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Materials and Molecular Research Laboratory

Author

Lawrence Berkeley National Laboratory

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CONCEPTUAL DESIGN REPORT FOR AN

ADDITION TO THE MATERIALS AND MOLECULAR RESEARCH LABORATORY

(SURFACE SCIENCE AND CATALYSIS FACILITY) BUILDING 62

LAWRENCE BERKELEY LABORATORY

MAY 1977 (REVISED)

LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

Pub. 93, Rev. 2

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CONTENTS

SECTION I. SUMMARY OF CONCEPTUAL DESIGN PLAN 1-1

SECTION II. PROJECT DESCRIPTION AND DESIGN CRITERIA 2-1

SECTION III. COST ESTIMATES
Table of Contents 3-i

SECTION IV. PROJECT TIME SCHEDULE, CONSTRUCTION SCHEDULE, AND METHODS OF PERFORMANCE 4-1

SECTION V. ARCHITECTURAL/MECHANICAL/ELECTRICAL DRAWINGS 5-1

SECTION VI. OUTLINE SPECIFICATIONS
Table of Contents 6-i

Division 1 - General Requirements 6-1
Division 2 - Site Work 6-3
Division 3 - Concrete 6-9
Division 4 - Masonry 6-10
Division 5 - Metals 6-10
Division 6 - Wood and Plastics 6-11
Division 7 - Thermal and Moisture Protection 6-12
Division 8 - Doors and Windows 6-14
Division 9 - Finishes 6-16
Division 10 - Specialties 6-20
Division 11 - Equipment 6-22
Division 12 - Furnishings 6-23
Division 13 - Special Construction: (NONE)
Division 14 - Conveying Systems 6-23
Division 15 - Mechanical 6-24
Division 16 - Electrical 6-30

SECTION VII. ENERGY CONSERVATION REPORT 7-1

Contents (continued)

SECTION VIII. SOLAR ENERGY SYSTEM

System Space and Service Water System 8-1
Solar Service Water System 8-1

SECTION IX. SAFETY, POLLUTION, AND ENVIRONMENTAL ASSESSMENTS

Analysis of Principal Hazards and Risks 9-1
Pollution Control and Treatment Measures 9-5
Environmental Assessment 9-6

SECTION X. DETAILED SUPPORTING DATA
Table of Contents 10-i
Recapitulation: Estimate Summary and Detail Breakdown (for Schedule 44) 10-1
Schedule 44: SCHEDULE I
Special Facilities 10-15
Standard Equipment 10-16
Schedule 44: SCHEDULE II 10-22
Preliminary Soil Investigation (Harding-Lawson Associates) 10-23
Consultant Resumes 10-39
Structural Calculations (Including Design Criteria) 10-41
Conceptual Design Mechanical Calculations 10-62
Basis of Mechanical Design Calculations 10-76
Electrical and Lighting Calculations 10-82
Basis of Electrical Design Calculations 10-90

SECTION I

SUMMARY OF CONCEPTUAL DESIGN PLAN

A. INTRODUCTION

An addition to the existing, overcrowded Building 62 is needed to house research groups and support facilities for programs in basic research of materials and molecular structures.

The proposed new building will provide space for programmatic work in surface science, catalysis, and molecular research, as well as for interdisciplinary physical research on energy problems that have been identified as priority programs by ERDA.

Such energy-related programs include the investigation of atomic processes on surfaces with the use of techniques in modern surface science such as Auger and photo-electron spectroscopy or electron diffraction and atomic beam scattering will be used in this work. The chemical makeup of fossil fuels will be characterized by newly-developed NMR spectroscopic techniques and basic research will be conducted on catalytic reactions in coal gasification and liquefaction. Surface reactions of containment materials for high-temperature processes will also be studied. Other program activities to be located in this facility include research of electrochemical processes for energy storage and conversion, materials studies investigations for photochemical energy conversion, corrosion and passivation of catalysts, energy transfer and structure of molecules on surfaces, homogeneous catalysis and corrosion-erosion in coal gasification.

The Materials and Molecular Research Division is an interdisciplinary group composed of scientists and engineers from seven academic disciplines in six campus departments at the University of California, Berkeley; namely, Chemistry and Chemical Engineering in the College of Chemistry, Physics in the College of Letters and Sciences, and Nuclear Engineering, Materials Science and Mineral Engineering (Metallurgy and Ceramics), and Mechanical Engineering in the College of Engineering. To optimize interaction among scientists and engineers, it is highly desirable to centralize their research activities.

Conceptual Design Reports on the Addition of Building 62 were submitted in May 1975 and as a revised report in May 1976. Therefore, the work presented here is a reconsideration of the May 1976 report in order to update the space needed for current and projected program requirements. For example, a new energy conservation report is included.

The estimated 67,000 total gross square feet as originally planned remains the same. The detailed cost estimate, the project schedule and the conceptual drawings have been updated.

B. METHOD OF PRODUCING THE CONCEPTUAL DESIGN REPORT

1. Lawrence Berkeley Laboratory

Project operational requirements, as supplied by the Materials and Molecular Research Division, have been the basis of design criteria developed by the LBL Plant Engineering Department. These criteria are reflected in the drawings, engineering data, and other project technical evaluation prepared by Garretson, Elmendorf, Zinov and Reibin, Architects and Engineers, San Francisco.

The quantity survey and cost estimate of the new addition is based on updated drawings and specifications, and was prepared by the Plant Engineering Department professional estimator. The LBL Safety Services Department contributed the pollution and environmental assessments. A soils investigation, including boring logs and recommended foundation design, was provided by consultants in the report of July 1975.

The final Conceptual Design Report was prepared by the LBL Plant Engineering Department and was edited and produced by the LBL Technical Information Department.

2. Consultants

Garretson, Elmendorf, Zinov and Reibin, Architects and Engineers, prepared architectural and engineering drawings, calculations, specifications and a project construction schedule.

Jointly with LBL, they have prepared energy-use calculations and developed an alternative system for using solar energy as well as incorporating all other energy conservation measures required by ERDA.

Harding-Lawson Associates, Engineers and Geologists, supervised and logged the site soil borings and trenching, analyzed the data, produced the site geology report and recommended the foundation design.

Engle and Engle, Structural Engineers, studied the soils report, recommended the building structure concept and reviewed the structural design of Garretson, Elmendorf, Zinov and Reibin for static and seismic resistance.

SECTION II

PROJECT DESCRIPTION AND DESIGN CRITERIA

A. PROJECT DESCRIPTION

The proposed addition to the Materials and Molecular Research Laboratory, Building 62, will have approximately 67,000 gross square feet of space. It is planned as a three-story laboratory building, with a partial basement and a connecting structure to the existing building totalling 63,500 gross square feet, plus an extension to the present high bay wing of about 3,500 gross square feet. Both the laboratory addition and the high bay extension will be of reinforced concrete with a structural steel frame. The architectural design will be similar to that of Building 62.

Two-thirds, or approximately 26,000 net feet, is planned for research laboratory use. The remaining one-third is divided among the support facilities of offices, administration, a conference room, and a mechanical shop.

Each floor will have a central utility and equipment corridor. An elevator from basement to roof will accommodate the transport of equipment and personnel.

The roof will house the usual mechanical equipment and exhaust outlets and will be the site of apparatus required for solar research.

The building will be air conditioned for temperature control of certain experimental apparatus and for laboratory environmental needs. Isolated vibration-free supports will be provided for supersensitive equipment in certain ground floor laboratories.

Other equipment and certain laboratory rooms require special operational and maintenance features, such as pollution control devices and certain safety precautions.

Site utilities will provide new pipelines for water, natural gas, and sanitary sewer systems. An acid waste monitoring system will evaluate laboratory fluid characteristics prior to discharge into the sanitary sewer system. Site electrical work involves removal of existing underground duct beams and replacement with larger capacity duct beams to existing transformer banks. Emergency power generation equipment will be provided for standby use in the event of a power failure.

B. DESIGN CRITERIA

1. Architectural

The addition to the existing Materials and Molecular Research Laboratory will involve the construction of two separate structural additions. The first is an extension to the existing high bay wing in the south portion of the site, and the second will be a multi-story laboratory and office building that will be connected to the existing laboratory and office building by a new main entry for the whole complex.

The site of these additions is the same as provided in the design of the original Building 62. The plan of the multi-story addition retains a strong schematic similarity to the existing building in that it includes a central utility corridor between interior laboratories. The facade is also a derivation of that of the existing building but modified on the exterior to accommodate laboratories. The exterior wall surfaces of the new laboratory and high bay additions will be form-board textured concrete, matching the existing building's texture.

Building levels have been terraced to follow the natural contours of the hillside. The site will be landscaped for wind protection and erosion control, as well as for esthetic effect.

Uniform Building Code criteria for the multi-story addition are as follows:

a. Site designation : Fire Zone 3
b. Estimated number of occupants : 199
c. Occupancy classification : F-2
d. Type of construction : Type 2

The space allocations for various uses are set forth in Table 2-1, Schedule of Net Areas, Functions, and Occupancy.

2. Structural

The structural system is composed of a vertical load-carrying steel frame with concrete shear walls designed for full lateral loads. The floor and roof system consist of 1½-inch-deep ribbed, hibond metal deck filled with lightweight concrete and placed over steel beams and girders, all acting as a composite section. Composite construction of this type provides good diaphragm rigidity while retaining flexibility for the installation of underfloor utilities.

All floors have been designed for 125 pounds per square foot live load capacity. The roof has been designed for a live load of 50 pounds per square foot and can accommodate roof-mounted solar energy equipment.

The structural design is based upon LBL lateral force criteria which are more stringent than the latest Uniform Building Code, 1976 Edition.

Foundation design utilizes drilled-in-place reinforced concrete caissons continuously tied together at grade with reinforced concrete grade beams.

3. Mechanical

The existing Molecular and Materials Research Laboratory Building has served as a guide for selection of the kinds of utilities required in the new addition. These utilities include the following systems: acid waste and monitoring low conductivity water (extended from existing building), industrial hot and cold water, compressed air (which will also supplement the existing building system), natural gas, and demineralized water.

The building will be 100% air conditioned to accommodate programmatic needs of laboratories which occupy the major portion of the total floor area. The design criteria and calculations for control of space temperatures are based on latest editions of ERDAM 6301 and the ASHRAE Guide.

Energy conservation and utilization of solar energy are included in this report in Sections VII and VIII.

New site services include city water and gas lines. The rainwater outfall and sanitary sewer system for the new addition will be connected to the existing storm drain and sanitary sewer located at the west end of the existing building.

4. Electrical

New 480Y/277V main switchgear will be installed on the east side of the existing high bay wing, and will serve both the existing and new high bay electrical loads.

Existing power loads in the existing high bay wing will be shifted to the new main switchgear from the existing main distribution panel. Power loads in the new Laboratory Building will be served from the existing main distribution panel using existing and new feeder circuit breakers. Anticipated electrical connected loads for the existing and new buildings are shown in tables in Section X, Detailed Supporting Data.

Site grading will require relocation of underground electrical power and communications system ducts which presently serve the existing building. A complete description of the electrical site work is contained in Section VI, Outline Specifications.

TABLE 2-1

SCHEDULE OF NET AREAS, FUNCTIONS, AND OCCUPANCY

Laboratory Building	Net Area (sq. ft.)			People
	Labs	Offices	Other	
Basement:				
Mechanical Shop	-	-	2000	10
First Floor:				
Conference Room - Foyer	-	-	1850	-
Second Floor:				
Solid State and Surface Reactions	1190	350	-	8
Surface Structure and Surface Composition	1190	335	-	10
Coal Gasification by Catalytic Conversion	1190	335	-	8
Corrosion - Erosion	1190	500	-	8
Corrosion and Passivation	895	335	-	6
Photochemical Energy Conversion	895	335	-	6
Computer Room	-	300	-	2
Administration	-	1870	-	10
Entrance - Reception	-	-	600	-
Supply, Storage and Misc. Rooms	-	-	350	-
Second Floor Subtotal	*6650*	*4360*	*950*	*58*
Third Floor:				
Electrochemical Processes	1190	335	-	10
Electrochemical Systems	595	170	-	4
Electrochemical Phase Boundaries	1190	335	-	12
Mass and Charge Transport	1190	390	-	12
Energy, Transfer and Structure of Molecules on Surfaces	1495	335	-	10
Homogeneous Catalysis	595	335	-	4
High Temperature Surface Reactions	895	335	-	8
Alloy Surface Studies	1190	335	-	12
Supply, Storage and Misc. Rooms	-	-	350	-
Third Floor Subtotal	*8340*	*2570*	*350*	*72*
Fourth Floor:				
Energy Transfer in Surface Reactions	2386	670	-	14
NMR of Fossil Fuels	1794	335	-	10
Electrochemical Synthesis	1190	500	-	8
Electron Spectroscopy of Surfaces	2670	840	-	20
Electrochemical Processes	-	335	-	4
Student Office	-	300	-	3
Supply, Storage and Misc. Rooms	-	-	350	-
Fourth Floor Subtotal	*8040*	*2980*	*350*	*59*

(TABLE 2-1, continued)

	——Net Area (sq. ft.)——			People
	Labs	Offices	Other	
High Bay Addition				
Materials Synthesis	1000	-	-	3
Working Environment	-	-	-	-
Simulation Testing	2000	-	-	4
High Bay Subtotal	*3,000*	-	-	*7*
Subtotal All Floor Nets	*25,930*	*9,910*	*5,500*	*206*

Total Net Functional Room Area = 41,340 square feet

Total Number of Occupants = 206 people

SECTION III

COST ESTIMATES

Contents

SCHEDULE 44

- Items 3 to 7 - Dates, Current Cost Estimates, Financial Schedule 3-1
- Items 10 - Details of Cost Estimate. 3-2

Recapitulation: Estimate Summary (for Schedule 44). 3-4

Basis of Estimate Summary 3-7

SCHEDULE 44-DUE MAY 15

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

3. Data A-E Work Initiated: 1st Quarter FY 1979

3a. Date Physical Construction Starts: 2nd Quarter FY 1979

4. Date Construction Ends: 4th Quarter FY 1981

5. Previous Cost Estimate:
Date: June 1, 1976 ($13,285,000)

6. Current Cost Estimate:
Date: June 1, 1977 $15,300,000*

*Does not include cost of Solar Heating & Cooling System.

7. Financial Schedule:

Fiscal Year	Authorizations	Appropriations	Obligations	Costs
FY 1979	---	---	$11,500,000	$3,060,000
FY 1980	---	---	$ 3,800,000	$5,350,000
FY 1981	---	---	---	$5,350,000
FY 1982	---	---	---	$1,540,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Personnel to be housed in this facility = 200
Estimated annual operating cost: 67,000 gr. sq. ft. at 2.20 sq. ft = $147,000
Estimated annual research program cost: $6,000,000
Incremental program cost in occupation of this facility: This facility will house ongoing programs from widely dispersed and overcrowded areas of the laboratory.

10. Details of Cost Estimate

	Item Cost	Total Cost
A. Engineering, Design and Inspection at about 15% of Construction Cost . .	$	$1,300,000
B. Construction Costs		8,690,000
1. Improvements to Land	155,000	
2. Building 67,000 sq. ft. gross at about $108/sq. ft.	7,205,000	
3. Special Facilities (Schedule I).	1,050,000	
4. Utilities (Schedule II).	280,000	
C. Standard Equipment (Schedule I).		2,790,000
Sub Total		$12,780,000
D. Contingencies at about 20% (of which $1,440,000 is for building contingency)		2,520,000
Total Project Cost		$15,300,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

NIVERSITY OF CALIFORNIA
AWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

10. Details and Cost Estimate (continued)

E. Estimated cost to add Solar Facility of ~4,250 sq. ft. (for collectors) for Partial Domestic Hot Water Heating and Space Hot Water Heating (per ERDAM 6501 Draft Dated 3-26-76) ($320,000). This amount is not included in the above Sec. 10 Cost Analysis.

(1) Revised Conceptual Design is about 90% complete. The final report will include an analysis of the Solar Facilities that may be added to this structure, and will also outline the considerations for energy conservation as required by ERDAM-6301.

(2) Consts have been escalated at 8% per annum for a period of 3 years to about the mid point of the construction period for a total of ~26%. In addition, ED & I has been increased by 2%, and contingency has been increased by 10%. Some changes have been made to special facilities and equipment to reflect current program requirements.

PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY. ESTIMATE NO. 4.
LOCATION BUILDING 62. SHEET NO. 1
A TECT EN IEER GARRETSON / ELMENDORF / ZINOV / REIBIN. DATE APRIL 1977.
SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION QUANTITY UNIT [redacted] [redacted] [redacted] [redacted] TOTAL

ESTIMATE SUMMARY. (FOR SCHEDULE 44).

		LABORATORIES AND OFFICES. (63 500 GROSS S.F)	HIGH BAY. (3500 GROSS S.F)	
1. IMPROVEMENTS TO LAND.		100 100	2290	
+ GENERAL CONDITIONS.	7%	7 010	160	
		107 110	2450	
+ BOND.	3/4%	800	20	
+ GENERAL CONTRACTOR O.H. & FEE	5%	5 360	120	
ESTIMATED CONSTRUCTION COST AS OF APRIL 1976		113 270	2590	
" " " ESCALATED (8%) TO APRIL 1977.		122 330	2800	
" " " " (26%) " " 1980		154 130	3520	157 650

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PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY. ESTIMATE NO. 4
LOCATION BUILDING 62. SHEET NO. 2
ARCHITECT ENGINEER GARRETSON / ELMENDORF / ZINOV / REIBIN. DATE APRIL 1977
SUMMARY BY DRD PRICES BY DRD. CHECKED BY

DESCRIPTION QUANTITY UNIT [redacted] [redacted] [redacted] [redacted] TOTAL

ESTIMATE SUMMARY (FOR SCHEDULE 44).

		LABORATORIES AND OFFICES (63,500 GROSS S.F.)	HIGH BAY. (3500 GROSS S.F.)	
2. BUILDING.				
STRUCTURAL EXCAVATION/BACKFILL		118750	2620	
ALTERATIONS TO EXISTING BUILDING 62		17700	9660	
CONCRETE CAISSONS.		110600	3000	
REINFORCING STEEL.		141650	} 46330	
CONCRETE, FORMS, FINISH.		762060		
MASONRY.		10190	—	
METALS.		600530	48380	
CARPENTRY		89540	1050	
THERMAL/MOISTURE PROTECTION		69640	7840	
DOORS & WINDOWS.		185000	1800	
SPECIALTIES.		19000	—	
FINISHES.		337700	7300	
CONVEYING SYSTEMS.		80000	—	
MECHANICAL — PLUMBING		367030	—	
— H.V.A.C.		668020	6970	
— FIRE PROTECTION		70490	4710	
ELECTRICAL.		853000	36600	
		4500900	176260	
+ GENERAL CONDITIONS	7%	315100	12340	
		4816000	188600	
+ BOND	¾%	36120	1410	
+ GENERAL CONTRACTOR O.H. & FEE	5%	240800	9430	
ESTIMATED CONSTRUCTION COST AS OF APRIL 1976		5092920	199440	
" " " ESCALATED (8%) TO APRIL 1977		5500350	215400	
" " " " (26%) " " 1980		6930450	271400	7201850

PRACTICAL
FORM 516 MFC. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY ESTIMATE NO. 4.
LOCATION BUILDING 62. SHEET NO. 3
ARCHITECT ENGINEER GARRETSON / ELMENDORF / ZINOV / REIBIN. DATE APRIL 1977
SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION QUANTITY UNIT [redacted] [redacted] [redacted] [redacted] TOTAL

ESTIMATE SUMMARY (FOR SCHEDULE 44).

		LABORATORIES AND OFFICES (63,500 GROSS S.F.)	HIGH BAY (3500 GROSS S.F.)	
3. SPECIAL FACILITIES.				
See Schedule I in Section 10.		→	→	833000
COST ESCALATED (26%) TO 1980				1050000
4. UTILITIES.				
ELECTRICAL.		119700	—	
MECHANICAL.		58730	—	
RE-LOCATION.		—	2160	
		178430	2160	
+ GENERAL CONDITIONS	7%	12490	150	
		190920	2310	
+ BOND.	3/4%	1430	20	
+ GENERAL CONTRACTOR O.H. & FEE	5%	9550	120	
ESTIMATED CONSTRUCTION COST AS OF APRIL 1976		201900	2450	
" " " ESCALATED (8%) TO APRIL 1977		218050	2650	
" " " " (26%) " " 1980		274750	3330	278080

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BASIS OF ESTIMATE SUMMARY

A. GENERAL

The preceding Estimate Summary is from the detail cost estimate included in Section X. The May 1976 cost estimate was updated to May 1977 by adding an 8% escalation factor on all items, excepting the building electrical system which was partially reworked and the new 2000 KVA substation eliminated due to a change in the electrical loads for the programs. These items reduced the electrical estimates. The May 1977 costs were escalated 8% per year compounded for 1978, 1979 and 1980 (26%) as shown under Construction Costs in Section X, item B, schedule 44. The 8% escalation was chosen for the update as a good medium figure after a survey of costs for this area. The 8% is thought to be reasonable because the 20% contingency added to the total project cost causes a multiplying effect. The 20% was used due to ERDA instructions. For a project of this type with the Conceptual Design definition, we believe 15% may be more realistic.

Special facilities and standard equipment costs are shown under Construction Costs in Section X, item B, are summarized and escalated (in accordance with above noted escalation) from the May 1977 prices of the facilities and equipment contained in Schedule 44 lists of Section X.

The breakdown of Engineering, Design, and Inspection costs during FY1979 to FY1981 is as follows:

Title I	$320,000
Title II	720,000
Title III	260,000
Total	$1,300,000

B. SPECIAL FACILITIES

The Special Facilities listed in Schedule I are the systems and special equipment required to support several experimental programs, interdisciplinary support laboratories, and work spaces planned for the new addition. Program investigators have analyzed the physical requirements of their activities and the special facilities provided in the existing building and have translated these analyses into the Special Facilities described. Costs have been estimated on the basis of known costs of the existing work and cost inquiries for known items of equipment.

C. STANDARD EQUIPMENT

The equipment estimates that appear in Schedule I for Standard Equipment were compiled from the latest catalogs, discussions with vendor representatives, and actual costs of recent purchases of similar equipment.

D. CONTINGENCIES

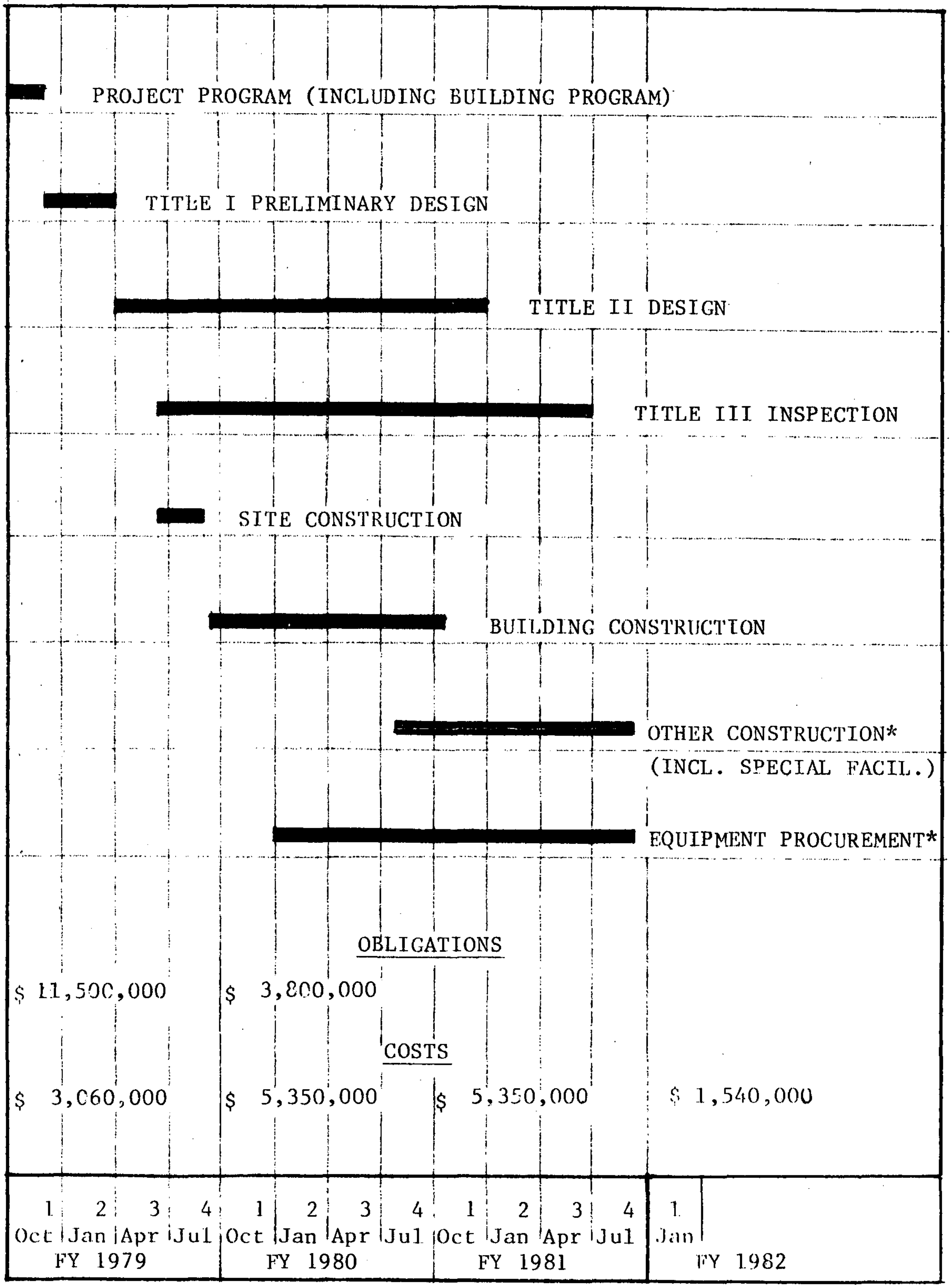
The contingency allowance is to provide relief from various uncertainties that may affect costs. These uncertainties may take several forms:

1. Unknown factors or discrepancies encountered during construction. One such item could be a variance in the amount of site work to be done depending upon geologic conditions or exact siting of the building.
2. Currently unknown changes in codes or environmental requirements that could increase costs.
3. Specifics in the Special Facilities or Standard Equipment may change by the time construction or procurement starts. The current lists reflect today's state of the art which may change at any time.
4. Escalation predictions follow the previously described guidelines and actual costs may be significantly different in future years.

SECTION IV

PROJECT TIME SCHEDULE, CONSTRUCTION SCHEDULE, AND METHODS OF PERFORMANCE

ADDITION TO MMRL - BLDG. 62 - PROJECT TIME SCHEDULE



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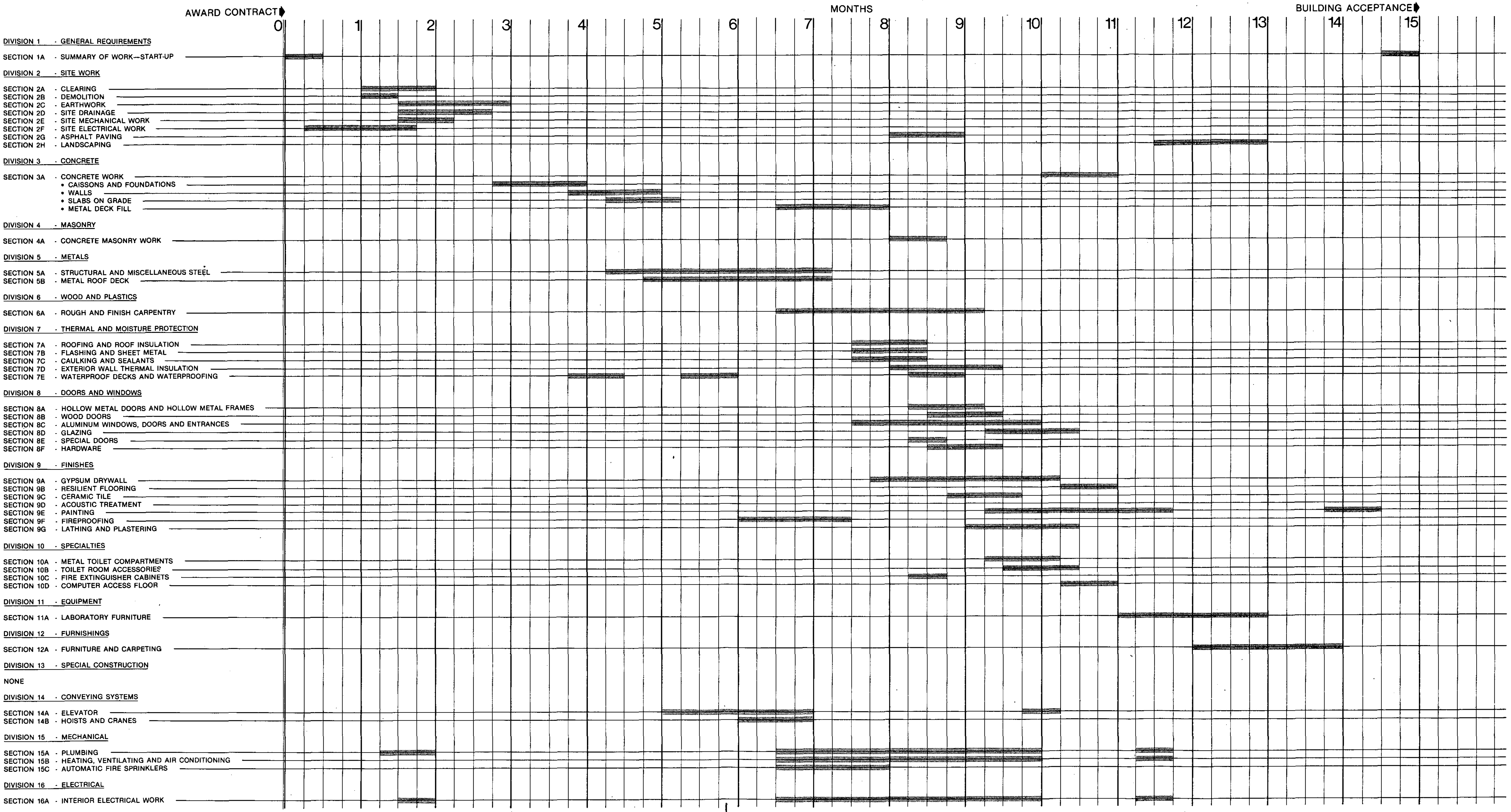
* These items have been considered as to their integration into the Building Construction Program. At this time there are no known conflicts and no known items of unusually long delivery time.

CONSTRUCTION SCHEDULE

ADDITION TO MATERIALS AND MOLECULAR RESEARCH LABORATORY
BUILDING 62
LAWRENCE BERKELEY LABORATORY, BERKELEY, CALIFORNIA

GARRETSON · ELMENDORF · ZINOV · REIBIN
ARCHITECTS AND ENGINEERS
SAN FRANCISCO, CALIFORNIA



METHODS OF PERFORMANCE

1. Design

a. A Design Program will be produced by the LBL Plant Engineering Department to direct the Architect-Engineer. This program will include design criteria for the architectural, mechanical and electrical aspects of the building as well as site work, utilities, special facilities, and equipment to be included in the construction subcontract documents.

b. A competent Architect-Engineer firm experienced in this type and scale project will be selected by the University and a lump-sum subcontract will be negotiated and awarded by the University.

c. The LBL Plant Engineering Department will prepare alterations and modifications to the existing building and utilities, as well as well as install and relocate equipment.

d. LBL construction inspectors will perform inspection of construction (Title III).

2. Construction

a. Major construction services will be performed under lump-sum subcontracts awarded after competitive bidding.

b. Some construction, alterations, modifications and equipment installation will be done by LBL crafts.

3. Procurement

Wherever feasible, LBL will procure standard equipment and some special facilities through competitive bidding.

SECTION V

ARCHITECTURAL/MECHANICAL/ELECTRICAL DRAWINGS

ADDITION TO

MATERIALS AND MOLECULAR RESEARCH LABORATORY

(SURFACE SCIENCE AND CATALYSIS FACILITY)

BUILDING 62

LAWRENCE BERKELEY LABORATORY

BERKELEY, CALIFORNIA

DRAWING LIST

C1	COVER SHEET
A1	SITE AND LOCATION PLANS
A2	BASEMENT
A3	FIRST FLOOR
A4	SECOND FLOOR
A5	THIRD FLOOR
A6	FOURTH FLOOR
A7	SECTIONS
A8	ELEVATIONS
ME1	MECHANICAL AND ELECTRICAL SITE PLAN
M1	BASEMENT MECHANICAL PLAN
M2	FIRST FLOOR MECHANICAL PLAN
M3	TYPICAL LABORATORY FLOORS MECHANICAL PLAN
E1	ONE LINE DIAGRAM NEW BUILDING
E2	REVISED ONE LINE DIAGRAM EXISTING BUILDING AND HIGH BAY

GARRETSON · ELMENDORF · ZINOV · REIBIN
ARCHITECTS AND ENGINEERS
SAN FRANCISCO, CALIFORNIA

REVISED MAY 1977

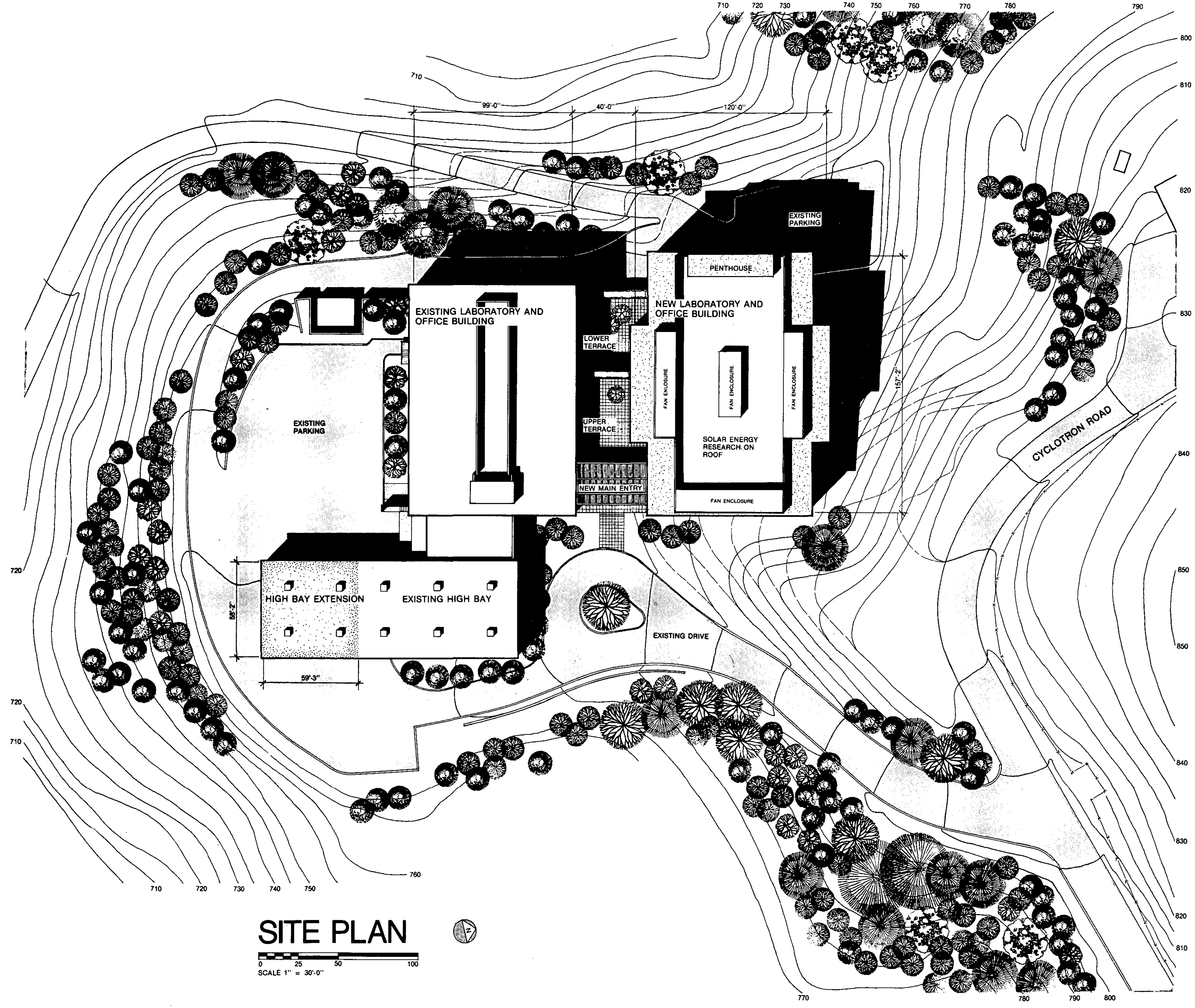
ADDITION TO MATERIALS AND
MOLECULAR RESEARCH LABORATORY
SHEET NO.
DRAWN BY
DATE APRIL 28, 1976
APPR. BY
DATE
SCALE
CKD BY
DATE
ACC'T NO.
UNIVERSITY OF CALIFORNIA LAWRENCE BERKELEY LABORATORY
PLANT ENGINEERING
SITE
DRAWING NUMBER 2B62B022

RL-1046 — SIZE 4

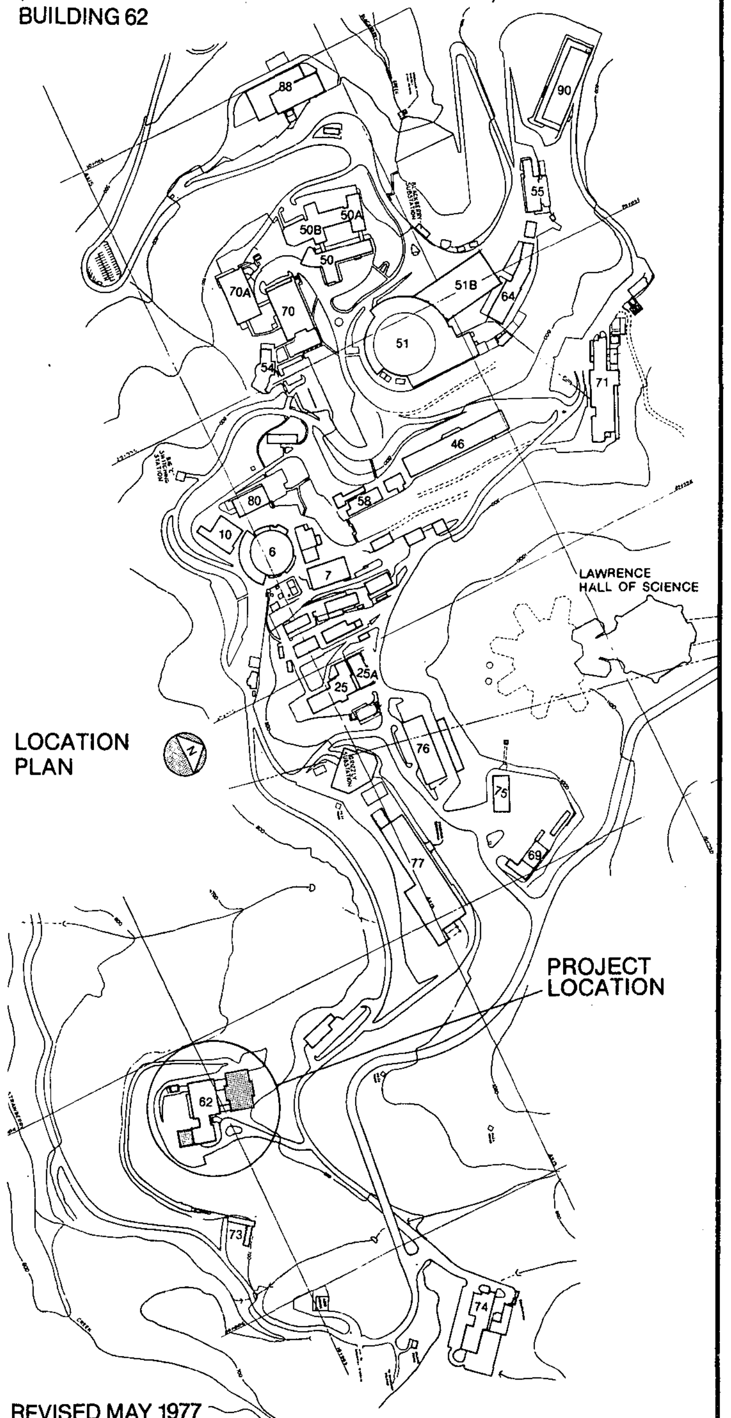
ADDITION TO THE

MATERIALS AND MOLECULAR RESEARCH LABORATORY

(SURFACE SCIENCE AND CATALYSIS FACILITY)
BUILDING 62



SITE PLAN



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A1

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RL-1046 — SIZE 4

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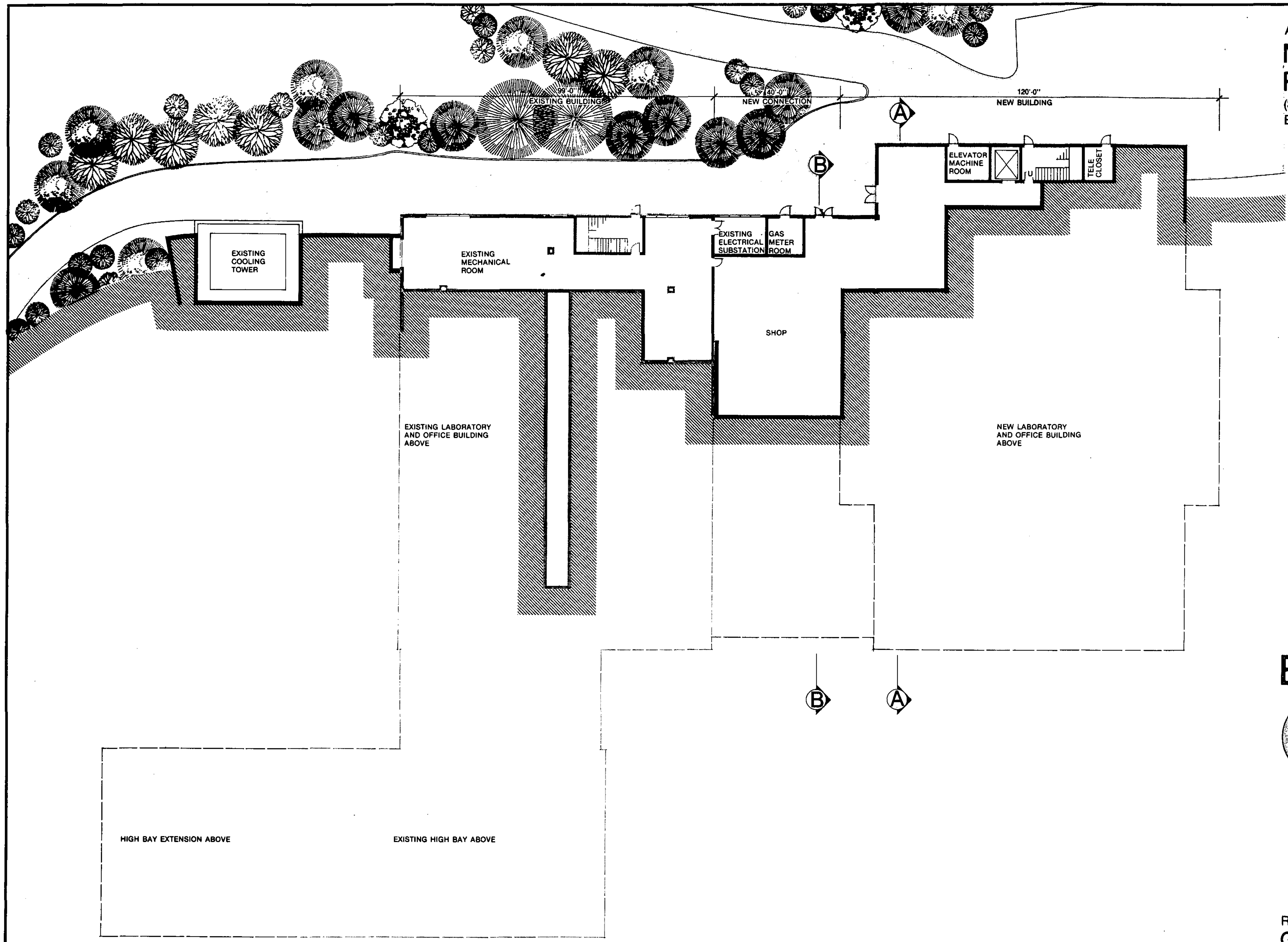
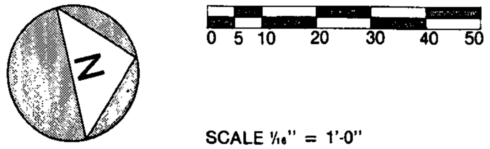


