74	1120	169.9		110.0	12	-27	-7	-413
9-11-74	1345	183.0		110.6	9	-29	-10	-420
9-25-74	1630	197.1		110.8	6	-31	-12	-431
10 -9-74	1430	211.0		110.7	2	-33	-15	-441
10-24-74	830	225.8		109.9	-2	-37	-19	-452
11 -8-74	1315	241.0		110.5	-4	-38	-21	-462
11-21-74	915	253.8		110.6	-6	-39	-22	-468
12 -4-74	1420	267.0		110.5	-8	-40	-24	-471
12-17-74	1630	280.1		111.1	-17	-44	-30	-480
1 -3-75	1500	297.0		111.2	-22	-47	-34	-492
1-15-75	1340	309.0		111.4	-25	-50	-37	-490
2-18-75	1515	343.1		110.8	-28	-49	-38	-498
2-28-75	1200	352.9		110.8	-30	-51	-40	-497
3-14-75	1235	366.9		110.9	-33	-52	-42	-499
4-12-75	1215	395.9		110.7	-36	-54	-45	-502
5-16-75	1215	429.9		111.0	-38	-54	-46	-498
6 -3-75	845	447.8		109.3	-44	-57	-50	-494
6-16-75	1500	461.0		108.8	-47	-60	-53	-486
6-23-75	910	467.8		109.4	-48	-61	-54	-491
7 -1-75	1620	476.1		109.9	-48	-61	-54	-493
7 -8-75	1500	483.0		71.6	-53	0	-53	-453
* 7 -8-75	1100	482.9	END OF TEST					

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AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS ** 110F, 90 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	347	11 15	0
NO.2	339	11 16	0
NO.3	346	11 17	0

ULT. STR.:SELECTED MIX : 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 6710. PSI AT 110.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.		AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.		DRYING SHRINKAGE SPECIMEN NO.3
*12-21-73	1000	0	SPECIMENS CAST							
12-22-73	1000	1.0		71.1	**	0	0	0	**	0
12-26-73	1200	5.1		70.5	**	-12	-11	-11	**	-9
12-28-73	1145	7.1		70.2	**	-30	-32	-31	**	-21
1 -2-74	1630	12.3		70.8	**	-37	-40	-38	**	-30
1-14-74	1220	24.1		70.1	**	-45	-43	-44	**	-34
3-16-74	1630	85.3		71.7	**	-64	-60	-62	**	-66
3-18-74	1345	87.2		108.4	**	-64	-58	-61	**	-57
3-19-74	1635	88.3		109.7	**	-74	-60	-67	**	-64
3-19-74	2010	88.4		110.1	**	-80	-65	-72	**	-70
3-21-74	1015	90.0		108.4	**	-81	-64	-72	**	-74
3-21-74	1025	90.0		108.0	**	-82	-67	-74	**	-88
3-21-74	1030	90.0		107.9	**	-80	-66	-73	**	-88
3-21-74	1045	90.0		107.8	**	-81	-64	-72	**	-88
3-21-74	1100	90.0		108.2	**	-82	-64	-73	**	-89
3-21-74	1119	90.1		107.7	**	-80	-63	-71	**	-89
3-21-74	1415	90.2		107.5	**	-79	-62	-70	**	-99
3-21-74	1615	90.3		107.8	**	-80	-63	-71	**	-106
3-21-74	2210	90.5		108.6	**	-80	-63	-71	**	-117
3-22-74	1200	91.1		108.9	**	-80	-62	-71	**	-137
3-23-74	1250	92.1		109.8	**	-81	-63	-72	**	-165
3-24-74	1430	93.2		109.5	**	-81	-61	-71	**	-185
3-25-74	1315	94.1		108.4	**	-80	-58	-69	**	-199
3-26-74	1500	95.2		109.6	**	-84	-60	-72	**	-216
3-29-74	1230	98.1		109.6	**	-88	-58	-73	**	-249
4 -1-74	1240	101.1		109.6	**	-94	-57	-75	**	-273
4 -3-74	1130	103.1		109.5	**	-97	-56	-76	**	-286
4 -4-74	1445	104.2		109.6	**	-98	-56	-77	**	-292
4 -8-74	1535	108.2		110.4	**	-105	-55	-80	**	-309
4-11-74	1405	111.2		109.4	**	-111	-56	-83	**	-322
4-15-74	1135	115.1		110.3	**	-112	-56	-84	**	-332
4-18-74	1315	118.1		111.0	**	-117	-58	-87	**	-343
4-22-74	1315	122.1		109.9	**	-119	-59	-89	**	-352
4-25-74	1530	125.2		110.1	**	-121	-59	-90	**	-360
4-30-74	1455	130.2		110.1	**	-124	-61	-92	**	-369
5 -6-74	1355	136.2		109.6	**	-127	-63	-95	**	-380
5-13-74	1420	143.2		110.0	**	-128	-63	-95	**	-390
5-17-74	1130	147.1		110.2	**	-131	-67	[illegible]	**	-400
5-21-74	1440	151.2		110.3	**	-133	[illegible]	-100	**	-405
5-24-74	1330	154.1		109.3	**	-132	[illegible]	[illegible]	**	-408
5-31-74	1600	161.2		110.2	**	-135	-66	-101	**	-414
6 -4-74	1630	165.3		110.7	**	-135	-70	-102	**	-419
6-14-74	915	175.0		110.5	**	-141	-76	-108	**	-430
6-21-74	1220	182.1		110.5	**	-144	-79	-111	**	-436
6-26-74	1150	187.1		110.6	**	-145	-81	-113	**	-442
7-10-74	1650	201.3		111.4	**	-150	-85	-117	**	-452
7-24-74	1615	215.3		111.1	**	-154	-90	-122	**	-461
8-21-74	1450	243.2		110.8	**	-162	-98	-130	**	-477
9-20-74	1105	273.0		111.2	**	-170	-103	-136	**	-494
10 -2-74	1330	285.1		111.7	**	-172	-105	-138	**	-501
10-24-74	830	306.9		111.0	**	-178	-111	-144	**	-516
11 -8-74	1315	322.1		111.2	**	-179	-112	-145	**	-525
11-21-74	915	335.0		111.5	**	-182	-114	-148	**	-533
12 -4-74	1420	348.2		111.1	**	-183	-116	-149	**	-537
12-17-74	1630	361.3		111.3	**	-186	-119	-152	**	-546
1 -3-75	1500	378.2		111.3	**	-190	-123	-156	**	-557
1-15-75	1340	390.2		111.5	**	-192	-126	-159	**	-556
2-18-75	1515	424.2		109.2	**	-196	-129	-162	**	-565
2-28-75	1200	434.1		111.5	**	-195	-128	-161	**	-569
3-14-75	1235	448.1		111.4	**	-198	-130	-164	**	-573
4 -1-75	1115	466.1		111.0	**	-201	-134	-167	**	-581
4-12-75	1215	477.1		111.2	**	-201	-134	-167	**	-580
5 -2-75	1115	497.1		111.6	**	-200	-133	-166	**	-581
5-16-75	1215	511.1		111.5	**	-202	-136	-169	**	-582
5-20-75	1325	515.1		109.8	**	-209	-141	-175	**	-586
5-21-75	1350	516.2		111.7	**	-202	-135	-168	**	-584
5-23-75	1310	518.1		111.9	**	-202	-136	-169	**	-584
5-27-75	1045	522.0		112.0	**	-203	-137	-170	**	-584
6 -3-75	845	528.9		110.5	**	-206	-139	-172	**	-582
6-16-75	1500	542.2		109.3	**	-209	-143	-176	**	-577
7 -1-75	1620	557.3		111.8	**	-207	-141	-174	**	-580
7-15-75	1440	571.2		110.8	**	-210	-145	-177	**	-578
8 -7-75	1600	594.2		111.2	**	-211	-147	-179	**	-574
8-19-75	1400	606.2		107.4	**	-207	0	-207	**	-570
* 8-19-75	1330	606.1	END OF TEST							

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 110F, 90 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 90. DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	420	11 21	0
NO.2	421	11 22	0
NO.3	422	11 23	0

