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67-27

STRUCTURES AND MATERIALS RESEARCH
DEPARTMENT OF CIVIL ENGINEERING

STRUCTURAL BEHAVIOR OF AN ORTHOTROPIC STEEL DECK BRIDGE

VOLUME 2 - FIGURES

BY

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Report to the Sponsors: Division of Highways, Department of Public Works, State of California, and the Bureau of Public Roads.

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STRUCTURAL ENGINEERING LABORATORY
COLLEGE OF ENGINEERING
UNIVERSITY OF CALIFORNIA
BERKELEY CALIFORNIA

Structures and Materials Research
Department of Civil Engineering
Division of Structural Engineering
and Structural Mechanics

Structural Engineering Laboratory Report No. 67-27

STRUCTURAL BEHAVIOR OF AN ORTHOTROPIC STEEL DECK BRIDGE

A Report of an Investigation

by

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and

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Assistant Professor of Civil Engineering

to

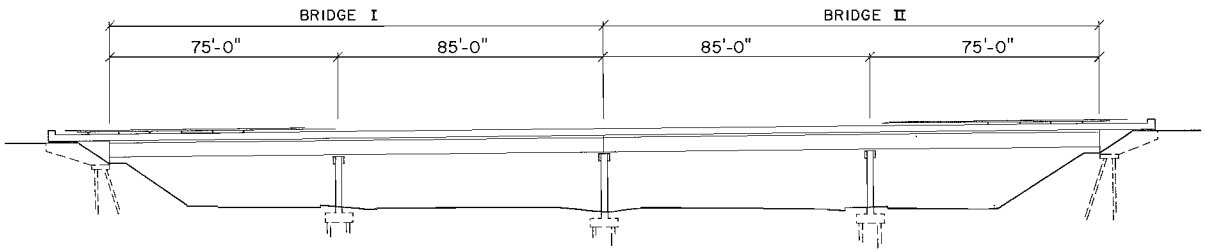
The Division of Highways
Department of Public Works
State of California
Under California Standard Agreement
No. 13548

and

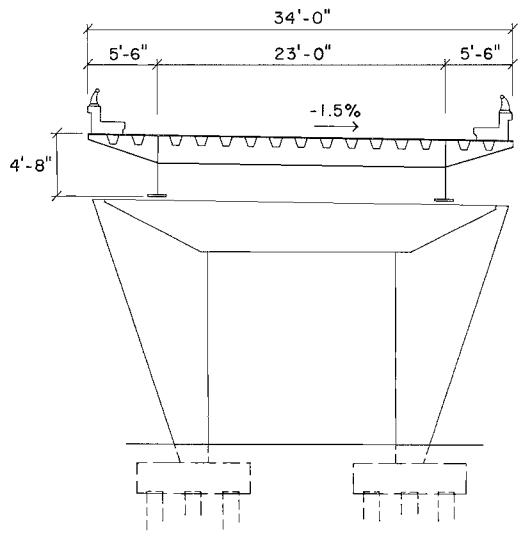
U. S. Department of Commerce
Bureau of Public Roads

College of Engineering
University of California
Berkeley, California

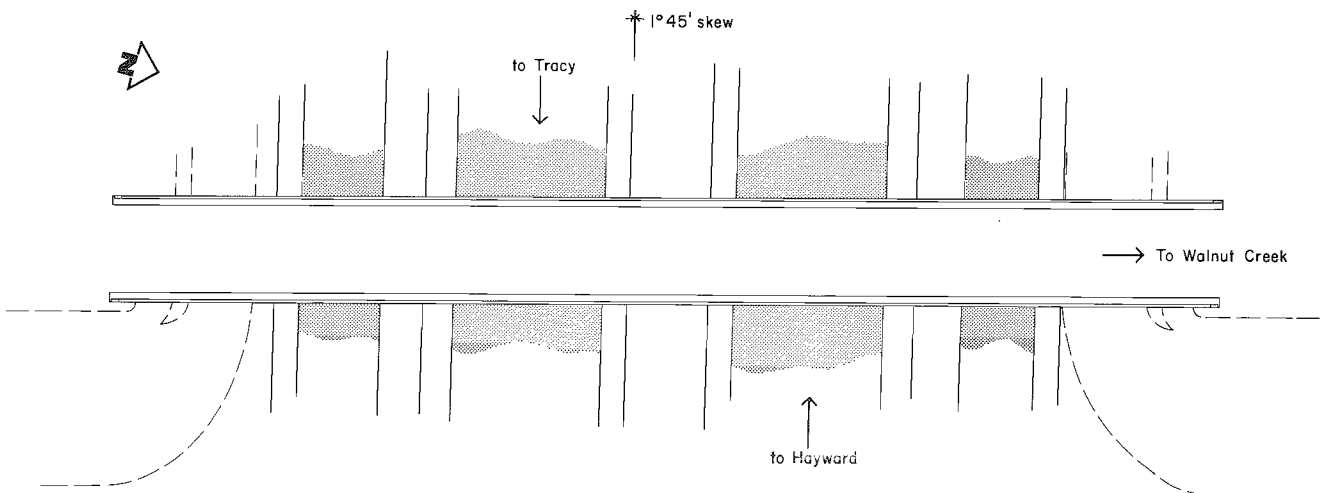
December 1967



ELEVATION



TYPICAL SECTION



PLAN

FIG. 1 GENERAL VIEWS OF BRIDGE.

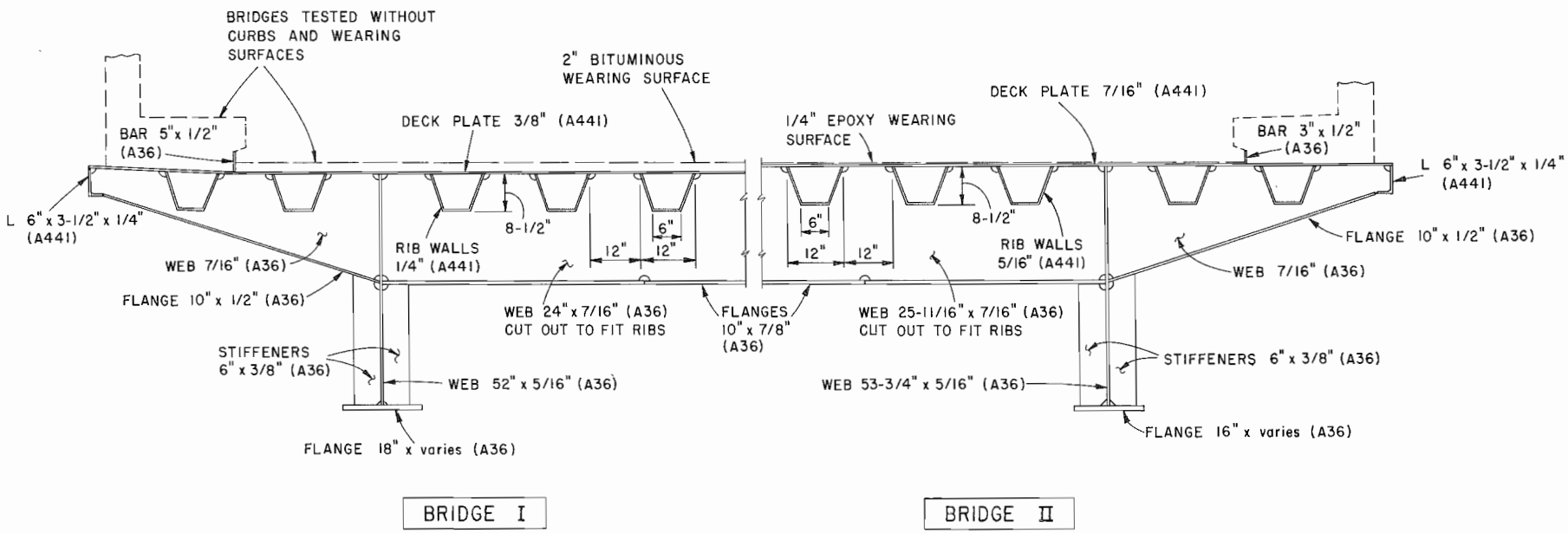
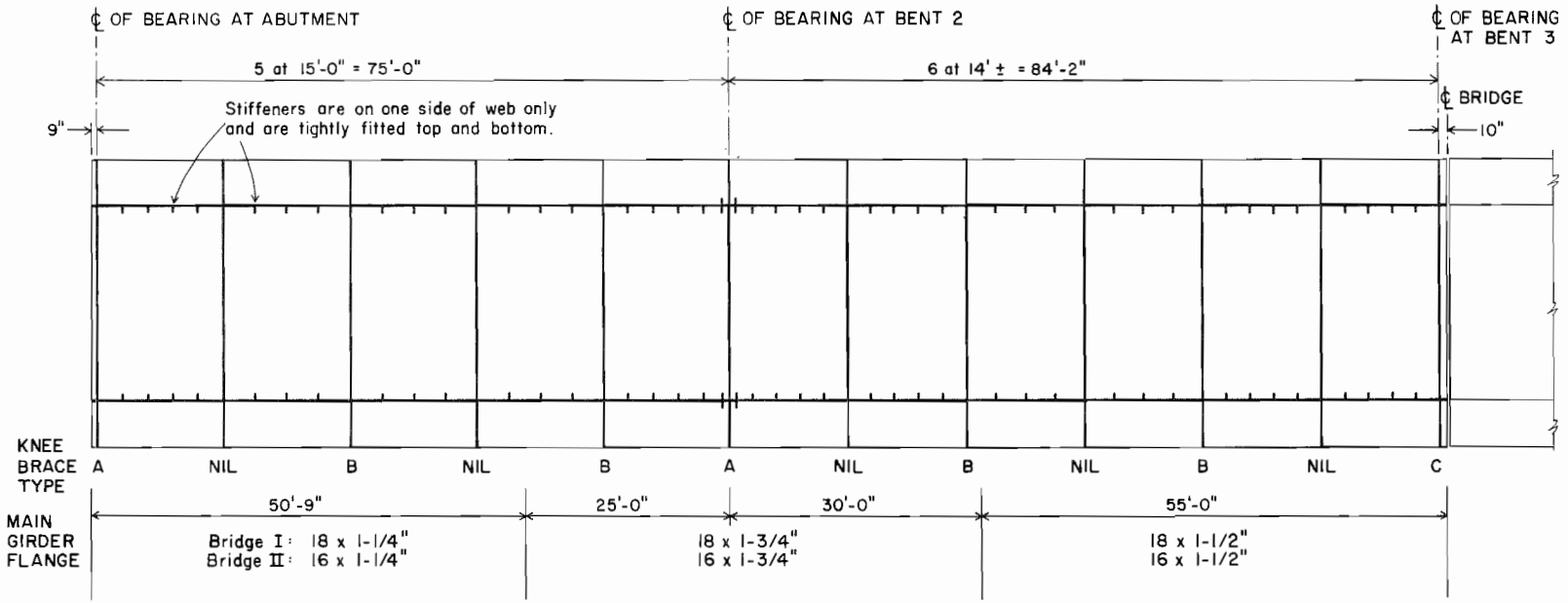
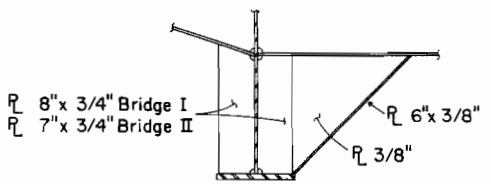
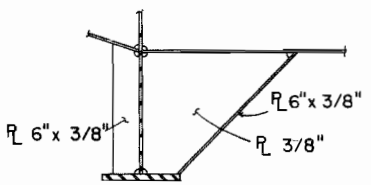


FIG. 2 PART SECTIONS SHOWING ESSENTIAL DETAILS.



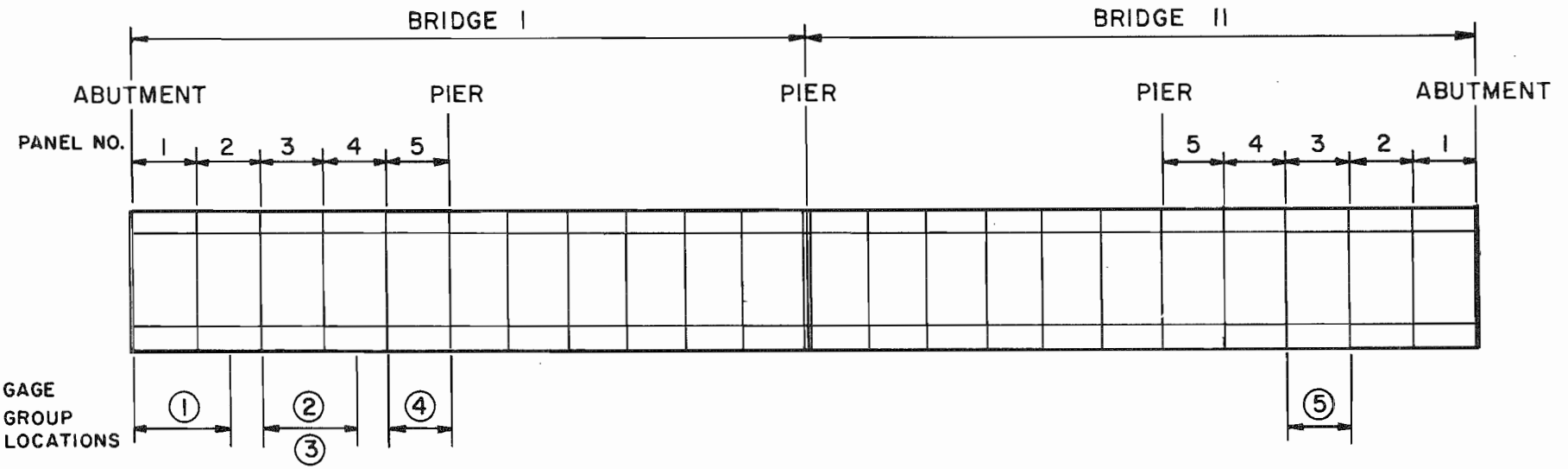


KNEE BRACE "A"



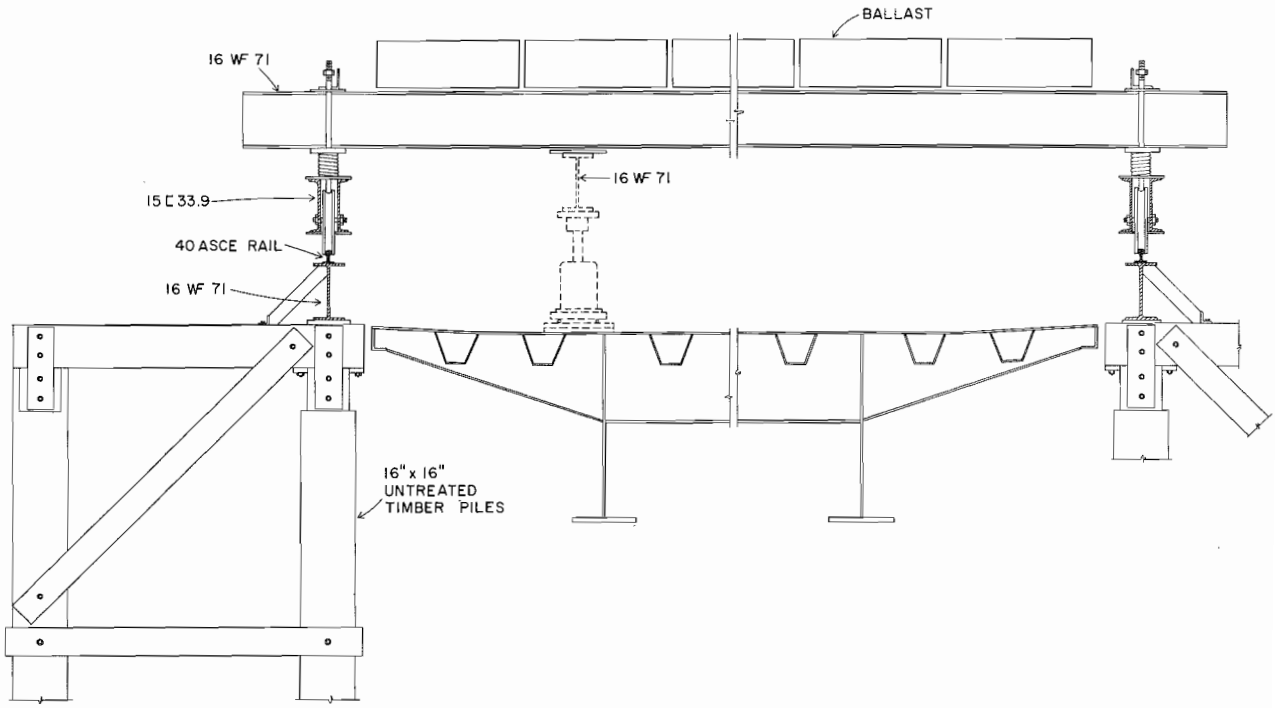
KNEE BRACE "B"

FIG. 3 PLAN OF BRIDGE SHOWING STIFFENER POSITIONS AND KNEE BRACE DETAILS.

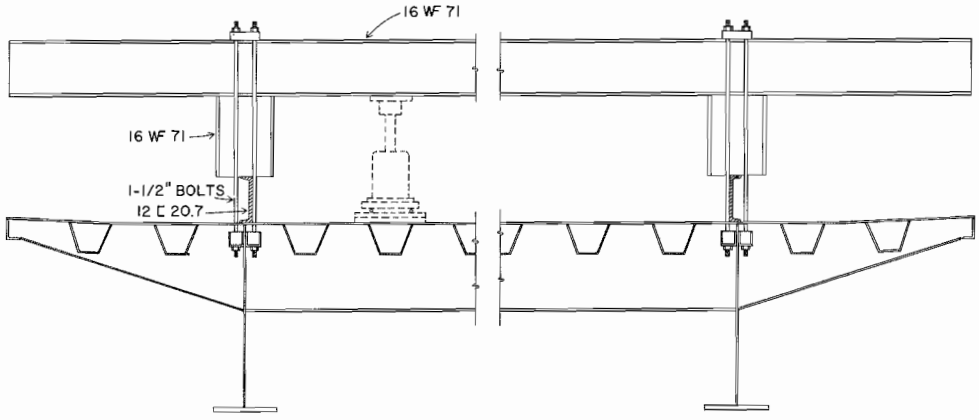


GAGE GROUP	①	②	③	④	⑤
NUMBER OF STRAIN GAGE GRIDS	248	305	331	98	143
NUMBER OF DEFLECTION GAGES	41	39	31	41	41

FIG. 4 LOCATIONS OF GAGE GROUPS ON BRIDGE, AND NUMBER OF GAGES IN EACH GROUP.



TYPE I LOADING



TYPE II LOADING

FIG. 5 TYPE I AND II LOADING SYSTEMS.

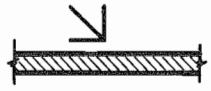
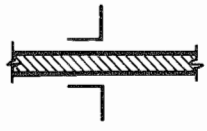
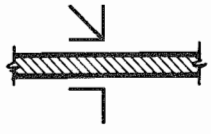
Designation	Pattern
D1	
D2	
D3	
D4	

FIG. 6 STRAIN GAGE PATTERNS.
DECK PLATE GAGES.

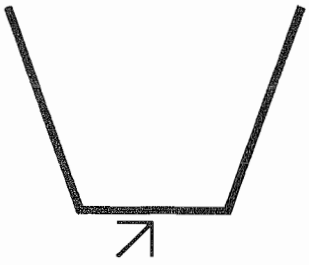
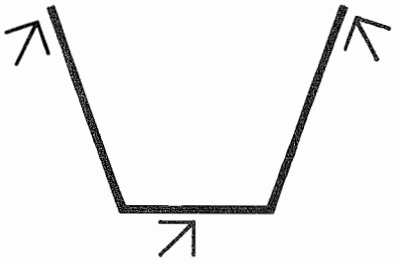
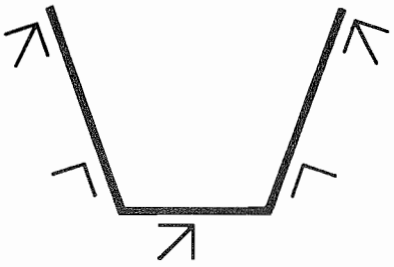
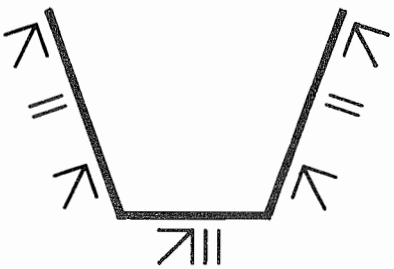
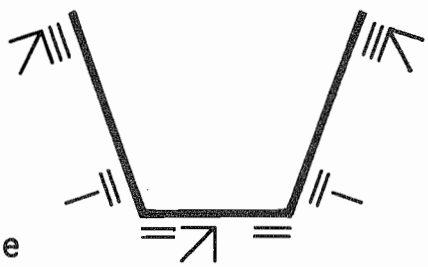
Designation	Pattern
R1	
R2	
R3	
R4	 // = Flexagage
R5	 // = Flexagage

FIG. 7 STRAIN GAGE PATTERNS. RIB GAGES.

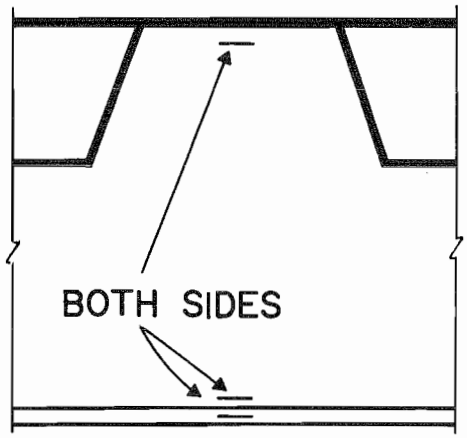
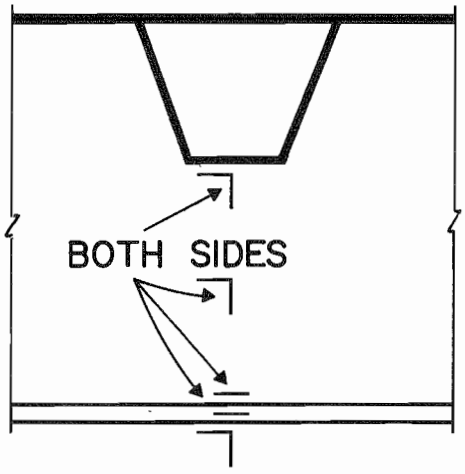
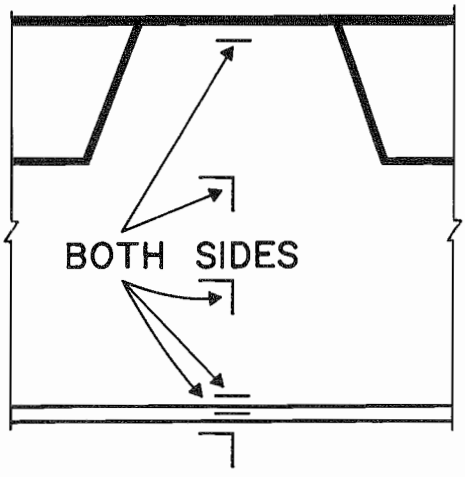
Designation	Pattern
F1	
F2	
F3	

FIG. 8 STRAIN GAGE PATTERNS.
FLOOR BEAM GAGES.

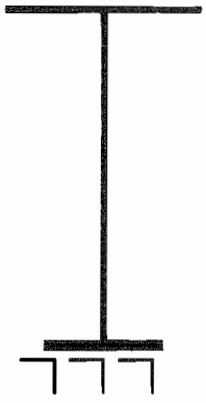
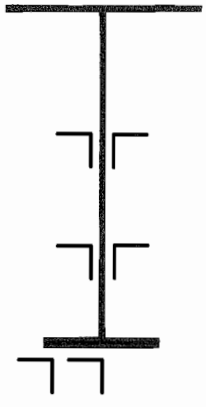
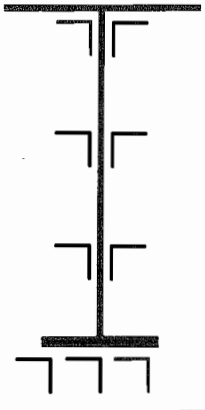
Designation	Pattern
M1	
M2	
M3	

FIG. 9 STRAIN GAGE PATTERNS.
MAIN GIRDER GAGES.

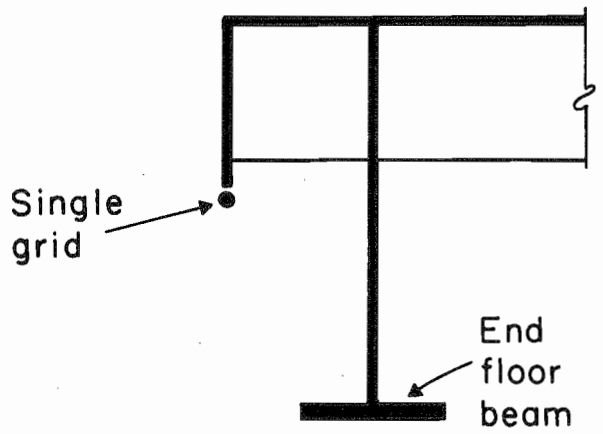
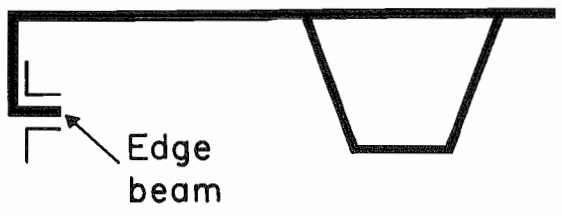
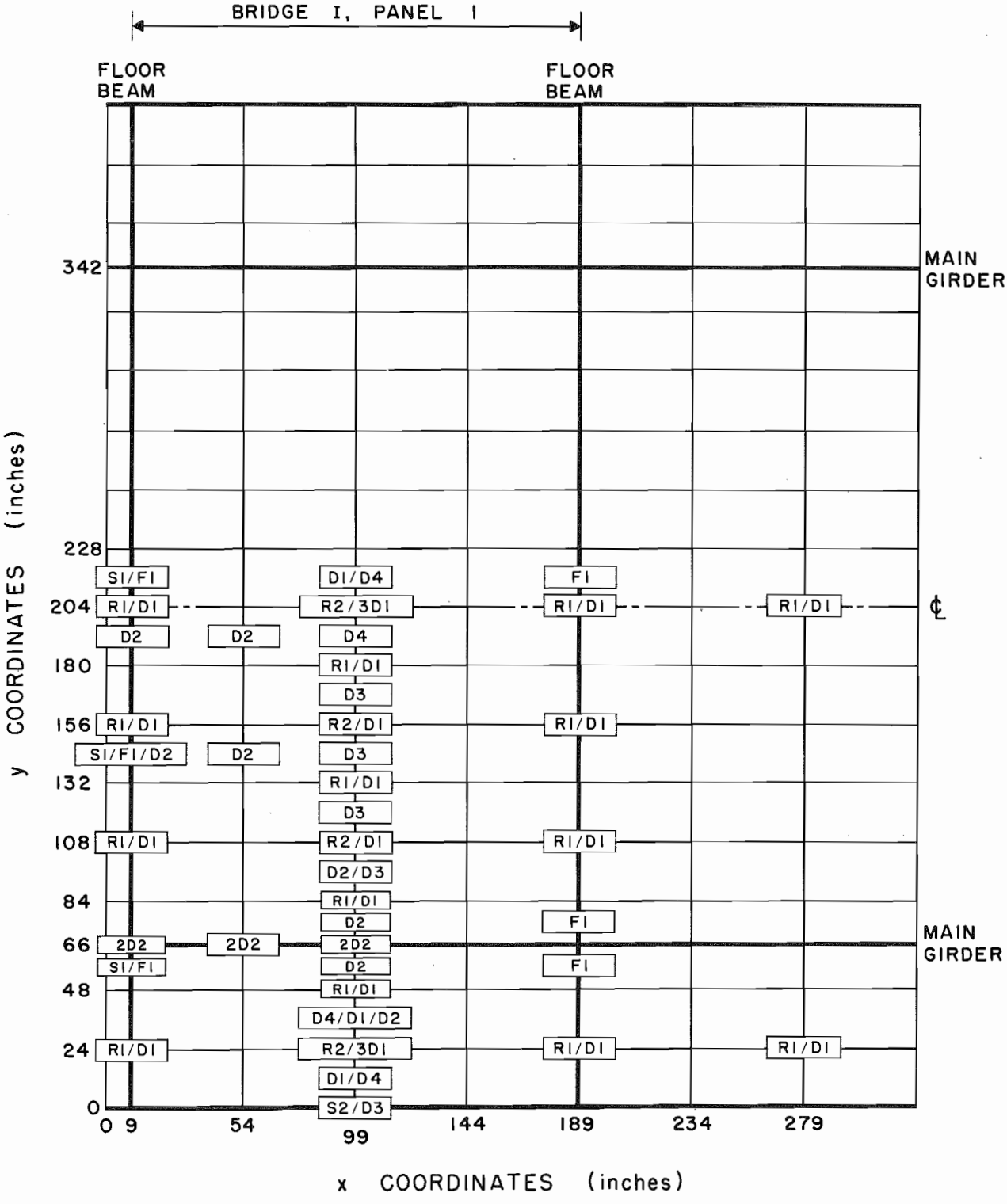
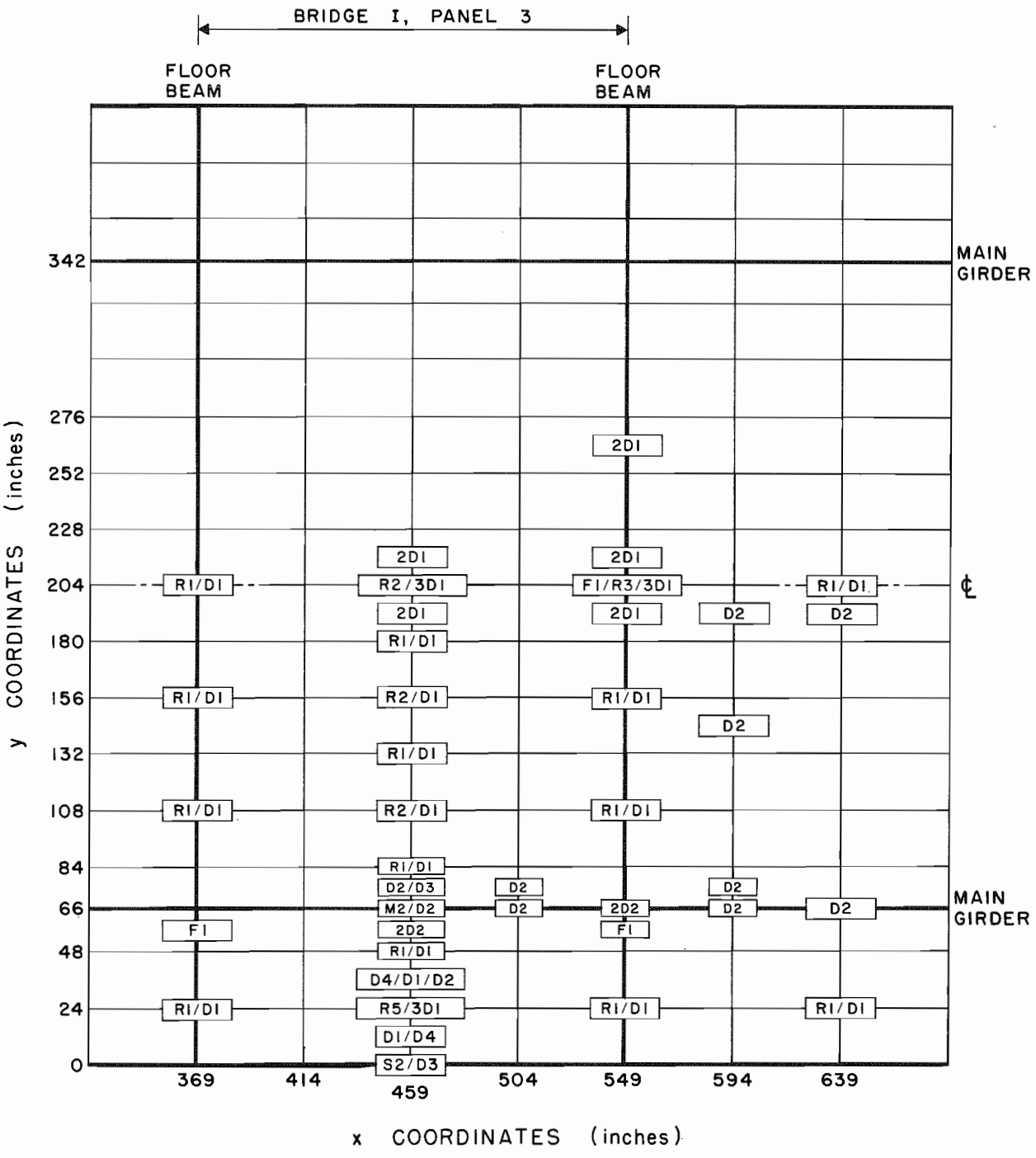
Designation	Pattern
S1	
S2	

FIG. 10 STRAIN GAGE PATTERNS. SPECIAL CASES.



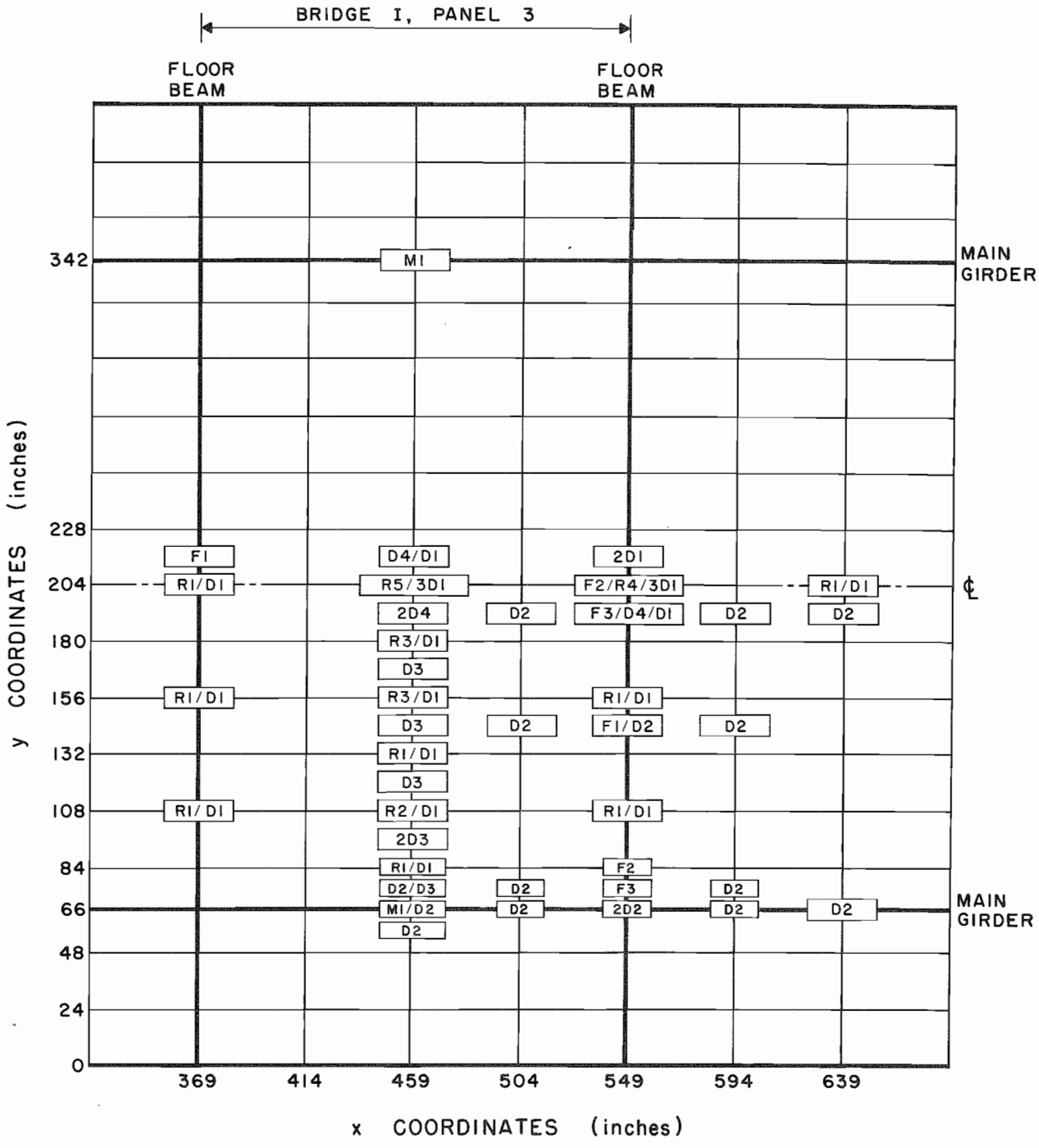
FOR KEY TO GAGE PATTERN DESIGNATIONS, SEE FIGS. No. 6 through 10.

FIG. 11 DISTRIBUTION OF STRAIN GAGES IN GAGE GROUP 1.



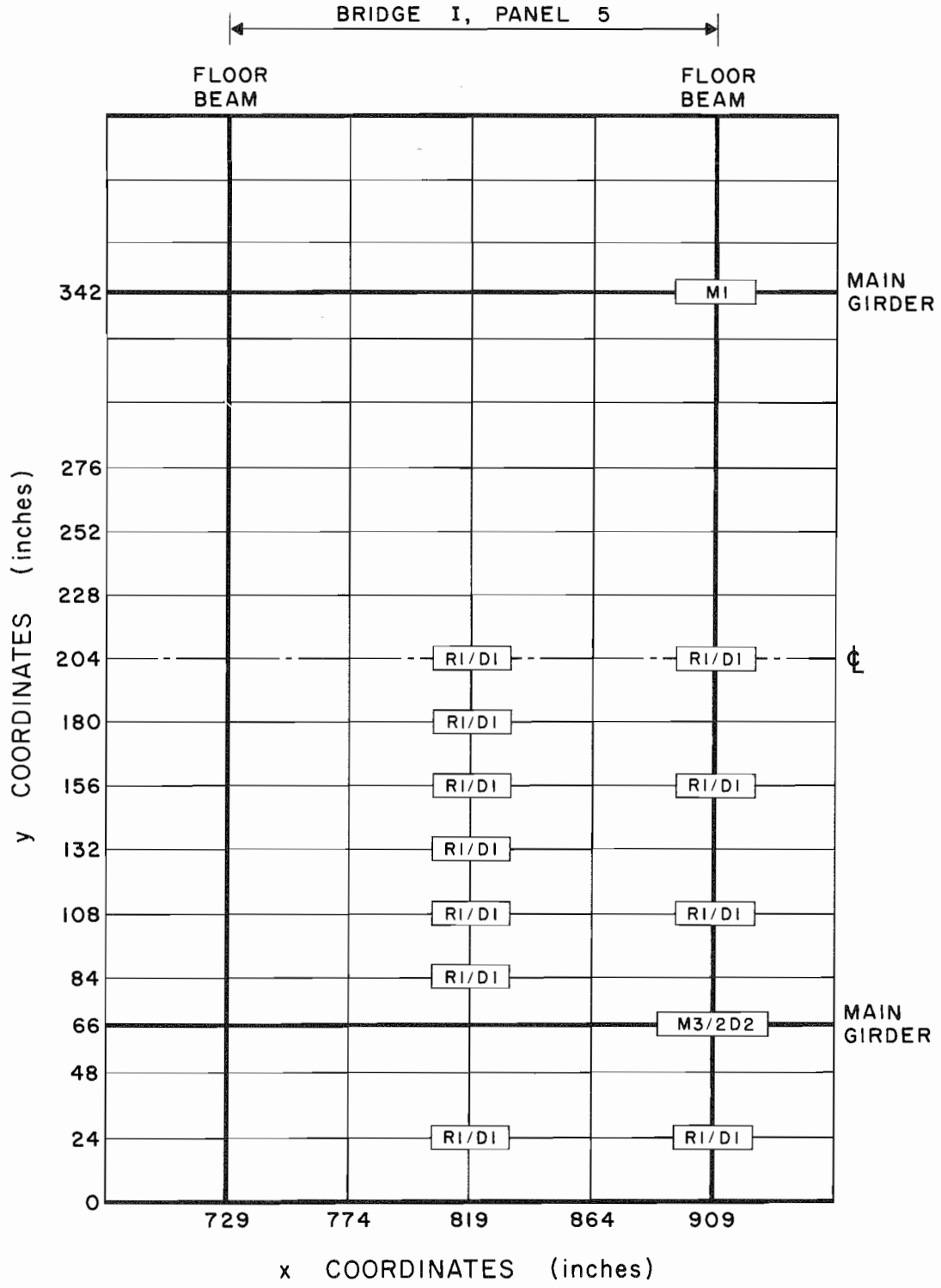
FOR KEY TO GAGE PATTERN DESIGNATIONS, SEE FIGS. No. 6 through 10.

FIG. 12 DISTRIBUTION OF STRAIN GAGES IN GAGE GROUP 2.



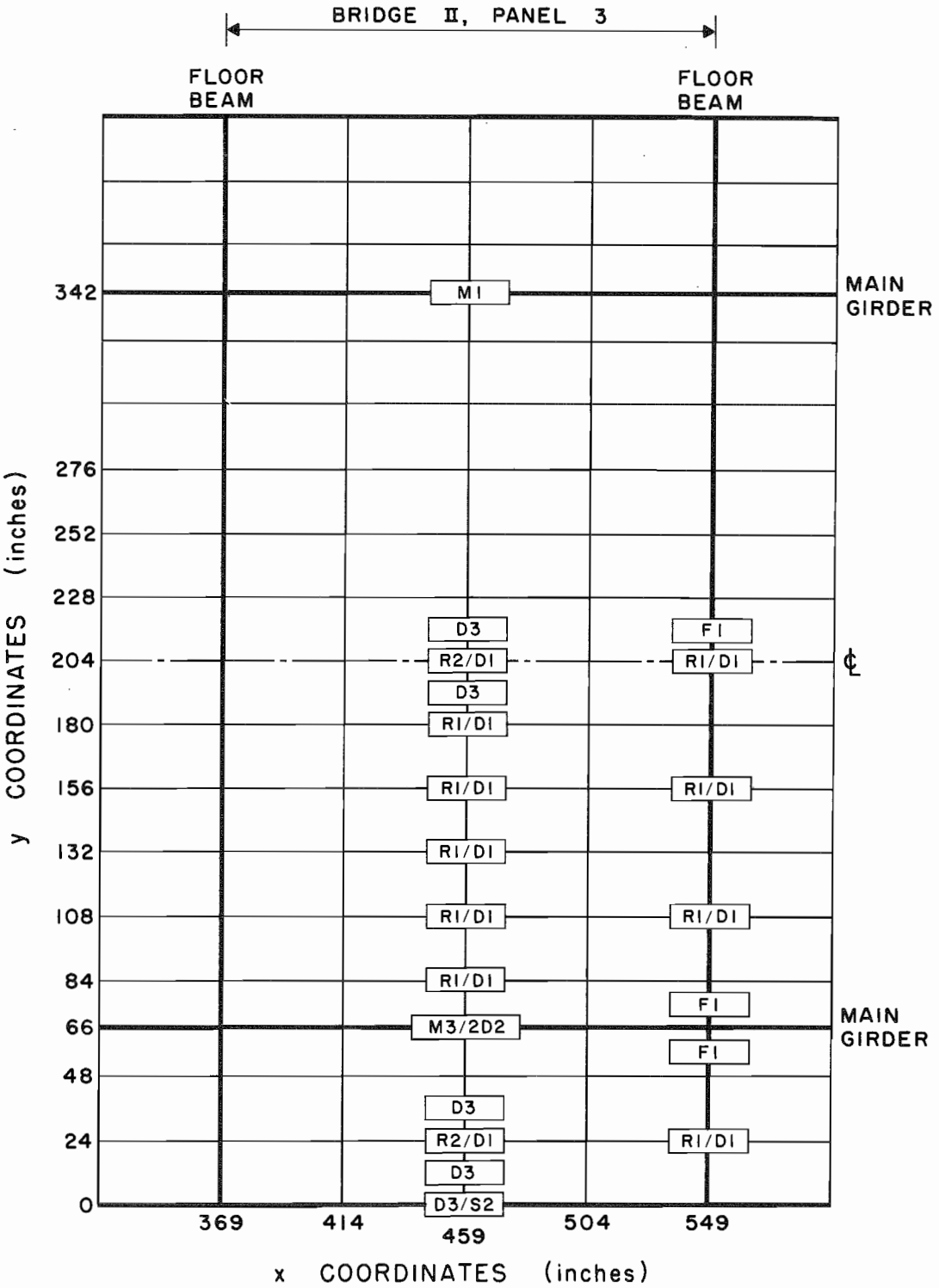
FOR KEY TO GAGE PATTERN DESIGNATIONS, SEE FIGS. No. 6 through 10

FIG. 13 DISTRIBUTION OF STRAIN GAGES IN GAGE GROUP 3.



FOR KEY TO GAGE PATTERN DESIGNATIONS, SEE FIGS. No. 6 through 10.

FIG. 14 DISTRIBUTION OF STRAIN GAGES IN GAGE GROUP 4.



FOR KEY TO GAGE PATTERN DESIGNATIONS, SEE FIGS. No. 6 through 10.

FIG. 15 DISTRIBUTION OF STRAIN GAGES IN GAGE GROUP 5.

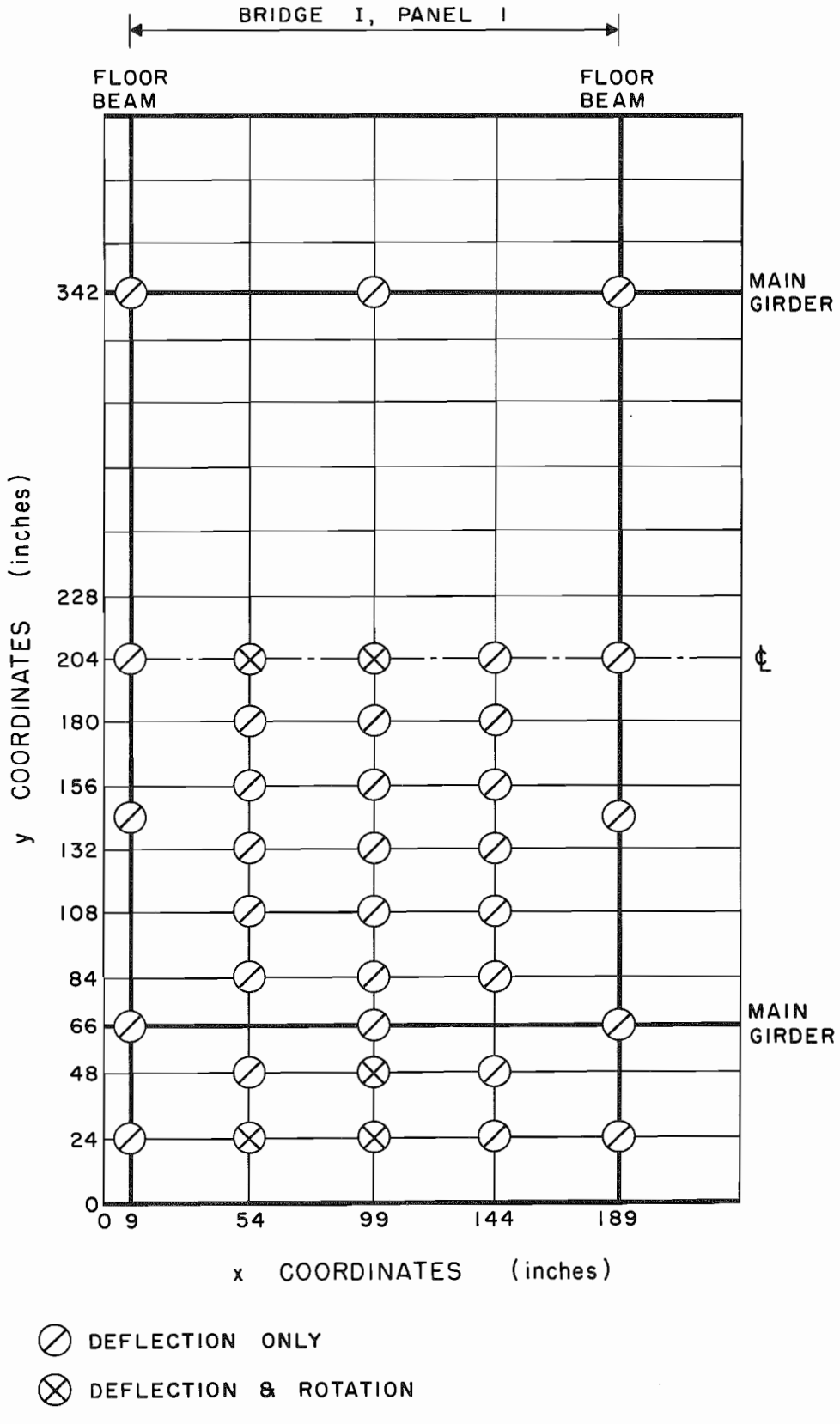


FIG. 16 DISTRIBUTION OF DEFLECTION GAGES IN GAGE GROUP I.

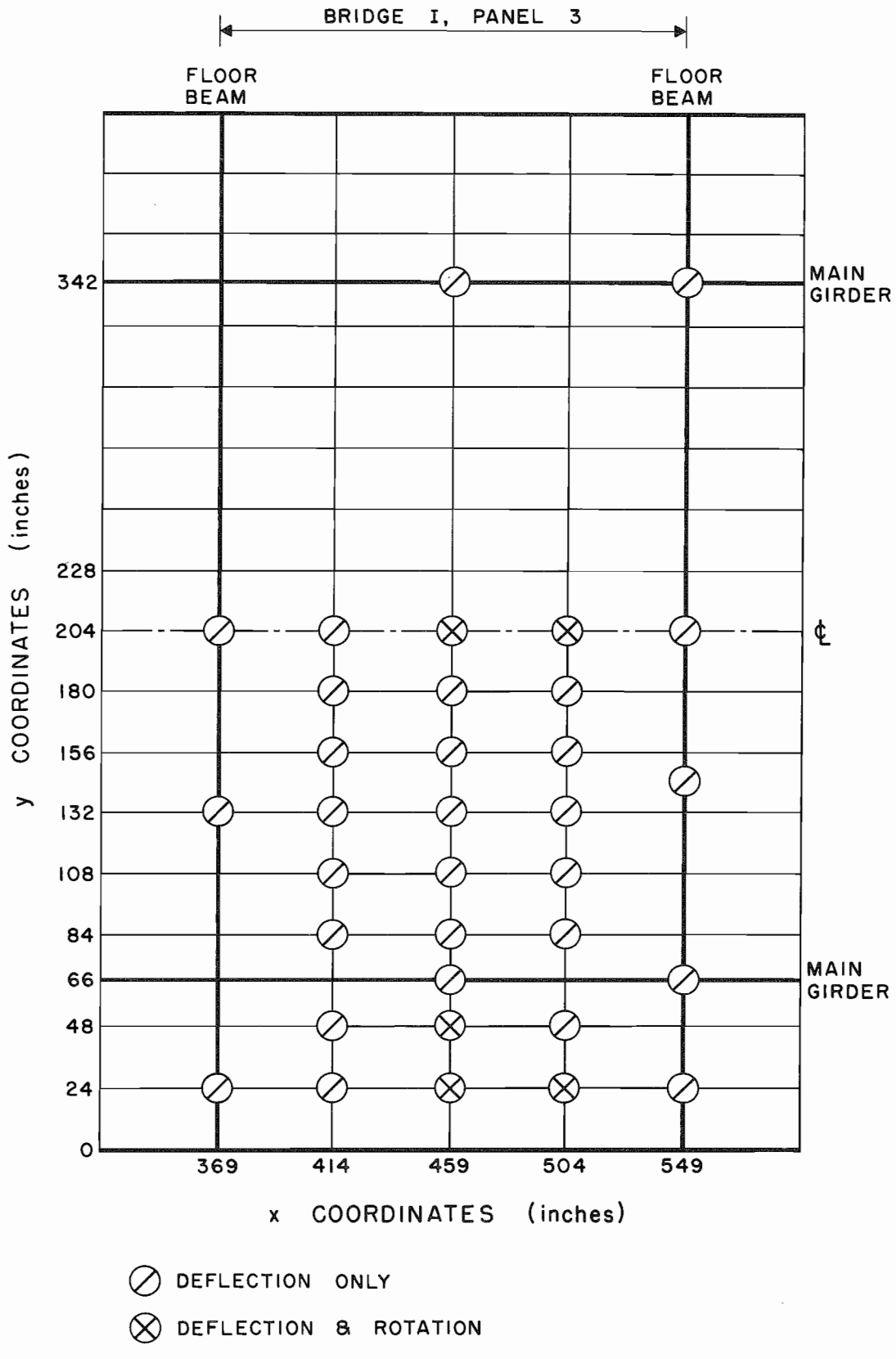


FIG. 17 DISTRIBUTION OF DEFLECTION GAGES IN GAGE GROUP 2.

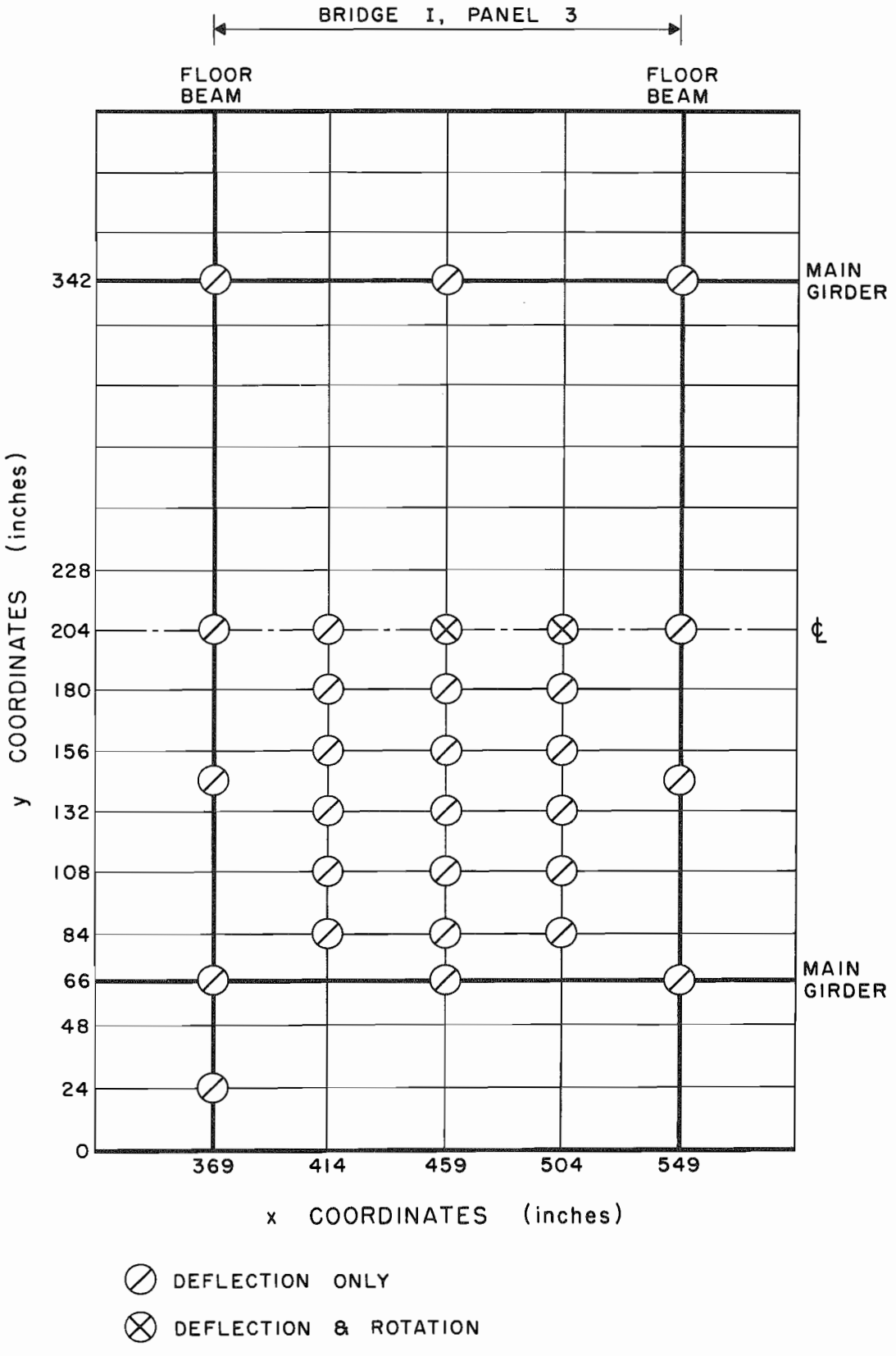


FIG. 18 DISTRIBUTION OF DEFLECTION GAGES IN GAGE GROUP 3.

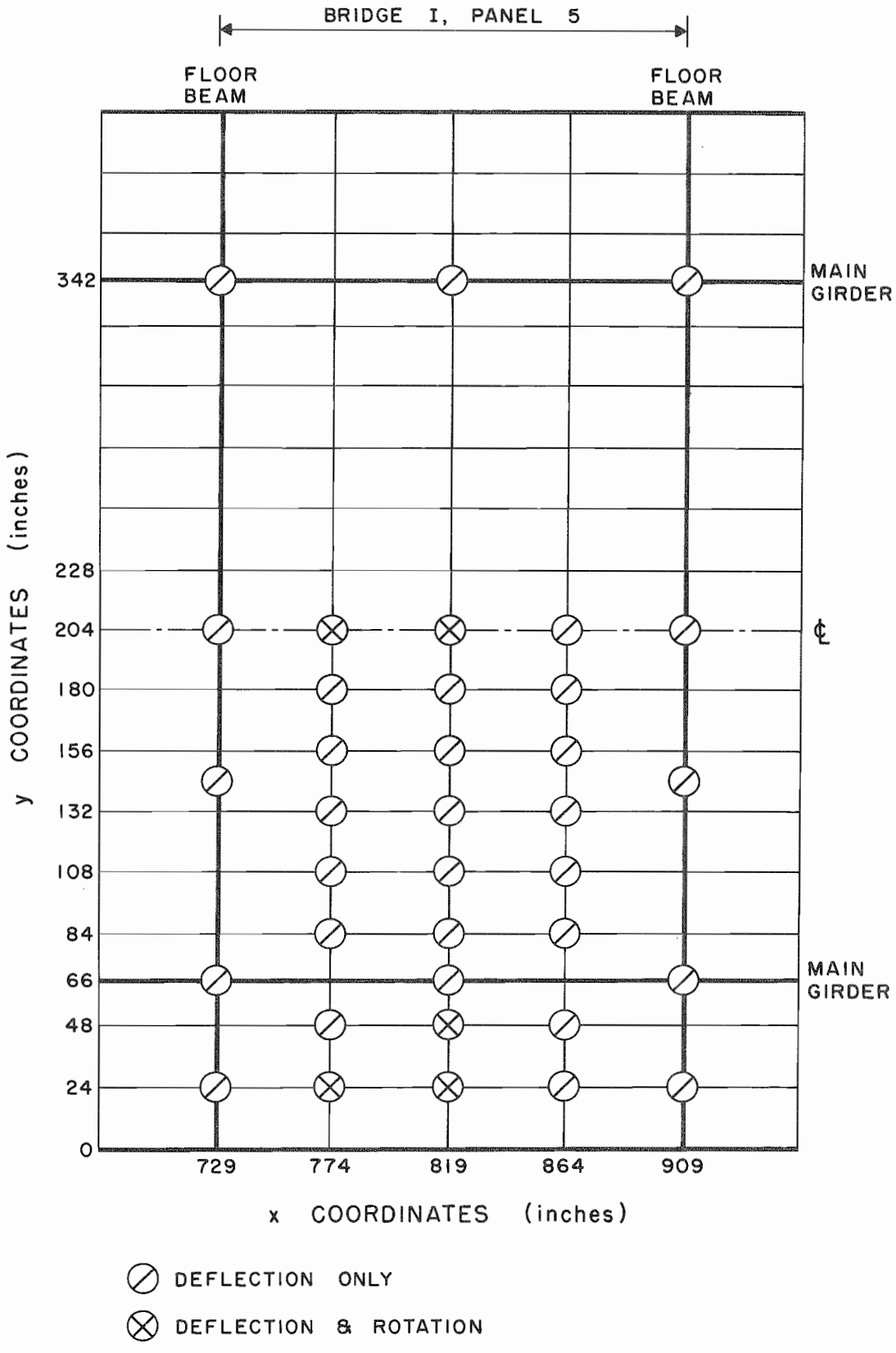


FIG. 19 DISTRIBUTION OF DEFLECTION GAGES IN GAGE GROUP 4.