BASEMENT



SCALE ¹⁄₁₆" = 1'-0"

A2

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RL-1046 — SIZE 4

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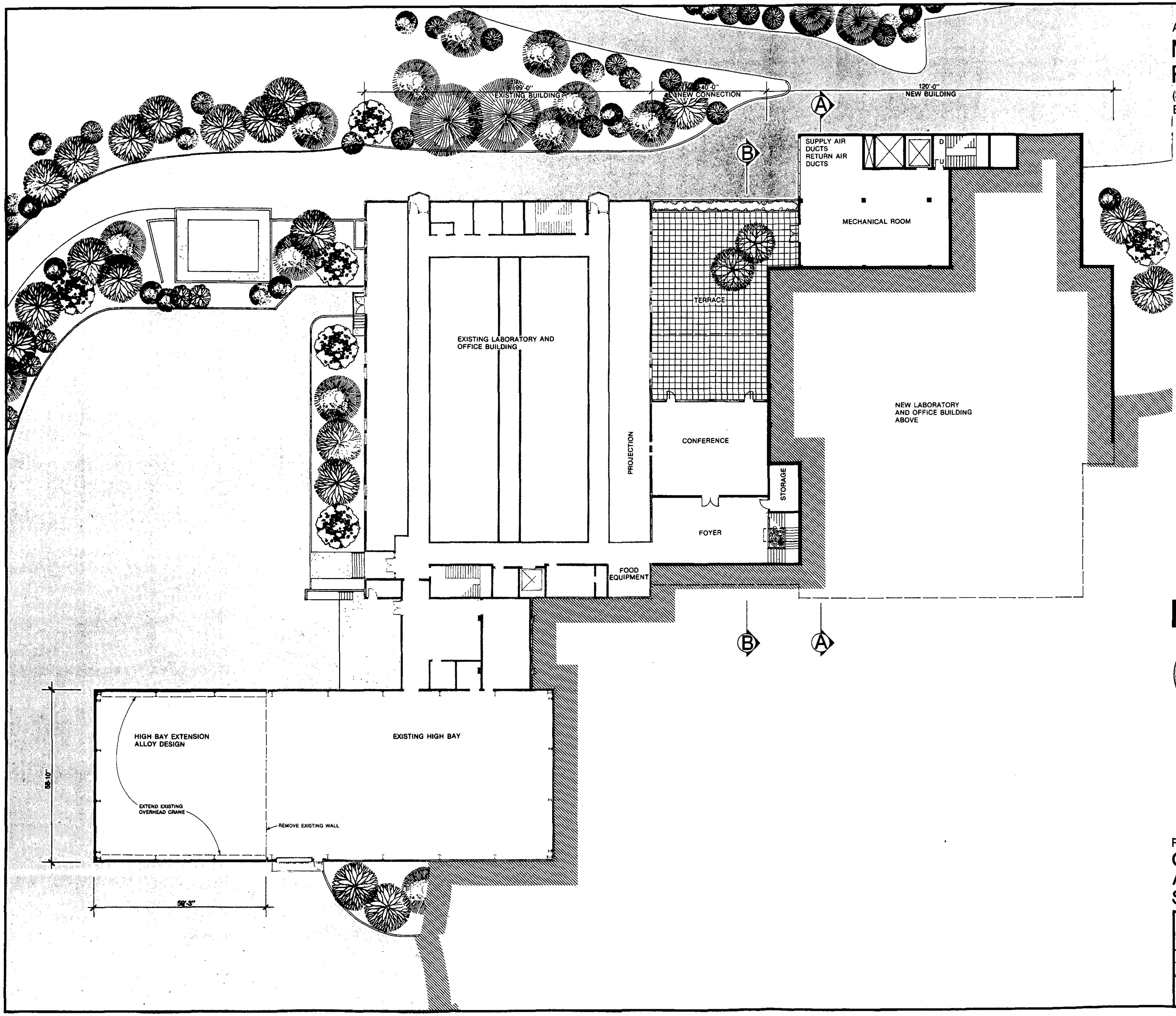
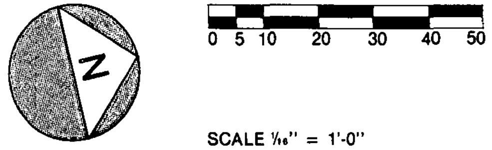


FIRST FLOOR



SCALE 1/16" = 1'-0"

A3

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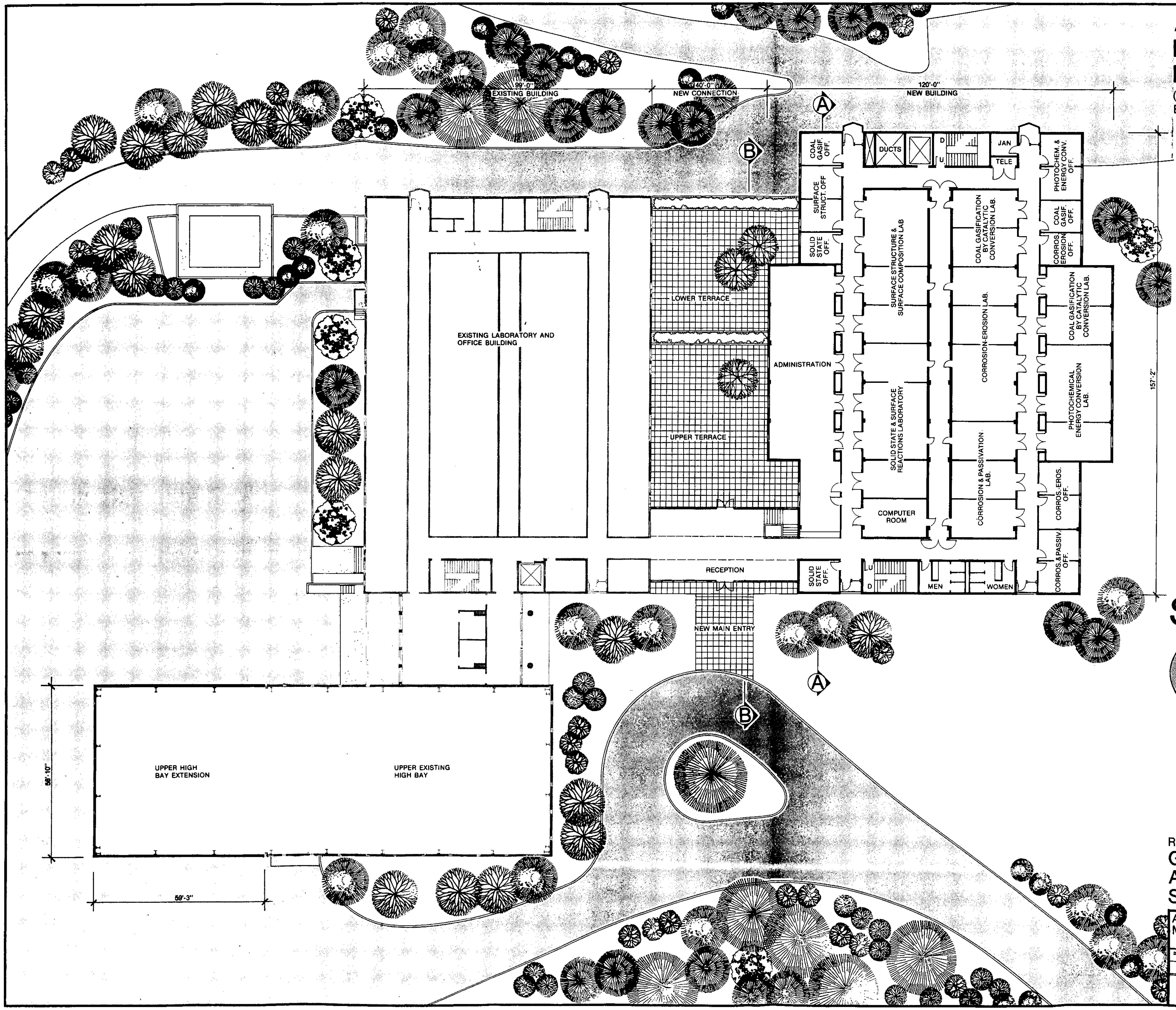
RL-1016 — SIZE 4



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BUILDING 62

SECOND FLOOR

N

0 5 10 20 30 40 50

SCALE 1/16" = 1'-0"

A4

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RL-1040 — SIZE 4

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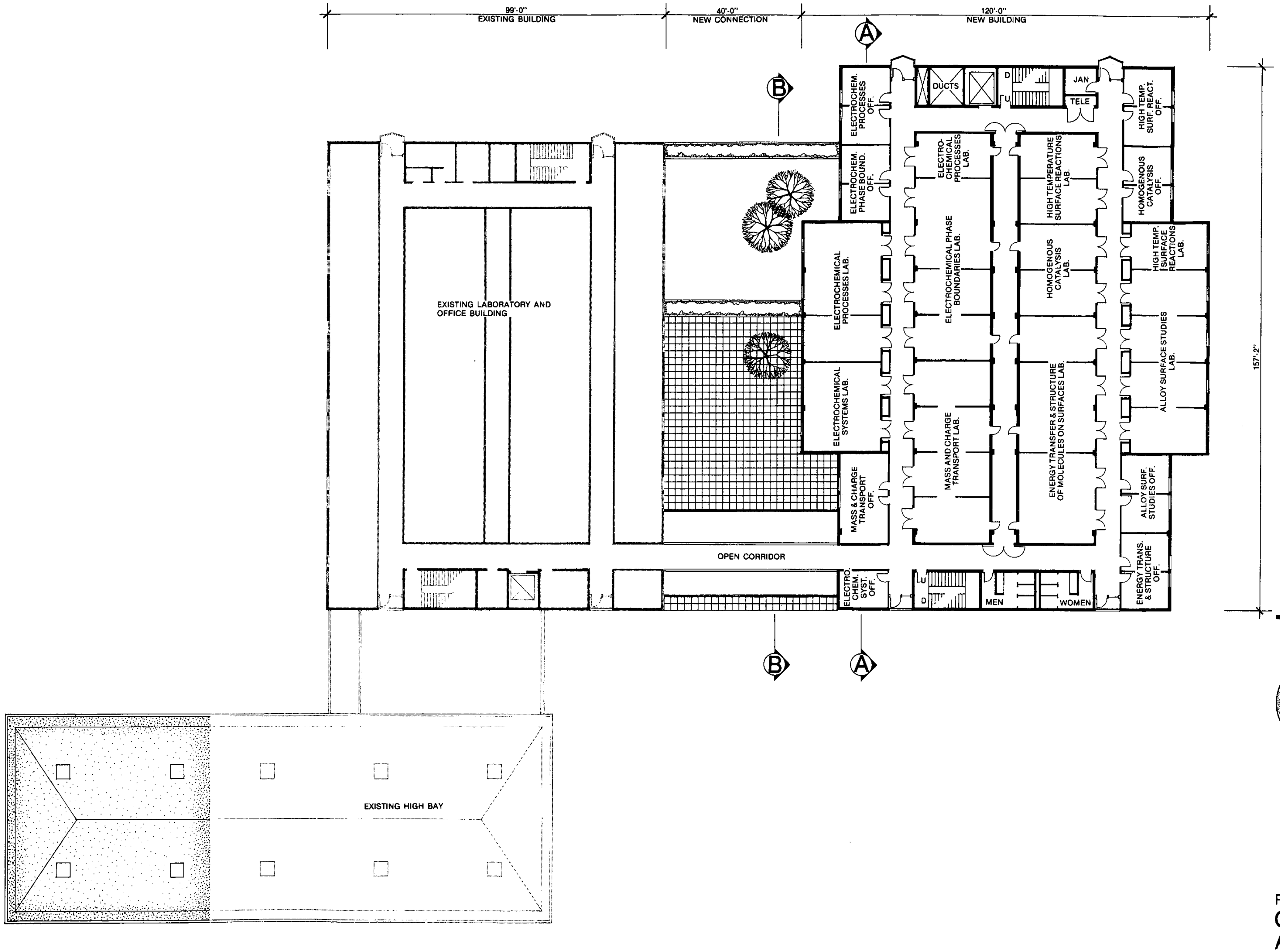
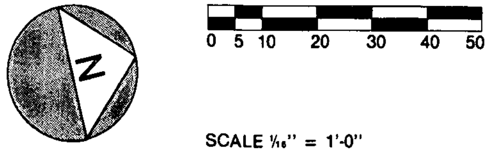
BUILDING 62



THIRD FLOOR



SCALE 1/16" = 1'-0"

A5

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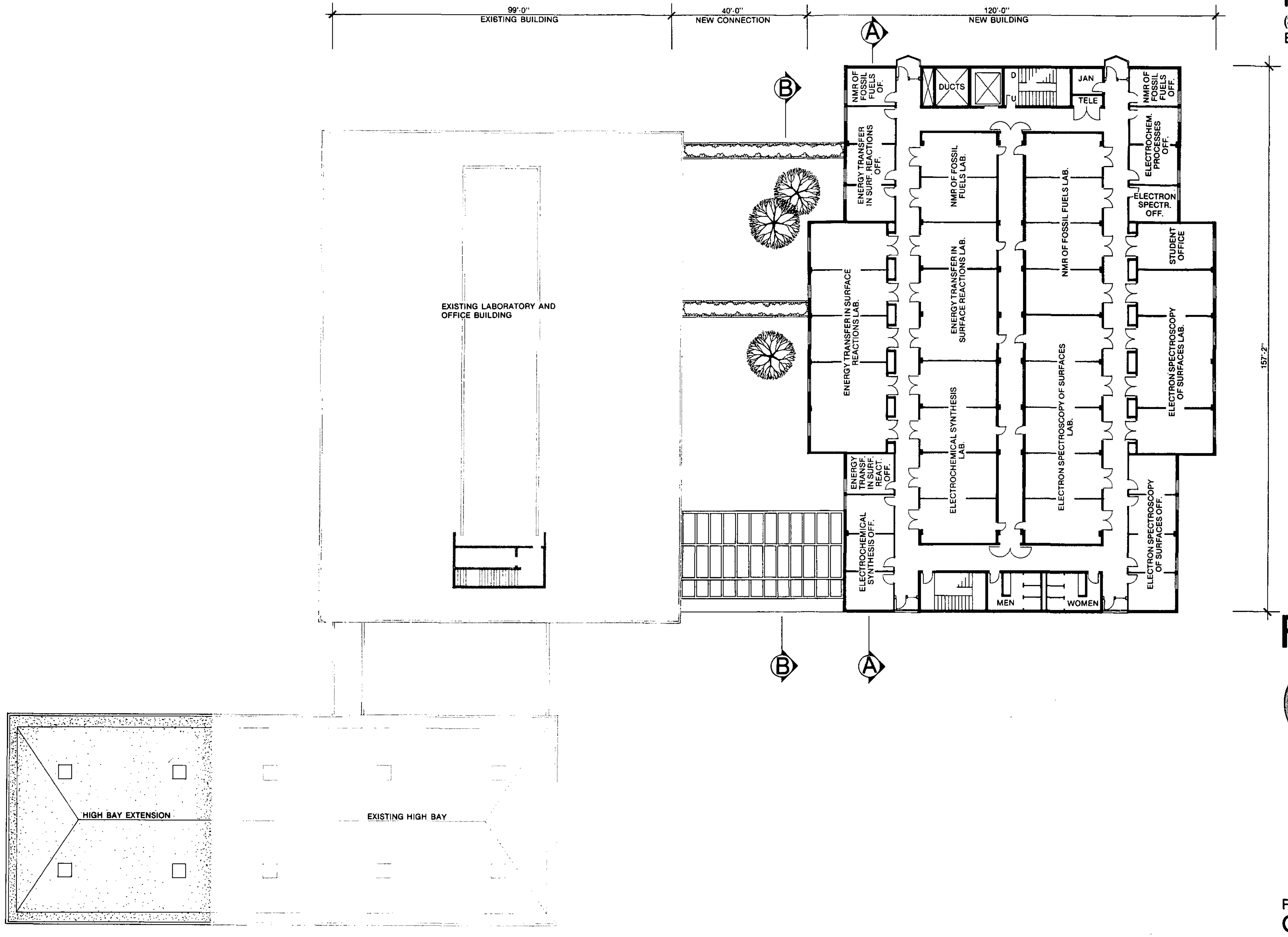

FOURTH FLOOR

0 5 10 20 30 40 50

SCALE 1/16" = 1'-0"

A6

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RL-1046 — SIZE 4

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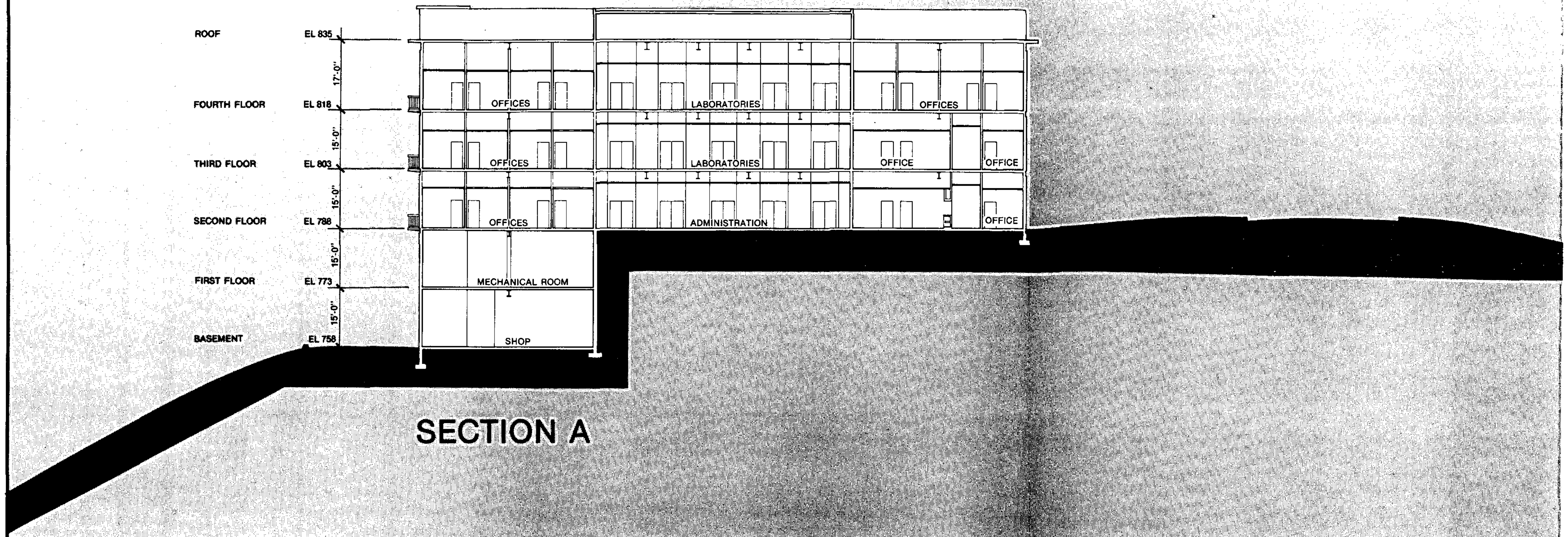
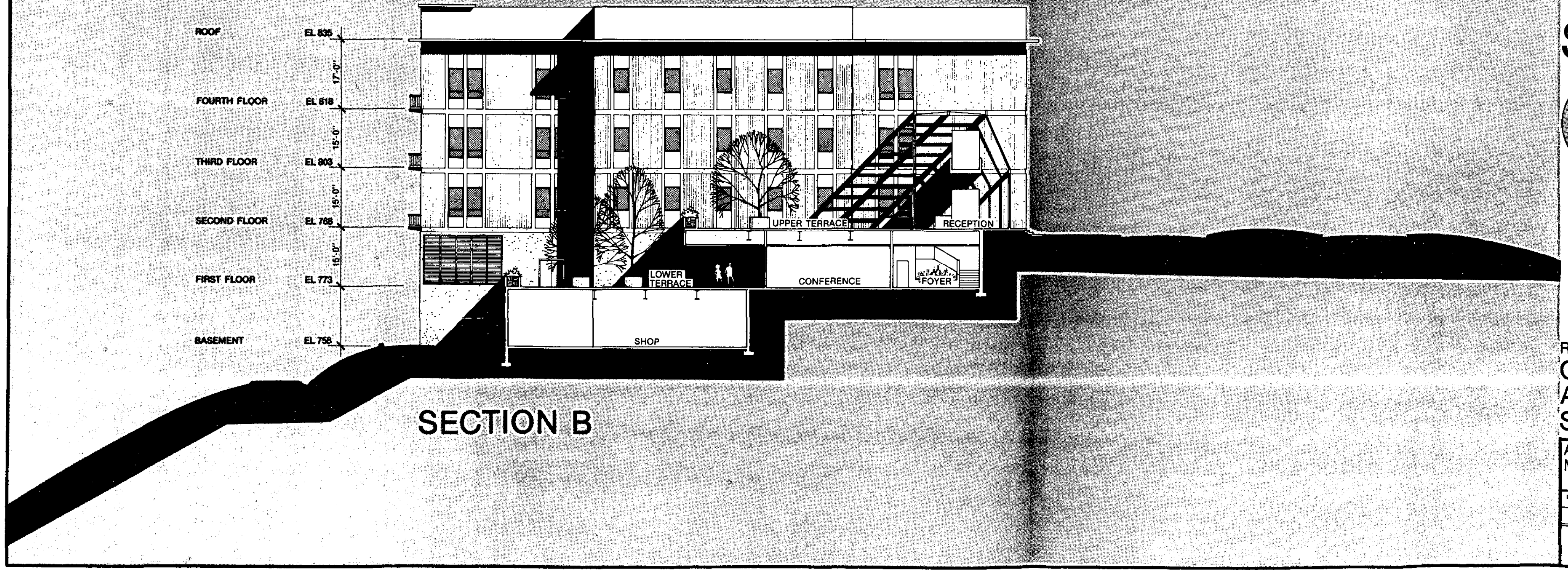
BUILDING 62



SECTION A



SECTION B

SECTIONS

0 5 10 20 30 40 50

SCALE 1/16" = 1'-0"

A7

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PLANT ENGINEERING

SITE

DRAWING NUMBER 2B62B029

RL-1046 — SIZE 4

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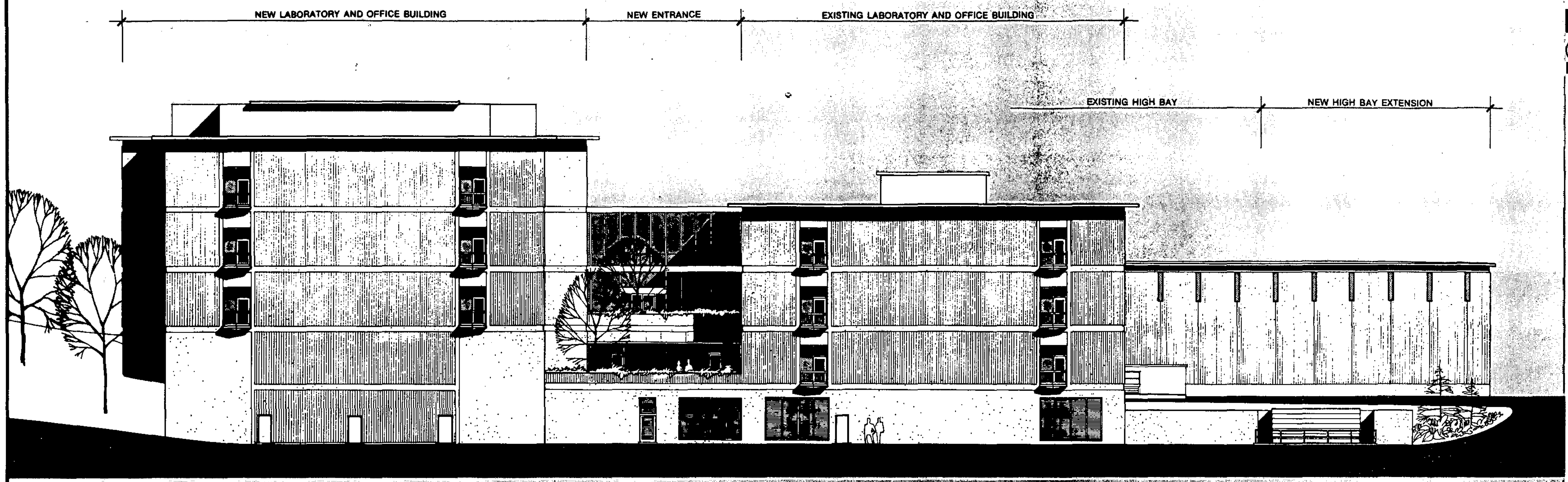
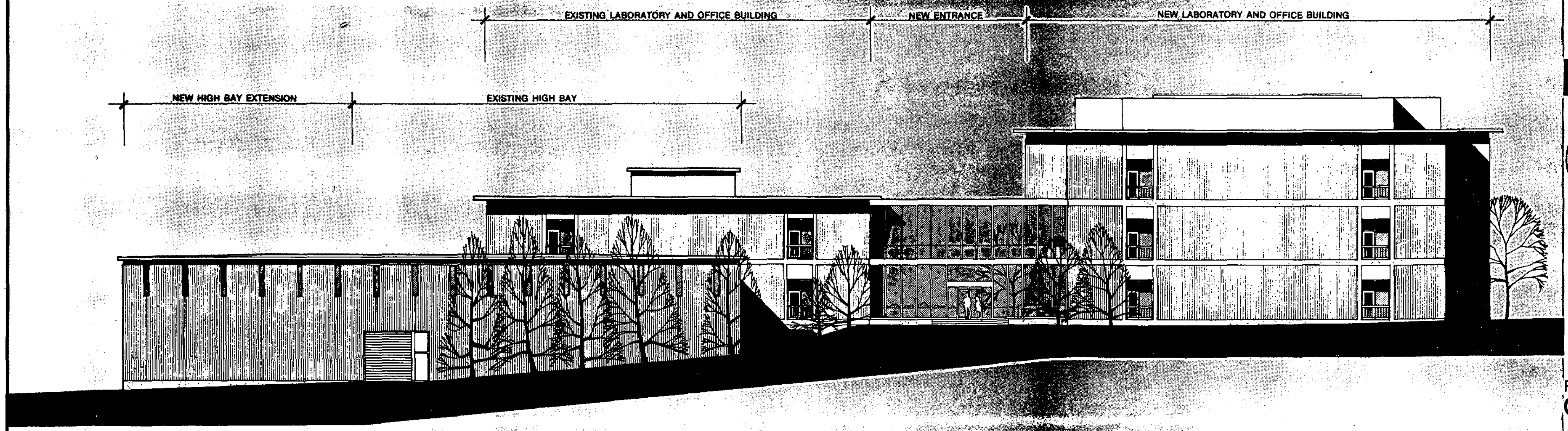
BUILDING 62

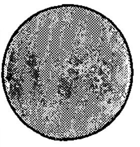


WEST ELEVATION



EAST ELEVATION

ELEVATIONS



0 5 10 20 30 40 50

SCALE 1/16" = 1'-0"

A8

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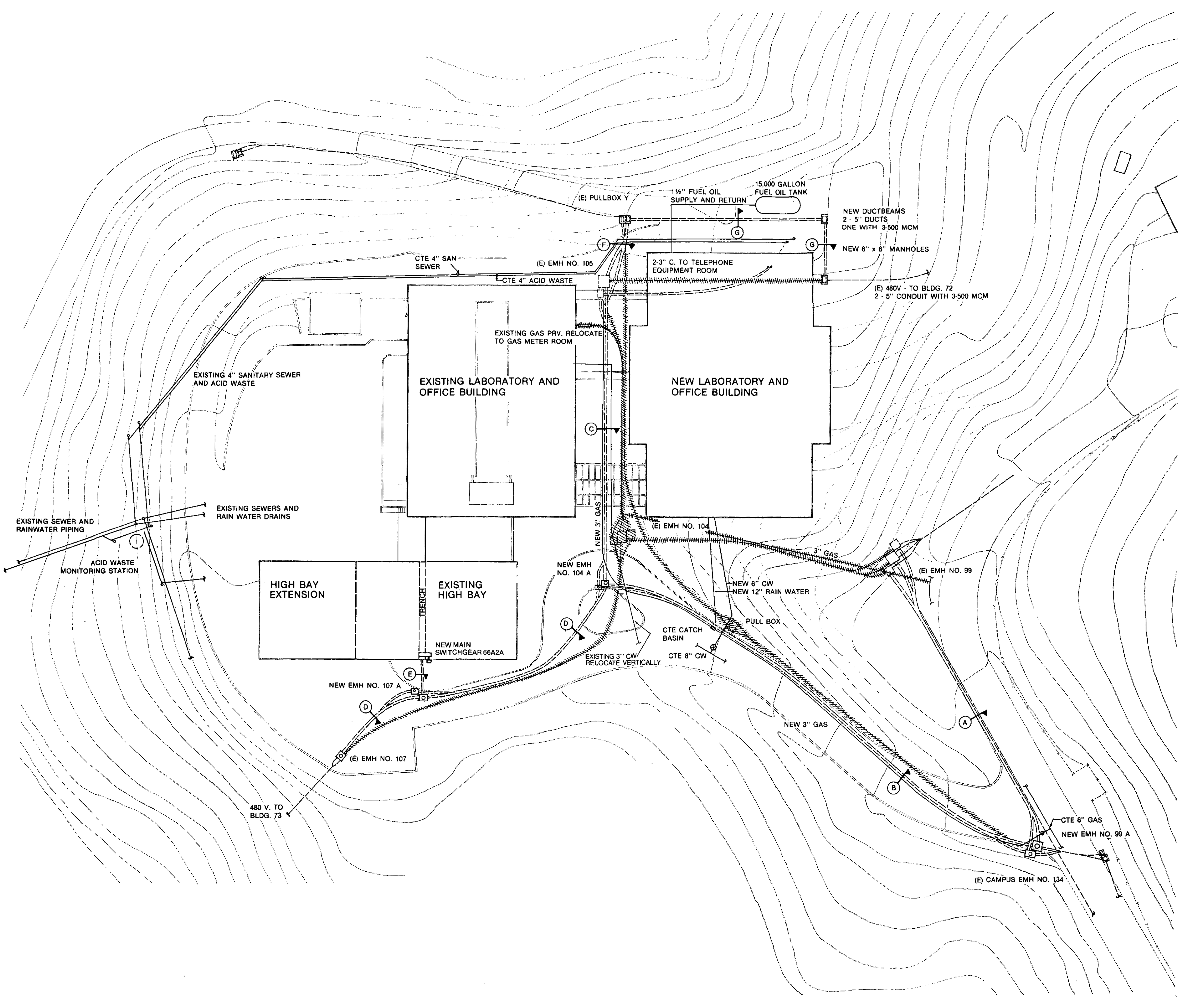
PLANT ENGINEERING
SITE
DRAWING NUMBER
2B62B030

RL-1946 — SIZE 4



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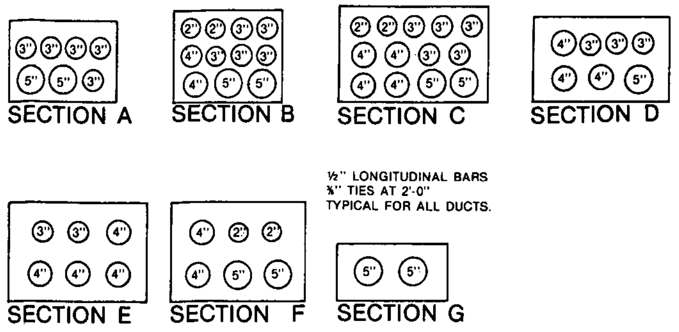
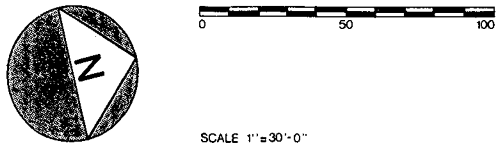


½" LONGITUDINAL BARS
⅜" TIES AT 2'-0"
TYPICAL FOR ALL DUCTS.

LEGEND

EMH	ELECTRIC MANHOLE
(E)	EXISTING
— — —	EXISTING DUCT BEAMS
▨	REMOVE AND/OR ABANDON UTILITIES
═══	NEW ELECTRICAL DUCTBEAMS
CTE	CONNECT TO EXISTING
o——	CLEANOUT TO GRADE
⊗	SHUT OFF VALVE
PRV	PRESSURE REDUCING VALVE

MECHANICAL AND ELECTRICAL SITE PLAN



SCALE 1"=30'-0"

ME1

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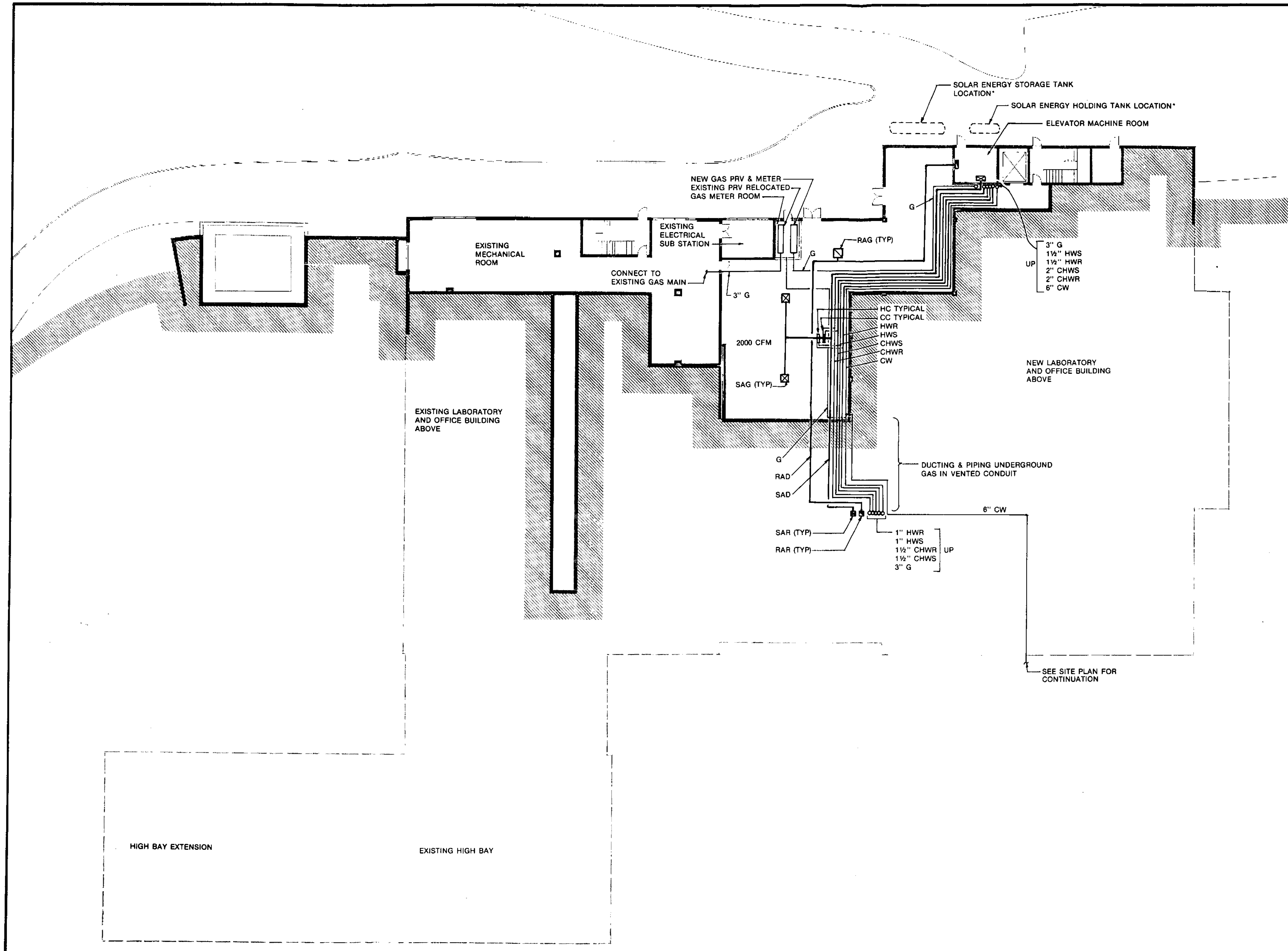
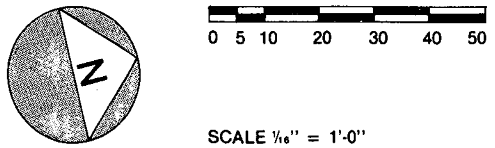


LEGEND

HWS	- HEATING WATER SUPPLY
HWR	- HEATING WATER RETURN
CHWS	- CHILLED WATER SUPPLY
CHWR	- CHILLED WATER RETURN
CW	- CITY WATER
G	- NATURAL GAS
CA	- COMPRESSED AIR
DHW	- DOMESTIC HOT WATER
LCWS	- LOW CONDUCTIVITY WATER SUPPLY
LCWR	- LOW CONDUCTIVITY WATER RETURN
IHW	- INDUSTRIAL HOT WATER
AW	- ACID WASTE
SS	- SANITARY SEWER
UR	- UTILITY RISER
SSR	- SANITARY SEWER RISER
AWR	- ACID WASTE RISER
SA	- SUPPLY AIR
RA	- RETURN AIR
SAG	- SUPPLY AIR GRILLE
RAG	- RETURN AIR GRILLE
SAD	- SUPPLY AIR DUCT
RAD	- RETURN AIR DUCT
EAG	- EXHAUST AIR GRILLE
SAR	- SUPPLY AIR RISER
RAR	- RETURN AIR RISER
EAR	- EXHAUST AIR RISER
*	- IF SOLAR ENERGY IS USED
CC	- COOLING COIL
HC	- HEATING COIL
CFM	- CUBIC FEET PER MINUTE SUPPLY AIR FLOW
PRV	- PRESSURE REDUCING VALVE

BASEMENT MECHANICAL PLAN



M1

SCALE ¹⁄₁₆" = 1'-0"