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 6320. PSI AT 110.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 5-29-74	1400	0	SPECIMENS CAST					
5-30-74	1400	1.0		72.1	0	0	0	0
8-27-74	1600	90.1		109.2	-41	-26	-33	-35
8-29-74	1100	91.9		110.3	-40	-24	-32	-33
9-11-74	1345	105.0		110.9	-31	-15	-23	-23
9-26-74	1030	119.9		110.8	-31	-17	-24	-21
10 -2-74	1330	126.0		110.8	-33	-18	-25	-22
10 -9-74	1430	133.0		110.9	-34	-21	-27	-23
10-22-74	1140	145.9		110.9	-36	-24	-30	-24
10-31-74	1429	155.0		110.6	-39	-28	-33	-26
11 -8-74	1315	163.0		110.7	-40	-30	-35	-27
11-21-74	915	175.8		110.8	-41	-33	-37	-28
12 -4-74	1420	189.0		110.7	-43	-36	-39	-29
12-17-74	1630	202.1		111.2	-47	-42	-44	-152
1 -3-75	1500	219.0		111.2	-51	-48	-49	-200
1-15-75	1340	231.0		111.5	-55	-51	-53	-222
2-18-75	1515	265.1		110.8	-57	-56	-56	-262
2-28-75	1200	274.9		110.9	-59	-58	-58	-269
3-14-75	1245	288.9		111.0	-61	-61	-61	-284
4 -1-75	1115	306.9		110.6	-64	-65	-64	-299
4-12-75	1215	317.9		110.8	-65	-65	-65	-304
5 -2-75	1115	337.9		111.1	-61	-63	-62	-315
5-16-75	1215	351.9		111.1	-64	-67	-65	-322
6 -3-75	845	369.8		109.5	-69	-71	-70	-329
6-16-75	1500	383.0		108.7	-72	-75	-73	-332
7 -1-75	1620	398.1		110.3	-73	-75	-74	-343
7-15-75	1440	412.0		110.3	-74	-78	-76	-346
8 -7-75	1600	435.1		109.7	-77	-80	-78	-354
8-27-75	1340	450.0		110.5	-79	-83	-81	-359
9 -2-75	1150	460.9		110.1	-80	-84	-82	-364
9-18-75	1620	477.1		110.5	-82	-85	-83	-368
10 -3-75	925	491.8		110.1	-82	-87	-84	-373
10-20-75	1310	509.0		109.8	-84	-89	-86	-376
11 -6-75	840	525.8		109.6	-86	-91	-88	-381
12-11-75	815	560.8		109.5	-89	-95	-92	-391
12-24-75	900	573.8		108.9	-92	-99	-95	-394
2-24-76	945	635.8		107.7	-92	-101	-96	-403

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS ** 110F, 270 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 4 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	246	11 64	0
NO.2	247	11 65	0
NO.3	344	11 66	0

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 7310. PSI AT 110.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
*12-21-73	1000	0	SPECIMENS CAST					
12-22-73	1000	1.0		71.3	0	0	0	0
9-11-74	1245	264.1		71.3	-74	-82	-78	-55
9-12-74	845	264.9		71.2	-72	-81	-76	-53
9-17-74	1054	270.0		109.8	-61	-53	-57	-48
9-17-74	1110	270.0		109.2	-60	-51	-55	-56
9-17-74	1155	270.1		109.0	-60	-51	-55	-64
9-17-74	1355	270.2		109.2	-60	-51	-55	-74
9-17-74	1655	270.3		109.5	-59	-50	-54	-84
9-19-74	1000	272.0		110.7	-56	-48	-52	-144
9-20-74	1105	273.0		110.9	-56	-48	-52	-164
9-23-74	1135	276.1		111.4	-54	-47	-50	-198
9-26-74	1030	279.0		111.3	-51	-45	-48	-219
10 -2-74	1330	285.1		111.3	-49	-44	-46	-249
10 -9-74	1430	292.2		110.9	-48	-44	-46	-273
10-15-74	810	297.9		110.8	-46	-42	-44	-287
10-22-74	1140	305.1		110.8	-48	-44	-46	-304
10-28-74	1325	311.1		110.6	-51	-47	-49	-316
11-14-74	930	328.0		111.5	-54	-50	-52	-339
12 -4-74	1420	348.2		110.6	-59	-54	-56	-359
12-17-74	1640	361.3		110.8	-65	-60	-62	-375
1 -3-75	1645	378.3		110.6	-70	-64	-67	-394
1-31-75	1430	406.2		109.3	-78	-71	-74	-410
2-28-75	1200	434.1		111.0	-81	-74	-77	-417
3-14-75	1235	448.1		110.9	-84	-77	-80	-425
4-12-75	1230	477.1		110.8	-89	-81	-85	-435
5-16-75	1215	511.1		111.2	-93	-84	-88	-442
6-16-75	1540	542.2		108.9	-100	-92	-96	-444
7-15-75	1450	571.2		110.2	-103	-95	-99	-447
8 -7-75	1600	594.2		110.2	-108	-97	-102	-450
9 -2-75	1155	620.1		110.1	-113	-101	-107	-457
10 -3-75	935	651.0		110.6	-114	-103	-108	-462
10-20-75	900	668.0		109.9	-118	-107	-112	-464
11 -6-75	840	684.9		109.4	-120	-109	-114	-468
11-10-75	1435	689.2		109.3	-121	-110	-115	-471
12-11-75	815	719.9		109.5	-123	-112	-117	-472
12-24-75	900	733.0		108.8	-128	-116	-122	-478
1-19-76	1315	759.1		109.3	-121	-108	-114	-478
* 1-19-76	1600	759.2	END OF TEST					

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 110F, 270 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 4 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 110 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	411	11 81	0
NO.2	424	11 83	0
NO.3	412	11 82	0

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 7270. PSI AT 110.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 3-12-74	1400	0	SPECIMENS CAST					
3-13-74	1400	1.0		71.7	0	0	0	0
12 -3-74	1030	265.9		83.9	-83	-63	-73	-83
12 -5-74	1100	267.9		102.7	-71	-52	-61	-65
12 -6-74	1118	258.9		110.4	-48	-51	-49	-65
12 -6-74	1130	268.9		110.4	-47	-51	-49	-65
12 -6-74	1135	268.9		110.4	-48	-51	-49	-65
12 -6-74	1140	268.9		110.4	-48	-51	-49	-65
12 -6-74	1145	268.9		110.4	-48	-51	-49	-76
12 -6-74	1200	268.9		110.4	-48	-51	-49	-77
12 -6-74	1230	268.9		110.4	-48	-51	-49	-81
12 -6-74	1430	269.0		110.5	-48	-51	-49	-90
12 -6-74	2310	269.4		110.6	-47	-50	-48	-110
12 -7-74	1445	270.0		110.7	-46	-50	-48	-131
12 -8-74	1640	271.1		111.8	-47	-42	-44	-158
12-10-74	1115	272.9		111.8	-44	-40	-42	-182
12-11-74	1330	274.0		111.7	-45	-39	-42	-198
12-12-74	1330	275.0		111.6	-44	-38	-41	-207
12-13-74	1500	276.0		111.5	-44	-38	-41	-216
12-17-74	1640	280.1		112.1	-43	-37	-40	-242
12-20-74	1100	282.9		111.9	-43	-36	-39	-254
12-24-74	1200	286.9		111.9	-45	-35	-40	-275
1 -3-75	1645	297.1		111.8	-46	-32	-39	-306
1 -6-75	830	299.8		111.8	-46	-32	-39	-311
1-10-75	1530	304.1		111.8	-48	-31	-39	-322
1-31-75	1430	325.0		111.9	-56	-32	-44	-362
2-18-75	1330	343.1		111.9	-61	-37	-49	-383
2-28-75	1200	352.9		112.0	-63	-40	-51	-390
3-14-75	1235	366.9		112.1	-67	-43	-55	-406
4 -1-75	1130	384.9		111.8	-71	-48	-59	-422
5 -2-75	1130	415.9		112.4	-71	-52	-61	-435
5-16-75	1215	429.9		112.4	-76	-51	-63	-442
6 -3-75	900	447.8		110.6	-81	-53	-67	-447
6-16-75	1540	461.1		110.2	-84	-57	-70	-448
7 -1-75	1630	476.1		111.0	-85	-57	-71	-460
7-15-75	1450	490.0		110.9	-88	-57	-72	-462
8 -7-75	1600	513.1		110.8	-91	-60	-75	-470
8-22-75	1340	528.0		110.8	-93	-66	-79	-472
9 -2-75	1155	538.9		110.9	-94	-75	-84	-475
9-18-75	1625	555.1		111.0	-95	-70	-82	-477
10 -3-75	935	569.8		110.6	-96	-73	-84	-480
10-20-75	1320	587.0		110.8	-98	-91	-94	-479
11 -6-75	840	603.8		110.7	-101	-91	-96	-487
12-11-75	815	638.8		110.2	-104	-91	-97	-496
12-16-75	1055	643.9		110.0	-106	-92	-99	-504
12-19-75	930	646.8		110.1	-107	-93	-100	-504
12-22-75	1300	650.0		90.6	-147	-93	-120	-2450
*12-23-75	930	650.8	END OF TEST					