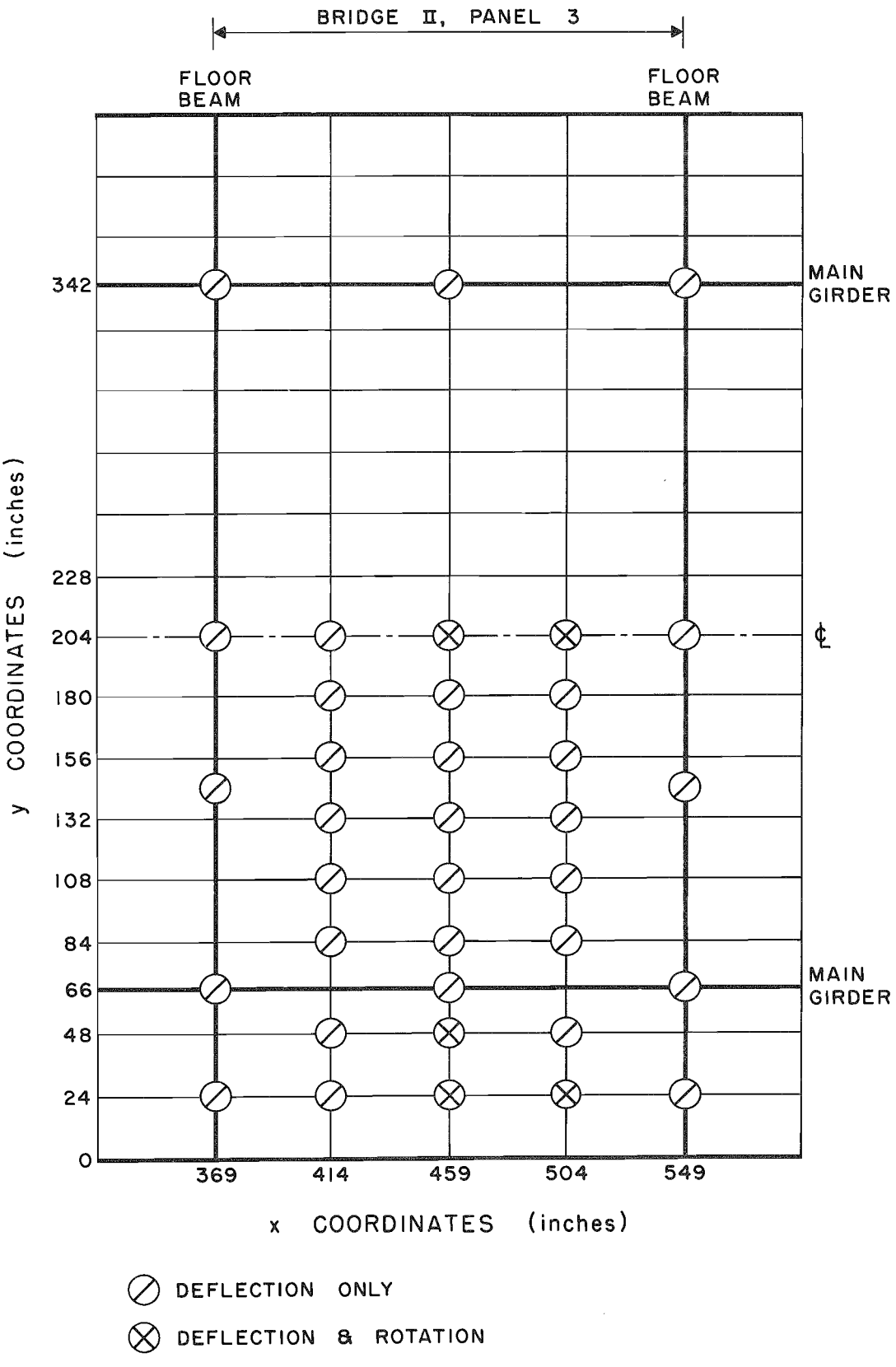
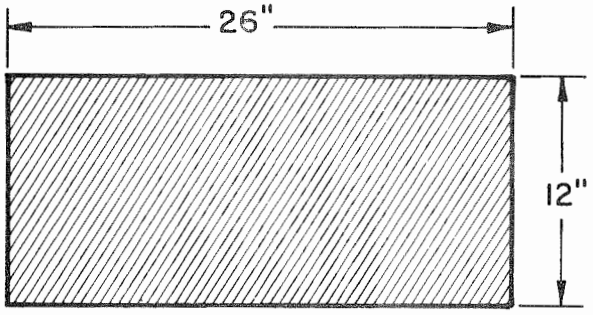
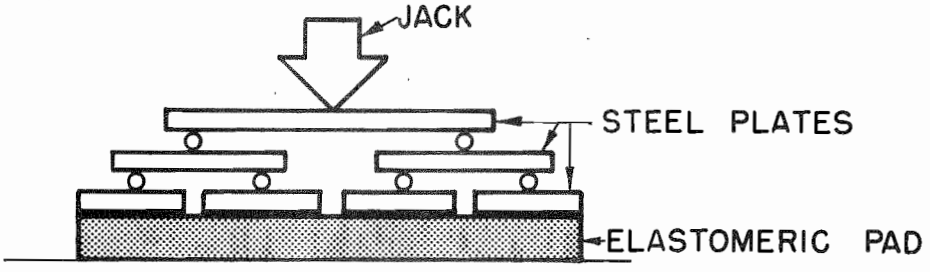


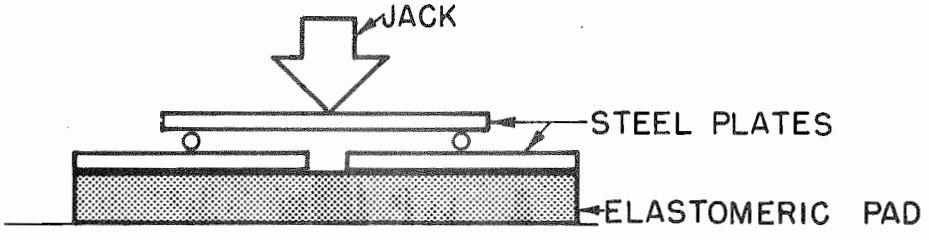
FIG. 20 DISTRIBUTION OF DEFLECTION GAGES IN GAGE GROUP 5.



(a) LOADED AREA



(b) FOUR-PLATE LOADING



(c) TWO-PLATE LOADING

FIG. 21 TWO AND FOUR-PLATE LOADING SYSTEMS

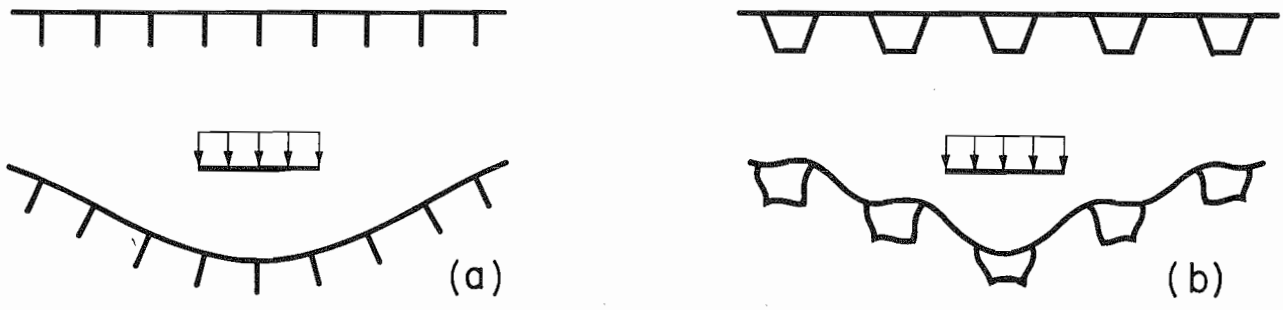


FIG. 22 DEFLECTION PATTERNS OF STIFFENED DECK PLATE.

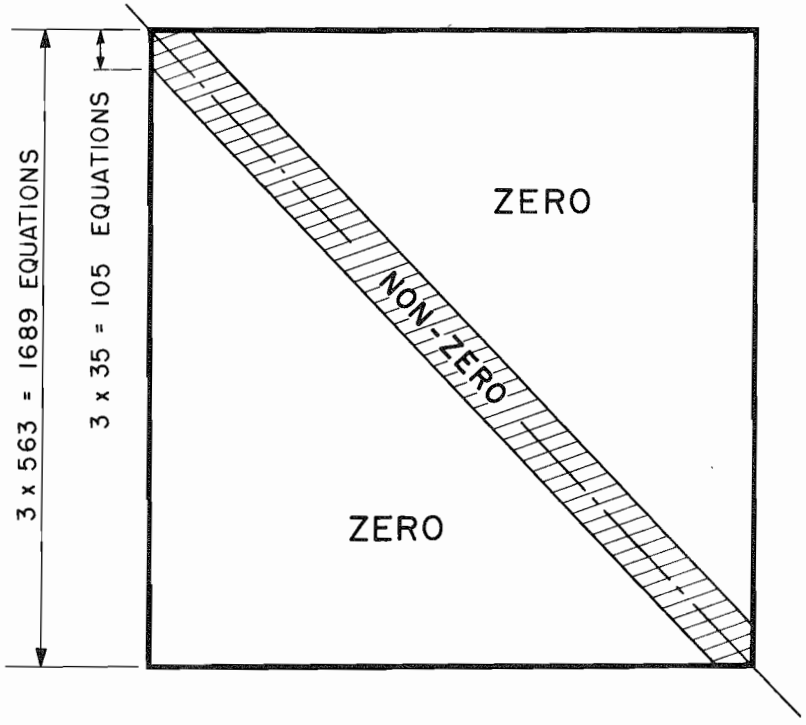
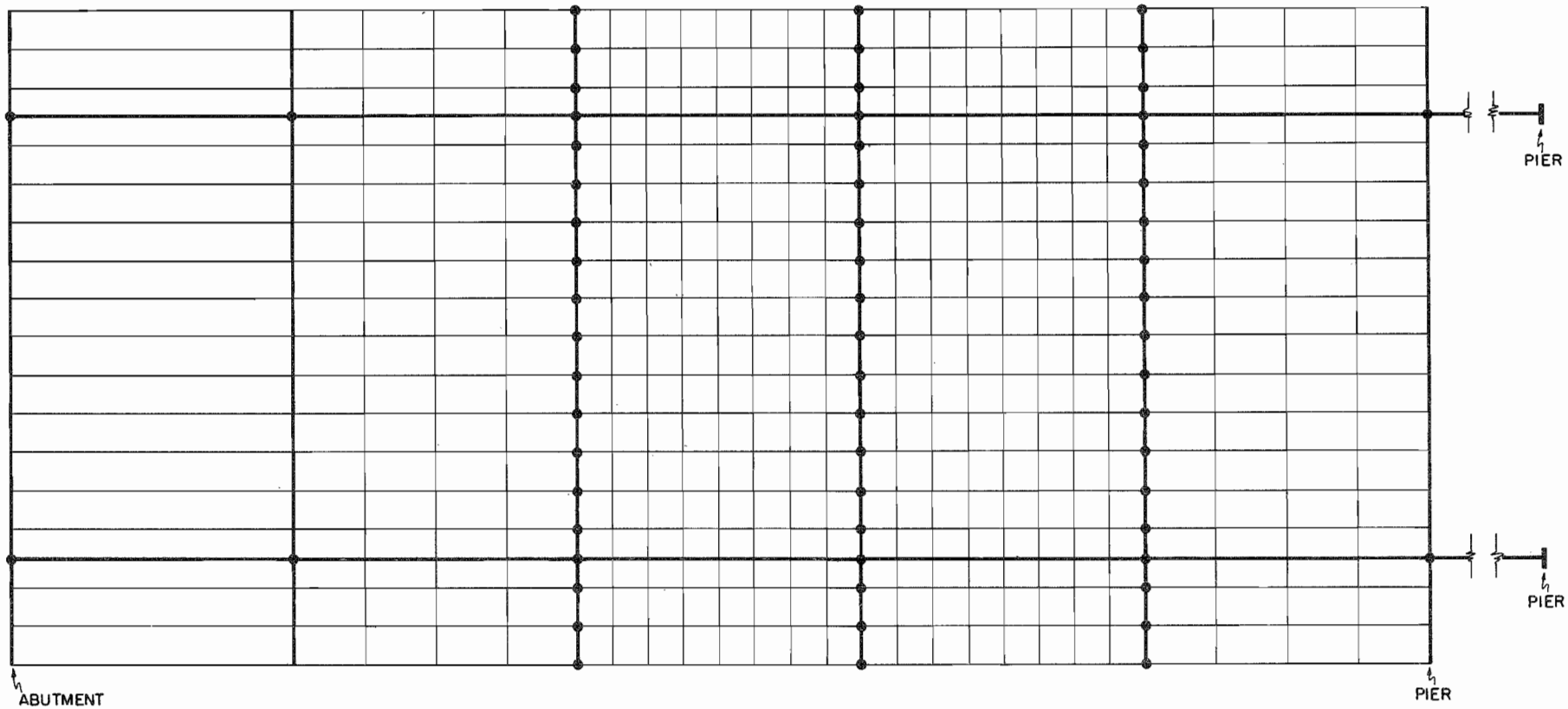


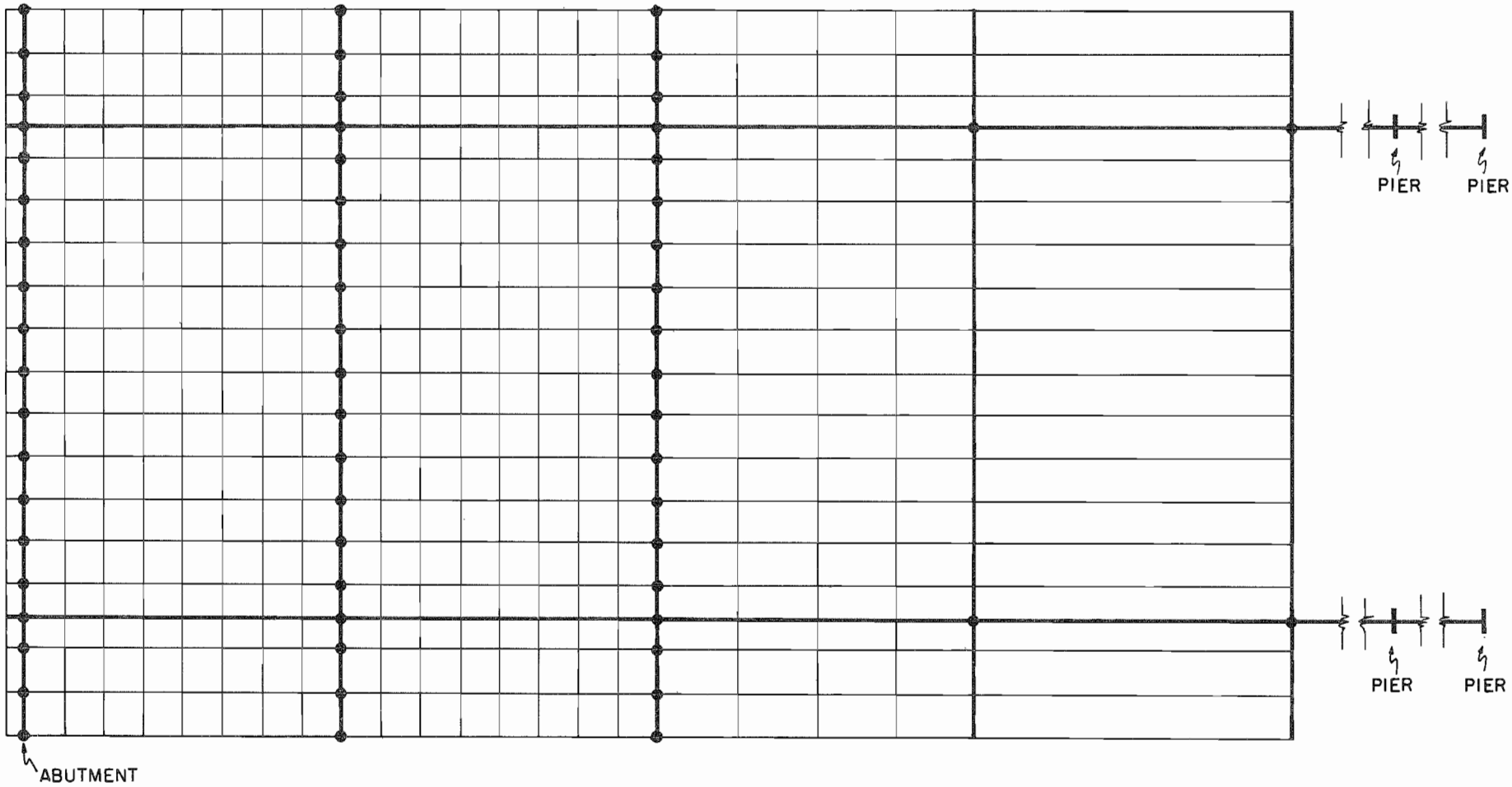
FIG. 23 FORM OF COEFFICIENT MATRIX FOR TYPICAL GRID ANALYSIS.



563 JOINTS; 1072 MEMBERS

● = VERTICAL (WEB) MEMBERS

FIG. 24 GRID FOR LOADS IN PANELS 3 AND 4



506 JOINTS; 959 MEMBERS

● = VERTICAL (WEB) MEMBER

FIG.25 GRID FOR LOADS IN PANEL 1

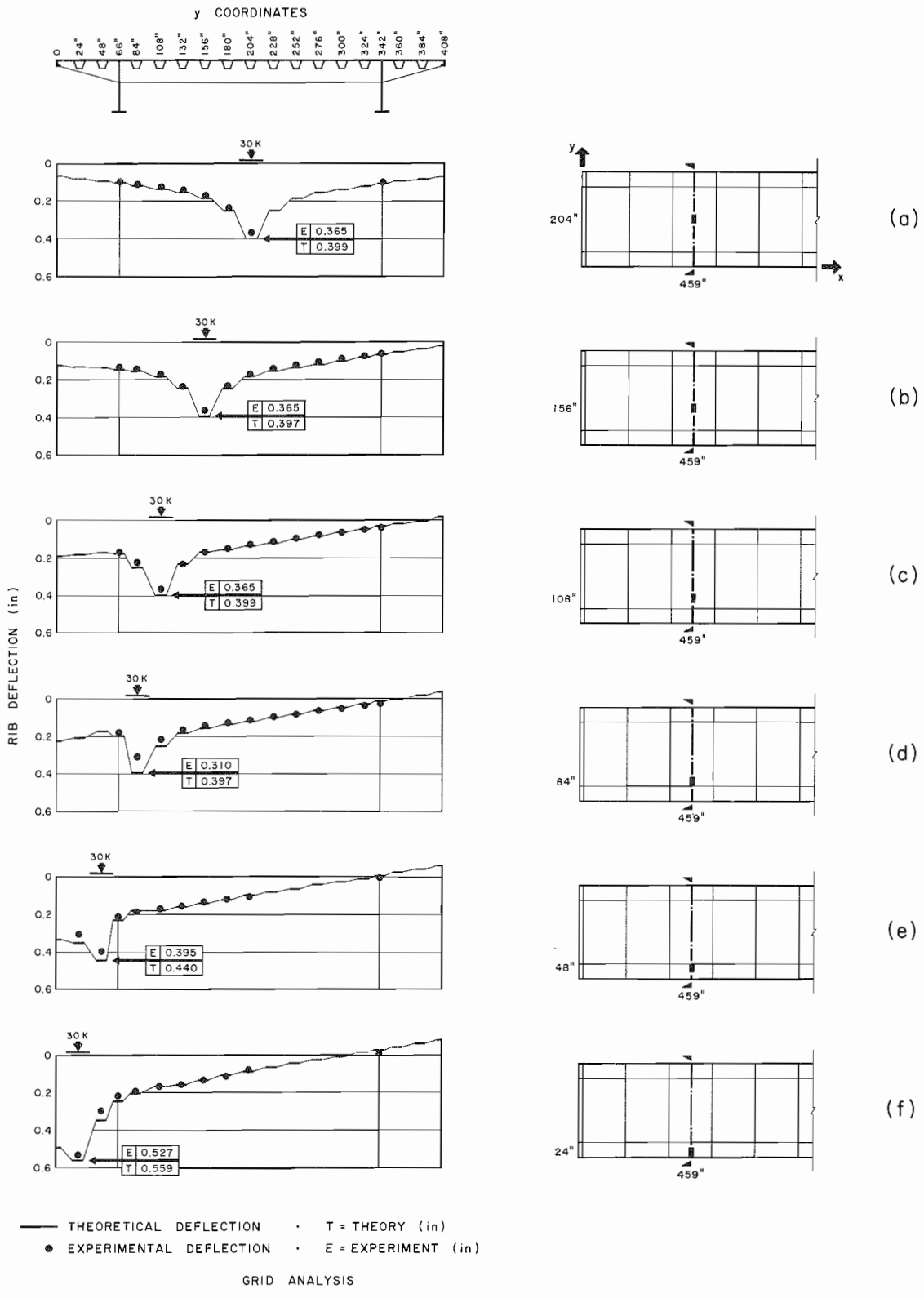


FIG. 26 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

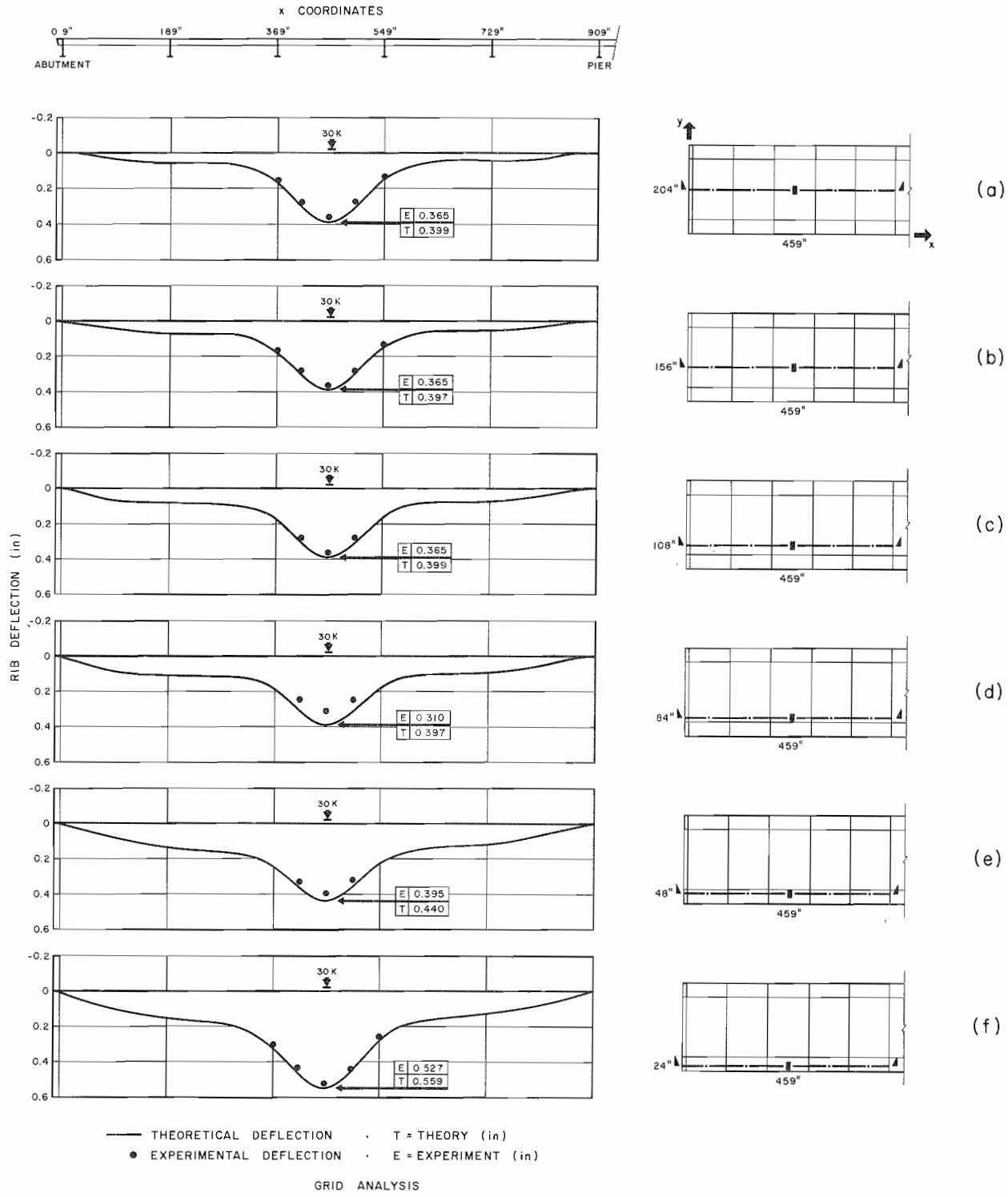


FIG. 27 RIB DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

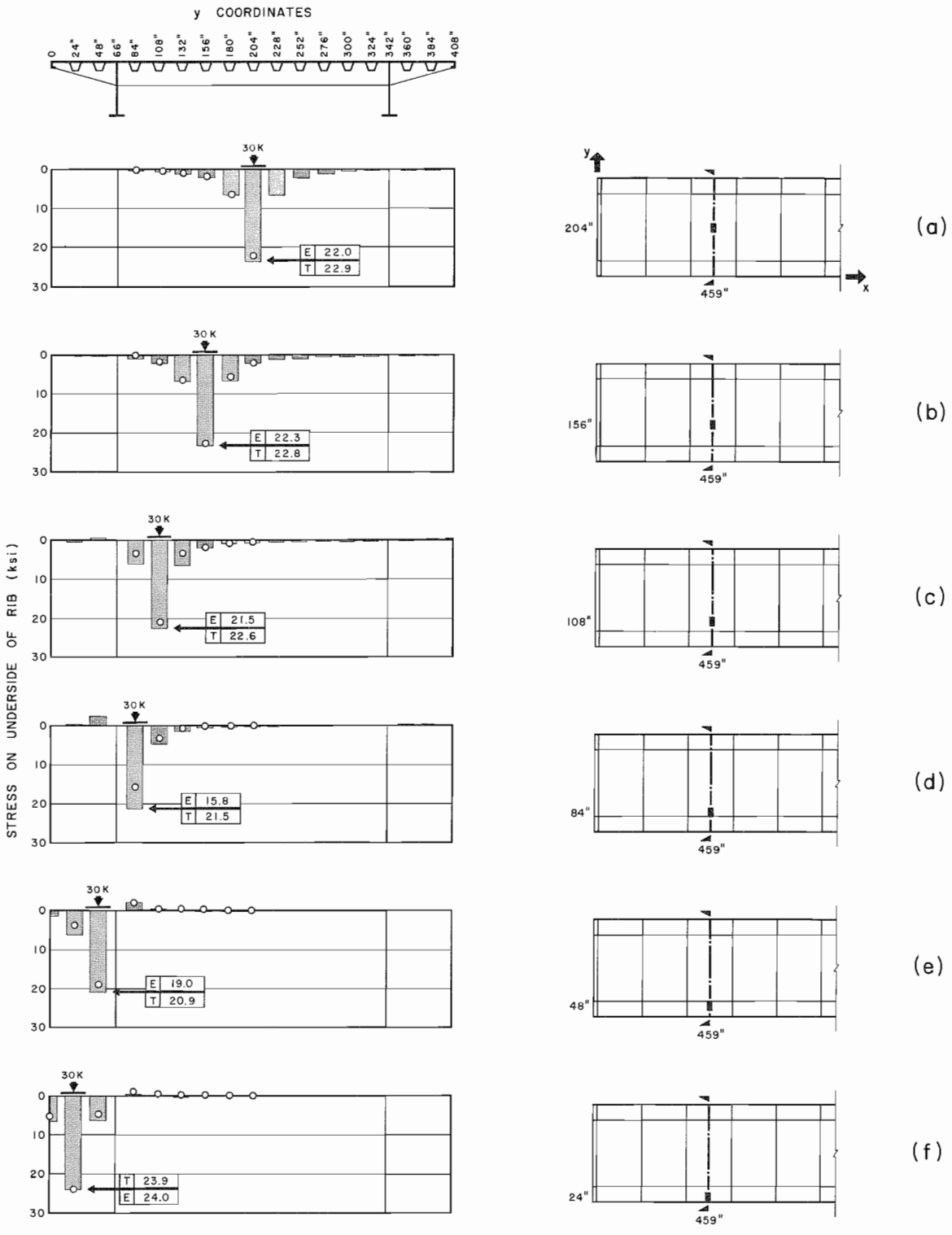


FIG. 28 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

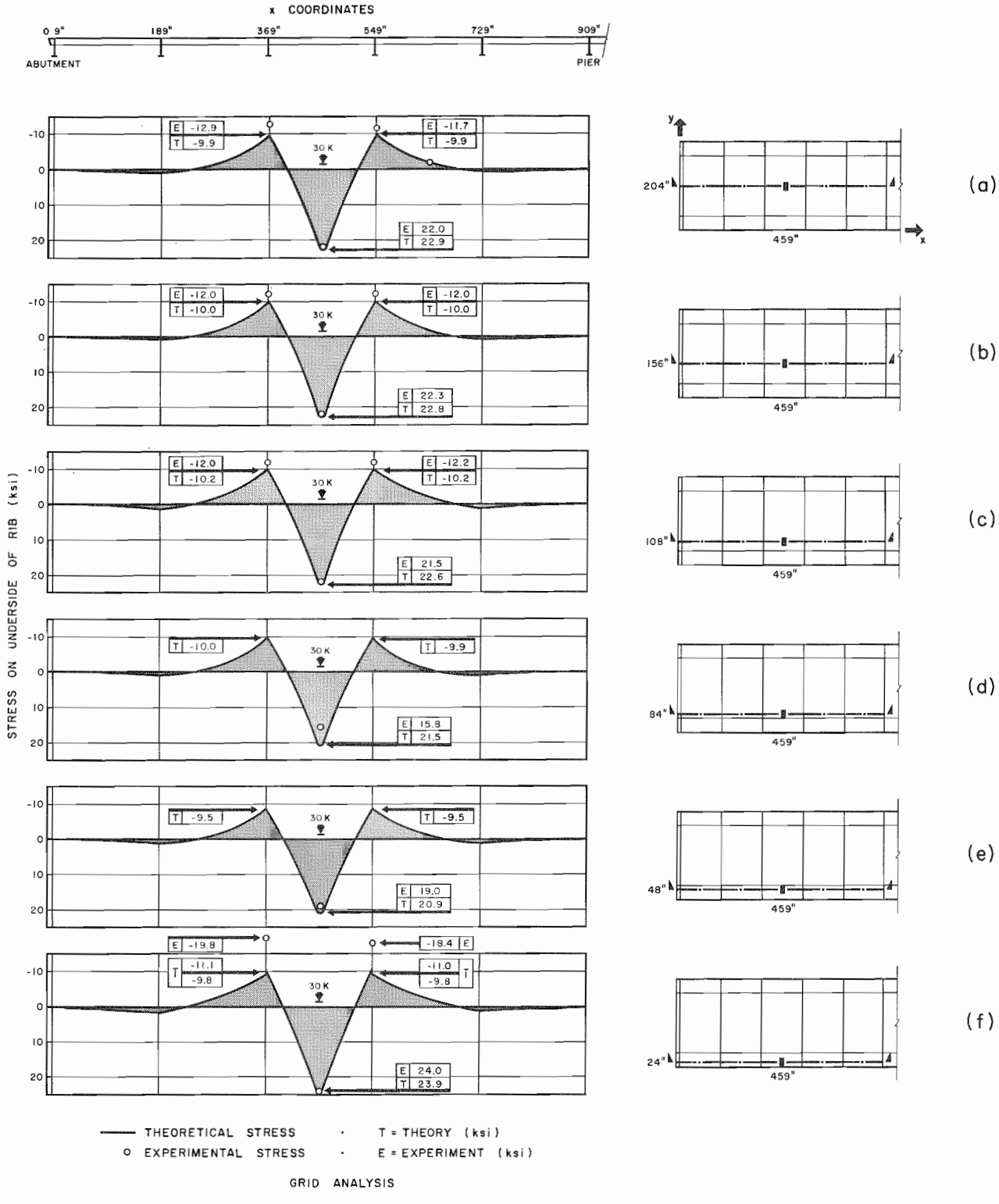
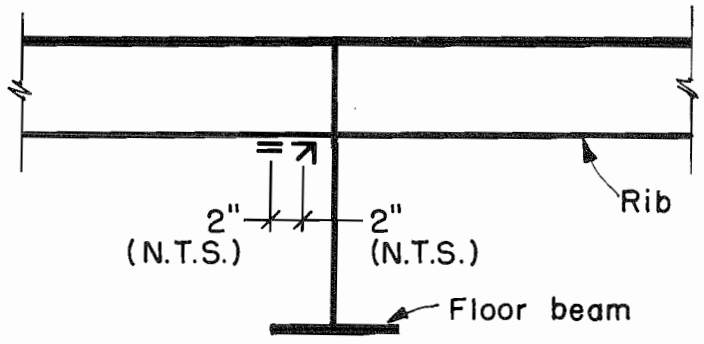
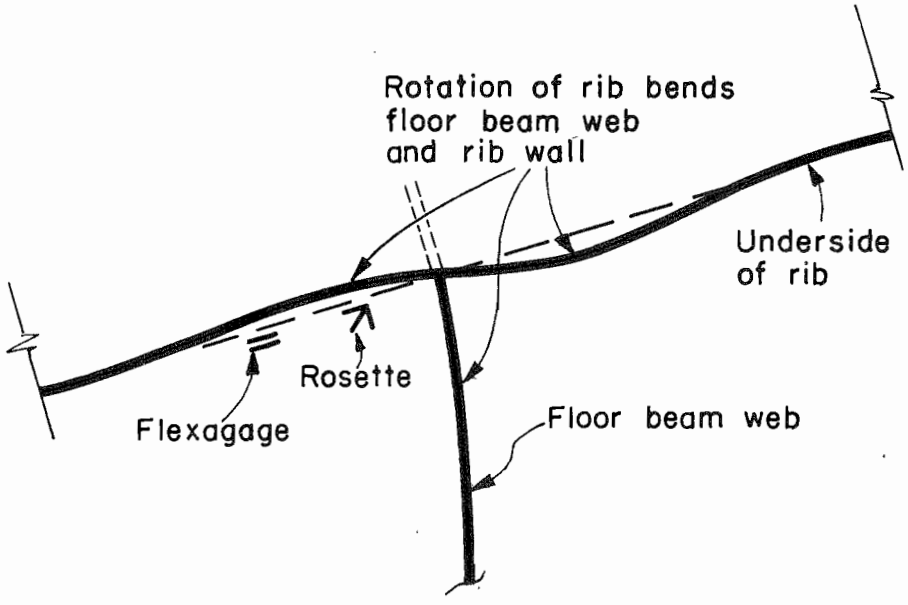


FIG. 29 RIB STRESSES IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

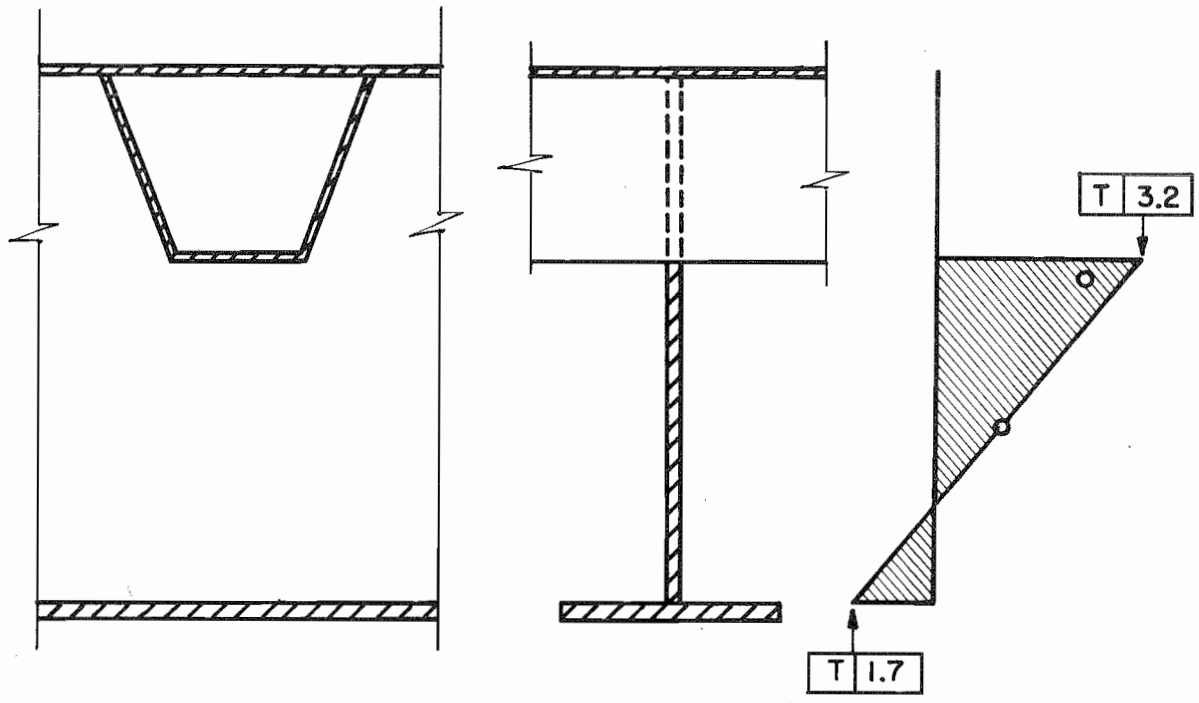


(a) POSITIONS OF STRAIN GAGES.



(b) ENLARGED VIEW SHOWING LOCAL BENDING OF RIB WALL.

FIG. 30 LOCAL BENDING IN RIB WALL AT A FLOOR BEAM.



KEY

T & LINE = THEORETICAL BENDING STRESS FROM GRID ANALYSIS

o = EXPERIMENTAL BENDING STRESS

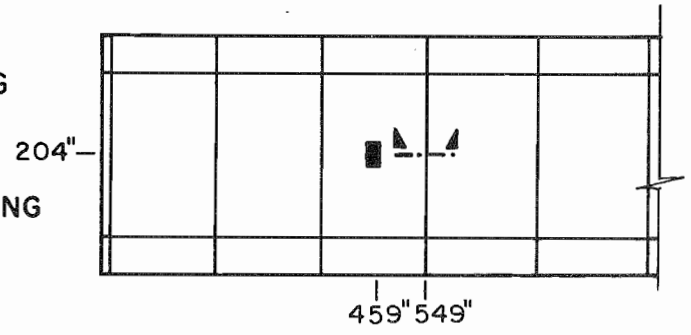


FIG. 31 VERTICAL BENDING STRESS IN FLOOR BEAM WEB

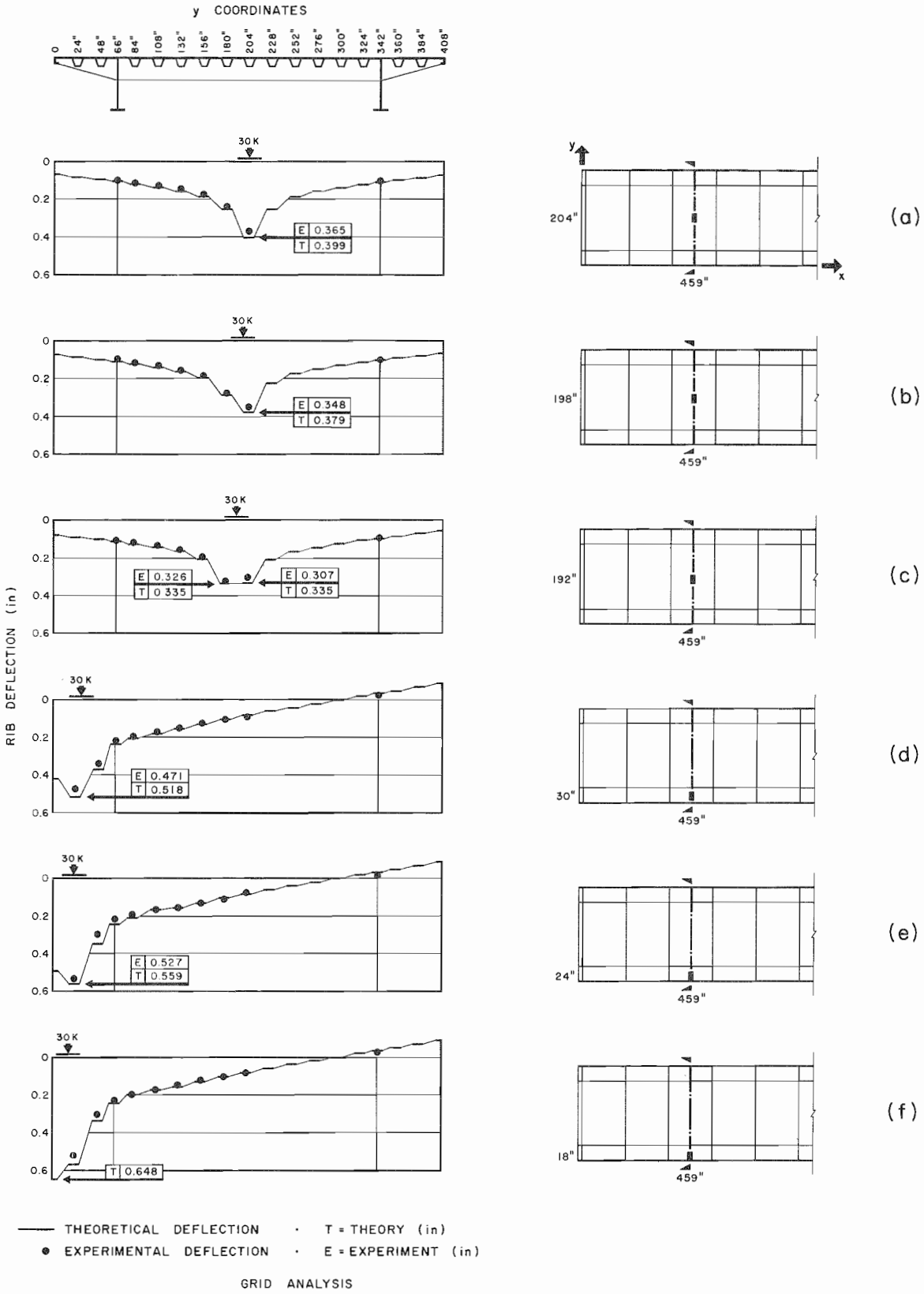
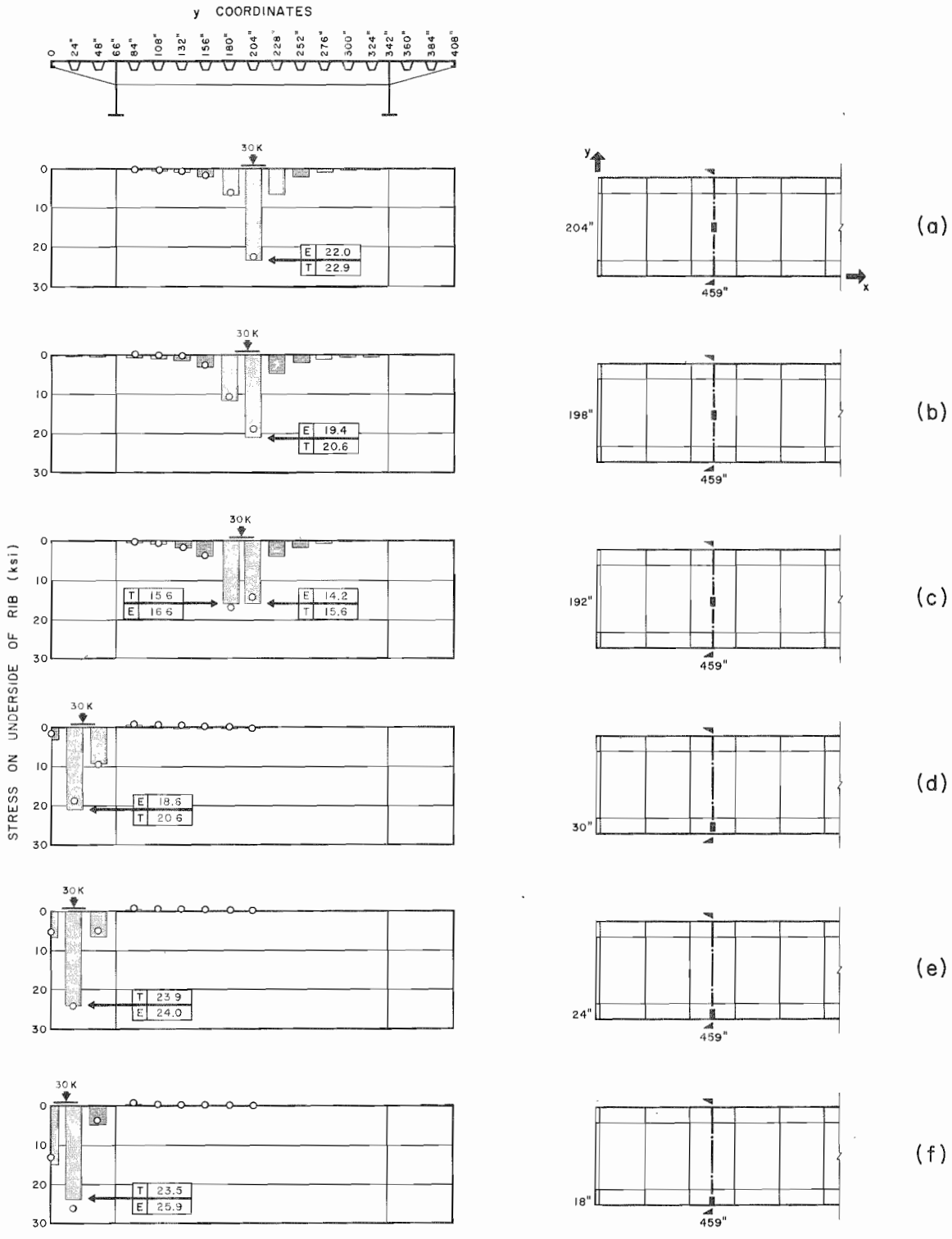


FIG. 32 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.



BARS = THEORETICAL STRESS · T = THEORY (ksi)
o EXPERIMENTAL STRESS · E = EXPERIMENT (ksi)

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FIG. 33 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

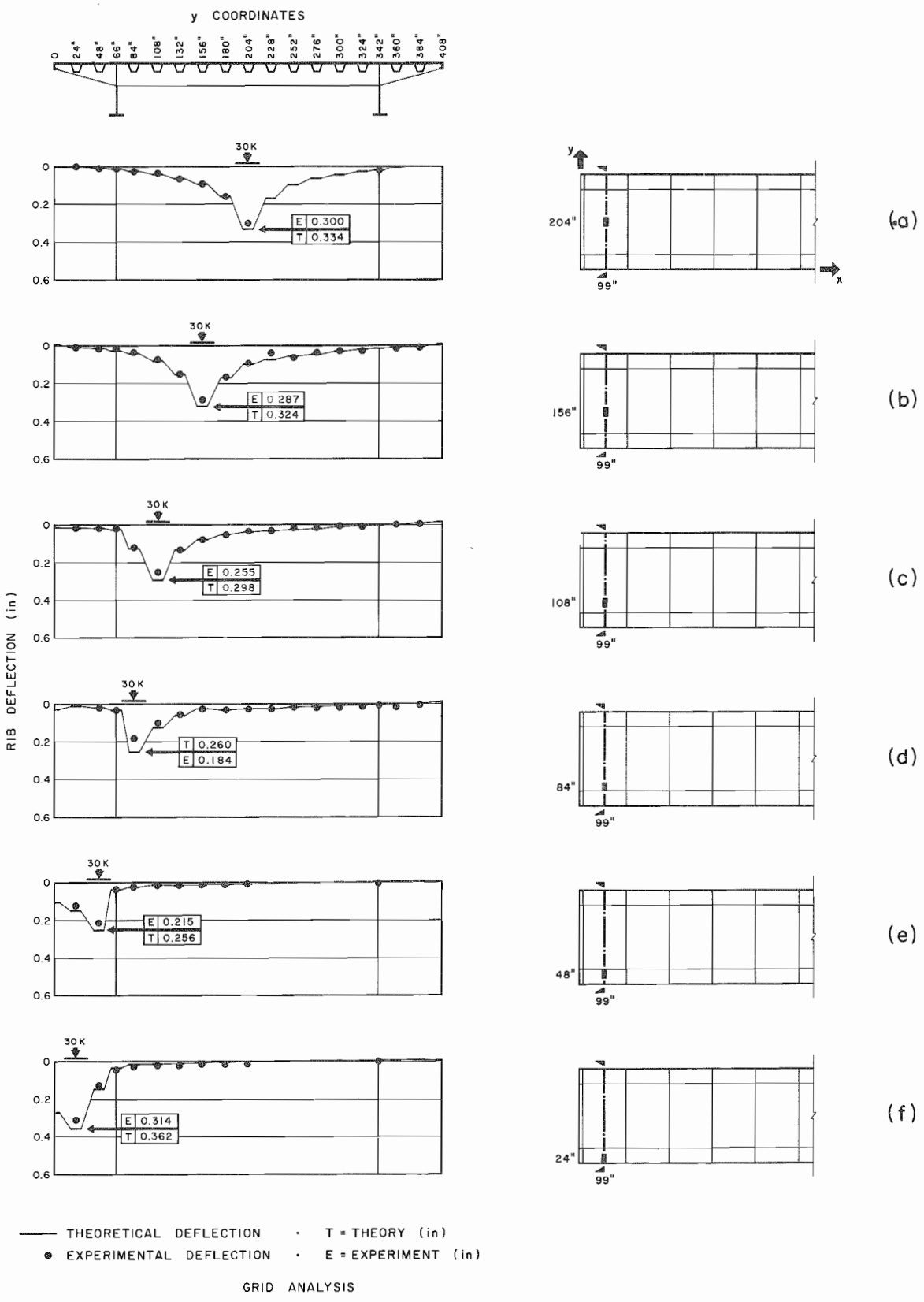


FIG. 34 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

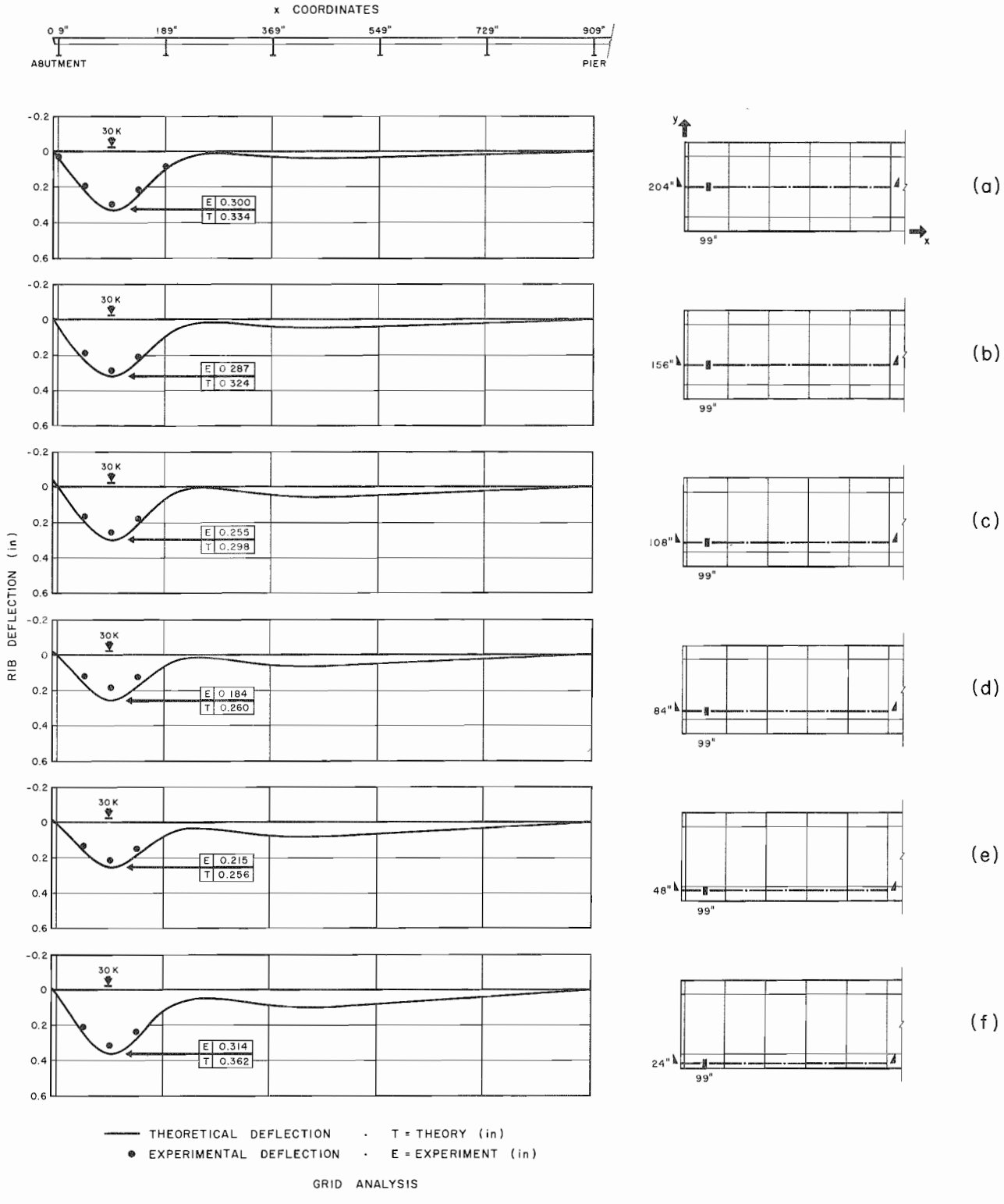


FIG. 35 RIB DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

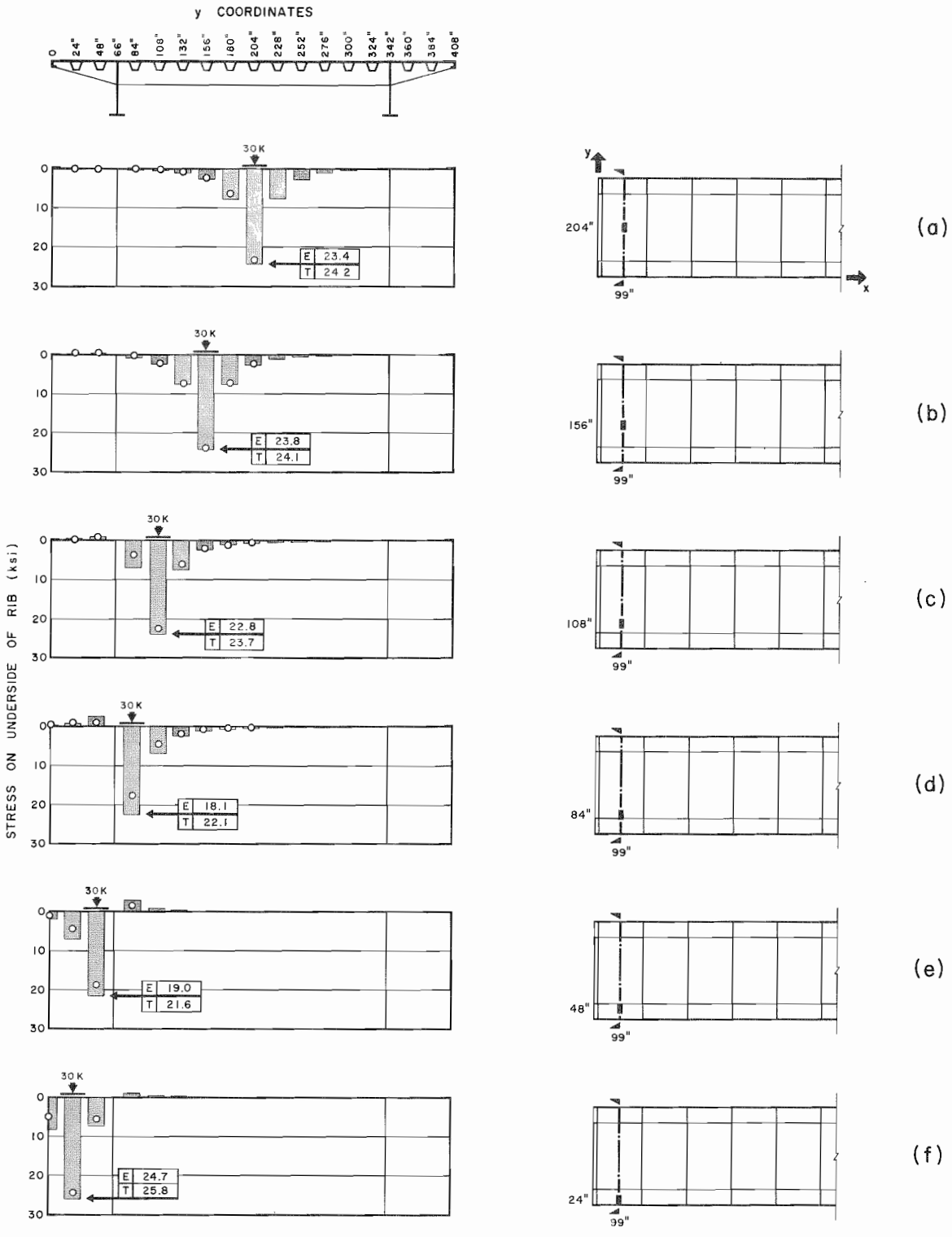


FIG. 36 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

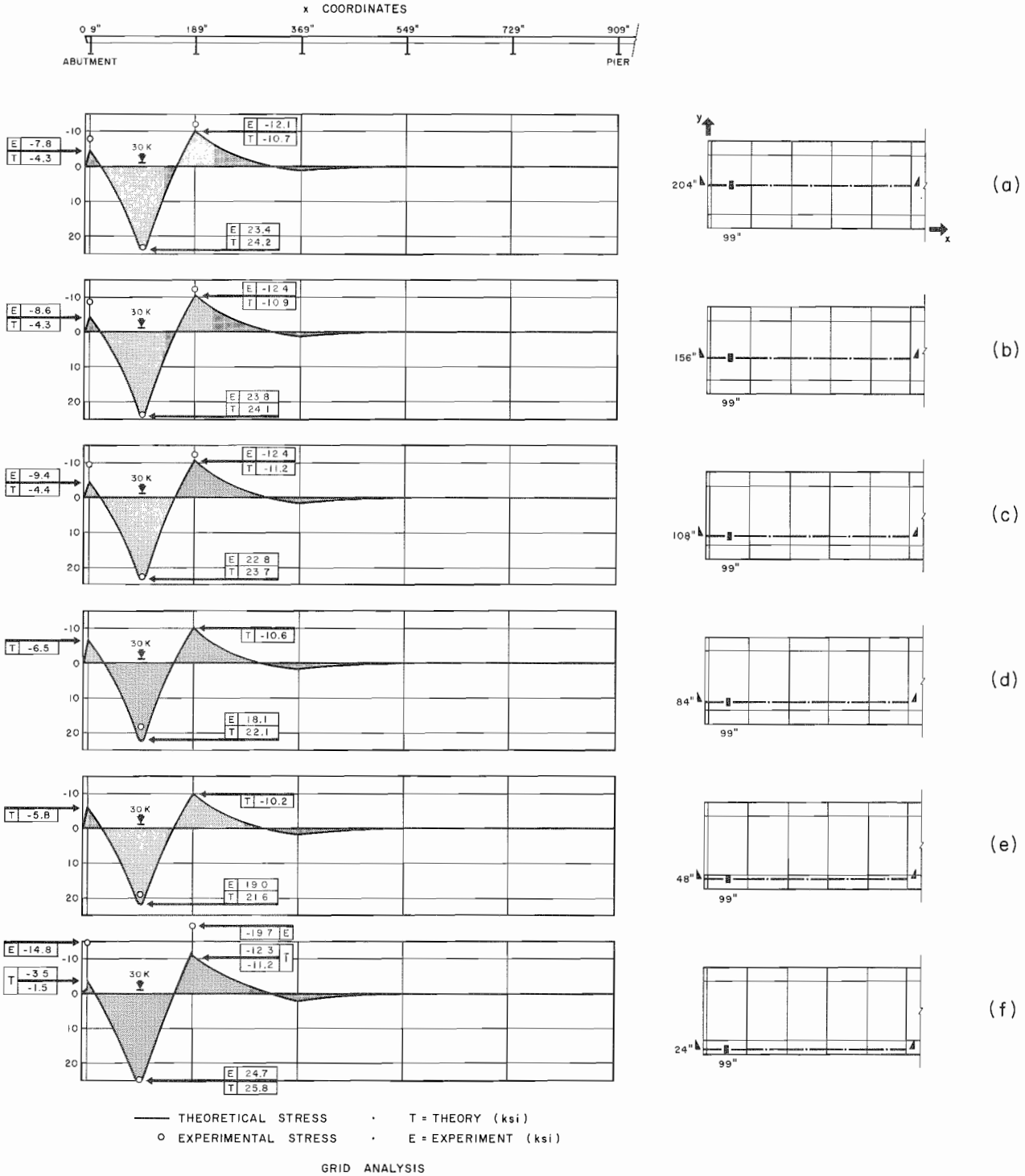


FIG. 37 RIB STRESSES IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

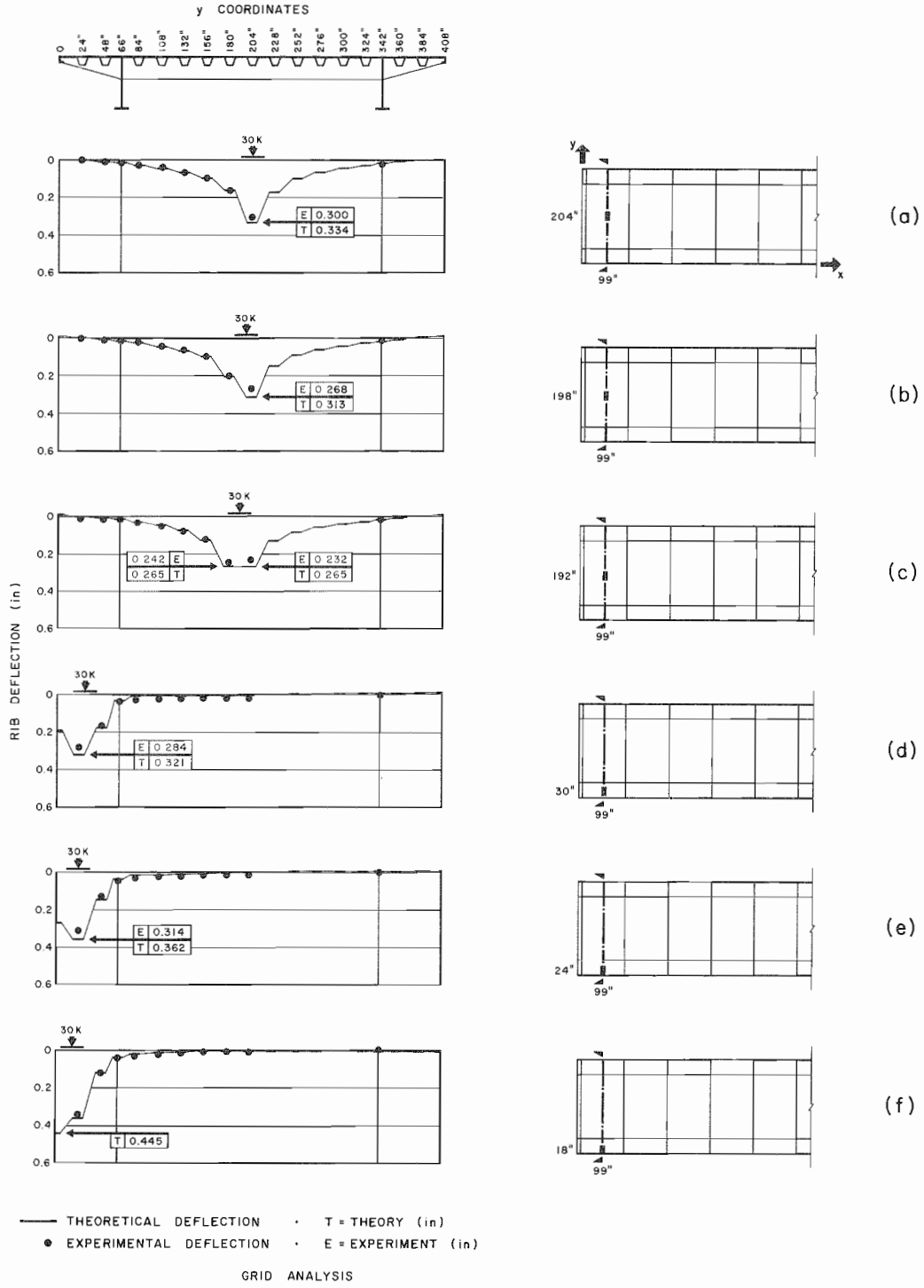


FIG. 38 RIB DEFLECTIONS IN LATERAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