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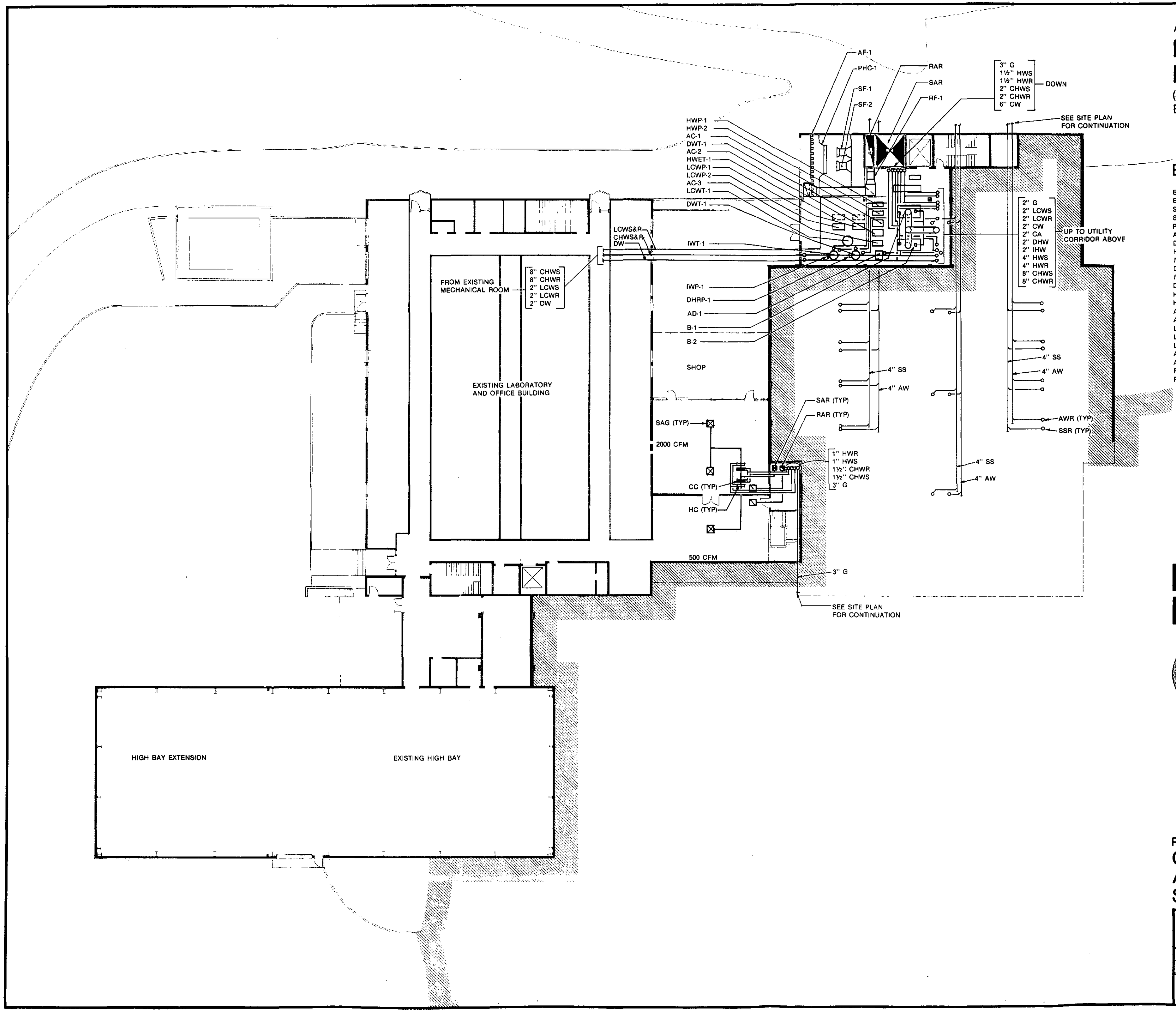
RL-1046 — SIZE 4



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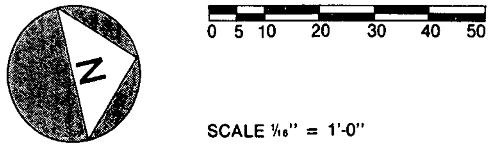
(SURFACE SCIENCE AND CATALYSIS FACILITY)
BUILDING 62

EQUIPMENT LEGEND

B-1	BOILER #1
B-2	BOILER #2
SF-1	BUILDING SUPPLY FAN #1
SF-2	BUILDING SUPPLY FAN #2
PHC-1	PREHEAT COOLING COIL
AF-1	AIR FILTER
DWT-1	DEMINERALIZED WATER TANK
HWET-1	H.W. EXPANSION TANK
IWT-1	INDUSTRIAL WATER TANK & HEATER
DWT-2	DOMESTIC WATER TANK & HEATER
IWP-1	INDUSTRIAL H.W. RECIRCULATING PUMP
DHRP-1	DOMESTIC H.W. RECIRCULATING PUMP
HWP-1	HEATING WATER PUMP #1
HWP-2	HEATING WATER PUMP #2
AC-1	AIR COMPRESSOR #1
AC-2	AIR COMPRESSOR #2
LCWP-1	LCW PUMP #1
LCWP-2	LCW PUMP #2
LCWT-1	LCW GRAVITY TANK
AD-1	AIR DRIER
AHU-1	AIR HANDLING UNIT #1
FH	FUME HOOD
RF-1	RETURN AIR FAN #1

FIRST FLOOR MECHANICAL PLAN



SCALE 1/16" = 1'-0"

M2

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RL-1946 — SIZE 4

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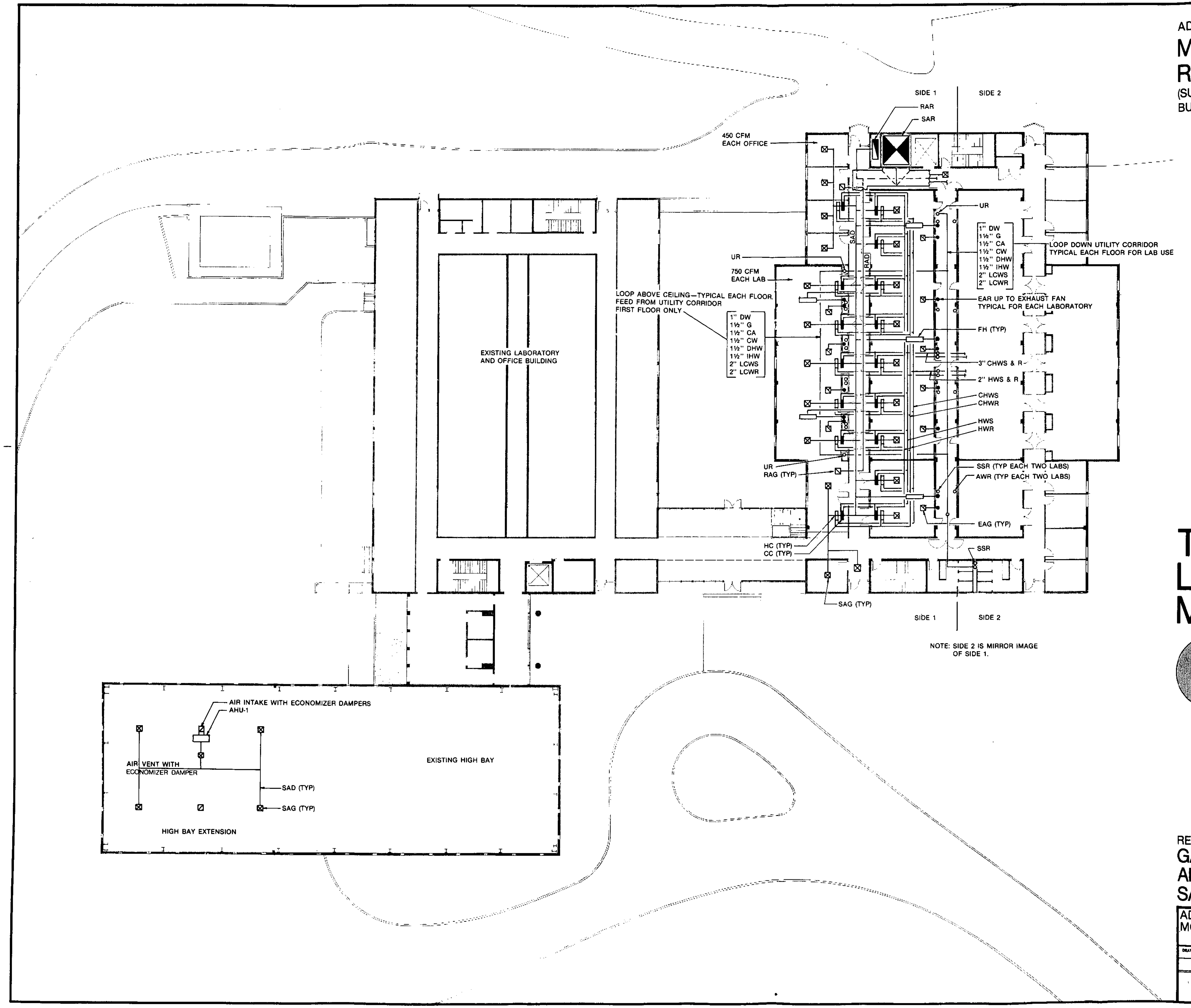

NOTE: SIDE 2 IS MIRROR IMAGE OF SIDE 1.

TYPICAL LABORATORY FLOOR MECHANICAL PLAN

0 5 10 20 30 40 50

SCALE 1/16" = 1'-0"

M3

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RL-1046 — SIZE 4

ADDITION TO THE

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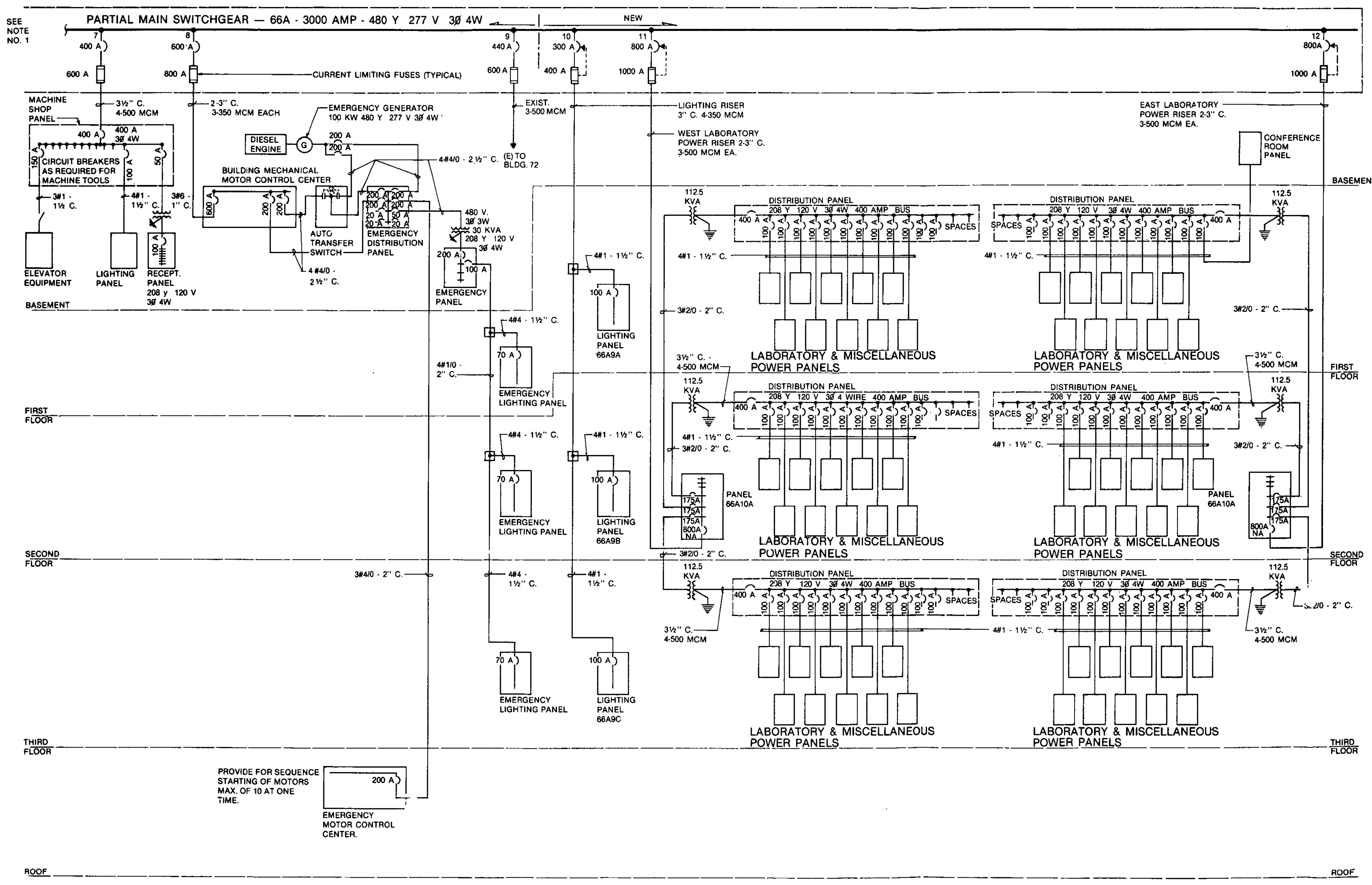
BUILDING 62

NOTES:

1. SEE DRAWING E2 FOR SWITCHGEAR 66A CIRCUITS 1 TO 6 INCLUSIVE. THESE CIRCUITS ARE FOR THE EXISTING BUILDING.



NEW BUILDING ONE LINE DIAGRAM

E1

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RL-1040 — SIZE 4

ADDITION TO THE

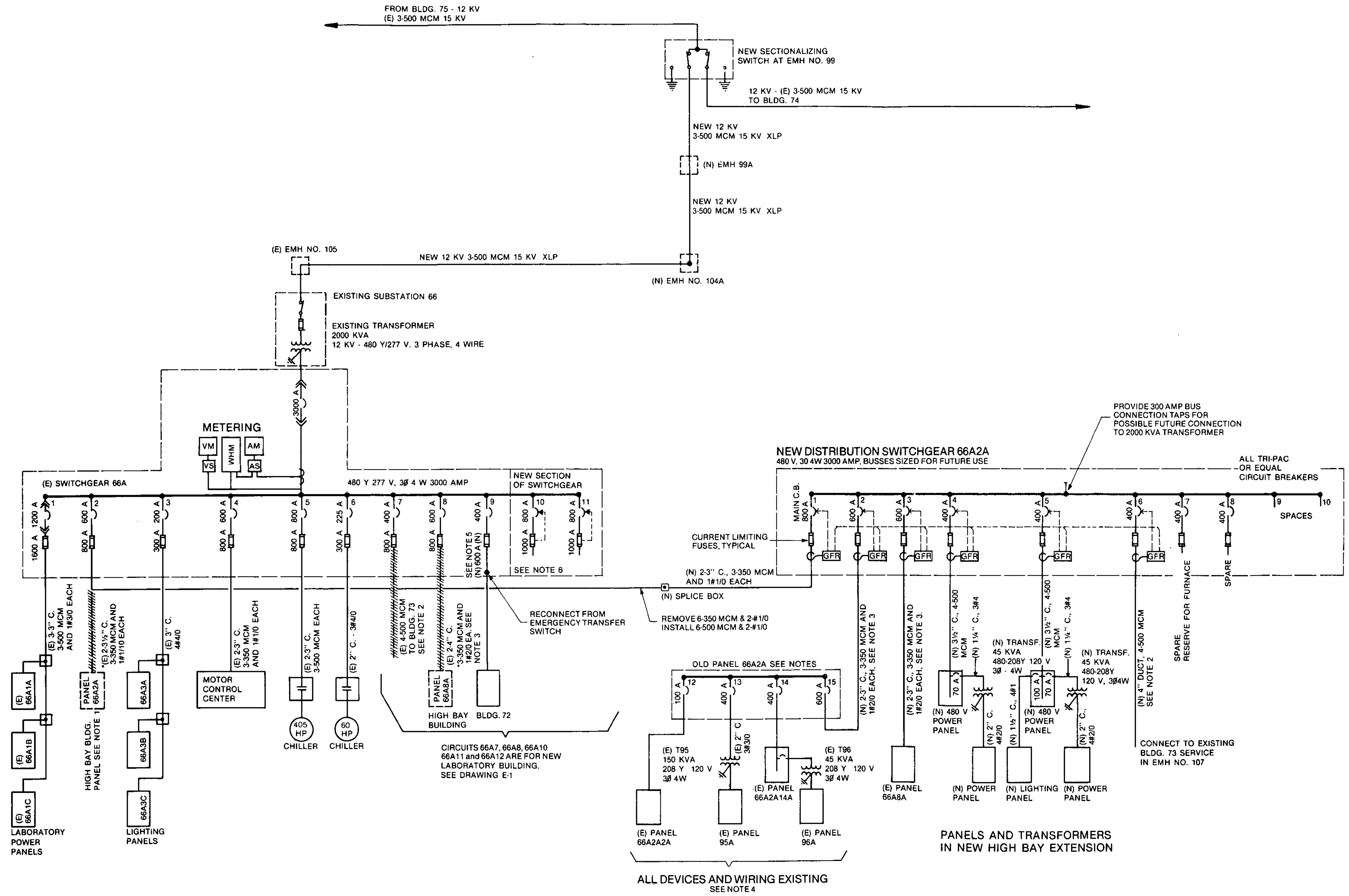
MATERIALS AND MOLECULAR RESEARCH LABORATORY

(SURFACE SCIENCE AND CATALYSIS FACILITY)
BUILDING 62

NOTES:

1. DISCONNECT FEEDER NO. 66A2 FROM PANEL 66A2A, REMOVE 2-350 MCM/ɸ & 2# 1/0 NEUTRALS & INSTALL 2-500 MCM/ɸ & 2# 3/0 NEUTRALS AND EXTEND TO NEW HIGH BAY SWITCHGEAR AND CONNECT TO CIRCUIT BREAKER NO. 1. THIS WILL BE USED AS A NORMAL FEEDER (800 AMP) TO NEW DISTRIBUTION SWITCHGEAR.
2. DISCONNECT FEEDER NO. 66A7 FOR BUILDING 73 AND REMOVE TO EMH NO. 107. NEW FEEDER WILL BE RUN FROM NEW SWITCHGEAR TO EMH NO. 107 AND CONNECTED TO EXISTING FEEDER TO BUILDING 73.
3. REMOVE FEEDER NO. 66A8. PANEL NO. 66A8A WILL BE FED FROM NEW SWITCHGEAR.
4. RENUMBER EXISTING 480 VOLT PANELS IN HIGH BAY BUILDING TO CORRESPOND TO NUMBER ASSIGNED TO NEW DISTRIBUTION SWITCHGEAR 66A2A.
5. IN EXISTING SWITCHGEAR NO. 66A SPACE NO. 9, PROVIDE & INSTALL A 400 AMP CIRCUIT BREAKER AND 600 AMP CURRENT LIMITING FUSE. THIS WORK TO BE DONE BY LBL.
6. FURNISH AND INSTALL A NEW SECTION OF SWITCHGEAR TO MATCH EXISTING WITH TRI-PAC CIRCUIT BREAKERS AS SHOWN.

*ALL EXISTING FEEDERS ARE TO REMAIN IN PLACE, EXCEPT DISCONNECT & REMOVE FROM SWITCHGEAR ENCLOSURES. THESE CAN BE USED AS FUTURE FEEDERS. REMOVE ONLY THOSE THAT MUST BE REMOVED SUCH AS WHEN DUCTS ARE TO BE ABANDONED AND TAKEN OUT.



REVISED ONE LINE DIAGRAM EXISTING BUILDING AND HIGH BAY

E2

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RL-1046 — SIZE 4

SECTION VI

OUTLINE SPECIFICATIONS

Contents

DIVISION 1 - GENERAL REQUIREMENTS

Section 1A - Summary of Work 6-1

DIVISION 2 - SITE WORK

Section 2A - Clearing 6-3
Section 2B - Demolition 6-3
Section 2C - Earthwork. 6-3
Section 2D - Site Drainage. 6-4
Section 2E - Site Mechanical Work 6-5
Section 2F - Site Electrical Work 6-6
Section 2G - Asphalt Paving 6-8
Section 2H - Landscaping 6-8

DIVISION 3 - CONCRETE

Section 3A - Concrete Work 6-9

DIVISION 4 - MASONRY

Section 4A - Concrete Masonry Work 6-10

DIVISION 5 - METALS

Section 5A - Structural and Miscellaneous Steel 6-10
Section 5B - Metal Deck and Siding 6-10
Section 5C - Metal Siding 6-11

DIVISION 6 - WOOD AND PLASTICS

Section 6A - Rough and Finish Carpentry 6-11

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Section 7A - Roofing and Roof Insulation 6-12
Section 7B - Flashing and Sheet Metal 6-12
Section 7C - Caulking and Sealants 6-13
Section 7D - Exterior Wall Thermal Insulation 6-13
Section 7E - Waterproof Decks and Waterproofing 6-13

Contents (continued)

DIVISION 8 - DOORS AND WINDOWS

Section 8A - Hollow Metal Doors and Hollow Metal Frames . . 6-14
Section 8B - Wood Doors 6-14
Section 8C - Aluminum Windows, Doors and Entrances. 6-15
Section 8D - Glazing 6-15
Section 8E - Special Doors. 6-16
Section 8F - Hardware 6-16

DIVISION 9 - FINISHES

Section 9A - Gypsum Drywall 6-16
Section 9B - Resilient Flooring 6-17
Section 9C - Ceramic Tile 6-17
Section 9D - Acoustic Treatment 6-18
Section 9E - Painting 6-19
Section 9F - Fireproofing 6-19
Section 9G - Lathing and Plastering 6-20

DIVISION 10 - SPECIALTIES

Section 10A - Metal Toilet Compartments 6-20
Section 10B - Toilet Room Accessories 6-21
Section 10C - Fire Extinguisher Cabinets. 6-21
Section 10D - Computer Access Floor 6-21

DIVISION 11 - EQUIPMENT

Section 11A - Laboratory Furniture 6-22

DIVISION 12 - FURNISHINGS

Section 12A - Furniture and Carpeting 6-23

DIVISION 13 - SPECIAL CONSTRUCTION

None

DIVISION 14 - CONVEYING SYSTEMS

Section 14A - Elevator 6-23
Section 14B - Hoists and Cranes 6-24

DIVISION 15 - MECHANICAL

Section 15A - Plumbing 6-25
Section 15B - Heating, Ventilating and Air Conditioning . . 6-26
Section 15C - Automatic Fire Sprinklers 6-29

DIVISION 16 - ELECTRICAL

Section 16A - Interior Electrical Work 6-30

SECTION VI

OUTLINE SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 1A - SUMMARY OF WORK

A. Scope

This project entails the following major categories of work.

1. Site development, including earthwork, excavation, finished grading, and landscaping.
2. Utility relocation, including major electric power rerouting and sampling and holding tanks for contaminated waste water.
3. New building construction, including a new Materials and Molecular Research Laboratory and existing High Bay Structure Extension. Enclosed connecting corridors, Machine Shop and Conference/Reception Area are also part of the new construction and provide the required support and tie-in with the existing facility.
4. Alteration work is required at the exterior of the existing facility to accommodate the above mentioned tie-ins.

B. Materials and Systems

New construction will match the existing and shall be steel and reinforced concrete. New Laboratory Building shall be fully air conditioned.

C. Execution

All work will conform to highest standards of construction practices, and will conform to special Lawrence Berkeley Laboratory design standards. Applicable provisions of the following codes are hereby referred to and made a part of this work. All work performed shall be in accordance with such laws, regulations, and the latest edition of all applicable codes including, but not limited to:

1. 29 CFR Part 1926, Safety and Health Regulations for Construction, Department of Labor.

2. 29 CFR Part 1910, Occupational Safety and Health Standards, Department of Labor.

3. General Safety Requirements, EM 385-1-1, U. S. Corps of Engineers, (Department of Army).

4. National Fire Codes.

5. National Electrical Safety Code.

6. Lists of Inspected Appliances, Equipment and Materials (U.L.).

7. Approved Equipment Listing (FM).

8. Handbook of Rigging (Rossnagel).

9. Safety Code for Building Construction, ANSI A10.2.

10. California Administrative Code, Title 8, General Industry Safety Orders, Construction Safety Orders.

11. California Administrative Code, Title 19, Chapter 1, Title 24; Part 2, and Title 24, Part 6, Division T-19.

12. Uniform Building Code.

13. National Plumbing Code, ANSI A.40.8.

14. National Bureau of Standards "Design and Evaluation Criteria for Energy Conservation in New Buildings", No. NBSIR 74-452 latest edition.

Where codes or standard specifications other than those listed in this paragraph are referred to in the different Divisions of these specifications, it is understood that they apply as fully as if cited here.

Where differences exist between codes affecting this work, the code affording the greatest protection shall govern.

DIVISION 2 - SITE WORK

SECTION 2A - CLEARING

A. Scope

Accomplish all clearing and grubbing of existing topography as required to accommodate the new construction.

B. Materials

Clearing will be accomplished by power operated equipment of appropriate type for the task required and by hand equipment for close work.

SECTION 2B - DEMOLITION

A. Scope

Demolition work will include removal of pavement, curbs, walks, entry stairs, and metal end wall at the existing High Bay Building. Also included will be the cutting of new openings in the existing building wall to accommodate new circulation tie-in.

B. Materials

Demolition will be accomplished with power tools, as required. New wall openings in existing construction will be cut with concrete power saws.

SECTION 2C - EARTHWORK

A. Scope

1. Work includes all excavation, fill, and backfill, as well as site preparation. Work also encompasses slope grading and stabilization, drilling for reinforced concrete piles, trenching, neat excavations for footings and retaining walls, roadway preparation, backfilling of trenches, foundations and retaining walls, and the placing of base materials for slabs on grade and roadways.

2. ASTM Standards will be applied for the testing and control of earthwork.

3. Testing will be done by an independent laboratory selected by the Lawrence Berkeley Laboratory.

4. Shoring and lagging will be the responsibility of the Subcontractor.

B. Materials

1. Backfill in trenches to be paved and behind retaining walls will be previous fill.

2. Base under slabs on grade and roadways will be Class 2 aggregate base.

3. All backfill will be a non-expansive material. On-site excavated materials meeting these requirements may be used.

SECTION 2D - SITE DRAINAGE

A. Scope

Work includes interceptor trench drains, installation of perforated pipe subsurface drains, culvert, erosion control channels and ditches, storm water inlets and junction boxes, and storm water conduits.

B. Materials

1. Perforated pipe will be corrugated galvanized pipe which has been protected with a bituminous coating.

2. Manholes, catch basins, and junction boxes will be precast heavy duty type; lids and grating will sustain highway loading wheel loads.

3. Shallow culverts will be galvanized corrugated steel pipe with a bituminous coating.

4. Storm water piping at depths greater than 4 ft will be reinforced concrete pipe.

SECTION 2E - SITE MECHANICAL WORK

A. Scope

1. Furnish and install the following:

    a. New city water service for the Materials and Molecular Research Building.

    b. New natural gas service extended from the Laboratory service to the existing Laboratory and new addition.

    c. New rainwater leader outfall for the Materials and Molecular Research Building, including the connection to the existing storm sewer system.

    d. New sanitary sewer outfall for the Materials and Molecular Building, including the connection to the existing site sanitary sewer system and a sampling-holding tank system for monitoring.

B. Materials

1. Piping

Piping materials will be as follows:

Symbol	Service	Pressure, psig	Temperature,° F	Construction
CW	City water	120	60	Class 200 pipe, Class 250 fittings. Mechanical joints, clamped bends.
L	Rainwater leader	atm	--	Vitrified clay with bell and spigot compression joints.
SS	Sanitary sewer	atm	--	Extra heavy cast iron soil pipe
G	Natural gas	1,5 and 12	--	Schedule 40 steel with butt welded fittings, PG&E wrapped.

SECTION 2F - SITE ELECTRICAL WORK

A. Scope

1. The existing electrical services to the facility are located in unimproved areas to be occupied by the new buildings. The required grading will necessitate relocation of these services. In order to maintain a continuity of electrical and communication services, these relocations should be accomplished and/or temporary connections made before removal of the existing work.

2. It is proposed to relocate the new services in the improved street areas to avoid any relocation that would be required by future expansion of the facility.

3. A sectionalizing switch on the 12 KV service will be located adjacent to Electric Manhole No. 99 to isolate the service to Building 62 and to facilitate temporary and permanent connections.

4. A new duct bank for power and communications will be run from Electric Manhole No. 99 easterly along Cyclotron Road parallel to existing ducts approximately 220 ft to a new Manhole No. 99A to be built over the existing campus 4160 volt standby service to the area at the intersection of the facility driveway and Cyclotron Road. The existing power ducts from Manhole No. 99A to Campus Electric Manhole No. 134 will be maintained. The existing communications ducts will be relocated into the communications section of Manhole No. 99A. Temporary communications service from Manhole No. 99A to Manhole No. 134 will be provided.

5. A new power communications duct bank will be run down the driveway from Manhole No. 99A to a new Manhole, No. 104A, to be located near the entrance of Building 62.

   The required power and communications cables will then be installed from Manhole No. 99 to Manhole No. 104A via Manhole No. 99A. From Manhole No. 104A overhead power and communications cables will be run to Manhole No. 105 for temporary service to Building 62 during grading and the construction of the duct bank between Manhole Nos. 104A and 105. Ducts for the campus 4,160 volt service and associated communications will be included in the duct banks from Manhole No. 99A to Manhole No. 104A and continue in the bank to Manhole No. 105, but will bypass Manhole No. 105 and continue to Pull Box Y.

6. After the completion of the above ducts, new cables will be pulled in and service to Building 62 and the campus 4,160 volt system established on a permanent basis.

7. New indoor switchgear will be installed on the east side of the High Bay section of Building 62 to serve the High Bay area and to serve Building 73.

8. A new duct bank will be installed from Manhole No. 104A to a new Manhole, No. 107A, and on to Manhole No. 107. Ducts will be run from Manhole No. 107A into the utility trench in Building 62 High Bay.

9. Communications cables for Building 73 will be run from Manhole No. 104A to Manhole No. 107 via Manhole 107A, and connected to existing.

10. New ducts for communications to the new Laboratory Building will be provided from Manhole No. 105.

11. The feeder duct bank to Building 72 will be relocated to clear the new Laboratory and Office Building. A new pull box will be cut into the existing duct bank between existing Manhole No. 105 and Building 72, 20-ft north of the new building, and a new pull box will be installed near the northwest corner of the building. A new duct bank will be installed from existing Manhole No. 105 to existing pull box Y to the new manhole at the northwest corner of the building, and from this manhole to the new manhole cut into the existing duct bank. Conductors will be installed in the new duct bank and spliced to the feeder for Building 72 in Manhole No. 105 and the latter manhole. The existing duct bank crossing the new building site will be removed.

B. Materials

1. Manholes will be reinforced concrete either poured in place or precast. Covers will be suitable for traffic.

2. Duct beams will be made up of transite ducts, Korduct or equal, encased in reinforced concrete.

3. Primary conductors will be single conductor, 500 MCM ethylene propylene rubber, high voltage cable rated at 15,000 volts ungrounded, Anaconda Unishield or approved equal.

4. Oil switch will be rated for 400 amperes, 15,000 volt with terminations suitable for the conductors used. The switch shall be C & W type CRAL-M or equal.

SECTION 2G - ASPHALT PAVING

A. Scope

1. Work includes all new paving and patch paving for roadways, pathways and access drives.

2. Materials and paving methods will conform to the Standard Specifications of the State of California, Division of Highways.

B. Materials

1. Asphalt concrete surface will consist of a two(2) inch minimum layer of Type B aggregate, 85 - 100 percent penetration, steam refined asphalt.

2. Penetration prime coat, asphalt paint binder, and seal coat will conform to the Standard Specifications.

SECTION 2H - LANDSCAPING

A. Scope

Provide new landscaping as indicated on the drawings to include the following erosion control:

1. Trees

2. Ground Cover

3. Accent Planting

Automatic irrigation system will be provided where required.

B. Materials

All landscaping materials will be native to the area, and/or such that will adapt well to the locale. Materials, in general, will be evergreen, except for certain flowering varieties that are seasonal. All materials will be selected for low maintenance after initial establishment.

DIVISION 3 - CONCRETE

SECTION 3A - CONCRETE WORK

A. Scope

1. Includes supply and placement of concrete for cast-in-place caisons, foundations, footings, slabs on grade, walls, suspended beams and slabs, and miscellaneous concrete structures, including membraned and concrete-topped roof at the new Laboratory Building within the sight screen.

2. Preparation of mix designs.

3. All concrete work and materials will conform to applicable ASTM and ACI Specifications.

B. Materials

1. Concrete will have the following minimum 28 day compressive strengths:

Foundations and Footings	3,000 psi
Slabs on Grade	3,500 psi
Beams and Girders	4,000 psi
Suspended Slabs	4,000 psi
Walls	3,000 psi
Prestressed Concrete (if required for special structural considerations)	5,000 psi

2. Reinforcing steel will be intermediate grade deformed bars.

3. Prestressing steel will be 1/2 inch diameter, 270,000 pound yield, strand.

DIVISION 4 - MASONRY

SECTION 4A - CONCRETE MASONRY WORK

A. Scope

Provide concrete masonry sight screen on roof of new Laboratory Building as indicated on the drawings.

B. Materials

Color and type of masonry units will match sight screen construction on the roof of the existing building.

DIVISION 5 - METALS

SECTION 5A-STRUCTURAL AND MISCELLANEOUS STEEL

A. Scope

1. Includes all structural and miscellaneous steel such as columns, beams, purlins, girts, framing for equipment and supports, and metals cast in concrete.
2. Shop drawings will be submitted for all fabricated steel.

B. Materials

1. All steel will conform to ASTM A-36
2. Field connections will be made with ASTM A-325 high strength bolts.
3. Welds will be made by certified welders and will confrom to AWS Standards.

SECTION 5B - METAL DECK AND SIDING

A. Scope

The extension to the High Bay will have a ribbed metal roof deck to match existing construction, and insulated metal siding. Laboratory building shall have metal floor deck.

B. Materials

The ribbed metal deck will be Robertson Number 3-18 or approved equal for high bay. Laboratory building shall have Inland Steel, type 1-1/2 in. BR Hi-Bond, 20 GA metal deck or approved equal.

SECTION 5C - METAL SIDING

A. Scope

The south wall of the High Bay extension shall be ribbed metal, insulated siding.

DIVISION 6 - WOOD AND PLASTICS

SECTION 6A - ROUGH AND FINISH CARPENTRY

A. Scope

This section includes all rough and finish carpentry work for interior nonbearing wood stud partitions, related fasteners and all other miscellaneous carpentry and mill work items.

B. Materials

Wood studs and miscellaneous wood framing will bear Underwriters Laboratories, Inc. FR-S Label indicating compliance with applicable regulations pertaining to use of noncombustible wood in building construction.

Cabinet work exclusive of Laboratory furniture will conform to WIC Standards for "Custom Grade" construction with plastic laminate exterior surfaces.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

SECTION 7A - ROOFING AND ROOF INSULATION

A. Scope

Furnish and install roofing and roof insulation at all roof areas with the exception of areas designated as "Solar Energy Research" and "Terrance", which shall be provided with roof insulation and waterproof walking deck construction.

B. Materials

1. Roof insulation:
    a. Laboratory Building roofing insulation will be lightweight, insulating concrete fill, sloped to drains and meeting prescribed "U" value for the roof construction in accordance with applicable regulations.

    b. High bay roof insulation will be rigid board insulation on metal roof deck.

2. Roofing shall be 4-ply asphalt, 20-year bondable type with aggregate surface. Color of aggregate to match existing.

SECTION 7B - FLASHING AND SHEET METAL

A. Scope

Flashing and sheet metal work will include all metal flashing, reglets, wall louvers, collars, and other miscellaneous items.

B. Materials

All flashing and sheet metal work will be fabricated from "Armco Zincgrip-Paintgrip" copper-bearing sheet steel, or approved equal. Reglets will be plastic, precaulked.

SECTION 7C - CAULKING AND SEALANTS

A. Scope

All joints at exterior surfaces subject to water penetration will be caulked.

B. Materials

Sealants will be either polysulfide, butyl, or silicone, as appropriate. Oil base compounds will not be permitted.

SECTION 7D - EXTERIOR WALL THERMAL INSULATION

A. Scope

Furnish and install exterior wall insulation for full height of wall at the exterior wall furring system (metal studs).

B. Materials

Insulation will be 3-1/2 inch glass fiber batt insulation meeting prescribed "U" value for the exterior wall construction in accordance with applicable regulations.

SECTION 7E - WATERPROOF DECKS AND WATERPROOFING

A. Scope

Furnish and install waterproof walking deck membrane at areas designated on the drawings as "Solar Energy Research" and "Terrace." Furnish and install waterproof membrane at walls of rooms below grade.

B. Materials

1. Waterproof walking decks will be built-up, continuous asphalt membrane applied over lightweight insulating concrete fill, all sloped to surface (and subsurface) drains. Walking surface will be concrete, provided under Division 3 - Concrete.

2. Below grade wall waterproofing membrane will be asphalt, gun applied, with glass fiber mat reinforcing.

DIVISION 8 - DOORS AND WINDOWS

SECTION 8A - HOLLOW METAL DOORS AND HOLLOW METAL FRAMES

A. Scope

Furnish and install hollow metal door frames at all door openings and hollow metal doors at all exterior locations and at rated interior openings, such as at stair enclosures and mechanical spaces. Furnish and install hollow metal trim at exterior windows to match existing detailing.

B. Materials

1. Door frames will be fully welded construction, 16 gauge steel.

2. Hollow metal doors will be flush seamless construction with incombustible core, 18 gauge steel.

3. Hollow metal window trim will be 18 gauge steel.

4. All hollow metal work will be job-delivered with a baked-on shop primer.

SECTION 8B - WOOD DOORS

A. Scope

Wood doors will be provided at all interior openings except at certain locations where metal doors are required at fire rated openings.

B. Materials

All interior wood doors will be flush face solid core, select white birch, conforming to Commercial Standard CS-171, Grade 1.

SECTION 8C - ALUMINUM WINDOWS, DOORS, AND ENTRANCES

A. Scope

Furnish and install aluminum windows, window wall construction, and new aluminum entrances.

B. Materials

1. Windows in the new Laboratory Building and High Bay Addition will be aluminum, and will match exactly the existing window design.
2. New window wall construction will be fabricated from stock aluminum rectangular extrusions, flush glazed.
3. New aluminum entrances will be fabricated from aluminum extrusions, narrow line design.

SECTION 8D - GLAZING

A. Scope

Furnish and install glass at all new windows, window wall construction, and aluminum entrances. Furnish and install glass at door lights and interior view windows.

B. Materials

1. Glass at exterior windows and window wall construction will be "B" quality, 7/32-inch thick.
2. Lights at interior doors, entrance doors, and view windows will be 1/4-inch thick, tempered.
3. Lights at hollow metal doors will be 1/4-inch thick, polished wire glass with welded diamond mesh.

SECTION 8E - SPECIAL DOORS

A. Scope

Metal roll-up doors will be provided where indicated on the drawings.

B. Materials

Doors will be electrically operated with safety toe piece, flat faced slats. Door assembly will be factory shop primed.

SECTION 8F - HARDWARE

A. Scope

Finish hardware will be provided at all new door openings.

B. Materials

1. Locksets and latchers will match existing construction and will be Schlage Type C, Saturn design, dull chrome (US 26D) finish.

2. Great grand master key all cylinders to existing system.

3. Closers, kickplates, butts, stops, and all other miscellaneous hardware will match existing design and quality.

DIVISION 9 - FINISHES

SECTION 9A - GYPSUM DRYWALL

A. Scope

1. Provide gypsum drywall finish surfaces at all interior non-bearing partitions, and exterior wall furring.

2. Provide 3-1/2 inch metal studs at all exterior walls (for 3-1/2 inch batt insulation), and metal furring channels at interior concrete walls where indicated on the drawings.

3. Provide suspended gypsum board ceilings in toilets and other designated areas.

B. Materials

1. Wall and ceiling gypsum board will be 5/8 inch thick.

2. Metal studs will be 3-1/2 inch, 25 gauge, galvanized.

3. Suspended ceiling system will be comprised of wire hangers, runner channels and furring channels with seismic bracing system per applicable standards.

SECTION 9B - RESILIENT FLOORING

A. Scope

Furnish and install resilient flooring and top-set resilient base at all room spaces except toilets, carpeted areas and mechanical areas.

B. Materials

1. Resilient flooring will be 12 inch by 12 inch vinyl asbestos, 1/8 inch thick.

2. Base will be vinyl or rubber, 4 inch high, coved, with preformed exterior corners.

SECTION 9C - CERAMIC TILE

A. Scope

Ceramic tile floors and wainscots will be provided in all toilet rooms. Mortar set method at floor tile, and inorganic adhesive setting method at wall tile.

B. Materials

Wall tile will be matt glazed 4-1/4 inch by 6 inch. Floor tile will be unglazed vitreous porcelain mosaic, one inch by one inch.

SECTION 9D - ACOUSTIC TREATMENT

A. Scope

Furnish and install suspended acoustical ceiling system in all laboratory and office spaces. Provide acoustical sound attenuation blanket in partition cavities of all toilet room partitions, office to laboratory separating partitions, mechanical and compressor room partitions, and other locations where sound attenuation is required.

Gypsum wall board will be installed on resilient sound attenuating channels over metal ceiling suspension system at mechanical equipment and compressor rooms, with a vinyl-faced sound attenuation blanket attached thereto.

B. Materials

1. Suspended acoustical ceiling system will be comprised of two foot by four foot lay-in washable face acoustical board in an inverted, factory finished metal tee-grid. Space above ceiling will be completely accessible. Seismic bracing system will be provided per applicable standards.

2. Acoustical sound deadening material will be three inches thick at walls, 2-inch thick at mechanical room ceiling.

SECTION 9E - PAINTING

A. Scope

Provide finish painting at all exposed nonfactory finished surfaces, interior and exterior, as follows:

1. Woodwork

2. Metals

3. Sheet Metal

4. Concrete Surfaces (Sealer at Exterior Concrete)

5. Cypsum Board

6. Exposed Piping and Duct Work

B. Materials

All paint materials will be of one manufacturer, with the exception of certain specialty items that may be required. Paints will be delivered to the site in manufacturer's unopened containers, and no thinning will be allowed unless specifically authorized by the manufacturer.

C. Execution

All paint work shall be three-coat except a four-coat stain and lacquer system will be used at wood doors, and exterior concrete sealer will be a two-coat system.

SECTION 9F - FIREPROOFING

A. Scope

Furnish all materials, labor, equipment and supervision to install steel spray fireproofing.

B. Materials

Steel spray fireproofing materials will be a mill mix, cementitious-only compound, bearing proper U.L. Inc. label.

C. Application

Application shall be to structural steel which is not encased in concrete, and the underside of steel floor and roof decking: Thicknesses for a minimum rating of 2 hour fire resistance shall be provided in accordance with applicable codes and regulations. Material shall be sprayed to surfaces which are clean of dust, grease, and oil base paint. Ducts, piping, conduit and other equipment which could cause interference with uniform application are to be positioned after fireproofing spray application.