NOTE: SPECIMEN NO.2: CAST 5-29-74, STRAINS MATCHED BY INTERPOLATION FOR AGES SHOWN

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS ** 160F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	383	11 09	0
NO.2	379	11 10	0
NO.3	357	11 11	0

ULT. STR.:SELECTED MIX: 6590. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 1-17-74	1500	0	SPECIMENS CAST					
1-18-74	1500	1.0		71.2	0	0	0	0
2-12-74	1615	26.1		148.9	-6	-7	-6	-3
2-13-74	930	26.8		151.5	-8	-9	-8	-5
2-14-74	1035	27.8		157.4	-6	-7	-6	-4
2-14-74	1115	27.8		158.5	-7	-11	-9	-26
2-14-74	1124	27.8		158.4	-6	-11	-8	-22
2-14-74	1155	27.9		158.9	-4	-10	-7	-20
2-14-74	1209	27.9		158.4	-8	-12	-10	-32
2-14-74	1255	27.9		159.7	-1	-9	-5	-28
2-14-74	1500	28.0		161.6	8	-3	2	-42
2-14-74	1940	28.2		160.1	5	-5	0	-57
2-14-74	2135	28.3		158.6	2	-6	-2	-61
2-15-74	125	28.4		158.8	-5	-1	-3	-62
2-15-74	1230	28.9		159.7	-6	6	0	-75
2-16-74	1115	29.8		158.8	-5	30	12	-98
2-17-74	2110	31.3		158.5	-49	34	-7	-111
2-18-74	1520	32.0		160.3	-59	29	-15	-137
2-19-74	1615	33.1		160.6	-61	30	-15	-151
2-21-74	1245	34.9		160.8	-60	33	-13	-172
2-22-74	1650	36.1		160.4	-60	33	-13	-186
2-25-74	1530	39.0		162.3	-55	33	-11	-220
3 -1-74	1120	42.8		162.3	-52	33	-9	-254
3 -4-74	1055	45.8		161.7	-37	33	-2	-274
3-11-74	1600	53.0		158.6	-76	28	-24	-313
3-21-74	1645	63.1		160.3	-67	29	-19	-347
3-25-74	1315	66.9		160.3	-62	26	-18	-355
3-26-74	1500	68.0		161.0	-69	21	-24	-361
3-29-74	1230	70.9		162.3	-66	21	-22	-366
4 -1-74	1240	73.9		160.9	-75	18	-28	-375
4 -4-74	1445	77.0		160.6	-74	18	-28	-383
4 -8-74	1535	81.0		161.9	-70	17	-26	-390
4-11-74	1405	84.0		162.6	-63	16	-23	-400
4-15-74	1135	87.9		162.6	-59	13	-23	-411
4-18-74	1315	90.9		162.5	-51	11	-20	-416
4-22-74	1315	94.9		162.6	-70	12	-29	-413
4-25-74	1630	98.0		162.8	-70	13	-28	-413
4-30-74	1455	103.8		160.4	-85	11	-37	-414
5 -3-74	1335	105.9		160.9	-84	10	-37	-416
5-10-74	1340	112.9		157.3	-87	8	-40	-418
5-16-74	1525	119.0		160.6	-79	14	-32	-421
5-21-74	1448	124.0		161.8	-78	10	-34	-421
5-24-74	1330	126.9		162.6	-78	9	-34	-422
5-28-74	1200	130.9		162.6	-77	8	-34	-422
5-31-74	1600	134.0		159.8	-89	7	-41	-424
6 -4-74	1630	138.1		160.0	-95	1	-47	-423
6-14-74	915	147.8		161.9	-85	-3	-44	-424
6-26-74	1150	159.9		162.6	-82	-13	-47	-426
7-17-74	1620	181.1		162.9	-77	-17	-47	-426
8-29-74	1120	223.8		159.6	-98	-19	-58	-421
9-11-74	1345	236.9		160.1	-100	-22	-61	-421
9-25-74	1630	251.1		160.2	-105	-25	-65	-426
10 -9-74	1430	265.0		160.9	-107	-21	-64	-426
10-24-74	830	279.7		158.7	-119	0	-119	-427
11 -8-74	1315	294.9		160.2	-122	0	-122	-431
11-21-74	915	307.8		157.9	-134	0	-134	-429
12 -4-74	1420	321.0		159.3	-138	0	-138	-429
12-17-74	1630	334.1		160.1	-143	0	-143	-433
1 -3-75	1500	351.0		160.1	-141	0	-141	-441
1-15-75	1340	362.9		161.3	-144	0	-144	-439
1-31-75	940	378.8		162.8	-133	0	-133	-436

Sealed controls malfunctioned from 1-31-75 on.

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 160F, 28 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 28 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	203	11 28	0
NO.2	227	11 27	0
NO.3	226	11 29	0

ULT. STR.:SELECTED MIX: 6280. PSI AT 73.F.
ULT. STR.:COMPANION : 5420. PSI AT 160.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 2-21-74	1500	0	SPECIMENS CAST					
2-22-74	1500	1.0		71.5	0	0	0	0
3-11-74	930	17.8		71.5	-32	-31	-31	-33
3-16-74	1630	23.1		71.5	-33	-34	-33	-37
3-18-74	1353	25.0		108.8	-17	-35	-26	-17
3-19-74	2015	26.2		133.6	-4	-11	-7	-12
3-21-74	1148	27.9		160.1	6	0	3	-5
3-21-74	1205	27.9		159.9	5	-0	3	-6
3-21-74	1215	27.9		159.5	7	0	3	-7
3-21-74	1300	27.9		160.1	8	3	5	-5
3-21-74	1500	28.0		160.3	9	6	7	-21
3-21-74	1700	28.1		160.6	11	8	9	-28
3-21-74	2210	28.3		160.7	12	15	13	-43
3-22-74	1200	28.9		160.7	18	27	22	-64
3-23-74	1250	29.9		160.6	21	39	30	-93
3-24-74	1430	31.0		160.5	34	25	29	-103
3-25-74	1315	31.9		161.3	37	33	35	-112
3-26-74	1500	33.0		161.8	32	63	47	-132
3-29-74	1230	35.9		162.3	34	77	55	-165
4 -1-74	1240	38.9		162.2	31	83	57	-197
4 -3-74	1130	40.9		162.0	29	86	57	-218
4 -4-74	1445	42.0		161.9	28	86	57	-228
4 -8-74	1535	46.0		162.5	23	90	56	-265
4-11-74	1405	49.0		162.4	17	89	53	-290
4-15-74	1135	52.9		152.8	12	90	51	-318
4-18-74	1315	55.9		162.5	11	89	50	-338
4-20-74	1130	57.9		162.0	12	77	44	-350
4-22-74	1315	59.9		162.6	9	75	42	-359
4-25-74	1530	63.0		162.7	6	74	40	-374
4-30-74	1455	68.0		160.4	1	63	32	-393
5 -6-74	1355	74.0		160.4	-0	64	32	-413
5-13-74	1420	81.0		161.3	0	68	34	-432
5-21-74	1440	89.0		161.6	0	67	33	-459
5-28-74	1200	95.9		162.2	2	69	35	-473
6 -7-74	1152	105.9		160.9	5	64	34	-483
6-26-74	1150	124.9		161.4	6	65	35	-501
7-10-74	1650	139.1		162.1	5	69	37	-508
8-21-74	1450	181.0		157.9	-0	54	27	-512
10 -9-74	1430	230.0		158.5	-4	44	20	-514
10-24-74	830	244.7		157.7	-4	37	16	-516
11-21-74	915	272.8		158.4	-7	38	15	-521
12 -4-74	1420	286.0		158.0	-8	32	12	-523
12-17-74	1630	299.1		157.9	-11	28	8	-526
1 -3-75	1500	316.0		157.4	-9	24	7	-523
1-15-75	1340	327.9		157.8	-17	20	1	-523
2-18-75	1515	362.0		158.5	-21	18	-1	-521
2-28-75	1200	371.9		157.9	-19	13	-3	-520
3-14-75	1235	385.9		157.9	-21	9	-6	-522
4-12-75	1215	414.9		158.7	-25	6	-9	-523
5 -2-75	1115	434.8		157.9	-29	3	-13	-520
5-16-75	1215	448.9		158.0	-30	-0	-15	-520
6 -3-75	845	466.7		157.7	-28	-7	-17	-518
6-16-75	1500	480.0		157.6	-28	-11	-19	-513
7-15-75	1440	509.0		159.0	-28	-9	-18	-519
8 -7-75	1600	532.0		159.3	-24	-12	-18	-520
8-22-75	1340	546.9		160.2	-22	-12	-17	-520
9 -2-75	1150	557.9		160.0	-24	-16	-20	-523
9-18-75	1620	574.1		161.3	-21	-18	-19	-526
10-20-75	1310	605.9		161.1	-17	-24	-20	-528
11 -6-75	840	622.7		161.6	-18	-23	-20	-534
12-11-75	815	657.7		160.5	-24	-23	-23	-539
12-24-75	900	670.7		160.4	-24	-18	-21	-542
2-24-76	945	732.8		161.3	-31	0	-31	-551