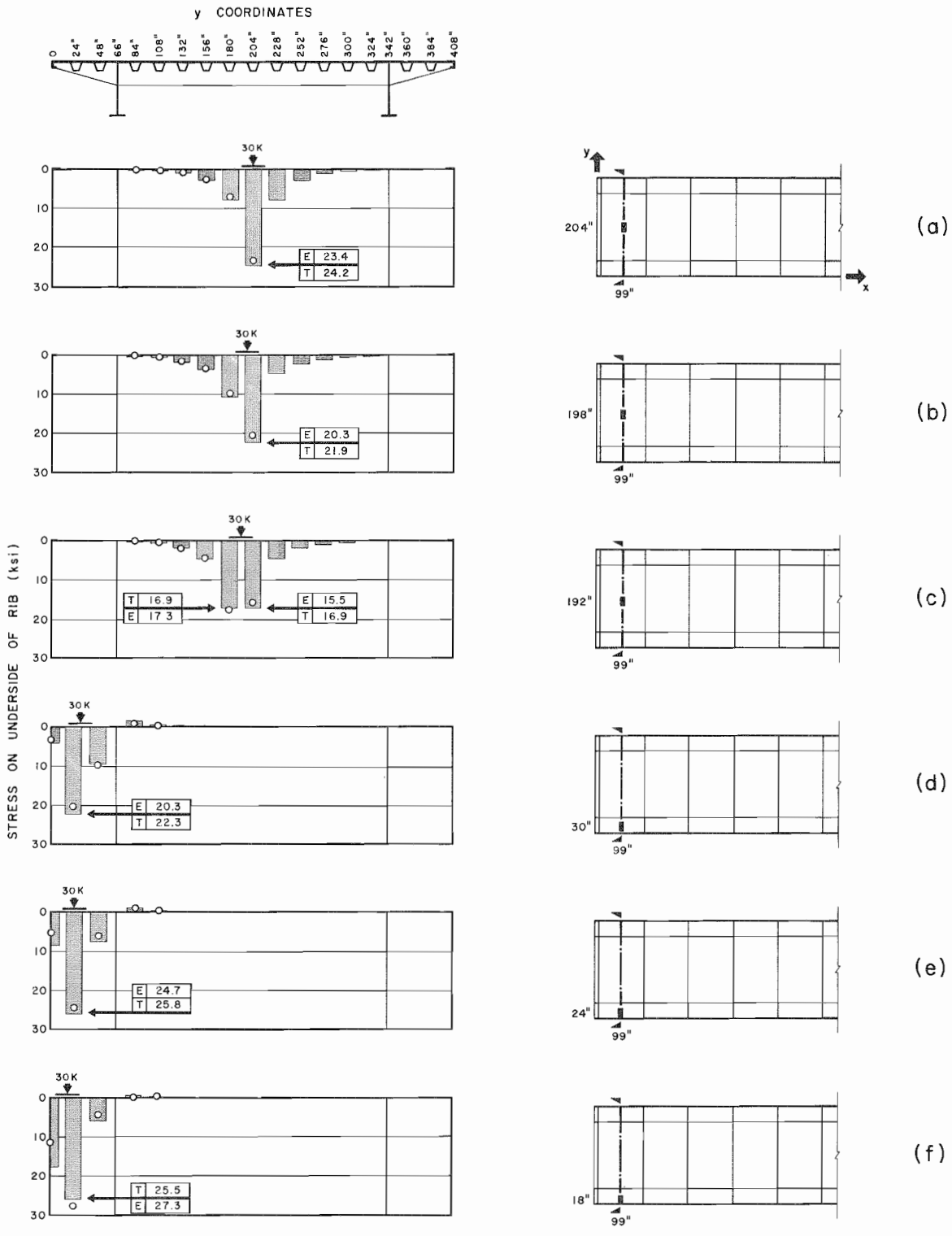


FIG. 39 RIB STRESSES IN LATERAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

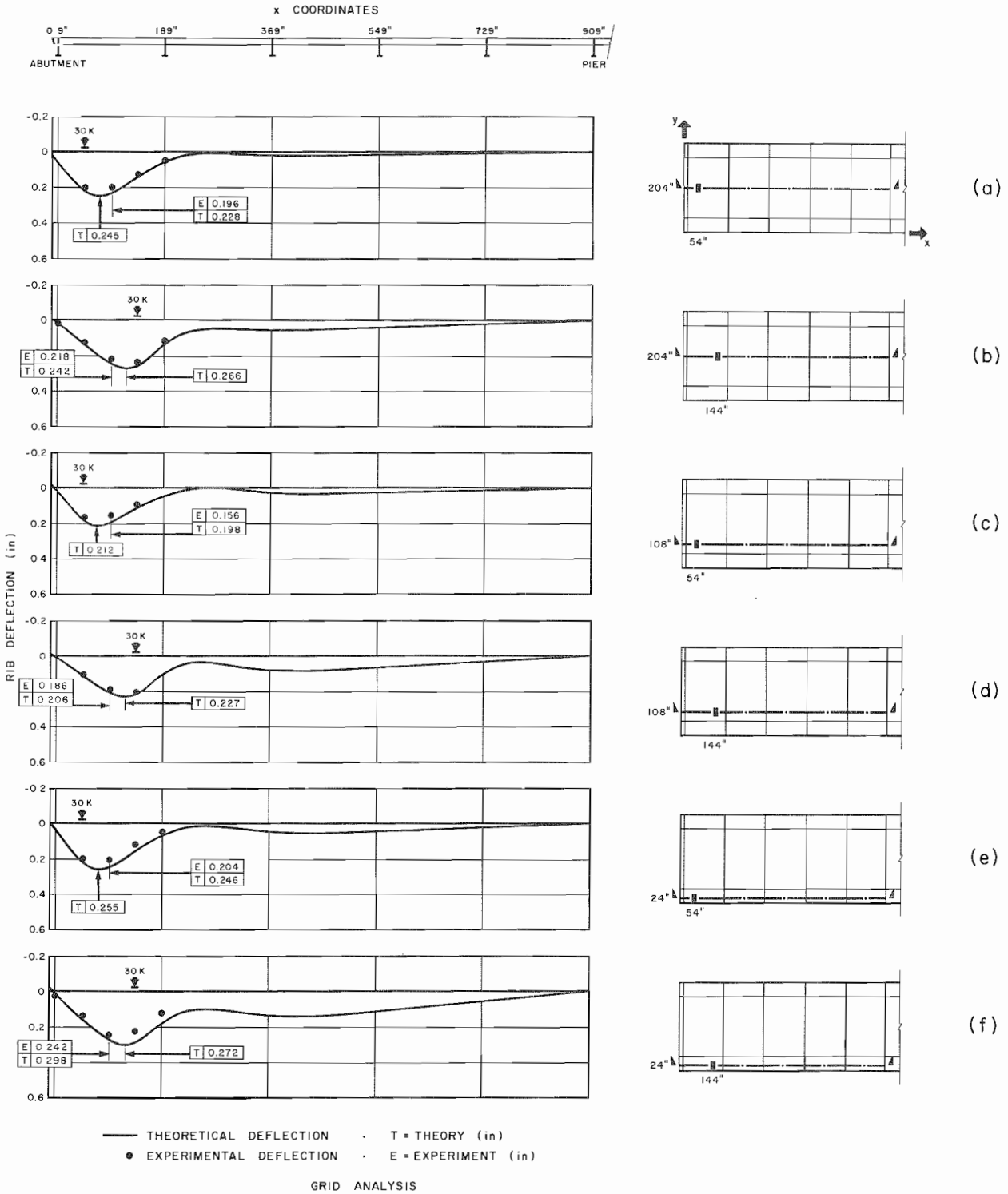


FIG. 40 RIB DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

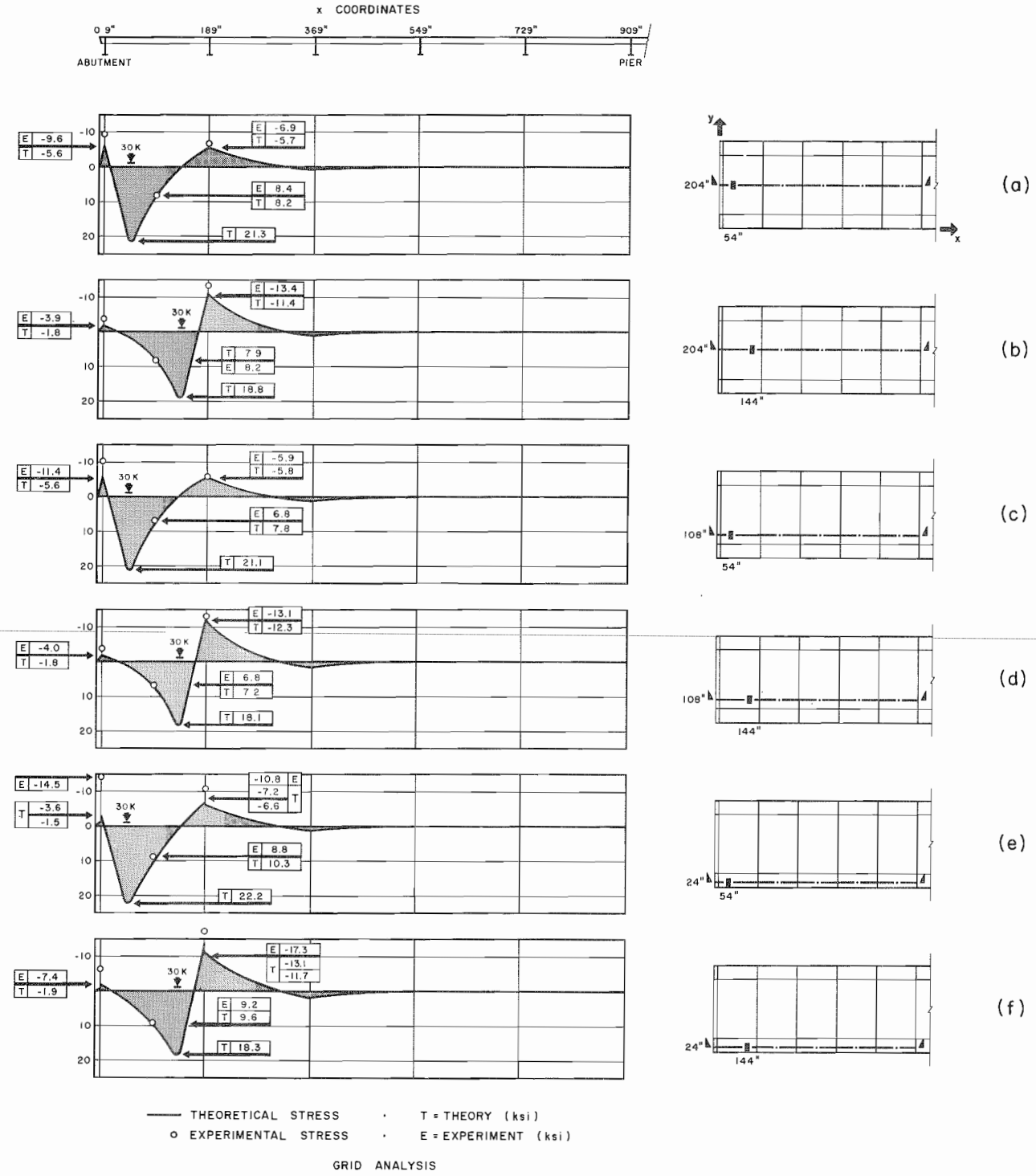


FIG. 41 RIB STRESSES IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

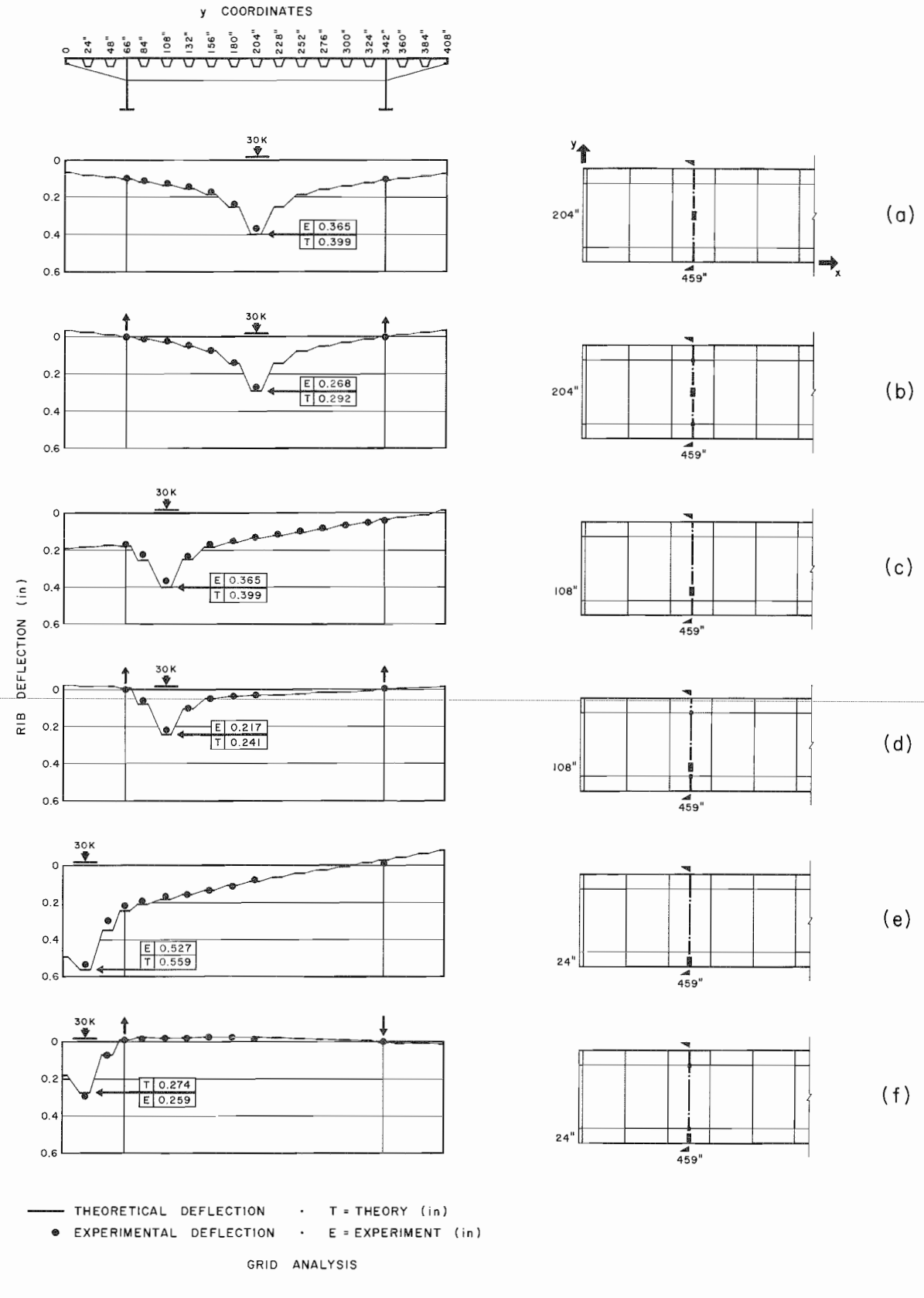


FIG. 42 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

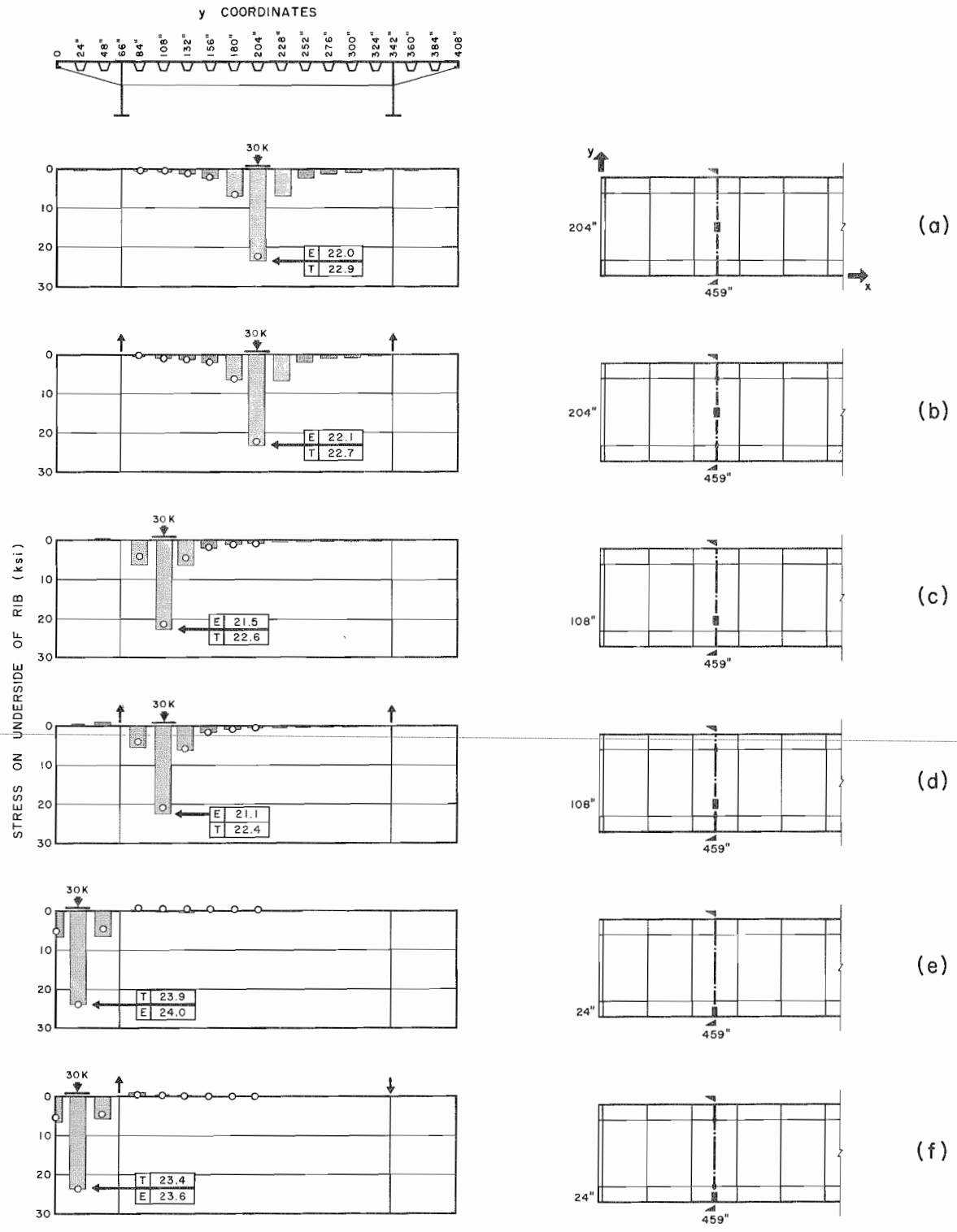


FIG.43 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

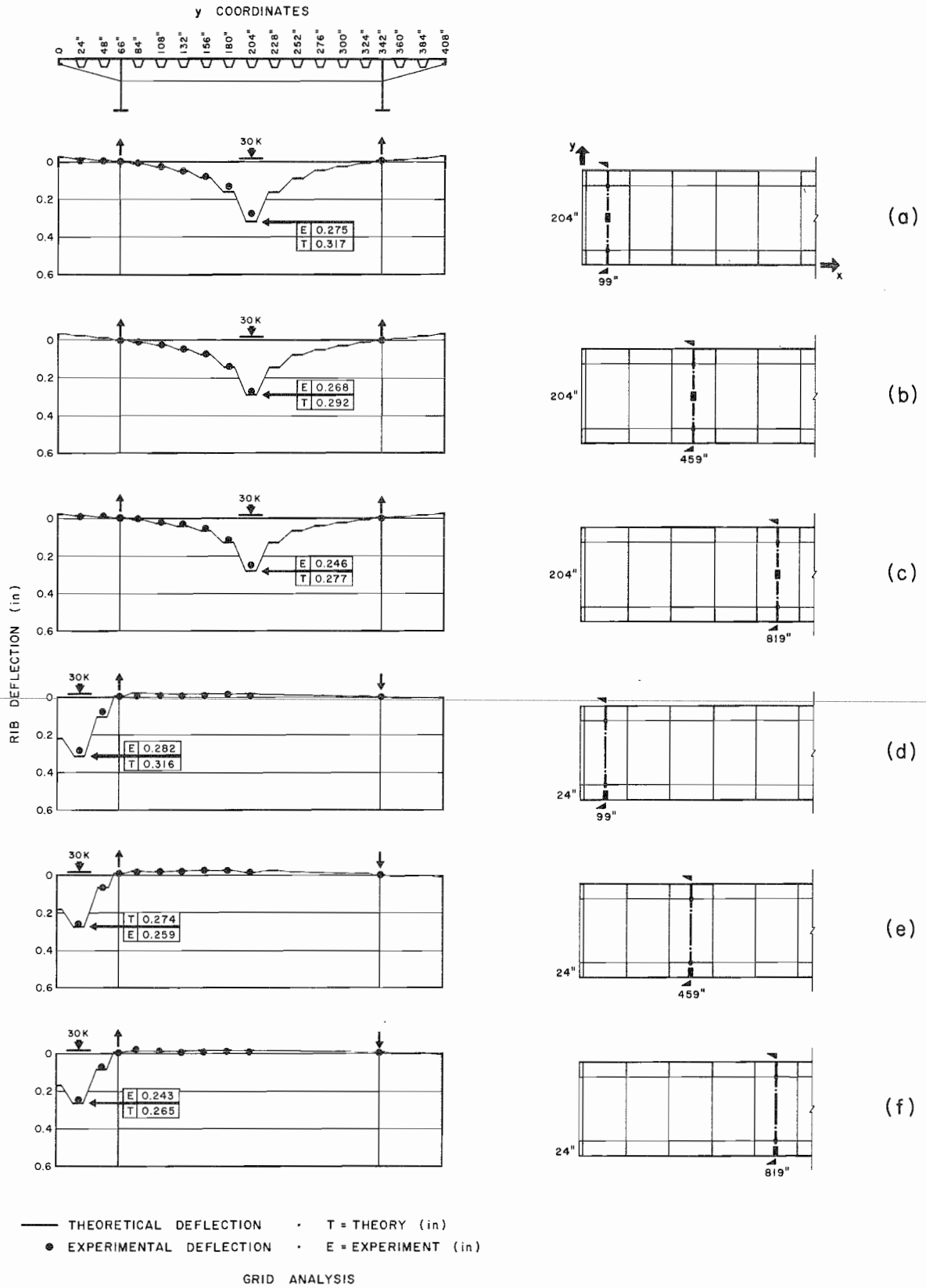


FIG. 44 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

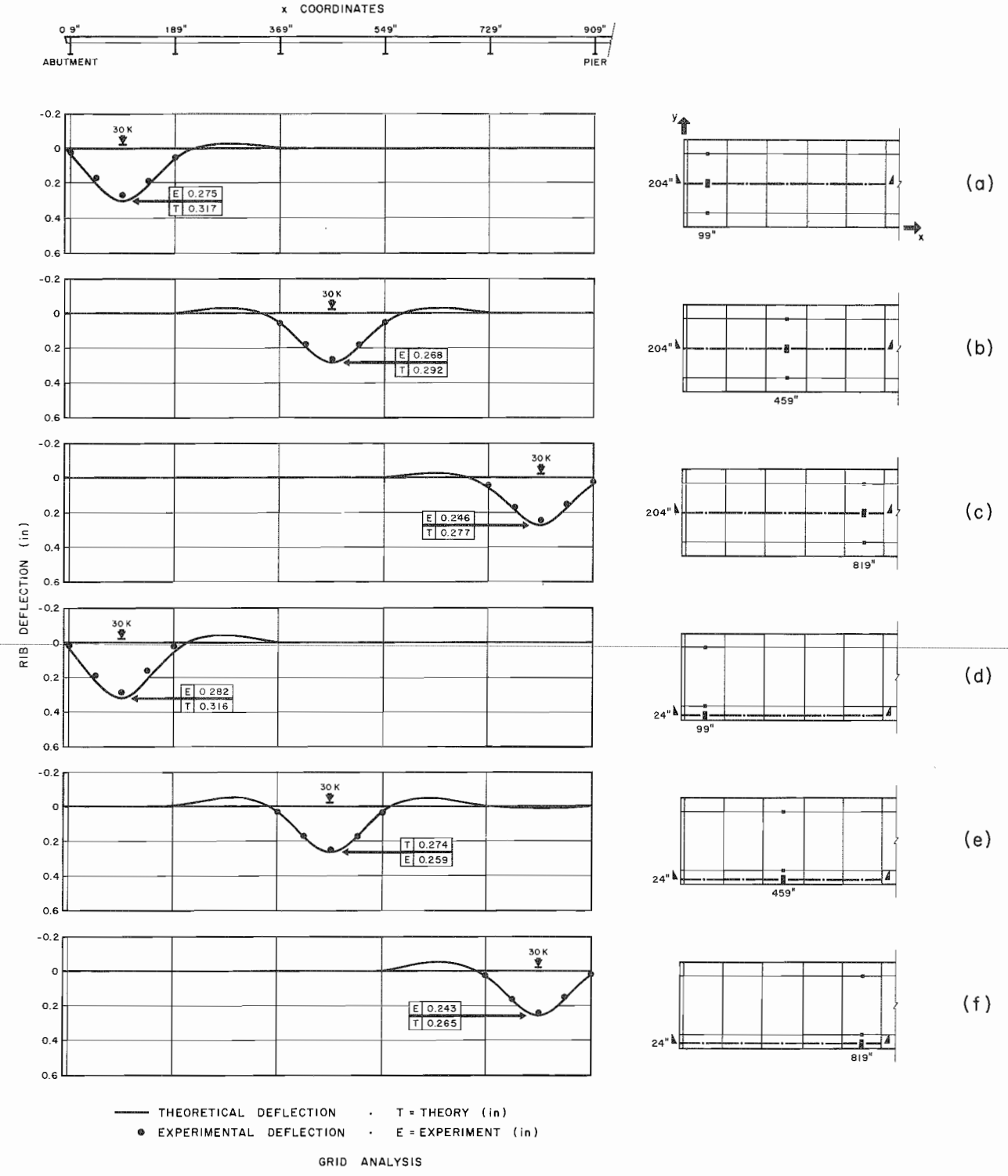
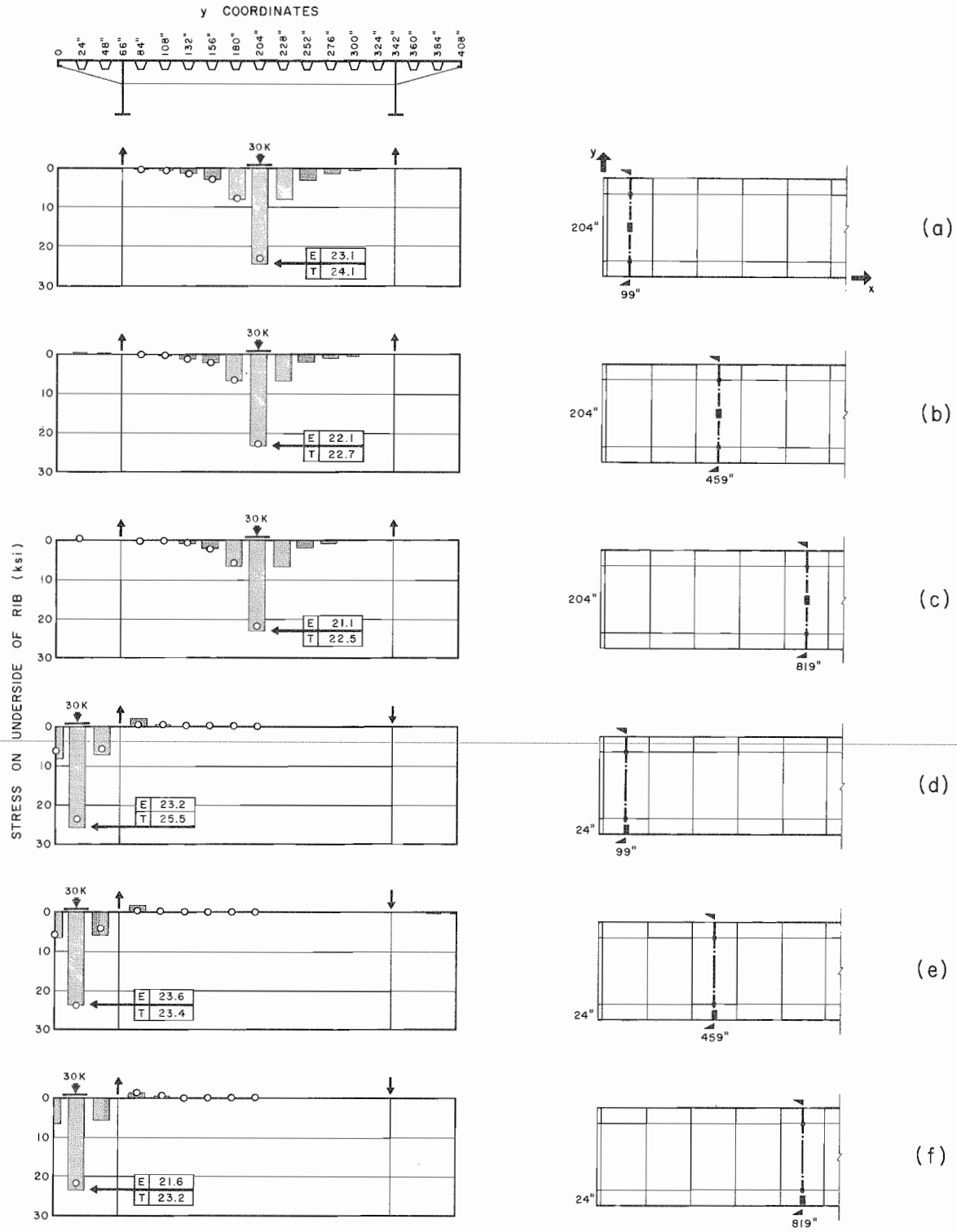


FIG. 45 RIB DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.



BARS = THEORETICAL STRESS · T = THEORY (ksi)
O EXPERIMENTAL STRESS · E = EXPERIMENT (ksi)

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FIG. 46 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

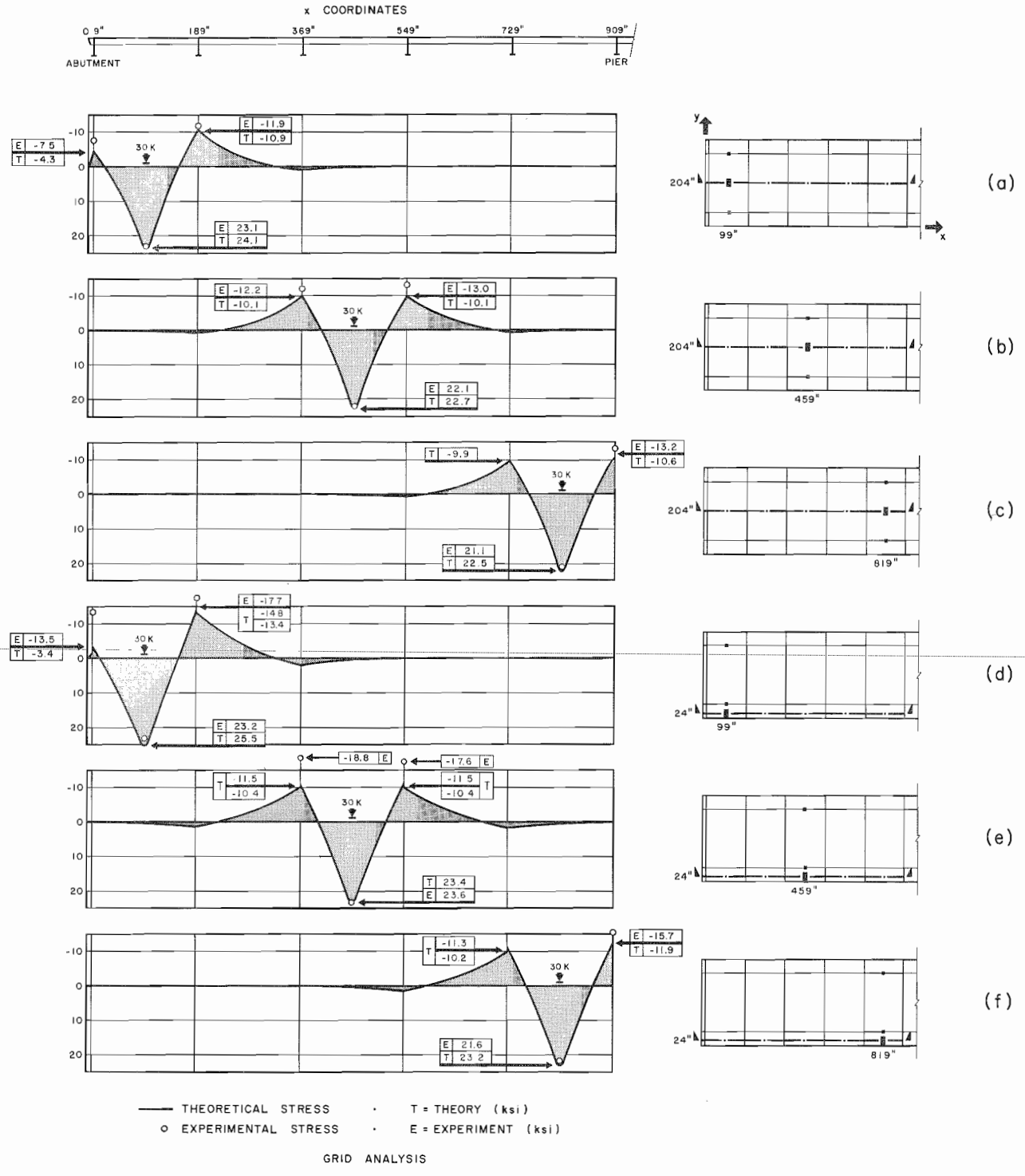


FIG. 47 RIB STRESSES IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

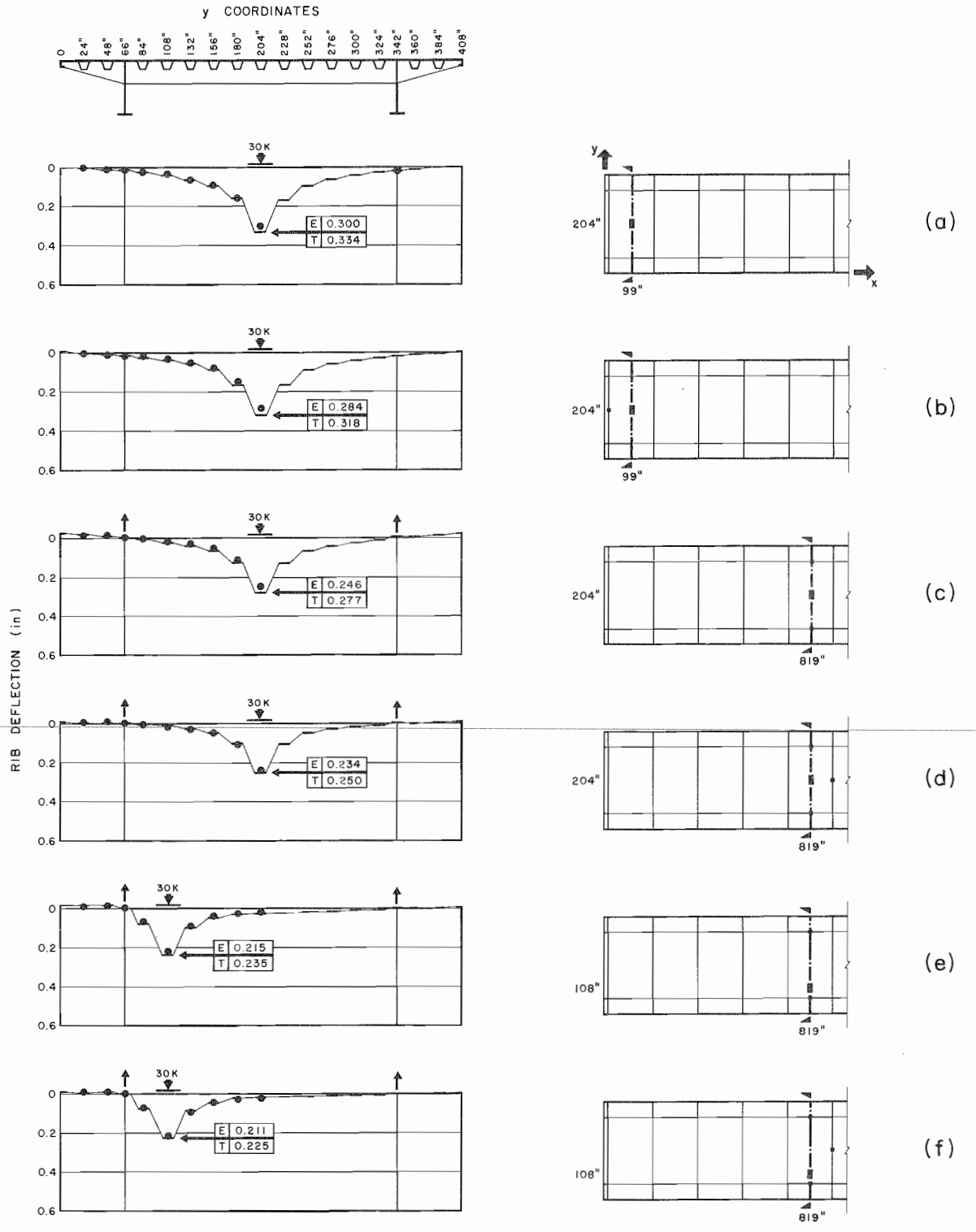


FIG. 48 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

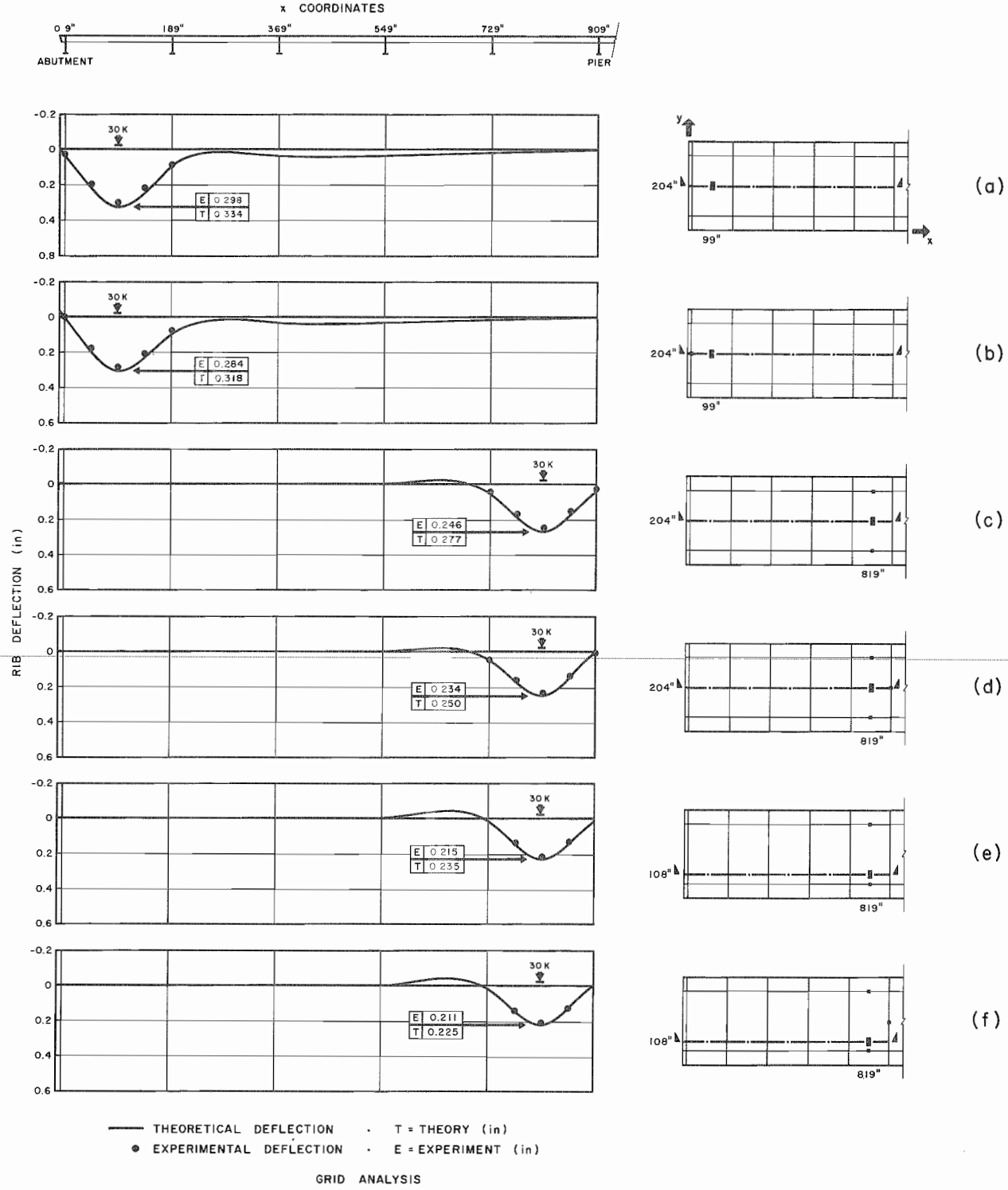
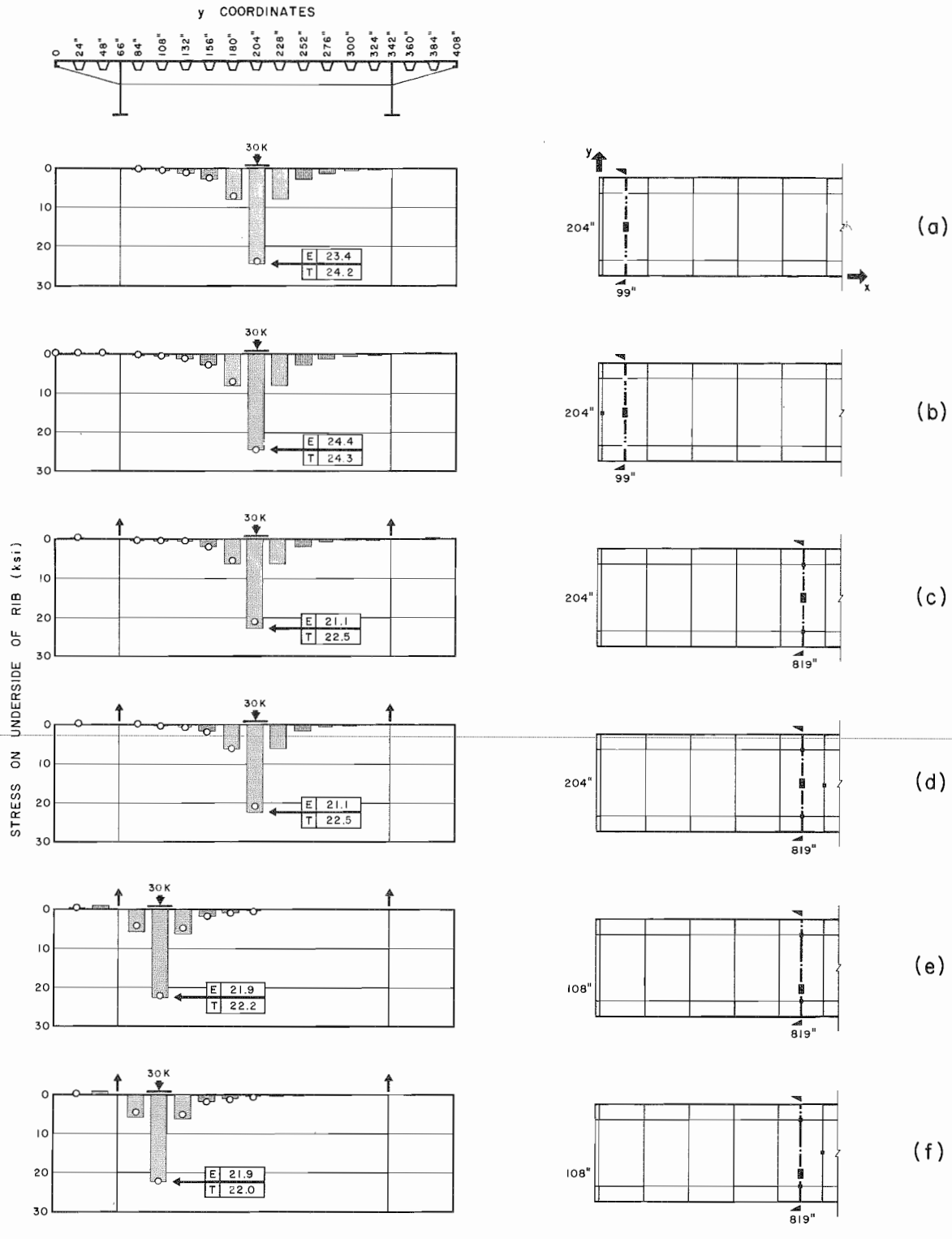


FIG. 49 RIB DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.



BARS = THEORETICAL STRESS · T = THEORY (ksi)
O EXPERIMENTAL STRESS · E = EXPERIMENT (ksi)

GRID ANALYSIS

FIG. 50 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

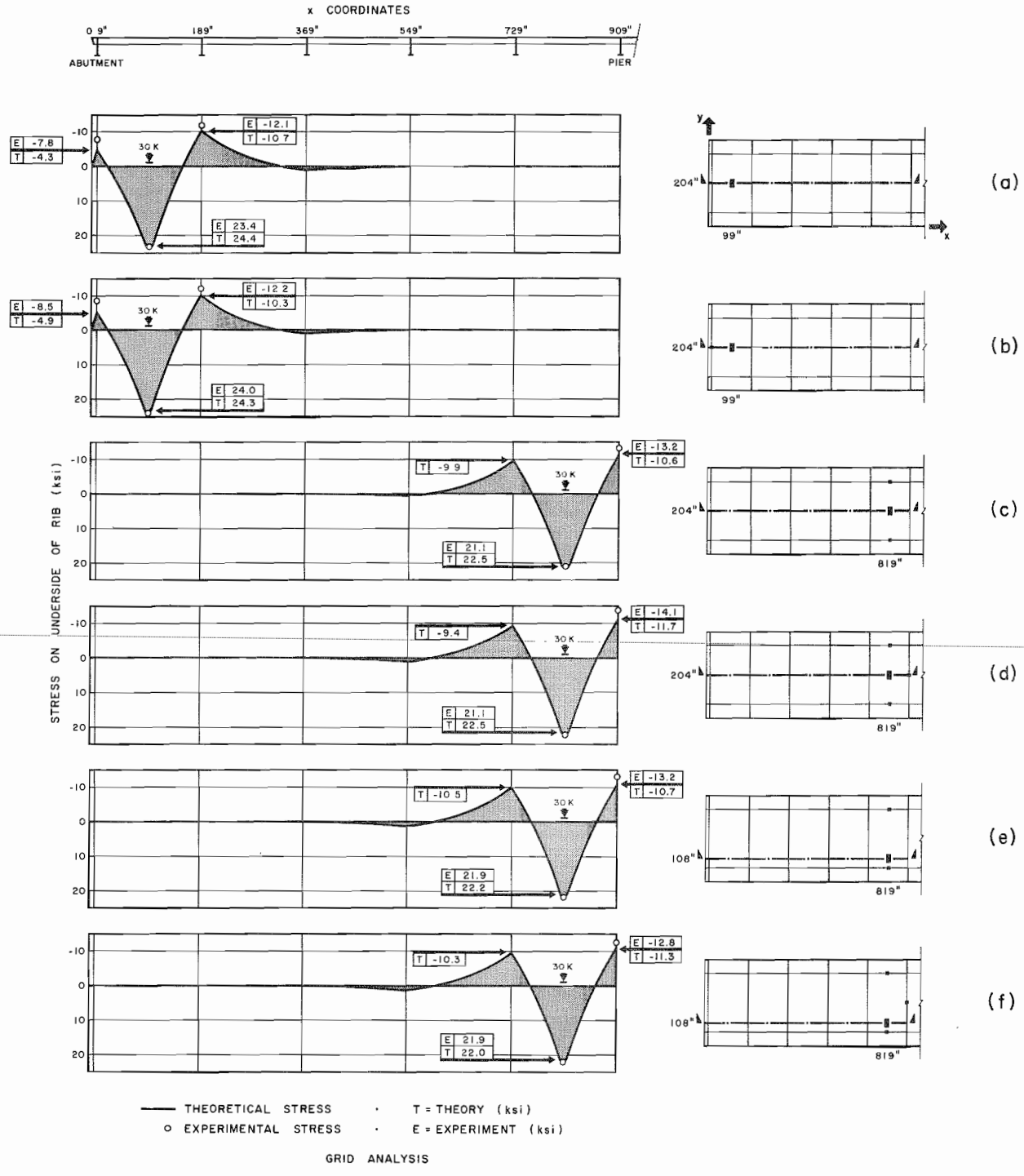


FIG. 51 RIB STRESSES IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE I.