SECTION 9G - LATHING AND PLASTERING

A. Scope

Furnish and install metal plaster studding, ceiling suspension system, metal lath, and cement plaster at balcony soffits and window spandrels.

B. Materials

1. Window spandrels:
    a. 18 gauge metal studs with paper backed metal lath.
    b. Scratch, brown and finish coat of cement plaster, with finish coat "Marblecrete," color of aggregate to match existing building. Total thickness, 1 inch.
2. Cement plaster soffits:
    a. Metal furring suspension system with expanded metal lath.
    b. Scratch, brown and finish coats of cement plaster. Total thickness, 1 inch.

DIVISION 10 - SPECIALTIES

SECTION 10A - METAL TOILET COMPARTMENTS

A. Scope

Furnish and install metal toilet compartments, urinal screens and sight screens as indicated on the drawings.

B. Materials

Toilet compartments will be floor supported type, baked enamel finish. Urinal and sight screens will be wall hung type, finish and construction to match the toilet compartments.

SECTION 10B - TOILET ROOM ACCESSORIES

A. Scope

In each toilet room provide mirror and shelf units, toilet paper dispensers, seat cover dispensers, and combination paper towel dispenser/disposal units.

B. Materials

All accessories will be stainless steel. Paper towel dispenser/ disposal unit will be wall-mounted, and semi-recessed type.

SECTION 10C - FIRE EXTINGUISHER CABINETS

A. Scope

Furnish and install wall-mounted fire extinguisher cabinets in locations as required by Code and Lawrence Berkeley Laboratory.

B. Materials

Cabinets will be of size and type as required by Lawrence Berkeley Laboratory.

SECTION 10D - COMPUTER ACCESS FLOOR

A. Scope

Furnish and install access floor for the Computer Terminal Room, complete with removable floor panels, floor support system, carpeting, and electrical grounding system.

B. Materials

1. Access floor panels will be 24 inch square, capable of supporting a 250 lb per square foot uniformly distributed live load, and a concentrated 1000 lb load on one square inch at any panel point. Fire rating of panel will be Class A.

2. Pedestal support system will be capable of supporting 1000 lb per pedestal vertical load, and with panel system installed, a 200 lb lateral load per pedestal (applied at top) without deformation.

3. Stringer grid system will support the previously described panel loadings plus a minimum lateral load of 1000 lb at any one grid intersection without transferring forces to building structure outside the grid.

4. Panel covering shall be nylon filament carpet, 24 oz per square yard weight, with metal fibers for control of static electricity.

5. Electrical grounding shall be continuous throughout panels, stringers and pedestal supports. Grounding of the floor system to the building ground will be accomplished by the installer of the access floor system.

DIVISION 11 - EQUIPMENT

SECTION 11A - LABORATORY FURNITURE

A. Scope

Manufacture, deliver, assemble and install all Laboratory furniture, including work tops and reagent shelves, base cabinets, work benches, storage cabinets and fume hoods.

B. Materials

Laboratory furniture will be modular, plastic laminate clad as manufactured by Hamilton Manufacturing Company, Laboratory Furniture Company, Permalab Equipment Corporation or other approved fabricator. Stainless steel tops will be provided where required.

DIVISION 12 - FURNISHINGS

SECTION 12A - FURNITURE AND CARPETING

A. Scope

Provide commercial grade specialty furniture items to include Reception Area seating, related tables and stack seating for the Conference Room. Provide commercial grade carpeting in same areas.

B. Materials

Furniture and carpeting will be design coordinated for color and and texture to properly define the special areas discussed above.

DIVISION 13 - SPECIAL CONSTRUCTION

None

DIVISION 14 - CONVEYING SYSTEMS

SECTION 14A - ELEVATOR

A. Scope

Furnish and install combination freight and passenger elevator in new Laboratory Building, with single automatic push button operation.

B. Materials

1. Car platform will be 7 ft wide and 8 ft 4-inch deep, resulting in an effective usable area of 6 ft 8-inch wide by 7 ft 7-inch deep.

2. Maximum capacity will be 5,000 pounds and minimum "up" speed shall be 80 feet per minute.

3. Car entrance will be 4 ft 6-inch by 7 ft clear with two-speed horizontal sliding doors.

4. Car ceiling panels will be readily removable to accommodate transport of excessively long test specimens.

5. Elevator operation will be hydraulic.

SECTION 14B - HOISTS AND CRANES

A. Scope

Extend existing ten ton overhead crane assembly in new High Bay Addition. Furnish and install new half ton traveling crane assembly in the Machine Shop.

B. Materials

New crane assemblies will meet all NEMA classification requirements, and applicable regulations of the Electric Overhead Crane Institute and the California Industrual Safety Regulations.

DIVISION 15A - MECHANICAL

SECTION 15 A - PLUMBING

A. Scope

1. Furnish and install the following:
    a. New building acid waste system.
    b. New building plumbing system, including plumbing fixtures, hot and cold water system.
    c. Extension of the low conductivity water system in the existing Laboratory building.
    d. New industrial hot and cold water system.

e. New compressed air system, and supplementing system in the existing Laboratory building.

f. New building natural gas system and extension of same to new High Bay Addition.

g. Extension of demineralized water system from existing to new Laboratory building.

h. Extension of existing services to the new High Bay Addition.

B. Materials

1. Piping

Piping materials will be as follows:

Symbols	Service	Pressure psig	Temperature,° F	Construction
CW,	City Water,	80	60-140	Type L copper with 95-5 solder fittings.
HW, ICW, IHW, LCWS&R	Domestic Hot water, Industrial Cold and Hot Water, Low Conductivity Supply and Return			
CA	Compressed Air	100	60	Type L copper with 95-5 solder fittings.
G	Natural Gas	7-inch Water Column 5	-	Schedule 40 steel with butt welded or socket welded fittings.
L,	Rainwater Leader,	atm	-	Schedule 40 galvanized steel with CI fittings
SS	Sanitary Sewer			C.I. Soil pipe, extra heavy
AW	Acid Waste	atm		Polypropylene drainage pipe with "Fusal" joints and metal spool through floors.
DES DER	Demineralized Water Supply and Return	55	-	Schedule 80 PVC with socket weld fittings.

2. Valves

Valves will be threaded or flanged, all bronze or bronze-trimmed iron disc or butterfly type as manufactured by Nibco, Kennedy or equal. Natural gas valves will be lubricated plug type. Demineralized water valves will be Hills McCanna or Cabot, PVC ball valves with teflon seats. Pressure reducing valves will be C. M. Bailey Model 30 or equal. Backflow preventers will be Watts or Beeko reduced pressure type.

3. Water Heaters

The water heaters will be vertical storage type, cement lined, ASME code stamped with copper "U" type heat exchangers.

4. Pumps

Circulating pumps will be all bronze in-line type with built-in thermostat, Thrush tupe BW or equal. LCW booster pumps will be Pacific Pumping Company or approved equal, Type L, end suction, centrifugals. The pumps will have flexibly coupled motors mounted on the pump base. The pumps shall be resiliently mounted.

5. Air Compressors

The air compressors will be Ingersoll-Rand or DeVilbiss tank mounted type, with ASME code stamped tanks, pressure reliev valves, and water cooled integral aftercoolers. The compressors will be supplied with drain traps.

6. Refrigerated Air Dryer

The refrigerated air dryer will be an Ingersoll-Rand or equal air-cooled refrigerated type capable of cooling twice the air compressor capacity of air to 35° F at 100 psig. All components will be rated for 100 psig.

SECTION 15B - HEATING, VENTILATING AND AIR CONDITIONING

A. Scope

1. Furnish and install the following:
    a. Exhaust system
    b. Central supply air system

c. Central hot water heating system

d. Extension of chilled water system from existing laboratory to new laboratory building

e. Replacement of chilled water pumps in the existing laboratory building.

f. Extension of the existing High Bay ventilating system to new High Bay addition.

B. Materials

1. Main supply fans will be Joy Series 1000 or approved equal vane axial fans, two each for the supply air system. The fans will be supplied with inlet bell, explosion proof motor, outlet cone, and adjustable pitch blades. They shall be mounted on spring-type vibration isolators with one-inch minimum deflection and lateral restraints.

2. Cooling and heating coils shall be copper tube copper fin type, minimum six rows, maximum eight fins per inch, sized for 500 fpm face velocity. The coils will be circuited for turbulent flow and provided with drain pans fabricated according to the SMACNA Manual.

3. Air filters will be high capacity extended media type, Cambridge Hi-Flo or approved equal with maximum face velocity of 250 fpm and minimum media of 60 square feet net area per 1,000 cfm. The filters shall be 93 to 97 percent efficient when tested according to the ASHRAE method. The filters shall be NFPA Class II.

4. All duct work and built-up fan and coil plenums will be galvanized steel, fabricated according to the low velocity section of the SMACNA Manual. It will be insulated and sound lined where necessary. The fan and coil plenums will be lined with minimum one inch thick six pound per cubic foot density, rigid fiberglass board, with air side coating, Fiberglass type 705 or equal.

   All laboratory exhaust system ducting will be flanged at 4 ft 0-inch maximum centers and epoxy coated inside for corrosion resistance. Factory fabricated fiberglass ducting will be considered for the supply air system.

5. Heating water boilers will be Bryan, type L or CL water tube forced draft burners suitable for conversion to oil.

6. Expansion tanks shall be American Tube and Controls Extrol or approved equal diaphragm type with accompanying air eliminator and makeup water inlet fittings. The expansion tank pressure will be 12 psig higher than the highest water column in the pipe lines above the boilers.

7. Pumps shall be Pacific Pumping Company or approved equal type L end suction centrifugals or type KP split case centrifugals. The pumps will have flexibly coupled motors mounted on the pump base. The pumps will be resiliently mounted.

8. Heating hot water and chilled water piping will be Schedule 40 steel pipe with butt welded steel fittings or 125 pound flanged fittings for pipes 2-1/2 inch and larger. Use 125 pound cast iron screwed fittings for smaller pipes. All piping will be resiliently mounted in the Mechanical Room and resiliently isolated from rotating machinery with flexible connectors. Piping will be insulated with one inch minimum thickness glass fiber insulation with fire retardant jacket and molded glass fiber pipe fitting insulation, except chilled wate piping which will be cellular glass one inch thick. All connections to machinery will be made with unions or flanges for ease of disconnection.

9. Valves will be threaded according to the fittings above, 125 pound standard, all bronze disc type, lug style butterfly type, or stainless steel ball type, Nibco, Kennedy, Dezurik, Wooster or equal. Check valves will be swing type, all bronze screwed or bronze trimmed, flanged Nibco or approved equal. All heating and cooling coils shall have Dezurik or approved equal Series 100 eccentric balancing valves with memory stops.

10. Control valves will be 125 pound standard screwed or flanged with equal percentage characterized ports for heating water and linear characterized ports for chilled or energy recovery water. All valves will be provided with pressure taps on all sides for balancing flows.

11. Exhaust fans will be American Standard or approved equal, Series 106 industrial exhaust fans with corrosion resistant epoxy coating on all parts in the air stream. The fans will be supplied with motor housing, bolt guard and vibration mounts.

SECTION 15C - AUTOMATIC FIRE SPRINKLERS

A. Scope

1. All spaces of new building will have fire sprinklers.
2. Water service for fire sprinklers including connection to the existing site water main.
3. Design of the entire system including submission to fire protection authorities.

B. Materials

1.	Piping	
	Below Grade	Class 200 cast iron pipe with mechanical joints and clamped fittings.
	Above Grade	Schedule 40 steel with 150 pound banded malleable iron threaded fittings.
2.	Valves	Underwriters' Laboratories listed OS&Y type, bronze fitted, cast iron.
3.	Sprinkler Heads	Pendant type in ceiling or where piping is exposed, flush type in areas with ceilings.
4.	Sprinkler Riser	Underwriters' Laboratories listed flow and control devices.

DIVISION 16 - ELECTRICAL

A. Scope

1. High Bay Building

a. In existing High Bay Building, install a new main distribution switchboard rated at 3,000 amperes, 480Y/277 volts, 3-phase, 4-wire. Panelboard will be served from existing switchgear No. 66A.

b. Reconnect existing High Bay Building feeders to new main distribution switchboard as follows:

(1) Panel 66A2A

(2) Panel 66A8A

(3) Building 73 feeder

c. Enlarge and extend existing feeder from existing switchgear 66A to new main distribution switchboard in the High Bay Building. This will serve as the normal power source to new main panel.

d. In new High Bay Building extension, install the following new panelboards:

(1) Two 400-amperes, 480-volt, 3-phase, 3-wire power panels, one on each side of the building.

(2) One 480Y/277 volt, 3-phase, 4-wire, lighting panel.

(3) Two 208Y/277 volt, 3-phase, 4-wire receptable and research power panelboards served by two 45 KVA 480-208Y/120 volt dry type transformers. Power for the transformers will be supplied by the 480 volt power panelboards.

(4) Install a 45 KVA 480-280Y/120 volt, 3-phase, 4-wire step-down transformer and panelboards as required to provide for emergency lighting and low voltage power.

e. Install 120 volts, 208 volt, and 480 volt power outlets as required.

f. Extend telephone system.

g. Extend paging system.

h. Extend fire alarm system.

i. Install system grounding and equipment grounding conductors.

2. Laboratory and Office Building

a. Modify existing Switchgear No. 66A and add a new section to provide circuit breakers for feeders to the new Laboratory Building.

b. Install laboratory power distribution system as follows:

(1) Install two main 480 volt power panels on second floor, one at each end of the service corridor.

(2) Install two 112.5 KVA 480 - 208Y/120 volt, 3 phase, 4 wire step down transformers on each floor.

(3) Install a 208Y/120 volt, 3 phase, 4 wire 400 ampere distribution panel for each of these transformers.

(4) Install 208Y/120 volt, 2 phase, 4 wire 100 ampere panelboards and feeders in each laboratory and where required to probide 208Y/120 volt power for general building use.

c. Install lighting panels at 277/480 volts on each floor. These panels will be tapped to a main lighting riser.

d. Install 480 volt, 3 phase, 4 wire 400 ampere. Machine Shop panelboard and feeder.

e. Install a 480 volt, 3 phase motor control center and feeder for building mechanical equipment.

f. Install emergency power system as follows:

(1) Install 100 KW 277Y/480 volt, 3 phase, 4 wire diesel-generator complete with automatic transfer switch.

(2) Install 277Y/480 volt, 3 phase, 4 wire emergency power distribution panel.

(3) Install 480 volt, 3 phase emergency motor control center for hood exhaust fans.

g. Install 120 volt, 208 volt, and 480 volt power outlets as required for laboratory and general use.

h. Install lighting system complete with all fixtures, switches and necessary auxiliary apparatus.

i. Install all motor branch circuits complete with motor connections and control devices as required.

j. Install a system of underfloor ducts in the machine shop for power distribution to machine tools.

k. Install power feeder and disconnect switch for elevator equipment.

l. Install a system of raceways and outlets for telephone equipment.

m. Install raceways and outlets for paging system.

n. Extend existing fire alarm system into the new Laboratory Building and connect up sprinkler system flow switches. Install manual fire alarm stations as required.

o. Install system and equipment grounding.

B. Materials

1. Main Distribution Switchboard - High Bay Building

The main distribution switchboard will be equipped with circuit breakers and current-limiting fuses to limit the fault current. Each feeder breaker will be equipped with a ground fault relay with a restraint circuit to the ground fault relay at the main circuit breaker.

2. Panelboards

Panelboards will be installed where required and shall be flush or surface mounted as required by building construction. Trim shall be of the door/indoor type. Panels will be equipped with equipment grounding blocks.

a. Panelboards for 277/480 volt, three phase, four wire and 480 volt, three phase, three wire shall be Westinghouse Type CDP, or approved equal. Circuit breakers shall have a minimum interrupting rating of 22,000 amperes RMS.

b. Lighting panelboards will be 277/480 volt, three phase, four wire, Westinghouse Type WEHB, or equal. Circuit breakers shall have a minimum interrupting rating of 14,000 amperes RMS. Main breakers will be current limiting type Westinghouse Tri-Pak, or equal.

c. The 208Y/120 volt, three phase, four wire panelboards for receptacles and miscellaneous equipment shall be Westinghouse Type WEB, or approved equal.

3. Motor Control Centers

Motor control centers will be installed where required for building mechanical equipment. The motor control centers will be made up of vertical sections having plug-in combination motor circuit protectors with current limiters as required for the equipment. Control voltage will be 120 volts with control transformer in each plug-in unit. A ground bus, full length of the motor control center, will be provided. The motor control centers will be General Electric 7700 line, or approved equal.

4. Lighting Fixtures

a. High Bay Building

Industrial fluorescent fixtures with 1500 -mA Power Groove lamps to match existing building lighting.

b. Laboratory Building

(1) Offices: 2 × 4 ft. lay-in fluorescent troffers, return air type, with acrylic prismatic lenses.

(2) Laboratories: 2 × 4 ft. lay-in fluorescent troffers with acrylic prismatic lenses.

(3) Conference Room: Same type as offices equipped with dimming controls.

(4) Service Corridors: Industrial two lamp fluorescent fixtures with baked enamel finish.

5. Receptacles

Receptacles at 120 volt, single phase and 208 volt, three phase will be provided as required for building services, research equipment and for convenience outlets.

a. Duplex receptacles will be rated 20 ampere, 125 volt, three wire Hubbell No. 5362, or approved equal.

b. Three phase receptacles shall be rate 20 amperes, 120/208 volt, three phase wye, four pole, five wire, Hubbell Twistlock No. 2510, or approved equal.

6. Conductors

All conductors will be copper as follows:

a. Conductors No. 10 AWG and smaller will be solid; No. 8 AWG and larger will be stranded.

b. Conductors No. 6 AWG and smaller will be Type THWN or THHN; No. 4 AWG and larger will be Type THWN or THHN.

c. Control conductors will be Type TWM, stranded copper.

7. Conduits

Conduits will be galvanized or sherardized steel.

C. Execution

1. Conduit Installation

a. Conduits will be installed concealed where possible. Outlet boxes in laboratories, offices, corridors and other finished areas will be installed flush. In service corridors, shops, equipment rooms, etc., boxes may be surface mounted.

b. All wiring will be installed in conduit. Electrical metallic tubing, two inch and smaller, will be used in all concealed work. Complete runs of exposed conduit, two inch and smaller, in protected areas, more than five feet above the floor may be electrical metallic tubing.

2. Grounding

   a. High Bay Building

      The existing building grounding system will be copper ground loop extended around the Building Addition. The new Main Switchgear will be grounded to this system.

   b. Laboratory Building

      Main ground shall be a 3/8-inch galvanized strand, minimum 25-feet long, within two inches of bottom of building foundations. This conductor will be center-tapped and brought out of foundation to connect to the building and service grounding system.

   c. System and equipment grounding

      (1) Connections will be made to the above grounding system for grounding the neutrals of the various 480Y/277 volt and 208Y/120 volt transformers.

      (2) The equipment ground block in each panel will be connected to the ground system.

      (3) Each feeder and branch circuit will have a bare copper equipment grounding conductor in the same raceway as the circuit power conductors. The grounding conductor will be electrically and mechanically connected to the panelboard equipment grounding block.

3. Fire alarm system

   a. High Bay Building

      The existing system of heat detectors and manual pull boxes will be extended into the Building Addition.

   b. Laboratory Building

      (1) The building will be protected by a sprinkler system. Flow switches will be provided under the Mechanical Division. These switches will be connected into the LBL fire alarm system with transmitters to properly indicate location.

      (2) Manual fire alarm stations, as required, will be provided.

4. Telephone system

Telephone terminal closets will be provided on each floor. Conduits sized to suit the system needs will be run from the terminal closets to telephone outlets in the offices, laboratories and elsewhere as required. The outlets will consist of a flush 4-11/16 in. square box with double device plaster ring and double device plate with cable hole.

5. Mechanical equipment connections

a. Necessary power and control wiring, starters, contactors, relays, push buttons and switches will be installed and connected for the mechanical equipment furnished under Mechanical Section.

b. The required power wiring, disconnect switches and crane runway conductors will be provided for all cranes.

6. Equipment identification

Each panelboard, motor control switch, starter, wiring device, etc., will be identified by circuit number with an engraved nameplate. Transformers will be identified by number, KVA and voltage ratings and primary circuit number.

D. Quality Assurance

The installation will comply with the requirements of the State of California Administrative Code, Title 8, Subchapter 5, Electrical Safety Orders, California Occupational Safety Health Act, applicable City and County rules and regulations, and the National Electrical Code, latest edition.

SECTION VII

ENERGY CONSERVATION REPORT

The purpose of this study is to comply with ASHRAE 90-75, "Design and Evaluation Criteria for Energy Conservation in New Buildings," and ERDA Appendix 6301, "Energy Conservation Design Criteria," to explore various energy saving methods and implement these methods in the conceptual design modification. The following outlines these conditions.

A. MECHANICAL SYSTEMS

1. Heating, Ventilating and Air Conditioning

The systems analyzed for the Addition to Building 62 utilize the ample capacity of existing water chilling equipment and cooling towers to handle the new HVAC load.

Two groups of systems have been analyzed based upon different approaches. The services of the Trane Company were used to model the building addition on the Trace Computer Program.

The first group consists of the two systems shown in Table I. Each represents a practical, conventional approach to maintaining constant air volume through the laboratories (and hoods) to ensure safe exhaust of hazardous fumes. Each supplies 100% air conditioning to the building.

The most energy-efficient of the two, System B, is the most expensive, but it provides for either heating or cooling through coils in each zone, obviating the necessity to cool air to the lowest temperature required by a given zone and then to reheat it to a higher temperature for other zones. System B is the basis for the HVAC cost estimate and is described in Section VI, Division 15, Section 15D, in the Outline Specifications of this report.

The second group of systems analyzed for this project represent approaches which we expect will result in less energy use and less first cost. These systems are based upon less predictable data with respect to the safe exhaust of hazardous fumes, with respect to the quantity of air conditioning required at start up and consequently as a basis for cost. The incentive for investigation of this second group of systems came as a result of the rather high energy use, 395.590 Btu/S.F./yr, predicted by the computer run for System B, Table I.

TABLE I

HEATING, VENTILATING, AND AIR CONDITIONING SYSTEM TYPES AND COMPONENTS

System	Air, Heating, and cooling system	Cooling Plant	Heating Plant	Total Cost/SF	Energy Consumed Btu/SF/yr
A	Constant volume terminal reheat	Existing centrifugal chiller	New oil-fired boilers	$13.96	529,044
B	Constant volume terminal heating and cooling	Existing centrifugal chiller	New oil-fired boilers	$15.37	395,590

TABLE II

HEATING, VENTILATING, AND AIR CONDITIONING ENERGY USE AND COST ANALYSIS

	Energy Consumed						Ranking	
System	Electric KW-hour per year	Oil Therms per year	Water 1000 gal per year	System first cost	Total annual owning and operating cost	Present worth owning and operating cost	Lowest energy use	Lowest owning and operating cost
A	3,058,180	205,697	2,659	$818,196	$967,981	$8,786,397	2	2
B	2,553,971	144,688	551	900,836	760,377	6,901,965	1	1

The results of the energy use analyses of systems in group B were not available when this report went to print, but will be presented as supplemental data in time for Field Review by ERDA Headquarters. Group II alternatives are described as follows:

a. Terminal Heating and Cooling

   (1) Air conditioning for 50% of laboratories, none for offices.

   (2) Same as (1) with heat recovery added.

b. Variable Air Volume

   (1) Air conditioning for 50% of laboratories, none for offices. Diversity factor of 50% applied to operation of hoods.

   (2) Same as (1) with heat recovery added.

B. IMPLEMENTED ENERGY SAVING METHODS

Other energy saving methods used and included in the conceptual design are as follows:

1. Heat gain and loss minimized by use of building materials with low heat transfer coefficients (Roof U = 0.084, Wall U = 0.110).
2. Return office portion ventilation air through the lighting fixtures, which reduces the heat load within the space, resulting in a reduction of fan capacity and motor horsepower requirements.

C. ADDITIONAL ENERGY CONSERVATION CONSIDERATIONS

Energy saving methods which are worthy of consideration, but are dependent on the type of heating, ventilating and air conditioning system equipment, are as follows:

1. Use of condenser water to heat water or outdoor air.
2. Use of an air-cooled condenser to heat incoming outdoor air.

3. Use of refrigerant hot gas to heat water or incoming outdoor air.

4. Use of solar energy to produce hot water for heating or domestic use, which is addressed separately under Section X. Hood air flow control to reduce amount of conditioned air exhausted by hoods. This could include one or more of the following:

   a. Variable air volume control

   b. Auxiliary outside air to hoods

   c. Exhaust heat recovery

NOTE: This section will be supplemented with additional material as soon as it is available. New computer runs are being made that have included alternate methods of energy conservation.

SECTION VIII

SOLAR ENERGY ANALYSIS

The feasibility of using solar energy for space and service water heating for MMRL was analyzed using the recent draft of the ERDA Solar Design Manual.

A. SOLAR SPACE AND SERVICE WATER SYSTEM

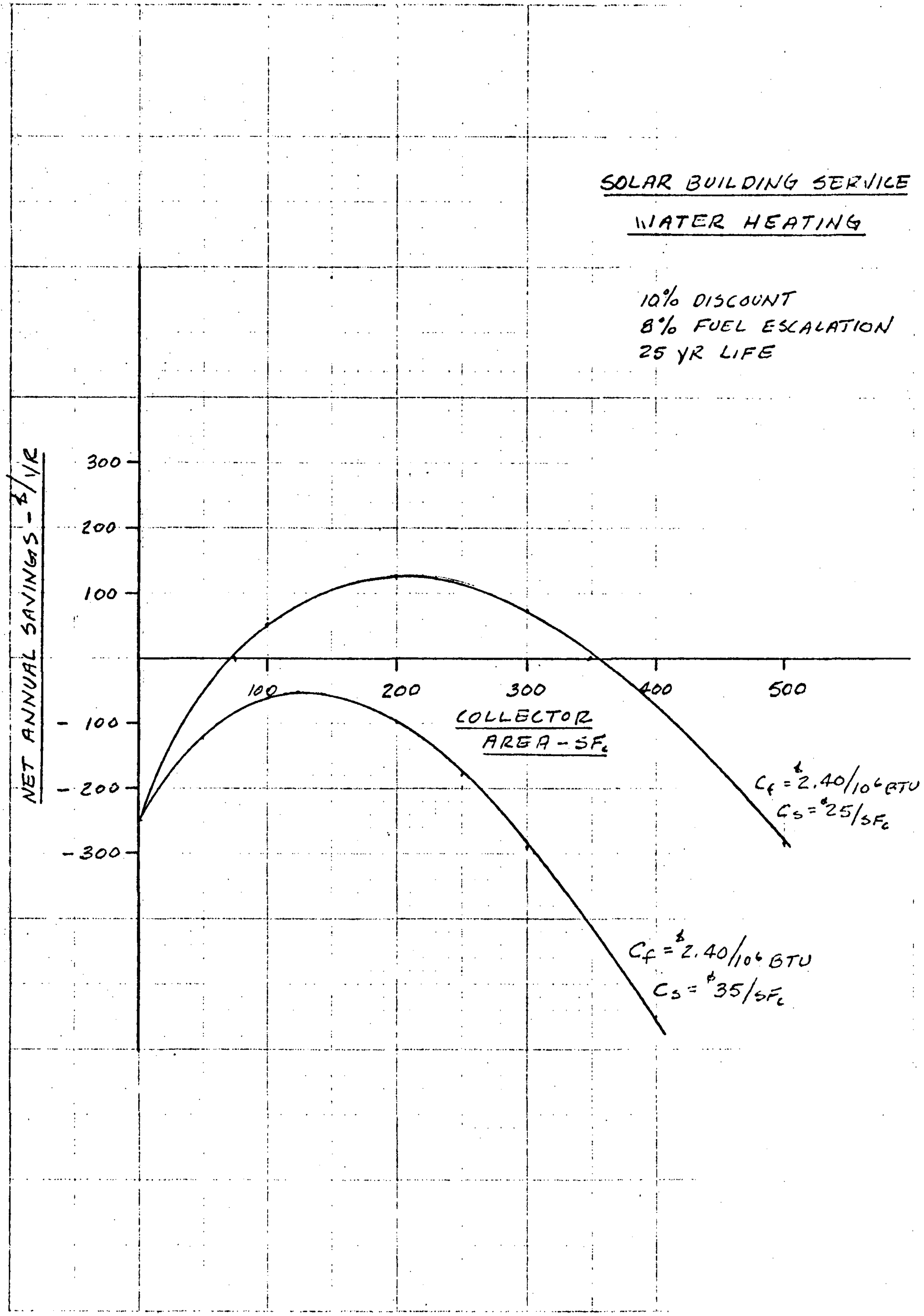
For a combination space and service water solar heating system assuming fuel oil prices of \$.35/gal (\$2.40/10^6 Btu), a 25 year life, 10% discount and 8% energy escalation rates, the simplified feasibility evaluation (Table 4-8) shows an allowable solar system cost of \$16 per square foot of collector (\$16/SF_c) to be cost effective in 25 years. This method assumes that 100% of the annual collected energy can be used, which is normally not the case for space heating systems in summer. Therefore, the actual allowable system cost would be less than \$16/SF_c. Since it is not currently feasible to construct a solar system of this type for these allowable costs no further analysis of a solar space heating system was undertaken.

B. SOLAR SERVICE WATER SYSTEM

As opposed to a solar space heating system, a service water-only system has a higher efficiency, the costs are often lower, and close to 100% of the annual collected energy could be utilized. This makes solar service water heating more practical. The simplified evaluation shows an allowable system cost of \$20/SF_c which is close enough to current costs to warrant further analysis.

The following curves were calculated using the optimization analysis in the ERDA Solar Design Manual. These curves indicate that for system costs between \$25-35/SF_c a collector area between 150 and 200 SF may be cost effective in 25 years.

Because this preliminary analysis indicates that a solar service water system may be feasible it is recommended that a more detailed analysis of costs and system performance be undertaken during Title I. The estimated construction cost of a 200 SF_c system is \$8,500 (FY1977 cost) or \$10,700 if escalated to mid-point in construction program. It is estimated that the most conservative costs escalated to mid-point construction would place the costs of this item under \$20,000 which is easily carried by the ample contingency item in the total project cost.


SOLAR BUILDING SERVICE
WATER HEATING
10% DISCOUNT
8% FUEL ESCALATION
25 YR LIFE
NET ANNUAL SAVINGS - $/YR
300
200
100
- 100
- 200
- 300
100
200
300
400
500
COLLECTOR AREA - SF$_c$
$C_f = \$2.40/10^6$ BTU
$C_s = \$25/SF_c$
$C_f = \$2.40/10^6$ BTU
$C_s = \$35/SF_c$

SECTION IX

SAFETY, POLLUTION, AND ENVIRONMENTAL ASSESSMENTS

A. ANALYSIS OF PRINCIPAL HAZARDS AND RISKS

1. Potential Injury and Property Damage Accidents

a. Fire/Safety

Sodium fires: Metallic sodium for sodium loop experiments will be received, stored, and used under inert atmosphere conditions. Argon is the preferred inerting gas. Experimental loops will be maintained in inert atmosphere enclosures containing less than a kilogram of metallic sodium. Metal trays will be used to catch spills if they occur. Each enclosure will contain a dry powder extinguisher (anhydrous sodium carbonate) to smother fires in the event of an inerting failure. Rigorous exclusion of materials containing water will be practiced in all areas where sodium is handled. Laboratory rooms for the loop experiments will not be sprinklered, and measures will be taken to keep combustible loadings to a minimum. Personnel will be trained in the suppression of Class A fires with portable extinguishers utilizing dry chemical suppressants. Supplies of metallic sodium not needed for immediate experimentation will be stored in the original shipping containers in a safe area outside the loop labs. All personnel associated with the project will be instructed in emergency response measures including first aid for liquid sodium burns. Special containers for sodium wastes pressurized to 3 psig with argon will be available. Wastes not considered salvable will be disposed of by reacting with an anhydrous alcohol – a relatively slow reaction with the liberation of hydrogen. The sodium alcoholates formed may be disposed of safely by dilution with water.

Combustible gases besides H_2: Coal gasification/liquefaction experiments will be conducted batch-wise in high-pressure reactors containing several grams of powdered coal and several hundred atmospheres of a reactant gas, usually hydrogen. After cycling the reactor to an elevated temperature, the operator will relieve the pressure and the gaseous, liquid, and solid fractions will be analyzed to determine the nature of the reactions that have taken place. The total volume of gases released will be tenths of a cubic meter and may contain both cyclic and aliphatic compounds. Those gases not required for analysis will not constitute a fire hazard because of their small volume. In the case of high sulfur coals there will be an odor problem and wet scrubbing techniques will be used for gas disposal and dilution to below the lower flammable limit.

Similar hazards are associated with the synthesis of hydrocarbons using hydrogen and carbon monoxide in the presence of a catalyst and the conversion of water to H_2 and O_2 utilizing photon (light) energy to promote electrolysis with gallium phosphide and titanium dioxide as electrodes. These operations also will be limited to small volumes (cc's) and disposal of the combustible gases will present no problems. The same situation obtains with the production of methane and acetylene on platinized graphite. Given the sensitivity of today's analytical techniques, literally microliters of gas constitute a sufficient sample for the tests, and this is true of all catalysis research proposed.

b. Radiation/Safety

No special facilities will be required for studies involving radioisotopes. The chief operations which include radiation will be studies of corrosion and radiation damage of fuel cladding, and surface composition analysis with x-ray, electron, and Auger electron spectroscopy. Although the studies of fuel cladding will involve sampling of cladding surfaces, the specimens will contribute little to the environmental background because the samples will have decayed to levels low enough to prevent the induced activity from interfering with the spectroscopic measurements. Exposures to personnel will be within the guidelines and consistent with LBL's "As Low As Practicable" policy. No penetrating radiation will reach off-site personnel, and any radioactive particulates generated in sample preparation will be captured in the HEPA filters which are part of the ventilation systems. Perimeter fallout trays and continuous air sampling heads confirm that radioactivity is contained and does not threaten the surrounding community. As further confirmation of the integrity of the contamination controls, sewage leaving the project is continuously sampled, as are nearby streams and other water sources. These measurements are routinely reported at less than 10% of the guideline values. Lastly, both neutron and gamma field measurements are made at the Laboratory perimeter, and these also show excursions only slightly above background characteristic of this location. X-ray spectroscopy is generally accomplished with relatively small (microcurie) radioactive sources which provide discrete low-energy (soft) gammas not readily available from x-ray machines, even with filtering. In those instances where x-ray machines are used, interlocks and administrative controls will insure that personnel exposures are kept as low as possible and that leakage radiation will not influence on-site nor off-site backgrounds.

c. Structural Failure and Seismic Activity

The building site has been investigated and found satisfactory for seismic stability and construction. The soils and geology report is included in Section X. Structural damage may result in the release of some toxic chemicals. The structural design will minimize the possibility of damage due to seismic activity by applying the following criteria.

Maximum potential earthquakes causing ground shaking at the LBL site would be a Richter magnitude 8.3 at the San Andreas Fault, which is about 20 miles away, and a magnitude 7.0 on the Hayward Fault, about half mile away. Intensity of ground shaking at the site is estimated to be VIII on the Modified Mercelli Scale.

The data on hand will be adequate to incorporate into the building design the present criteria for safety from seismic disturbances.

The building proper will be designed to structural criteria that will provide lateral force resistance above that required by the latest Uniform Building Code. Final design will be reviewed independently by structural engineers specializing in seismic design and earthquake damage surveys. These engineers have reviewed the conceptual design.

Specific design criteria for tie-downs will be applied to all critical equipment and emergency utility supplies to ensure that damage to the equipment and support systems would be minimized.

d. Operating Error

The chief risks for serious injury and property damage are those associated with material handling during the construction phase. The controllable hazards associated with operation of high voltage experimental apparatus must also be considered. The potential for operating errors involving fire and explosions have been mentioned in the previous section.

The MMRL has a very low incidence of injuries and an effective internal Safety Organization. Analysis of MMRL injuries over the past three years reveals a preponderance of minor injuries that are typical shop and laboratory-types. These were self-inflicted cuts to fingers with sharp objects; bruises and abrasions where the injured part was struck by an agent were 25% of the total. OSHA recordable injuries were approximately 7% of the total injuries with a three-year average recordable rate of less than 1 per 100 employees. Although the new programs scheduled for this expansion will include pilot plant operations of types not previously used by this group, the safety approaches used with past success should be adequate to control the potential hazards.

2. Predicted Consequences and Measures Proposed for Prevention of Accidents

a. Fire/Safety

All facilities will be sprinklered with the exception of the relatively small areas that house sodium loop experiments. Maximum fire loss is predicted to be in the $5,000 range when controlled by the sprinklers or other automatic suppression/alarm systems. Response to automatic alarms will be by an on-site professional department at less than a half mile distance.

Areas using hydrogen as a reactant will be equipped with diffusion head-type monitors that will sound alarms before explosive limits are reached in the event of uncontrolled release of hydrogen gas. In addition, adequate exhaust venting will be installed.

The technology related to the safety of liquid metal sodium as a heat exchange medium is well developed. Proven measures for fire suppression and response to other emergencies will be established, such as the use of inert gas and inert powder fire suppressants. Isolation in relatively small enclosures should limit losses to below $100.

b. Radiation/Safety

Metallurgical examination of pile-irradiated alloy specimens for radiation damage can be delayed until decay reduces the principal penetrating radiations to safe levels. In those instances where long-lived isotopes are present, master slave and cave facilities maintained by Safety Services personnel are available elsewhere in the Laboratory. Interlocks, shielding, and administrative procedures will prevent exposures to x-rays. Further measures to control radioactive contamination are discussed in the section on pollution controls.

Interlocks, shielding, and access controls with alarms will prevent inadvertant exposures to laser light and the possibility of eye damage. Medical surveillance of laser operators for base line eye conditions and retinal damage has been routine for LBL laser controls.

B. POLLUTION CONTROL AND TREATMENT MEASURES

1. Air

The chief difference between the operations in the new facilities and those existing in the present Building 62 relate to the pilot plant operations under consideration. Operations scaled to pilot plant size will add significantly to the efforts required to control air and water pollution. Stack gas wet-scrubbers will be utilized to control fly-ash and other air contaminants in the fossil fuel studies. In addition to the instrumentation required in the research studies, the Safety Services Industrial Hygiene Section will conduct surveys of air and water pollution potentials to evaluate the adequacy of control measures and to determine corrections of deficiencies if they occur. Special hood and inert gas enclosure filters will be installed to control the release of smokes generated from liquid sodium corrosion studies of fuel rods.

Radioactive particulates that may become airborne are controlled with closed systems fitted with high-efficiency filters. In the experimental areas continuous sampling of the ambient breathing air for particulate contamination assures the researchers that the containment systems are intact. Filtered exhausts from the closed systems are discharged through stacks monitored continuously with membrane filters to assess the efficiency of the systems. Reports of total release are made to governmental agencies and routinely show average concentrations one-tenth or less than the guidelines set by the regulatory authorities. Area heating for LBL buildings is accomplished with hot air or hot water systems fired by natural gas whose sulfur content is limited to the added ppm's of odorant.

2. Water

At LBL each laboratory building has two separate sewage systems. The wastes from the restrooms, janitorial closets, drinking fountains, and other non-laboratory sources are collected as sanitary wastes and piped directly to the municipal sewage system. The wastes from lab sinks and other research areas are consigned to the "acid waste" system which provides for collection and monitoring. The waste stream is sampled in proportion to its flow rate. Procedures for analyzing the samples for radioactive substances and chemical elements are established so that proper treatment and handling techniques can be applied for the disposal of the acid wastes accumulated in the holding tanks. No acid wastes are released unless the contaminants are within the municipal sewage guidelines for deleterious substances or the federal guidelines for radioactive liquid wastes. Liquid wastes known to contain radioactivity are sequestered in small containers before they reach the sinks and are solidified for perpetual storage at an approved site.

3. Solids

Solid wastes are largely materials and replaced parts from maintenance operations as well as paper from office and computer operations. Metals and a large fraction of the paper from computers are recycled. Replacement filters from heating and cooling equipment add to this volume. Radioactive solids and contaminated filters are consigned to steel barrels which are routinely collected by a licensed disposal firm. Non-active solid wastes are collected by a commercial firm for landfill disposal.

C. ENVIRONMENTAL ASSESSMENT

The site selected for the high-bay structure encompasses part of an existing parking lot and will therefore not add to the total rainfall runoff. The other wing will be constructed on a presently undisturbed site of rocky soil covered with native grasses. Although the new five-story wing will cover an area equal to that of the present four-story structure, the net addition to total rainfall runoff when parking and access roads are included will be less than 20% of the present total runoff area. The present Building 62 is one of the few LBL buildings visible from the campus one mile below and this fact will influence the architectural design so that no negative visual impact will be added.

Control of air and water pollution was discussed in the preceding section. Sanitary and laboratory sewage join the main collector in Strawberry Canyon. Storm run-off will drain naturally into Strawberry Creek and eventually into San Francisco Bay. Repeated samplings taken over many years from natural streams and precipitation in the Laboratory environs have shown concentrations of undesirable materials well below the guidelines for sewage and for drinking water.

An increase in personnel of about 50 additional people, or about 75% of the present MMRL staff, will not add significantly to the economy of the East Bay communities. A large part of this effort will come from graduate students working on advanced degrees. Because the proposal involves changes to existing facilities, no controversy is anticipated. Similarly, there will be no displacement of historical, archeological, or esthetic values. Depletion of resources will not be noticed on a national or local basis. Alternative facilities are unavailable either on the campus or from commercial sources.