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS** 160F, 90 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 6 (MIX G-19)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	350	11 39	0
NO.2	375	11 40	0
NO.3	426	11 59	0

ULT. STR.:SELECTED MIX: 7510. PSI AT 73.F.
ULT. STR.:COMPANION : 5980. PSI AT 160.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 1-10-74	1500	0	SPECIMENS CAST					
1-11-74	1500	1.0		70.8	0	0	0	0
1-12-74	1245	1.9		70.8	-9	-7	-8	0
4 -6-74	1130	85.9		71.2	-66	-55	-60	-23
4 -8-74	1615	88.1		104.2	-62	-54	-58	-23
4 -9-74	1135	88.9		130.9	-62	-58	-60	-24
4-10-74	1050	89.8		159.9	-49	-28	-38	-24
4-10-74	1240	89.9		160.3	-50	-30	-40	-24
4-11-74	830	90.7		162.0	-38	-13	-25	-18
4-11-74	915	90.8		161.9	-39	-15	-27	-18
4-11-74	925	90.8		161.6	-41	-15	-28	-18
4-11-74	945	90.8		160.2	-39	-14	-26	-19
4-11-74	1145	90.9		160.7	-38	-13	-25	-17
4-11-74	1450	91.0		162.1	-32	-10	-21	-16
4-11-74	1800	91.1		162.1	-29	-9	-19	-15
4-11-74	2220	91.3		161.7	-26	-7	-16	-13
4-12-74	1110	91.8		162.2	-19	-2	-10	-8
4-13-74	1135	92.9		162.1	-6	0	-3	-7
4-14-74	1500	94.0		162.4	4	5	4	-6
4-15-74	1135	94.9		162.1	6	4	5	-5
4-16-74	1720	96.1		162.3	12	10	11	-4
4-18-74	1315	97.9		161.2	17	6	11	-2
4-20-74	1130	99.9		159.6	7	8	7	-0
4-22-74	1315	101.9		159.9	10	6	8	1
4-25-74	1530	105.0		160.1	9	4	6	4
4-30-74	1455	110.0		157.7	-1	0	-0	1
5 -3-74	1335	112.9		158.3	-1	-2	-1	0
5 -6-74	1355	116.0		157.9	-3	-3	-3	-1
5-13-74	1420	123.0		158.6	-4	-5	-4	-6
5-21-74	1440	131.0		159.2	-7	-11	-9	-10
5-31-74	1600	141.0		157.3	-19	-20	-19	-15
6 -7-74	1152	147.9		158.5	-17	-22	-19	-17
6-14-74	915	154.8		158.6	-21	-27	-24	-21
6-26-74	1150	166.9		159.4	-19	-31	-25	-24
7-17-74	1620	188.1		160.9	-12	-36	-24	-26
8 -9-74	1430	211.0		158.2	-32	-35	-33	-237
9-11-74	1345	243.9		157.0	-30	-52	-41	-342
9-25-74	1630	258.1		157.0	-33	-54	-43	-366
10-24-74	830	286.7		157.7	-37	-52	-44	-396
11 -8-74	1315	301.9		[illegible]	-54	[illegible]	[illegible]	-403
11-21-74	915	314.8		157.7	-41	-57	-49	-406
12 -4-74	1420	328.0		158.2	-38	-59	-48	-411
12-17-74	1640	341.1		156.6	-42	-68	-55	-415
1 -3-75	1500	358.0		158.3	-32	-72	-52	-419
1-15-75	1340	369.9		158.7	-35	-82	-58	-424
1-31-75	940	385.8		159.0	-31	0	-31	-424
2-18-75	1515	404.0		158.0	-35	0	-35	-429
2-28-75	1200	413.9		157.0	-51	0	-51	-430

NOTE: SEALED CONTROLS MALFUNCTIONED FROM 2-28-75 ON, RESISTANCE INCREASED

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 160F, 90 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 6 (MIX G-26)
AGE OF LOADING : 90 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	403	11 53	0
NO.2	413	11 54	0
NO.3	398	11 55	0