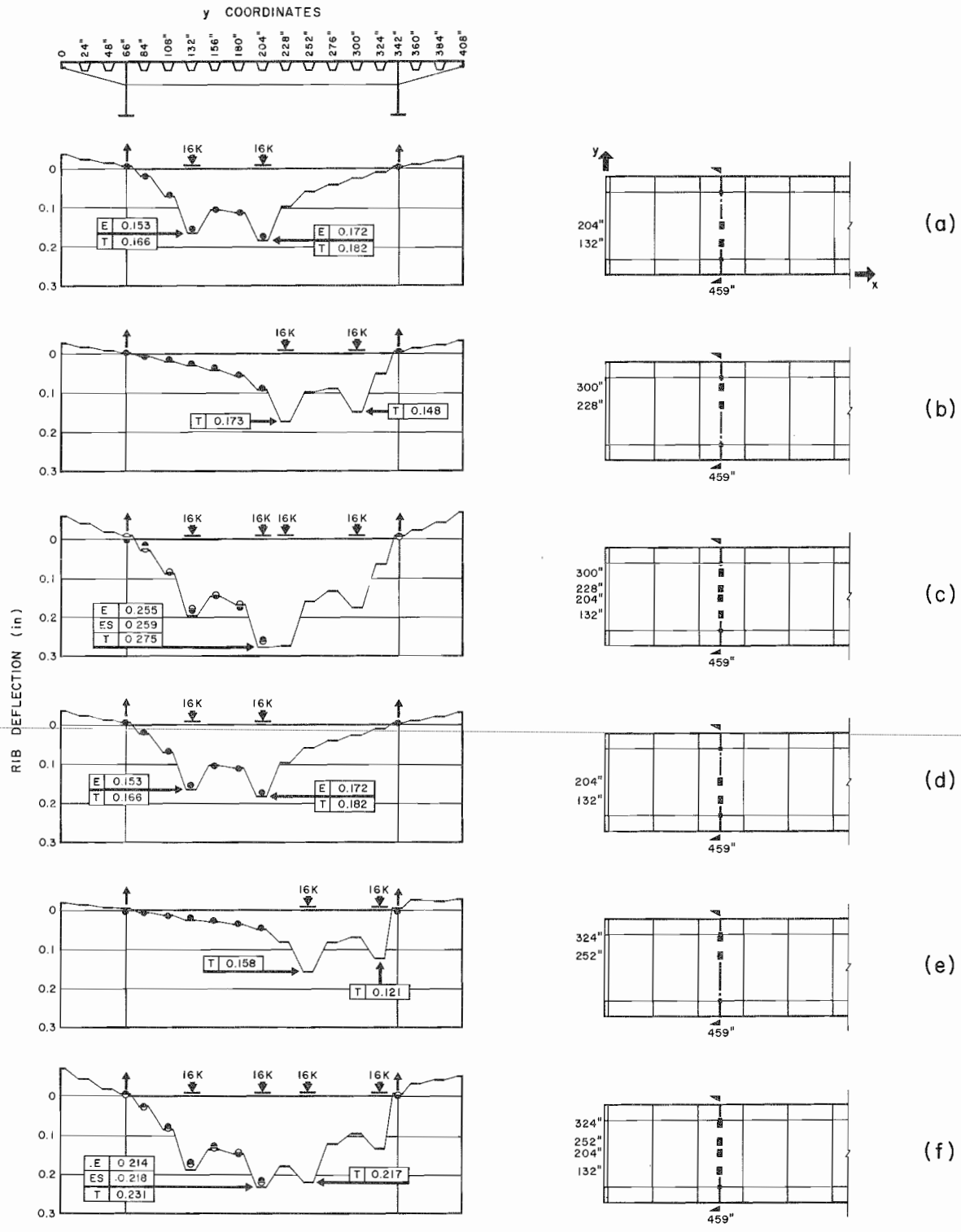


FIG. 52 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

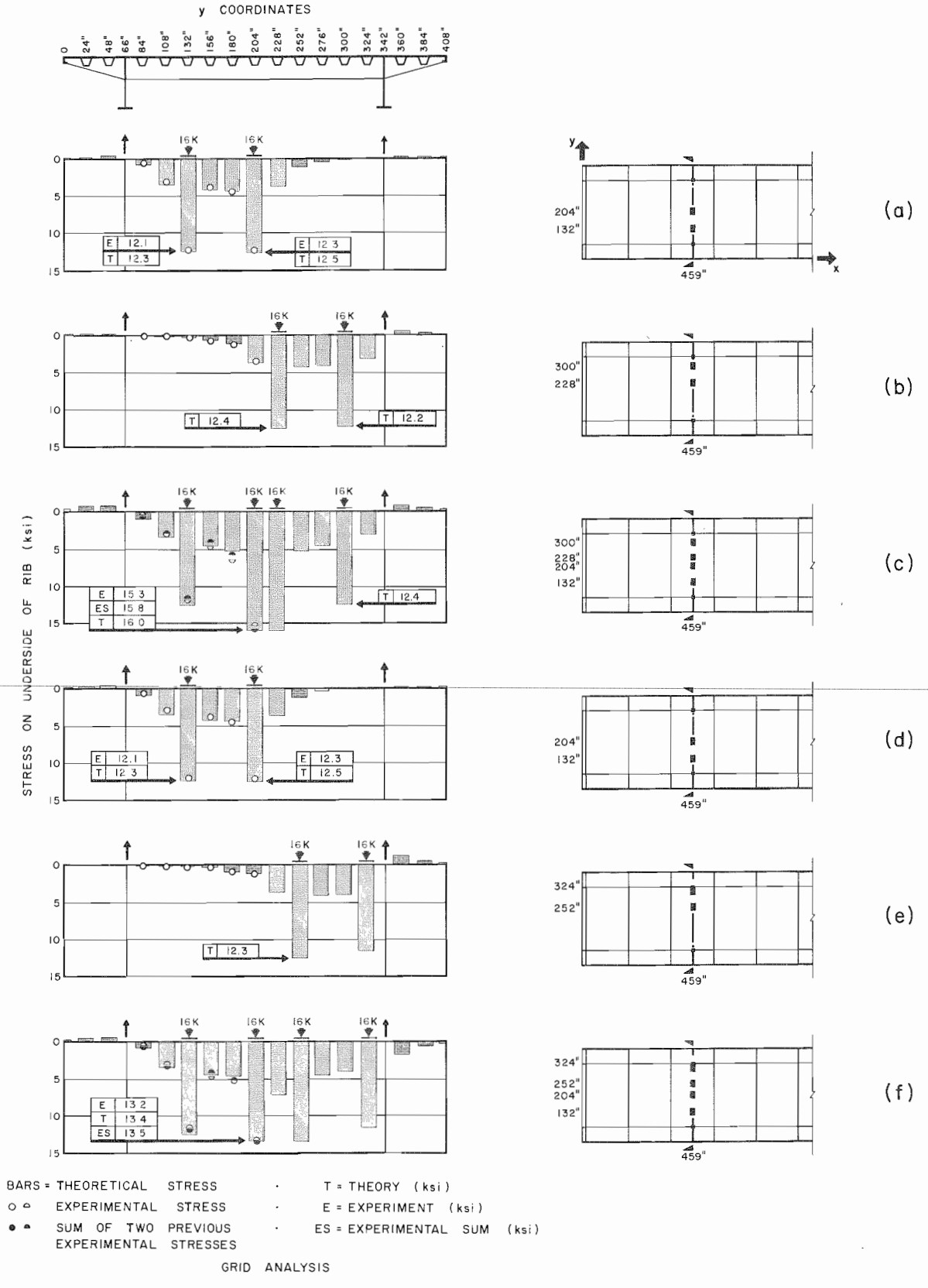


FIG. 53 RIB STRESSES IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

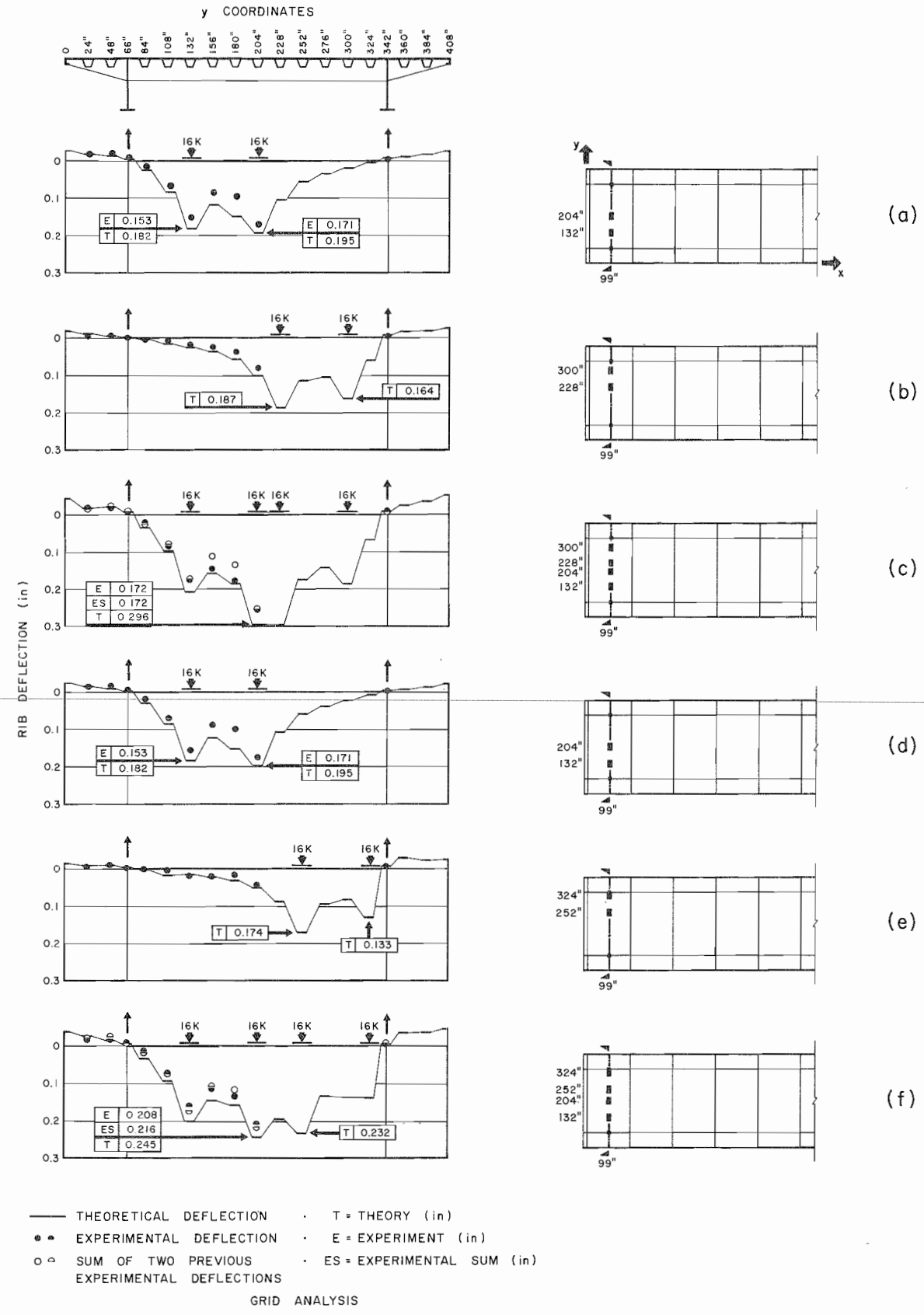


FIG. 54 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

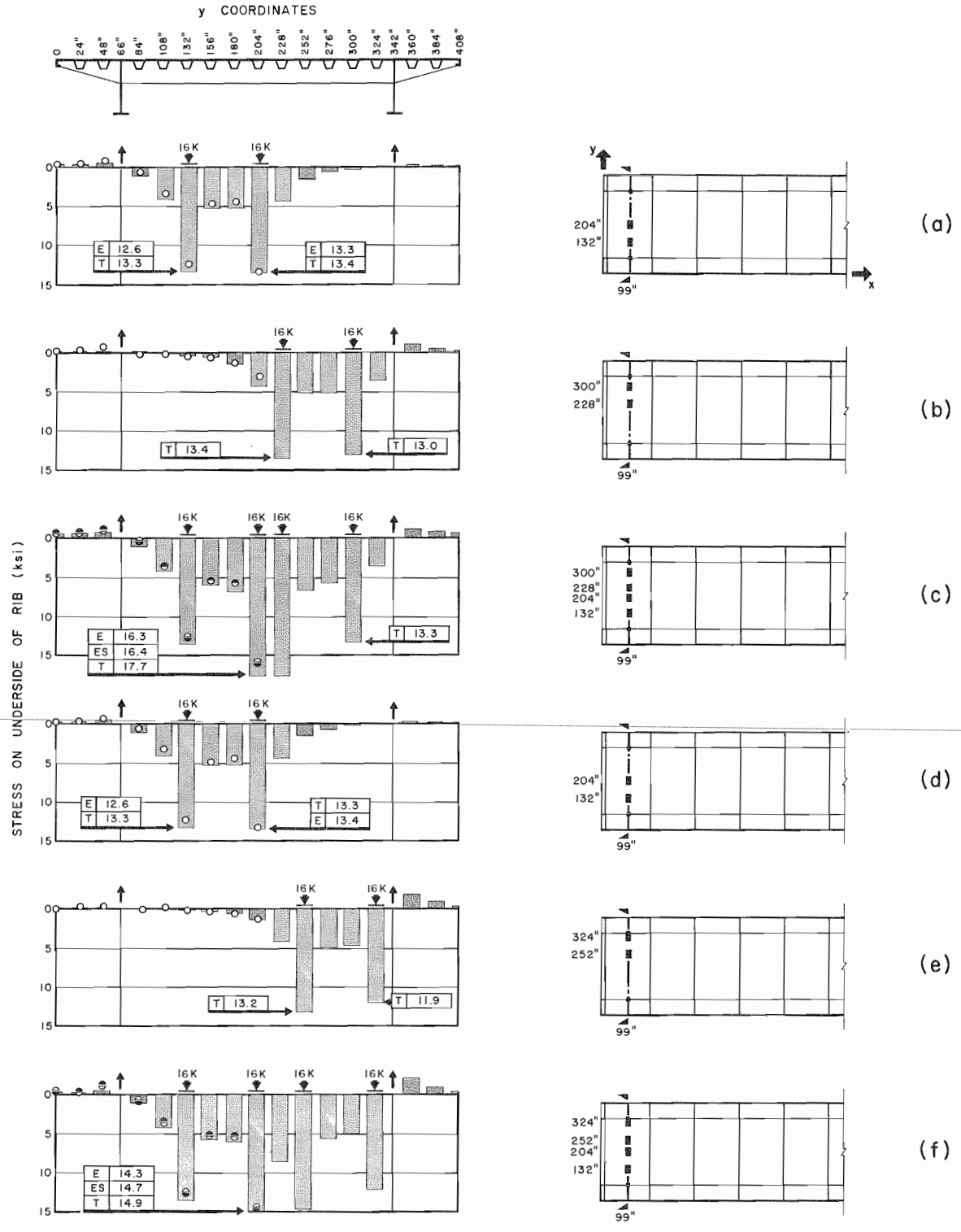


FIG. 55 RIB STRESSES IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

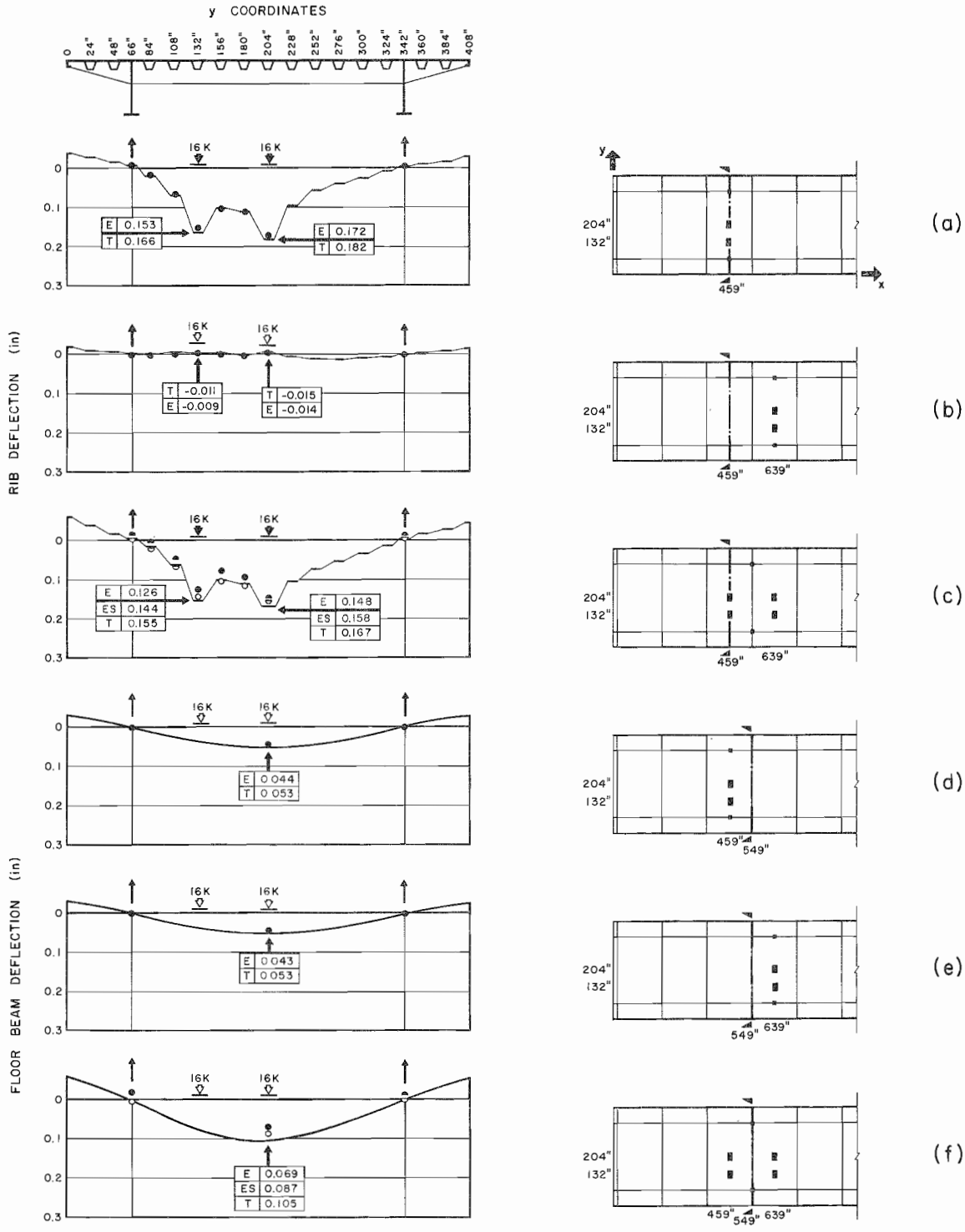
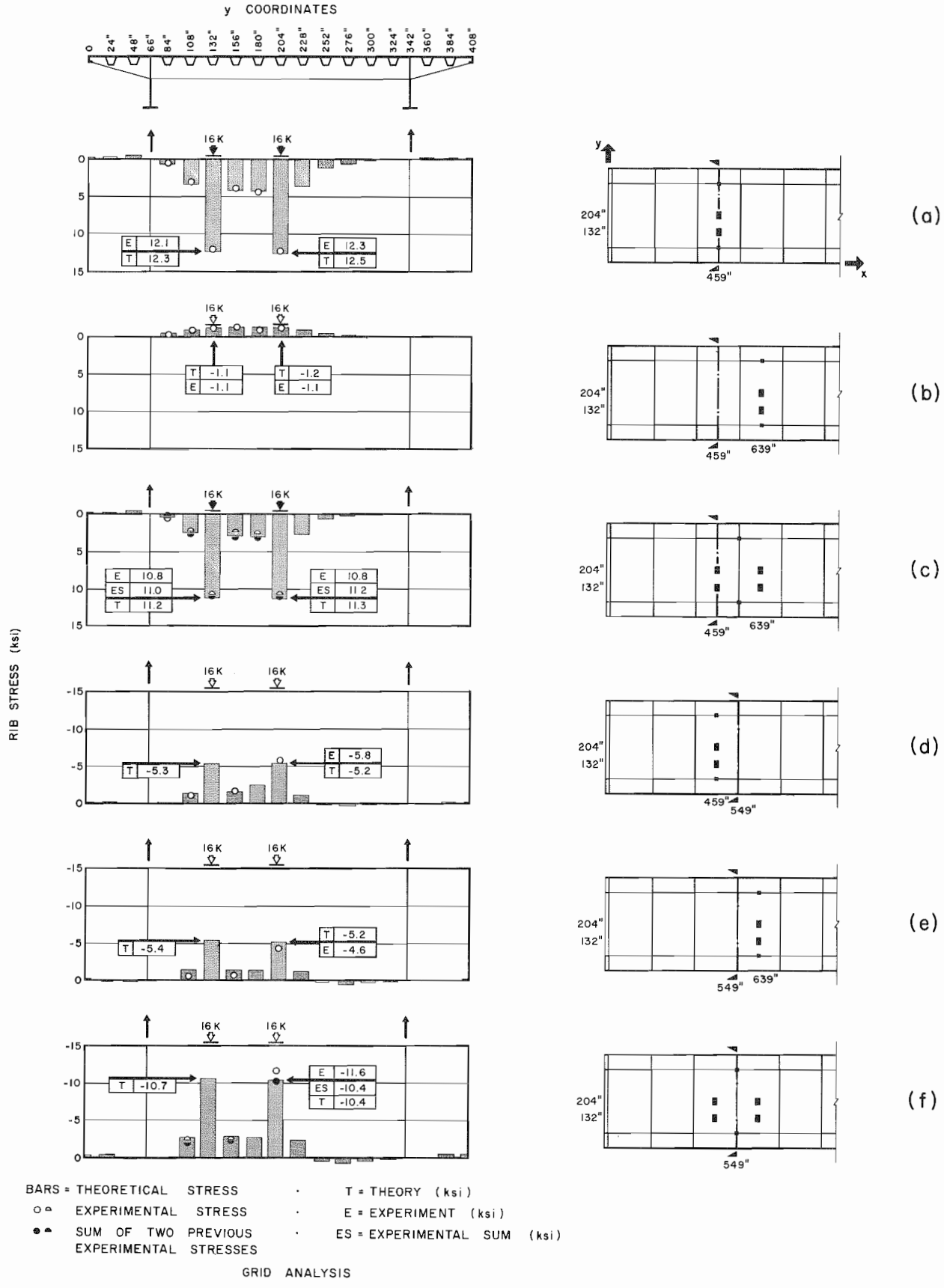


FIG. 56 RIB AND FLOOR BEAM DEFLECTIONS IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.



BARS = THEORETICAL STRESS · T = THEORY (ksi)

○ ⌓ EXPERIMENTAL STRESS · E = EXPERIMENT (ksi)

● ⌓ SUM OF TWO PREVIOUS EXPERIMENTAL STRESSES · ES = EXPERIMENTAL SUM (ksi)

GRID ANALYSIS

FIG. 57 RIB STRESSES IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

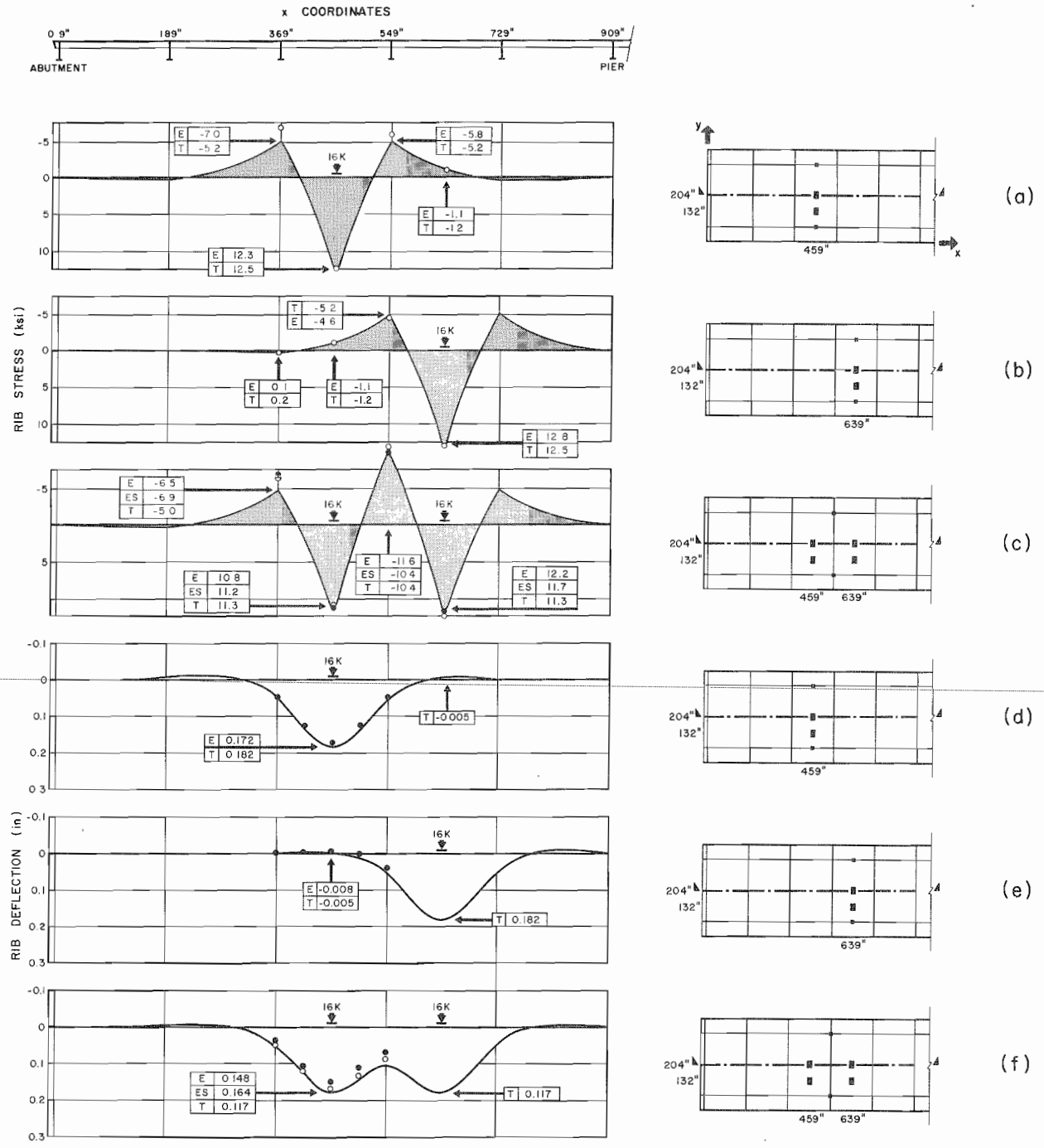
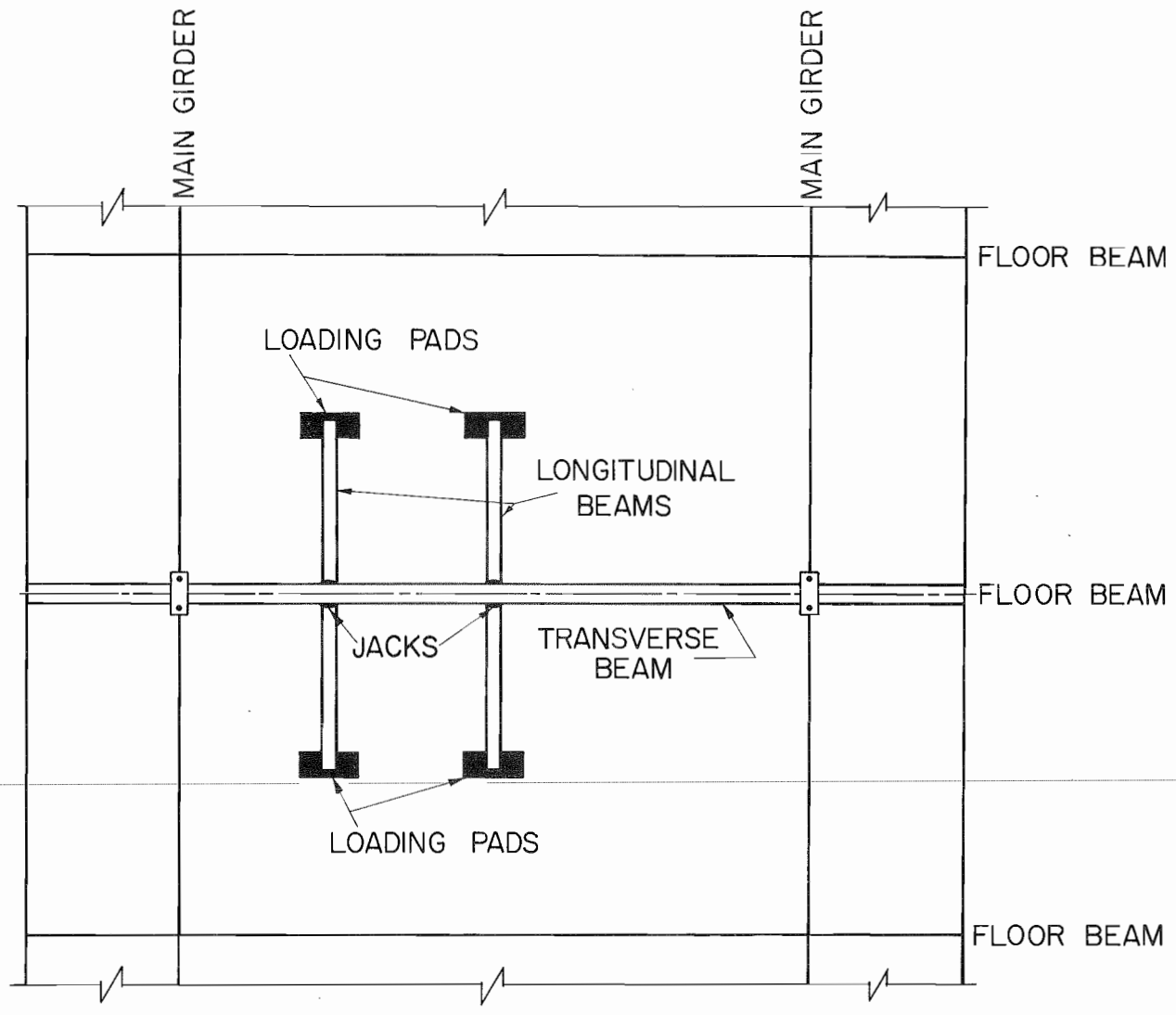
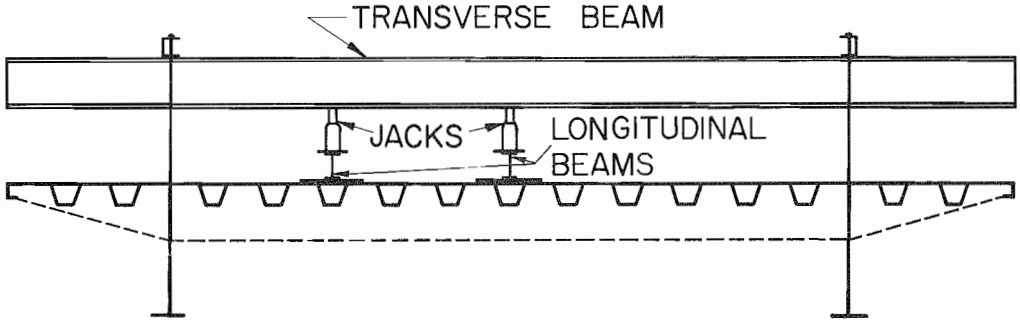


FIG. 58 RIB STRESSES AND DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.



PLAN



ELEVATION

FIG. 59 MODIFIED TYPE II LOADING

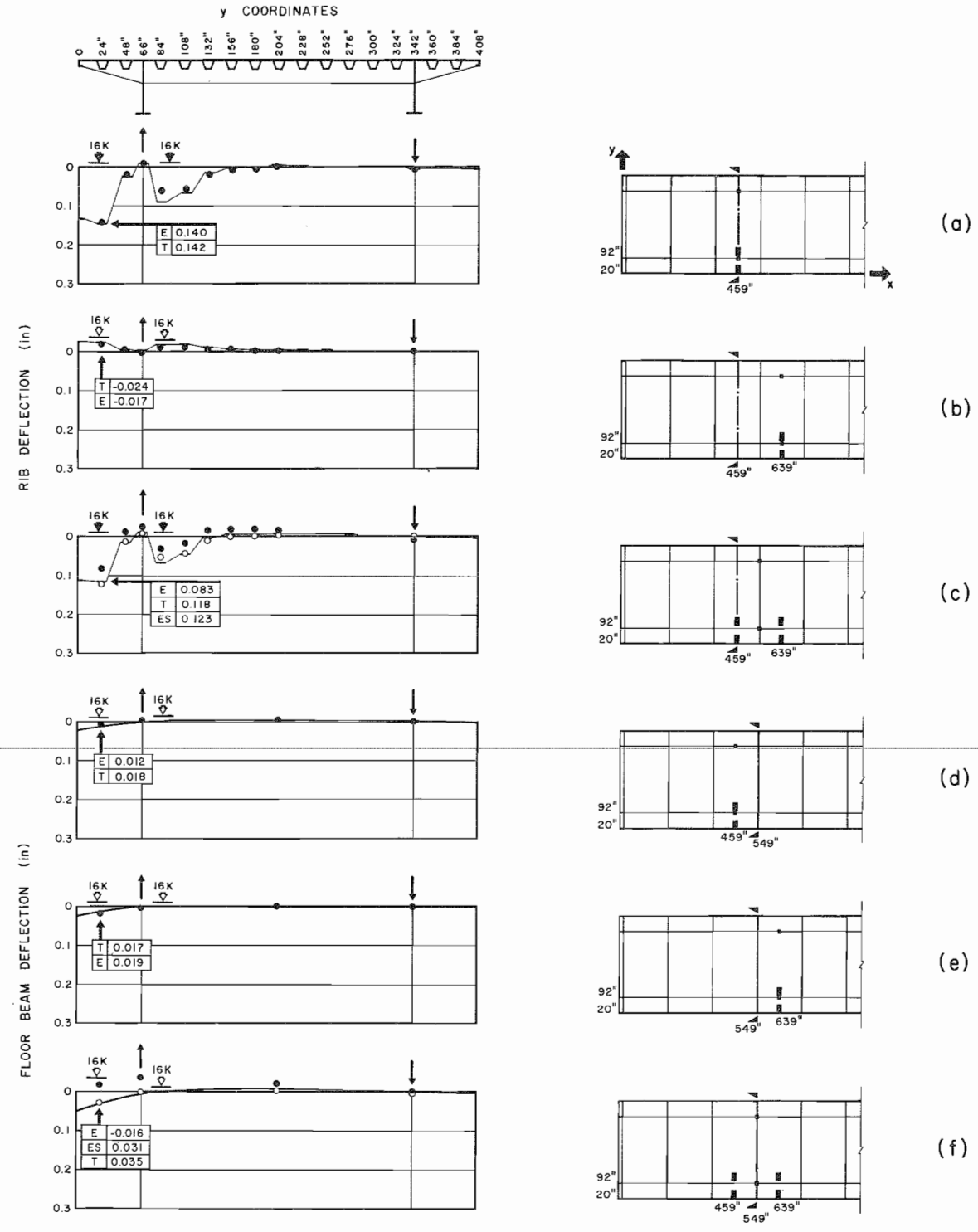
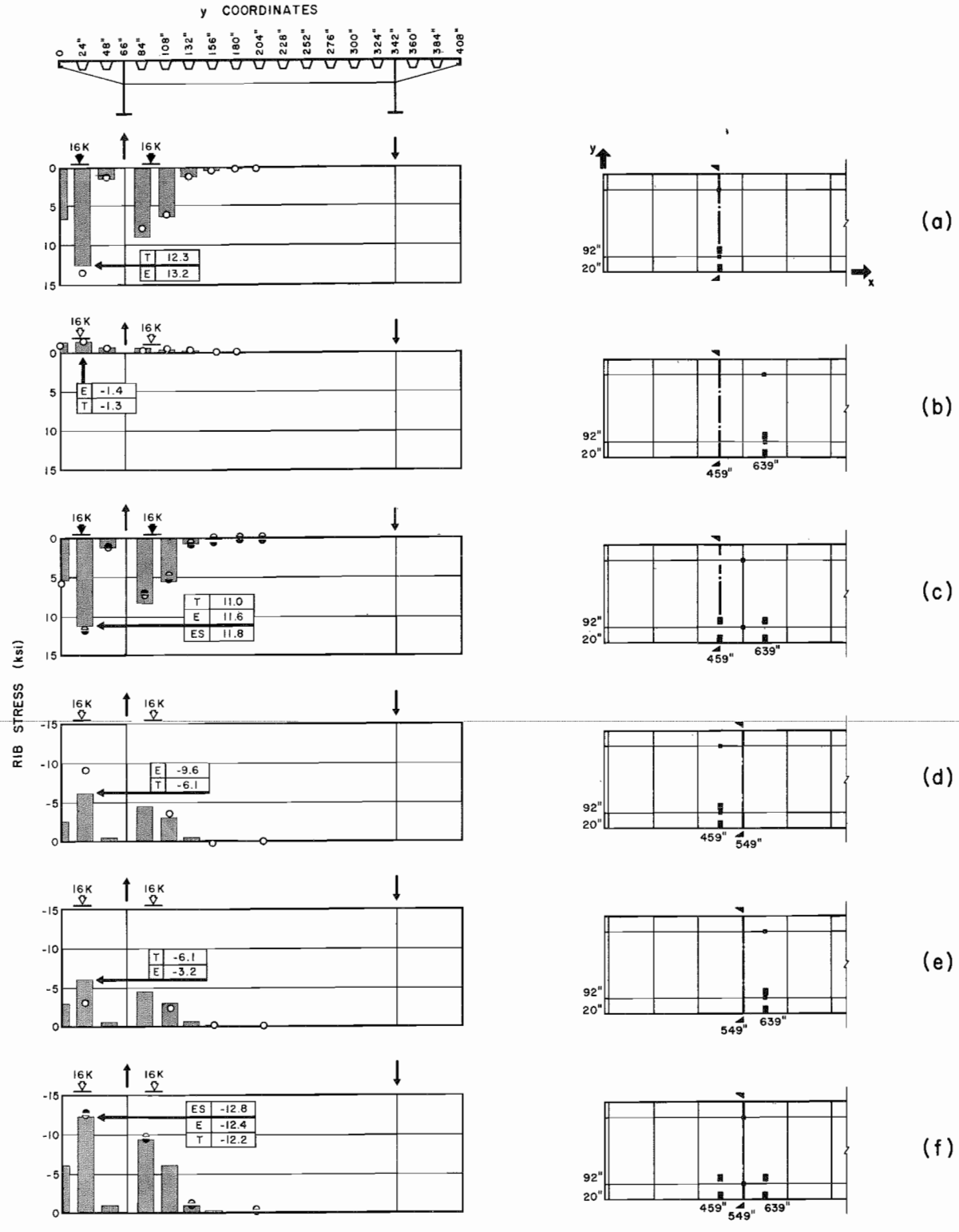


FIG. 60 RIB AND FLOOR BEAM DEFLECTIONS IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.



BARS = THEORETICAL STRESS · T = THEORY (ksi)

o o EXPERIMENTAL STRESS · E = EXPERIMENT (ksi)

● ● SUM OF TWO PREVIOUS EXPERIMENTAL STRESSES · ES = EXPERIMENTAL SUM (ksi)

GRID ANALYSIS

FIG. 61 RIB STRESSES IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

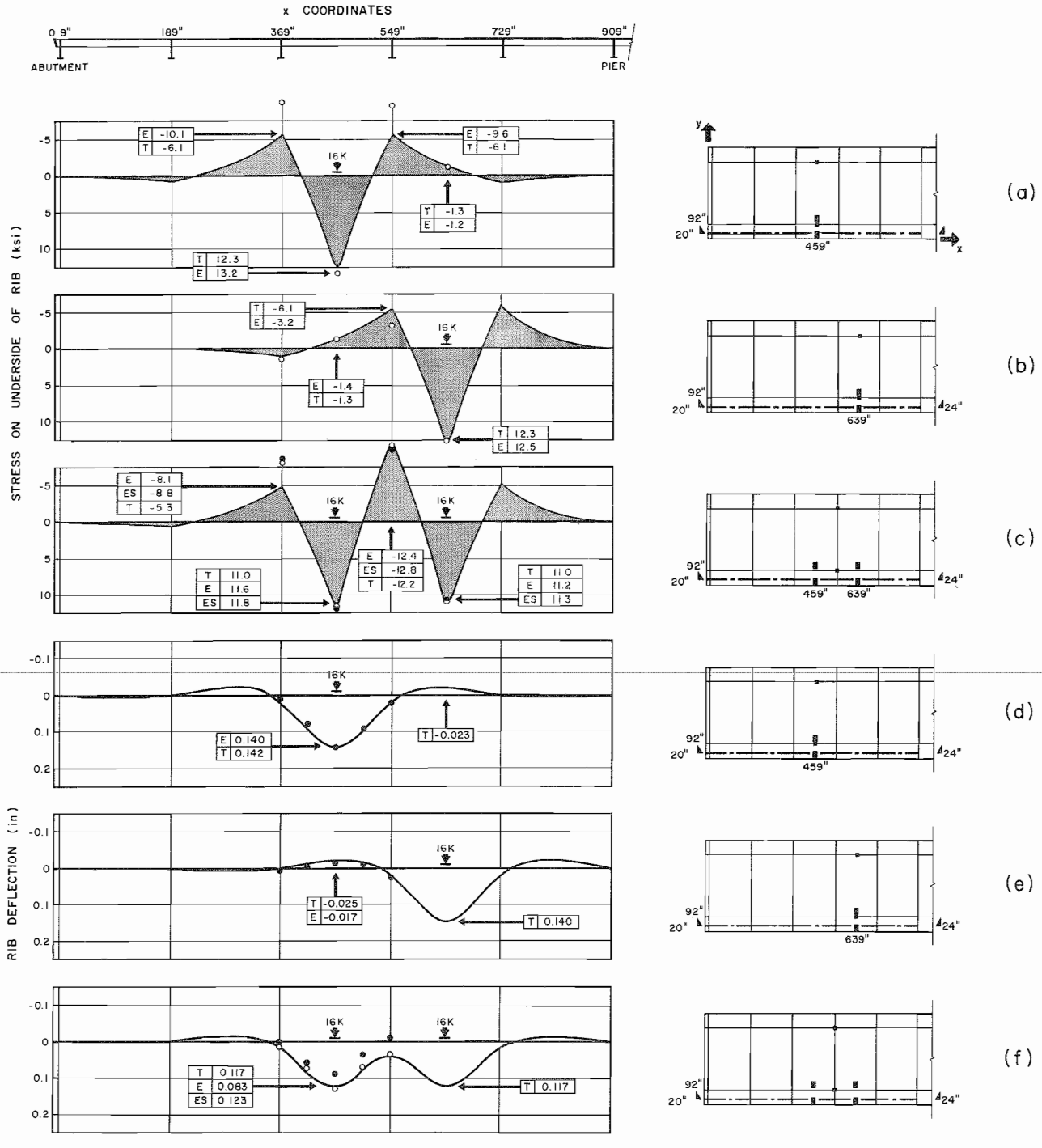


FIG. 62 RIB STRESSES AND DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

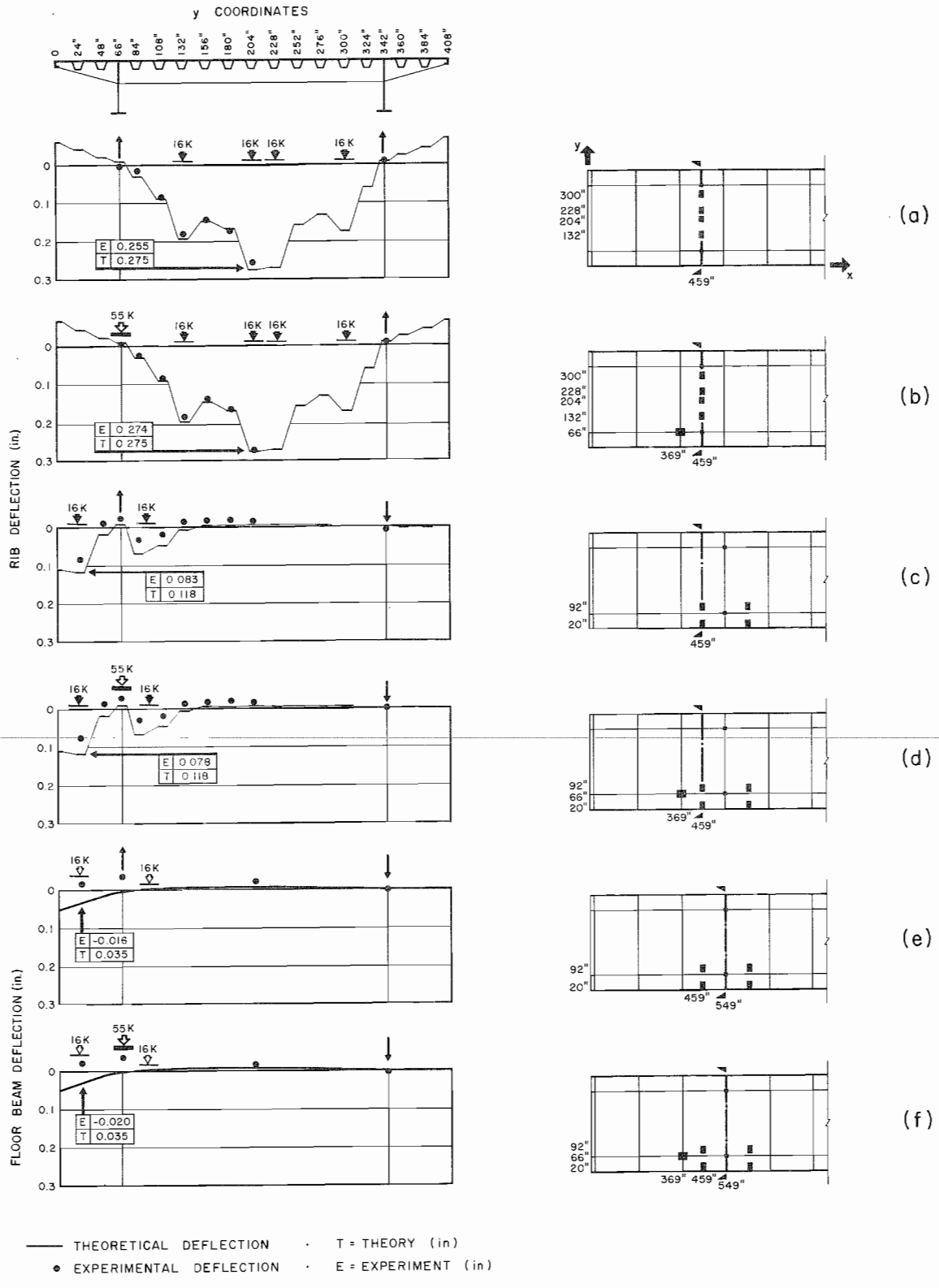


FIG. 63 RIB AND FLOOR BEAM DEFLECTIONS IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

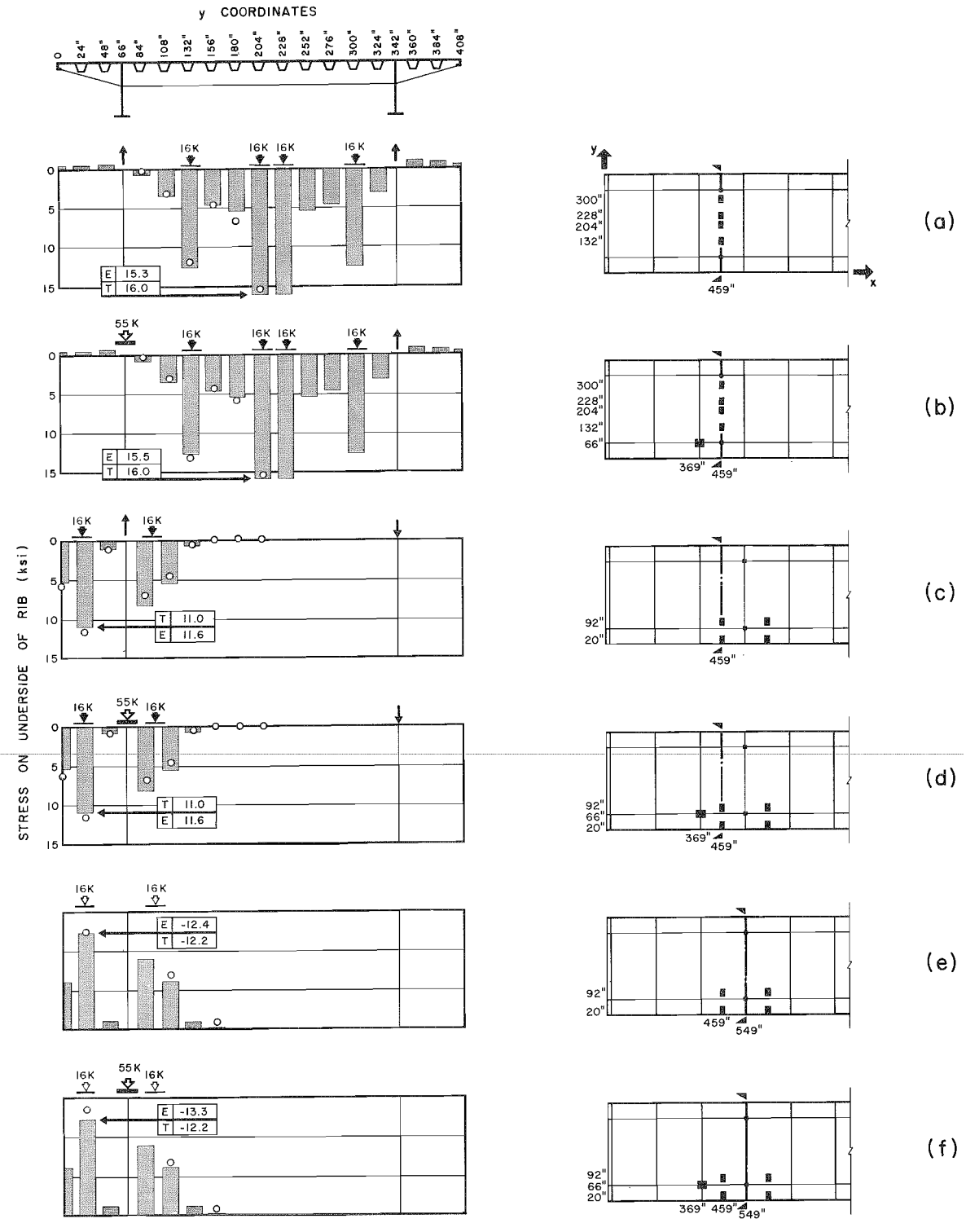


FIG. 64 RIB STRESSES IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE I.

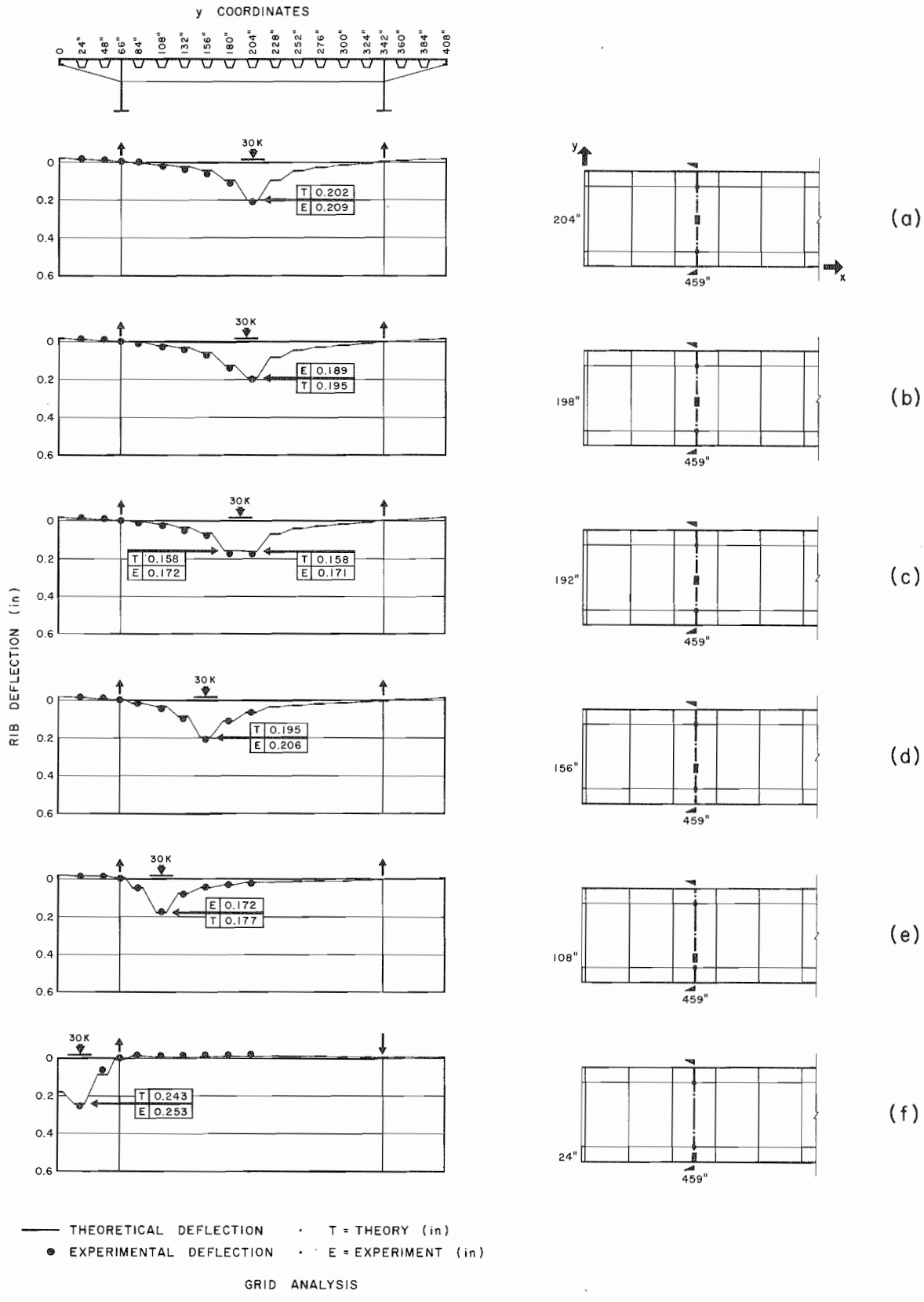


FIG. 65 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE II.

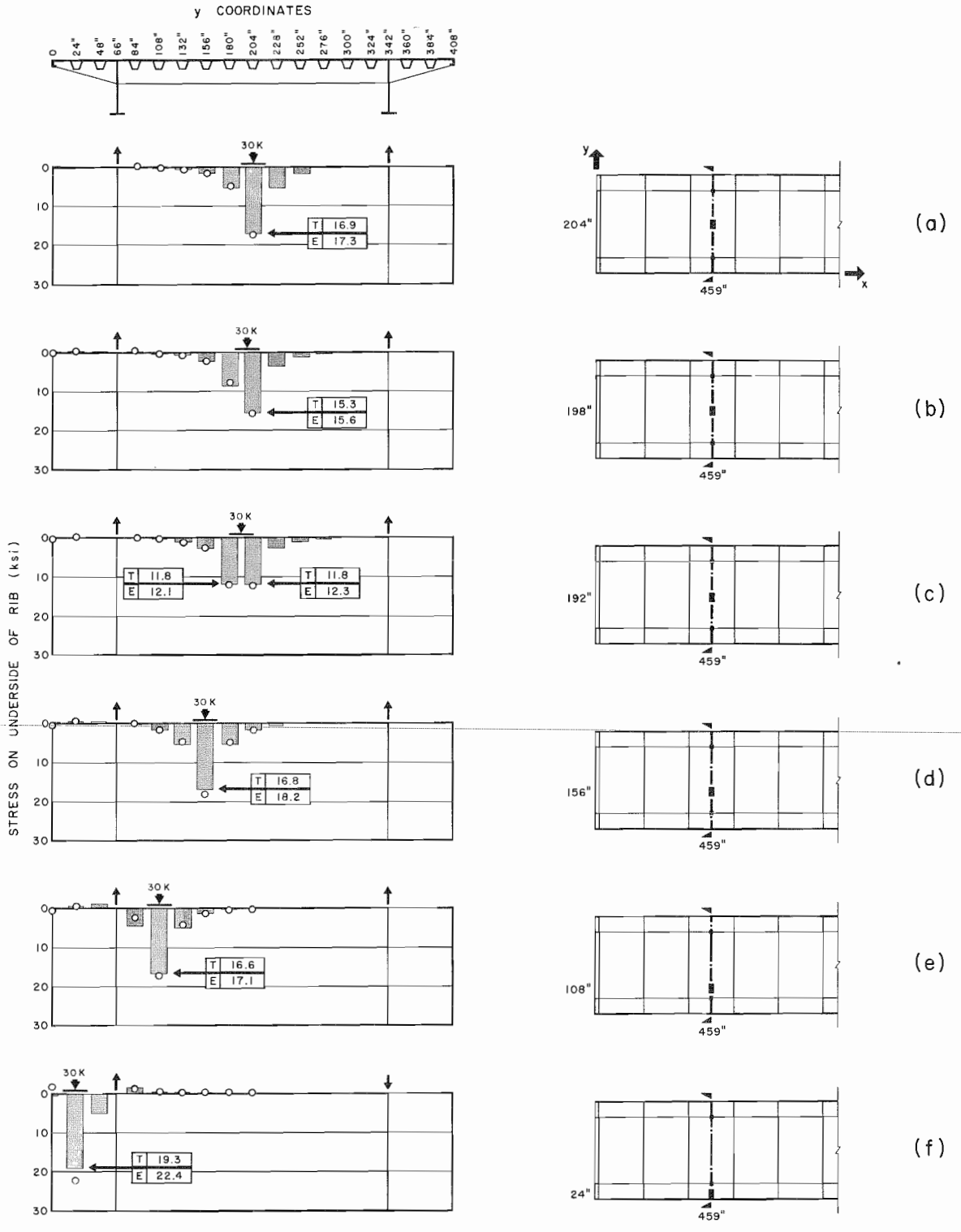


FIG. 66 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE II.

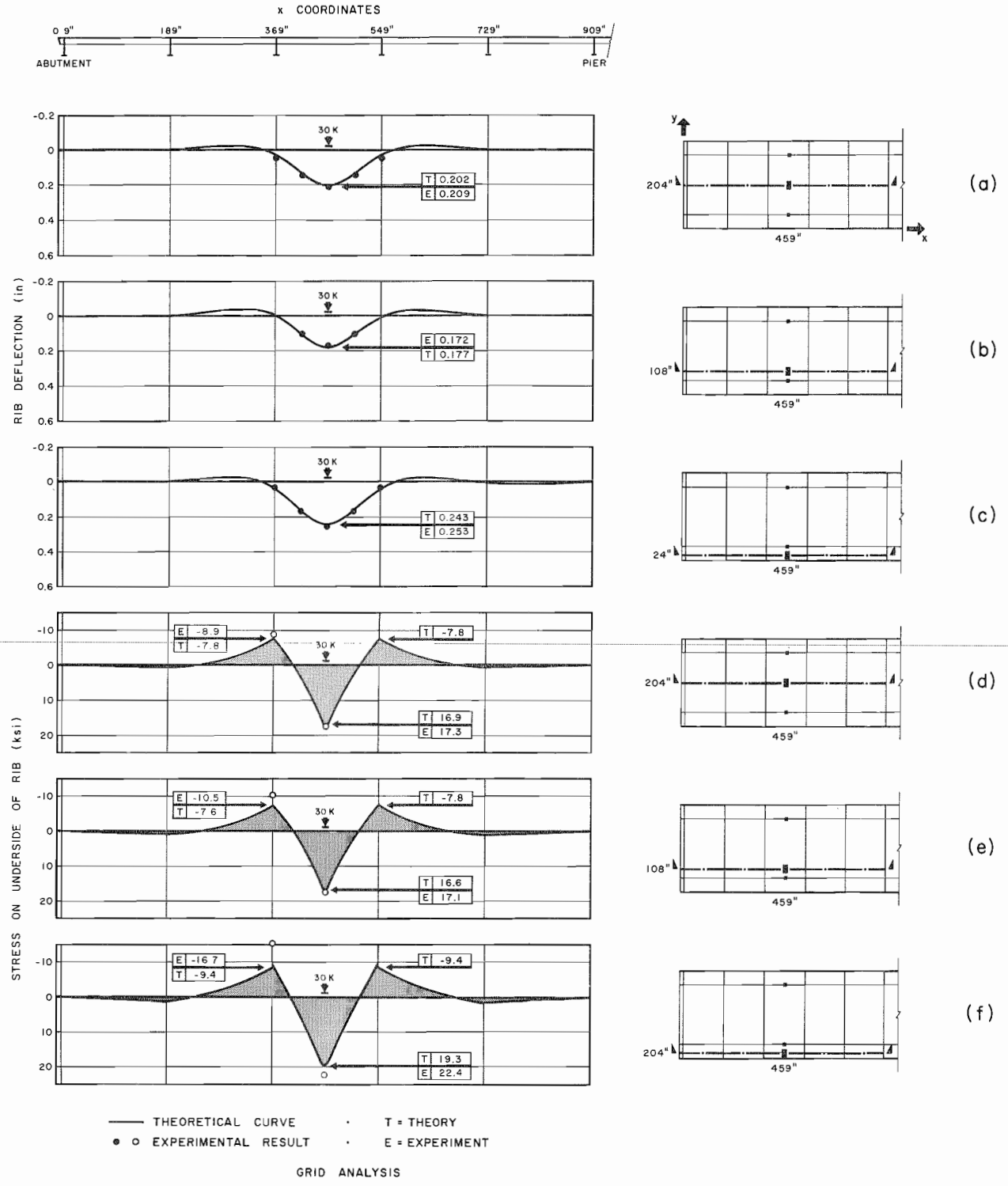


FIG. 67 RIB STRESSES AND DEFLECTIONS IN LONGITUDINAL SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGE II.

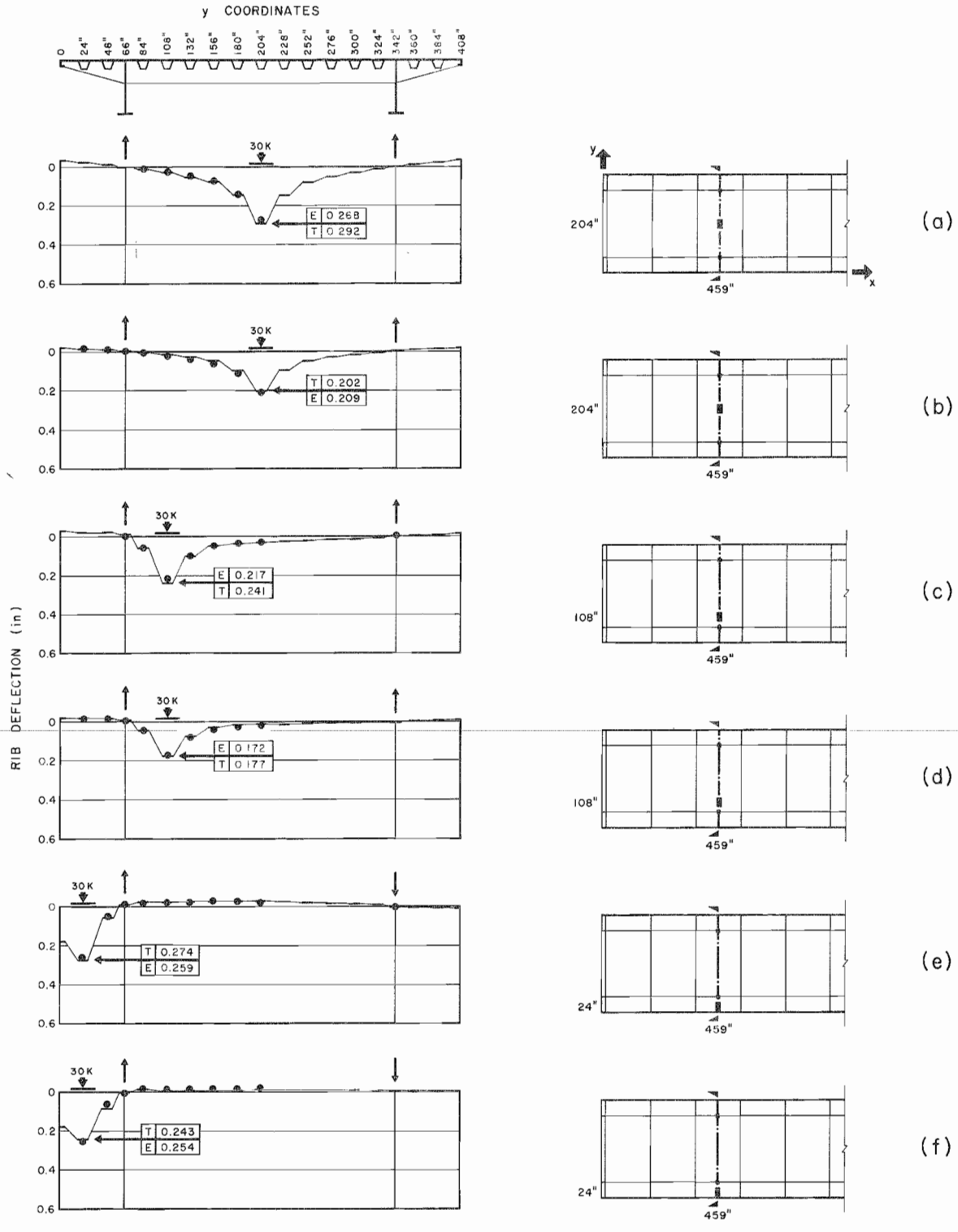


FIG. 68 RIB DEFLECTIONS IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGES I and II.