SECTION X

DETAILED SUPPORTING DATA

Contents

Recapitulation: Estimate Summary and Detail Breakdown (for Schedule 44) 10-1

Schedule 44: SCHEDULE I

Special Facilities 10-15
Standard Equipment 10-16

Schedule 44: SCHEDULE II 10-22

Preliminary Soil Investigation (Harding-Lawson Associates) 10-23

Consultant Resumes 10-39

Structural Calculations (Including Design Criteria). 10-41

Conceptual Design Mechanical Calculations. 10-62

Basis of Mechanical Design Calculations. 10-76

Electrical and Lighting Calculations 10-82

Basis of Electrical Design Calculations. 10-90

PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY. ESTIMATE NO. 4.
LOCATION BUILDING 62. SHEET NO. 1
ARCHITECT ENGINEER GARRETSON / ELMENDORF / ZINOV / REIBIN. DATE APRIL 1977.
SUMMARY BY PRICES BY CHECKED BY

ESTIMATE SUMMARY. (FOR SCHEDULE 44).

[redacted]

DESCRIPTION	QUANTITY UNIT	LABORATORIES AND OFFICES. (63 500 GROSS S.F)	HIGH BAY. (3500 GROSS S.F)	TOTAL
1. IMPROVEMENTS TO LAND.		100 100	2290	
+ GENERAL CONDITIONS.	7%	7010	160	
		107 110	2450	
+ BOND.	¾%	800	20	
+ GENERAL CONTRACTOR O.H. & FEE	5%	5360	120	
ESTIMATED CONSTRUCTION COST AS OF APRIL 1976		113 270	2590	
" " " ESCALATED (8%) TO APRIL 1977.		122 330	2800	
" " " " (26%) " " 1980		154 130	3520	157 650

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PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY. ESTIMATE NO. 4
LOCATION BUILDING 62. SHEET NO. 2
ARCHITECT ENGINEER GARRETSON / ELMENDORF / ZINOV / REIBIN. DATE APRIL 1977
SUMMARY BY PRICES BY CHECKED BY

[redacted] [redacted] [redacted] [redacted]

ESTIMATE SUMMARY (FOR SCHEDULE 44).

DESCRIPTION	QUANTITY	LABORATORIES AND OFFICES (63,500 GROSS S.F.)	HIGH BAY. (3500 GROSS S.F.)	TOTAL
2. BUILDING.				
STRUCTURAL EXCAVATION/BACKFILL		118750	2620	
ALTERATIONS TO EXISTING BUILDING 62		17700	9660	
CONCRETE CAISSONS.		110600	3000	
REINFORCING STEEL.		141650	} 46330	
CONCRETE, FORMS, FINISH.		762060	}	
MASONRY.		10190	—	
METALS.		600530	48380	
CARPENTRY.		89540	1050	
THERMAL/MOISTURE PROTECTION		69640	7840	
DOORS & WINDOWS.		185000	1800	
SPECIALTIES.		19000	—	
FINISHES.		337700	7300	
CONVEYING SYSTEMS.		80000	—	
MECHANICAL — PLUMBING		367030	—	
— H.V.A.C.		668020	6970	
— FIRE PROTECTION		70490	4710	
ELECTRICAL		853000	36600	
		4500900	176260	
+ GENERAL CONDITIONS	7%	315100	12340	
		4816000	188600	
+ BOND	¾%	36120	1410	
+ GENERAL CONTRACTOR O.H. & FEE	5%	240800	9430	
ESTIMATED CONSTRUCTION COST AS OF APRIL 1976		5092920	199440	
" " " ESCALATED (8%) TO APRIL 1977		5500350	215400	
" " " " (26%) " " 1980		6930450	271400	7201850

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PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY **ESTIMATE NO.** 4.

LOCATION BUILDING 62. **SHEET NO.** 3

ARCHITECT ENGINEER GARRETSON / ELMENDORF / ZINOV / REIBIN. **DATE** APRIL 1977

SUMMARY BY **PRICES BY** **CHECKED BY**

ESTIMATE SUMMARY (FOR SCHEDULE 44)

DESCRIPTION	QUANTITY	UNIT	[redacted] [redacted]	[redacted] [redacted]	TOTAL
			LABORATORIES AND OFFICES (63,500 GROSS S.F.)	HIGH BAY (3500 GROSS S.F.)	
3. SPECIAL FACILITIES.					
See Schedule I in Section 10.			→	→	833000
COST ESCALATED (26%) TO 1980					1050000
4. UTILITIES.					
ELECTRICAL.			119700	—	
MECHANICAL.			58730	—	
RE-LOCATION.			—	2160	
			178430	2160	
+ GENERAL CONDITIONS	7%		12490	150	
			190920	2310	
+ BOND.	3/4%		1430	20	
+ GENERAL CONTRACTOR O.H. & FEE	5%		9550	120	
ESTIMATED CONSTRUCTION COST AS OF APRIL 1976			201900	2450	
" " " ESCALATED (8%) TO APRIL 1977			218050	2650	
" " " " (26%) " " 1980			274750	3330	278080

PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORIES ESTIMATE NO. 3.
LOCATION BUILDING 62 SHEET NO. 4
ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1976.
SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
SITEWORK/IMPROVEMENTS TO LAND.							
Clear site / light grade.	40000	S.F.	6^{d}	2400			
Demolish asphalt curb.	320	L.F.	54^{d}	173			
" asphalt paving & base.	67	C.Y.	7^{56}	507			
New asphalt curb.	450	L.F.	2^{16}	972			
New asphalt paving & base.	3000	S.F.	1^{62}	4860			
Brick paving / steps at entries	1000	S.F.	4^{32}	4320			
Mass excavate & haul off site.	12000	C.Y.	4^{32}	51840			
Site drainage		L.S.		1750			
Landscaped areas (ground cover only).	10000	S.F.	33^{d}	3300			
Terrace areas. (Paving, planters, seats, plants, etc.)	5550	SF.	5^{40}	29970			
TO SUMMARY.				100092			
STRUCTURAL EXCAVATION & BACKFILL.							
Structural excavation.	606	C.Y.	7^{60}	4606			
Backfill to walls (Compacted).	3651	C.Y.	14^{00}	51114			
Rock fill to foundation walls.	456	C.Y.	15^{00}	6840			
Engineered fill under slab-on-grade.	2170	C.Y.	14^{00}	30380			
Temp. work & layout	63500	S.F.	10^{c}	6350			
8" Rock u/s slab-on-grade.	677	C.Y.	15^{00}	10155			
2" Sand " " " "	165	C.Y.	2^{20}	363			
4" P.V.C. drain to " " "	2080	L.F.	4^{30}	8944			
TO SUMMARY				118752			

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PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY ESTIMATE NO. 3.

LOCATION BUILDING 62. SHEET NO. 5

ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1976

SUMMARY BY PRICES BY . CHECKED BY [redacted]

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]
ALTERATIONS TO EXISTING BUILDING 62.				
Cut openings in interior conc. walls & repair	126	S.F.	5^{40}	680
Saw-cutting exterior 12" concrete wall.	64	LF.	32^{40}	2074
Alteration work at revised room areas.	730	SF.	16^{20}	11826
Misc. demolition/alterations.		L.S.		1000
Clean-up, repairs, scaffold.		L.S.		1620
Temporary protection.		L.S.		500
TO SUMMARY				17700
CONCRETE CAISSONS (NO CASING, INCL. REINF. STEEL)				
Drilled concrete caissons, 36"⌀.	2765	LF.	40^{00}	110600
TO SUMMARY.				110600
REINFORCING STEEL.				
Reinforcing steel. (excl. caissons).	566600	lbs.	25¢	141650
" mesh.	—	SF.	11¢	—
TO SUMMARY.				141650

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PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORIES ESTIMATE NO. 2.
LOCATION BUILDING 62. SHEET NO. 6.
ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1976
SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]
CONCRETE, FORMS, FINISH				
Concrete in foundation grade beams.	606	C.Y.	51^{84}	31415
Forming ditto.	10904	SF.	1^{62}	17664
Concrete in Slab-on-grade	454	C.Y.	45^{36}	20593
Finish ditto.	22720	SF.	27¢	6134
Construction/expansion joints.	1500	LF.	1^{08}	1620
Concrete in foundation walls.	443	CY.	51^{84}	22965
Forming ditto.	23922	SF.	2^{43}	58130
Finish ditto. (interior).	11960	SF.	32¢	3827
" " . (ext. for membrane).	11960	SF.	22¢	2631
Concrete in exterior (exposed) walls.	1120	C.Y.	54^{00}	60480
Forming ditto.	60464	SF.	2^{60}	157206
Finish ditto. (int. — Sack & patch).	30232	SF.	25¢	7558
" " . (ext. archtl. finish)	30232	SF.	1^{30}	39302
Concrete in interior walls.	909	C.Y.	54^{00}	49086
Forming ditto.	49056	SF.	2^{60}	127546
Finish ditto. (patch & Sack).	49056	SF.	38¢	18641
Concrete fill (rock) on metal deck.	631	C.Y.	49^{68}	31348
" " (ltwt.) " " "	242	C.Y.	55^{68}	13475
Finish ditto.	76000	S.F.	27¢	20520
Concrete roof overhang.	1890	SF.	10^{00}	18900
Concrete in roof work surface.	152	C.Y.	49^{68}	7551
Finish ditto.	12400	S.F.	27¢	3348
Form edge of ditto.	500	LF.	1^{00}	500
Exposed concrete floor finish.	9430	SF.		IN ABOVE.
P.I.P. concrete stair flights. (av. 15' storey height).	9	EA.	2160^{00}	19440
Extra for tieing roof work slab to struct.	12400	SF.	10¢	1240
Conc. balcony walls @ corr. bridge.	—	SF.		
Susp. concrete corridor floor slab	408	SF.	5^{00}	2040
Concrete in column pilasters.	140	C.Y.	54^{00}	7560
Forming ditto	3207	S.F.	2^{60}	8338
Special Foyer/Reception stair flight.	1	EA	3000^{00}	3000
TO SUMMARY.				762058

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PRACTICAL
FORM 518 MFG. IN U. S. A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORIES ESTIMATE NO. 3
LOCATION BUILDING 62. SHEET NO. 7
ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1976
SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
MASONRY.							
4" Concrete block screen wall	3042	SF.	3^{35}	10190			
To summary.				10190			
METALS.							
Structural Steel.	524	TONS.	800^{00}	419200			
Metal deck.	76000	S.F.	1^{50}	114000			
Miscellaneous/Ornam. metals.	63500	SF.	1^{03}	65405			
Fan enclosure screens/fences	1920	SF.	1^{00}	1920			
To SUMMARY.				600525			
CARPENTRY.							
Rough Carpentry.	63500	SF.	76¢	48260			
Finish Carpentry.	63500	SF.	65¢	41275			
To SUMMARY				89535			
THERMAL/MOISTURE PROTECTION.							
Roofing (Built-up).	5080	SF.	1^{00}	5080			
2" Rigid insulation to u/s. of metal roof deck.	16720	SF.	1^{00}	16720			
Waterproof membrane to found. walls.	10270	S.F.	63¢	6470			
" " " Slab-on-grade	22720	SF	58¢	13178			
Sheet metal work.	63500	SF.	20¢	12700			
Caulking & Sealants..	63500	SF.	8¢	5080			
Waterproof membrane to roof working slab.	12400	SF.	58¢	7192			
Ditto ditto to terrace areas.	5550	S.F.	58¢	3219			
To SUMMARY.				69639			

PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORIES ESTIMATE NO. 3

LOCATION BUILDING 62. SHEET NO. 8

ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1976

SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
DOORS & WINDOWS							
Single H.M. door (rated).	79	EA.	133^{00}	10507			
" " " frame.	101	EA.	69^{00}	6969			
Double " " "	100	EA.	81^{00}	8100			
Single wood door.	222	EA.	115^{00}	25530			
Typical alum. windows to match existing, incl. glazing.	1488	SF.	8^{60}	12797			
Alum. curtainwall incl. glazing.	590	SF.	11^{00}	6490			
Single glazed alum. entry doors.	14	EA.	400^{00}	5600			
PAIRS " " " "	2	EA.	865^{00}	1730			
Misc. glazing / mirrors.		L.S.		1100			
Metal curtainwall/glazing @ corr. bridge.	4160	SF.	12^{50}	52000			
Finish hardware sets.	301	EA.	180^{00}	54180			
TO SUMMARY.				185003			
SPECIALTIES.							
Metal toilet compartments.	18	EA.	175^{00}	3150			
Vanities, 7^{0} long × 2^{0} × 3^{0}	6	EA.	350^{00}	2100			
Toilet paper dispensers.	18	EA.	11^{00}	198			
" Seat paper " .	18	EA.	5^{00}	90			
Robe hooks.	24	EA.	4^{00}	96			
Soap dispensers.	12	EA.	16^{00}	192			
Paper towel dispensers/waste disposal compartments.	6	EA.	240^{00}	1440			
Sanitary napkin dispensers.	3	EA.	180^{00}	540			
" " disposal.	3	EA.	22^{00}	66			
Fire extinguisher cabinets.	14	EA.	90^{00}	1260			
Folding partitions.		L.S.		650			
Directories.	4	EA.	540^{00}	2160			
Room numbers.		L.S.		1000			
Telephone enclosures.	4	EA.	270^{00}	1080			
Graphics.		L.S.		1000			
Floor mats. (recessed).		L.S.		200			
Chalkboards / tackboards.		L.S.		3780			
TO SUMMARY				19002			

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PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORIES ESTIMATE NO. 3

LOCATION BUILDING 62. SHEET NO. 9

ARCHITECT ENGINEER G.E.2.R. DATE APRIL 1976

SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
FINISHES.							
Typical int. wood stud/gypsum board partition.	47080	SF	2^{00}	94160			
3½" metal studs & gyp bd. at ext. Concrete walls.	24040	SF	1^{40}	33656			
Metal furring Channels & gyp. board at interior conc. walls.	17808	SF	1^{08}	19233			
Ditto ditto to steel columns.	4520	SF.	1^{50}	6780			
Metal studs/plaster/gyp. bd. @ Spandrels.	2480	S.F.	2^{50}	6200			
Sound insulation @ partitions.	5040	SF.	22¢	1109			
" " " ceilings.	1080	SF	25¢	270			
Suspended lath & plaster soffits.	384	SF.	2^{00}	768			
Resilient flooring (V.A.T.).	47940	SF.	58¢	27805			
Rubber base.	8140	LF.	75¢	6105			
3½" Batt insulation to ext. walls	24040	SF.	20¢	4808			
Suspended drywall ceiling.	1380	SF.	1^{60}	2208			
Suspended acoustic ceiling.	48900	SF.	85¢	41565			
3" Solid plaster duct walls.	3600	S.F	2^{00}	7200			
Ceramic tile floors.	1120	SF.	3^{70}	4144			
" " wainscots (6').	2520	SF.	3^{25}	8190			
Paint concrete walls. (ext.) 2ct.	30230	SF.	32¢	9674			
" " " (int.) ".	9000	SF.	21¢	1890			
" " Soffits	6000	SF.	35¢	2100			
" doors/frames.	301	EA.	16^{00}	4816			
" misc. metal.		L.S.		850			
" finish carpentry.		L.S.		1100			
" (2ct) gyp. board walls	146610	S.F.	18¢	26390			
" (") " " ceilings.	1380	S.F.	19¢	262			
" (") conc. block screen wall.	6080	S.F.	22¢	1338			
" mech/elect. equip.		L.S		1500			
" misc. items.		L.S.		1000			
Spray-on fireproof coating to structural steel.	50,000	S.F.	40¢	20000			
Computer floor.	322	S.F.	8^{00}	2576			
TO SUMMARY.				337697			

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PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY. ESTIMATE NO. 4.
LOCATION BUILDING 62. SHEET NO. 10.
ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1977.
SUMMARY BY JBP PRICES BY JBP. CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	TOTAL
LABORATORY EQUIPMENT (BUILT-IN).							
Laboratory furniture, fume hoods, and all Mech./Elect. work }	SEE SCHEDULE I. IN SECTION 10						
	TO SUMMARY.			—	SPECIAL FACILITIES		
FURNISHINGS.							
Carpet.	SEE SCHEDULE I IN SECTION 10						
Specialty furniture items (Reception area/Conference Room) }	"	"	" "	" "			
	TO SUMMARY			—	SPECIAL FACILITIES		
CONVEYING SYSTEMS.							
Geared elevator (6 stop, 5000#).	1	EA.		80000			
Travelling crane. (½ ton).	SEE SCHEDULE I IN SECTION 10				SPECIAL FACILITIES		
	TO SUMMARY.			80000			
MECHANICAL.							
Plumbing	63,500	S.F.	5^{78}	367030			
Heating, Ventilating, Air-Cond.	63,500	S.F.	10^{52}	668020			
Automatic fire Sprinklers.	63,500	S.F.	1^{11}	70485			
	TO SUMMARY.			1105535			
ELECTRICAL.							
Electrical work in Building.	63,500	S.F.	13^{43}	852805			
	TO SUMMARY			852805			

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PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — MATERIALS & MOLECULAR RESEARCH LABORATORY ESTIMATE NO. 4

LOCATION BUILDING 62. SHEET NO. 11

ARCHITECT ENGINEER DATE APRIL 1977.

SUMMARY BY PRICES BY CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	TOTAL
SITE UTILITIES — ELECTRICAL.							
Demolish existing duct beams.	1307	LF.		— ABANDON —			
Demolish existing manholes.	4	EA.	160^{00}	640			
Excavate trenches for duct beams	841	C.Y.	8^{65}	7275			
Concrete surround to duct beams.	263	C.Y.	60^{00}	15780			
Backfill ductbeam trenches.	694	C.Y.	11^{00}	7634			
Reinforcing steel.	15780	lbs.	25¢	3945			
Cement asbestos duct, 2" dia.	1474	LF.	2^{27}	3346			
" " " , 3" dia.	5720	LF.	2^{43}	13900			
" " " , 4" "	2864	LF.	2^{70}	7733			
" " " , 5" "	2708	LF.	3^{50}	9478			
New electrical manholes.	10	EA.	1600^{00}	16000			
12 KV Feeders & sectionalizing sw.		L.S.		23760			
Pull-out existing 12 KV feeders.		L.S.		6400			
Modifications to fire alarm system.		L.S.		2700			
" " communication "		L.S.		1100			
TO SUMMARY.				119691			
SITE UTILITIES — MECHANICAL.							
3" Gas line. (SCHED. 40)	685	L.F.	8^{00}	5480			
Connection to existing 6" (incl. valve).	1	EA.	270^{00}	270			
6" H.P. cold water. (C.I./Mech. Jts).	56	LF.	14^{00}	784			
4" Sanitary sewer. (C.I.).	162	LF.	11^{00}	1782			
Connections to existing.	1	EA.	108^{00}	108			
4" Acid waste (Plastic).	160	LF.	11^{00}	1760			
Connection to existing.	1	EA.	490^{00}	490			
3" Temp. water supply. (Galv. steel).	125	LF.	9^{00}	1125			
Connections to existing	2	EA.	270^{00}	540			
Oil storage tanks. (below grade).		L.S.		46000			
Connection to 6" H.P. cold water (incl. valve).	1	EA.	390^{00}	390			
TO SUMMARY.				58729			

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PRACTICAL
FORM 510 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS —— HIGH BAY.
ESTIMATE ~~NO.~~ 3
LOCATION BUILDING 62.
SHEET NO. 12
ARCHITECT ENGINEER G.E.Z.R.
DATE APRIL 1976
SUMMARY BY
PRICES BY
CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
SITEWORK/IMPROVEMENTS TO LAND.							
Demolish concrete curb	60	L.F.	2^{50}	150			
" asphalt paving & base.	133	C.Y.	7^{60}	1010			
Remove signs, etc.		L.S.		500			
Repair paving, curbs, & planting at building perimeter }	180	L.F.	3^{50}	630			
Re-locate site utilities		L.S.	—UTILITIES—				
	TO SUMMARY			2290			
STRUCTURAL EXCAVATION & BACKFILL.							
Structural excavation	75	C.Y.	6^{50}	488			
Compacted earth backfill	25	C.Y.	12^{00}	300			
8" rock fill to slab-on-grade	105	C.Y.	15^{00}	1575			
2" Sand " " " " "	26	C.Y.	2^{20}	57			
Vapor barrier	3850	S.F.	5¢	193			
	TO SUMMARY			2613			
ALTERATIONS/DEMOLITION TO EXISTING HIGH BAY.							
Remove external metal siding.	1765	S.F.	2^{20}	3883			
Dismantle steel framing.	5643	lbs.	20¢	1129			
Remove interior metal insulated panel }	1765	S.F.	30¢	530			
Remove gravel stop, flashing etc.	60	LF.	3^{25}	195			
Tie new roofing into existing incl. welding, flashings, etc. }	60	LF.	5^{40}	324			
Drilling & setting concrete dowels	121	EA.	16^{20}	1960			
Re-locate electrical conduit etc.		L.S.		1100			
" mech. equipt., piping etc.		L.S.		540			
	TO SUMMARY			9661			

PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — HIGH BAY.
ESTIMATE NO. 3
LOCATION BUILDING 62.
SHEET NO. 13
ARCHITECT ENGINEER G.E.Z.R.
DATE APRIL 1976
SUMMARY BY
PRICES BY
CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
CONCRETE CAISSONS (NO CASING, INCL. REINF. STEEL).							
Drilled concrete caissons, 24"ϕ x 15' deep.	120	LF.	25^{00}	3000			
To SUMMARY.				3000			
CONCRETE/FORMS/FINISH/REINF. STEEL.							
Concrete footings.	50	C.Y.	162^{00}	8100			
6" Slab-on-grade.	3486	S.F.	1^{50}	5229			
9" Concrete walls.	104	C.Y.	300^{00}	31200			
Projecting concrete coping incl. flashings.	120	LF.	15^{00}	1800			
To SUMMARY				46329			
METALS.							
Structural Steel.	30	TONS	1000^{00}	30000			
Anchor bolts/grout @ col. bases.	6	EA.	54^{00}	324			
3½" metal insulated panels at end wall	1860	SF.	6^{50}	12090			
Reinstal Struct. steel @ end wall.	3	TONS.	220^{00}	660			
Metal deck at roof.	3540	S.F.	1^{50}	5310			
To SUMMARY				48384			
CARPENTRY.							
Rough / finish carpentry	3486	S.F.	30¢	1046			
To SUMMARY.				1046			
THERMAL & MOISTURE PROTECTION.							
Built-up roofing & 2" rigid insul.	3540	SF.	1^{75}	6195			
Caulking & Sealing.		L.S.		500			
Cant strip, gravel stop, flashings, etc.	60	L.F.	6^{50}	390			
Misc. Sheet metal.		L.S.		750			
To SUMMARY.				7835			

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PRACTICAL
FORM 518 MFG. IN U.S.A.

RECAPITULATION

PROJECT ADDITIONS — HIGH BAY. ESTIMATE NO. 3
LOCATION BUILDING 62. SHEET NO. 14
ARCHITECT ENGINEER G.E.Z.R. DATE APRIL 1976
SUMMARY BY [redacted] PRICES BY [redacted]. CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	[redacted]	[redacted]	[redacted]	[redacted]
DOORS & WINDOWS.							
Painted steel, fixed sash windows with rough wire glass	121	S.F.	12^{00}	1452			
Single H.M. door, frame & finish hardware	1	EA.	350^{00}	350			
TO SUMMARY				1802			
FINISHES.							
Painting.	20840	S.F.	35¢	7294			
TO SUMMARY				7294			
CONVEYING SYSTEMS.							
Extend crane rails & modify existing 10 ton crane controls, etc for building extension	SEE SCHEDULE I IN SECTION 10 ←				SPECIAL FACILITIES		
TO SUMMARY							
MECHANICAL.							
Heating & Ventilating.	3486	S.F.	2^{00}	6972			
Automatic fire sprinklers	3486	S.F.	1^{35}	4706			
TO SUMMARY				11678			
ELECTRICAL.							
Interior electrical work	3486	S.F.	10^{50}	36603			
TO SUMMARY				36603			
UTILITIES.							
Re-locate site utilities.		L.S.		2160			
TO SUMMARY				2160			

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SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory

Schedule I

Special Facilities	Est. FY 1977 Costs
Walk in Hoods (2)	$ 24,000
Laboratory Built-In Furniture	153,000
Laboratory Fume Hoods and Exhaust Ducts (40)	200,000
Vibration-Free Rooms (2)	33,000
Dust-Free Rooms (2)	56,000
Sodium Loop Laboratory Provisions	17,000
Computer terminal facility--to LBL computer	150,000
High Pressure Bays (4)	200,000
TOTAL	$833,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Standard Equipment

A. Catalysis and Surface Reactions on Solids

I. Catalytic Conversion of Coal to Goseous and Liquid Fuels

		Est. FY 1977 Costs
1.	Catalyst surface area measurement instrument	$ 20,000
2.	Gas chromatograph (1)	20,000
3.	High resolution mass spectrometer and multiple mass monitor	45,000
4.	Vacuum pumping stations (2)	10,000
5.	PDP-11 computer, interface, and silent keyboard	20,000
6.	Electron spectroscopic system for study of supported catalysts	150,000
7.	Recorders and power supplies	10,000
	SUB TOTAL	$275,000

II. Solid State and Surface Reactiion Studies

1.	Physical electronics scanning auger microscope	$150,000
2.	High resolution mass spectrometers (2)	30,000
3.	Gas chromatographs (2)	16,000
4.	Damage intensifier and electronics	12,000
5.	Microwave power supply (2)	6,000
6.	Time of flight analyzer	14,000
7.	Vacuum pumping station	8,000
8.	Microdensitometer	80,000
9.	Terbomuclear pump	12,000
10.	Recorders and power supplies	10,000
	SUB TOTAL	$338,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Standard Equipment	Est. FY 1977 Costs
III. Photochemical Energy Conversion	
1. Electronics for current and voltage measurements	$ 25,000
SUB TOTAL	$ 25,000
IV. Studies of Alloy Surfaces	
1. Scanning Electron Microscope	$ 50,000
SUB TOTAL	$ 50,000
V. Energy Transfer in Surface Reactions	
1. PDP-11, interface, and silent keyboard	$ 25,000
2. Sample manipulator	10,000
SUB TOTAL	$ 35,000
A. SUB TOTAL	$723,000
B. Studies of High Surface Area Oxides	
1. Mass spectrometer	$ 16,000
B. SUB TOTAL	$ 16,000
C. Electron Spectroscopy of Surfaces	
1. UV monochromator	$ 14,000
2. Gas phase photoemission spectrometer	92,000
3. X-ray emission spectrometer	69,000
4. ESCA--Auger varible sweep controller	8,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. **Title and Location of Project:** Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. **Project Number:** LBL-79-1

Standard Equipment	Est. FY 1977 Costs
5. VUV monochromator	$ 7,000
6. He Lamp and power supply for UV PES	5,000
7. Quadrupole mass spectrometer	12,000
8. Physical electronics ESCA-LEED-Auger system	240,000
C. SUB TOTAL	$447,000
D. Energy Transfer and structural Studies of Molecules on Surfaces	
1. PDP8E and teletype	$ 6,000
2. Dye laser	11,000
3. Image intensifier tube and supplies	16,000
4. Oscilloscope	7,000
5. Turbomolecular pump	12,000
D. SUB TOTAL	$ 52,000
E. Corrosion & Erosion	
1. Differential thermal analysis equipment for corrosion	$ 20,000
2. Erosion--corrosion tester	50,000
3. Corrosion--fatigue crack testing facility	100,000
4. Liquid corrosion test system	55,000
E. SUB TOTAL	$225,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Standard Equipment	Est. FY 1977 Costs
F. Electrochemistry	
I. Phase Boundaries	
1. Inert atmosphere glove boxes with gas purification train	$ 10,000
2. Prescision electrochemical machining equipment	30,000
3. Advanced automatic ellipsometer	45,000
4. Fast fourier spectrum analyzer	12,000
SUB TOTAL I	$ 97,000
II. Electrochemical Processes	
1. Polarographic analyzer	$ 10,000
2. 2 Rotating disk systems	12,000
3. 3 high-current potentiostats	12,000
4. PAR 170 electrochemical system	14,000
5. Battery testing station	15,000
6. Programmable electrolysis power supply	9,000
SUB TOTAL II	$ 72,000
III. Electrochemical Systems	
1. High-speed potentiostat	$ 4,000
2. Oscilloscope	8,000
SUB TOTAL III	$ 12,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Standard Equipment	Est. FY 1977 Costs
IV. Mass and Charge Transport	
1. Multichannel, rapid-scan data collection and evaluation system	$ 46,000
2. Test equipment for electrolysis and galvanic cells	18,000
3. Digital oscilloscope	8,000
4. High-current potentiostat	5,000
5. Gas chromatograph	7,000
6. High-resolution, high-speed color video recording system	20,000
SUB TOTAL IV	$104,000
F. SUB TOTAL	$285,000
G. Nuclear Magnetic Resonance of Coal	
1. Oscilloscope	$ 7,000
2. High resolution NMR attachment	$ 24,000
3. Gas chromatograph	$ 9,000
G. SUB TOTAL	$ 40,000
H. Homogeneous Catalysis	
1. High Pressure autocloves and instrumentation (4)	$ 80,000
2. Glove Box	12,000
3. Gas chromatograph--Mass spectrometer	150,000
4. Gas chromatograph and peak integrator	30,000
5. Infrared spectrocmeter	10,000
H. SUB TOTAL	$282,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Standard Equipment	Est. FY 1977 Costs
I. General	
1. Vacuum evaporator	$ 5,000
2. Liquid honer for surface preparation	6,000
3. Discoplane grinder for crystal preparation	19,000
4. Induction generator for crystal growing	4,000
	40,000
5. Gap lathe--20 in.	14,000
6. Vertical milling machine	18,000
7. Electrical discharge machine	30,000
8. Spot welder	4,000
9. Surface grinder	6,000
I. SUB TOTAL	$ 146,000
TOTAL STANDARD EQUIPMENT	$2,216,000

SCHEDULE 44-DUE MAY 15 - Continued

CONSTRUCTION PROJECT DATA SHEET
(In Thousands)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

Program: 39 EE-Basic Energy Sciences

1. Title and Location of Project: Addition to Materials and Molecular Research Laboratory (Surface Science and Catalysis Facility)

2. Project Number: LBL-79-1

Schedule II

Standard Equipment Utilities	Est. FY 1977 Costs
Relocate and extend existing electrical and mechanical site utilities	162,000
Oil storage tanks (below grade)	60,000
TOTAL	$222,000

PRELIMINARY SOIL INVESTIGATION
PROPOSED ADDITIONS
BUILDING 62
LAWRENCE BERKELEY LABORATORY
BERKELEY, CALIFORNIA

HLA Job No. 2000,100.01

Prepared for

Lawrence Berkeley Laboratory
Berkeley, California

by

Lyle E Lewis
Lyle E. Lewis,
Civil Engineer - 16360

Richard S. Harding
Richard S. Harding,
Civil Engineer - 9841

Harding-Lawson Associates
55 Mitchell Boulevard, P.O. Box 3030
San Rafael, California 94902
415/472-1400

July 7, 1975

INTRODUCTION

This report presents the results of our preliminary soil investigation for the proposed additions to Building 62 at the Lawrence Berkeley Laboratory, Berkeley, California. We understand that these building additions are included in the proposal for FY1977 building projects and that design and construction funds have not yet been authorized.

The locations of the proposed additions to Building 62 are as shown on Plate 1. They consist of an office and laboratory portion (four stories and basement) and a reception area on the northeast side of Building 62, and a 59-foot extension of the existing high bay on the southwest side. The structures will be steel-frame with reinforced concrete shear walls. Loads will be as high as 500 kips (total load) for interior columns and 480 kips for exterior columns. Column loads for the high bay extension will be about 30 kips.

The object of our work was to provide preliminary foundation recommendations based on data from soil borings drilled in the area previously and supplemented if necessary by new boring information.

FIELD AND LABORATORY INVESTIGATION

A review of the existing test boring information indicated that additional subsurface data should be obtained and two new borings were drilled and two test trenches were excavated in the locations shown on Plate 1. The test borings were drilled with a six-inch-diameter flight auger to depths of 47-1/2 and 32 feet; the test trenches were 20 feet and 82 feet in length. The borings and test trenches were logged by our geologist and undisturbed samples were obtained for visual identification and laboratory testing. The boring and trench logs are illustrated on Plates 2 through 4. A geologic cross section is presented on Plate 5. The soil has been classified in accordance with the Unified Soil Classification System presented on Plate 6. Physical properties of the rock have been identified according to the Physical Properties Criteria table, Plate 7.

The samples were reexamined in our laboratory and moisture/density determinations and triaxial shear strength tests were performed on representative samples. The laboratory test data are presented on the boring logs as explained by the Key to Test Data, Plate 6.

SITE CONDITIONS

The proposed office and laboratory addition to Building 62 will be located in a sloping area north of and adjacent to the existing building. At the present time, the terrain slopes to the southwest with the natural slope at approximately three horizontal to one vertical. Elevations vary from 755 to 810 feet. The surface is covered by grasses and occasional pine trees. An access road and parking area are present along the west boundary of the proposed addition. The proposed high bay extension is to be located southwest of the existing Building 62 in a nearly level paved parking area.

SOIL AND GEOLOGIC CONDITIONS

Soils

The surface soils in the proposed multistory building addition area consist of shallow clays and silts which are residual components of the underlying sedimentary bedrock. In general, the soils are stiff and about five feet in maximum thickness.

Weak and potentially unstable soils are present on the steeper slope west of the proposed office and laboratory addition. In this area, shallow wet-weather sloughing and erosion have occurred in the past and more recently a shallow landslide has developed in the corner of the existing parking area. The limits of the weak and unstable surface soils are shown on the Site Plan.

Bedrock

Two bedrock units are present in the area. The older unit, the Knoxville formation of Cretaceous age, consists of massive to blocky sandstones with occasional shale interbeds. The sandstones are generally well consolidated; however, the shales are frequently weak and of low hardness.* Temporary cut slopes in this rock unit failed during excavations for the existing Building 62. Failures generally occurred along weak planes associated with the shale interbeds.

Sedimentary rock of the Orinda formation is present in the north half of the proposed office and laboratory addition area and consists of poorly consolidated siltstones, claystones, sandstones

---

* Qualitative descriptions are based on the Physical Properties Criteria table, Plate 7.

and occasional conglomerate. Characteristically, the Orinda formation is a weaker unit and rock strength and hardness are generally lower than rock of the Knoxville formation.

An ancient fault separates the two geologic formations at the approximate location shown on the Site Plan and the Geologic Cross Section. The fault was exposed in Test Trench 2 and consists of crushed rock and weak clay in a zone up to several feet in width. The small landslide located in the corner of the existing parking area is associated with the weak clays in the fault zone. Highly fractured rock exposed in the Building 62 excavation indicates the presence of numerous weak planes associated with the fault.

Ground Water

The ground-water levels in the test borings a few hours after drilling were at +751 feet in Boring 1 and +783 feet in Boring 2 (LBL Datum).

DISCUSSION AND CONCLUSIONS

On the basis of our past work in the area and our current studies we conclude the following.

High Bay Extension Addition

The Cretaceous bedrock in the area of this proposed structure should provide excellent foundation support for shallow spread footings. Little or no settlement is anticipated from the proposed building loads.

Office and Laboratory Addition

The proposed location of this building addition is in an area where there are two rock types with a fault contact between them. Much of the Knoxville formation contains competent sandstone which should provide adequate support for the proposed building using spread footings; however, the upper weathered portion of the poorly consolidated Orinda formation sediments, the weak shale interbeds of the Knoxville formation, and the crushed rock and weak clay in the fault zone could settle under the loads imposed by shallow spread footings. This settlement would be differential between footings in the competent sandstone and footings in other areas. Essentially the same weak conditions were found during previous work by Dames & Moore in the rock underlying the north and west wall footings of the existing Building 62. Therefore, we conclude that the proposed structure should be founded on drilled, cast-in-place concrete piles similar to those supporting portions of the existing building.

On the basis of the test borings and test trench data, as well as our knowledge of the characteristics of the Orinda sediments, we believe that the fault separating the Knoxville and Orinda formations is not active and dips steeply to the northeast as shown on the Geologic Cross Section.

Cut slopes in the Orinda formation behind the proposed addition should be no steeper than two horizontal to one vertical. The presence of weak material in the fault zone creates a higher than normal risk of instability for cut slopes. If potentially unstable conditions are exposed during grading, some modification of the slope and/or correction could be required to improve stability. Since the total height of cut slope may be close to 50 feet, an intermediate drain bench will be required to reduce surface water runoff.

We judge that both rock units can be excavated without blasting; however, some difficult ripping may be encountered in the deeper portions of the Cretaceous rock. Temporary cut slopes excavated for construction of basement walls may require shoring or flattening where weak materials are encountered. Ground water may be encountered in the deepest portion of the cuts for the proposed building and dewatering may be necessary to improve working conditions and reduce the risk of temporary cut slope failures.

The proposed office and laboratory addition will be located close to the weak, unstable soils on the west slope. Although believed to be relatively shallow, these soils could experience deep instability in the event of severe ground shaking from earthquakes, particularly during the winter months when the weak soils are saturated. It is possible that slope failure could reduce support of the west wall of the proposed building; therefore, a careful analysis of this area will be necessary during the final investigation.

RECOMMENDATIONS

Foundation Support

On the basis of this preliminary investigation and previous work in the area, we recommend that

1. The high bay extension addition be supported on spread footings founded on the Cretaceous bedrock. The footings can be designed for dead load bearing pressures of 6000 psf and total design loads of 9000 psf. The spread footings should be a minimum of 18 inches wide and 18 inches below lowest adjacent grade.
2. The office and laboratory addition be supported on drilled, cast-in-place concrete piles. For the purposes of preliminary design, use a skin friction value of 1500 pounds per square foot (psf) for dead load and 2500 psf for total design loads. We believe that these friction values are conservative for the Cretaceous rock and may be increased after further investigation. The drilled, cast-in-place concrete piles should be spaced no closer than three diameters center-to-center.