ULT. STR.:SELECTED MIX: 7200. PSI AT 73.F.
ULT. STR.:COMPANION : 5500. PSI AT 160.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 3 -7-74	1430	0	SPECIMENS CAST					
3 -8-74	1430	1.0		71.2	0	0	0	0
3-11-74	930	3.8		71.2	-11	-11	-11	-12
6 -2-74	1345	87.0		89.6	-58	-46	-52	-53
6 -3-74	850	87.8		110.4	-63	-49	-56	-42
6 -4-74	850	88.8		130.1	-57	-45	-51	-38
6 -4-74	1500	89.0		135.0	-41	-53	-47	-42
6 -5-74	1046	89.8		159.9	-26	-30	-28	-27
6 -5-74	1100	89.9		160.1	-27	-30	-28	-26
6 -5-74	1105	89.9		160.1	-27	-31	-29	-40
6 -5-74	1125	89.9		160.3	-27	-30	-28	-40
6 -5-74	1240	89.9		160.4	-28	-31	-29	-53
6 -5-74	1405	90.0		160.1	-27	-30	-28	-61
6 -5-74	1538	90.0		160.7	-26	-27	-26	-69
6 -5-74	1735	90.1		160.9	-24	-26	-25	-76
6 -5-74	2112	90.3		161.6	-23	-25	-24	-86
6 -6-74	850	90.8		161.5	-16	-19	-17	-105
6 -6-74	1225	90.9		161.5	-15	-17	-16	-107
6 -7-74	1152	91.9		161.1	-7	-9	-8	-126
6 -8-74	1215	92.9		162.3	-1	-6	-3	-145
6 -9-74	1300	93.9		162.2	3	-2	0	-159
6-10-74	1135	94.9		160.7	5	1	3	-172
6-11-74	843	95.8		160.9	6	1	3	-182
6-12-74	1152	96.9		160.4	8	2	5	-196
6-14-74	915	98.8		160.8	9	2	5	-216
6-17-74	1600	102.1		160.6	8	0	4	-248
6-21-74	1220	105.9		161.3	7	-1	3	-281
6-26-74	1150	110.9		161.8	6	-3	1	-316
6-30-74	950	114.8		161.9	4	-5	-0	-338
7 -9-74	1045	123.8		162.6	-0	-11	-5	-381
7-10-74	1650	125.1		162.4	-1	-12	-6	-385
7-15-74	1310	129.9		163.2	-3	-15	-9	-405
7-24-74	1615	139.1		162.9	-8	-24	-16	-432
8-29-74	1120	174.9		157.6	-8	-32	-20	-460
9-11-74	1345	188.0		158.0	-3	-34	-18	-464
9-25-74	1630	202.1		158.2	-6	-39	-22	-469
10 -9-74	1430	216.0		158.5	-8	-40	-24	-469
10-24-74	830	230.7		158.2	-13	-42	-27	-470
11 -8-74	1315	245.9		159.4	-16	-48	-32	-476
11-21-74	915	258.8		[illegible]	-18	[illegible]	-33	-476
12 -4-74	1420	272.0		158.9	-23	-51	-37	-474
12-17-74	1640	285.1		159.1	-27	-57	-42	-479
1-15-75	1350	314.0		161.0	-23	-64	-43	-467
2-18-75	1530	349.0		157.6	-29	-68	-48	-468
2-28-75	1200	357.9		157.7	-32	-73	-52	-470
3-14-75	1235	371.9		157.7	-36	-77	-56	-471
4-12-75	1230	400.9		159.2	-38	-81	-59	-469
5 -2-75	1130	420.9		161.1	-40	-85	-62	-469
5-16-75	1215	434.9		159.2	-46	-86	-66	-466
6-16-75	1540	466.0		160.4	-46	0	-46	-460
6-23-75	745	472.7		160.5	-49	0	-49	-470
7 -1-75	1630	481.1		160.4	-47	0	-47	-467
7-15-75	1450	495.0		159.3	-49	0	-49	-468
8 -7-75	1600	518.1		160.2	-37	0	-37	-468

Sealed controls malfunctioned from 8-7-75 on.

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** BERKS ** 160F, 270 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : BERKS 5 (MIX G-19)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	425	11 60	0
NO.2	385	11 70	0
NO.3	389	11 71	0

ULT. STR.:SELECTED MIX: 8220. PSI AT 73.F.
ULT. STR.:COMPANION : 6130. PSI AT 160.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3		
* 5-29-74	1400	0	SPECIMENS CAST							
5-30-74	1400	1.0		67.8	0	0	0	0		
6 -6-74	1351	3.0		115.0	-21	0	-10	-1		
1-15-75	1330	231.0		115.7	-71	-6	-38	-61		
1-20-75	810	235.8		115.6	-73	-6	-39	-63		
1-31-75	830	246.8		115.8	-75	-6	-40	-66		
2-18-75	1430	265.0		115.3	-70	-7	-38	-70		
2-20-75	1315	267.0		129.0	-37	-8	-22	-72		
2-22-75	1200	268.9		140.5	-31	3	-14	-44		
2-24-75	1000	270.8		136.6	-5	8	1	-107		
2-28-75	1200	274.9		160.4	15	8	11	-182		
3-14-75	1235	288.9		160.5	12	7	9	-303		
4 -1-75	1130	306.9		160.7	-24	8	-8	-374		
4-12-75	1230	317.9		159.9	-35	5	-15	-393		
5 -2-75	1130	337.9		160.2	-50	-0	-25	-403		
5-16-75	1215	351.9		158.4	-59	-0	-29	-406		

NOTE: SPECIMENS NO.2 AND NO.3: CAST 1-17-74, STRAINS MATCHED BY INTERPOLATION FOR AGES SHOWN

Individual data for Specimen #3 not available after 5-16-75; specimen still under observation.

AVERAGE AUTOGENOUS AND DRYING SHRINKAGE STRAINS ** YORK ** 160F, 270 DAY CONTROL
(2 AUTOGENOUS SPECIMENS: SEALED 6 BY 16 IN. CONCRETE CYL.)
(1 DRYING SHRINKAGE SPECIMEN: UNSEALED 6 BY 16 IN.)

SPECIMEN GROUP : YORK 5 (MIX G-26)
AGE OF LOADING : 270 DAYS
TEST TEMPERATURE : 160 DEG. F.

SPECIMEN	METER NO.	CHANNEL	FACTOR
NO.1	215	11 75	0
NO.2	216	11 76	0
NO.3	214	11 77	0

ULT. STR.:SELECTED MIX: 8200. PSI AT 73.F.
ULT. STR.:COMPANION : 6350. PSI AT 160.F.
APPLIED TEST STRESS : 0. PSI

MICROSTRAIN--CORRECTED FOR TEMPERATURE

DATE	TIME	AGE, DAYS	DAYS UNDER STRESS	AVG. TEMP. DEG.F.	AUTOGENOUS STRAINS SPECIMEN NO.1	AUTOGENOUS STRAINS SPECIMEN NO.2	AUTOGENOUS STRAINS AVG.	DRYING SHRINKAGE SPECIMEN NO.3
* 2-21-74	1500	0	SPECIMENS CAST					
2-22-74	1500	1.0		71.4	0	0	0	0
11-13-74	1200	264.9		71.3	-83	-77	-80	-69
11-14-74	930	265.8		98.3	-67	-60	-63	-48
11-15-74	925	266.8		109.4	-61	-60	-60	-42
11-16-74	1100	267.8		135.8	-47	-51	-49	-30
11-17-74	1750	269.1		162.3	-15	-25	-20	-11
11-18-74	1038	269.8		161.7	-45	-16	-30	-18
11-18-74	1042	269.8		161.7	-45	-16	-30	-18
11-18-74	1053	269.8		161.5	-46	-15	-30	-43
11-18-74	1138	269.9		161.6	-45	-14	-29	-48
11-18-74	1443	270.0		162.1	-41	-13	-27	-59
11-18-74	1638	270.1		162.2	-40	-12	-26	-65
11-19-74	1040	270.8		162.3	-33	-6	-19	-108
11-20-74	1300	271.9		162.5	-22	-0	-11	-148
11-21-74	915	272.8		162.8	-17	3	-7	-164
11-22-74	1135	273.9		162.7	-14	5	-4	-184
11-25-74	1430	277.0		162.9	-6	6	0	-222
12 -4-74	1420	286.0		163.0	-4	5	0	-315
12 -6-74	1430	288.0		162.9	-4	2	-1	-334
12-10-74	1115	291.8		162.6	-4	3	-0	-363
12-11-74	1330	292.9		162.7	-4	2	-1	-370
12-17-74	1640	299.1		163.1	0	-0	0	-408
12-24-74	1200	305.9		163.1	-0	-3	-1	-444
1 -3-75	1645	316.1		160.0	-11	-0	-5	-475
1 -6-75	830	313.7		160.9	-10	-3	-6	-481
1-10-75	1530	323.0		160.5	-14	-6	-10	-489
1-31-75	1430	344.0		160.3	-76	-4	-40	-516
2-18-75	1530	362.0		158.3	-120	-10	-65	-517
2-28-75	1200	371.9		160.0	-115	-13	-64	-520
3-14-75	1235	385.9		160.3	-126	-18	-72	-527
4 -1-75	1130	403.9		158.8	-141	-24	-82	-529
4-12-75	1230	414.9		158.7	-143	-26	-84	-526
5 -2-75	1130	434.9		159.1	-149	-29	-89	-528
5-16-75	1215	443.9		159.1	-153	-34	-93	-528
6 -3-75	900	466.7		160.4	-158	-36	-97	-531
6-16-75	1540	480.0		160.5	-162	-42	-102	-529
7 -1-75	1630	495.1		160.8	-163	-44	-103	-537

Sealed controls malfunctioned from 7-1-75 on.