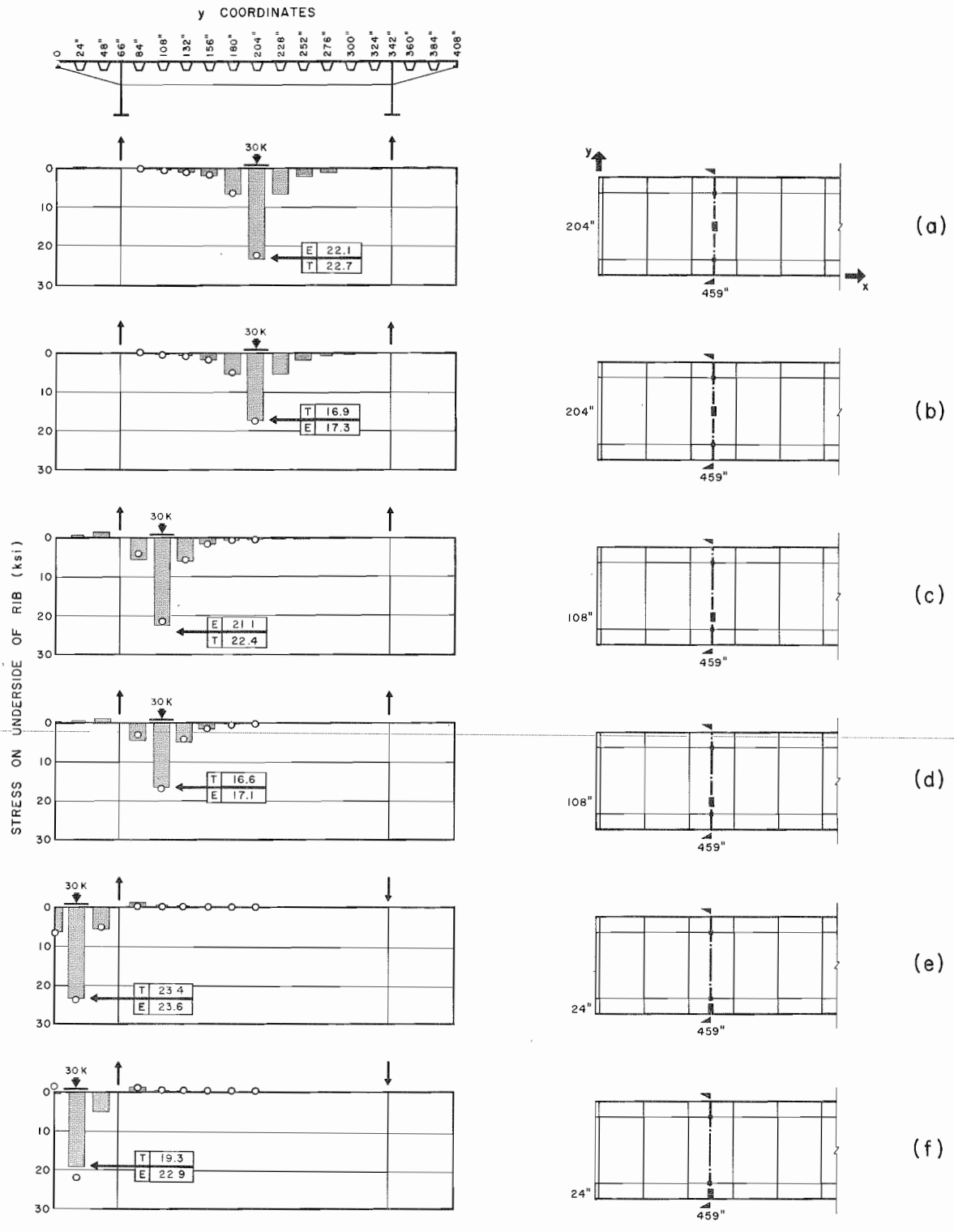


FIG. 69 RIB STRESSES IN TRANSVERSE SECTIONS UNDER SINGLE WHEEL LOADS, BRIDGES I and II

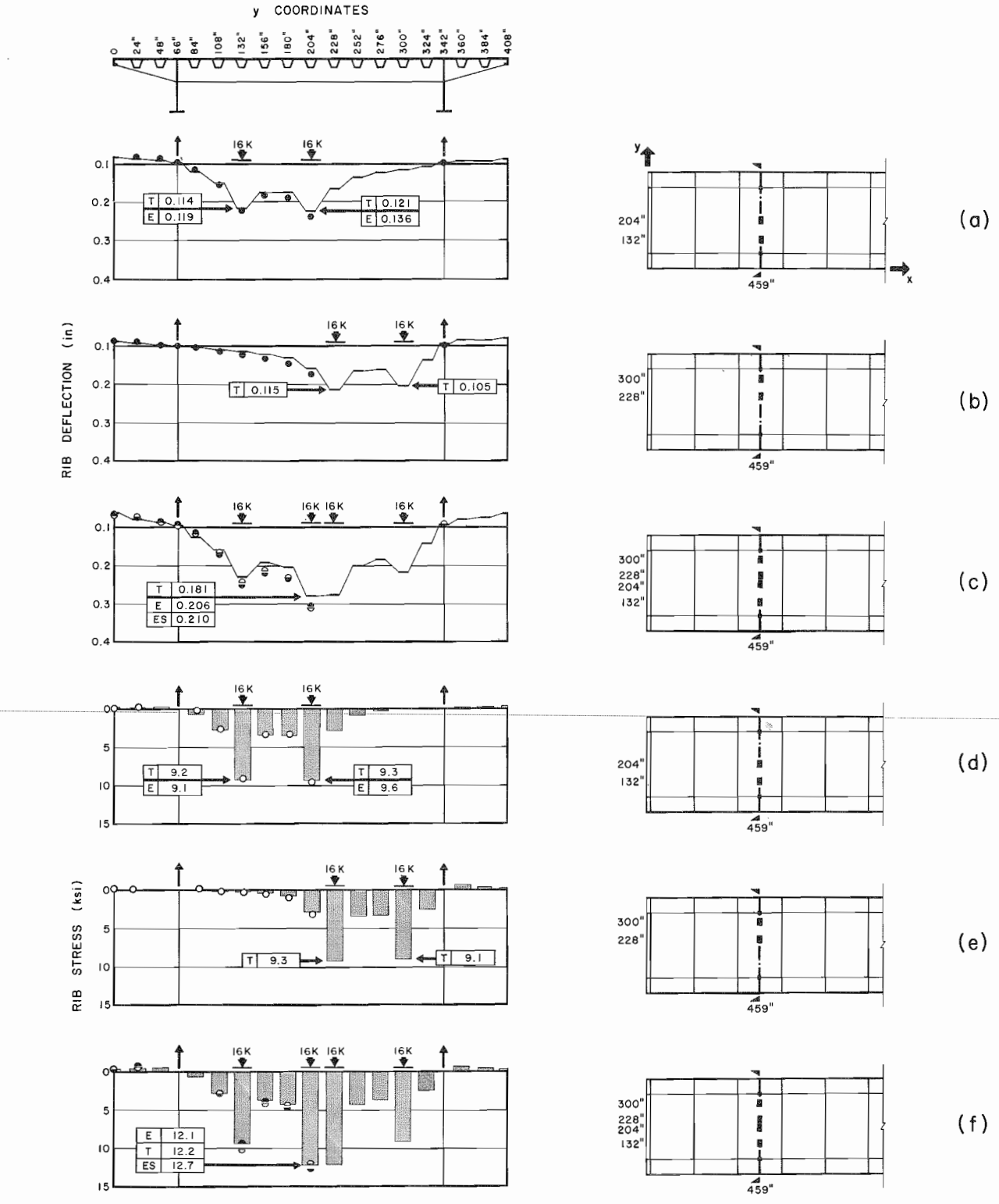


FIG. 70 RIB STRESSES AND DEFLECTIONS IN TRANSVERSE SECTIONS UNDER MULTIPLE WHEEL LOADS, BRIDGE II.

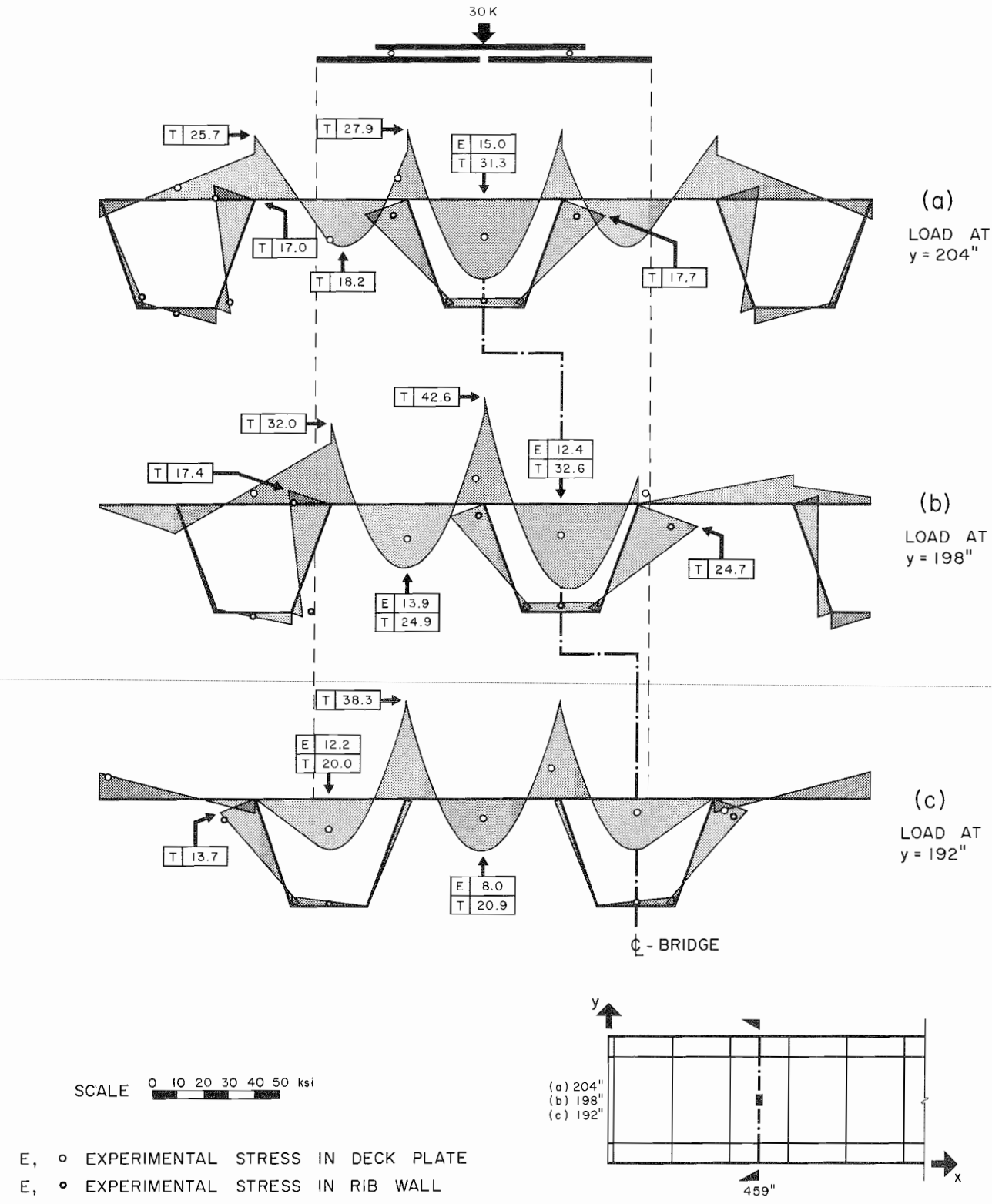


FIG. 71 TRANSVERSE BENDING STRESSES IN DECK PLATE AND RIB WALLS, BRIDGE I.

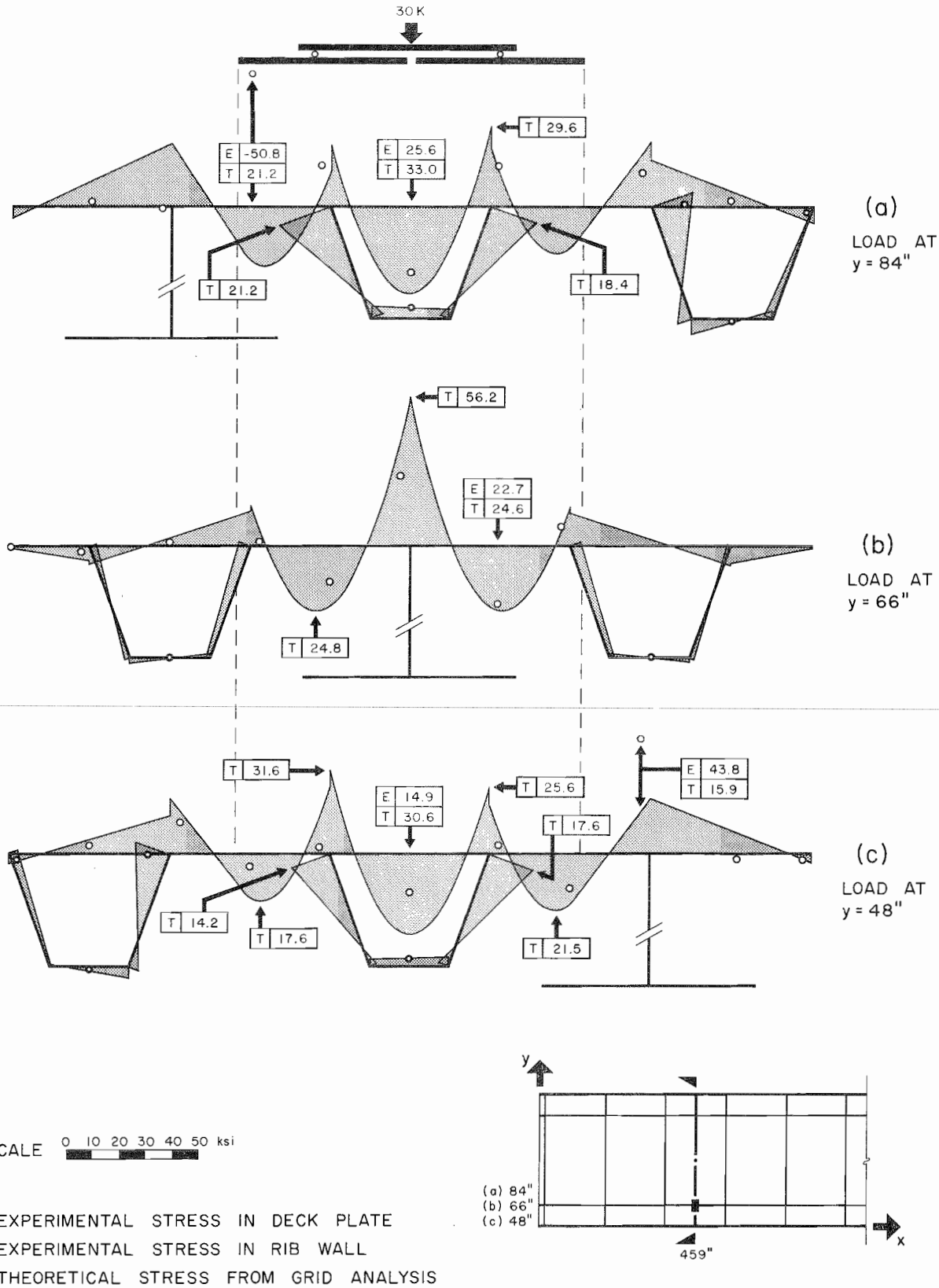


FIG. 72 TRANSVERSE BENDING STRESSES IN DECK PLATE AND RIB WALLS, BRIDGE I.

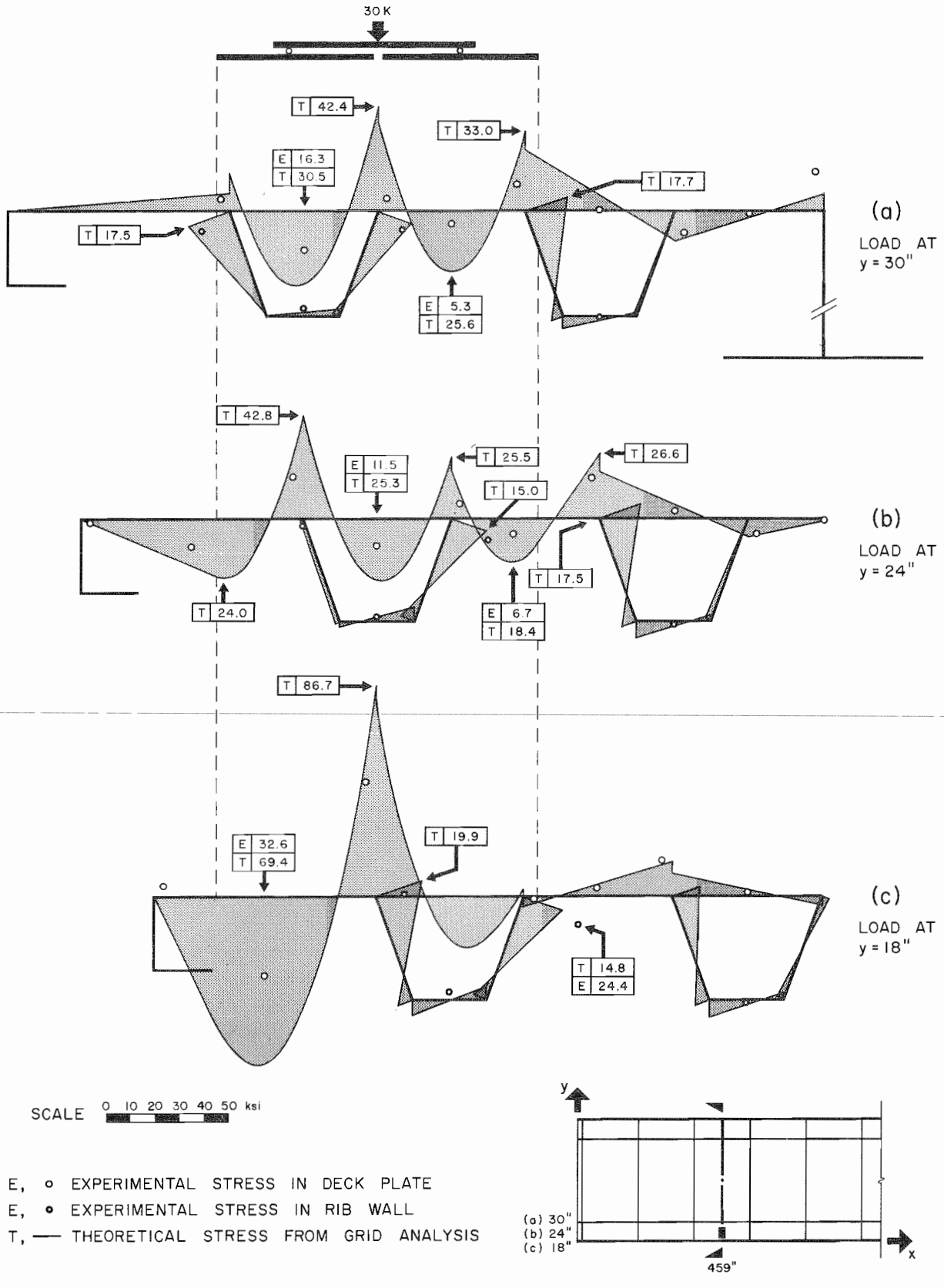
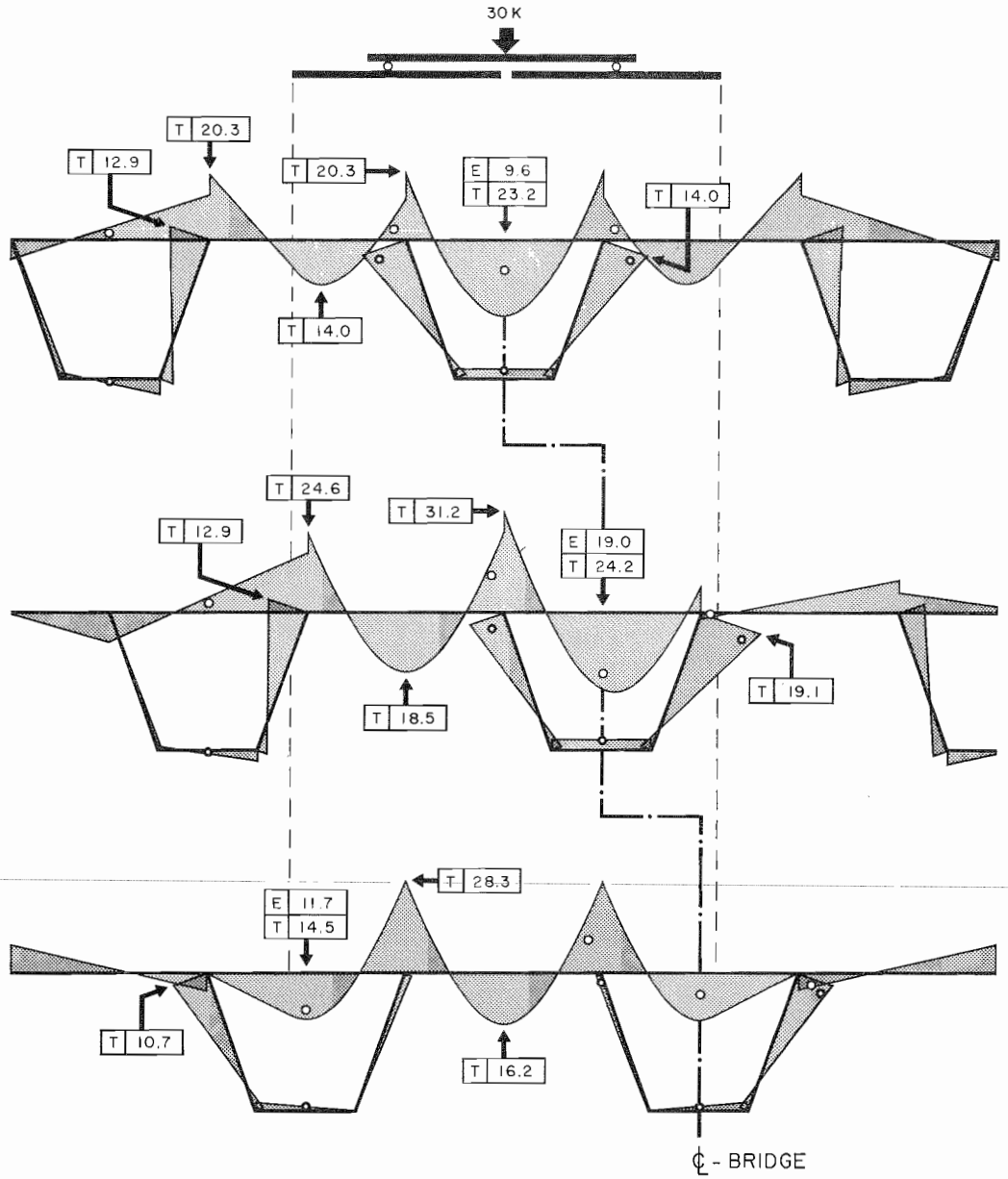
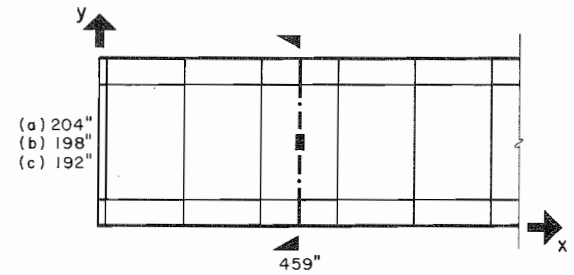


FIG. 73 TRANSVERSE BENDING STRESSES IN DECK PLATE AND RIB WALLS, BRIDGE I.





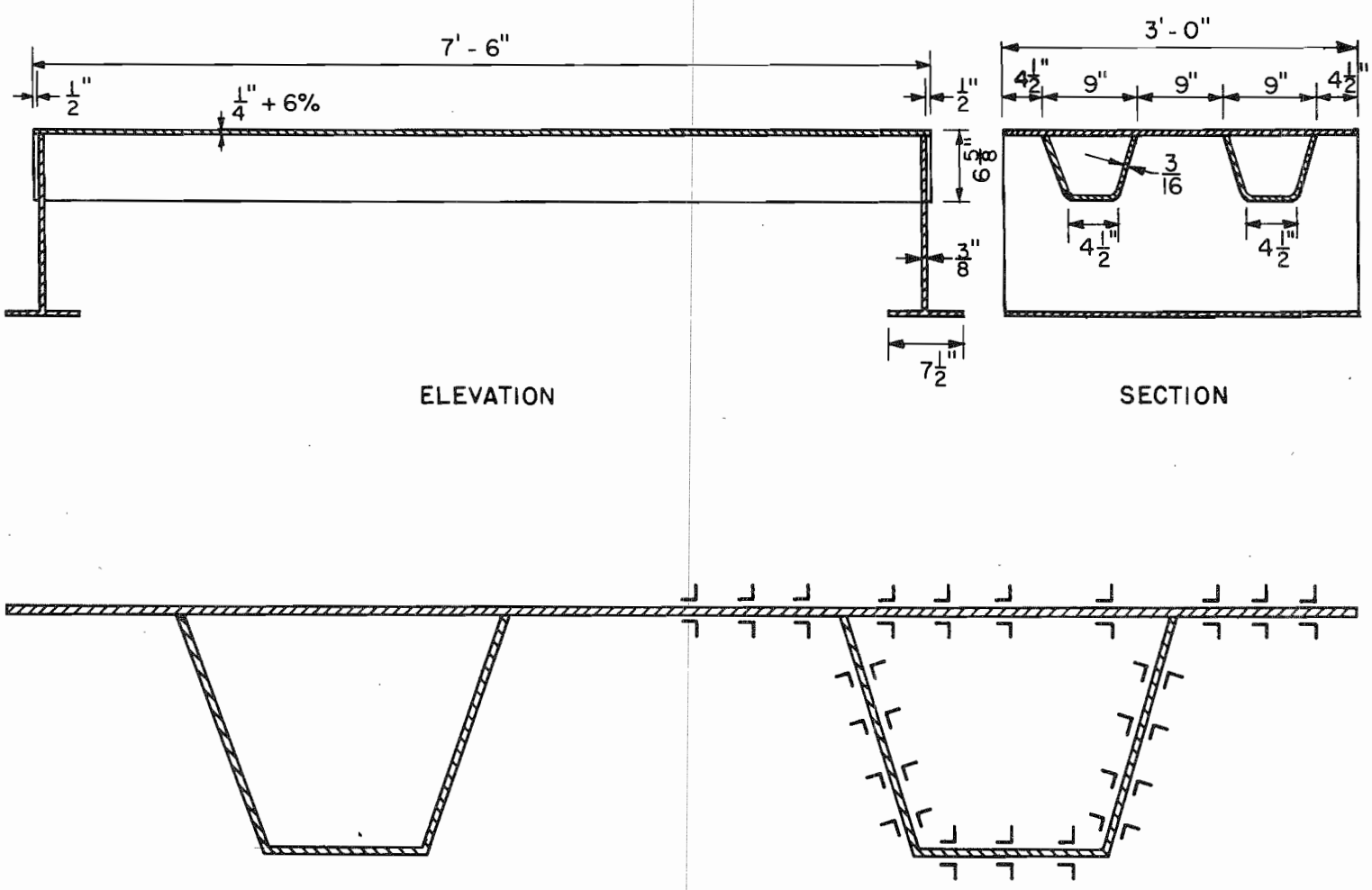
SCALE 0 10 20 30 40 50 ksi

E, ○ EXPERIMENTAL STRESS IN DECK PLATE

E, ○ EXPERIMENTAL STRESS IN RIB WALL

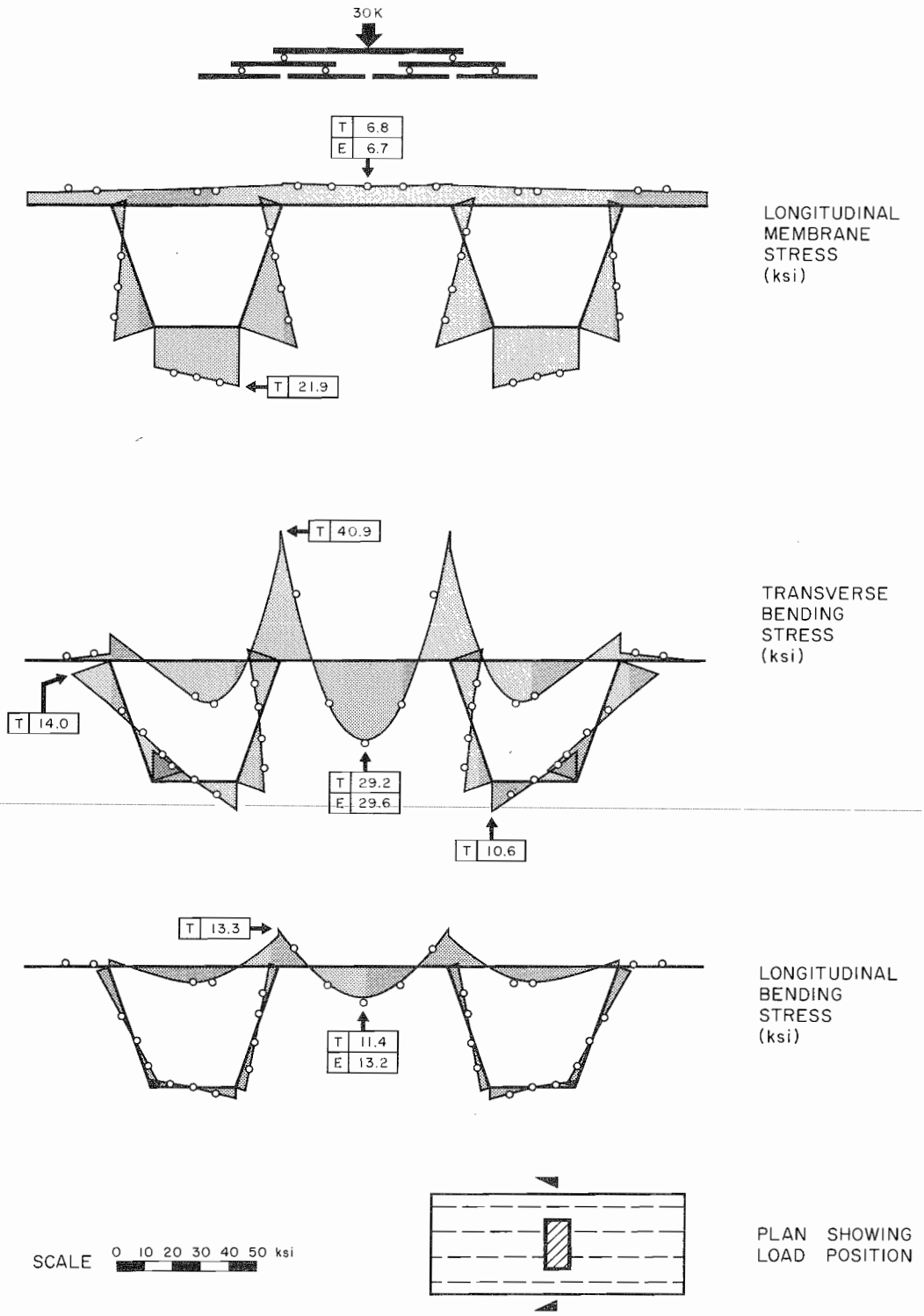
T, — THEORETICAL STRESS FROM GRID ANALYSIS

FIG. 74 TRANSVERSE BENDING STRESSES IN DECK PLATE AND RIB WALLS, BRIDGE II.



SECTION SHOWING GAGE POSITIONS

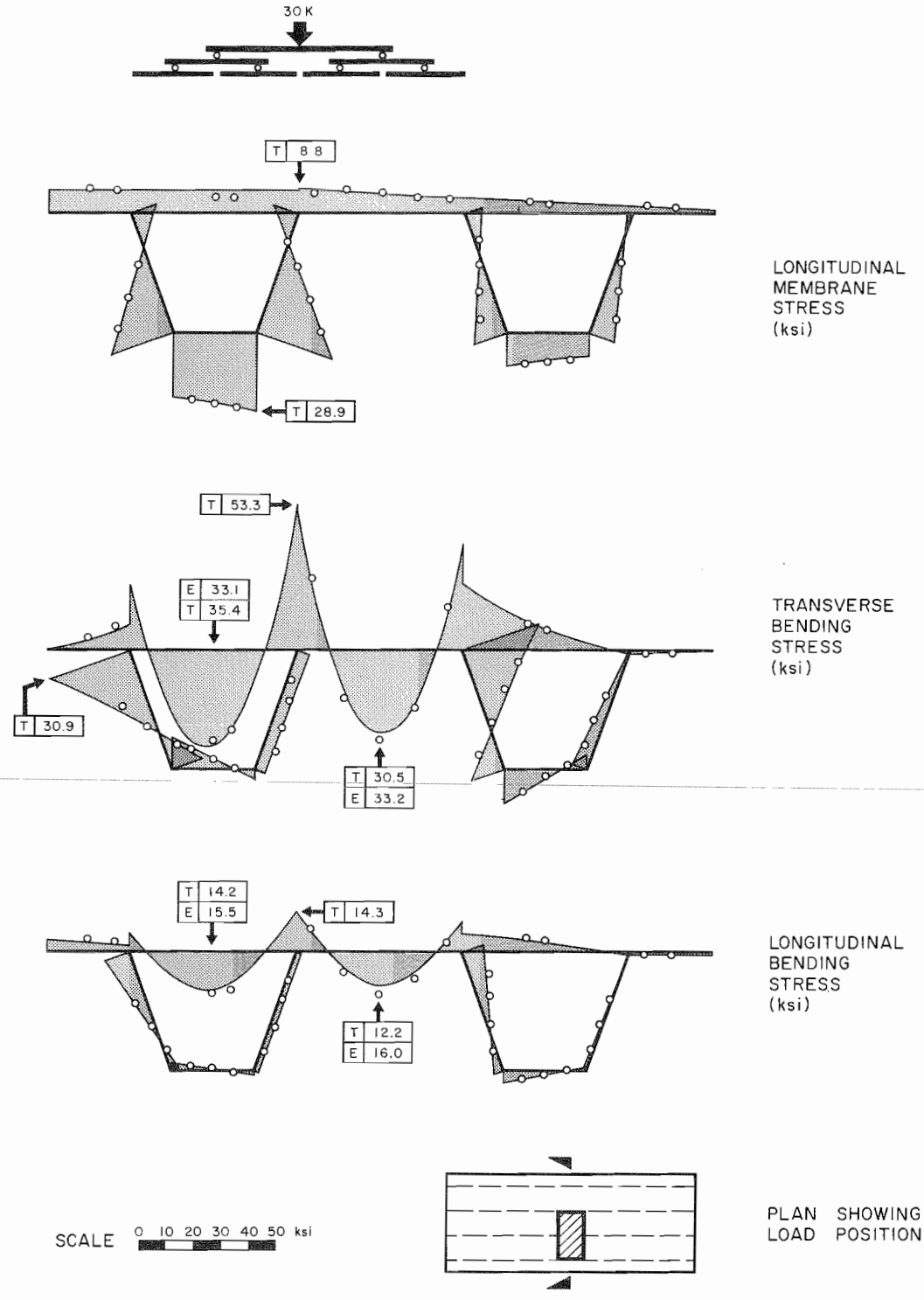
FIG. 75 MODEL OF ORTHOTROPIC DECK



E, o EXPERIMENTAL STRESS

T, —— THEORETICAL STRESS FROM FOLDED PLATE ANALYSIS

FIG. 76 STRESSES IN DECK PLATE AND RIB WALLS, MODEL OF BRIDGE I.



E, ○ EXPERIMENTAL STRESS

T, —— THEORETICAL STRESS FROM FOLDED PLATE ANALYSIS

FIG. 77 STRESSES IN DECK PLATE AND RIB WALLS, MODEL OF BRIDGE I.

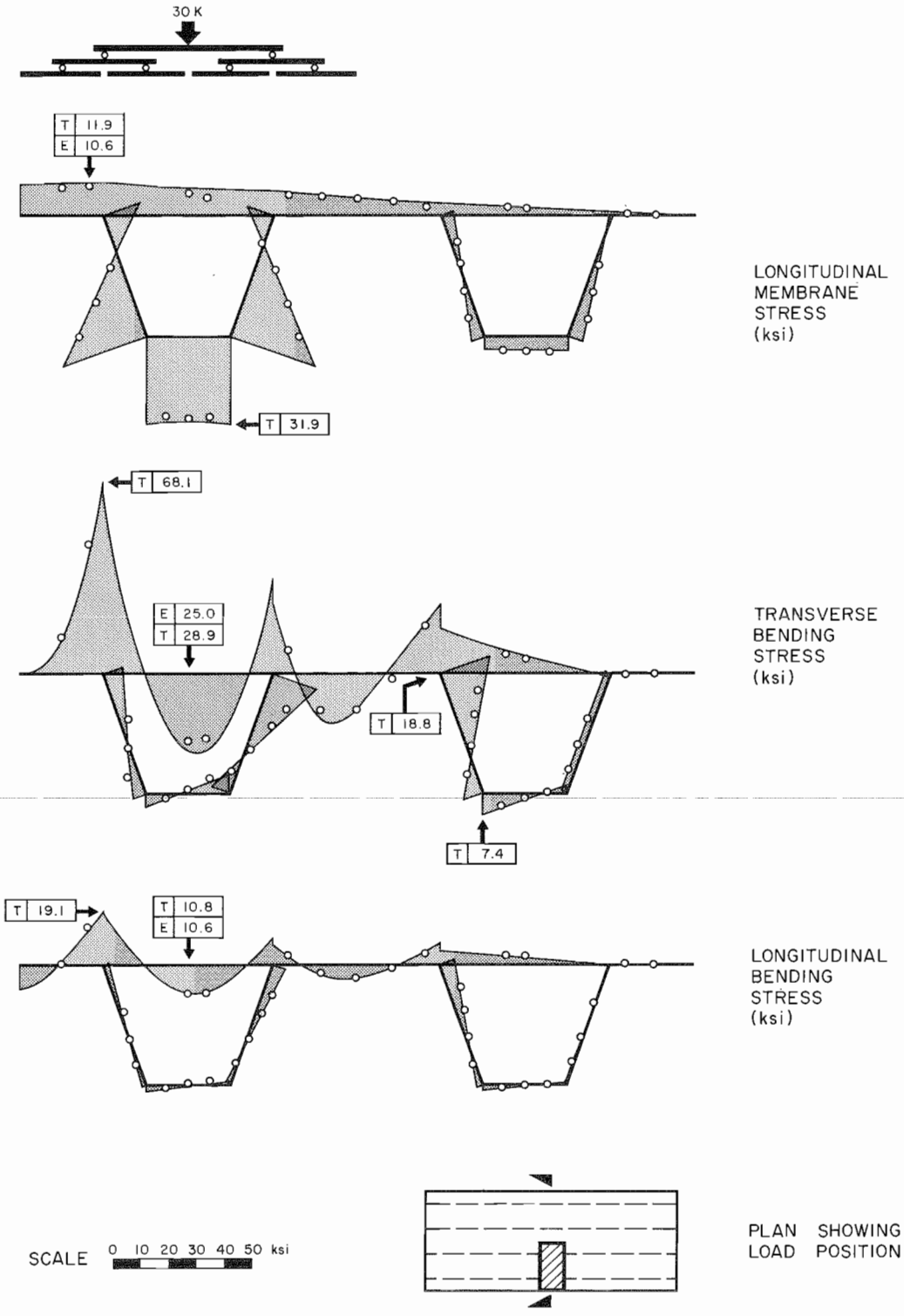


FIG. 78 STRESSES IN DECK PLATE AND RIB WALLS, MODEL OF BRIDGE I.

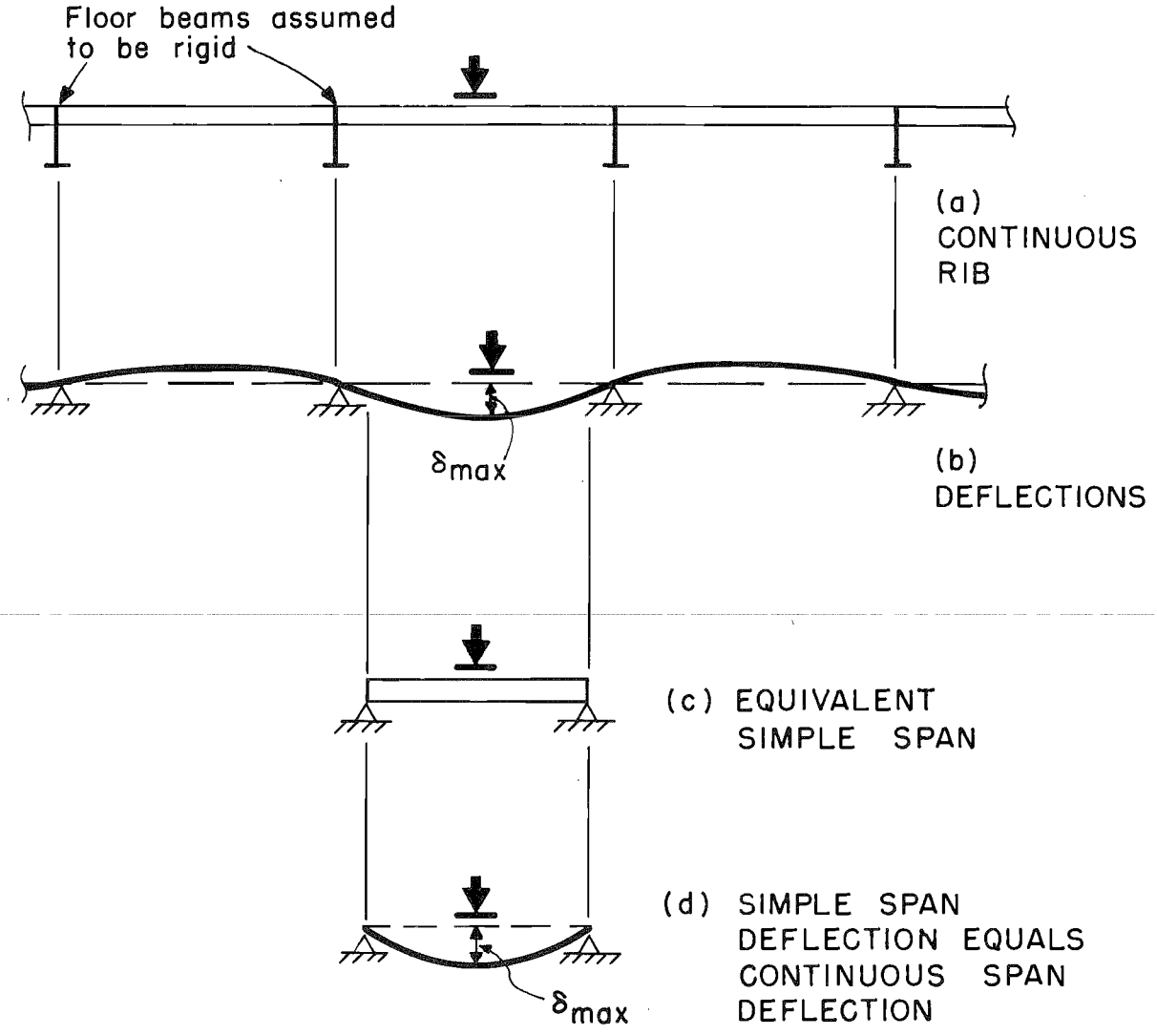


FIG. 79 DETERMINATION OF EQUIVALENT SPAN FOR FOLDED PLATE ANALYSIS.

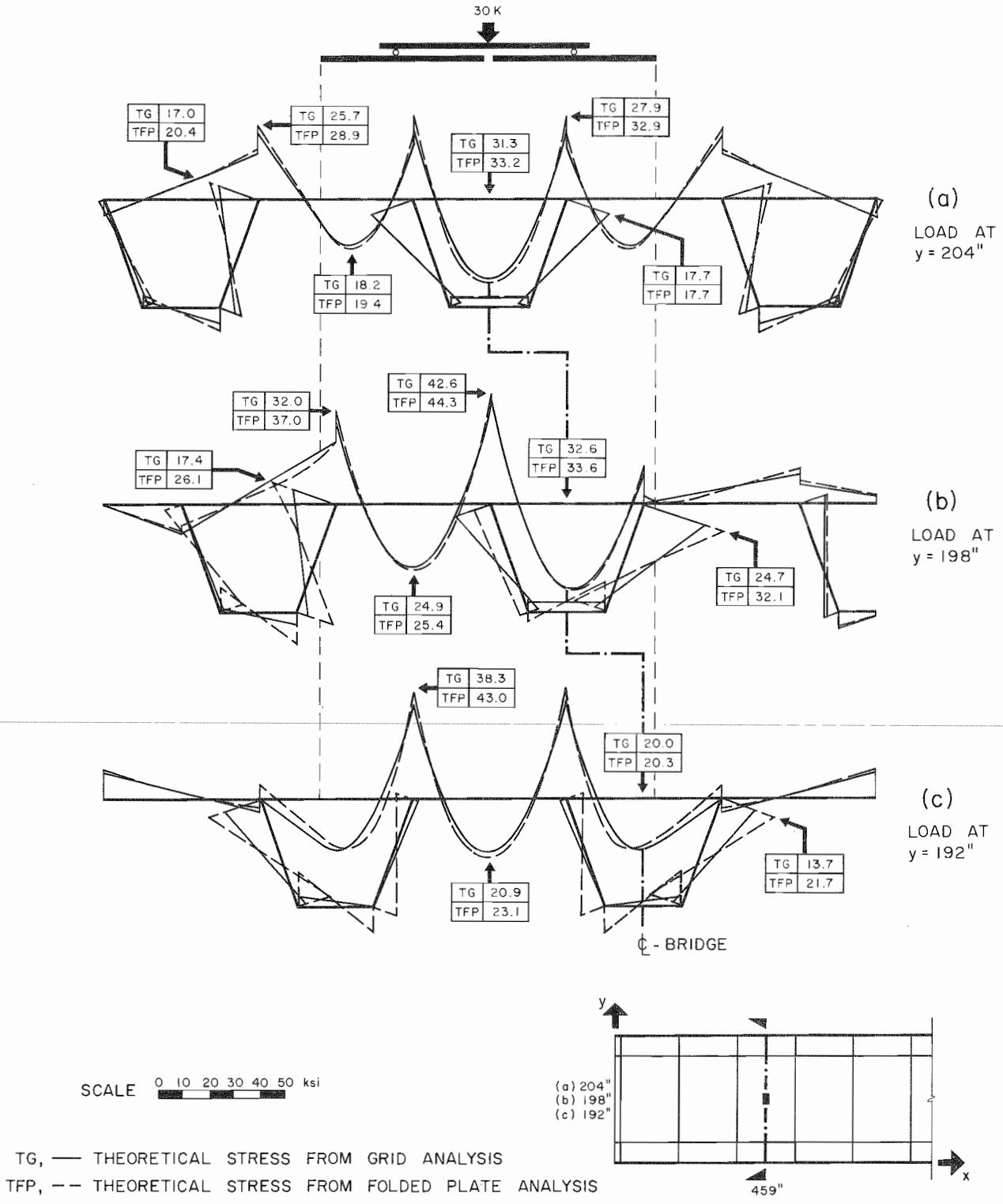


FIG. 80 TRANSVERSE BENDING STRESSES IN DECK PLATE AND RIB WALLS, BRIDGE I, COMPARISON OF TWO THEORIES.

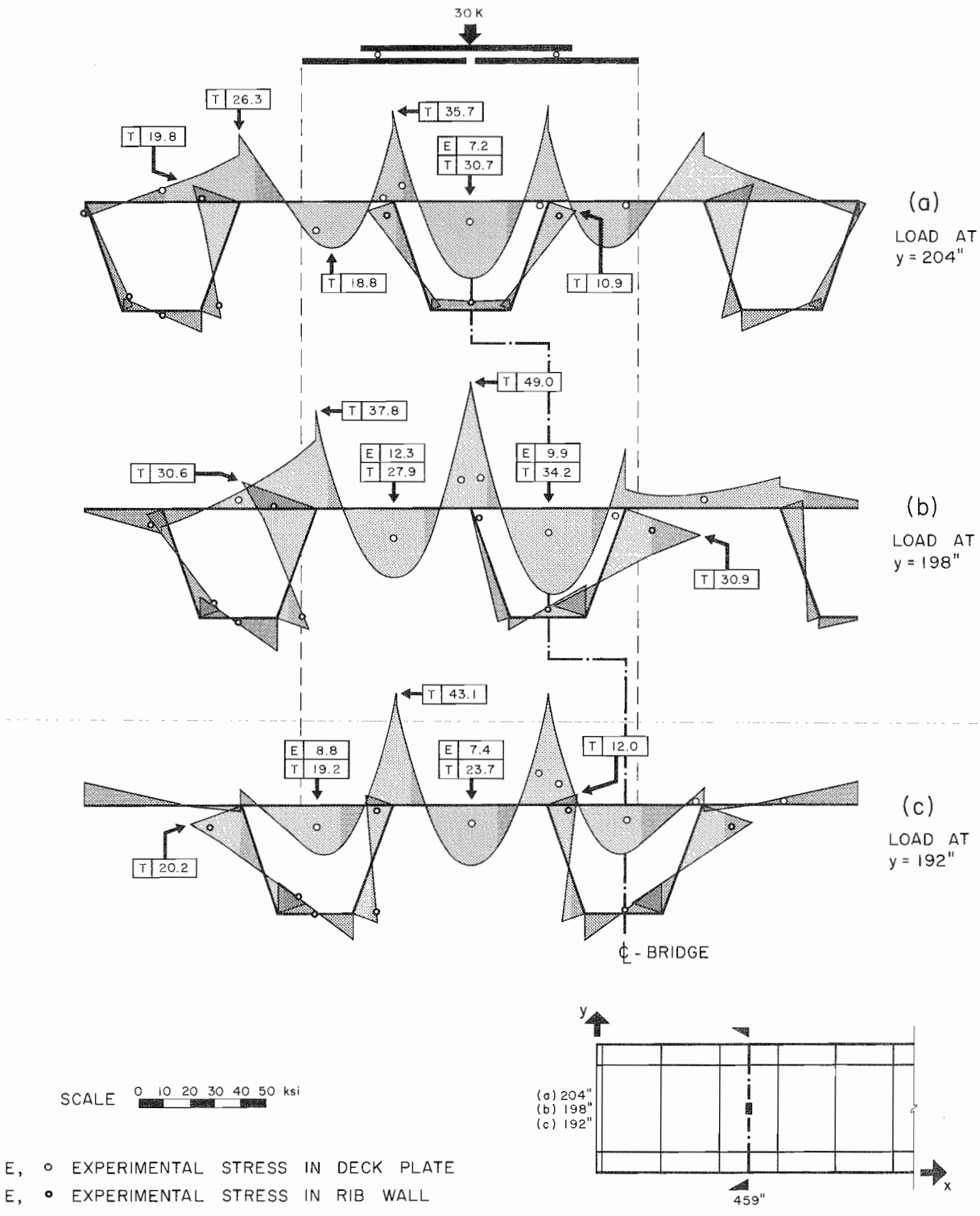


FIG. 81 TRANSVERSE STRESSES ON TOP SURFACE OF DECK PLATE AND OUTER SURFACE OF RIB WALLS, BRIDGE I.

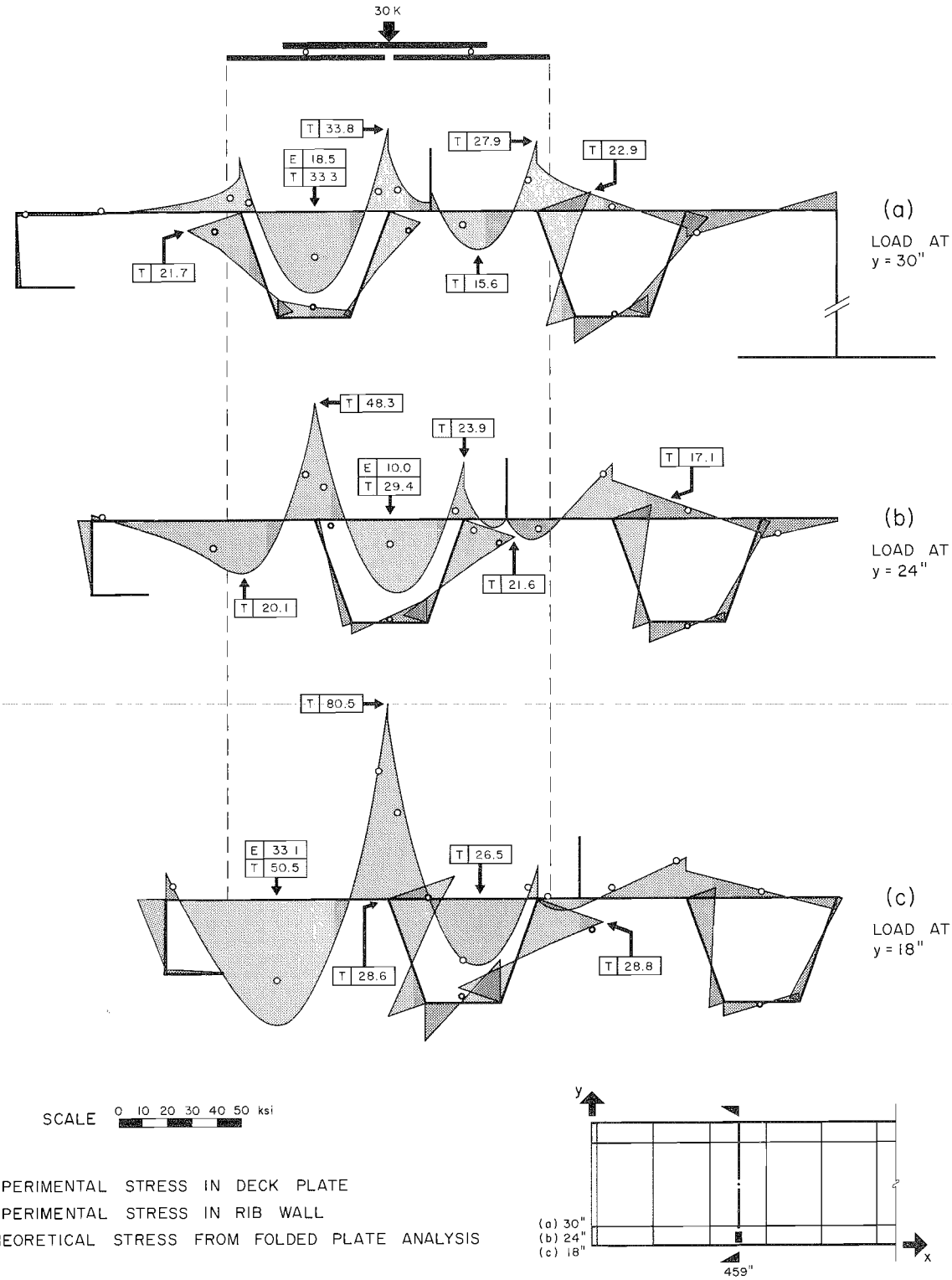


FIG. 82 TRANSVERSE STRESSES ON TOP SURFACE OF DECK PLATE AND OUTER SURFACE OF RIB WALLS, BRIDGE I.

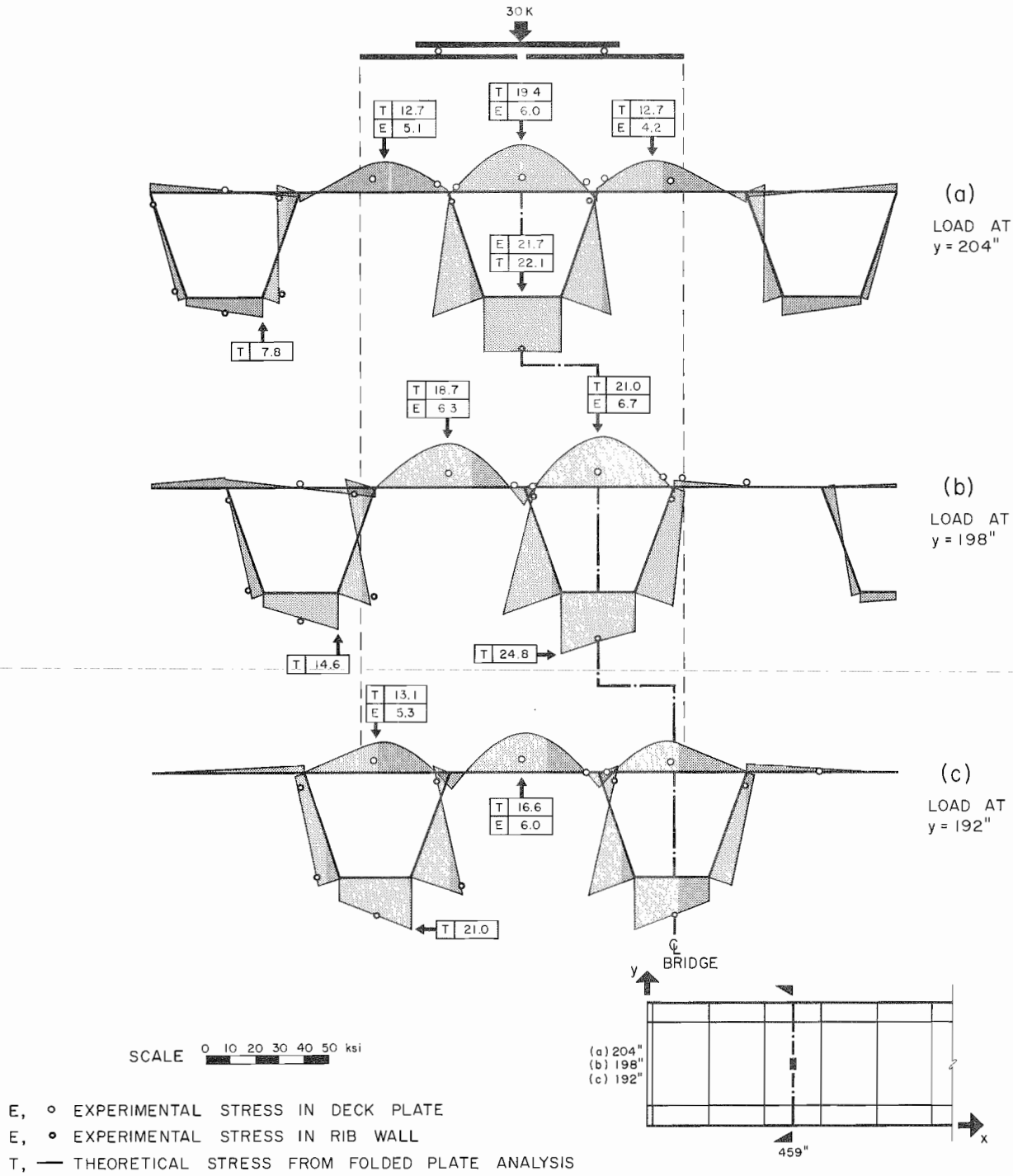


FIG. 83 LONGITUDINAL STRESSES ON TOP SURFACE OF DECK PLATE AND OUTER SURFACE OF RIB WALLS, BRIDGE I.