Future Work

After authorization of funds for the building addition, a final investigation should be performed including one or two additional test borings, laboratory testing, and engineering analyses to provide or determine

1. A more definitive determination of skin friction values for the drilled, cast-in-place concrete piles located in the various rock conditions
2. Estimates of foundation settlements
3. Ground-water conditions in the deepest portion of the excavation
4. Potential unstable zones in the permanent cut slope
5. A judgment of the amount of instability which might occur in the slope west of the office and laboratory addition during severe earthquake ground shaking

PLATES

Plate 1	Site Plan
Plates 2 and 3	Logs of Borings 1 and 2
Plate 4	Test Pit Profiles
Plate 5	Geologic Cross Section
Plate 6	Soil Classification Chart and Key to Test Data
Plate 7	Physical Properties Criteria For Rock Descriptions

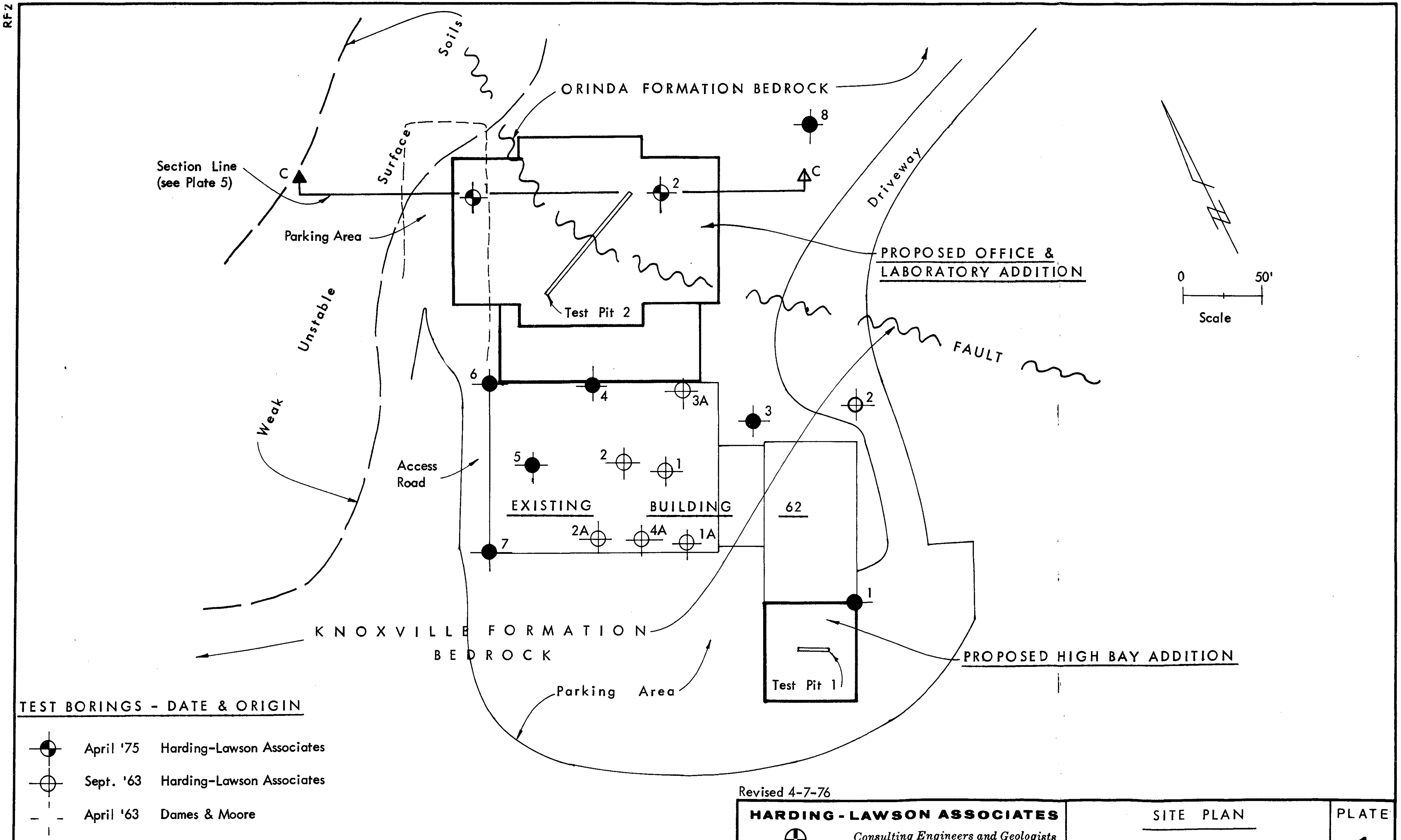
DISTRIBUTION

3 copies: Lawrence Berkeley Laboratory
Berkeley, California

Attention: Mr. Donald Eagling,
Plant Engineer
Building 90

LEL/SRK/RSH/jd

RF 2



Revised 4-7-76

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2000,100.01 Appr: Date 5/30/75

SITE PLAN

Building 62 Additions
Lawrence Berkeley Laboratory

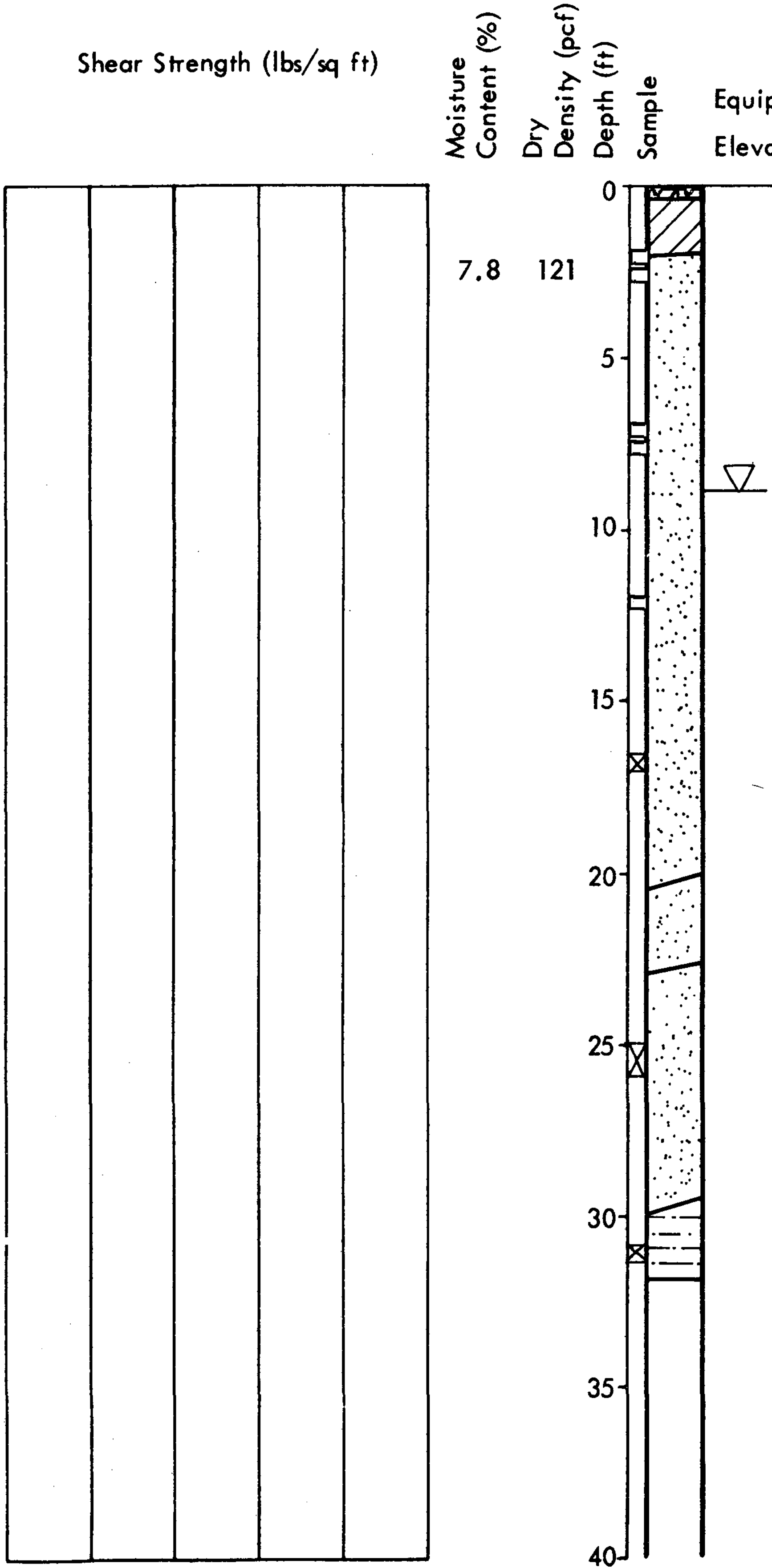
PLATE
1

RI --

LOG OF BORING 1

Equipment Flight Auger

Elevation 760 Date 4/10/75



GRAY-BROWN SILTY GRAVEL (GM) - dense, wet

DARK BROWN SANDY CLAY (CL) stiff, wet, with occasional gravel

LIGHT BROWN SILTY SANDSTONE closely fractured, moderately hard, moderately strong, deeply weathered

change to dark brown, strong, moderately weathered @ 7'

water level 4/16/75

change to hard, with occasional clay-filled fractures

GRAY SANDSTONE hard, strong, little weathered

VARIEGATED GRAY-BROWN SILTY FINE SANDSTONE - moderately hard, moderately strong, little weathered

GRAY SILTSTONE low hardness, moderately strong, little weathered

FILL

KNOXVILLE FORMATION

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Job No. 2000,100.01 Appr: LEL Date 5/29/75

LOG OF BORING 1

Building 62 Addition
Lawrence Berkeley Laboratory

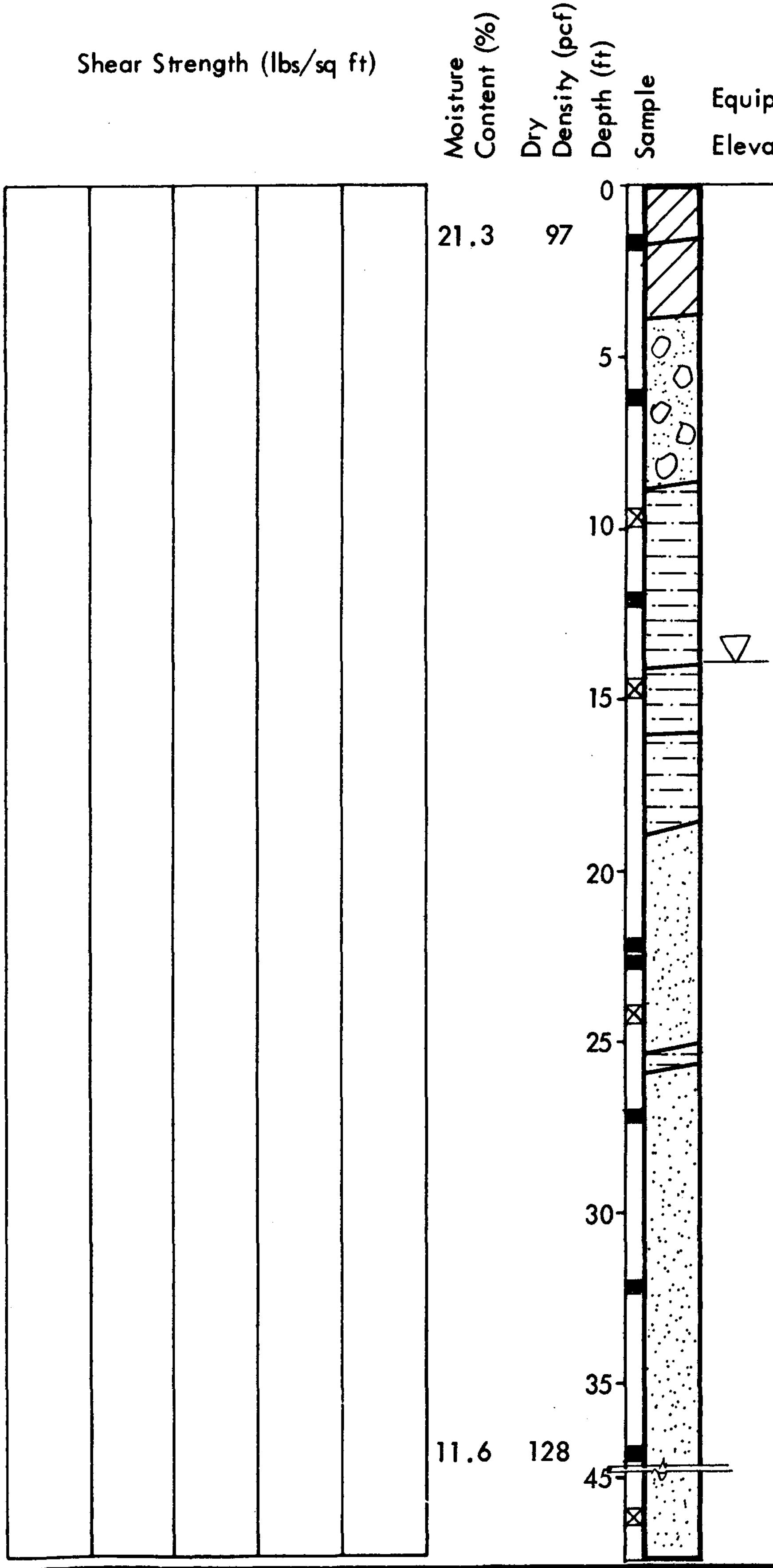
PLATE

2

LOG OF BORING 2

Equipment Flight Auger

Elevation 797 Date 4/10/75



BROWN GRAVELLY CLAY (CL)
stiff, wet

MOTTLED DARK BROWN & YELLOW SILTY CLAY (CL)
stiff, wet

GRAY-BROWN CONGLOMERATE
moderately hard, strong, little weathered

LIGHT GREEN-GRAY SANDY SILTSTONE - low hardness, moderately strong, little weathered

water level 4/16/75

RED-BROWN CLAYSTONE
low hardness, friable, little weathered

GRAY CLAYSTONE
intensely fractured, low hardness, weak, little weathered, with occasional slickensides

BLUE-GRAY SILTY SANDSTONE
low hardness, weak, fresh

BROWN CLAYSTONE
low hardness, weak

LIGHT GRAY SANDSTONE
low hardness, moderately strong, fresh

change to strong

FILL

ORINDA FORMATION

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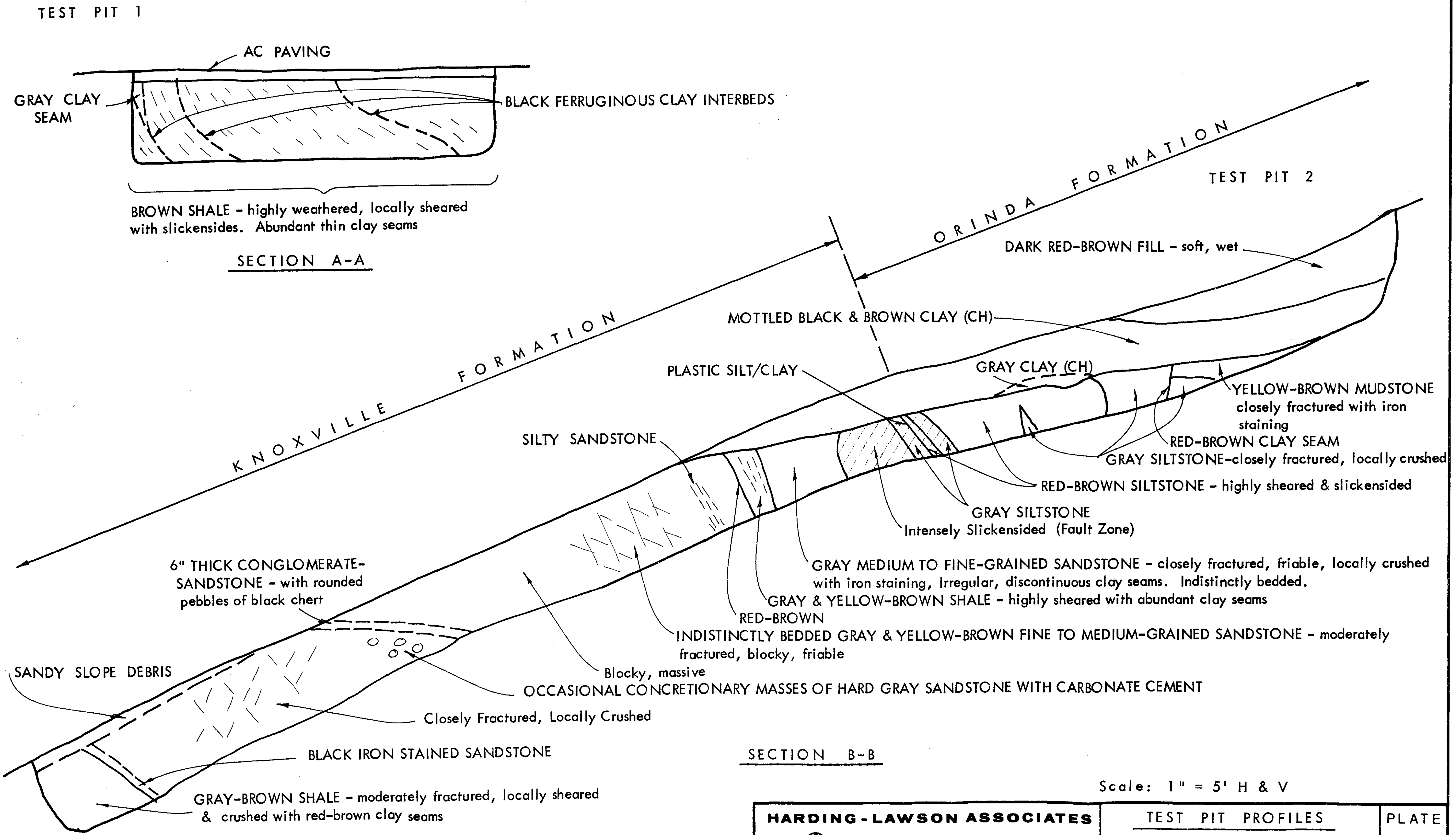
Job No. 2000,100.01 Appr: LEL Date 5/29/75

LOG OF BORING 2
Building 62 Addition
Lawrence Berkeley Laboratory

PLATE

3



SECTION A-A

SECTION B-B

Scale: 1" = 5' H & V

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Consulting Engineers and Geologists

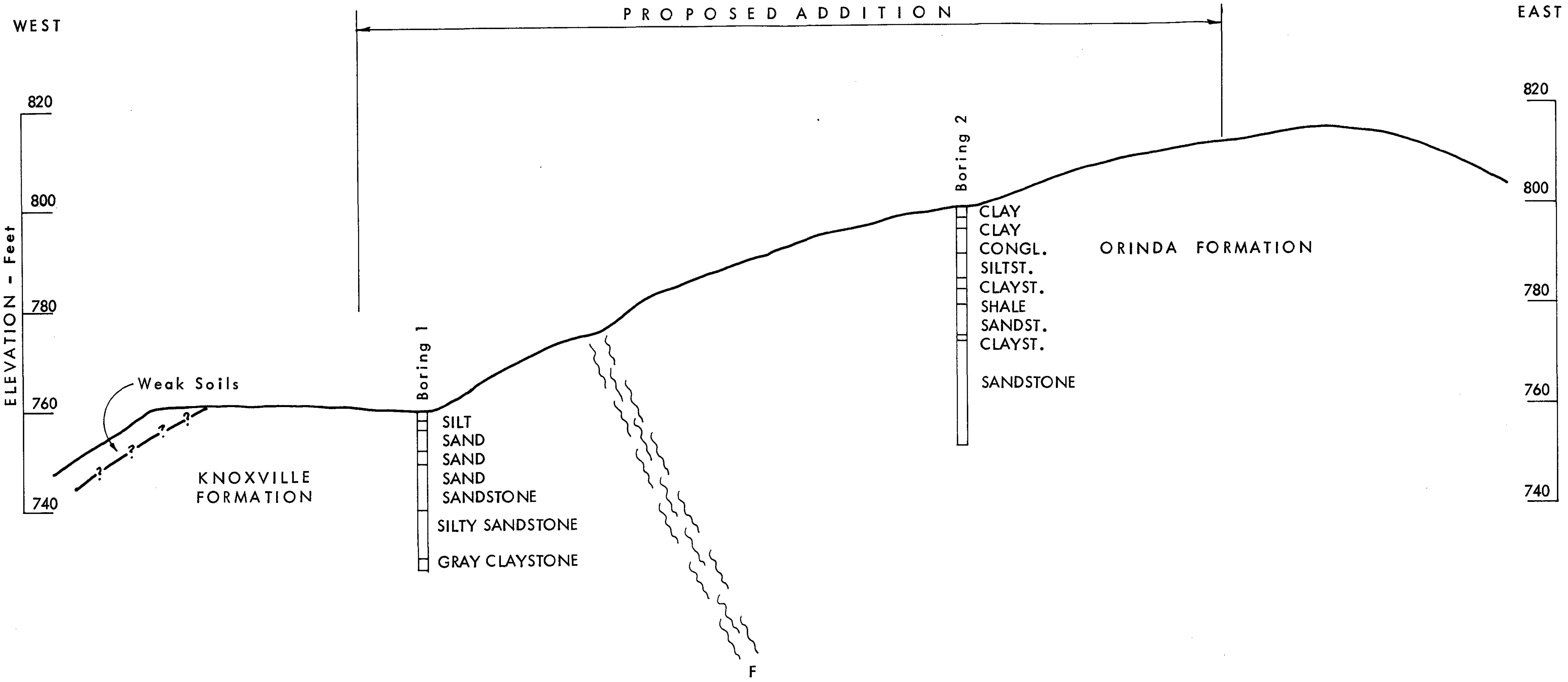
Job No. 2000,100.01 Appr: LEL Date 5/30/75

TEST PIT PROFILES

Building 62 Addition
Lawrence Berkeley Laboratory

PLATE
4

RF-2



Scale: 1" = 20' H & V

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GEOLOGIC CROSS SECTION

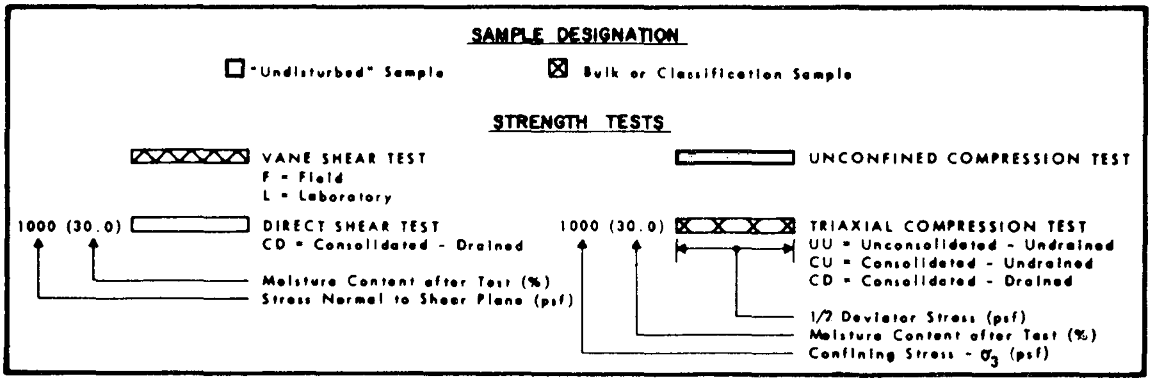
Building 62 Addition
Lawrence Berkeley Laboratory

PLATE
5

RF_

MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	⁘	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	⁘	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	▥	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	▨	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	⁘	WELL GRADED SANDS, GRAVELLY SANDS
			SP	⁘	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	▥	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	▨	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	▥	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	▨	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	▥	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	▥	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	▨	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	▨	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	≈	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DESIGNATION

☐ "Undisturbed" Sample

☒ Bulk or Classification Sample

STRENGTH TESTS

VANE SHEAR TEST
F - Field
L - Laboratory

UNCONFINED COMPRESSION TEST

1000 (30.0) DIRECT SHEAR TEST
CD = Consolidated - Drained
Moisture Content after Test (%)
Stress Normal to Shear Plane (psf)

1000 (30.0) TRIAXIAL COMPRESSION TEST
UU = Unconsolidated - Undrained
CU = Consolidated - Undrained
CD = Consolidated - Drained
1/2 Deviator Stress (psf)
Moisture Content after Test (%)
Confining Stress - σ_3 (psf)

KEY TO TEST DATA

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No. 2000,100.01 Appr: LEL Date 5/29/75

SOIL CLASSIFICATION CHART
AND
KEY TO TEST DATA

Building 62 Addition

PLATE
6

N02470

I **Consolidation** of Sedimentary Rocks; usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

II **Bedding** of Sedimentary Rocks

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick bedded
Blocky	2.0 to 4.0 ft.	thick-bedded
Slabby	0.2 to 2.0 ft.	thin-bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01 ft.	thinly laminated

III **Fracturing**

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

IV **Hardness**

1. **Soft** - Reserved for plastic material alone
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produces little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

V **Strength**

1. **Plastic** or very low strength
2. **Friable** - crumbles easily by rubbing with fingers
3. **Weak** - An unfractured specimen of such material will crumble under light hammer blows.

4. **Moderately strong** - Specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** - Specimen will withstand a few heavy ringing hammer blows before breaking into large fragments.
6. **Very strong** - Specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

VI **Weathering** - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

D. **Deep** - Moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

M. **Moderate** - Slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.

L. **Little** - No megascopic decomposition of minerals; little to no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.

F. **Fresh** - Unaffected by weathering agents. No disintegration or discoloration. Fractures usually less numerous than joints.

HARDING-LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2000,100.01 Appr: LEL Date 5/30/75

PHYSICAL PROPERTIES
CRITERIA FOR ROCK
DESCRIPTIONS

Building 62 Addition

PLATE
7

CONSULTANT RESUMES

1. Engle and Engle, Structural Engineers.

   This firm has specialized in earthquake engineering and hazard evaluation for many years. Mr. H. M. Engle, Sr., serves as Consulting Engineer for the Board of Fire Underwriters of the Pacific and its successor, Pacific Fire Rating Bureau, in charge of all investigation and rating of buildings and structures for 25 years. He is also Consulting Structural Engineer for Factory Insurance Association on earthquake safety. He was a Member of the Advisory Board to the California Division of Architecture for the design of school buildings for 18 years, and a Member of the Board of Directors of the Seismological Society of America for several years. The Engles and Mr. Donald F. Moran, Consulting Structural Engineer associated with Engle & Engle, recently completed an investigation of three of Pacific Gas & Electric Company's largest power plants for earthquake safety.

2. Harding-Lawson Associates, Soils Engineers, Geologists and Geophysicists.

   This firm has carried out extensive work in foundation and earthquake engineering for seismic restraint design for numerous large projects throughout the local area, including soild dynamics for major slide repair at LBL.

3. Garretson-Elmendorf-Zinov-Reibin, Architects and Engineers.

   This firm offers services and Architectural, Civil, Structural, Mechanical, Electrical, and Sanitary Engineering. They have extensive experience in many types of facilities including laboratories and testing, electronic and communications, shops and service centers, educational, manufacturing, office and commercial, civil/structural, electrical and mechan ical systems and master planning and site development. They have executed projects for a great variety of clients including private and public corporations and governmental agencies from districts of various sorts, municipal, state, and national bodies. Their clients include ERDA, Sandia Laboratory, and NASA. The company principals are:

Bradley B. Garretson	Civil Engineer
James H. Elmendorf	Civil Engineer
Paul L. Zinov	Architect
Fred M. Reiben	Electrical Engineer
James D. Leach	Civil/Structural Engineer
Robert H. Ahearn	Mechanical Engineer

4. Derek Daniels

Mr. Daniels prepared the detailed estimate for this project, is a professional construction estimator in the Plant Engineering Department at Lawrence Berkeley Laboratory. He has has excellent training and experience in preparation of construction estimates, surveys and analyses for large construction projects of all types. His technical training includes the Harris Technical Institute, Preston, England - Building Construction; and Liverpool University, College of Building, Liverpool, England - Quantity Surveying/Estimating. He has worked for a number of large construction concerns including the following:

Lee Saylor, Inc.	Construction Management Consultants Walnut Creek, California
Skidmore, Owings & Merrill	Architects, San Francisco
Perrini Corporation	General Contractors, San Francisco
Rush & Tompkins Construction Ltd.	General Contractors Edmonton, Alberta, Canada
Poole Construction Company	General Contractors, Edmonton, Alberta, Canada

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CLIENT L. B. L.

JOB NO 1322

PROJECT MATERIAL & MOLECULAR LAB.

BY RTL DATE 4-20-76

SUBJECT INDEX —— STRUCTURAL CALCULATIONS
PRELIMINARY

CK DATE

SH. OF

INDEX

DESIGN CRITERIA 1 —— 4

TYPICAL FLOOR FRAMING 4 —— 8

ROOF FRAMING 9 —— 11

TYP. COLUMN & FOUNDATION 12 —— 14

LATERAL LOADS 15 —— 19

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CLIENT: L.B.L.

JOB NO. 1322

PROJECT: MATERIAL & MOLECULAR LAB.

BY RTL DATE 4-15-76

SUBJECT: DESIGN CRITERIA

CK DATE

SH. 1 OF

DESIGN CRITERIA

1. CODES :—
   - a) UNIFORM BUILDING CODE, 1973 EDITION
   - b) STRUCTURAL ENGINEERS ASSOC. OF CALIF. RECOMMENDED LATERAL FORCE REQUIREMENTS, 1974 EDITION
   - c) AMERICAN INSTITUTE OF STEEL CONST. SPECIFICATIONS, 1969 EDITION
   - d) AMERICAN CONCRETE INSTITUTE BUILDING CODE, 1971 EDITION.

2. LOADS :—
   - a) FLOOR LIVE LOAD 1ST FLR THRU 4TH FLR. = 125 $^{\#}/_{FT^2}$
   - b) ADDITIONAL PARTITION LOAD AT ALL FLRS. = 15 $^{\#}/_{FT^2}$.
   - c) ROOF L.L. INCLUDES SOLAR HEATING EQPT. = 50 $^{\#}/_{FT^2}$.
   - d) LATERAL LOADS

     WIND = 15 $^{\#}/_{FT^2}$.

     SEISMIC — 1974 RECOMMENDATIONS OF SEAOC.

$$V = ZIKCSW$$
$$\nless 0.2\,W$$

WHERE

$$Z = 1.0$$
$$I = 1.0$$

$K = 1.33$ BUILDING WITH DUAL BRACING SYSTEM

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CLIENT: L. B. L.

JOB NO 1322

PROJECT: MATERIAL & MOLECULAR LAB.

BY RTL. DATE 4-15-76

SUBJECT: DESIGN CRITERIA

CK DATE

SH. 2 OF

3. BUILDING STRUCTURAL SYSTEM

a) VERT. LOADS FRAMING :— THE FLOORS & ROOF CONSISTS OF LIGHT WEIGHT CONCRETE FILL OVER $1\frac{1}{2}$" DEEP, 20 GA. METAL DECK & STEEL PURLINS & GIRDERS, ALL ACTING AS A COMPOSITE SECTION.

b) HORIZONTAL LOAD CARRYING SYSTEM : THE BUILDING HAS BEEN DESIGNED TO HAVE HORIZONTAL CONCRETE DIAPHRAGM & CONCRETE SHEAR WALLS AS SEISMIC LOADS RESISTING ELEMENTS. THE SHEAR WALLS ARE SYMMETRICALLY ARRANGED SO THAT THERE IS A MINIMUM OF TORSIONAL SHEAR STRESSES.

THE STEEL FRAMES PROVIDES A COMPLETE VERTICAL LOAD CARRYING SYSTEM.

c) FOUNDATIONS :— ALL COLUMNS & WALLS SHALL BE SUPPORTED BY DRILLED CAISSONS WITH LOAD CARRYING CAPACITY BASED ON FRICTION VALUE OF $1500\ \#/FT^2$. ALL CAISSONS SHALL BE TIED TOGETHER WITH GRADE BEAMS CAPABLE OF RESISTING 10% OF MAXIMUM COLUMN LOADING IN COMPRESSION OR TENSION.

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CLIENT	L B L	JOB NO 1322	
PROJECT	MATERIAL & MOLECULAR LAB	BY RTL	DATE 4-16-76
SUBJECT	DESIGN CRITERIA	CK	DATE
		SH. 3	OF

4. <u>MATERIALS</u> :-

a) ALL STRUCTURAL STEEL SHALL CONFORM TO ASTM A-36. ALL BOLTS FOR STRUCTURAL CONNECTIONS SHALL BE A-325 HIGH STRENGTH.

b) CONCRETE FILL OVER METAL DECK SHALL BE LIGHT WEIGHT CONCRETE OF MAXIMUM DENSITY OF 110 #/FT^3, & $f_c' = 3000$ psi
ALL OTHER CONCRETE SHALL BE OF REGULAR STONE TYPE WITH DENSITY OF 150 #/FT^3 & $f_c' = 3000$ psi
ALL REINFORCING STEEL SHALL BE A-615, GRADE 40 OR 60.

c) METAL DECK SHALL BE GALVANIZED 20 GA., $1\frac{1}{2}$" DEEP.

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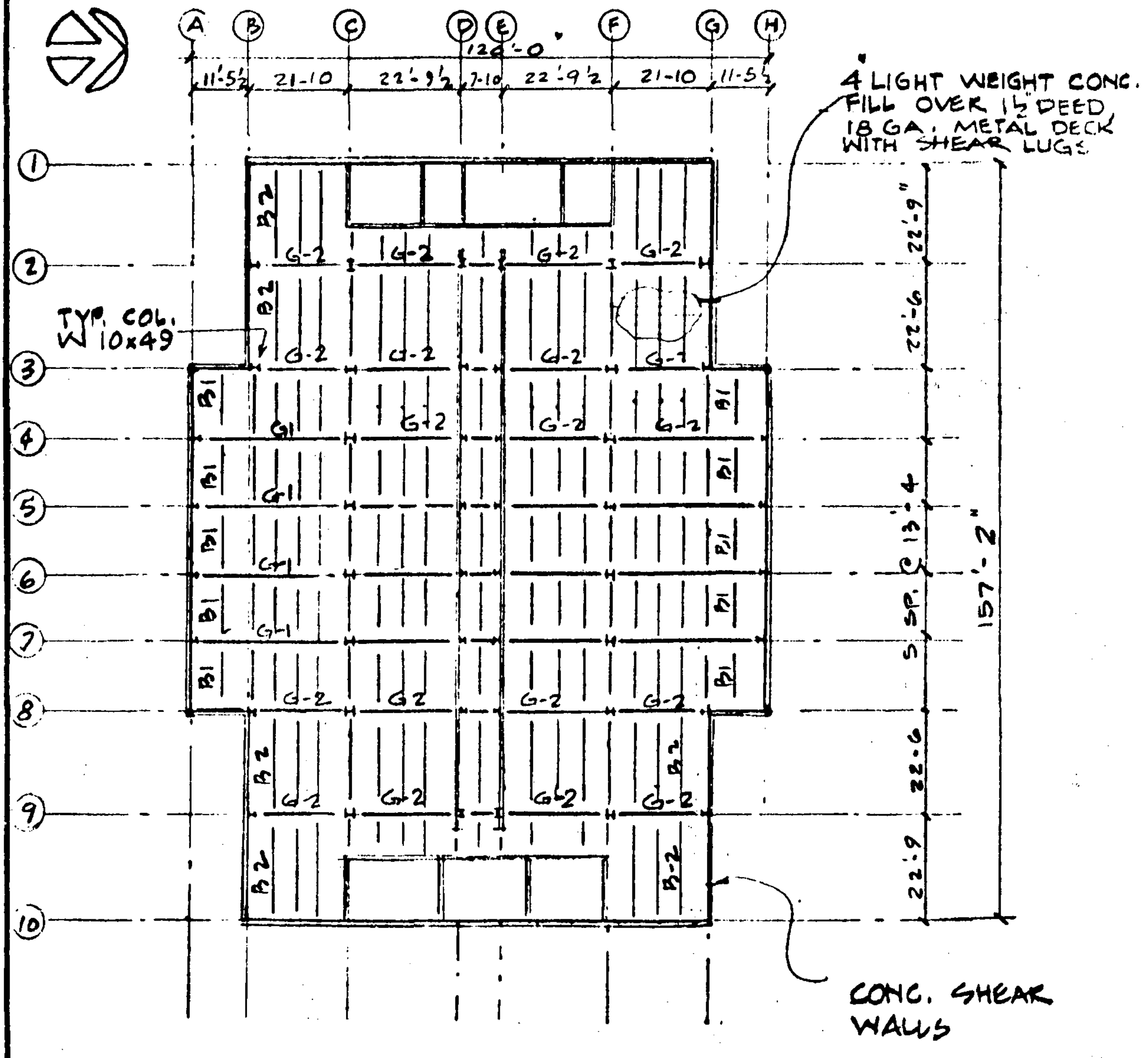
CLIENT	L. B. L.	JOB NO.	1322
PROJECT:	MATERIALS & MOLECULAR LAB.	BY RTL	DATE 4-15-76
SUBJECT	TYPICAL FLOOR FRAMING	CK	DATE
		SH. 4	OF



TYP. FLOOR FRAMING

B1	W 12x 16.5
B2	W 16x 31
G1	W 24x 94
G2	W 24x 68

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CLIENT L B L

JOB NO. 1322

PROJECT: MATERIALS & MOLECULAR LAB

BY KTL DATE 4-15-76

SUBJECT: TYP. FLOOR FRAMING

CK DATE

SH. 5 OF

FLOOR LOADS

$$\text{L.L.} = 125^{\#/FT^2}$$

FLOOR D.L.

CONC. SLAB ($5\frac{1}{2}$" TK.)	=	$50^{\#/ft^2}$
METAL DECK	=	3
STEEL FRAMING	=	6
FLR. FINISH	=	1
PARTITIONS	=	15
MECH. & ELECT.	=	2.5
CEILING	=	2.5
		$80^{\#/ft^2}$

PURLINS B-1

$$\text{SPAN} = 13'\text{-}4" = 13.5'$$

DESIGN FOR TRIB. WIDTH OF 7'

$$w = (80^{\#/ft^2} + 125^{\#/ft^2}) \times 7' = 1.43\ ^{K}/_{'}$$

$$M = \frac{1.43^{K/'} \times (13.5')^2}{8} = 32.5^{FtK}$$

TRY W 12× 16.5 $S = 17.6^{in^3}$

$$f_b = \frac{32.5^{FtK} \times 12^{in/ft}}{17.5\ in^3} = 22.2\ \text{ksi}$$

ok.

COMP. FLANGE FULLY SUPPORTED

USE W 12×16.5

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CLIENT: L.B.L.
PROJECT: MATERIAL & MOLECULAR LAB
SUBJECT: TYPICAL FLOOR FRAMING

JOB NO. 1322
BY RTL DATE 4-15-76
CK DATE
SH. 6 OF

PURLIN B-2

$D.L. = 80^{\#/ft^2}$
$L.L. = 125^{\#/ft^2}$

SPAN = 22.75'

TRIB. WIDTH = 6'

$w = 205^{\#/ft^2} \times 6' = 1.23^{k/'}$

$M = \frac{1.23^{k/'} \times (22.75')^2}{8} = 79.6^{ft\text{-}k}$

TRY W16×31 $S = 47.2^{in^3}$

$f = \frac{79.6^{ft\text{-}k} \times 12^{in/ft}}{47.2^{in^3}} = 20.23$ ksi

USE W16×31

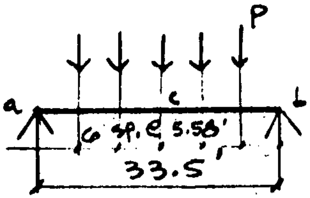
GIRDER G-1

SPAN = 33.5'

$P = (80+125^{\#/ft^2}) \times 5.58' \times 13.5' = 15.5^{k}$

$R_a = 15.5^{k} \times 2.5 = 38.75^{k}$

$M_c = 38.75^{k} \times 16.75' - 15.5^{k}(5.58+2\times5.58')$
$= 649$ ft-k $- 259.4$
$= 389.6$ ft-k.



TRY W 24×94 $S = 221^{in^3}$

$f_b = \frac{389.6^{ft\text{-}k} \times 12^{in/ft}}{221^{in^3}} = 21.1$ ksi

USE W24×94.

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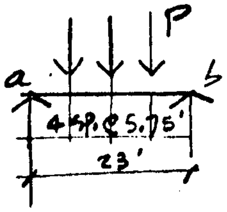
CLIENT	L. B. L.	JOB NO. 1322
PROJECT:	MATERIALS & MOLECULE LAB.	BY RTL DATE 4-15-76
SUBJECT	TYP. FLR. FRAMING	CK DATE
		SH. 7 OF

GIRDER G-2

SPAN = 22'-9½; USE 23'



$P = 205^{\#/ft^2} \times 5.75' \times 22.75' = 26.8^k$

$R_a = 1.5^k \times 26.8^k = 40.2^k$

$M = 40.2^k \times 11.5' - 26.8^k \times 5.75'$

$= 462.3^{Ftk} - 154.1$

$= 308.2 \text{ Ftk}$

TRY W 24x68

$S = 153^{in^3}$

$f_b = \dfrac{308.2^{Ftk} \times 12^{in/ft}}{153 in^3} = 24.17^{ksi}$

USE W 24x68

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CLIENT: L.B.L.

JOB NO. 1322

PROJECT: MATERIAL & MOLECULAR LAB.

BY RTL DATE 4-19-76

SUBJECT: FLR. FRAMING

CK DATE

SH. 8 OF

GIRDER G-3 (AT 1ST. & 2ND FLR.) SPAN = 40'; TRIB. WIDTH = 18'

$$w = (\underset{DL}{80^{\#/ft^2}} + \underset{LL}{125^{\#/ft^2}}) \times 18' = 3.69^{k/'}$$

$$M = 3.69^{k/'} \times (40')^2/8 = 738^{ft\text{-}k}$$

TRY W 30×132

$S = 380^{in^3}$

$$f_b = \frac{738^{ft\text{-}k} \times 12^{in/ft}}{380^{in^3}} = 23.3\ ksi$$

ok → COMPOSITE DESIGN WILL REDUCE STRESSES.

USE W 30×132

GIRDER G-4 (AT 1ST. & 2nd FLR.)

SPAN = 40'

TRIB. WIDTH = 13.5'

$$w = 205^{\#/ft^2} \times 13.5' = 2.76^{k/'}$$

$$M = 2.76^{k/'} \times (40')^2/8 = 552^{ft\text{-}k}$$

TRY W 30×108

$S = 300^{in^3}$

$$f_b = \frac{552^{ft\text{-}k} \times 12^{in/ft}}{300^{in^3}} = 22.08\ ksi$$

ok

USE 30×108 ✓

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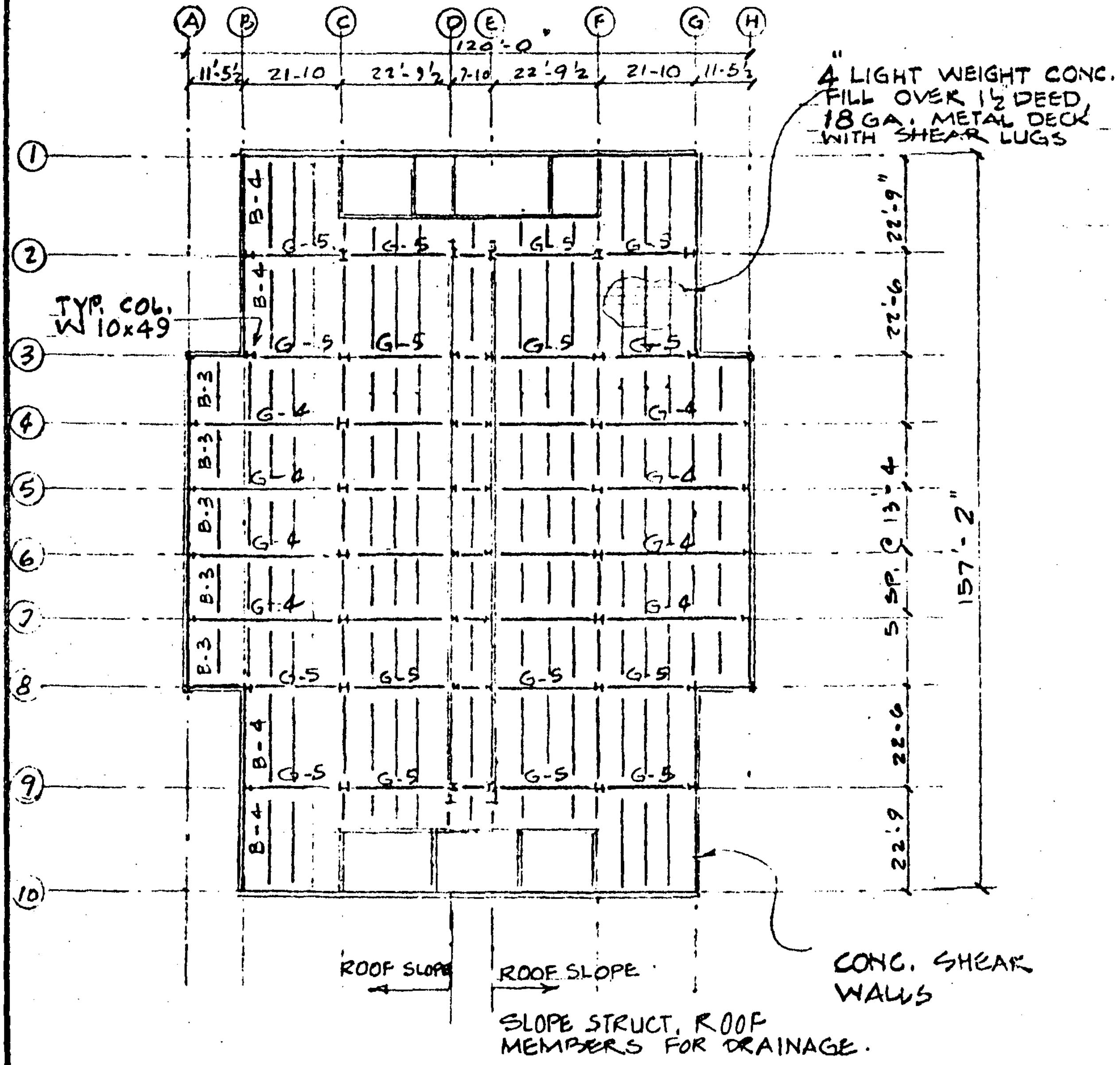
CLIENT: L.B.L.
JOB NO. 1325
PROJECT: MATERIALS & MOLECULAR LAB.
BY RTL DATE 3-15-76
SUBJECT: TYPICAL ROOF FRAMING
CK DATE
SH. 9 OF



4" LIGHT WEIGHT CONC. FILL OVER 1½ DEED 18 GA. METAL DECK WITH SHEAR LUGS

TYP. COL. W 10x49

CONC. SHEAR WALLS

SLOPE STRUCT. ROOF MEMBERS FOR DRAINAGE.