APPENDIX D -- PETROGRAPHIC EXAMINATION REPORT ON AGGREGATES AND MILL CERTIFICATES FOR CEMENTS

APPENDIX D -- PETROGRAPHIC EXAMINATION REPORT ON AGGREGATES AND MILL CERTIFICATES FOR CEMENTS

GENERAL ATOMIC

GENERAL ATOMIC COMPANY
P.O. BOX 81608
SAN DIEGO, CALIFORNIA 92138
(714) 453-1000

March 17, 1976

COMMENTS ON POTENTIAL REACTIVITY OF COARSE AGGREGATE FOR PCRV CONCRETE

by

Vladimir Nicolayeff

The accompanying petrographic report, submitted by Dr. R. C. Mielenz on August 24, 1972, states that the two sources of limestone (York Stone & Supply and Berks Products, Oley quarry) considered for use as coarse aggregate for the PCRV could be deleteriously reactive with cement alkalies, but that the degree of reactivity could not be determined quantitatively by petrographic examination. Dr. Mielenz recommended that cement used with these aggregates contain no more than 0.40% alkalies, unless test data or service records indicate that reactivity is not a problem.

A General Atomic survey of cement suppliers in Eastern Pennsylvania indicated that cement with such a low alkali content was not economically available but that a few manufacturers could produce cement with an alkali content of about 0.60 percent. Accordingly, a cement containing 0.60 percent alkalies was selected for the concrete test program at the University of California, Berkeley and the potential reactivity of the aggregates was investigated further as described below.

1. In 1972, during the initial screening of prospective aggregate suppliers, General Atomic examined results of tests conducted by the Pennsylvania and New Jersey Departments of Transportation and by Allentown, E. L. Conwell and Ambric Testing Laboratories. All results of interest were satisfactory for York and Berks aggregates. In particular, results of several chemical reactivity tests (per ASTM C 289) consistently indicated that the aggregates were not reactive. It was also observed that although the calcite to dolomite ratios were similar to those found in reactive aggregates, the insoluble residues were lower.

2. The record showed that the two quarries were long-standing, established sources of good quality aggregates which have been used in concrete containing local high alkali cements (well above 0.60%) for many years with satisfactory performance.

3. Both aggregates have been used in concrete for Philadelphia Electric's nuclear generating stations with York Stone supplying Peach Bottom and Berks supplying Limerick.

4. Prior to selection of Berks' Oley quarry for the Limerick plant (circa 1970), the reactivity of this aggregate was checked by the New Jersey Testing Laboratory, Hoboken, N.J. The laboratory also inspected structures built with Berks aggregate in the previous 8 years for evidence of reactivity. According to the aggregate manufacturer all results were favorable, although a copy of the report was not available.

5. Following the results of the Petrographic examination, General Atomic requested E. L. Conwell of Philadelphia, Pa. to conduct reactivity tests per ASTM C 586 on both aggregates. One randomly selected rock from each quarry was tested and the results presented in the accompanying report dated January 18, 1973 indicate that the aggregates did not exhibit expansive tendencies.

6. Finally, results of autogenous length change tests conducted by the University of California and presented in this report indicate that after more than two years exposure to temperatures of 73, 110 and 160°F, the concretes considered for the PCRV construction did not experience deleterious expansions.

CONCLUSION

In view of the above investigations and the results of concrete behavior presented in this report, it was concluded that satisfactory aggregates had been selected for the construction of the PCRV and that every effort had been made to ensure that the materials will behave adequately throughout the economic life of the structure.

RICHARD C. MIELENZ — GEOLOGIST AND PETROGRAPHER

PETROGRAPHIC EXAMINATION OF SAMPLES OF AGGREGATE FOR PORTLAND-CEMENT CONCRETE, GULF ENERGY AND ENVIRONMENTAL SYSTEMS, DIVISION OF GULF OIL CORPORATION, SAN DIEGO, CALIFORNIA

INTRODUCTION

In accordance with Purchase Order No. 458669, dated July 21, 1972, issued by Gulf Energy and Environmental Systems, Division of Gulf Oil Corporation, San Diego, California, I have examined by petrographic methods three samples of aggregate that were received in separate shipments, as follows:

Material	Source	Date of Receipt
Coarse aggregate	Berks Products Corporation Reading, Pennsylvania	July 31, 1972
Coarse aggregate	York Stone and Supply Company York, Pennsylvania	August 17, 1972
Fine aggregate	York Building Products Company, Inc., Perryville, Maryland	July 22, 1972

It was requested that the samples be examined in accordance with ASTM Designation: C 295, Recommended Practice for Petrographic Examination of Aggregates for Concrete. For the coarse aggregates, three size fractions were examined and analyzed by petrographic methods in accordance with ASTM C 295, namely, the 1-1/2- to 3/4-in., 3/4- to 3/8-in., and 3/8- to 3/16-in. fractions. For the sample of fine aggregate, five size fractions were examined and analyzed in accordance with ASTM C 295, namely, the No. 4-8, No. 8-16, No. 16-30, No. 30-50, and No. 50-100 fractions. The fine aggregate passing the No. 100 sieve was examined microscopically but no quantitative analysis was attempted.

CONCLUSIONS

Coarse Aggregate, Berks Products Corporation, Reading, Pennsylvania

1. The samples are crushed stone coarse aggregate in the size range from 1-1/2-in. to 3/16-in. The material is composed almost entirely of medium to dark gray, fine-grained, hard to moderately hard, calcitic dolomites and dolomitic limestones.

2. In my opinion, the samples are structurally sound for use as coarse aggregate for portland-cement concrete.

3. The dolomites and dolomitic limestones are similar in texture, internal structure, and mineralogic composition to dolomites and dolomitic limestones that are known elsewhere, such as in western Virginia and in southern Ontario, to be deleteriously reactive with cement alkalies, that is, sodium and potassium, in concrete in service. The deleterious reactivity in these instances is exhibited by progressive expansion, cracking, and general deterioration of the concrete, although the rate and extent of the distress of the concrete constructions depend upon many factors. The degree of potential alkali reactivity of these rock types cannot be determined quantitatively by petrographic examination. The dolomites and dolomitic limestones constituting the greater portion of the samples contain lesser proportions of acid-insoluble materials, that is, clay, silt, and fine sand, than do the deleterious rock types occurring in other localities, where the acid-insoluble materials usually constitute 5 to 35 per cent by weight of the rocks in contrast to an average value of 4.4 per cent for the dolomites and dolomitic limestones of the submitted sample, although this determination was made on pieces of the aggregate that were free from visible seams or segregations of clayey materials.

4. The following comments are provided with regard to use of the aggregate:

a. No deleterious alkali-carbonate rock reaction is expected if the alkali content of the portland cement is 0.40 per cent or less, expressed as equivalents of sodium oxide (Na_2O), calculated as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide (K_2O).

b. Prior test data or service records on use of the aggregate in concrete construction may be obtainable from the aggregate producer or from other agencies, such as the Pennsylvania State Department of Transportation or appropriate departments of the Pennsylvania State University.

c. The geologic formation at the quarry may be examined, logged, and sampled by a geologist or materials engineer, and representative samples so obtained may be tested for potential alkali reactivity in accordance with ASTM Designation: C 586, Method of Test for Potential

Alkali Reactivity of Carbonate Rocks for Concrete Aggregate (Rock Cylinder Method) and/or by tests of concrete containing the aggregate and the one or more cements that are proposed for use in the work. See ASTM Designation: C 33-71, Specifications for Concrete Aggregates, Appendix, for evaluation criteria on alkali-carbonate rock reactivity.

Coarse Aggregate, York Stone and Supply Company, York, Pennsylvania

5. The samples are crushed stone coarse aggregates in the size range from 1-1/2- to 3/16-in. The material is composed of a mixture of light gray to pale buff dolomites and medium to dark gray dolomites and dolomitic limestones. The latter are similar lithologically to the dolomites and dolomitic limestones that constitute almost the entirety of the samples from Berks Products Corporation, except that the samples from the York Stone and Supply Company are more dolomitic, contain lesser proportions of clay, silt, and fine sand, and the rock is more uniform in texture, internal structure, and mineralogic composition.