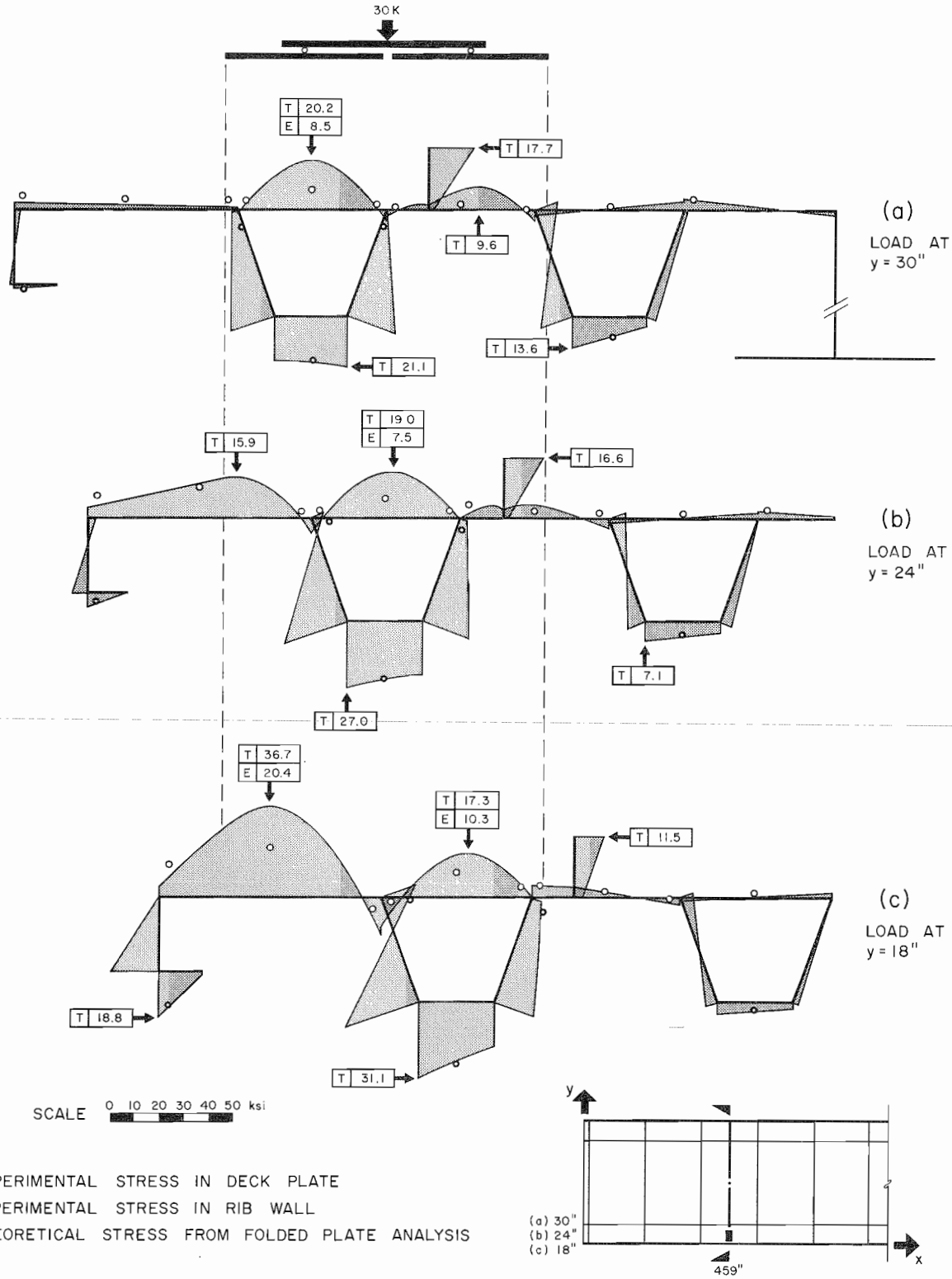


FIG. 84 LONGITUDINAL STRESSES ON TOP SURFACE OF DECK PLATE AND OUTER SURFACE OF RIB WALLS, BRIDGE I.

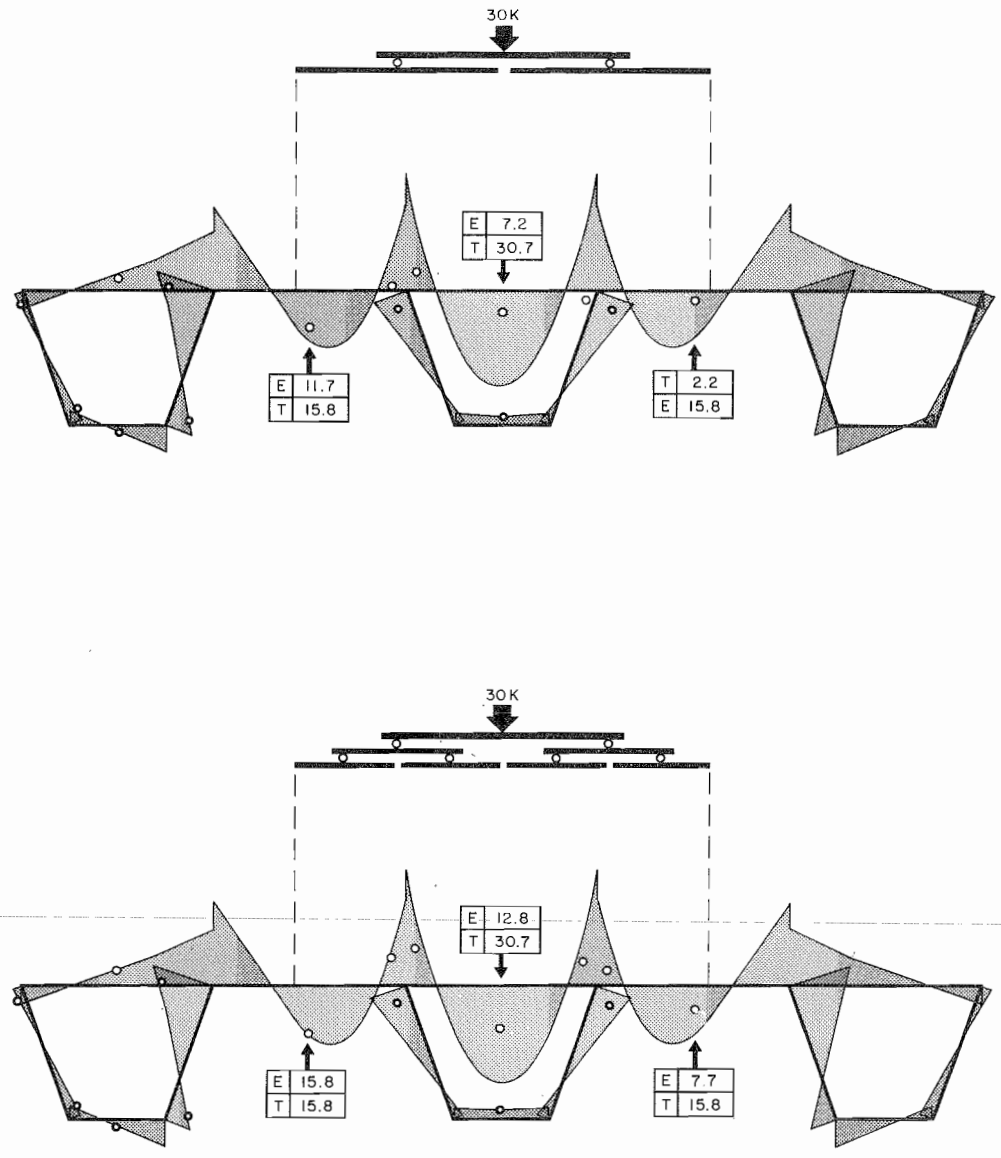
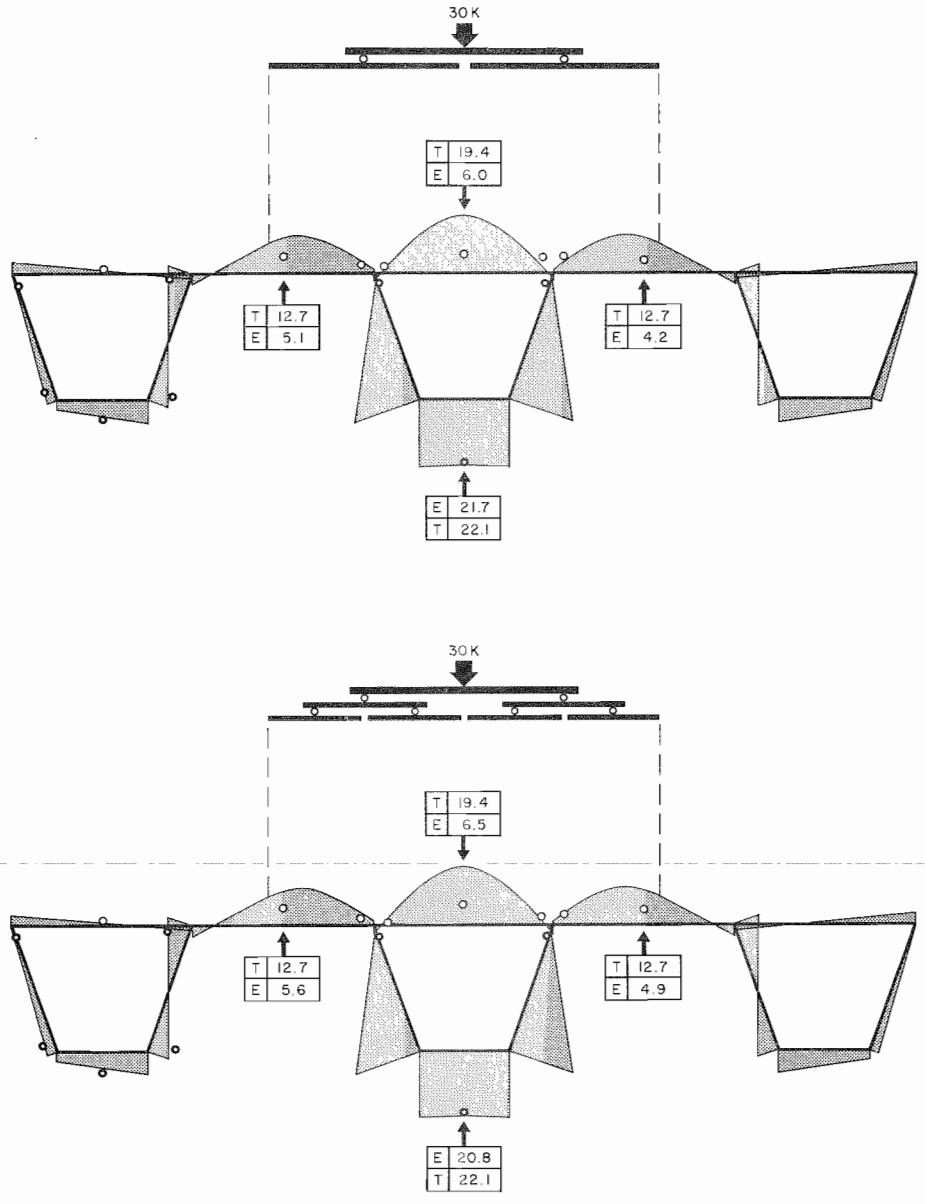
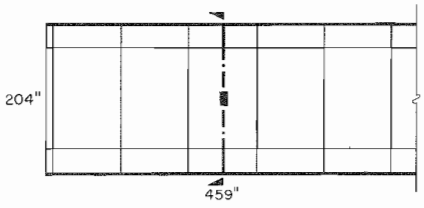


FIG. 85 TRANSVERSE STRESSES ON TOP SURFACE OF DECK PLATE AND OUTER SURFACE OF RIB WALLS. COMPARISON OF TWO AND FOUR PLATE LOADING SYSTEMS. BRIDGE I.





SCALE 0 10 20 30 40 50 ksi

E, ○ EXPERIMENTAL STRESS IN DECK PLATE
E, ● EXPERIMENTAL STRESS IN RIB WALL
T, — THEORETICAL STRESS FROM FOLDED PLATE ANALYSIS

FIG. 86 LONGITUDINAL STRESSES ON TOP SURFACE OF DECK PLATE AND OUTER SURFACE OF RIB WALLS. COMPARISON OF TWO AND FOUR PLATE LOADING SYSTEMS. BRIDGE I.

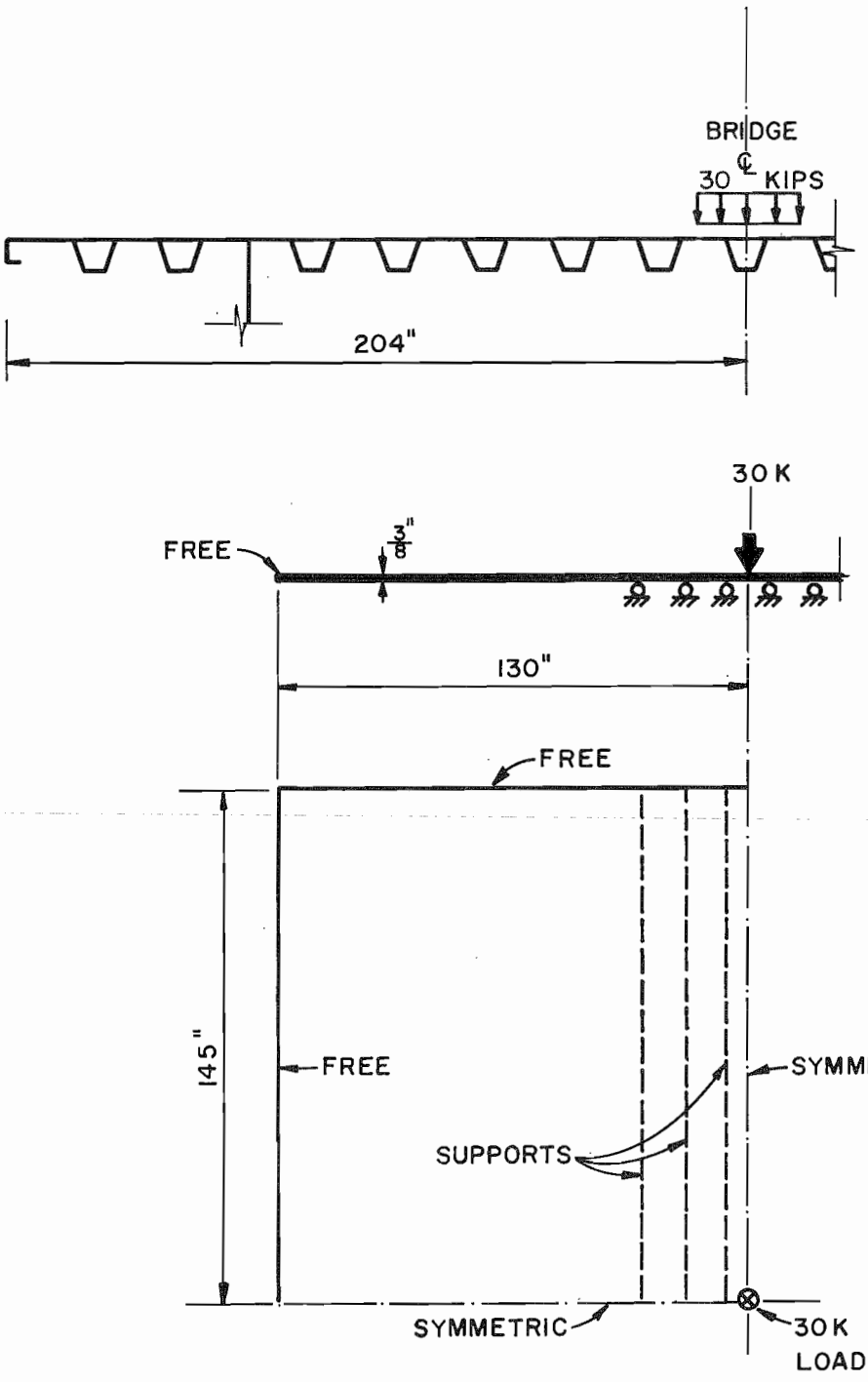


FIG. 87 SIMPLIFIED DECK PLATE FOR LARGE DISPLACEMENT ANALYSIS

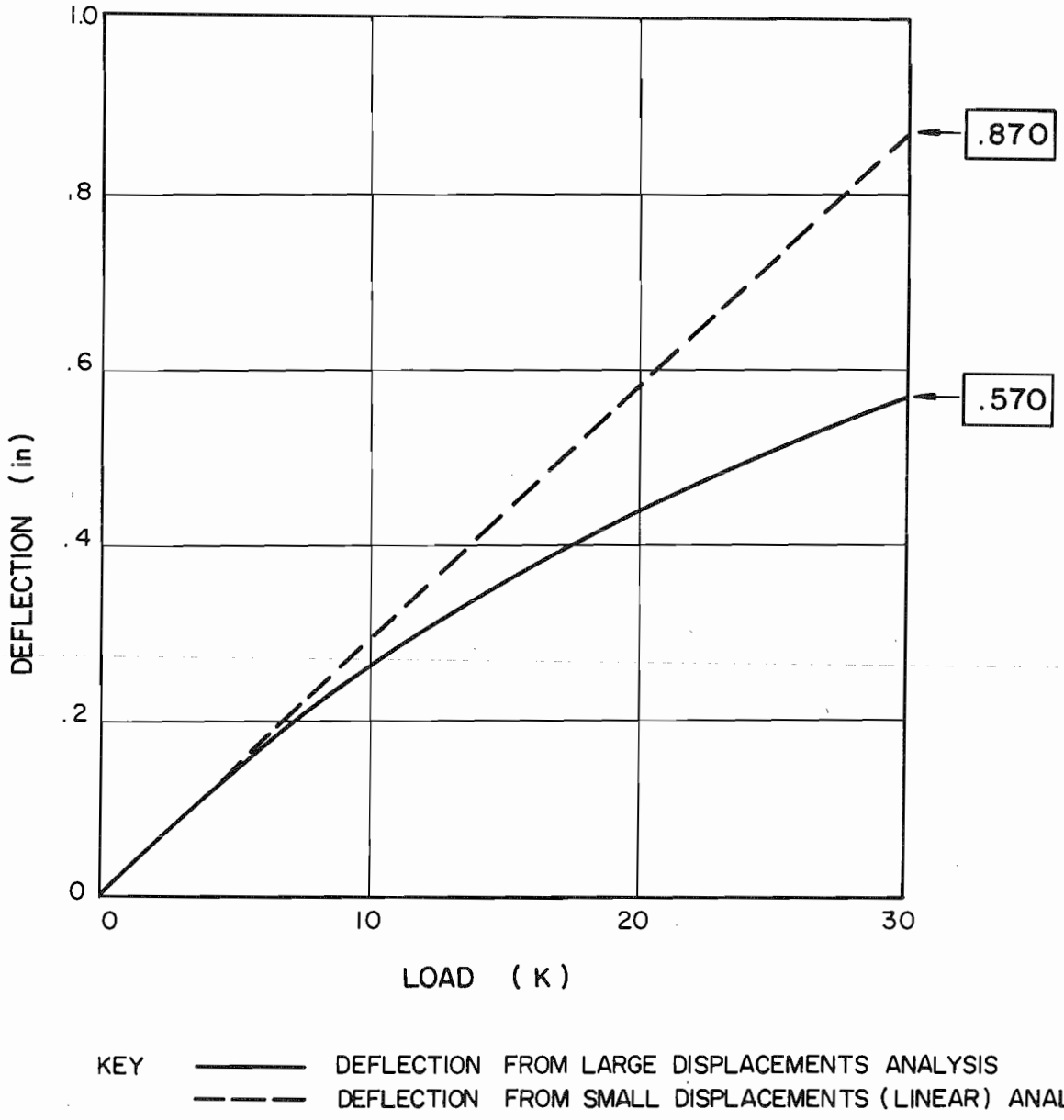


FIG. 88 DISPLACEMENT UNDER POINT LOAD FROM DECK PLATE ANALYSIS

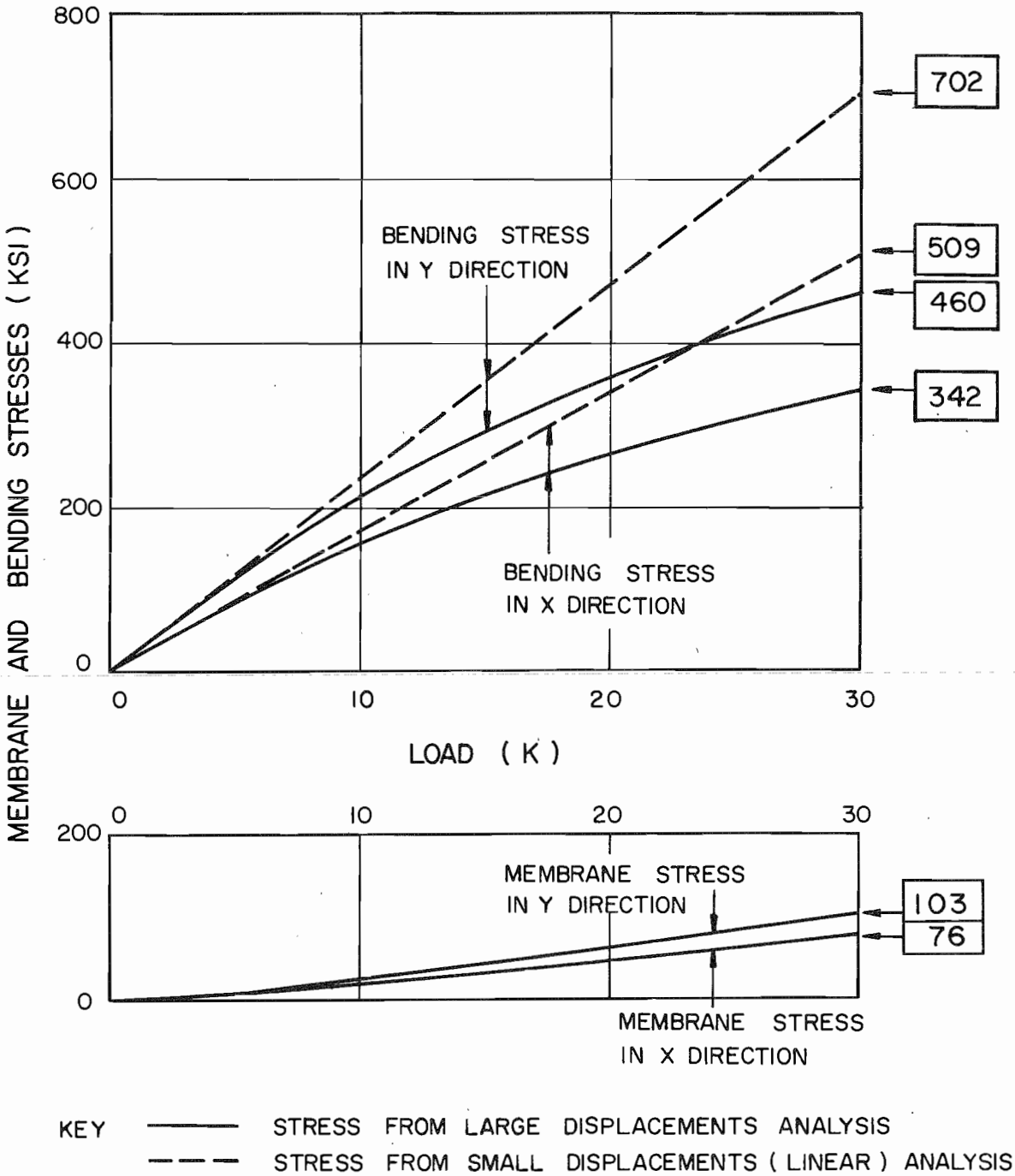


FIG.89 BENDING AND MEMBRANE STRESS UNDER POINT LOAD FROM DECK PLATE ANALYSIS

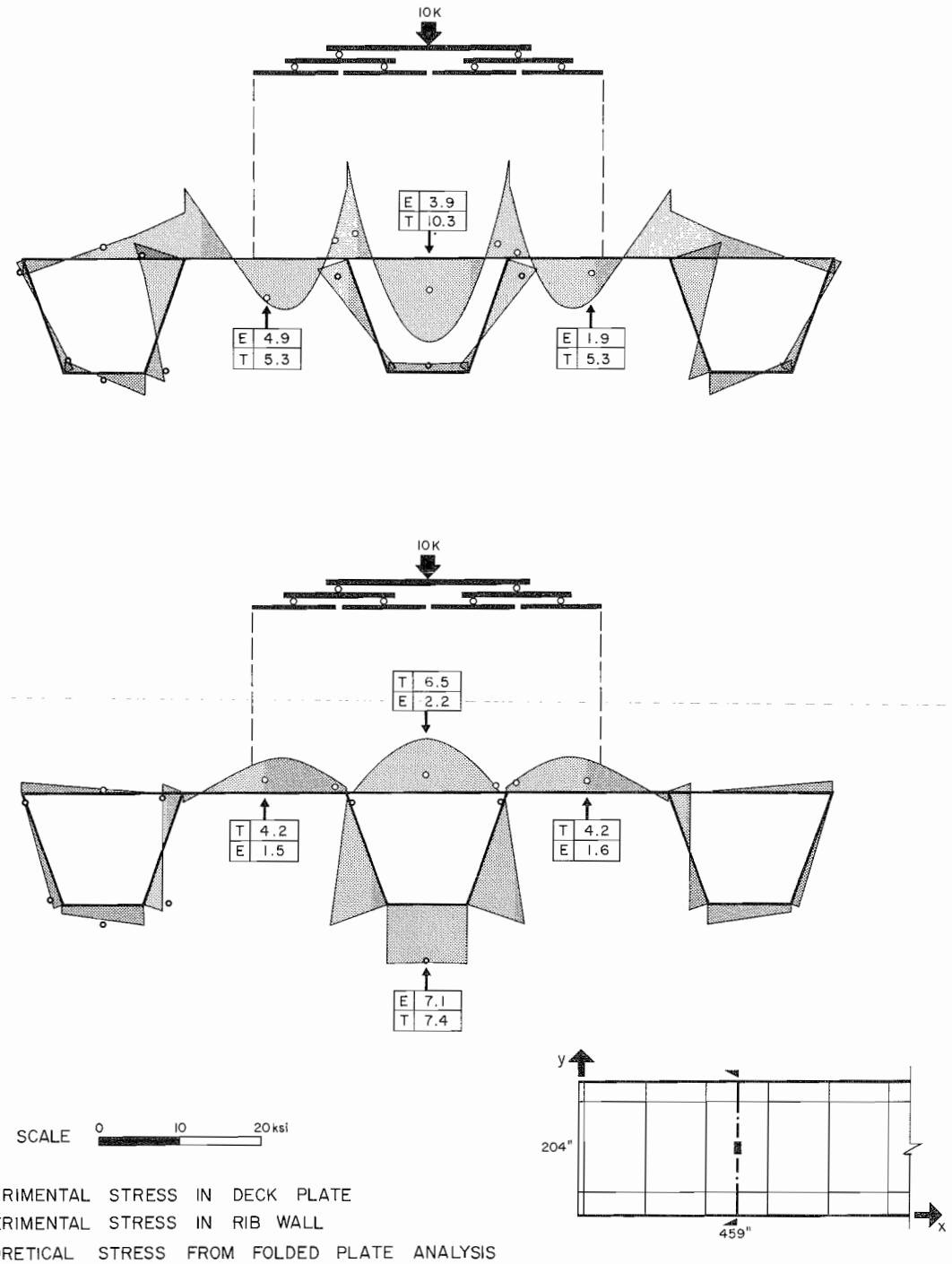


FIG. 90 TRANSVERSE AND LONGITUDINAL SURFACE STRESSES FOR 10 K APPLIED LOAD. BRIDGE I.

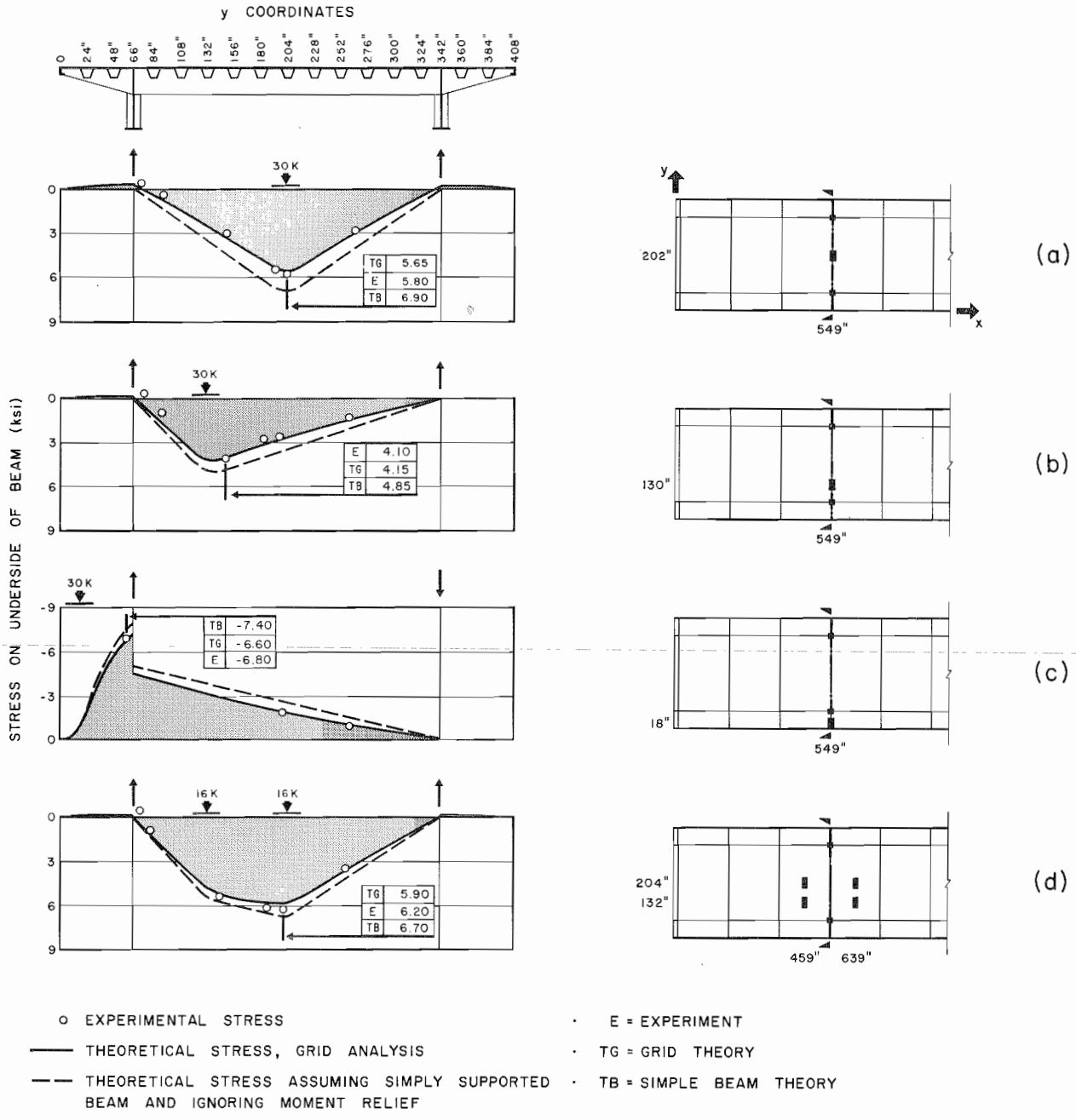


FIG. 91 STRESSES IN FLOOR BEAM BOTTOM FLANGE, INTERIOR FLOOR BEAM, BRIDGE I.

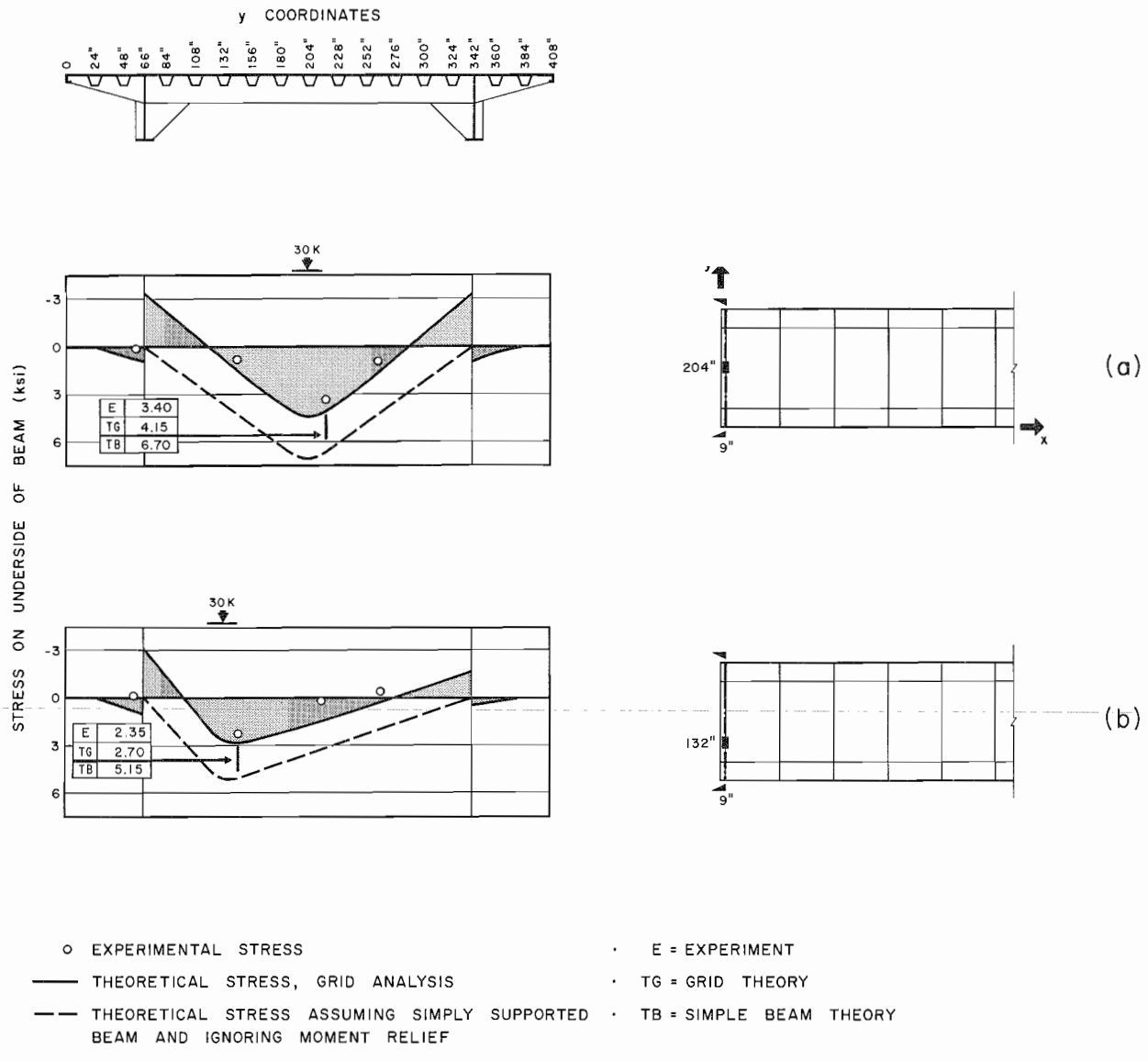
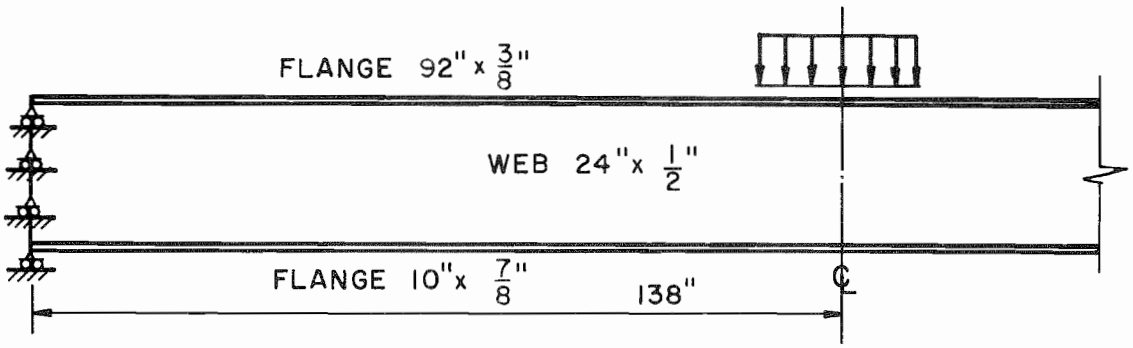
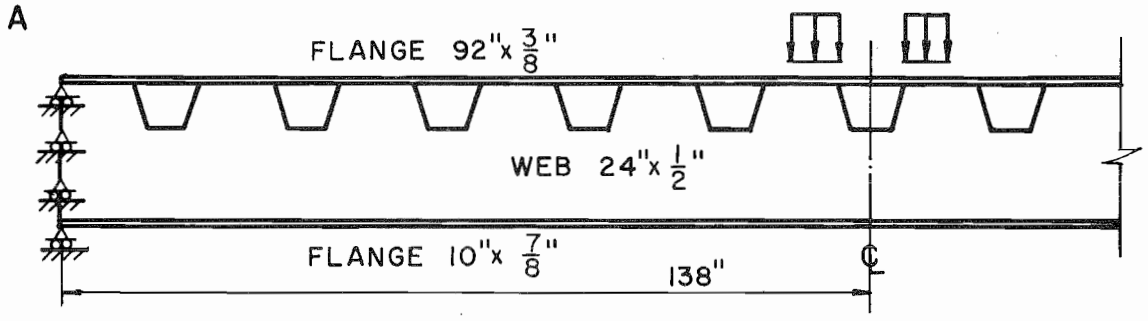


FIG. 92 STRESSES IN FLOOR BEAM BOTTOM FLANGE, END FLOOR BEAM, BRIDGE I.



(a) BEAM WITH SOLID WEB



(b) BEAM WITH CUT-OUT WEB

FIG. 93 BEAMS ANALYZED BY FINITE ELEMENT METHOD

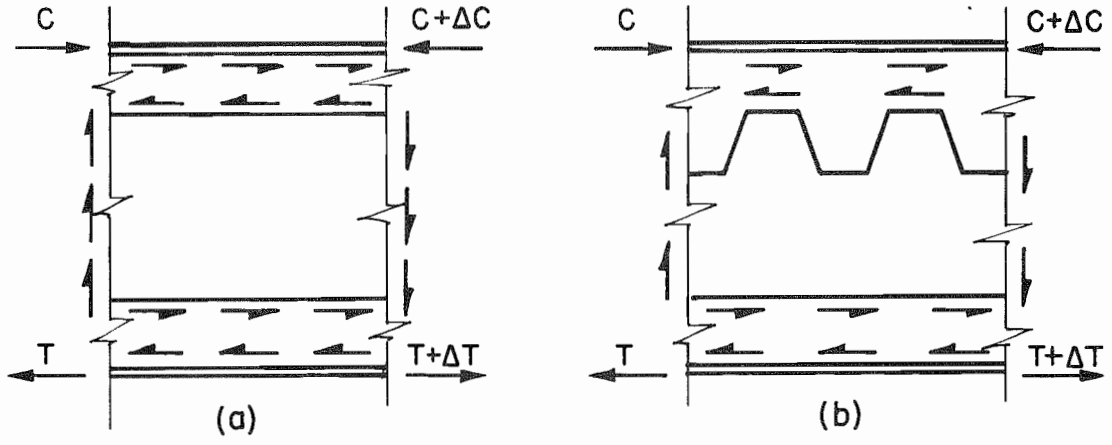


FIG. 94 FORCE TRANSFER THROUGH THE WEB OF A BEAM

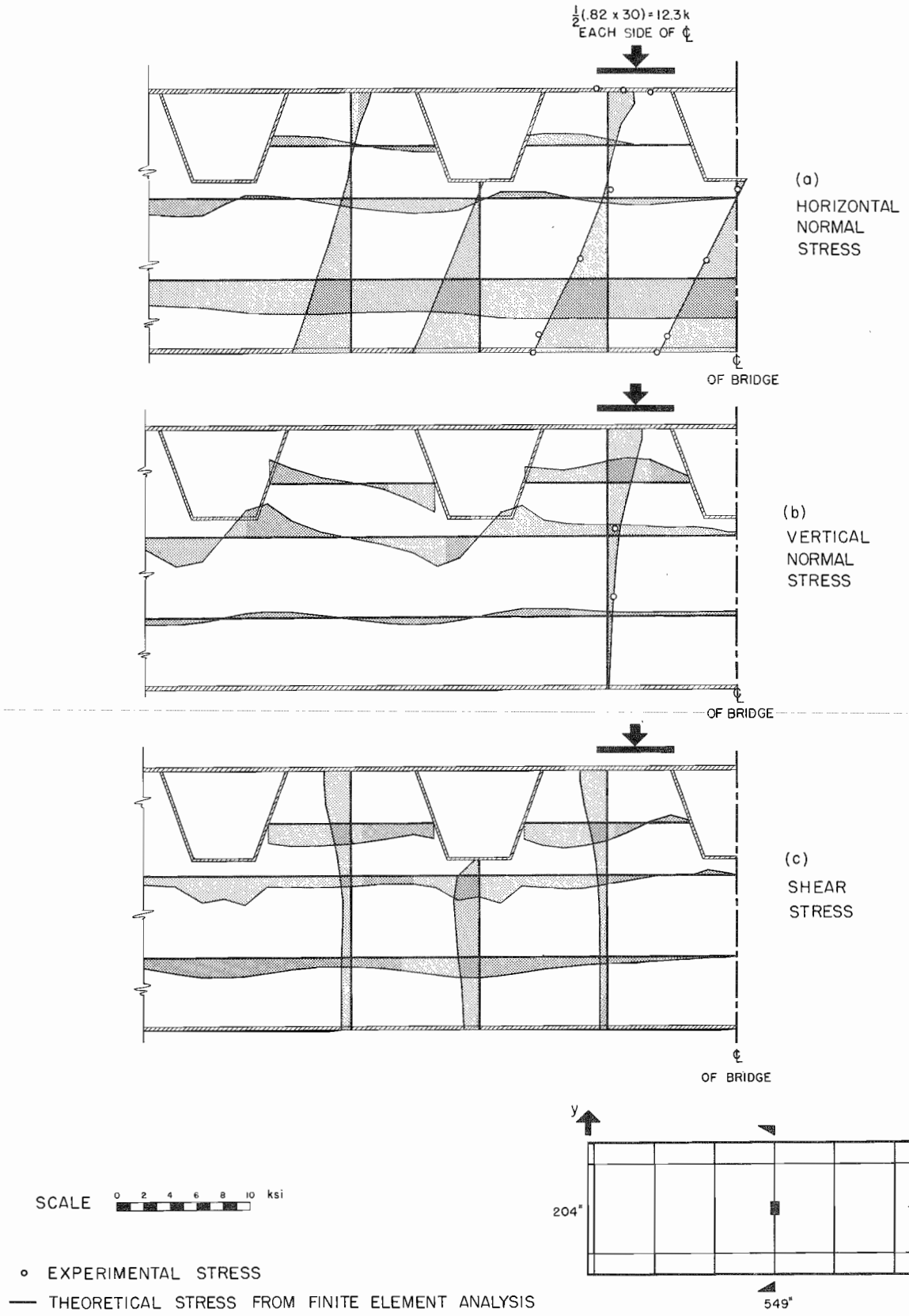


FIG. 95 STRESSES IN FLOOR BEAM WEB AND FLANGES, BRIDGE I.

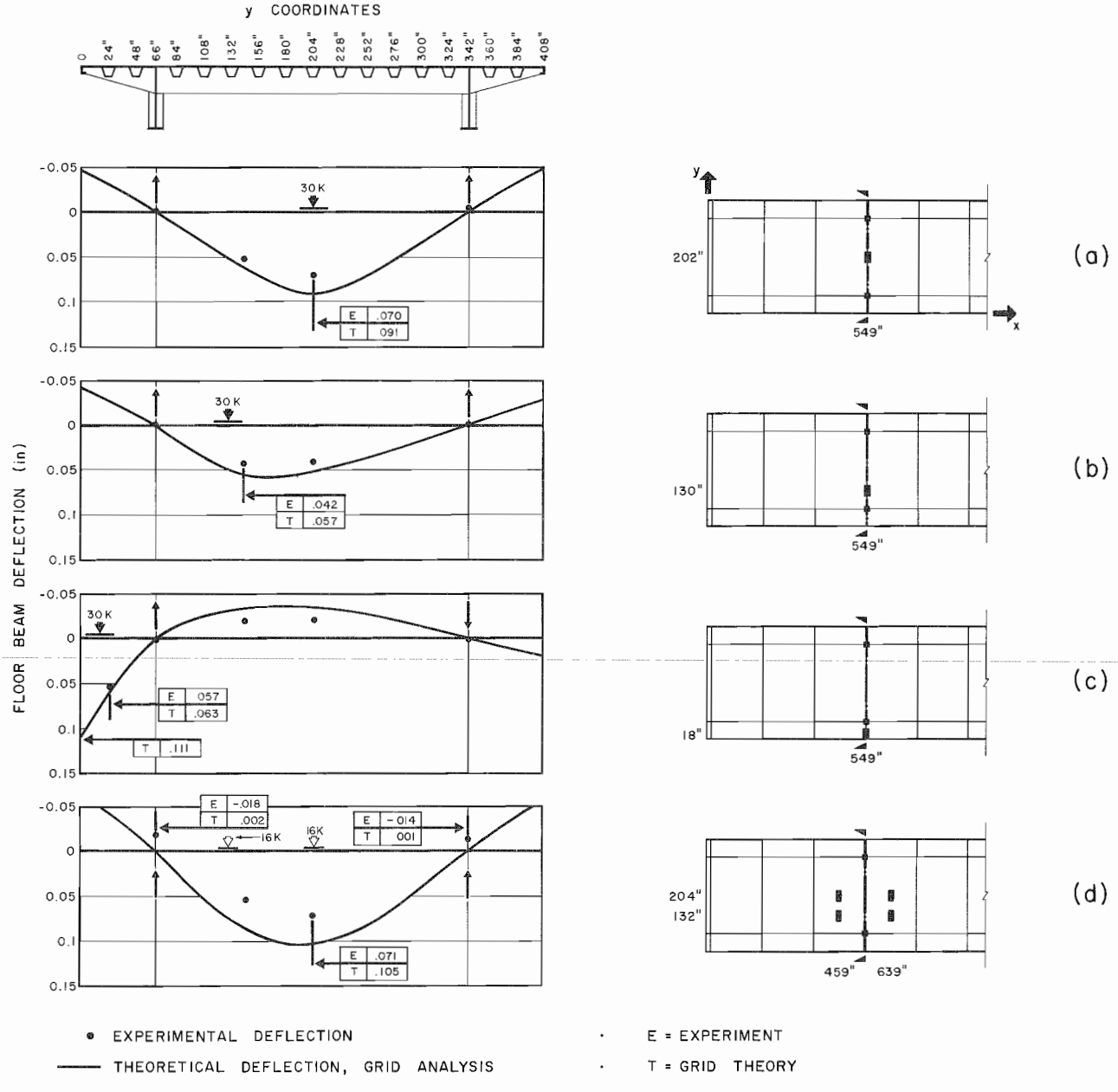


FIG. 96 INTERIOR FLOOR BEAM DEFLECTIONS, BRIDGE I.

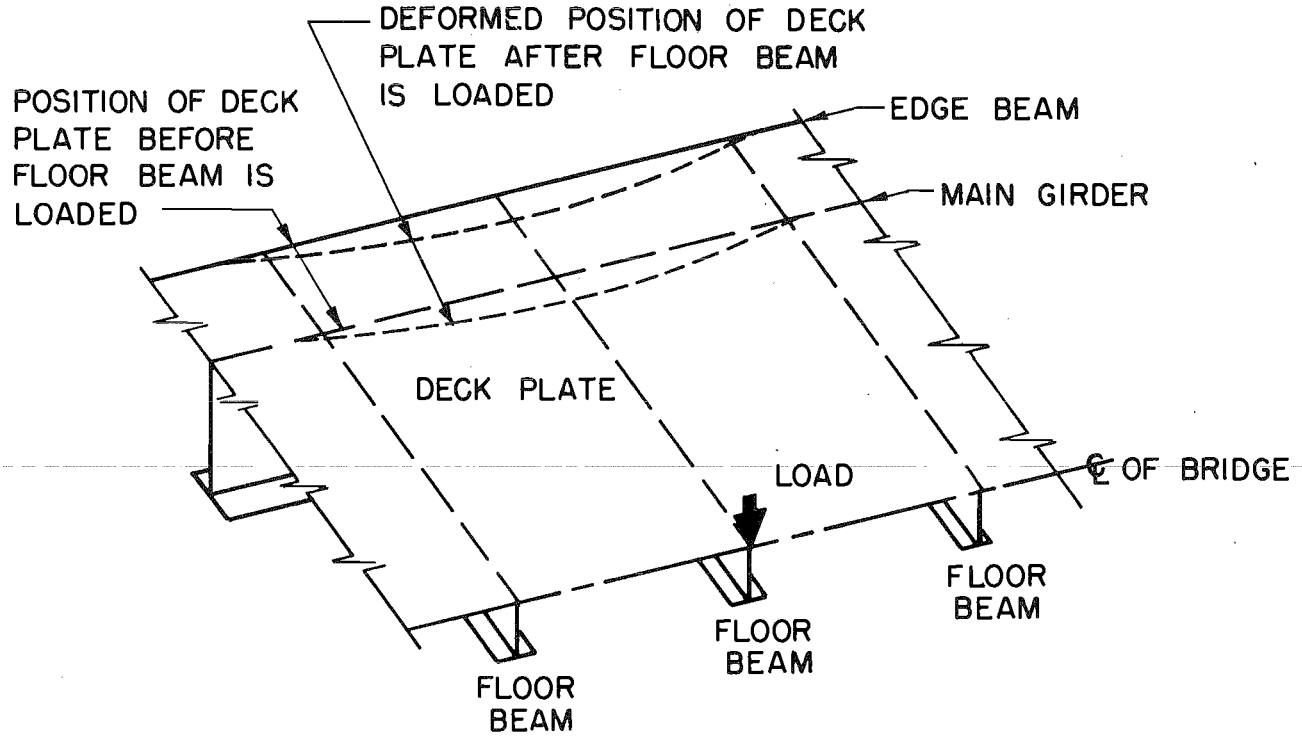


FIG. 97 DECK PLATE DEFORMATION RESULTING FROM A LOAD ON ONE FLOOR BEAM.

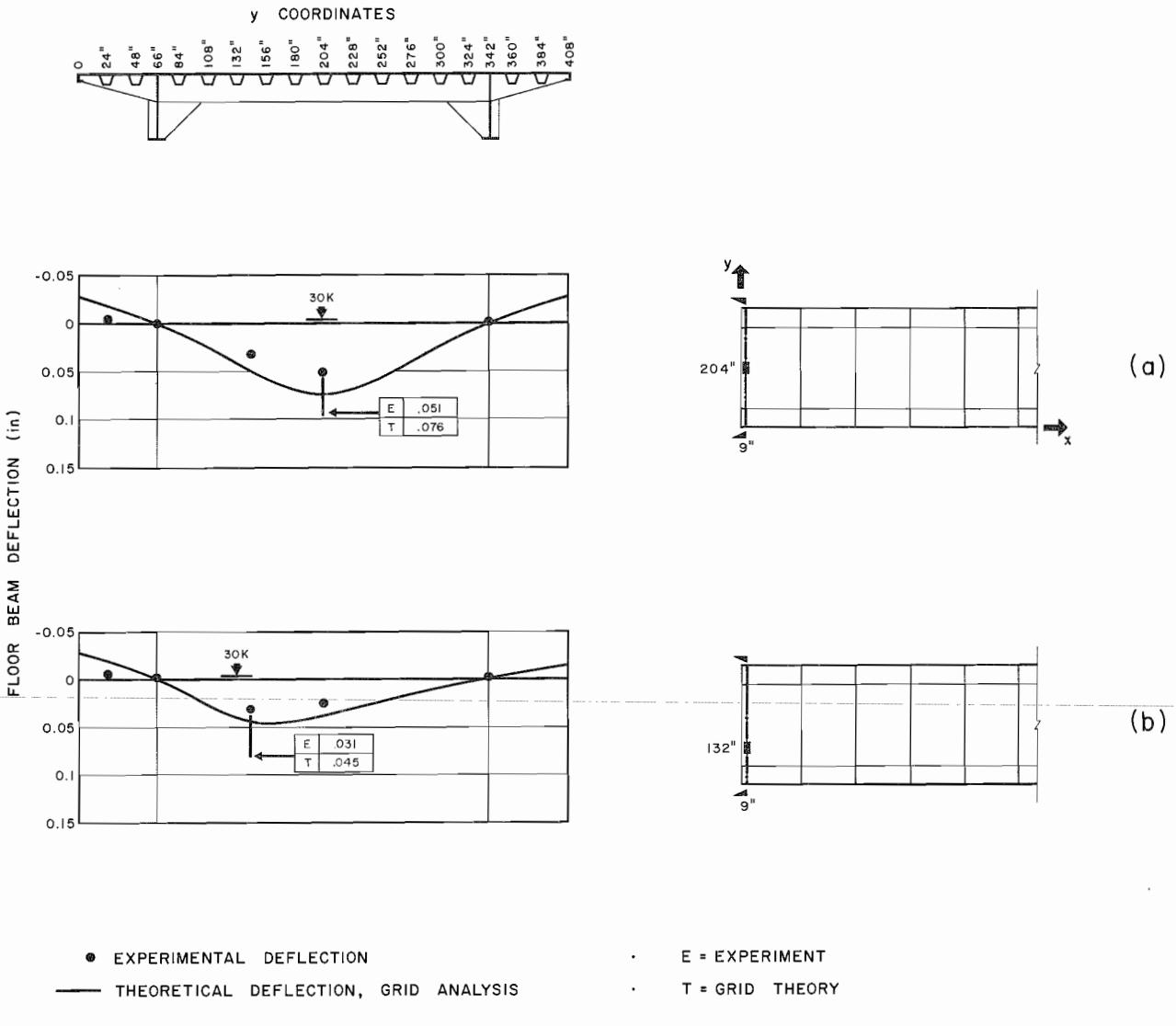
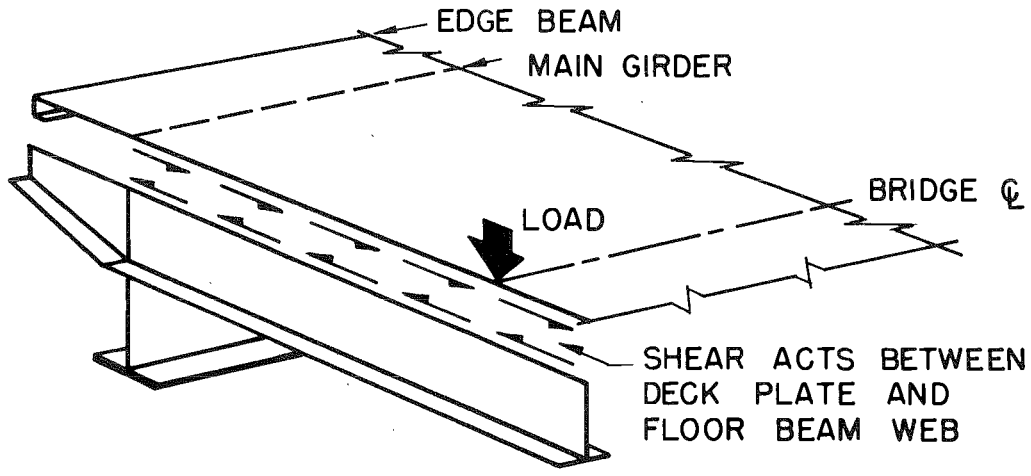
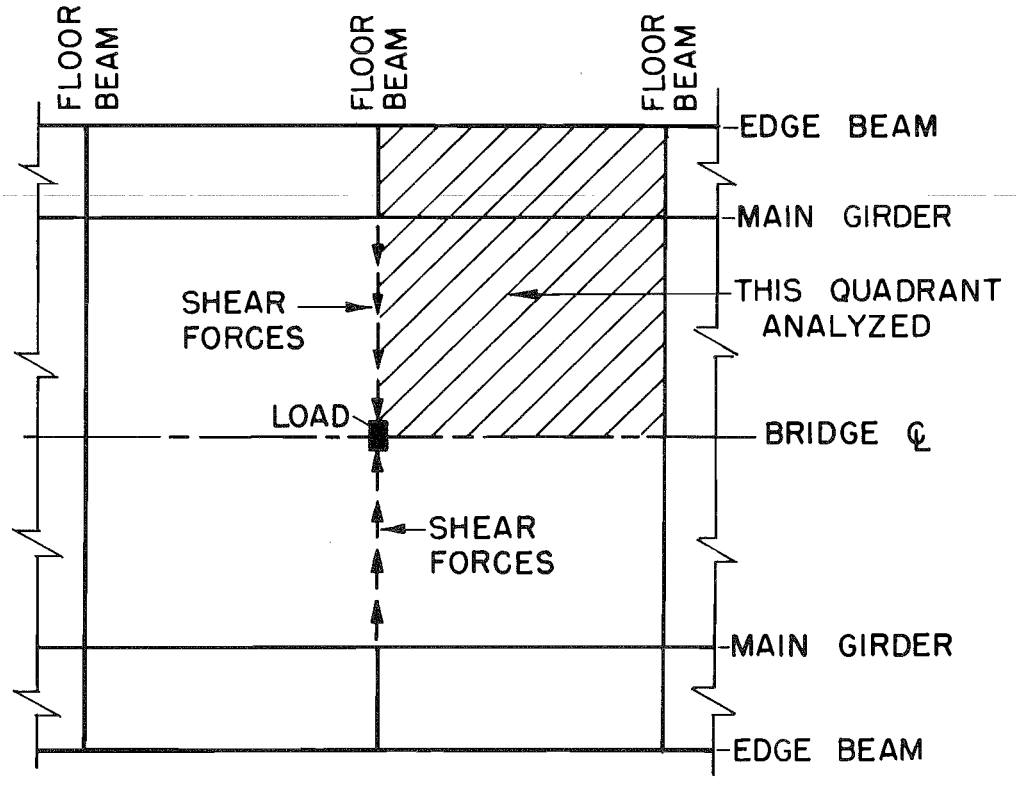


FIG. 98 END FLOOR BEAM DEFLECTIONS, BRIDGE I.