TYP. ROOF FRAMING

B-3	W	12x14
B-4	W	16x26
G-4	W	21x68
G-5	W	21x55.

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CLIENT L. B. L.

JOB NO. 1322

PROJECT: MATERIAL & MOLECULAR LAB.

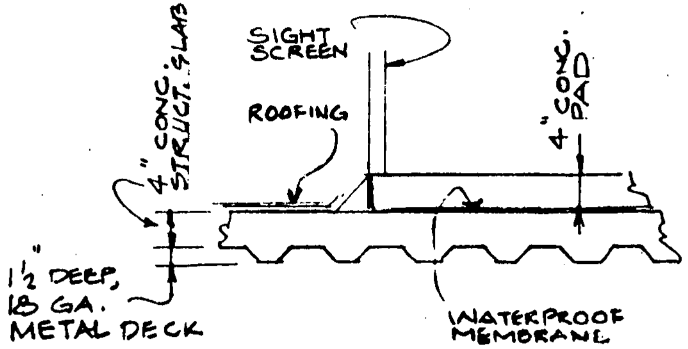
BY RTL DATE 4-23-7

SUBJECT TYP. ROOF FRAMING

CK DATE

SH. 9A OF

ROOF LOADS



ROOF LIVE LOAD = $50^{\#/ft^2}$. ← INCLUDES SOLAR EQUIPMENT

ROOF DEAD LOAD

4" CONC. FILL OVER METAL DECK (5" TK. AV.) = $62.5^{\#/ft^2}$.

4" CONC. PAD OR ROOFING ($6.5^{\#/ft^2}$) = $50.0^{\#/ft^2}$.

METAL DECK = $3.0^{\#/ft^2}$

STRUCTURAL FRAMING = $9.0^{\#/ft^2}$.

INSULATION = $2.0^{\#/ft^2}$.

CEILING = $2.5^{\#/ft^2}$.

MECH., ELECT. & MISC. = $1.0^{\#/ft^2}$.

$130.0^{\#/ft^2}$.

ROOF DEAD LOAD + LIVE LOAD = $130^{\#/ft^2} + 50^{\#/ft^2}$

= $180^{\#/ft^2}$.

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CLIENT L. B. L.
PROJECT MATERIAL & MOLECULAR LAB.
SUBJECT TYP. ROOF FRAMING
JOB NO 1322
BY RTL DATE 4-13-76
CK DATE
SH. 10 OF

ROOF LOADS

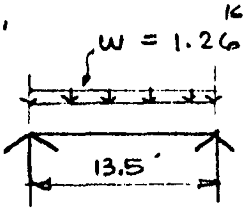
LIVE LOAD $= 50^{\#/ft^2}$ ← INCLUDING SOLAR EQUIPMENT

DEAD LOAD $= 130^{\#/ft^2}$

T.L. $= 180^{\#/ft^2}$

PURLIN B-3

SPAN = 13'-4" ; USE 13.5'
DESIGN FOR TRIB. WIDTH OF 7'



$$w = 180^{\#/ft^2} \times 7' = 1260^{\#/'}$$

$$M = 1.26^{k/'} \times (13.5')^2/8 = 28.7^{Ft\,k}$$

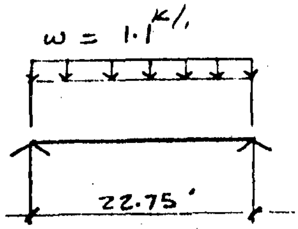
TRY W 12x16.5
$S = 17.6\ in^3$

$$f_b = \frac{28.7^{Ft\,k} \times 12^{in/ft}}{17.6\ in^3} = 19.56\ ksi \quad ok$$

USE W 12x16.5

PURLIN B-4

SPAN = 22.75'
TRIB. WIDTH = 6'



$$w = 180^{\#/ft^2} \times 6' = 1080^{\#/'} \cong 1.1^{k/'}$$

$$M = 1.1^{k/'} \times (22.75ft)^2/8 = 71.2^{Ftk}$$

TRY W 16x31
$S = 47.2\ in^3$

$$f_b = \frac{71.2^{Ftk} \times 12^{in/ft}}{47.2\ in^3} = 18.1\ ksi \quad ok$$

USE W 16x31

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CLIENT	L.B.L.	JOB NO.	1322
PROJECT	MATERIALS & MOLECULAR LAB.	BY RTL	DATE 4-19-72
SUBJECT	TYP. ROOF FRAMING	CK	DATE
		SH. 11	OF

GIRDER G-3.

SPAN = 33.5'

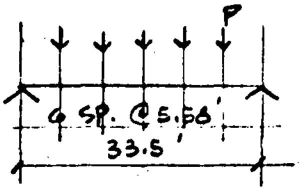
$P = 180^{\#/ft^2} \times 5.58' \times 13.5' = 13.6^k$

$R_a = 13.6^k \times 2.5 = 34^k$

$M_c = 34^k \times 16.75' - 13.6^k \times (5.58' + 2 \times 5.58')$

$= 569.5 - 227.6$

$= 341.9$ Ftk



TRY W 24×84

$S = 197\ in^3$

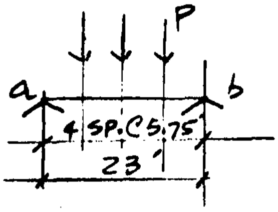
$$f_b = \frac{341.9^{Ftk} \times 12^{in/ft}}{197\ in^3} = 20.8\ ksi$$

OK

USE W 24×84

GIRDER G-4

SPAN = 23'



$P = 180^{\#/ft^2} \times 5.75' \times 22.75' = 23.6^k$

$R_a = 1.5 \times 23.6^k = 35.4^{Ftk}$

$M = 35.4^k \times 11.5' - 23.6^k \times 5.75$

$= 407.1^{Ftk} - 135.7$ Ftk

$= 271.4$ Ftk.

TRY W 24×68

$S = 153\ in^3$

$$f_b = \frac{271.4^{Ftk} \times 12^{in/ft}}{153\ in^3} = 21.2^{ksi}$$

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CLIENT L.B.L.
JOB NO. 1322
PROJECT: MATERIAL & MOLECULAR LAB.
BY RTL DATE 4-13-76
SUBJECT TYP. COLUMN & FOUNTATION
CK DATE
SH. 12 OF

TYP. COLUMN DESIGN

COL. C-2 CONTINUES FROM THE BASEMENT TO ROOF

TRIB. AREA AT EA. FLR. $= 22.8' \times 22.66' = 516.64\ ft^2$

COL. LOAD $= 180^{\#/ft^2} \times 516.64\ ft^2$
$+ 4 \times (80^{\#/ft^2} + 100^{\#/ft^2}) \times 516.64$

REDUCED LIVE LOAD $= .8 \times 125^{\#/ft}$ $= 100^{\#/ft}$

$= 92.9^k + 371.9^k$
$= 464.8$
$= 470^k$

TRY W 12x92

A = $27.1\ in^2$
$r_y = 3.08$

$l = 15'$; $\frac{kl}{r} = \frac{1.0 \times 15' \times 12^{in/ft}}{3.08} = 58.44$

Fa = 17.6 ksi → ok

fa = $\frac{470}{27.1\ in^2} = 17.34^{ksi}$

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CLIENT:	L.B.L.	JOB NO.	1322
PROJECT:	MATERIAL & MOLECULAR LAB.	BY RTL	DATE 4-19-76
SUBJECT:	TYP. COL. FOUNDATION	CK	DATE
		SH. 13	OF

TYP. COLUMN FOUNDATION

INTERIOR COL. FTG.

MAX. COL. LOAD = 470^{k}

ADD WT. OF GRADE BM. = 20^{k}

490^{k}

CAPACITY OF 36" ϕ CAISSON / FT. BASED ON 1500 #/ft² FRICTION VALUE = $\pi \times 3' \times 1' \times 1500^{\#/ft^2}$ = $14.13^{k/1}$

LENGTH OF PIER NEEDED = $\frac{490^{k}}{14.13^{k/1}}$ = $34.6^{FT.}$

USE 3'ϕ x 35 CAISSON

EXTERIOR COL. FTG.

TRIB. AREA (3RD FLR. TO ROOF) = $11' \times 23'$ = 253^{ft^2}

TRIB. AREA (1ST & 2ND FLR) GL. A-3 = $20' \times 18'$ = 360^{ft^2}

REDUCED FLR. LL = $.8 \times 125^{\#/ft^2}$ = $100^{\#/ft^2}$

LOADS = $180^{\#/ft^2} \times 253^{ft^2}$ ROOF

$+ 2(80 + 100^{\#/ft^2}) \times 253^{ft^2}$ 3RD, 4TH FLR

$+ 2(80 + 100^{\#/ft^2}) \times 360^{ft^2}$ 1ST & 2ND FLR.

$+ 150^{\#/ft^2} \times 13.33' \times 77'$ CONC. WALL

$+ 20^{k}$ GRADE BM.

$= 45.5^{k} + 91.1^{k} + 129.6^{k} + 154^{k} + 20^{k}$

$= 440.2 \simeq 440^{k}$.

LENGTH REQD. OF CAISSON = $\frac{440^{k}}{14.13^{k/1}}$ = 31.13'

USE 3'ϕ x 35' CAISSON.

CLIENT L.B.L.

JOB NO. 15[illegible]

PROJECT MATERIAL & MOLECULAR LAB.

BY RTL DATE 4-17-76

SUBJECT BASEMENT COL. & FOUNDATION

CK DATE

SH. 14 OF

BASEMENT COLUMN & FOUNDATION

(COLUMN SOUTH OF COL. LINE Ⓐ).

THESE COLS. EXTEND FROM THE BASEMENT TO 2ND FLR.

MAX. TRIB. WIDTH $= 20' \times 20 = 400\ \text{FT}^2$.

MAX. COL. LOAD $= 2 \times \left(\underset{DL}{\overset{\#/ft^2}{80}} + \underset{LL}{\overset{\#/ft^2}{125}} \right) \times 400^{FT^2}$

$= 164^k$.

USE W 10 x 49

CAPACITY OF COL. FOR 17' UNSUPPORTED LENGTH $= 221^k$

$> 164^k$.

O.K.

COLUMN FOOTING

LOAD $= 164.0^k + (\underset{(WALL)}{150^{\#/ft^2}} \times \overset{HT}{30} \times \overset{TRIB. WIDTH}{20'}) + (\underset{GRADE\ BM.}{20^k})$

$= 164 + 90^k + 20^k$

$= 274^k$.

LENGTH OF 3'ϕ CAISSON REQ'D. $= \dfrac{274^k}{\underset{\uparrow\ PAGE\ 13.}{14.13^{k/'}}} = 19.39^{FT.}$

USE 3'ϕ CAISSON x 20' LONG

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CLIENT L.B.L.
JOB NO. 1322
PROJECT: MATERIAL & MOLECULAR LAB.
BY RTL DATE 4-20-76
SUBJECT LATERAL LOADS
CK DATE
SH. 15 OF

LATERAL LOADS

$$V = ZIKCSW$$

$Z = 1.0$, AREA OF HIGHEST SEISMICITY
$I = 1.0$

TIME PERIOD OF BUILDING $T = \frac{.05 h_n}{\sqrt{D}}$ (N-S) $= \frac{.05 \times 77'}{\sqrt{120}} = .35^{SECS}$ $h_n = 77'$, $D = 120'$, OR $= 157.16$

(E-W) $= \frac{.05 \times 77'}{\sqrt{157.16'}} = .307$ SECS.

$$C = \frac{1}{15\sqrt{T}} = \frac{1}{15 \times \sqrt{.307}} = .120$$

$$S = \quad = 1.5$$

$$CS = .12 \times 1.5 \quad = .18; \text{ USE } .14.$$

$$K = 1.33$$

$V = .2\,W$ MIN. (LBL. REQUIREMENT)

OR

$$V = Z \times I \times K \times CS \times W$$
$$= 1.0 \times 1.0 \times 1.33 \times .14 \times W$$
$$= 0.186\,W$$

THE BLDG. IS SYMMETRICAL. DESIGN FOR 5% ACCIDENTAL TORSION.

DESIGN SHEAR WALLS TO RESIST TOTAL SEISMIC LOADS

USE $V = 0.2\,W$.

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BY RTL DATE 4-19-76

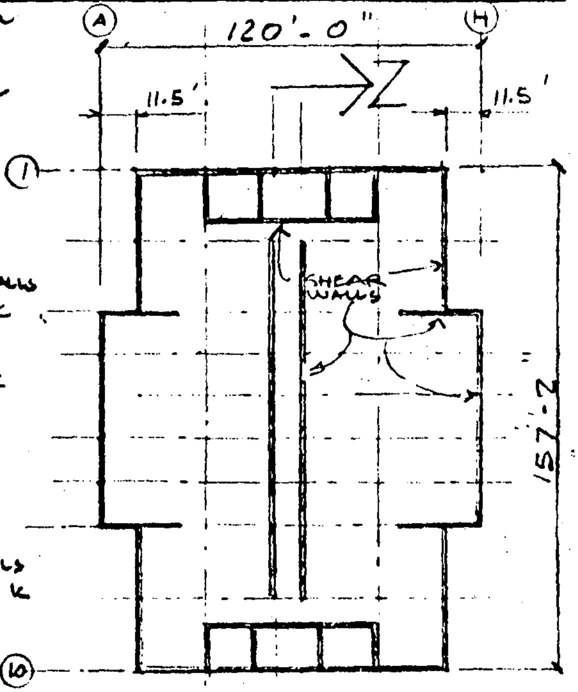
SUBJECT LATERAL LOADS

CK DATE

SH. 16 OF

ROOF D.L. = $130^{\#/ft^2}$ (D.L.) $+ .25 \times 50^{\#/ft^2}$ (SOLAR EQP.) $= 142.5^{\#/ft^2}$.

FLRS DL = $80^{\#/ft^2} + .25 \times 125^{\#/ft^2}$ (L.L.) $= 112^{\#/ft^2}$.



$W_{ROOF \; N\text{-}S} = 142.5^{\#/ft^2} \times 157.2' \times 108.5'$ ROOF

$+ 100^{\#/ft^2} \times 4 \times 157.2' \times 10'$ N & S WALLS

$= 2430 + 628^k = 3058^k$

$W_{ES} = 2430^k + 100^{\#/ft^2} \times 4 \times 120 \times 10$ E&W WALLS

$= 2430 + 480^k = 2910^k$

$W_{3RD, 4TH \; FLR} = 112^{\#/ft^2} \times 157.2' \times 108.5'$ FLR.

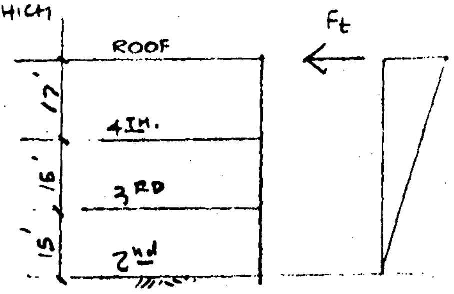
$+ 100^{\#/ft^2} \times 4 \times 157.2' \times 15'$ N & S WALLS

$W_{N\text{-}S} = 1910 + 944 = 2854^k$

$W_{EW} = 1910^k + 100^{\#/ft^2} \times 4 \times 120 \times 15$ E & W WALLS

$= 1910^k + 720^k = 2630^k$

THE LATERAL LOADS FROM FLRS. ABOVE 2ND FLRS. ARE TRANSFERRED TO GROUND AT SECOND FLR. LEVEL. THE LATERAL LOADS FROM 2ND & 1ST FLR. (WHICH ARE SMALL AREAS) ARE RESISTED BY SHEAR WALLS (OR BASEMENT WALLS) WHICH SUPPORT THEM.



BASE SHEAR V = .168W

$V_{N\text{-}S} = .20(3058 + 2 \times 2854^k)$

$= .20 \times 8766^k$

$= 1753.2^k \simeq 1760$

$V_{E\text{-}W} = .20(2910^k + 2 \times 2630)$

$= .20 \times 8170$

$= 1634^k$

DESIGN FOR V = 1480^k FOR N-S OR E-W EARTHQUAKE

$F_t = .07 \times TV$

$= .07 \times .35 \text{ SEC.} \times 1760$

$= 43.12 \simeq 44^k$ (SAY)

$V - F_t = 1760^k - 44^k = 1716^k$

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PROJECT	MATERIAL & MOLECULAR LAB.	BY RTL	DATE 4-[illegible]
SUBJECT	LATERAL LOADS – PRELIMINARY	CK	DATE
		SH. 17	OF

DISTRIBUTION OF LATERAL LOADS

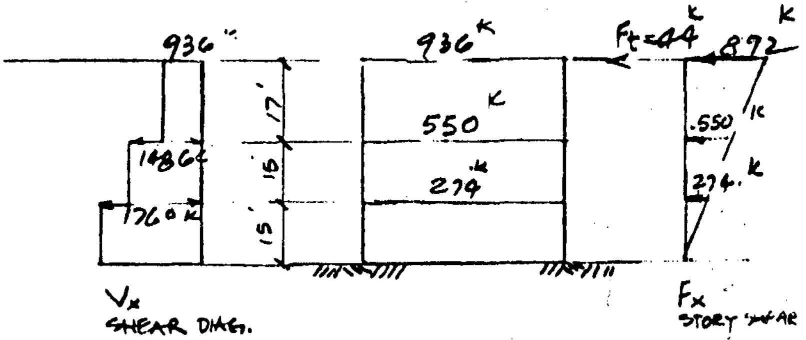
$V = 1760^k$

$F_t = 44^k$

$V - F_t = 1716^k.$

$$F_x = (V - F_t)\frac{w_x h_x}{\sum w_i h_i} = 1716^k \frac{w_x h_x}{\sum w_i h_i}$$

FLR.	w_x	h_x	$w_x h_x$	$\frac{w_x h_x}{\sum w_i h_i}$	F_x (STORY SHEAR)		V_x
ROOF	3058^k	47'	143,726	.52	$892^k + 44^k$	$= 936^k$	936
4^{TH}	2854	30'	85,620	.32	550	= 550	1486
3^{RD}	2854	15'	42,810	.16.	274	= 274	1760
2^{ND}							
			272,156	1.00	$\sum V = 1760K$		



EAST WEST SEISMIC

MAX. STORY SHEAR $= 936^k$

ACCIDENTAL TORSION

MAX. DIAPHRAGM SHEAR (ASSUME THAT DIAPHRAGM SPANS BETWEEN THE END WALLS) $= \frac{936^k}{2} \times \frac{1}{152'} \times 1.05$

$= 3.125\ ^k/_1$

MAX. DIAPHRAGM SHEAR STRESS $= \frac{3.125\ ^k/_1}{12 \times 4''}$ SLAB TK.

$= 65.1$ psi

OK

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PROJECT:	MATERIAL & MOLECULAR LAB.	BY RTL DATE 4-[illegible]-76
SUBJECT	LATERAL LOADS — PRELIM.	CK DATE SH. 18 OF

EAST - WEST SEISMIC (CONT'D.)

SHEAR WALLS

EFFECT OF ACCID. TORSION

UBC 2314(b)

$$\text{MAX. WALL SHEAR} = 1.5 \times \frac{1760^k}{4} \times 1.05 = 693^k$$

NO. OF WALLS (ASSUME ALL EQUALLY STIFF)

$$\text{MAX. WALL SHEAR PER FT.} = \frac{693^k}{(157.2 - 50')} = 6.46^{k/'}$$

OPN'GS.

$$\text{MAX. WALL SHEAR STRESS} = \frac{6.46^{k/'}}{12 \times 8''} = 67.3 \text{ PSI}$$

WALL TK.

OK

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PROJECT	MATERIAL & MOLECULAR LAB.	BY RTL DATE 4-28-76
SUBJECT	LATERAL LOADS - PRELIM.	CK DATE
		SH. 19 OF

NORTH - SOUTH SEISMIC

MAX. STORY SHEAR = 936^k

DIAPHRAGM SHEAR

ACCIDENTAL TORSION

MAX. DIAPHRAGM SHEAR (ASSUME THAT DIAPHRAGM SPANS BETWEEN THE END WALLS.) $= \frac{936^k}{2} \times \frac{1}{120'} \times 1.05 = 4.09^{k/1}$

MAX. DIAPHRAGM SHEAR STRESS $= \frac{3.44^{k/1}}{12 \times 4''} = 65.3$ PSi.

SLAB TK.

O.K.

SHEAR WALLS

UBC 2314 (b)

MAX. WALL SHEAR $= 1.5 \times \frac{1760}{4} \times 1.05 = 693^K$

NO. OF WALLS (ASSUME ALL EQUALLY STIFF)

MAX. WALL SHEAR PER FT. LENGTH $= \frac{693^k}{(120' - 40')} = 8.66^{k/1}$

OPN'GS.

MAX. WALL SHEAR STRESS $= \frac{8.66^{k/1}}{12'' \times 8''} = 90.2$ PSI

O.K.

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PROJECT Materials & Molecular Research Lab Additions
BY [illegible] DATE [illegible]
SUBJECT Conceptual Design Mechanical Calcs
CK DATE
SH. 1 OF

Heating "U" values according to ERDAM 6301, & State of Cal. Title 24.

1. Degree days heating for Berkeley - 2870

2. U factor - 6301 Walls - 0.16 $\frac{Btu}{hr\text{-}ft^2\,{}^\circ F}$

Roof 3.5 $\frac{Btu}{hr\text{-}ft^2}$

For - 72°F - 36°F = 36°F ΔT

$$\text{Roof } U = \frac{3.5}{36^\circ} \approx \boxed{0.10 \frac{Btu}{hr\text{-}ft^2\,{}^\circ F}}$$

3. U - factor Title 24

Wall area - 27,335 ft² = A_w
Glass area - 6,753 ft² = A_g
33,908 ft² = A_{ow}

From tables $U_{ow} = 0.40$

For single glazing $U_{glass} = 1.06 \frac{Btu}{hr\text{-}{}^\circ F\text{-}ft^2}$

$$U_{wall} = \frac{U_{ow} \times A_{ow} - U_g \times A_g}{A_w} = \frac{0.4 \times 33908 - 1.06 \times 6355}{27,335}$$

$$= \frac{13563 - 6736}{27,335} = \frac{6827}{27,335} = 0.25 \frac{Btu}{hr\,{}^\circ F\,ft^2}$$

Roof

$$U_{or} = U_r = 0.10 \frac{Btu}{hr\,{}^\circ F \cdot ft^2}$$

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CLIENT LBL
JOB NO [illegible]
PROJECT Materials & Molecular Research lab Additions
BY [illegible] DATE [illegible]
SUBJECT Conceptual Design Mechanical Calcs.
CK DATE
SH. 2 OF

Cooling "U" values according to ERDAM 6301 & State of Cal. Title 24

1. 6301 allows 2.0 Btu/hr ft²

For group K wall $\Delta T_{eq} \approx 25^\circ$

$$\boxed{U_w = \frac{2.0}{25} = 0.08}$$

2. Title 24

Walls

$$32.6\ \text{Btu/hr ft}^2 = \frac{U_w \times A_w \times TD_{eq} + A_F \times SF \times SC + U_f \times A_f \times \Delta T}{A_{ow}}$$

$A_w = 27,335\ \text{ft}^2$ SF - shading factor = 0.75

$TD_{eq} = 23^\circ$ SC - solar coeff = 125

$A_F = 6,753\ \text{ft}^2$ ΔT - $84^\circ - 76^\circ = 8^\circ$

$U_F = 1.06$ A_{ow} - 33,908 ft²

$$U_w = \frac{32.6 \times A_{ow} - A_F \times SF \times SC - U_f \times A_f \times \Delta T}{A_w \times TD_{eq}}$$

$$= \frac{32.6 \times 33,908 - 6,753 \times 0.75 \times 125 - 1.06 \times 6,753 \times 8^\circ}{27,335 \times 23^\circ}$$

$$U_w = \frac{1,105,400 - 633,094 - 57,265}{628,705} = \frac{415,041}{628,705} = 0.66$$

Roof - $4.1\ \frac{\text{Btu}}{\text{hr ft}^2} = 41 \times U_r \times 0.79 \times 0.84$

$$U_r = \frac{4.1}{41 \times 0.79 \times 0.84} = 0.15$$

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SH. 3 OF

Wall & Roof Insulation Thicknesses

$U_R = 0.08 \frac{\text{Btu}}{\text{hr-ft}^2\,{}^\circ\text{F}}$ $U_w = 0.10 \frac{\text{Btu}}{\text{hr-ft}^2\,{}^\circ\text{F}}$

Neglect all other resistances

$R_I = \frac{1}{0.08} = 12.5$ –

USE R-11 insulation

3½" Fiber glass

2" Poly urethane

$R_w = \frac{1}{0.10} = 10$

Also use R-11 insulation

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CK DATE

SH. 4 OF

Existing Materials & Molecular Research Lab

1. Laboratory air Flow Typical - 800 CFM

   Area 23'x14' = 322 SF ≃ 2.5 CFM/SF

2. Office air Air Flow typical - 400 CFM

   Area 14' x 11' = 154 ≃ 2.5 CFM/SF

3. Office Return Air % $\frac{350}{400}$ = 87%

4 Existing air conditioning - 64 tons

5. Water heating - 20 GPM heated 100°F.

Existing Materials Research Lab High Bay Area

1. Air flow 16,800 CFM

   Area 100' x 56' = 5600 SF ≃ 3 CFM/SF

2. Return Air % $\frac{16,800 - 3600}{16,800}$ ≃ 80%

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PROJECT Materials & Molecular Research Lab Additions

BY E. Horvitz DATE 3[illegible]

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CK DATE

SH. 5 OF

New Materials & Molecular Research Lab

1. Base calcs on existing Lab - page 1.

2. Floor Areas

Labs-Int. - 120' × 22' × 2 = 5280 ϕ
Labs-Ext. - 67' × 22' × 2 = 2948 ϕ
Offices - 44' × 14' × 4' = 2464 ϕ
10,692 ϕ / Floor

For 3 Floors 3 × 10,692 ϕ = 32,076 ϕ

Conference Room	40' × 30'	=	1200 ϕ
Foyer	40' × 28'	=	1120 ϕ
Mech Room	44' × 50'	=	2200 ϕ
Shop	40' × 66'	=	2440 ϕ
			39,036 ϕ

3. Total Conditioned Air Flow 39,036 ϕ × 2.5 $\frac{CFM}{SF}$ (From p1,

≈ 100,000 CFM

4. Return Air Flow from Offices,
Conf. Room, Foyer Mech Room & Shop - 2464 ϕ
1200
1120
2200
2440
9424 ϕ

From page 1.

RA = 9424 ϕ × 2.5 $\frac{CFM}{SF}$ × 87%
≈ 20,000 CFM

5. Exhaust Air flow 100,000 - 20,000 = 80,000 CFM.

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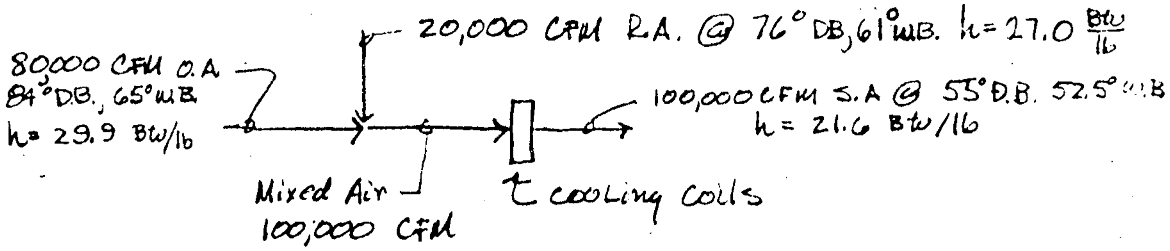
CK DATE

SH 6 OF

6. Cooling Load



$h_{\text{mixed air}} = 0.8 \times 29.9 + 0.2 \times 27.0 = 23.9 + 5.4 = 29.3 \ \frac{\text{Btu}}{\text{lb}}$

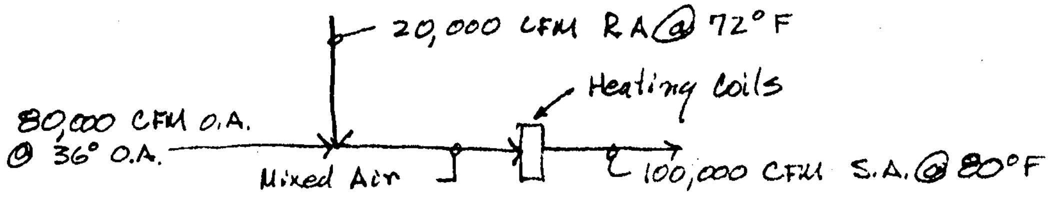
$T_{\text{mixed air}} = 0.8 \times 84° + 0.2 \times 76° = 67.2° + 15.2° = 82.4° F$

Cooling load $= 100{,}000 \times 4.45 \times (29.3 - 21.6) = 3{,}426{,}500 \ \frac{\text{Btu}}{\text{hr}}$

$= 285$ tons

Mixed air wet bulb (from psych chart)
64.0 F

7. Heating Load



Mixed Air Temp $= 0.2 \times 72° + 0.8 \times 36° = 14.4 + 28.8 = 43.2°$

Heating load $= 100{,}000 \times 1.08 \times (80° - 43.2) = 3{,}974{,}400 \ \frac{\text{Btu}}{\text{hr}}$

8. Chilled Water Flow

285 tons × 3 GPM/ton = 855 GPM

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CK DATE

SH 7 OF

9. Water Heating Load - (Same as existing Materials and Molecular Research Lab)

20 GPM x 500 x 100°F = 1,000,000 $\frac{\text{Btu}}{\text{hr}}$

This includes domestic and Industrial hot water.

10. Total Load on Existing Chillers

Existing bldg -	64 tons	189 GPM
New bldg -	285 tons	855 GPM
	474 tons	1044 GPM

11. Total New Boiler Load

Heating -	3,974,400 Btu/hr
Water Htg -	1,000,000 " "
	4,974,400 Btu/hr output

Input $\frac{4,974,400}{0.8}$ = 6,218,000 Btu/hr.

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SUBJECT Conceptual Design Mechanical Calcs.

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BY R. [illegible] DATE [illegible]

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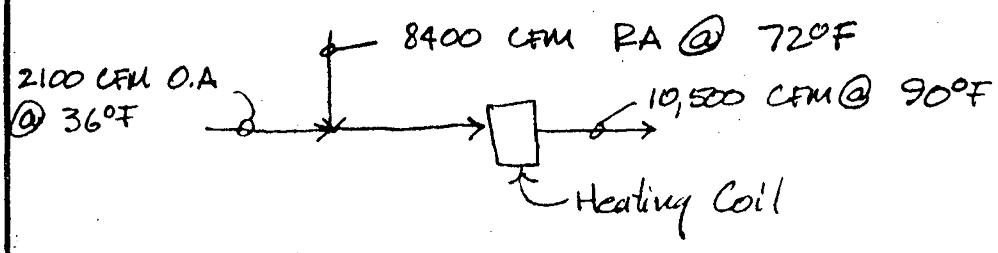
SH. 8 OF

New High Bay Lab Addition

1. Floor Area - 3500 #
2. Supply Air - 3500 x 3 $\frac{\text{CFM}}{\text{SF}}$ = 10,500 CFM
3. Return Air - 10,500 x 0.8 = 8,400 CFM
4. Heating -



Mixed air temp. = 0.2 x 36° + 0.8 x 72° = 7.2° + 57.6°

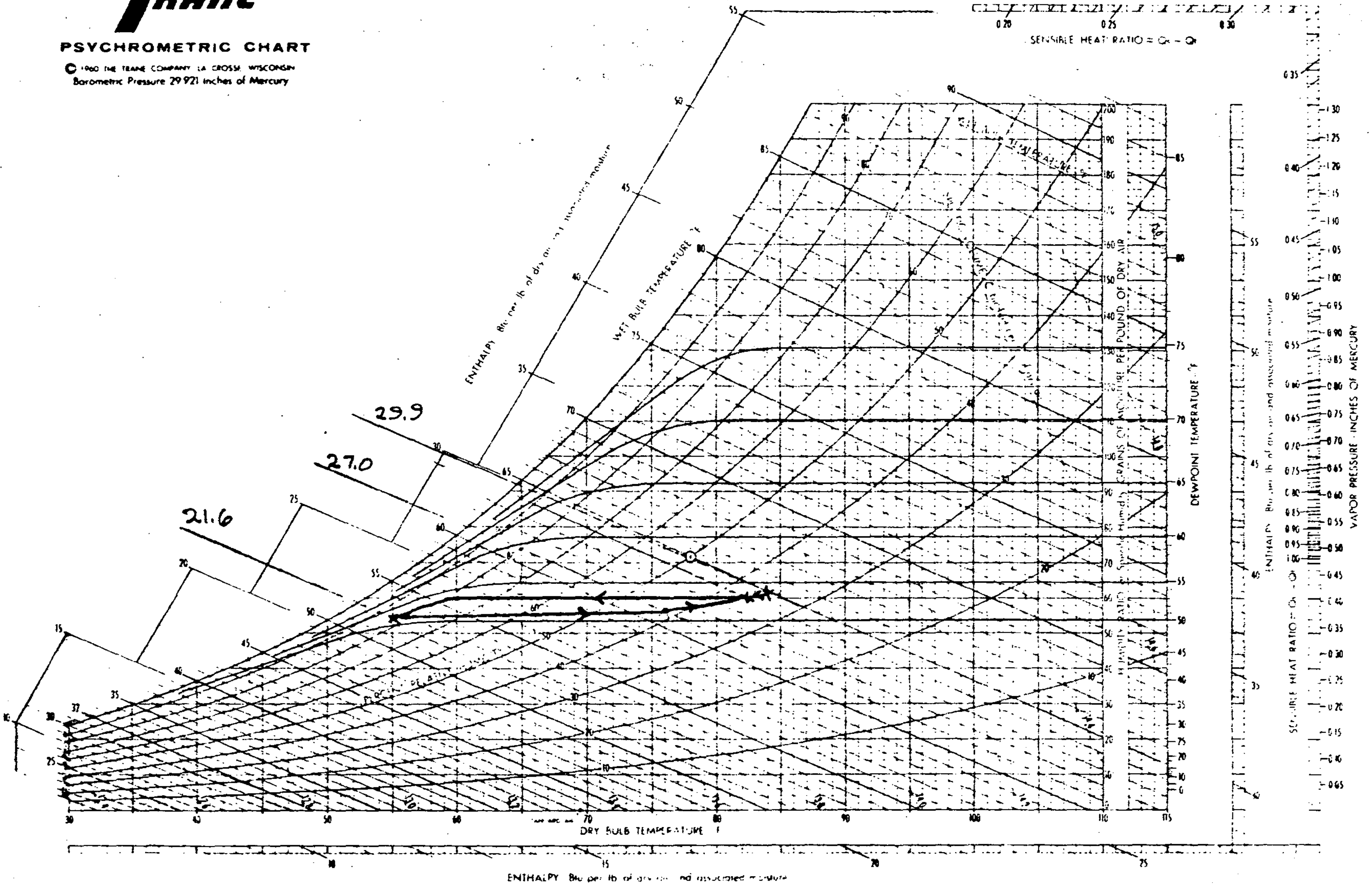
= 64.8°

Heating - 10,500 x 1.08 x (90° - 64.8°) = 285,768 $\frac{\text{Btu}}{\text{hr.}}$

TRANE

PSYCHROMETRIC CHART

Barometric Pressure 29.921 inches of Mercury



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ENGINEERING NOTE

SUBJECT	FILE NO.	PAGE
SOLAR ENERGY ANALYSIS	NAME TLW	
	DATE 5-9-77	

1. NOMENCLATURE:

C_s - Solar system cost - \$/SFc

S - Annual incident Solar energy - BTU/SFc/YR

η_s - Solar system efficiency

η_h - heating system efficiency

C_f - Cost of fuel - \$/10^6 BTU

DEF - Summed product Discount energy growth factor

2. SPACE & SERVICE WATER HEATING:

$$C_s = \frac{S \times \eta_s}{\eta_h} \times C_f \times DEF$$

Assume:

S = 570,000 B/SFc/YR LBL Solar Data Manual
slope = 45°, due South

η_s = 35% }
η_h = 60% } ERDA Solar Design Manual

C_f = \$35/GAL = \$2.40/10^6 BTU

DEF = 19.78 ERDA Solar Design Manual @ 25 YRS.

$$\therefore C_s = \frac{.570 \times 10^6 (.35)}{.60} (2.40 \times 10^{-6})(19.78) = \underline{15.8 \text{ SAY } \$16/\text{SFc}}$$

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ENGINEERING NOTE

FILE NO.
PAGE
SUBJECT
NAME TLW
DATE 5-9-77

3. SERVICE WATER HEATING:

$$C_s = \frac{S \times \eta_s}{\eta_h} \times C_f \times DEF$$

Assume

$S = 570,000$

$\eta_s = 45\%$

$\eta_h = 60\%$

$C_f = \$2.40/10^6$ BTU

$DEF = 19.78$

$$C_s = \frac{.57\times10^6(.45)}{(.60)}(\$2.40\times10^{-6})(19.78) = \$20.3 \text{ say } \$20/\text{sFt}$$

∴ Look @ optimization curves analysis.

4. YEARLY HOT WATER LOAD:

Lavatories etc 1 GAL/person-day × 205 people = 205 GAL/Day
Lab use etc = 595 "
Total Service hot water 800 "

300 Days/YR × 800 GAL/DAY = 240,000 GAL/YR

240,000 × 8.34 #/GAL = 2,001,600 #/YR

Heat 60°F → 120°F ΔT = 60°F

$H_s = 2,001,600 \times 60 = 120,096,000$ BTU/YR

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JOB NO. 1450

PROJECT MATERIALS & MOLECULAR RESEARCH LAB
BY SRP DAT 5/5/7

SUBJECT BUILDING SERVICE HOT WATER
CK dr DAT 5/

SH. 1 OF 3

5. FROM ABOVE TAKE 800 GAL/DAY.

(1 BTU/LB °F)(800 GAL/DAY)(120°F − 60°F)(8.34 LBS/GAL)(25 DAYS/MONTH) = 10.00 E6 BTU/MO

THE EXAMPLE OF APPENDIX A-1 OF "ERDA FACILITIES DESIGN HAND BOOK" BY B. D. HUNN LA-UR-77-186 HAS BEEN FOLLOWED TO EVALUATE THE ECONOMIC FEASIBILITY OF SOLAR FOR BUILDING SERVICE HOT WATER.
INSOLATION (10^3 BTU/MO/SF$_C$) HAS BEEN SUPPLIED FROM THE DRAFT OF SOLAR DATA MANUAL OF L.B.L. FOR A 45° DUE SOUTH COLLECTOR LOCATED AT RICHMOND, CALIFORNIA:

JAN	38	MAY	54	SEPT	54
FEB	42	JUNE	53	OCT	45
MARCH	53	JULY	55	NOV	31
APRIL	56	AUG	56	DEC	33.

A DISCOUNT RATE OF 10% HAS BEEN USED WITH ENERGY GROWTH FOR OIL AT 8% AND GAS AT 10% PER LA-UR-77-186 TABLE 4-7. A 25 YEAR LIFE HAS BEEN USED FROM TABLE 4-12 AND TABLE 4-14 BASED ON 25 $/SF$_C$ AND 35 $/SF$_C$ FROM TABLE 4-6 AND 45% SYSTEM EFFICIENCIES FROM TABLE 4-9.
OIL AND GAS ENERGY COST WAS TAKEN AT 2.40 $/10^6 BTU.
THE CURVE FIT OF MONTHLY FRACTION SOLAR = $1 - 1.175e^{-.96\,SBLR}$ WHERE SBLR IS MONTHLY SOLAR/BUILDING LOAD RATIO WAS USED BASED ON FIGURE 4-4 OF LA-UR-77-186.
ANNUAL OPERATING COST IS TAKEN AT 1% OF CAPITAL COST.

IT IS SEEN FROM THE CURVES OF SAVINGS VS COLLECTOR AREA THAT SOLAR AT 35 $/SF$_C$ DOES NOT QUITE RESULT IN A NET SAVING BASED ON OIL ENERGY GROWTH RATES. BASED ON GAS ENERGY GROWTH RATE A SMALL ANNUAL SAVING IS PROJECTED. IF SYSTEM COST IS 25 $/SF$_C$ THEN THE OIL ENERGY GROWTH RATES RESULT IN A NET SAVING. IT IS RECCOMENDED THAT MORE ANALYSIS BE DONE BASED ON TITLE I DESIGN TO DETERMINE THE JUSTIFICATION FOR USE OF SOLAR.