6. In my opinion, the samples are structurally sound for use as coarse aggregate for portland-cement concrete.

7. The medium to dark gray dolomites and dolomitic limestones that constitute 56.7 to 76.6 per cent of the three size fractions are generally similar in texture, internal structure, and mineralogic composition to rock types that are known elsewhere to be deleteriously reactive with cement alkalies in concrete in service, although the content of non-carbonate constituents is lower than is characteristic of such reactive rocks. The comments provided above with regard to the use of the coarse aggregate supplied by the Berks Products Corporation are applicable to this sample. Light gray to pale buff dolomites and calcite seam material constituting the remainder of the samples are of a different lithology and are not considered to be potentially deleteriously reactive with cement alkalies.

Concrete Sand, York Building Products, Perryville, Maryland

8. The sample is a natural sand that is composed almost entirely of angular particles of quartz.

9. In my opinion, the sample is suitable for use as fine aggregate in portland-cement concrete. The aggregate is harsh.

10. In my opinion, the sample is not potentially deleteriously reactive with cement alkalies or with other constituents of portland cement or its hydration products.

DESCRIPTION OF THE SAMPLES

Crushed Stone, Berks Products Corporation, Reading, Pennsylvania

The shipment consisted of two size fractions of coarse aggregate, as follows:

Size Fraction	Net weight, lb.
3/4- to 1-1/2-in.	25
3/16- to 3/4-in.	15-1/2

The aggregate is a crushed stone. The particles are angular and irregular in shape, although edges and corners of the particles commonly are slightly rounded as a result of attrition incidental to processing and handling. The particles mainly are roughly cubical to thick-tabular in shape, but flat and elongated pieces are present in moderately high proportions in the finest fractions of the coarse aggregate. Particles that are flat or elongated in shape, that is, whose length is five or more times the width or thickness, constitute 13.3 per cent of the 3/4- to 1-1/2-in., 28.6 per cent of the 3/8- to 3/4-in., and 40.0 per cent by count of the 3/16- to 3/8-in. fraction. The particles are lightly coated by non-clayey dust of fracture that is easily removed by washing.

The aggregate is composed of a mixture of very fine-grained, medium to very dark gray, massive to faintly banded or stratified, hard to moderately hard, tough calcitic dolomites and dolomitic limestones (Table 1). Most of the particles are free from discrete seams or segregations of clay or shale; such particles of calcitic dolomites and dolomitic limestones constitute 80.0 to 92.7 per cent by count of the three size fractions that were analyzed. These types vary widely in the ratio of dolomite (calcium-magnesium carbonate) to calcite (calcium carbonate); non-carbonate fractions always are very subordinate in amount and are well dispersed through the finely crystalline carbonate rock material. The particles range from limestones containing separate seams or laminations rich in minute, separate crystals of dolomite, the dolomitic seams being spaced 1.0 to 6.0 mm apart, to dolomites in which finely divided calcite forms only a minor matrix phase. Intermediate types contain scattered, well-formed crystals or aggregated clusters of dolomite crystals within the matrix of fine-grained calcite and dispersed non-carbonate material; in this type of calcitic dolomite or dolomitic limestone, the dolomite crystals commonly are spaced 0.01 to 0.10 mm. apart.

The amount of acid-insoluble residue occurring in this series of rock types was determined on representative particles taken from the 3/8- to 3/16-in. fraction and pulverized so as to pass the No. 50 sieve. The pulverized material then was digested in dilute hydrochloric acid. The acid-insoluble residue was found to constitute 4.4 per cent by weight of the rock. The acid-insoluble residue is a dark gray powder that is composed mainly of illite clay that is charged with very finely divided carbonaceous matter. Minor constituents are sand- and silt-sized quartz and alkali feldspars together with small proportions of hydrated ferric oxides (limonite) and granules of pyrite. The quartz and feldspars are estimated to constitute about one-fourth of the acid-insoluble residue.

Particles that are internally fractured, porous as a result of weathering or leaching, or include thin films of seams of illite clay usually up to about 0.1 mm thick, are classified as only fair in physical quality as constituents of aggregate for portland-cement concrete. Such particles constitute 19.3 per cent of the 3/4- to 1-1/2-in. fraction, 14.0 per cent of the 3/8- to 3/4-in. fraction, and 7.3 per cent of the 3/16- to 3/8-in. fraction, or an average of 13.6 per cent. Particles of calcareous shale are classified as poor in physical quality as constituents of coarse aggregate for portland-cement concrete; such particles constitute 0.7 per cent of the coarsest fraction. None was detected in the two finer fractions.

No chert or cherty particles were found in the sample.

Crushed Stone, York Stone and Supply Company, York, Pennsylvania

The shipment consisted of two size fractions of coarse aggregate, as follows:

Size Fraction	Net Weight, lb.
3/4- to 1-1/2-in.	25
3/16- to 3/4-in.	15

The aggregate is a crushed stone. The particles are angular and irregular, although edges and corners commonly are slightly rounded as a result of attrition during processing and handling. The particles mainly are roughly cubical to thick-tabular in shape, but flat or elongated pieces, as defined above, are present. Particles that are flat or elongated in shape constitute 2.7 per cent by count of the 3/4- to 1-1/2-in. fraction, 12.6 per cent of the 3/8- to 3/4-in. fraction, and 17.3 per cent of the 3/16- to 3/8-in. fraction. The particles are lightly coated by non-clayey, calcareous dust of fracture that is easily removed by washing.

The aggregate is composed of a mixture of very fine-grained, light gray to pale buff dolomites and dark gray, very fine-grained, medium to very dark gray, massive to faintly banded, hard to moderately hard, tough, calcitic dolomites and dolomitic limestones (Table 2). The light gray to pale buff dolomites are massive, commonly somewhat calcitic, and occasionally internally fractured, with or without porous zones produced by leaching of the rock in the formation during geologic time. The remaining types of dolomitic limestones and calcitic dolomites that are medium to dark gray are generally similar to the comparable types occurring in the aggregate submitted by Berks Products Corporation (see above), although the rock is more uniform in texture, internal structure, and mineralogic composition. In particular, the particles include lesser amounts of the non-dolomitic or slightly dolomitic limestones that occur as thin laminations in a minor proportion of the particles in the sample from Berks Products Corporation.

The amount of acid-insoluble residue occurring in the medium to dark gray dolomites and dolomitic limestones (exclusive of the types containing visible seams of clay) was determined on representative particles taken from the 3/8- to 3/16-in fraction and pulverized so as to pass the No. 50 sieve. The pulverized material then was digested in dilute hydrochloric acid. The acid-insoluble residue was found to constitute about 1.0 per cent by weight of the rock. The acid-insoluble residue is a dark gray powder that is composed mainly of illite clay that is charged with very finely divided carbonaceous matter. Minor constituents are fine-sand and silt-sized quartz and alkali feldspars together with small proportions of hydrated iron oxides (limonite) and granules of pyrite. The quartz and feldspars are estimated to constitute about 50 per cent of the acid-insoluble residue.

Particles that are internally fractured, porous, or include thin films or seams of illite clay are classified as only fair in physical quality as constituents of aggregate for portland-cement concrete. Such particles constitute 22.1 to 26.7 per cent by count of the three size fractions that were analyzed, or an average of 24.1 per cent. No particles that are classified as poor in physical quality as constituents of aggregate for concrete were found in the analyzed portions.

No cherty particles or cherts were found in the sample.

Concrete Sand, York Building Products, Perryville, Maryland

The sample consisted of approximately 5 lb. of dry, cream-colored to faintly pink, natural sand. The particles are angular and irregular in shape except for sparse particles that are subangular to subround. The particles are composed largely of quartz grains that were released by deep weathering and minor erosion of granitic rocks and granitic gneisses. The particles are lightly coated by a mixture of finely divided clay and hydrated iron oxides that is largely removed by washing. The particles are free from encrustations of mineral matter such as form by precipitation of dissolved substances from groundwater within natural deposits.