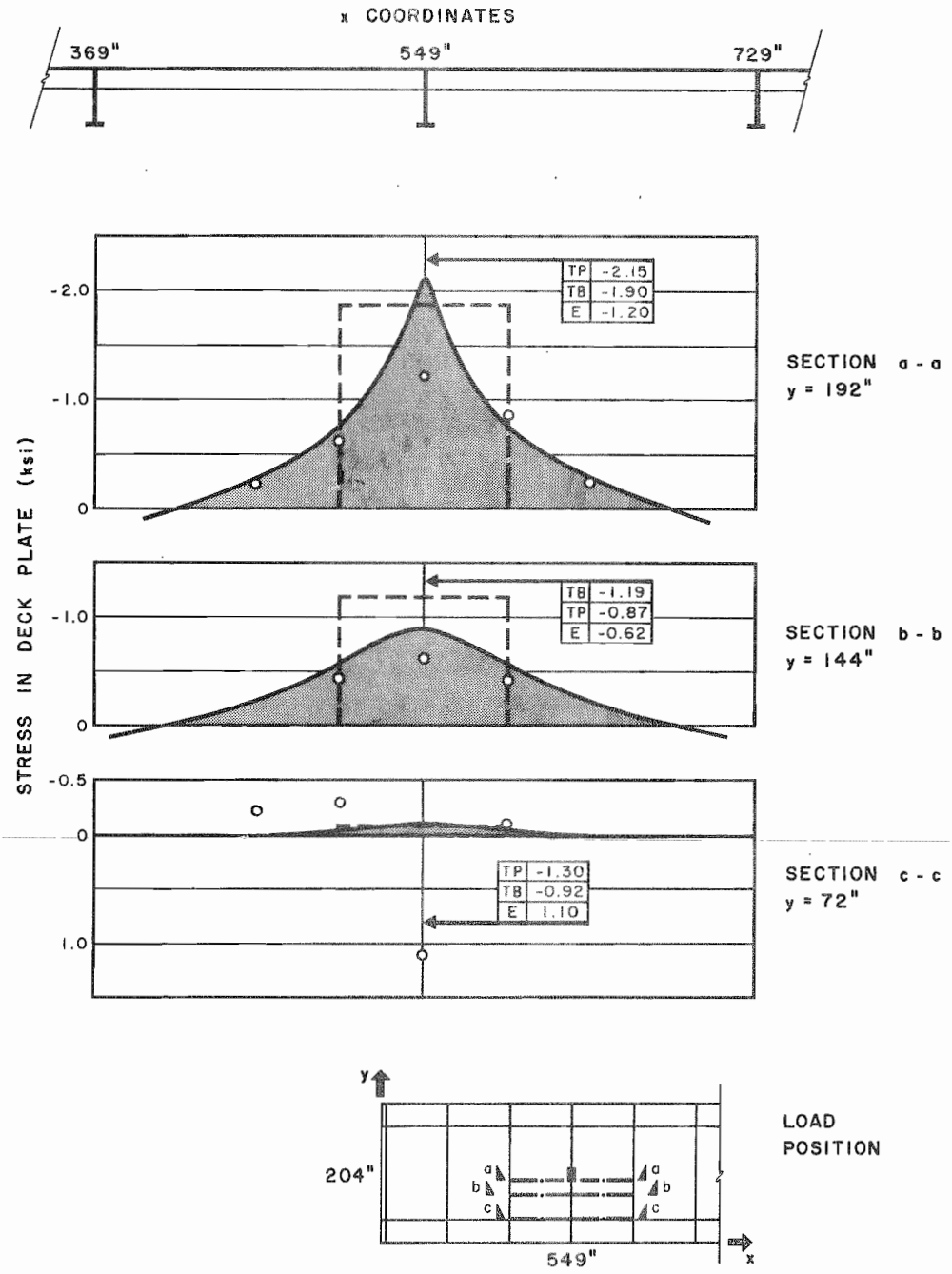


(a) INTERACTION BETWEEN WEB AND DECK PLATE



(b) SHEAR LOADING ON DECK PLATE

FIG. 99 DECK PLATE IDEALIZATION FOR ANALYSIS OF FINITE ELEMENT METHOD

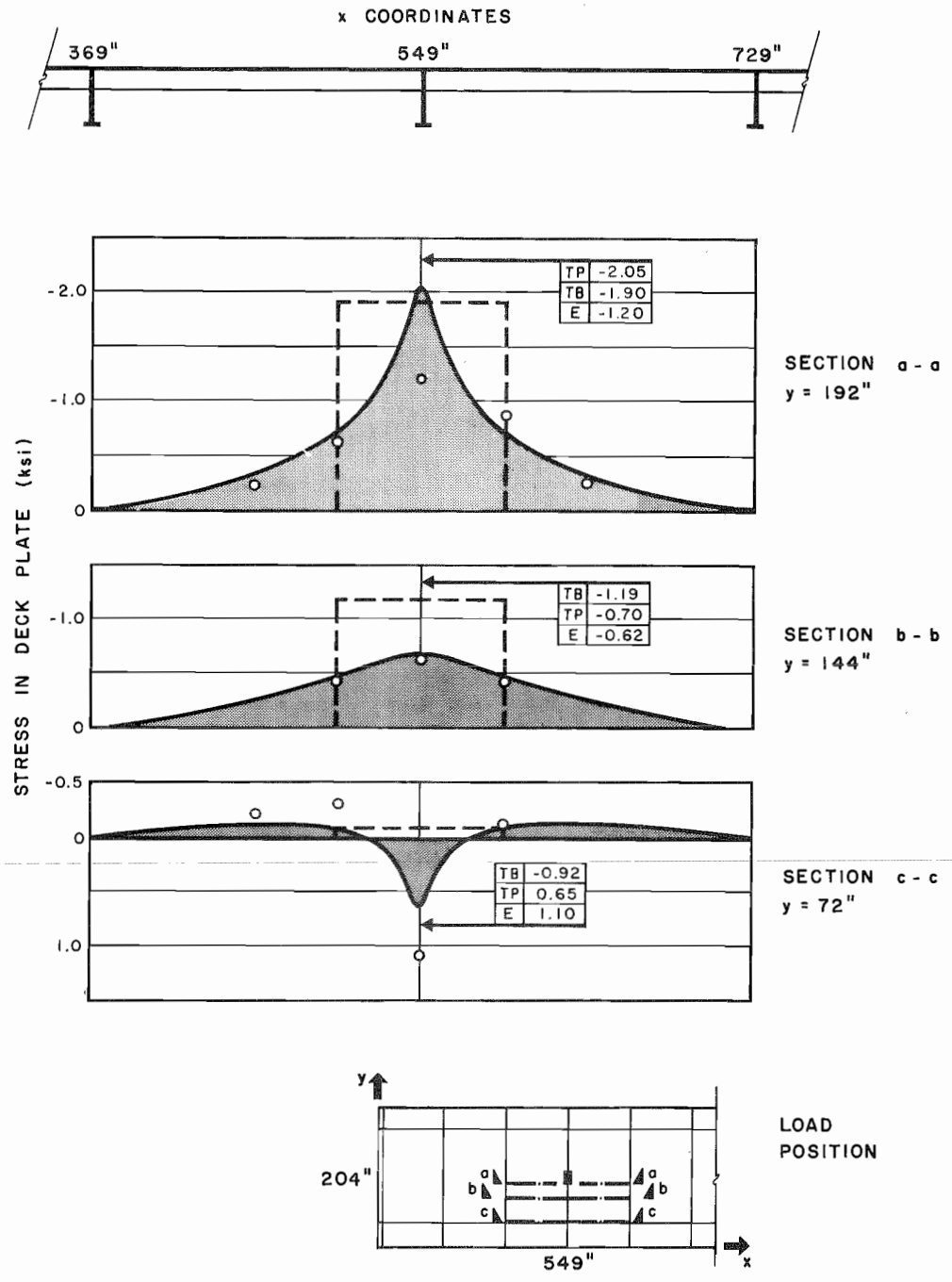


E, o EXPERIMENTAL STRESS AT DECK PLATE MIDTHICKNESS

TP, —— THEORETICAL STRESS FROM PLANE STRESS ANALYSIS OF DECK PLATE, IGNORING DECK PLATE OVERHANG

TB, — — THEORETICAL STRESS ASSUMING A RECTANGULAR STRESS BLOCK OF 92" WIDTH

FIG. 100 STRESSES IN FLOOR BEAM TOP FLANGE, DECK PLATE OVERHANG IGNORED IN THEORY; BRIDGE I.



E, o EXPERIMENTAL STRESS AT DECK PLATE MIDTHICKNESS

TP, —— THEORETICAL STRESS FROM PLANE STRESS ANALYSIS OF DECK PLATE, INCLUDING DECK PLATE OVERHANG

TB, — — THEORETICAL STRESS ASSUMING A RECTANGULAR STRESS BLOCK OF 92" WIDTH

FIG. 101 STRESSES IN FLOOR BEAM TOP FLANGE, DECK PLATE OVERHANG INCLUDED IN THEORY; BRIDGE I.

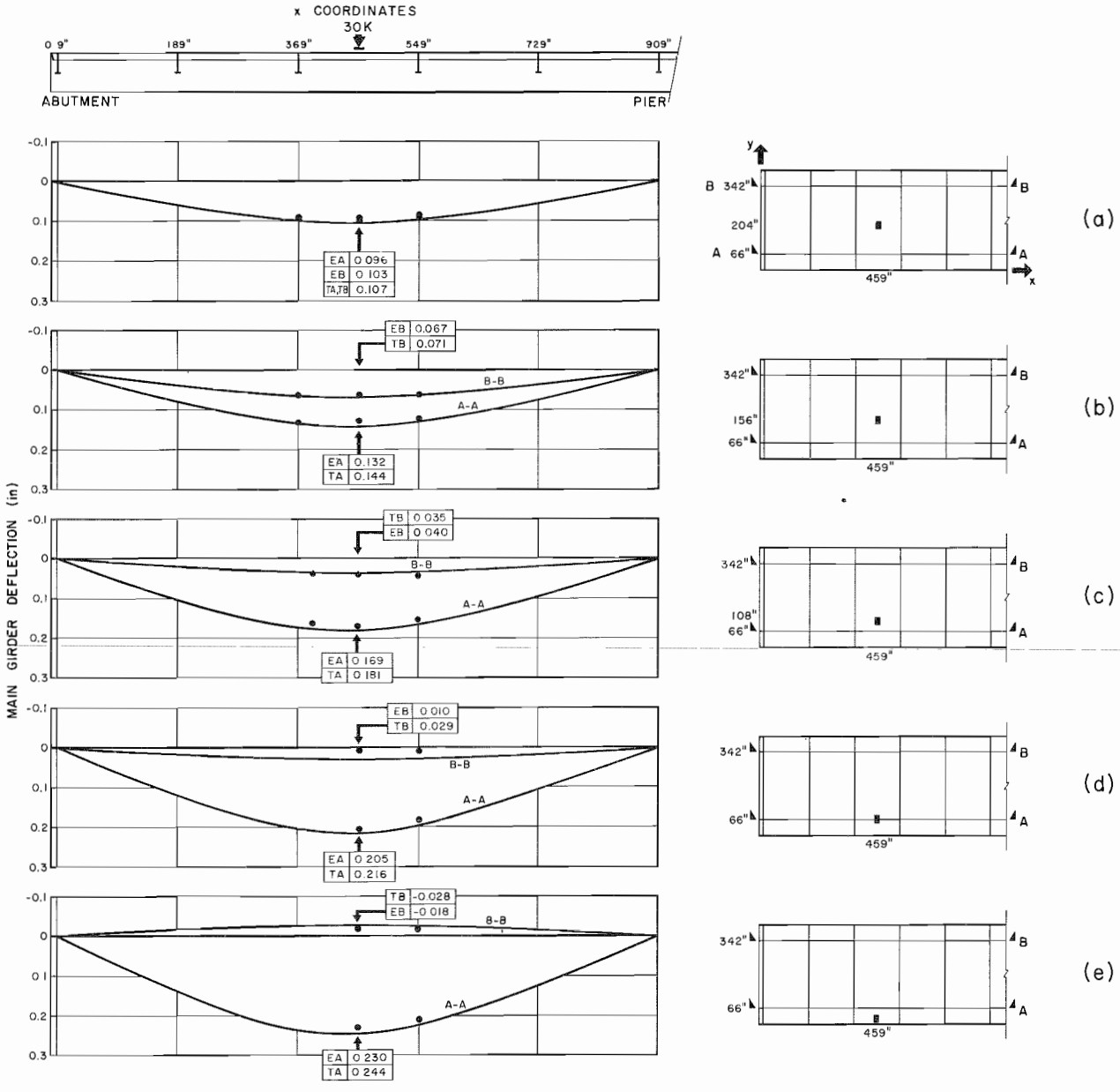


FIG. 102 MAIN GIRDER DEFLECTIONS, BRIDGE I.

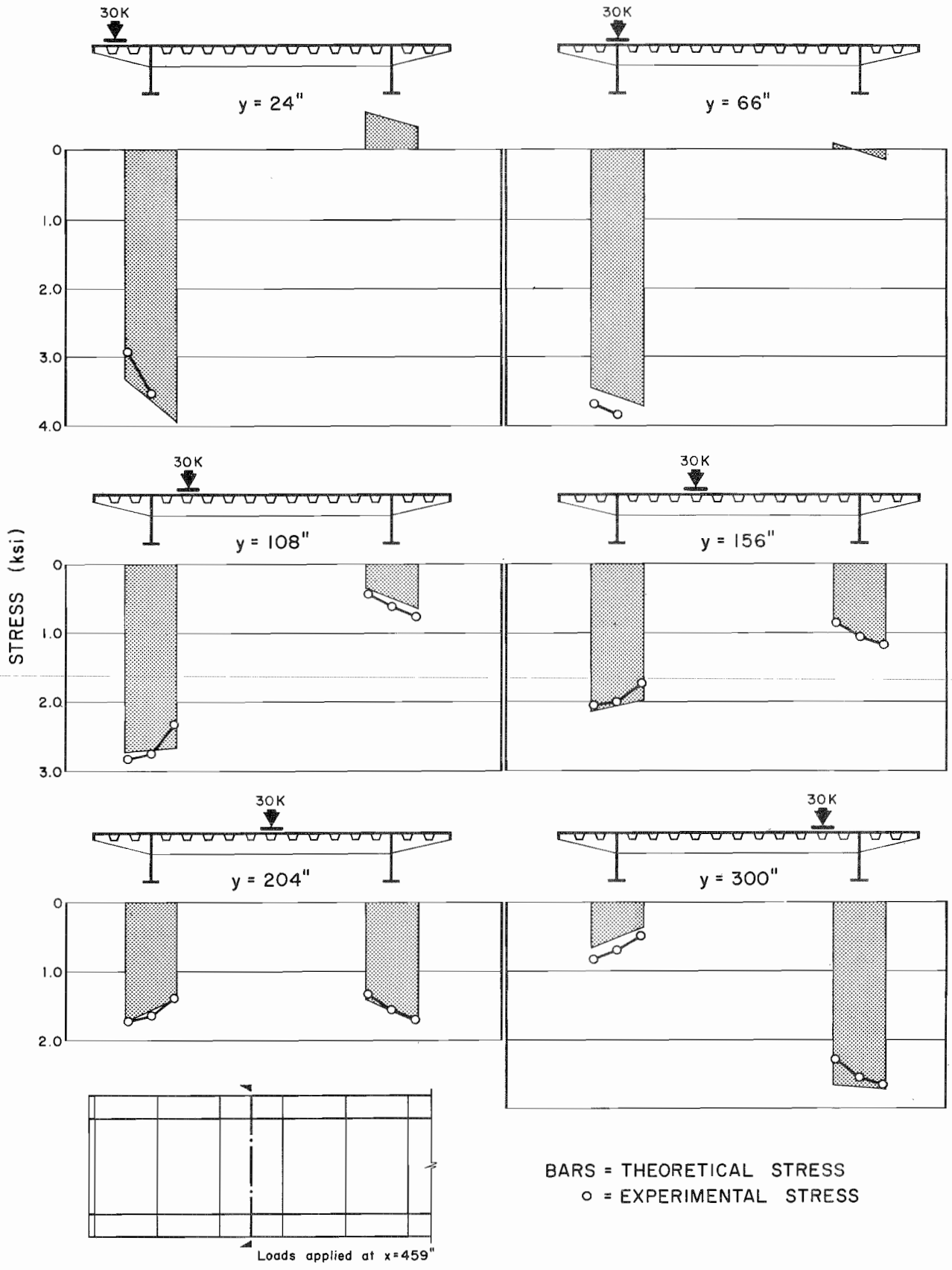
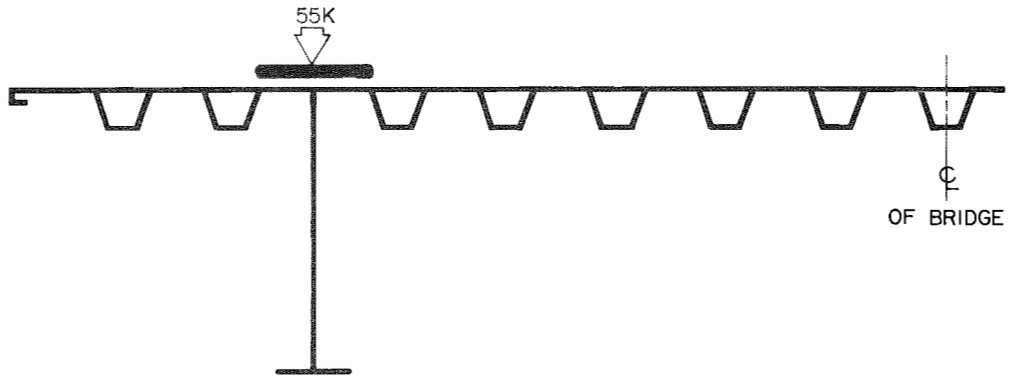
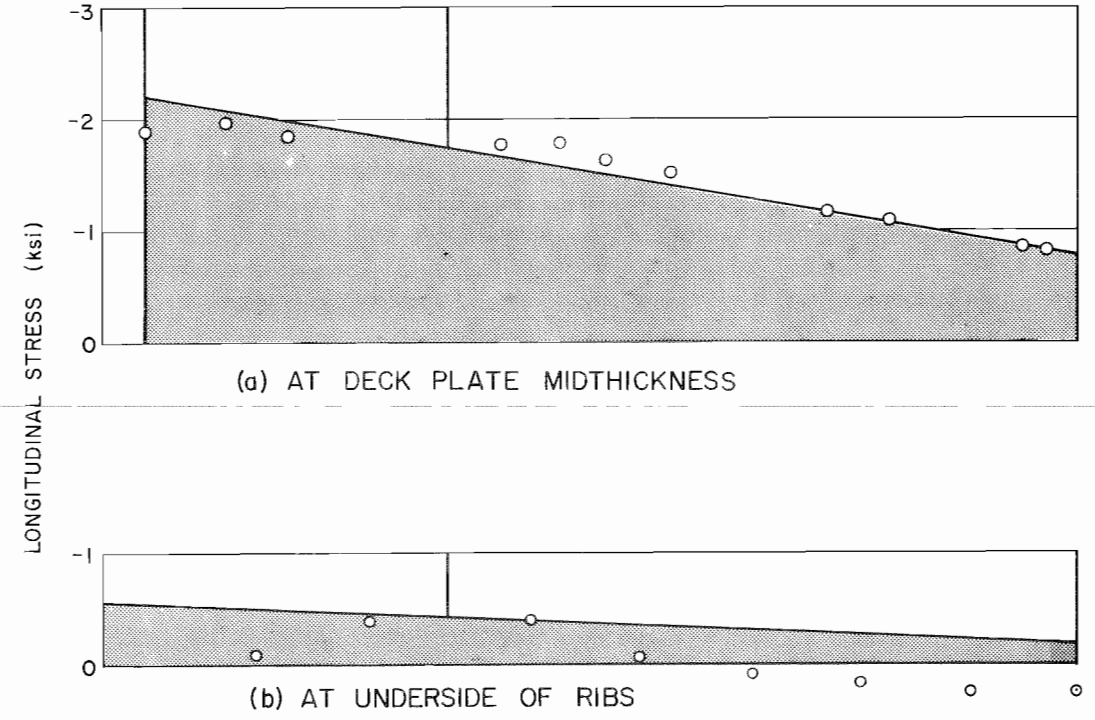
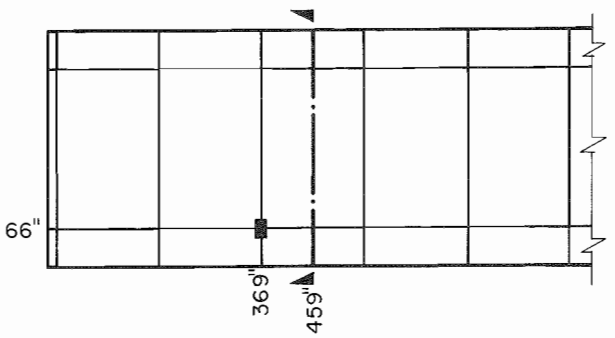


FIG. 103 STRESS IN MAIN GIRDER BOTTOM FLANGE, BRIDGE I. GRID ANALYSIS.



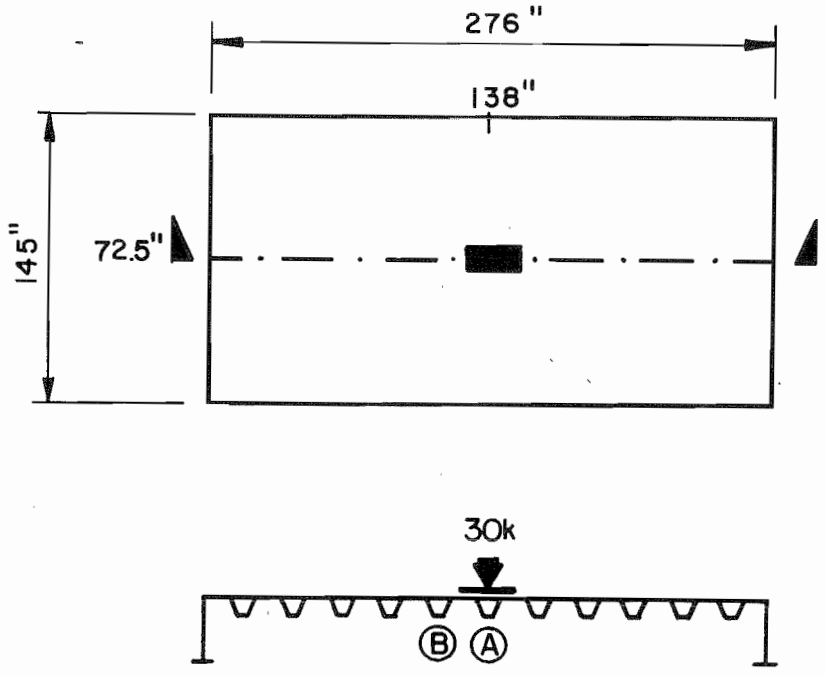




O EXPERIMENTAL LONGITUDINAL STRESS AT DECK PLATE MIDTHICKNESS

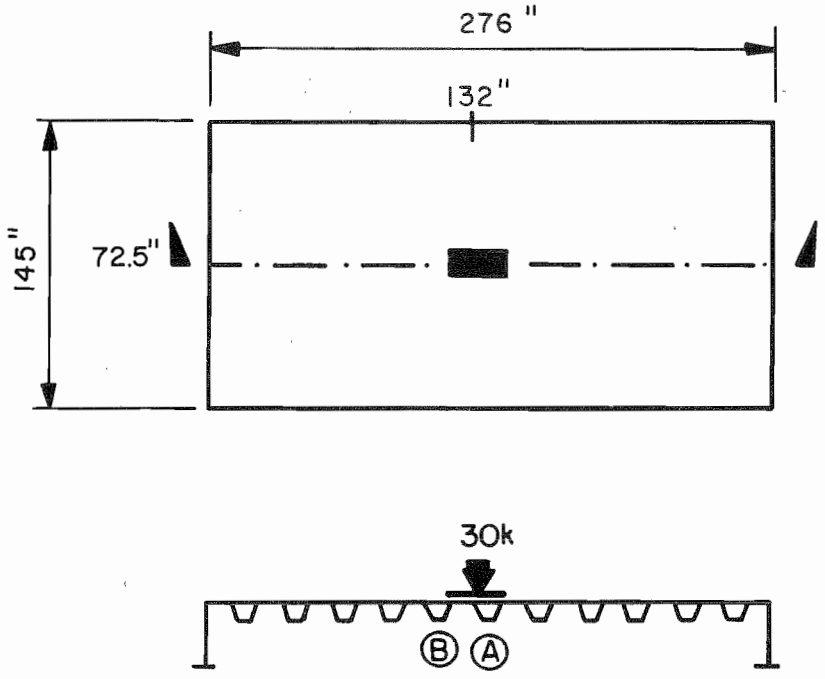
— THEORETICAL LONGITUDINAL STRESS ASSUMING LINEAR VARIATION ACROSS WIDTH OF BRIDGE

FIG. 104 STRESSES IN MAIN GIRDER TOP FLANGE, BRIDGE I.



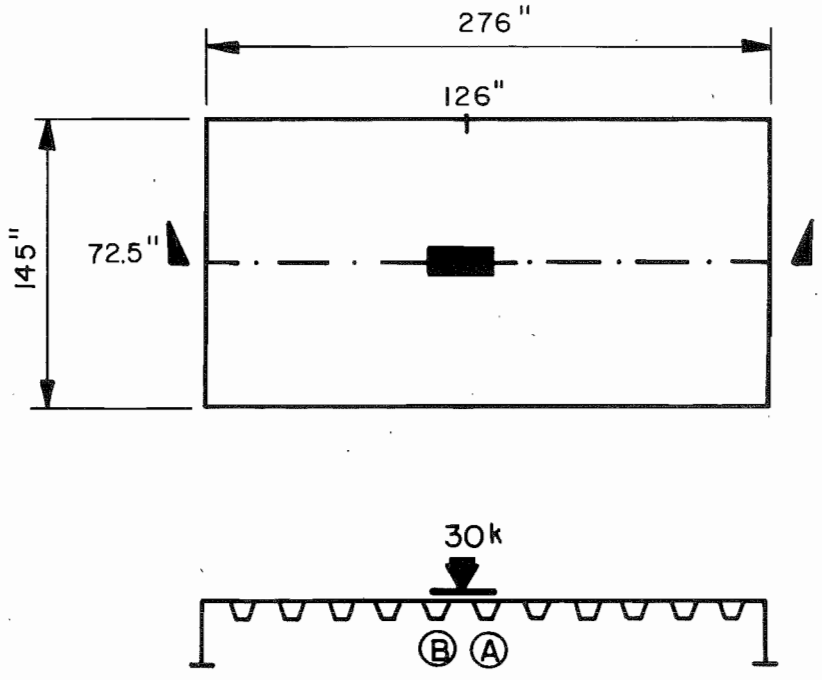
	ORTHO SLAB	GRID	FOLDED PLATE
RIB DEFLECTION AT Ⓐ	.222	.234	.244
RIB DEFLECTION AT Ⓑ	.076	.074	.075
RIB STRESS AT Ⓐ	23.6	25.8	28.1
RIB STRESS AT Ⓑ	8.0	6.9	6.0

FIG. 105 COMPARISON OF THEORIES FOR SINGLE SIMPLY SUPPORTED PANEL



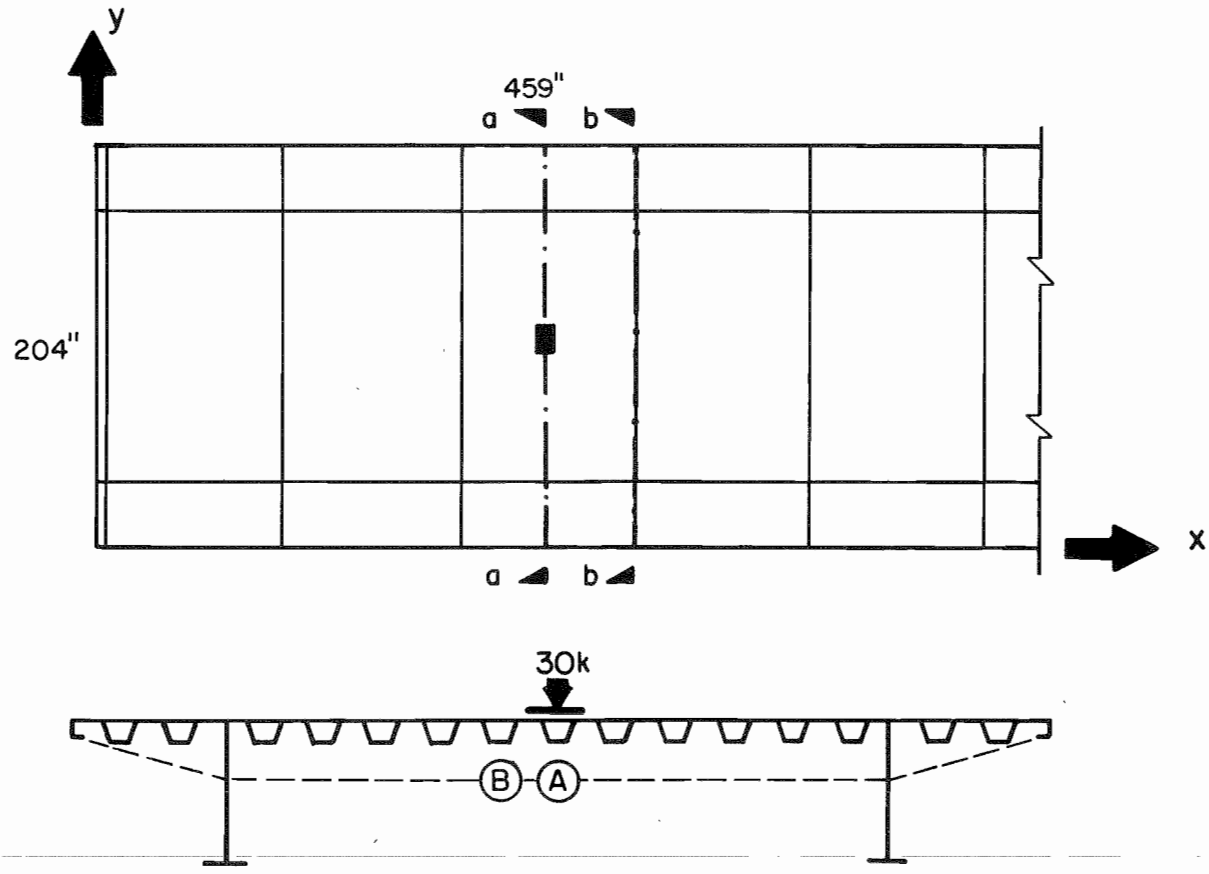
	ORTHO SLAB	GRID	FOLDED PLATE
RIB DEFLECTION AT Ⓐ	.210	.212	.227
RIB DEFLECTION AT Ⓑ	.112	.114	.115
RIB STRESS AT Ⓐ	21.7	23.2	25.7
RIB STRESS AT Ⓑ	12.6	11.5	10.9

FIG. 106 COMPARISON OF THEORIES FOR SINGLE SIMPLY SUPPORTED PANEL



	ORTHO SLAB	GRID	FOLDED PLATE
RIB DEFLECTION AT (A)	.167	.164	.171
RIB DEFLECTION AT (B)	.034	.038	.041
RIB STRESS AT (A)	17.5	17.5	17.4
RIB STRESS AT (B)	3.4	3.3	2.7

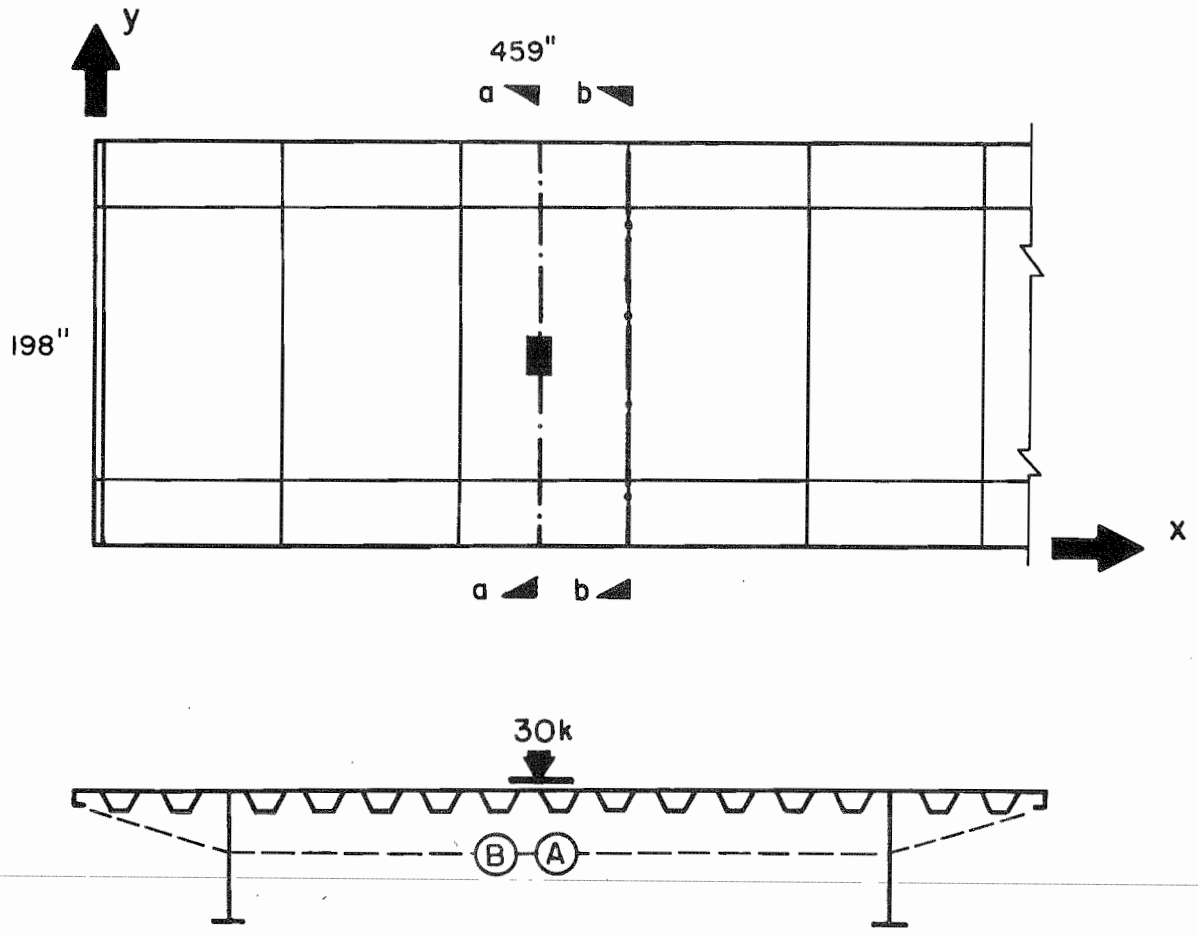
FIG. 107 COMPARISON OF THEORIES FOR SINGLE SIMPLY SUPPORTED PANEL



	ORTHO SLAB	GRID	EXPT.
RIB DEFLECTION AT (A) IN a - a	.297	.292	.268
RIB DEFLECTION AT (B) IN a - a	.150	.142	.139
RIB STRESS AT (A) IN a - a	21.6	22.7	22.1
RIB STRESS AT (B) IN a - a	7.4	6.3	6.2
RIB STRESS AT (A) IN b - b	-9.9	-10.1	*

* NOT COMPARABLE BECAUSE OF LOCAL STRESS EFFECTS

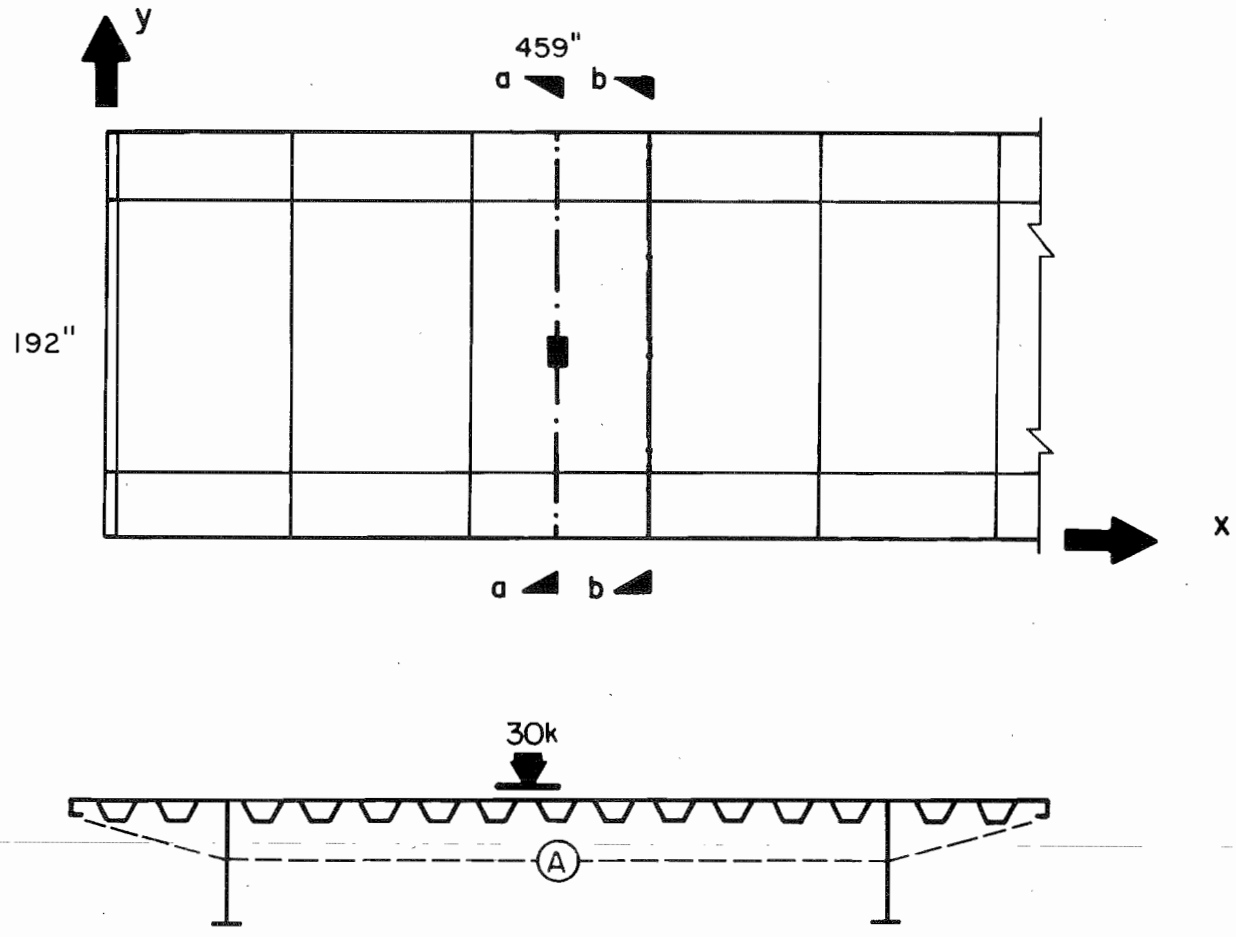
FIG. 108 COMPARISON OF THEORIES AND EXPERIMENT FOR SINGLE LOADS, BRIDGE _I



	ORTHO SLAB	GRID	EXPT.
RIB DEFLECTION AT (A) IN a-a	.283	.272	.249
RIB DEFLECTION AT (B) IN a-a	.190	.181	.175
RIB STRESS AT (A) IN a-a	19.8	20.4	19.4
RIB STRESS AT (B) IN a-a	11.6	10.4	10.6
RIB STRESS AT (A) IN b-b	-8.9	-9.0	*

* NOT COMPARABLE BECAUSE OF LOCAL STRESS EFFECTS

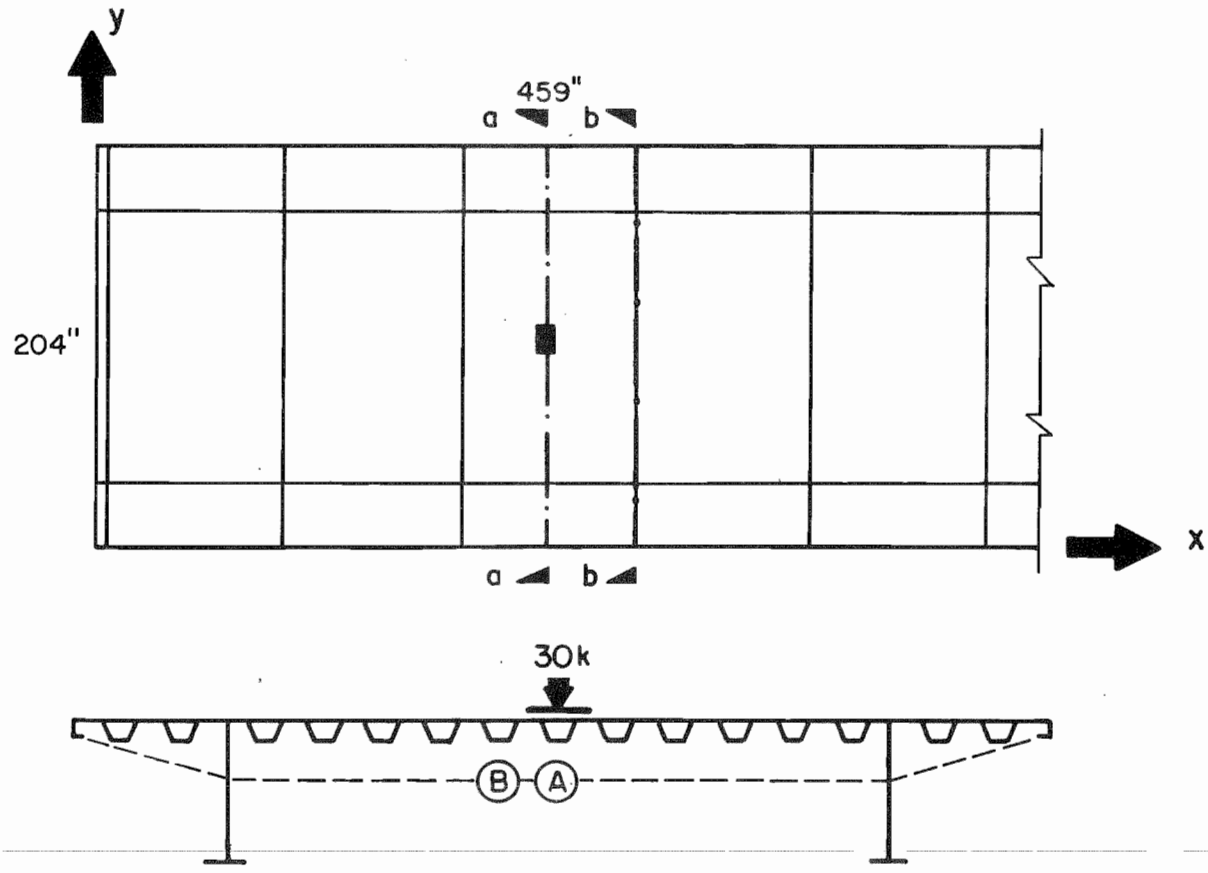
FIG. 109 COMPARISON OF THEORIES AND EXPERIMENTS FOR SINGLE LOADS, BRIDGE I



	ORTHO SLAB	GRID	EXPT.
RIB DEFLECTION AT (A) IN a a	.242	.228	.210
RIB STRESS AT (A) IN a-a	16.0	15.5	15.3
RIB STRESS AT (A) IN b-b	-7.1	-6.9	*

* NOT COMPARABLE BECAUSE OF LOCAL STRESS EFFECTS

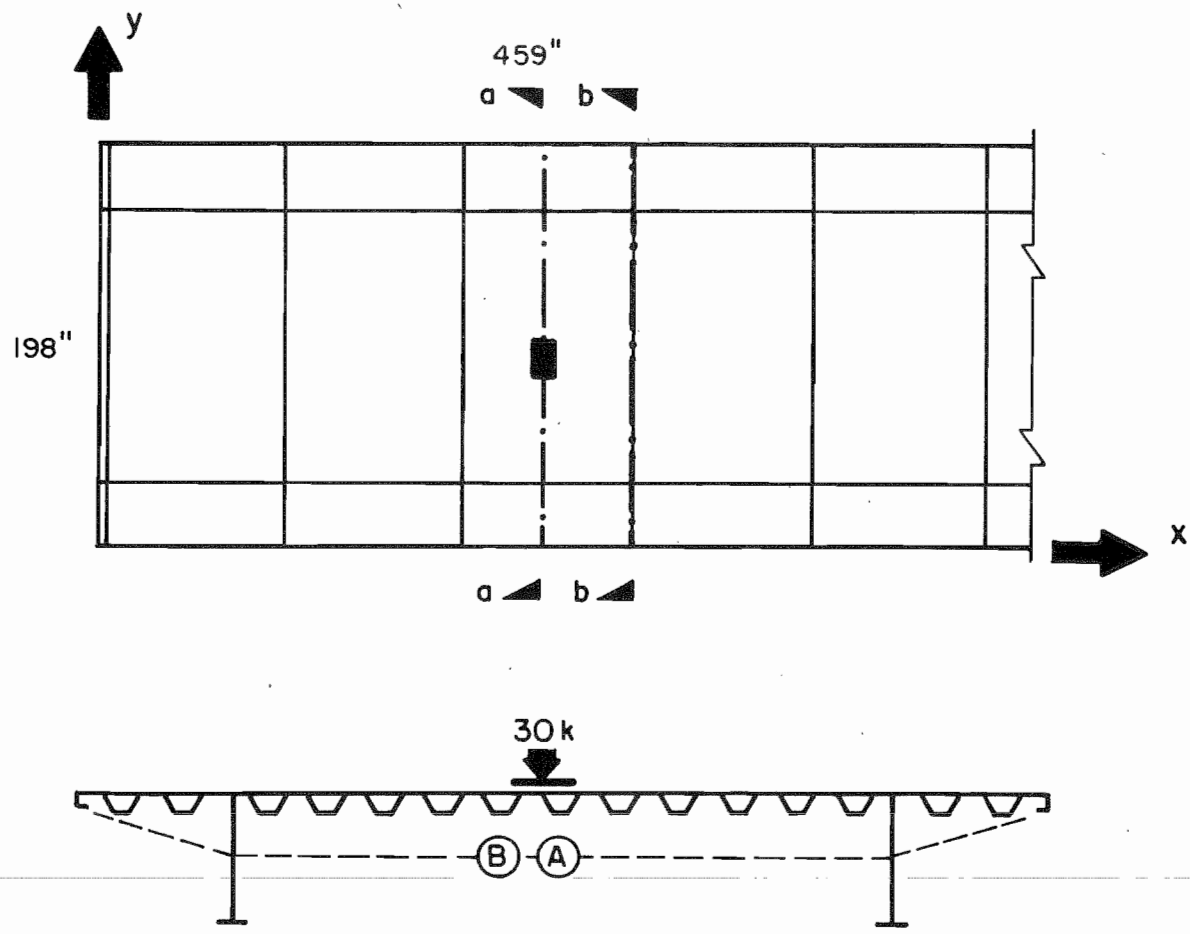
FIG. 110 COMPARISON OF THEORIES AND EXPERIMENT FOR SINGLE LOADS, BRIDGE I



	ORTHO SLAB	GRID	EXPT.
RIB DEFLECTION AT (A) IN a - a	.235	.202	.209
RIB DEFLECTION AT (B) IN a - a	.128	.098	.113
RIB STRESS AT (A) IN a - a	16.7	16.9	17.3
RIB STRESS AT (B) IN a - a	6.1	5.1	4.8
RIB STRESS AT (A) IN b - b	-7.7	-7.8	*

* NOT COMPARABLE BECAUSE OF LOCAL STRESS EFFECTS

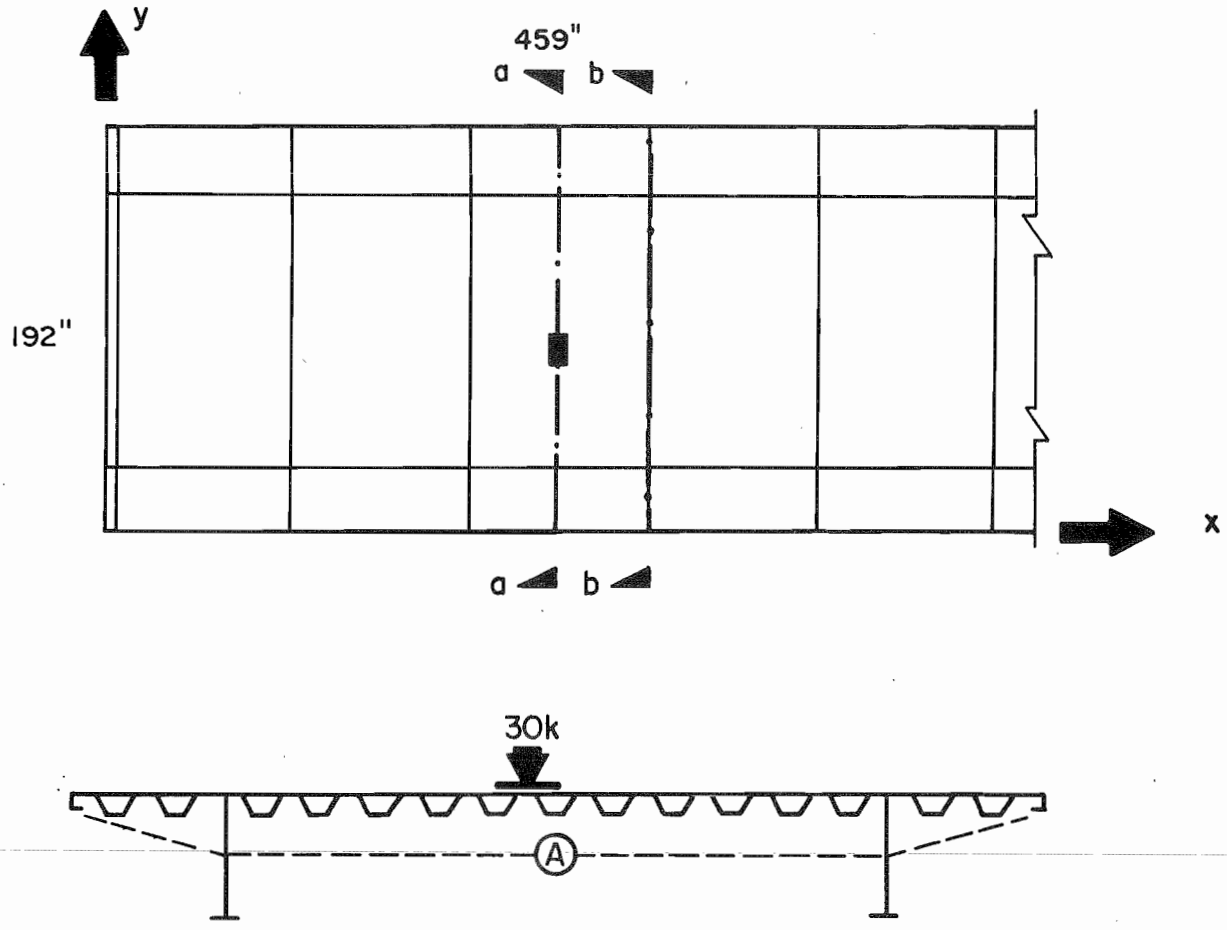
FIG. 111 COMPARISON OF THEORIES AND EXPERIMENT FOR SINGLE LOADS, BRIDGE II



	ORTHO SLAB	GRID	EXPT.
RIB DEFLECTION AT (A) IN a-a	.225	.195	.189
RIB DEFLECTION AT (B) IN a-a	.159	.124	.138
RIB STRESS AT (A) IN a a	15.4	15.3	15.6
RIB STRESS AT (B) IN a-a	9.3	8.6	7.9
RIB STRESS AT (A) IN b-b	-7.0	-7.0	*

* NOT COMPARABLE BECAUSE OF LOCAL STRESS EFFECTS

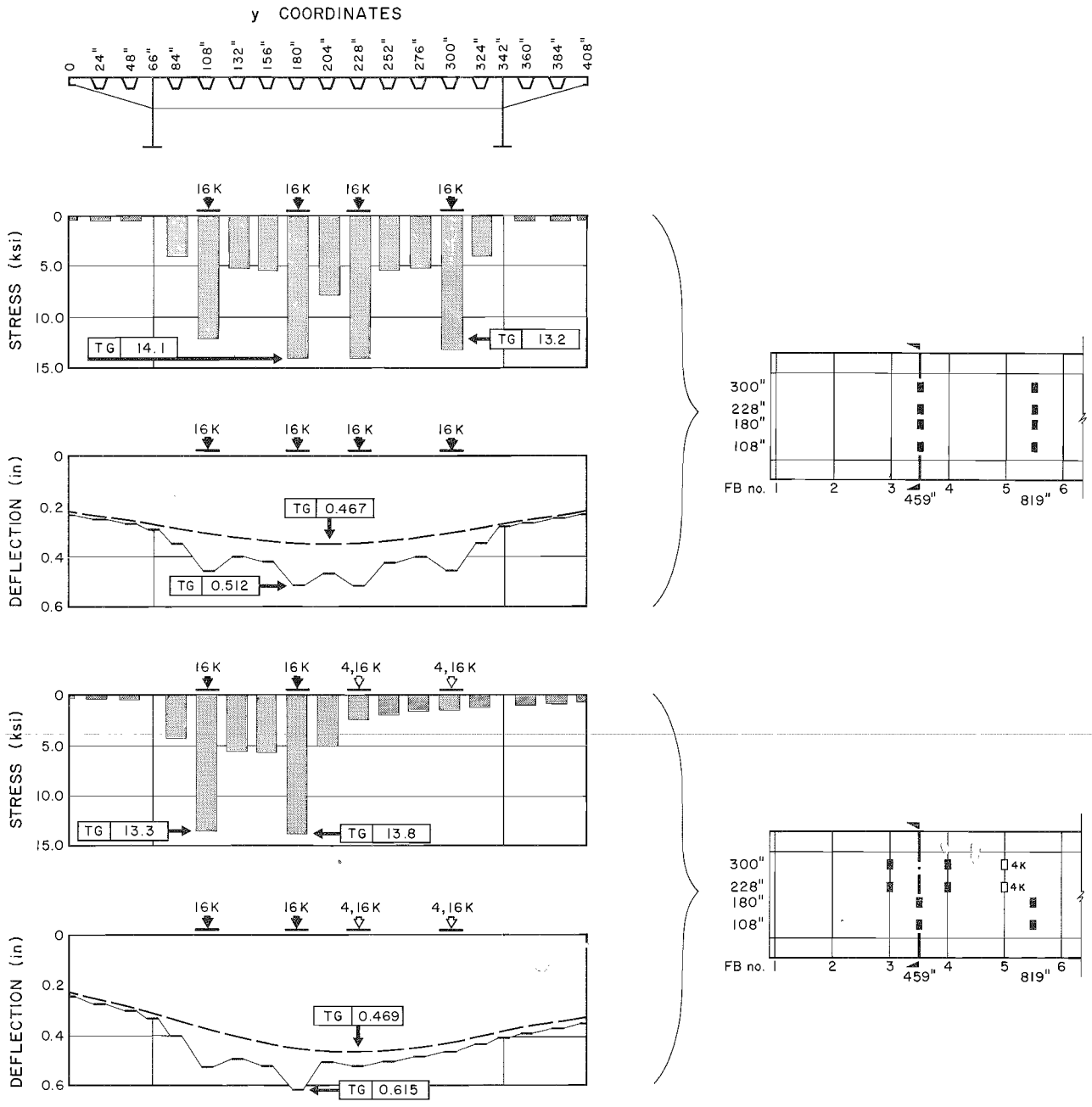
FIG. 112 COMPARISON OF THEORIES AND EXPERIMENTS FOR SINGLE LOADS, BRIDGE II



	ORTHO SLAB	GRID	EXPT.
RIB DEFLECTION AT (A) IN a - a	.196	.158	.171
RIB STRESS AT (A) IN a - a	12.6	11.8	12.2
RIB STRESS AT (A) IN b - b	-5.6	-5.5	*

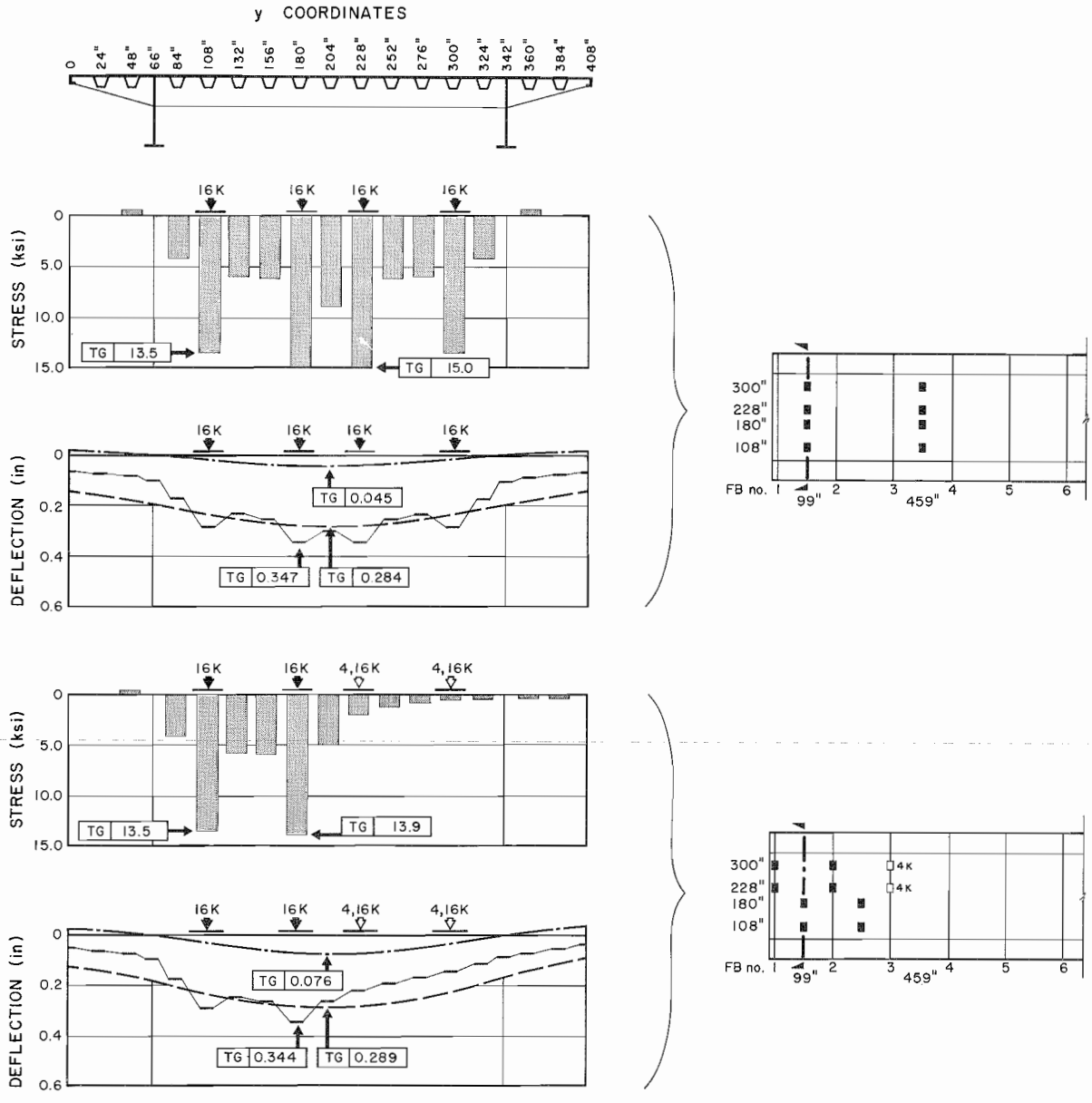
* NOT COMPARABLE BECAUSE OF LOCAL STRESS EFFECTS

FIG. 113 COMPARISON OF THEORIES AND EXPERIMENT FOR SINGLE LOADS, BRIDGE II



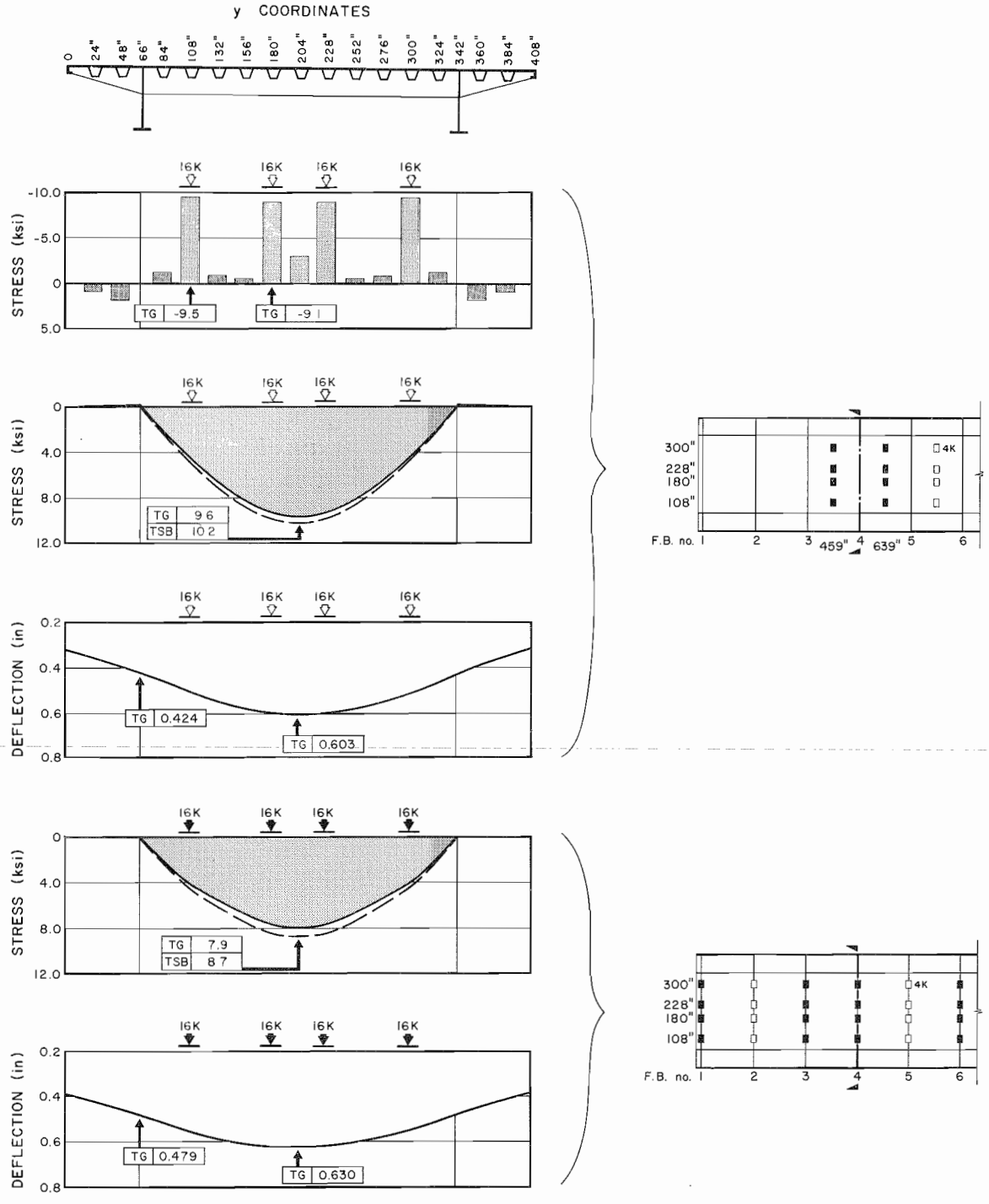
BARS = STRESS ON UNDERSIDE OF RIB, FROM GRID ANALYSIS.
—— = DEFLECTION OF RIB, FROM GRID ANALYSIS.
– – = DEFLECTION OF FLOOR BEAM Nº 4, FROM GRID ANALYSIS.
TG = STRESS OR DEFLECTION FROM GRID ANALYSIS.