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PROJECT MATERIALS & MOLECULAR RESEARCH LAB

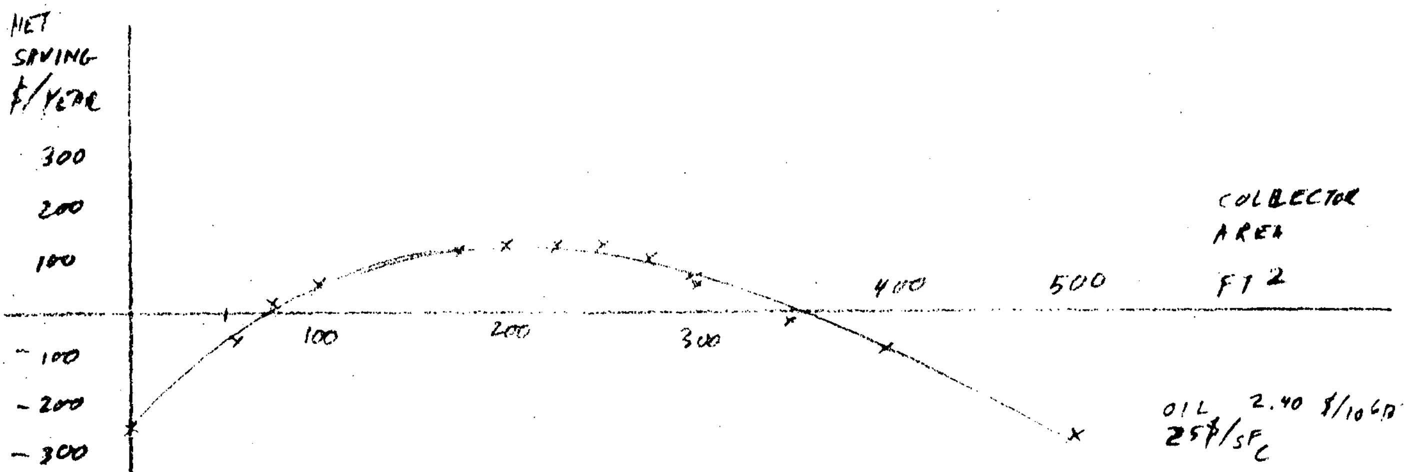
SUBJECT BUILDING SERVICE HOT WATER

JOB NO. 1450

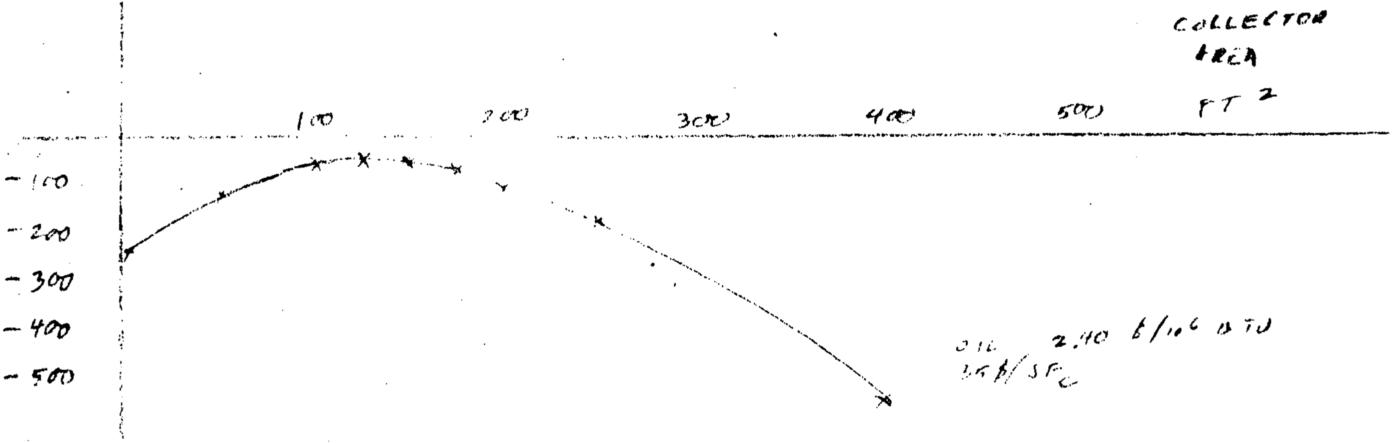
BY SRF 5/6/7

CK 5/9/

SH. 2 OF 3



OIL 2.40 $/$10^6$ BTU
25$/$SF_C$



OIL 2.40 $/$10^6$ BTU
35$/$SF_C$

CLIENT U OF C LBL

JOB NO. 14[illegible]

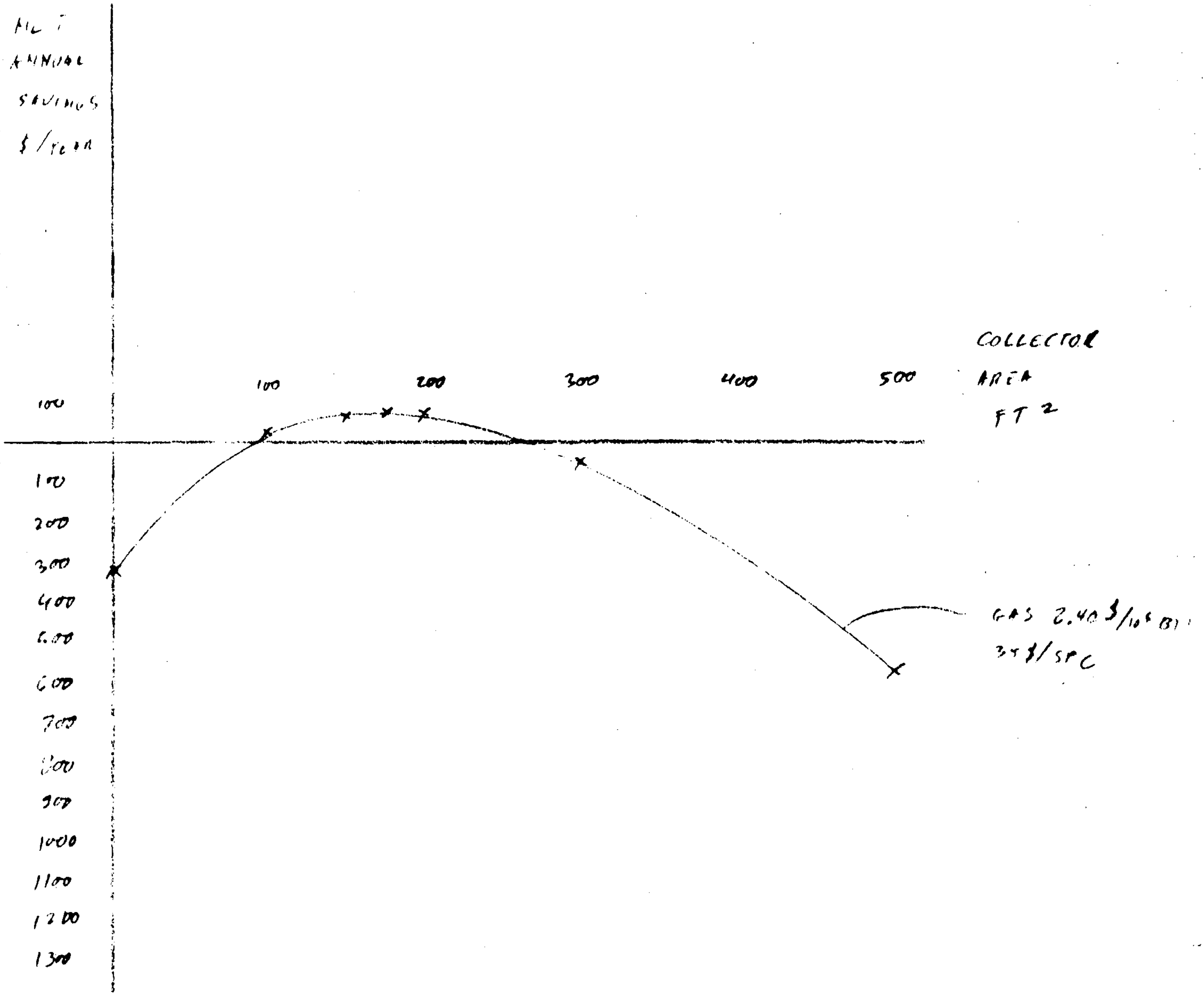
PROJECT MATERIALS + MOLECULAR RESEARCH LAB

BY [illegible] DATE [illegible]

SUBJECT BUILDING SERVICE HOT WATER

CK [illegible] DATE [illegible]

SH. 3 OF [illegible]



BASIS OF MECHANICAL DESIGN CALCULATIONS

A. SITE

1. City Water Service

A new 6-in. CW connection will be made in the 8-in. main on the east side of the new building. The new CW service will be brought underground to the new Materials and Molecular Research Laboratory building. A 6-in. curb shut-off valve will be installed in the new service. Also during construction the 3-in. water service to the existing building will have to be relocated vertically to accommodate the excavation for the new building.

2. Natural Gas Service

A new natural gas service will be installed to accommodate the total gas load of 12,800.000 BTU/hr. The gas will be piped at 1 psig to the boilers in the new laboratory building and at 5 psig underground to the existing laboratory. The existing gas service will have to be relocated because of the siting of the new building.

3. Rainwater System

The new rainwater outfall will bring the rainwater collected in the new building out underground to connect into the existing storm drainage spillway system at the east side of the new building. The system will be designed for a 2 in./hr rainfall.

4. Sanitary Sewer System

The sewer will be run in stacks in the new building and brought out under the new shop to the site sanitary sewer at the west side of the existing laboratory where it will connect at invert elevation 755+. The sewer will be designed for a 1/4 inch per foot slope. A waste monitoring system will be constructed to intercept the sewer wastes of the new and existing buildings in the future.

B. BUILDING

1. Acid Waste System

All waste outlets in laboratories will be connected to a central acid waste system within the building that is to be completely isolated from the sanitary sewer system. This waste system will connect into the sanitary sewer system at a point remote from the building. The distance from the building to the sewer connection will be controlled by the space required for an installed sump and monitoring system to be installed between the building and sewer connection.

2. Plumbing System

The new plumbing system will have American Standard or equal plumbing fixtures. All fixtures will have integral or remote stops; all exposed piping will be chrome plated. The new water heater will be a vertical storage type converter with the domestic water heated to 120° F by 150° F heating hot water. The heater will heat 10 gpm of water from 60° F to 120° F and will provide 200 gallons of storage capacity. The hot water system will have balanced loop returns on each floor with a 10 gpm recirculating pump in the Mechanical Room. All plumbing fixtures with flush valves will have shock absorbers in the pipe line. The domestic hot and cold water will be connected to the water service with a pressure reducing valve set at 80 psig.

3. Low Conductivity Water System (LCW)

The LCW system in the existing laboratory building will be extended to the new laboratory building. The system will be installed in balanced closed loops the length of the utility chase on each floor for laboratory equipment cooling. The water will be boosted to a maximum pressure of 90 psig by two new LCW pumps in the new Mechanical Room. The pumps will each circulate 50 gpm at 240 feet of head.

4. Industrial Hot and Cold Water System

Industrial hot and cold water will be supplied through the length of the utility chases on each floor of the new building. The hot water will have a balanced recirculating loop. The hot water heater and recirculating pump will be the sam type and size as for the domestic water system. A pressure reducing valve and reduced pressure backflow preventer will connect the industrial hot and cold water system to the cold water service.

5. Compressed Air System

Source of supply will be three new tank mounted air compressors with supply pressures of 90 to 100 psig. The system will include a distribution piping to furnish 75 psig within shops and laboratory areas. System shall be dried to dew point temperature of 40° F by a refrigerated air dryer. Each duplex compressor will deliver 52.5 acfm at 100 psig. They will be mounted on horizontal 120 gallon receivers. The new compressors will be connected to the system in the existing laboratory.

6. Natural Gas System

Natural gas will be distributed within the new building to laboratory and shop areas within the utility corridors and chases at a distribution pressure of 7 in. W.C. Extension from the pressure regulator installation at point of building connection will be provided.

7. Demineralized Water System

The demineralized water system will be using the water that is both cooled and conditioned in the LCW System and will be extended from the existing laboratory building. This sytem shall have non-metallic pipe and fittings. The system will have a minimum pressure of 35 psig and a maximum of 55 psig. The temperature of the water in this system will be 15° C. The system will be looped down the length of the utility corridor and chases on each floor with a booster pump in the Mechanical Room of the new building. The piping system will be sized for 15 gpm per floor.

8. Heating, Ventilating and Air Conditioning

a. Design Criteria

Design criteria and calculations for control of space temperatures shall be according to the latest editions of the ASHRAE Guide and Data Book and according to ERDAM 6301. Design conditions shall be as follows:

	Indoors	Outdoors
Summer	76° F 45% rh	84° D.B. 65° W.B.
Winter	72° F	36° F

b. Exhaust System

All of the air supplied to each laboratory will be exhausted up through ducting in the utility corridor or chases to the roof top industrial type exhausters. The exhaust from each lab will be separate and will not connect into the exhaust duct from any other lab. Each lab will also have a separate exhaust fan. If there are fume hoods in a laboratory, all of the exhaust air will be drawn through the fume hoods. Auxiliary air type fume hoods will be utilized to avoid conditioning of all exhaust air. See Supply Air System Subsection.

c. Supply Air-Return Air System

The supply air-return air system will supply air to all portions of the building at a rate of approximately 2-1/2 cfm.sq. ft. of conditional space. The supply system will consist of two in-line vane-axial type fans,a draw-through type hot water preheat coil, and air filters in a built-up housing heated in the basement mechanical room. Air will be filtered, tempered to 55° F by the pre-heat coil, and ducted up to the spaces through the duct shaft and sheet metal ducting. No air will be returned from the laboratories, but approximately 90% of the air supplied to other areas will be returned by a vane-axial type return fan located in the basement mechanical room. The return air to total supply air fraction will be approximately 20%.

Each laboratory and each office zone and other zones in the building will have a cooling and heating coil installed in the supply air ducting to the laboratory or zone. The control of these coils will be in the heating-off cooling mode with no overlap or reheat. The heating and cooling coils will be chilled water and heating water type with modulating control valves positioned by room thermostats.

The supply air quantity to a laboratory may have to be increased to provide 100 fpm fume hood face velocities. Any additional air above the air quantity required to cool the space will be ducted directly into the auxiliary air feature of the fume hood and will not pass through the room heating and cooling coil. This will reduce the heating and cooling loads.

The pre-heat, heating, and cooling coils will be sized for 500 cfm/sq. ft. of face area. The preh-heat coil will heat the air from the mixed air temperature at the winter design conditions of 43.2° F to 55° F which is above the conditioned space dew point. The zone heating coils will then heat the air from 55° F to 80° F at winter design conditions. The zone cooling coils will cool the air from the mixed air condition of 82.5° F, 64.0° F W.B. to 55° F, 52.5° F W.B.

Total supply air fan flow will be approximately 100,000 cfm with approximately 20,000 cfm return air fan flow.

The air filters will have an ASHRAE efficiency of 90%, will be sized for 250 cfm per square foot, and will be NFPA Class II.

Air will be introduced into all areas through ceiling diffusers and returned through light troffers into ceiling plenums in all areas except the laboratories.

d. <u>Hot Water Heating System</u>

The zone heating coils in the new Materials and Molecular Research Laboratory building will be supplied with 150° F hot water from two new 3,750,000 BTU/hr natural gas fired boilers and two new circulating pumps located in the basement Mechanical Room. The pumps and piping will be sized for a 20° F temperature drop. The hot water will be piped through the central utility trench and central utility corridors to the reheat coils. The piping shall be arranged for loop returns with three-way mixing type control valves on all reheat coils requiring 2.5 gpm and more of hot water. The system will have manual air relief valves at each reheat coil and automatic air relief valves at the high points of the system. It will also have a diaphragm tube expansion tank and air elimination fitting near the boilers in the Mechanical Room sized for the total capacity of the system. The boilers will be fired independently to maintain the hot water temperature. In addition, the heating hot water will be used for domestic and industrial water heating. The heated hot water temperature will be maintained by thermostats throttling three-way mixing type heating hot water valves. The heating water piping will be sized for a maximum velocity of 4 ft per second and a maximum friction loss of 4 ft of water column per 100 ft of pipe at C 100. The control valves shall be sized for a minimum of 1/3 of the total system pressure drop.

e. <u>Chilled Water System</u>

The 100 and 400 ton chillers in the existing Materials and Molecular Research Laboratory building have enough excess capacity to handle the new building. Chilled water will be piped through the new basement to the new zone cooling coils. The piping system will be sized and distributed according to the criteria for the heating water system above. New chilled water pumps, circulating 1200 gpm at 90 ft of water column head, will replace the pumps in the existing Materials and Molecular Research Laboratory building mechanical room.

f. High Bay Addition

The High Bay addition will be heated and ventilated by a hot water coil heating and ventilating unit supported from the roof in the addition. Approximately 10,500 cfm of supply air will be distributed through sheet metal ducting. Approximately 80% of it will be returned to the unit. Fresh air will be drawn through a roof inlet. The fresh air and return air will have an economized dampering system so that outdoor air up to 100% of the supply air quantity can be used for cooling when conditions are right. The heating coil will be connected to the heating water mains in the existing part of the building.

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CLIENT: LAWRENCE BERKELEY LABORATORY.
JOB NO 1[illegible]2
PROJECT: MMRL
BY K[illegible] DATE 4-[illegible]-7[illegible]
SUBJECT: LOAD ANALYSIS ELECTRICAL
CK DATE
SH. 1 OF 1

	CONNECTED LOAD KVA	DEMAND FACTOR	DEMAND KVA
LIGHTING			
3 FLOORS @ 52	156.		
CONF. ROOM & LOBBY	15		
MACHINE SHOP	12		
MECH. ROOM	6		
OUTSIDE	6		
TOTAL	195.	.9	175
RECEPTACLES			
LABS & OFFICES	85		
CONF ROOM	4		
MACHINE SHOP	7		
MECH ROOM	4		
TOTAL	100	.3	30
RESEARCH EQUIP 32 LABS @ 15 KVA. 20 LABS @ 10 KVA	680	.4	272
MACHINE SHOP 20 MOTORS @ 3 HP	60	.3	18
BUILDING MECH			
SUPPLY FANS 2 @ 40 HP	80		
HWHP 2 @ 10 HP	20		
DWCP 2 @ 1 HP	2		
AIR COMPR	7½		
CONTROL AIR COMPR	2		
LCW PUMPS 2 @ 25 HP	50		
ENERGY RECOVERY	7½		
EXH FANS 2 @ 3 HP	6		
HOOD EXH. FANS 52 @ 3/4 HP	39		
TOTAL	214	.8	171.
ELEVATOR	75	.3	22.
TOTAL	1324	.515	678

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CLIENT LBL

PROJECT MMRL

SUBJECT SHORT CIRCUIT CALCULATIONS LABORATORIES

JOB NO [illegible]

BY JHR DATE 4/16/75

CK DATE

SH. 1 OF 1

249 MVA S.C. at Exist Substa (Per LBL Data)

2000 KVA base

$\% Z_{Utility} = \frac{2000}{249000} \times 100 = 0.80$

$\% Z_{Transf} = 5.40$

$Z\ Total = 6.20\ \%$

TRANSF. F.L. AMPS = 2400

I_{SC} TRANSF AT 480 V = $\frac{2400}{6.2} \times 100 =$ 38,709 AMP SYMM MAIN BKR INT. RATING

MOTOR CONTRIBUTION - 1600 KVA CST

$= \frac{1000}{25} \times 100 = 6{,}400$ AMP

$I_{SC\ TOTAL}$ = 45,109 AMP. SYM FEEDER BKRS INT. RATING

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CLIENT: LAWRENCE BERKELEY LABORATORY

JOB NO [illegible]

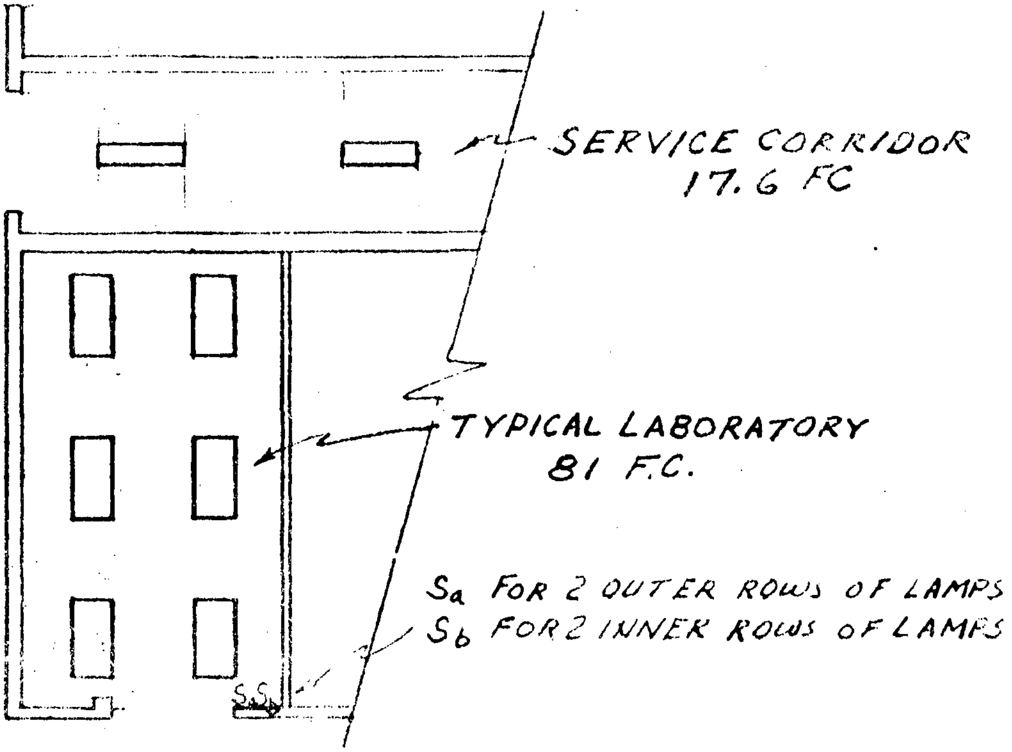
PROJECT: MMRL

BY RGF [illegible]

CK DATE

SUBJECT: LABORATORY & SERVICE CORRIDOR LIGHTING

SH OF



LIGHTING PLAN

SCALE 1/8" = 1'-0"

LABORATORY FIXTURES:

2FT X 4FT LAY IN RECESSED FLUORESCENT FIXTURE WITH FLAT ACRYLIC LENSE & 4 F40 RS. LAMPS. KEENE CAT No NRTS 2GVA440 OR EQUAL

SERVICE CORRIDOR FIXTURES:

4 FT INDUSTRIAL FLUORESCENT FIXTURE WITH PORCELAIN ENAMELED REFLECTOR SLOTTED FOR 10% UPLIGHT & 2 F40 RS LAMPS KEENE CAT No SF1240 POR OR EQUAL

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CLIENT LAWRENCE BERKELEY LABORATORY

JOB NO 13

PROJECT: MMRL

BY RGB

SUBJECT: OFFICE LIGHTING.

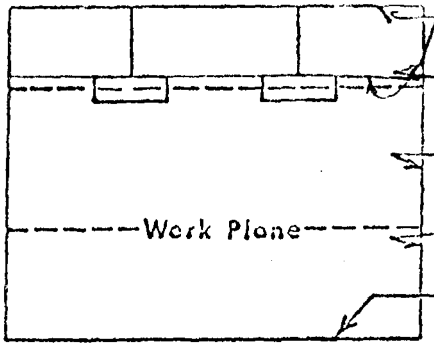
CK

SH. OF

CEILING CAVITY 0 ft.

ROOM CAVITY 7.5 ft.

FLOOR CAVITY 2.5 ft.



CEILING REFLECTANCE .80

WALL REFLECTANCE

WALL REFLECTANCE .50

WALL REFLECTANCE .50

FLOOR REFLECTANCE .20

TOTAL HEIGHT = 10 ft.

ROOM LENGTH 13.67 ft. x ROOM WIDTH 11 ft. = ROOM AREA 150 sq

I. DETERMINE CEILING CAVITY RATIO: From Table I or Formula = CC

DETERMINE ROOM CAVITY RATIO: From Table I or Formula = 6.2 RC

DETERMINE FLOOR CAVITY RATIO: From Table I or Formula = 2. FC

$$\text{Cavity Ratio} = \frac{5hc\,(L+W)}{LW}$$

II. DETERMINE:

EFFECTIVE CEILING CAVITY REFLECTANCE = 78 ρcc
(From Table II)

EFFECTIVE FLOOR CAVITY REFLECTANCE = ρfc
(From Table II)

III. FROM THE MANUFACTURER'S APPLICATION DATA CHART,
DETERMINE THE MAINTENANCE FACTOR (M.F.) = .70 M.F.
DETERMINE THE COEFFICIENT OF UTILIZATION (C.U.) = .40 C.U.

If Floor Cavity Reflectance (ρfc) is other than 20%, adjust by the factors in Table III.
______ C.U. $\overset{x}{\div}$ ______ Factor = ______ Adjusted C.U.

IV. DETERMINE THE NUMBER OF FIXTURES REQUIRED BY FORMULA

$$\frac{\_\_\_\_\ \text{f.c.} \times \_\_\_\_\ \text{sq. ft. Area}}{\_\_\_\_\ \text{Lumens/Luminaire} \times \_\_\_\_\ \text{Adj. C.U.} \times \_\_\_\_\ \text{M.F.}} = \_\_\_\_\ \text{Luminaire}$$

V. DETERMINE THE LIGHTING LEVEL PROVIDED BY FORMULA

$$\frac{3 \times 3200\ \text{L/L} \times 4\ \text{Luminaires} \times .40\ \text{Adj. C.U.} \times .70\ \text{M.F.}}{150\ \text{sq. ft. Area}} = 72\ \text{Footcandles}$$

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CLIENT LAWRENCE BERKELEY LABORATORY

JOB NO

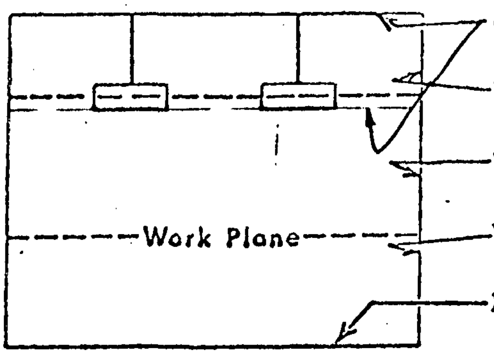
PROJECT: MMRL

BY

SUBJECT: CORRIDOR LIGHTING.

CK

SH. OF



CEILING CAVITY ____ ft.

ROOM CAVITY 6' ft.

FLOOR CAVITY 2.6 ft.

TOTAL HEIGHT= 8.6 ft.

CEILING REFLECTANCE .80

WALL REFLECTANCE ____

WALL REFLECTANCE .60

WALL REFLECTANCE .50

FLOOR REFLECTANCE .20

ROOM LENGTH 156 ft. x ROOM WIDTH 7 ft. = ROOM AREA 1090 sq

I. DETERMINE CEILING CAVITY RATIO: From Table I or Formula= ____ C

DETERMINE ROOM CAVITY RATIO: From Table I or Formula= 4.5 R

DETERMINE FLOOR CAVITY RATIO: From Table I or Formula= 2.0 F

$$\text{Cavity Ratio} = \frac{5hc\ (L \div W)}{LW}$$

II. DETERMINE:

EFFECTIVE CEILING CAVITY REFLECTANCE = 0.77 ρcc
(From Table II)

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20 ρfc
(From Table II)

III. FROM THE MANUFACTURER'S APPLICATION DATA CHART,
DETERMINE THE MAINTENANCE FACTOR (M.F.) = .70 M.F.
DETERMINE THE COEFFICIENT OF UTILIZATION (C.U.) = .42 C.U.

If Floor Cavity Reflectance (ρfc) is other than 20%, adjust by the factors in Table III.
____ C.U. $\div/\times$ ____ Factor = ____ Adjusted C.U.

IV. DETERMINE THE NUMBER OF FIXTURES REQUIRED BY FORMULA

$$\frac{\_\_\_\_\ \text{f.c.} \times \_\_\_\_\ \text{sq. ft. Area}}{\_\_\_\_\ \text{Lumens/Luminaire} \times \_\_\_\_\ \text{Adj. C.U.} \times \_\_\_\_\ \text{M.F.}} = \_\_\_\_\ \text{Luminaire}$$

V. DETERMINE THE LIGHTING LEVEL PROVIDED BY FORMULA

$$\frac{2 \times 3200\ \text{L/L} \times 1\ \text{Luminaires} \times .42\ \text{Adj. C.U.} \times 70\ \text{M.F.}}{84\ \text{sq. ft. Area}} = 22\ \text{Footcandles}$$

• BASED ON FIXTURES @ 12 FT SPACING

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CLIENT LAWRENCE BERKELEY LABORATORY

JOB NO 132

PROJECT: MMRL

BY RCB 4-5-7

SUBJECT: SERVICE CORRIDOR LIGHTING

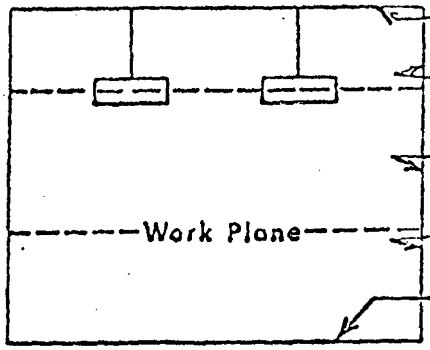
CK

SH. OF

CEILING CAVITY 5.5 ft.

ROOM CAVITY 6.5 ft.

FLOOR CAVITY 2.5 ft.



CEILING REFLECTANCE .30

WALL REFLECTANCE .30

WALL REFLECTANCE .30

WALL REFLECTANCE .30

FLOOR REFLECTANCE .10

TOTAL HEIGHT=14 ft.

ROOM LENGTH 120 ft. x ROOM WIDTH 8 ft. = ROOM AREA 960 sq

I. DETERMINE CEILING CAVITY RATIO: From Table I or Formula= 3.7 CC

DETERMINE ROOM CAVITY RATIO: From Table I or Formula= 4.4 RC

DETERMINE FLOOR CAVITY RATIO: From Table I or Formula= 1.7 FC

$$\text{Cavity Ratio} = \frac{5hc\ (L+W)}{LW}$$

II. DETERMINE:

EFFECTIVE CEILING CAVITY REFLECTANCE = .28 ρcc
(From Table II)

EFFECTIVE FLOOR CAVITY REFLECTANCE = .09 ρfc
(From Table II)

III. FROM THE MANUFACTURER'S APPLICATION DATA CHART,
DETERMINE THE MAINTENANCE FACTOR (M.F.) = .70 M.F.
DETERMINE THE COEFFICIENT OF UTILIZATION (C.U.) = .40 C.U.

If Floor Cavity Reflectance (ρfc) is other than 20%, adjust by the factors in Table III.
.40 C.U. $\div$/x 1.05 Factor = .38 Adjusted C.U.

IV. DETERMINE THE NUMBER OF FIXTURES REQUIRED BY FORMULA

$$\frac{\_\_\_\_\ \text{f.c.} \times \_\_\_\_\ \text{sq. ft. Area}}{\_\_\_\_\ \text{Lumens/Luminaire} \times \_\_\_\_\ \text{Adj. C.U.} \times \_\_\_\_\ \text{M.F.}} = \_\_\_\_\ \text{Luminaire}$$

V. DETERMINE THE LIGHTING LEVEL PROVIDED BY FORMULA

$$\frac{2X\ 3200\ \text{L/L} \times 10\ \text{Luminaires} \times .38\ \text{Adj. C.U.} \times .70\ \text{M.F.}}{960\ \text{sq. ft. Area}} = 17.6\ \text{Footcandles}$$

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CLIENT LAWRENCE BERKELEY LABORATORY

JOB NO

PROJECT: MMRL

BY PGP 4-87

SUBJECT: LABORATORY LIGHTING.

CK

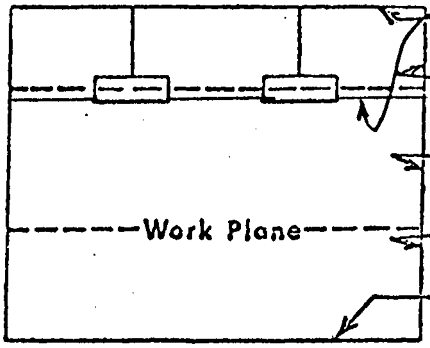
SH. OF

CEILING CAVITY 0 ft.

ROOM CAVITY 8.5 ft.

FLOOR CAVITY 3 ft.

TOTAL HEIGHT= 11.5 ft.



CEILING REFLECTANCE .80

WALL REFLECTANCE

WALL REFLECTANCE .50

WALL REFLECTANCE .50

FLOOR REFLECTANCE .20

ROOM LENGTH 22.4 ft. x ROOM WIDTH 13 ft. = ROOM AREA 291 sq

I. DETERMINE CEILING CAVITY RATIO: From Table I or Formula= C

DETERMINE ROOM CAVITY RATIO: From Table I or Formula= 5.2 R

DETERMINE FLOOR CAVITY RATIO: From Table I or Formula= 1.8 F

$$\text{Cavity Ratio} = \frac{5hc\,(L+W)}{LW}$$

II. DETERMINE:

EFFECTIVE CEILING CAVITY REFLECTANCE = .80 ρcc
(From Table II)

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20 ρfc
(From Table II)

III. FROM THE MANUFACTURER'S APPLICATION DATA CHART,
DETERMINE THE MAINTENANCE FACTOR (M.F.) = .70 M.F.
DETERMINE THE COEFFICIENT OF UTILIZATION (C.U.) = .44 C.U.

If Floor Cavity Reflectance (ρfc) is other than 20%, adjust by the factors in Table III.

C.U. $\div$ $\times$ Factor = .44 Adjusted C.U.

IV. DETERMINE THE NUMBER OF FIXTURES REQUIRED BY FORMULA

$$\frac{\_\_\_\text{ f.c.} \times \_\_\_\text{ sq. ft. Area}}{\_\_\_\text{ Lumens/Luminaire} \times \_\_\_\text{ Adj. C.U.} \times \_\_\_\text{ M.F.}} = \_\_\_\text{ Luminaire}$$

V. DETERMINE THE LIGHTING LEVEL PROVIDED BY FORMULA

$$\frac{12\text{X } 3200 \text{ L/L} \times 6 \text{ Luminaires} \times .44 \text{ Adj. C.U.} \times .70 \text{ M.F.}}{291 \text{ sq. ft. Area}} = 81 \text{ Footcandles}$$

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CLIENT: LAWRENCE BERKELEY LABORATORY

PROJECT: MMRL

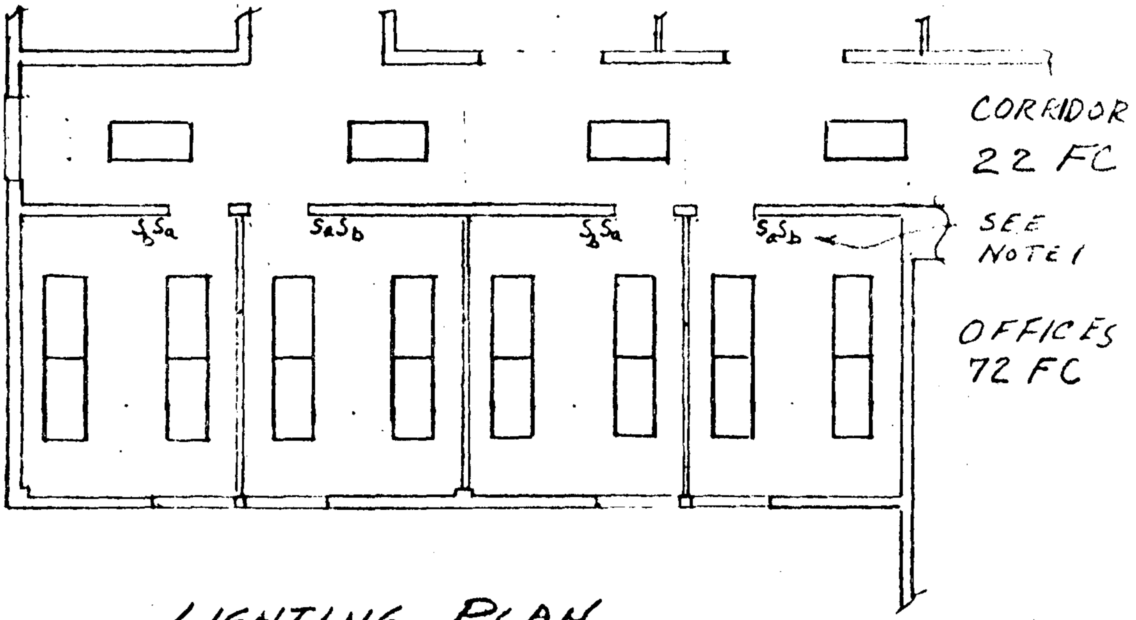
SUBJECT: OFFICE & CORRIDOR LIGHTING

JOB NO [illegible]

BY RGB DATE [illegible]

CK DATE

SH OF



LIGHTING PLAN

SCALE 1/8" = 1'-0"

OFFICE FIXTURES.

2 FT X 4 FT LAY-IN RECESSED FLUORESCENT FIXTURE WITH AIR EXHAUST THROUGH FIXTURE, FLAT ACRYLIC LENS AND 3 F40 RS LAMPS.
KEENE HEAT REMOVAL TYPE CAT. No. HTS2GVA340 OR EQUAL.

CORRIDOR FIXTURES.

2 FT X 4 FT LAY-IN RECESSED FLUORESCENT FIXTURE WITH FLAT ACRYLIC LENS AND 2 F40 RS. LAMPS
KEENE CAT NO NRTS2GVA240 OR EQUAL

NOTES

1 Sa FOR (2) OUTER ROWS OF LAMPS
2 Sb FOR (1) INNER ROW OF LAMPS.

BASIS OF ELECTRICAL DESIGN CALCULATIONS

A. HIGH BAY BUILDING

1. A new main distribution panel will be installed over the utility trench of the existing High Bay Building. It will be served from the existing laboratory main power panel.

2. The existing High Bay Building loads, which are now served from the existing Laboratory Building main power panel, will be reconnected to the new High Bay Building main distribution panel.

3. Lighting in the High Bay Building extension will be at 277/480 volts. A new panelboard will be provided for this service.

4. Power for receptacles and miscellaneous 120/208-volt equipment is provided from two 480-208Y/120-volt, three-phase, four-wire dry-type transformers. The building addition will require two new 400 ampere, 480 volt, three-phase, three-wire power panels, on each side of the building addition. Power for 120/208 volt equipment will be provided from 45 KVA 480-208Y/120-volt, three-phase, four-wire dry-type transformers and associated 208/120 volt, three-phase, four-wire panelboards located adjacent to the new 480-volt panelboards.

B. NEW LABORATORY BUILDING

1. Existing Switchgear No. 66A serves both the existing Laboratory Building and the existing High Bay Building. An extension to this switchgear will be installed to provide additional feeder circuit breaker space for the new Laboratory Building.

2. Lighting at 277/480 volts will be served by panels at each floor tapped to a main lighting feeder running from Switchgear No. 66A, in the basement, to the third floor.

3. Two main risers, one at each end of the building will supply power to 480-volt distribution panels on the second floor. These panels will provide power to step-down transformers and 208Y/120-volt, 3-phase, 4-wire distribution panels which will provide power to each laboratory panel. Laboratory power outlets will be served at 120 volts, single phase or 208 volts, three phase as required.

4. A separate 480-volt, 3-phase, 4-wire feeder will serve the Machine Shop power panelboard. This panel will provide branch circuits for the machine tools, lighting panelboard, elevator motor, and step-down transformer for the 208Y/120-volt, 3-phase, 4-wire receptacle panelboard. A system of underfloor ducts will be installed to serve the machine tools.

5. Mechanical equipment will be served from a motor control center, in the basement, connected to Main Distribution Panel No. 66A. Critical exhaust fans will be served from a motor control center on the roof, connected to the Emergency Power Panel.

6. Emergency power for the new Laboratory Building will be supplied by a new 100 KW diesel-generator set, complete with automatic load transfer switch.

C. LOAD ANALYSIS

1. High Bay Building connected load is estimated to be as follows:

Load	Existing Building KVA	New Building KVA	Total KVA
Lighting	32.4	18.9	51.3
Receptacles	30.0	20.0	50.0
Research equipment	150.0	150.0	300.0
Heat and ventilation	7.5	5.0	12.5
Building 73	151.2	--	151.2
Spare capacity for future loads	--	75.0	75.0
TOTAL	371.1	268.9	640.0

Estimated Demand = 320.0 KVA

2. The Laboratory Building connected loads are estimated to be as follows:

Load	Existing Building KVA	New Building KVA	Total KVA
Lighting	154	195	349
Receptacles	100	100	200
Research equipment	331	680	1,011
Mechanical building	596	214	810
Machine shop	--	60	60
Elevator	75	75	150
Building 72	200	--	200
TOTAL	1,456	1,324	2,780

Estimated Demand = 1,390 KVA

3. Emergency power requirements are estimated to be as follows:

Load	Total KVA
Exhaust fans	69.0
Laboratory lighting	8.4
General lighting	10.0
TOTAL	84.3

D. LIGHTING

1. High Bay Building: The existing power groove lighting system will be continued in the Building Addition using similar fixtures and lighting layout. All lighting will be panel-switched.

2. Laboratory Building

    a. General lighting fixtures in the office, laboratories, corridors, Conference Room, and areas with 2' × 4' modular acoustical ceilings will be 2' × 4' recessed fluorescent fixtures with acrylic, prismatic lenses and two, three, or four rapid-start lamps to give the following intensities

    (1) Laboratories - general, 50 FC to 70 FC
    - close work, 70 FC to 100 FC

    (2) Offices, 50 FC to 70 FC

    (3) Corridors, lobby, and means of egress, 10 FC to 20 FC.

    (4) Conference Room, 30 FC to 50 FC with dimming controls.

    b. Lighting fixtures in the offices and laboratories shall be controlled by two switches to provide two or more evenly distributed levels of lighting for energy conservation.

    c. Lighting in rest rooms and toilets will be 15 to 30 FC using surface-mounted fluorescent fixtures with acrylic wrap-around lenses.

    d. Lighting in the service corridors and other areas without finished ceilings will be 10 FC to 20 FC using industrial fluorescent fixtures.

    e. Lighting in the Machine Shop will be at 70 FC to 100 FC using eight foot industrial fixtures with power groove lamps.

f. Incandescent accent lighting will be provided in public area as required for architectural effect.

g. Outdoor lighting will be provided where required for use and architectural accent.

h. Emergency lighting will be provided in corridors, laboratories, stairwells and other public areas by connected selected fixtures of the general lighting system to emergency circuits.

i. Exit lights, connected to the emergency system will be provided where required by codes.

j. Task lighting will be provided where required.

TECHNICAL INFORMATION DIVISION
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720