The sand is composed almost entirely of dense to internally fractured particles of quartz (Table 3). Sparse particles of granite containing residual amounts of moderately to deeply weathered feldspars are present in the various fractions. Occasional particles of soft, brown, ferruginous claystones and sandy claystones are present. Particles that are internally shattered by natural fractures or are weakened by moderate weathering are classified as only fair in physical quality as constituents of aggregate for portland-cement concrete; such particles constitute 10.5 to 30.3 per cent of the various size fractions that were analyzed, or an average of 20.7 per cent. The frequency of occurrence of such particles decreases as the particle size decreases. Particles that are soft, highly porous, or highly clayey are classified as poor in physical quality as constituents of aggregate for concrete; such particles constitute 0.0 to 3.3 per cent of the various size fractions that were analyzed, or an average of 2.0 per cent.

The fraction passing the No. 100 sieve is composed entirely of particles of quartz except for trace amounts of clayey and ferruginous material and carbonates in the finest fractions. The particles are coated by films of kaolinite and hydrated iron oxides or mixtures thereof that account for the coloration of the sand.

Richard C. Mielenz, P. E.
Geologist and Petrographer

August 24, 1972

Route 1, Box 103
Brigham Road
Gates Mills, Ohio 44040

TABLE 1. -- PETROGRAPHIC ANALYSIS OF A SAMPLE OF CRUSHED STONE COARSE AGGREGATE

Crushed Stone
Berks Products Corporation, Reading, Pennsylvania

Constituents	Amount as Number of Particles (per cent) 1/ In the Size Fractions Shown Below		
	3/4- to 1-1/2-in.	3/8- to 3/4-in.	3/16- to 3/8-in.
Gray dolomites and dolomitic limestones	80.0	86.0	92.7
Gray internally fractured dolomites and dolomitic limestones	4.0	5.3	4.7
Gray porous dolomites and dolomitic limestones	2.0	4.0	1.3
Gray dolomites and dolomitic limestones with clay seams	13.3	4.7	1.3
Calcareous shales	0.7	-	-

1/ Based on examination and identification of 150 particles in each of the size fractions shown above.

The various constituents are classified as follows with respect to physical quality: Satisfactory: Dolomites and dolomitic limestones. Fair: Fractured types, porous types, dolomites and dolomitic limestones with clay seams. Poor: Calcareous shales.

TABLE 2. --- PETROGRAPHIC ANALYSIS OF SAMPLES OF COARSE AGGREGATE

Crushed Stone
York Stone and Supply Company, York, Pennsylvania

Constituents	Amount as Number of Particles (per cent) 1/ In the Size Fractions Shown Below		
	3/4- to 1-1/2-in.	3/8- to 3/4-in.	3/16- to 3/8-in.
Light gray to pale buff dolomites	18.0	32.6	37.9
Fractured, light gray to pale buff dolomites	4.7	2.0	4.7
Gray dolomites and dolomitic limestones	55.3	45.3	38.7
Fractured, gray, dolomites and dolomitic limestones	7.3	6.7	9.3
Porous, gray dolomites and dolomitic limestones	1.3	0.7	2.0
Gray dolomites and dolomitic limestones with clay seams	12.7	11.4	6.7
Calcite seam material	0.7	1.3	0.7

1/ Based on examination and identification of 150 particles in each of the size fractions shown above.

The various constituents are classified as follows with respect to physical quality. Satisfactory: Light gray to pale buff dolomites and dark gray dolomites and dolomitic limestones. Fair: Fractured types, porous types, dark gray dolomites and dolomitic limestones with clay seams, and calcite seam material.

TABLE 3. --- PETROGRAPHIC ANALYSIS OF A SAMPLE OF FINE AGGREGATE

Concrete Sand
York Building Products, Perryville, Maryland

Constituents	Amount as number of Particles, per cent 1/				
	No. 4-8	No. 8-16	No. 16-30	No. 30-50	No. 50-100
Quartz	67.1	68.5	79.1	81.3	86.2
Internally shattered quartz	29.0	28.7	18.2	14.9	10.5
Quartzose sandstones	2.6	0.7	0.7	0.6	-
Weathered granites	1.3	0.7	-	-	-
Deeply weathered granites	-	0.7	1.3	1.3	1.3
Ferruginous claystones	-	0.7	0.7	1.9	2.0

1/ Based on examination and identification of more than 153 particles in each of the size fractions shown above.

The various constituents are classified as follows with respect to physical quality as constituents of aggregate for concrete: Satisfactory: Quartz and quartzose sandstones. Fair: Internally fractured quartz and weathered granites. Poor: Deeply weathered granites and ferruginous claystones.

E. L. CONWELL & CO.
ESTABLISHED 1894
ENGINEERS - CHEMISTS - INSPECTORS
2024 ARCH STREET
PHILADELPHIA, PA. 19103

January 18, 1973

Gulf Energy & Environmental Systems
10955 John Jay Hopkins Drive
San Diego, California 92121

Attention: Mr. R. B. Nation

RE: Potential Reactivity Test of Rock
P.O. # 458666

Gentlemen:

The following is a report of Potential Reactivity Tests (ASTM C586-69) performed by our laboratory on two samples of limestone rock submitted to us marked as shown below.

Laboratory No. A 457147

	Expansion, % original length	
	Berks Products	York Stone & Supply
1 week	.032	none
2 weeks	.016	none
4 weeks	.008	none
8 weeks	.008	none

These results are not indicative of expansive tendancies in these materials.

Respectfully submitted,
E. L. CONWELL & CO.

W. E. Capper, P.E.

WEC/ch

D15

SHIPMENT A

MEDUSA PORTLAND CEMENT COMPANY

CEMENT TEST REPORT

Shipped from:	Bin No: 20	Date: 9/20/72

Car No. & Initial	Truck Ticket No.	Bbls. Contract No.	Shipped To:
		R. B. Nation P. O. Box 608 San Diego, Cal. 92112	

PORTLAND CEMENT TYPE: II

Chemical		Physical	
SiO_2	21.2	SPECIFIC SURFACE:	
Al_2O_3	4.3	WAGNER	1950
Fe_2O_3	3.9	BLAINE	3690
CaO	62.2	AUTOCLAVE SOUNDNESS	.17
MgO	4.2	GILLMORE SET:	
SO_3	2.35	INITIAL	3:30
LOI	.70	FINAL	6:30
Insol.		VICAT SET	2:15
C_3S	50.3	AIR CONTENT	7.0
C_2S	22.8	COMP. STRENGTHS	
C_3A	5.0	1 DAY	1400
C_4AF	11.9	3 DAY	2800
Alkalies as Na_2O	.6	7 DAY	3530
		28 DAY	5000

RECEIVED
SEP 25 1972
PROJECT PURCHASING

THIS CEMENT MEETS ASTM C-150 AND FEDERAL ____ SPECIFICATIONS FOR TYPE II PORTLAND CEMENT. DATA REPORTED IS ONLY THAT NECESSARY TO ESTABLISH CONFORMANCE TO APPLICABLE SPECIFICATIONS.

Plant Chemist ____

SHIPMENT B D16

MEDUSA CEMENT COMPANY

DIVISION OF MEDUSA CORPORATION

CEMENT TEST REPORT

Shipped from:		Bin No:		Date: 3/30/73
Car No. & Initial	Truck Ticket No.	Bbls.	Contract No.	Shipped To:

PORTLAND CEMENT TYPE: II

Chemical		Physical	
SiO_2	21.4	SPECIFIC SURFACE:	
Al_2O_3	4.6	WAGNER	2130
Fe_2O_3	3.6	BLAINE	3700
CaO	62.9	AUTOCLAVE SOUNDNESS	.15
MgO	3.3	GILLMORE SET:	
SO_3	2.09	INITIAL	3:15
LOI	.80	FINAL	6:30
Insol.		VICAT SET	2:30
C_3S	51.2	AIR CONTENT	6.7
C_2S	22.7	COMP. STRENGTHS	
C_3A	6.1	1 DAY	1580
C_4AF	11.0	3 DAY	2570
Alkalies as Na_2O	.55	7 DAY	3370
		28 DAY	5230

THIS CEMENT MEETS ASTM ________ AND FEDERAL ________ SPECIFICATIONS FOR TYPE ________ PORTLAND CEMENT. DATA REPORTED IS ONLY THAT NECESSARY TO ESTABLISH CONFORMANCE TO APPLICABLE SPECIFICATIONS.

SO 2375 4/70

Plant Chemist ____________