FIG. 114 THEORETICAL RIB STRESSES AND DEFLECTIONS AT MID-PANEL UNDER TYPICAL LIVE LOADS, BRIDGE I.



BARS = STRESS ON UNDERSIDE OF RIB, FROM GRID ANALYSIS.
—— = DEFLECTION OF RIB, FROM GRID ANALYSIS.
– – = DEFLECTION OF FLOOR BEAM Nº 2, FROM GRID ANALYSIS.
–·– = DEFLECTION OF FLOOR BEAM Nº 1, FROM GRID ANALYSIS.
TG = STRESS OR DEFLECTION FROM GRID ANALYSIS.

FIG. 115 THEORETICAL RIB STRESSES AND DEFLECTIONS AT CENTER OF END PANEL UNDER TYPICAL LIVE LOADS, BRIDGE I.

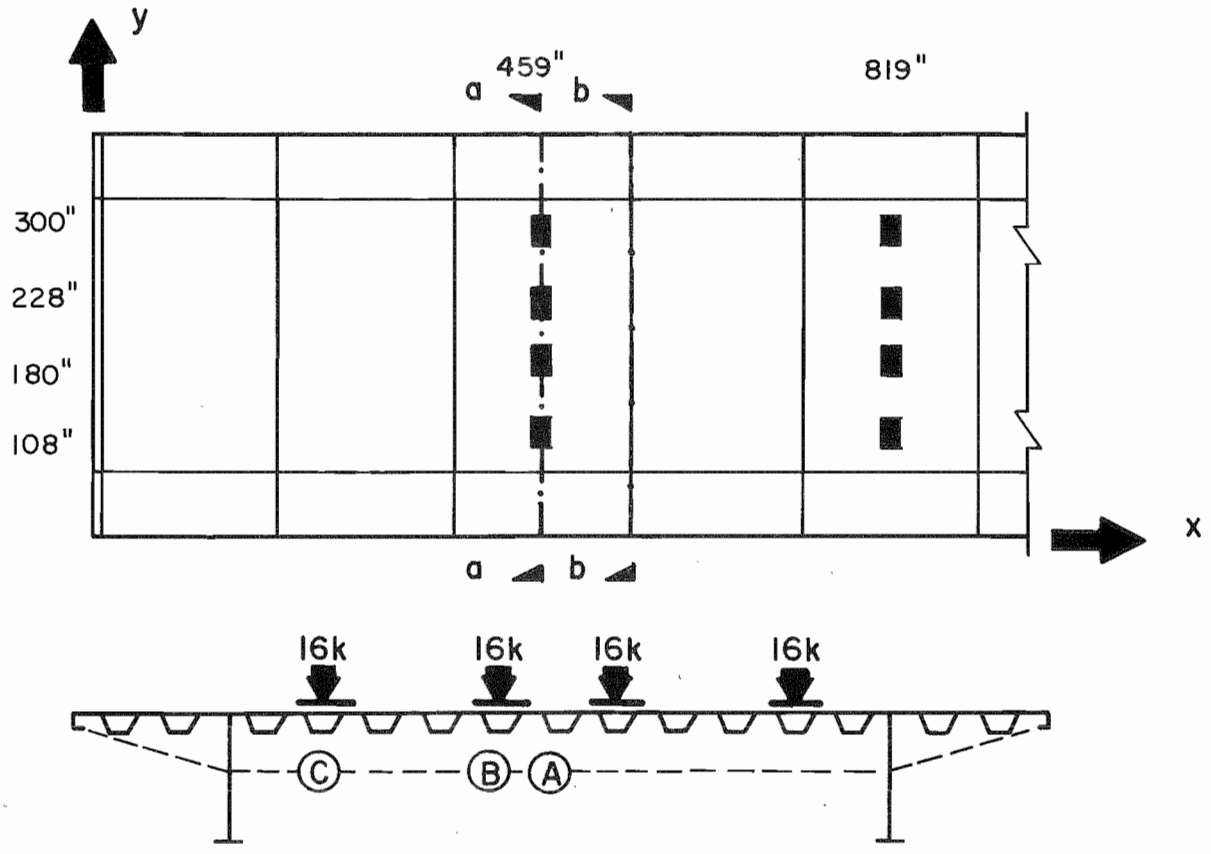


BARS, TG = STRESS ON UNDERSIDE OF RIB, FROM GRID ANALYSIS.

——, TG = STRESS ON UNDERSIDE OF BEAM, OR BEAM DEFLECTION, FROM GRID ANALYSIS.

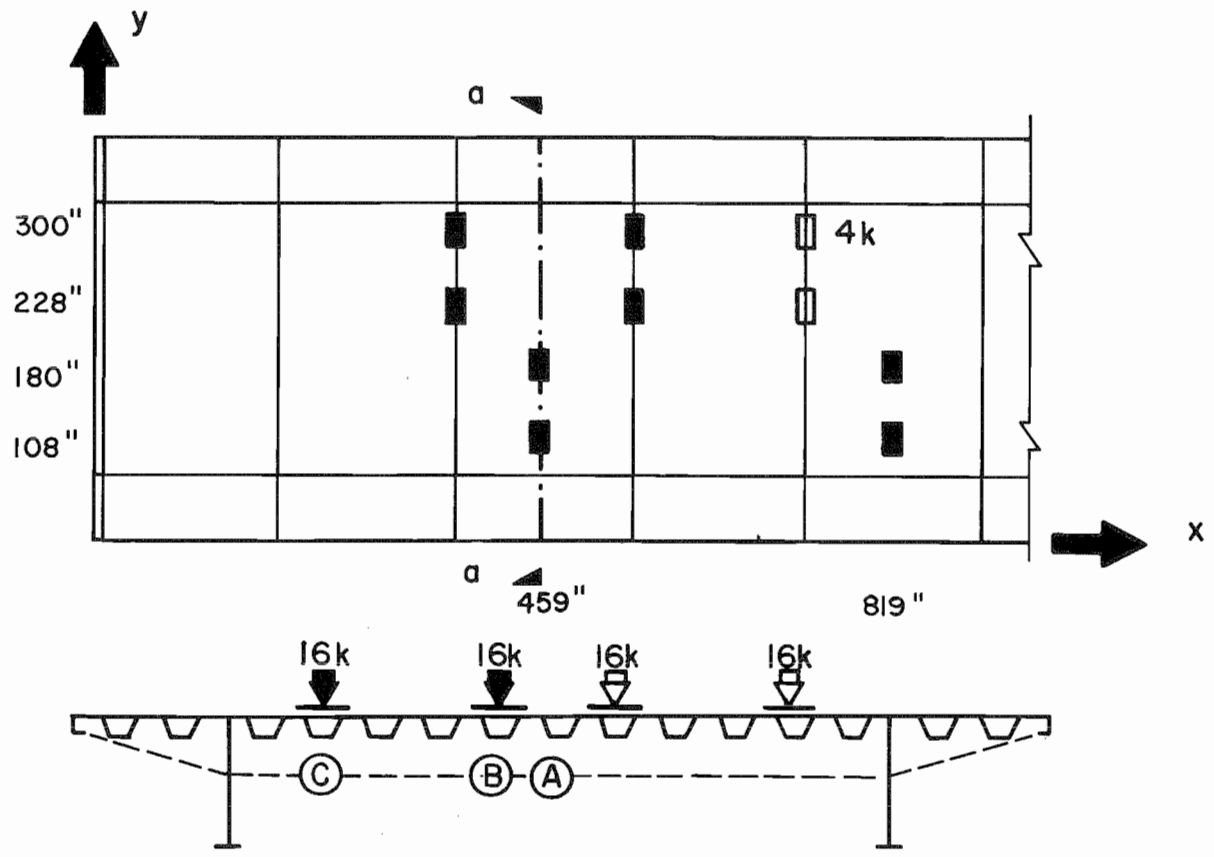
– – , TSB = STRESS ON UNDERSIDE OF BEAM ASSUMING RIGID, SIMPLY SUPPORTED BEAMS WITH NO MOMENT RELIEF.

FIG. 116 THEORETICAL STRESSES AND DEFLECTIONS AT FLOOR BEAM UNDER TYPICAL LIVE LOADS, BRIDGE I.



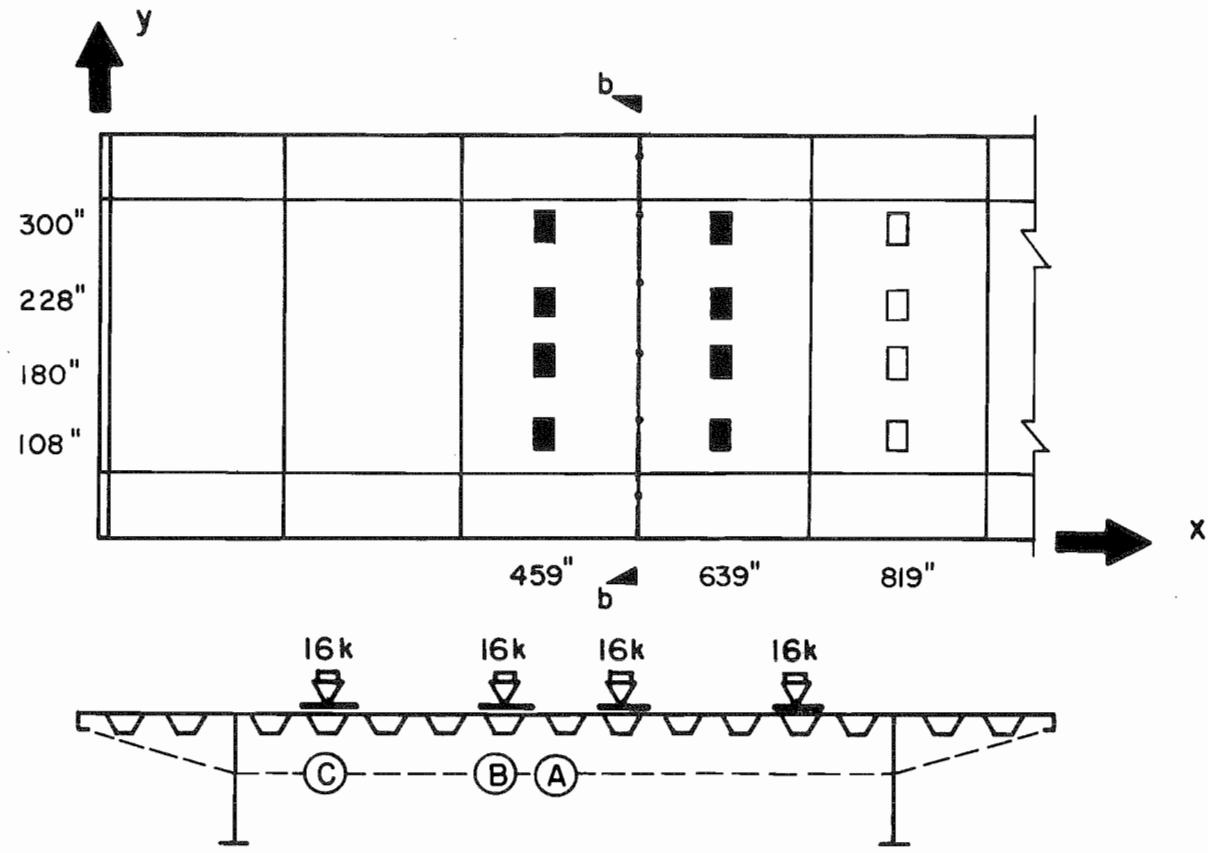
	ORTHO SLAB	GRID
RIB DEFLECTION AT (A) IN a - a	.189	.182
RIB DEFLECTION AT (B) IN a - a	.228	.227
RIB DEFLECTION AT (C) IN a - a	.171	.168
RIB STRESS AT (A) IN a a	8.2	7.7
RIB STRESS AT (B) IN a - a	12.7	14.2
RIB STRESS AT (C) IN a - a	11.7	13.2
RIB STRESS AT (B) IN b - b	5.0	4.4

FIG. 117 COMPARISON OF GRID AND ORTHOTROPIC SLAB ANALYSES UNDER TYPICAL LIVE LOADS, BRIDGE I



	ORTHO SLAB	GRID
RIB DEFLECTION AT Ⓐ IN a - a	.187	.184
RIB DEFLECTION AT Ⓑ IN a - a	.257	.243
RIB DEFLECTION AT Ⓒ IN a - a	.184	.176
RIB STRESS AT Ⓐ IN a - a	4.7	4.9
RIB STRESS AT Ⓑ IN a - a	12.3	13.8
RIB STRESS AT Ⓒ IN a - a	11.9	13.3

FIG. 118 COMPARISON OF GRID AND ORTHOTROPIC SLAB ANALYSES UNDER TYPICAL LIVE LOAD, BRIDGE I



	ORTHO SLAB	GRID
FLOOR BEAM DEFLECTION AT (A)	.179	.179
FLOOR BEAM FLANGE STRESS AT (A)	9.6	9.6
RIB STRESS AT (A) IN b - b	-5.2	-3.0
RIB STRESS AT (B) IN b - b	-9.8	-9.1
RIB STRESS AT (C) IN b - b	-10.3	-9.3

FIG. 119 COMPARISON OF GRID AND ORTHOTROPIC SLAB ANALYSES UNDER TYPICAL LIVE LOAD, BRIDGE I

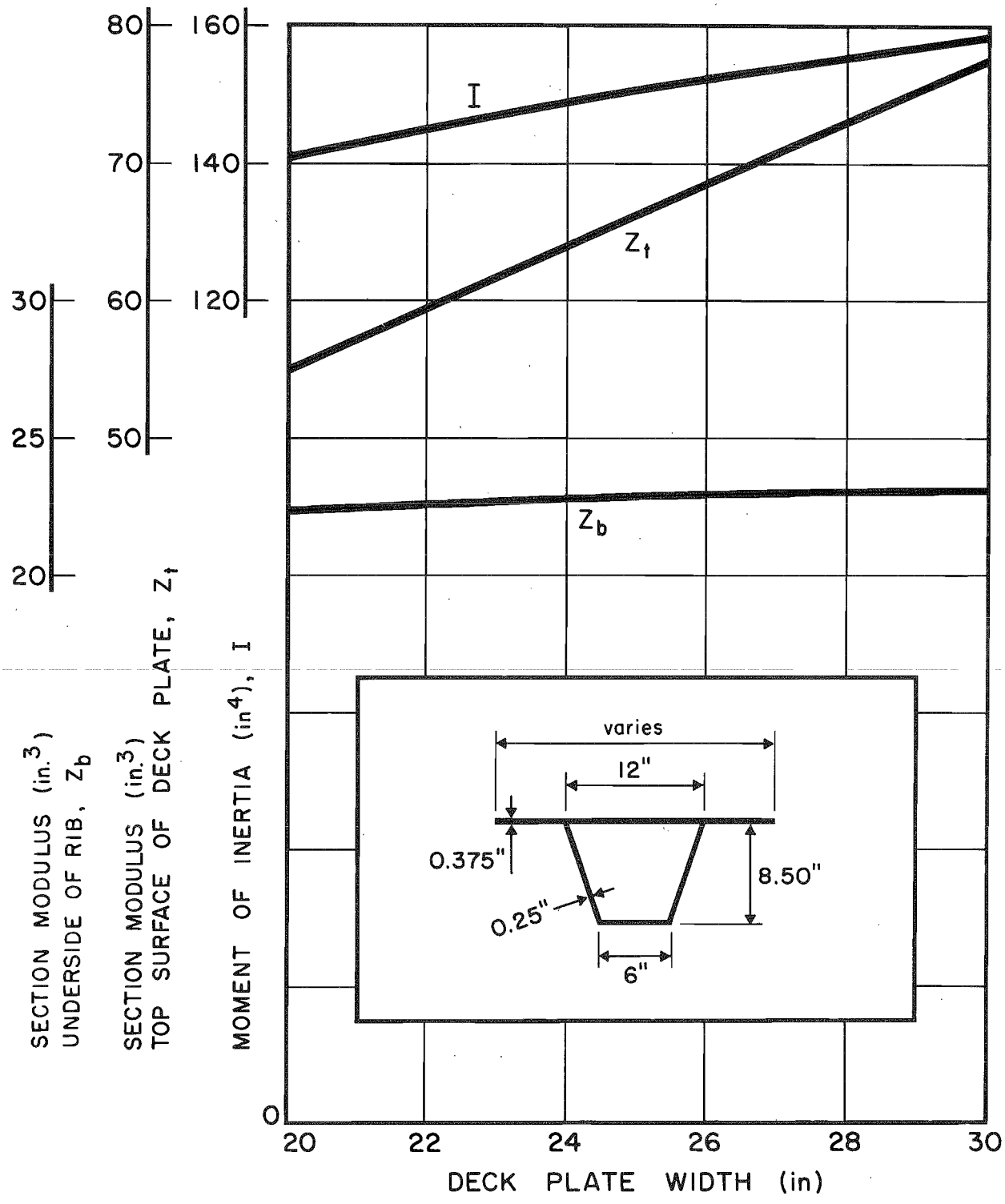


FIG. A1 INFLUENCE OF DECK PLATE EFFECTIVE WIDTH ON RIB PROPERTIES. BRIDGE I.

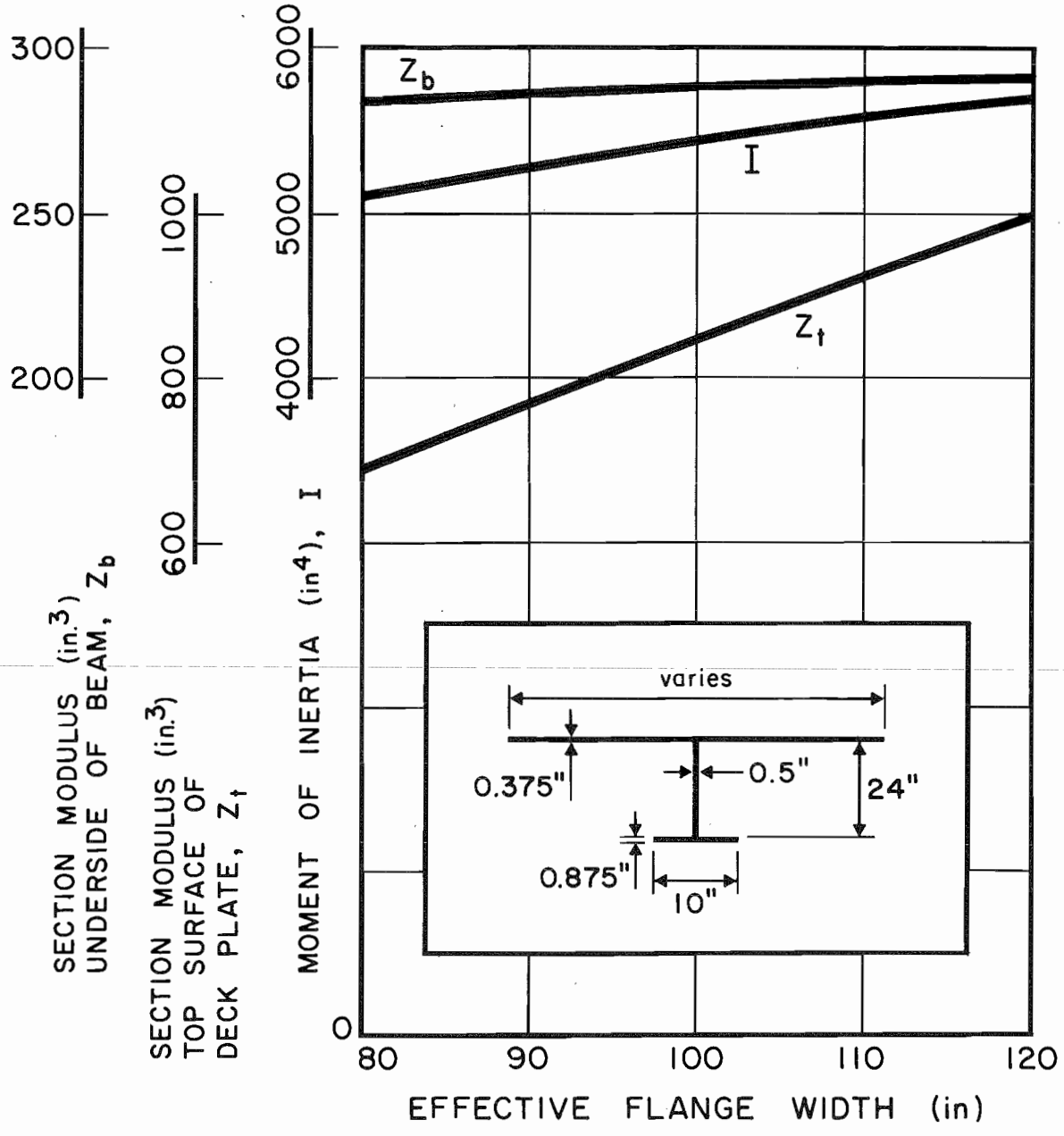
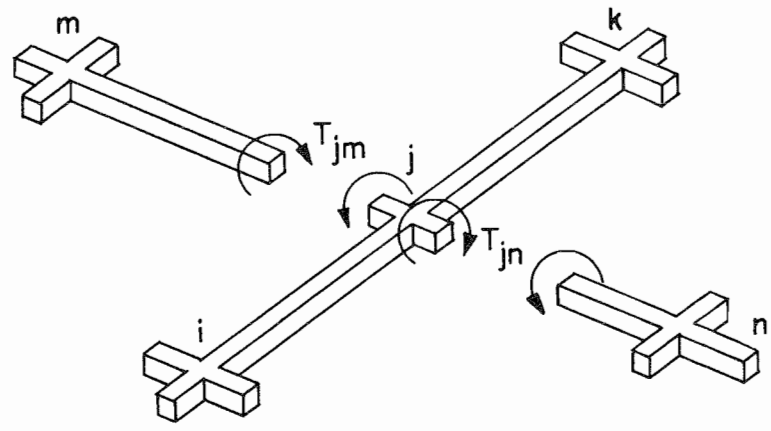
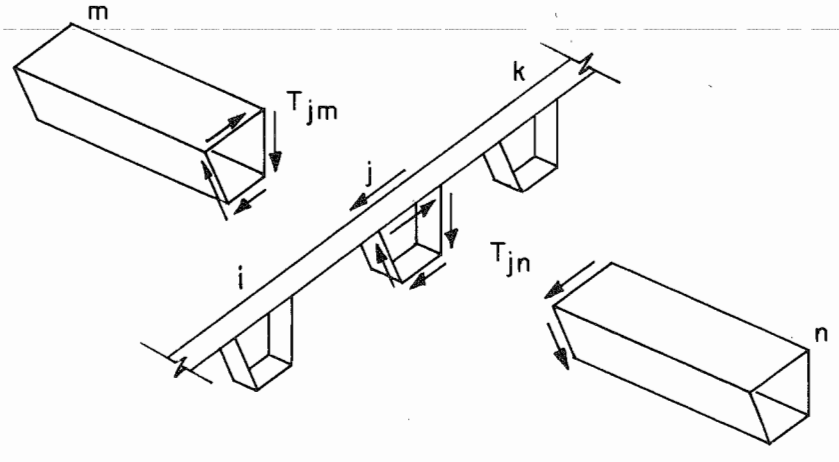


FIG. A2 INFLUENCE OF DECK PLATE EFFECTIVE WIDTH ON FLOOR BEAM PROPERTIES. BRIDGE I.

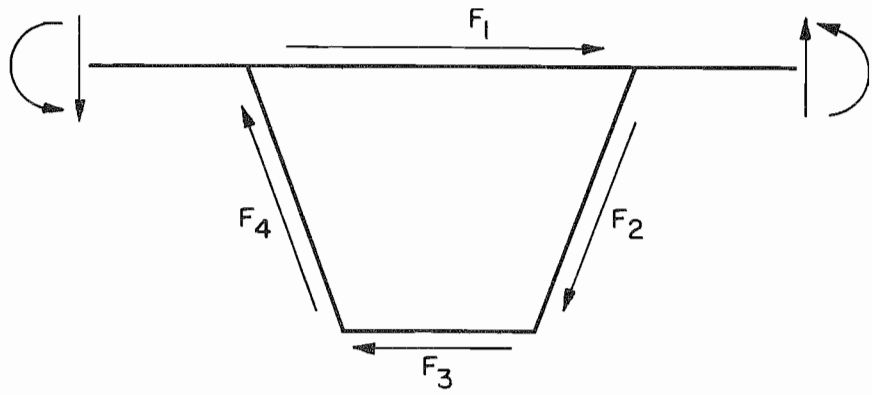


(a)

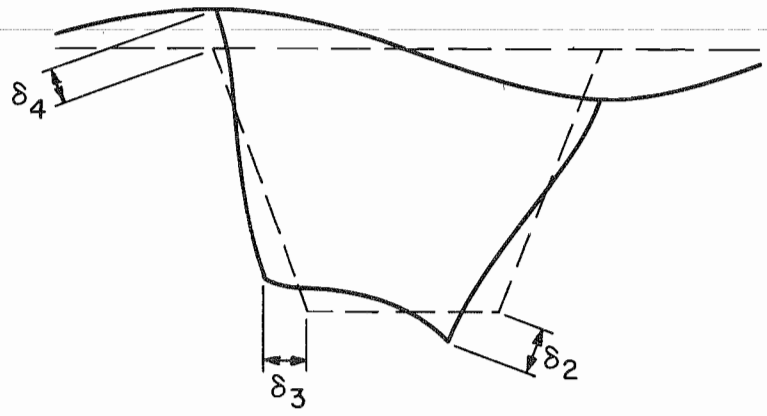


(b)

FIG. A3 TRANSFER OF MOMENT BETWEEN GRID MEMBERS.



(a)



(b)

FIG. A4 DEFORMATION OF RIB BY SHEAR FLOW FORCES.

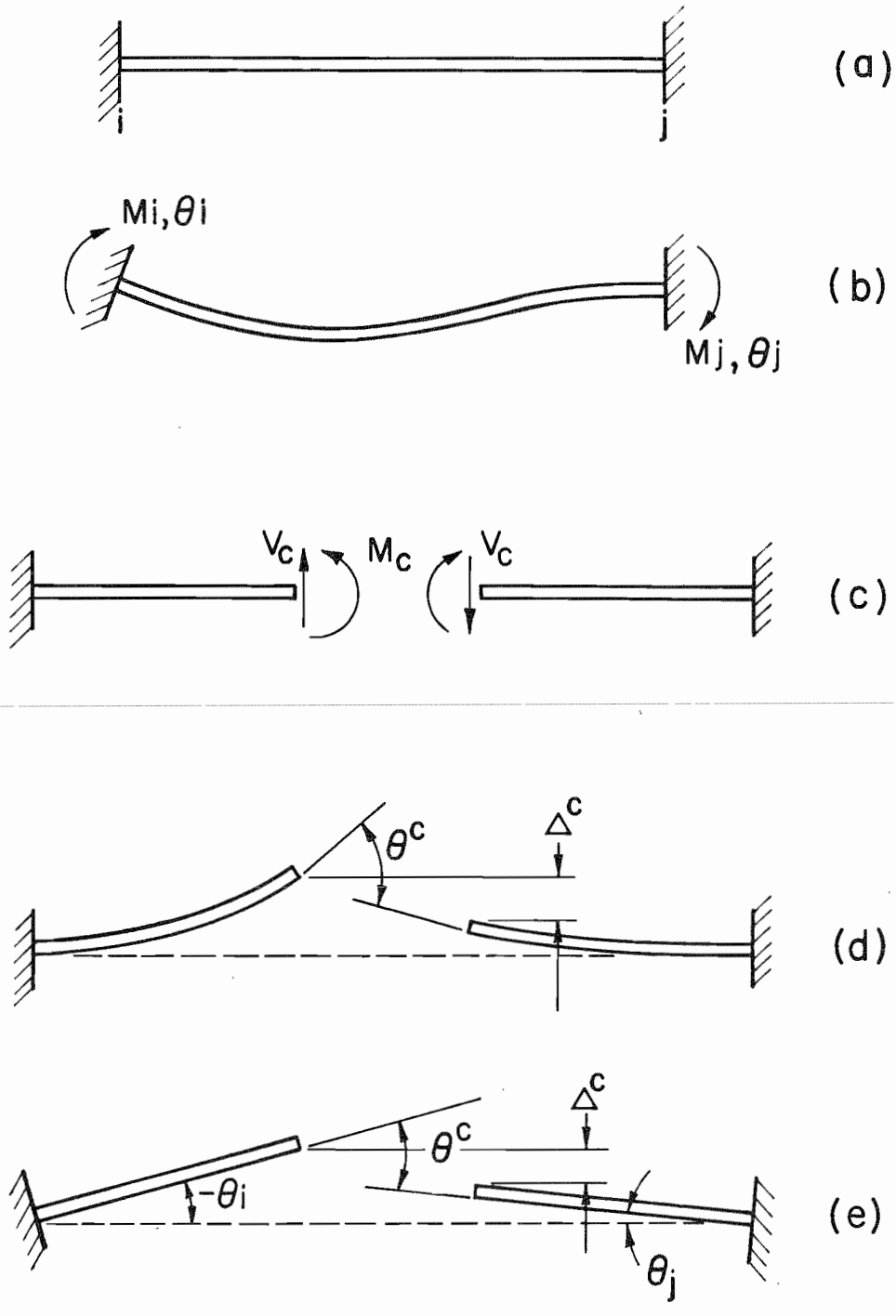


FIG. A5 DETERMINATION OF GRID MEMBER STIFFNESS

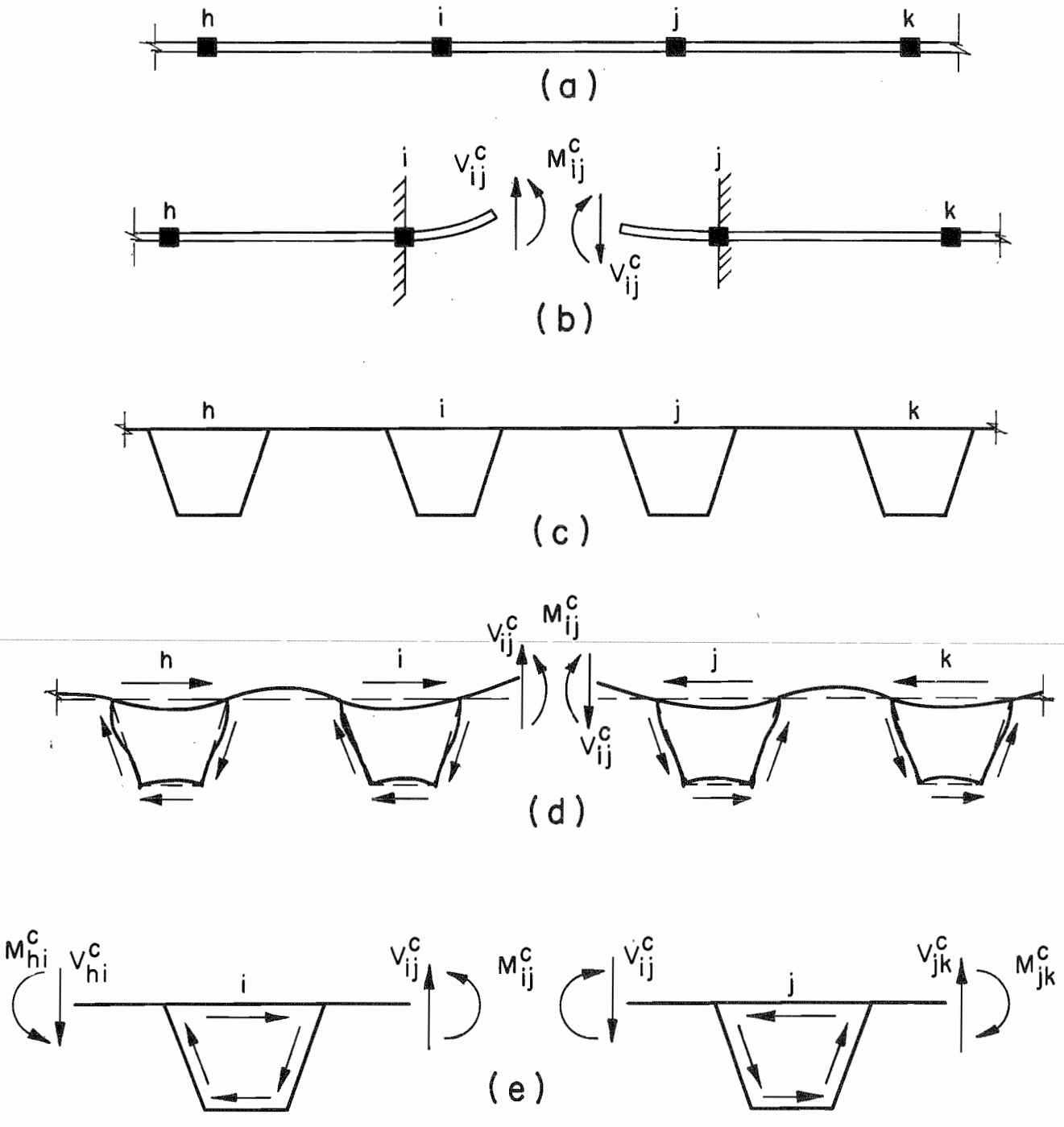


FIG. A6 STIFFNESS DETERMINATION FOR TRANSVERSE DECK STRIP.

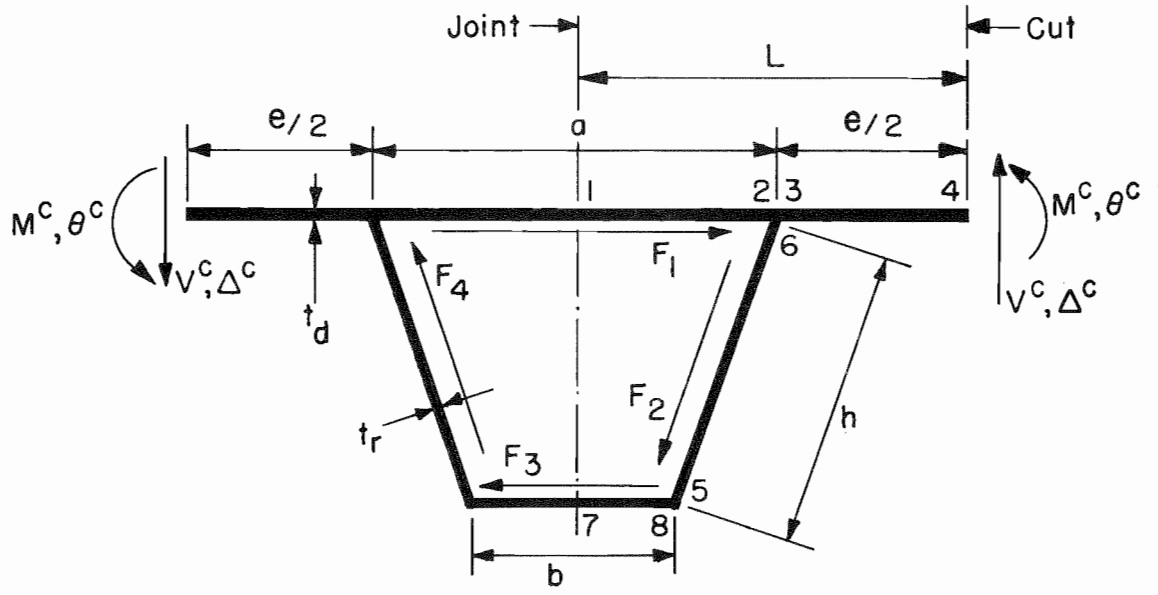


FIG. A7 RIB GEOMETRY, LOADS AND SUPPORTING FORCES FOR DETERMINATION OF FLEXIBILITY MATRIX.

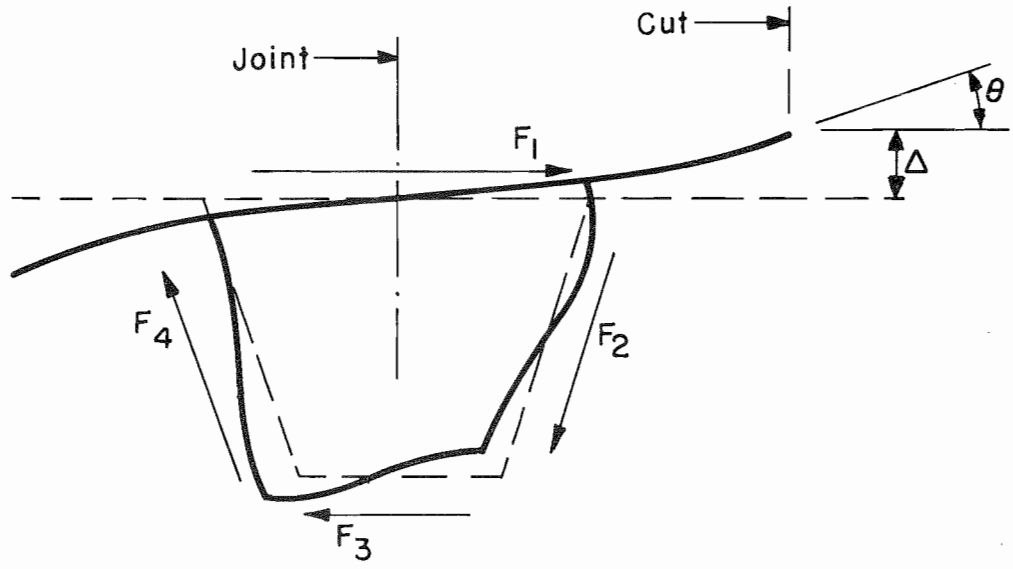


FIG. A8 RIB DEFORMATION FOR ZERO JOINT ROTATION.

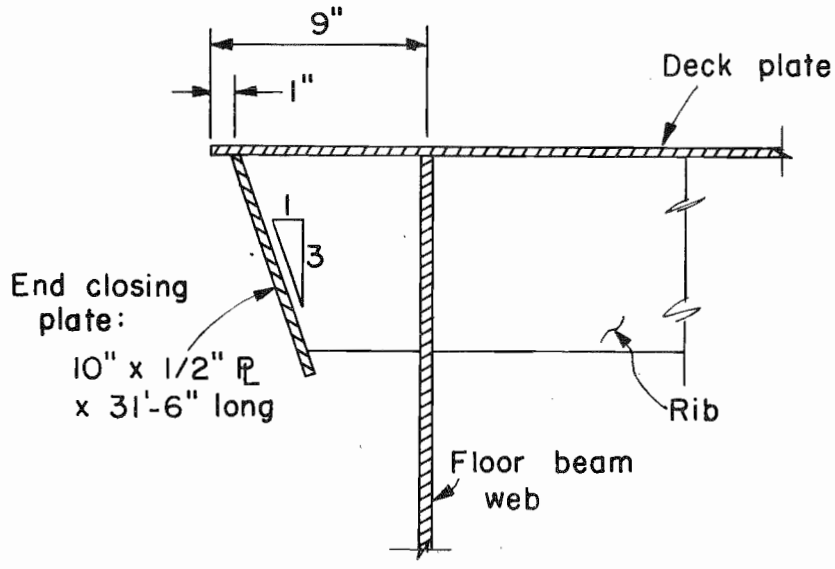


FIG. A9 CROSS SECTION AT END OF BRIDGE.

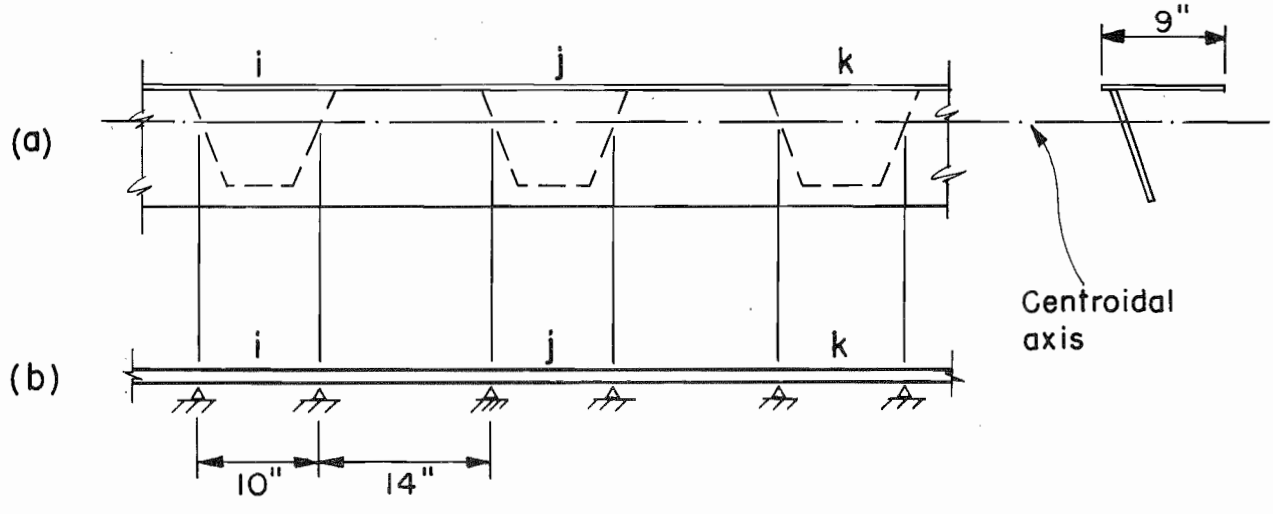


FIG. A10 CROSS SECTION AND SUPPORT CONDITION OF MEMBER REPRESENTING END CLOSING PLATE.

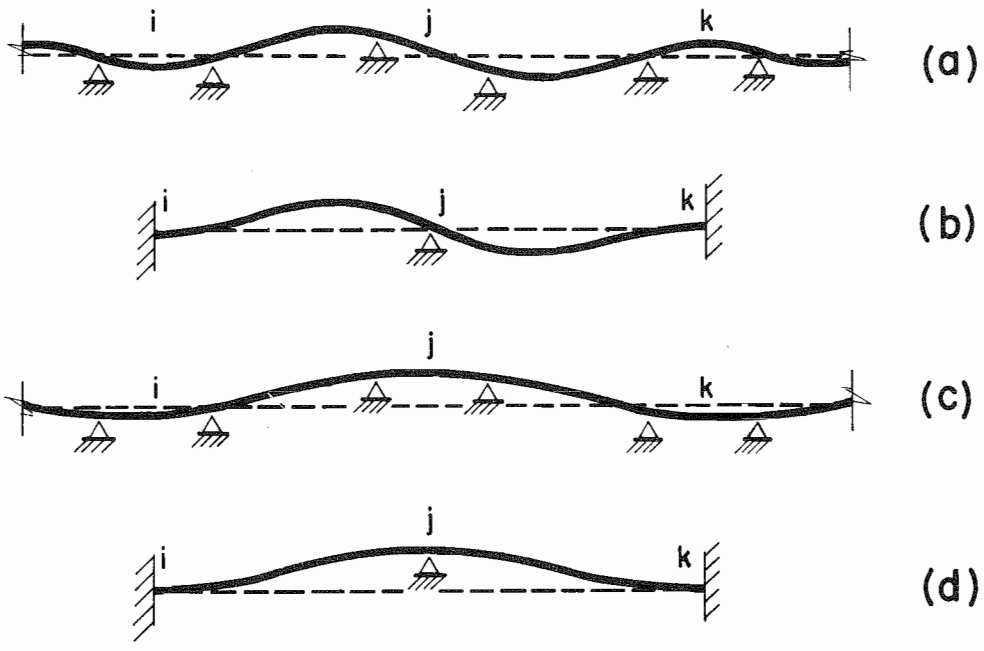


FIG. A11 ESTIMATION OF EQUIVALENT STIFFNESS FOR END CLOSING PLATE

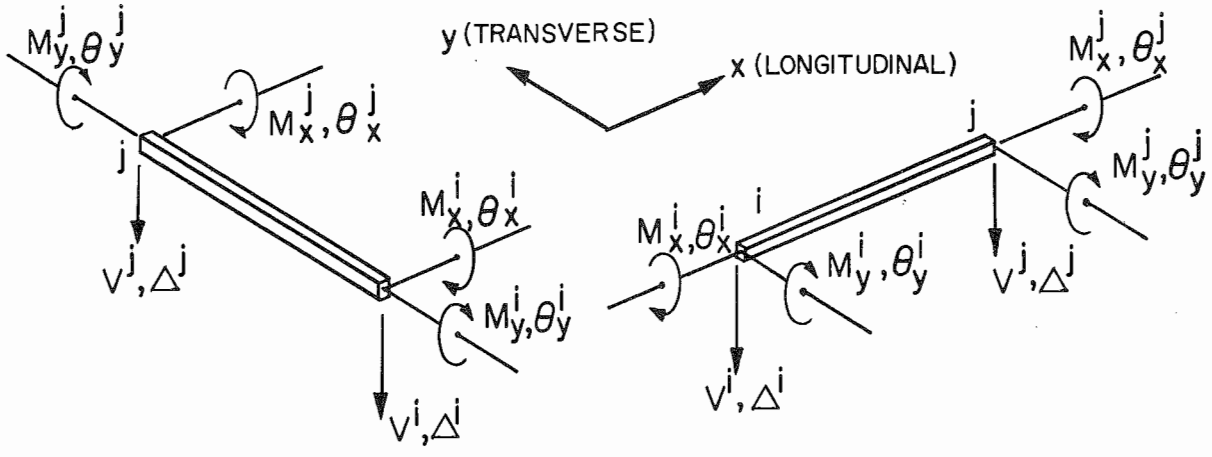


FIG. A12 LONGITUDINAL AND TRANSVERSE GRID MEMBERS

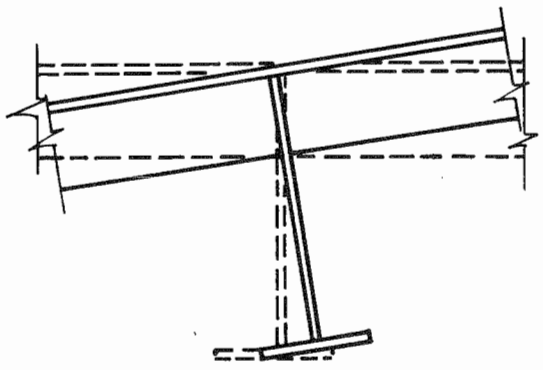
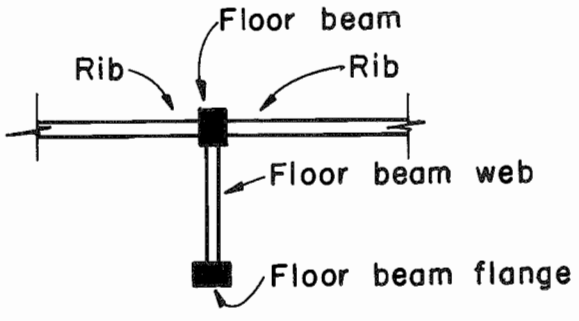
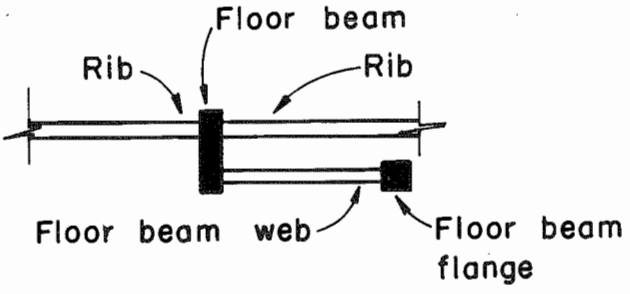


FIG. A13 EFFECT OF RIB ROTATION ON FLOOR BEAM



(a)



(b)

FIG. A14 ROTATION OF FLOOR BEAM WEB MEMBER INTO PLANE OF GRID

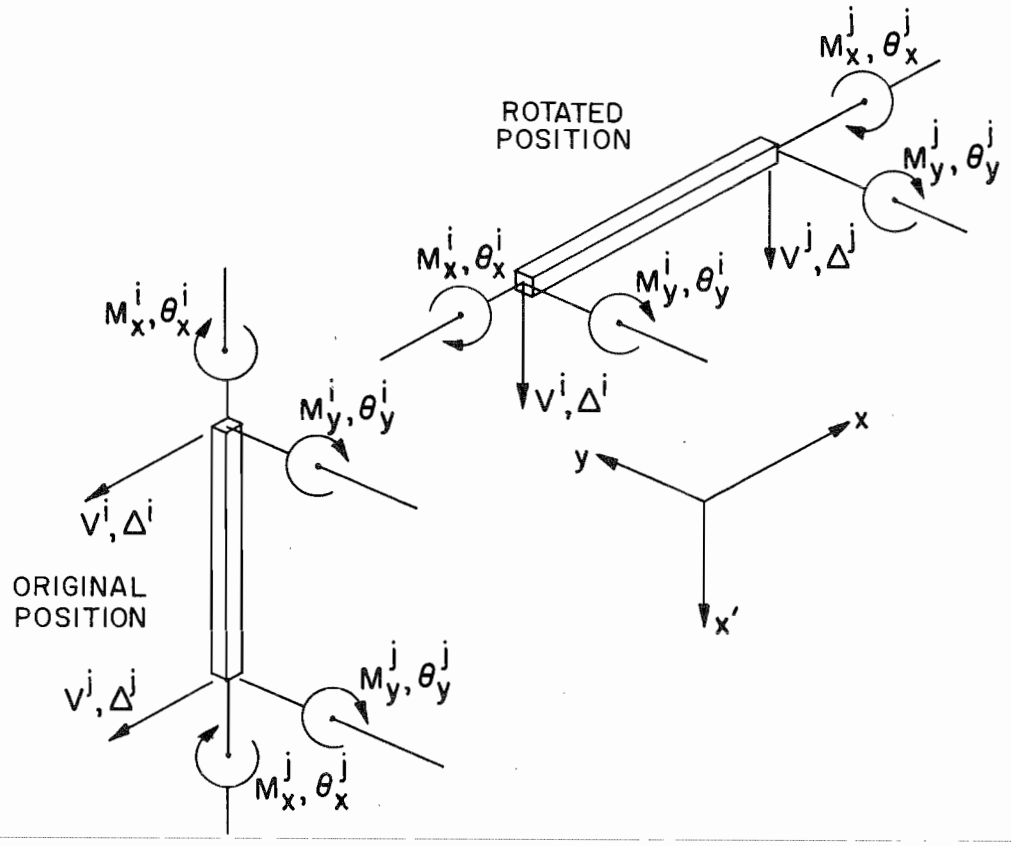


FIG. A15 ACTIONS AND DISPLACEMENTS OF WEB MEMBER IN ORIGINAL AND ROTATED POSITIONS.

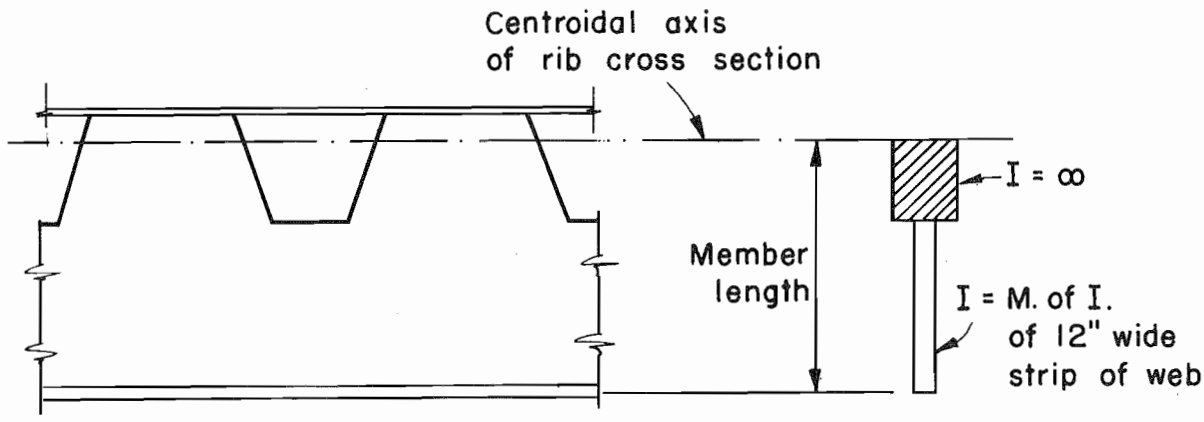


FIG. A16 GRID MEMBER REPRESENTING FLOOR BEAM WEB.

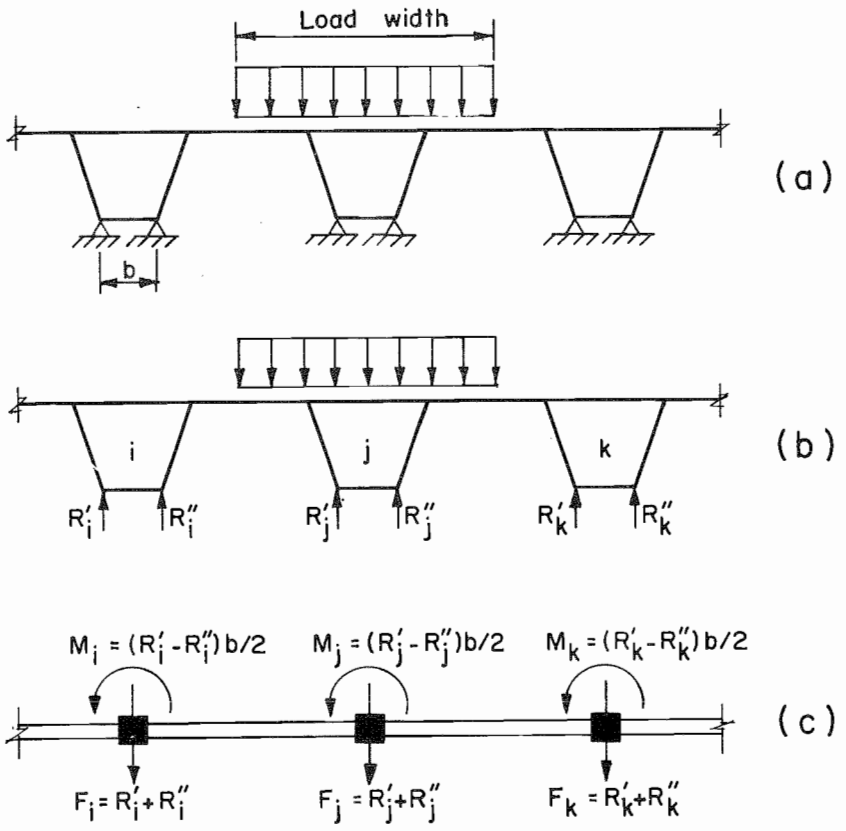


FIG. A17 TRANSVERSE DISTRIBUTION OF LOADS TO GRID JOINTS.

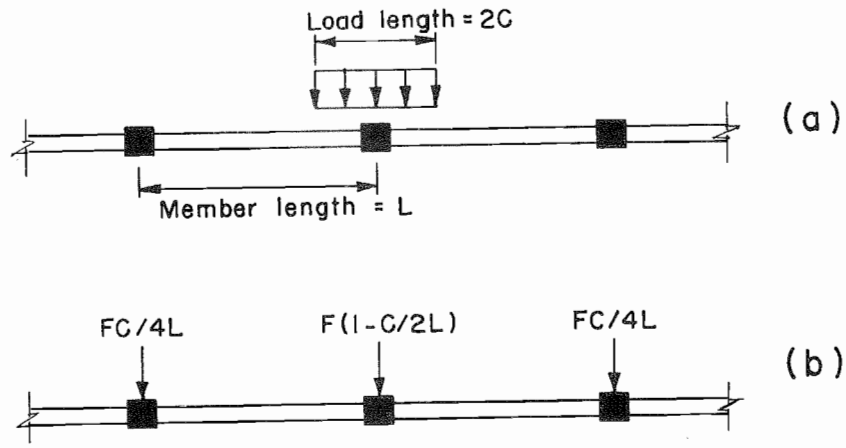


FIG. A18 LONGITUDINAL DISTRIBUTION OF LOADS TO GRID JOINTS.

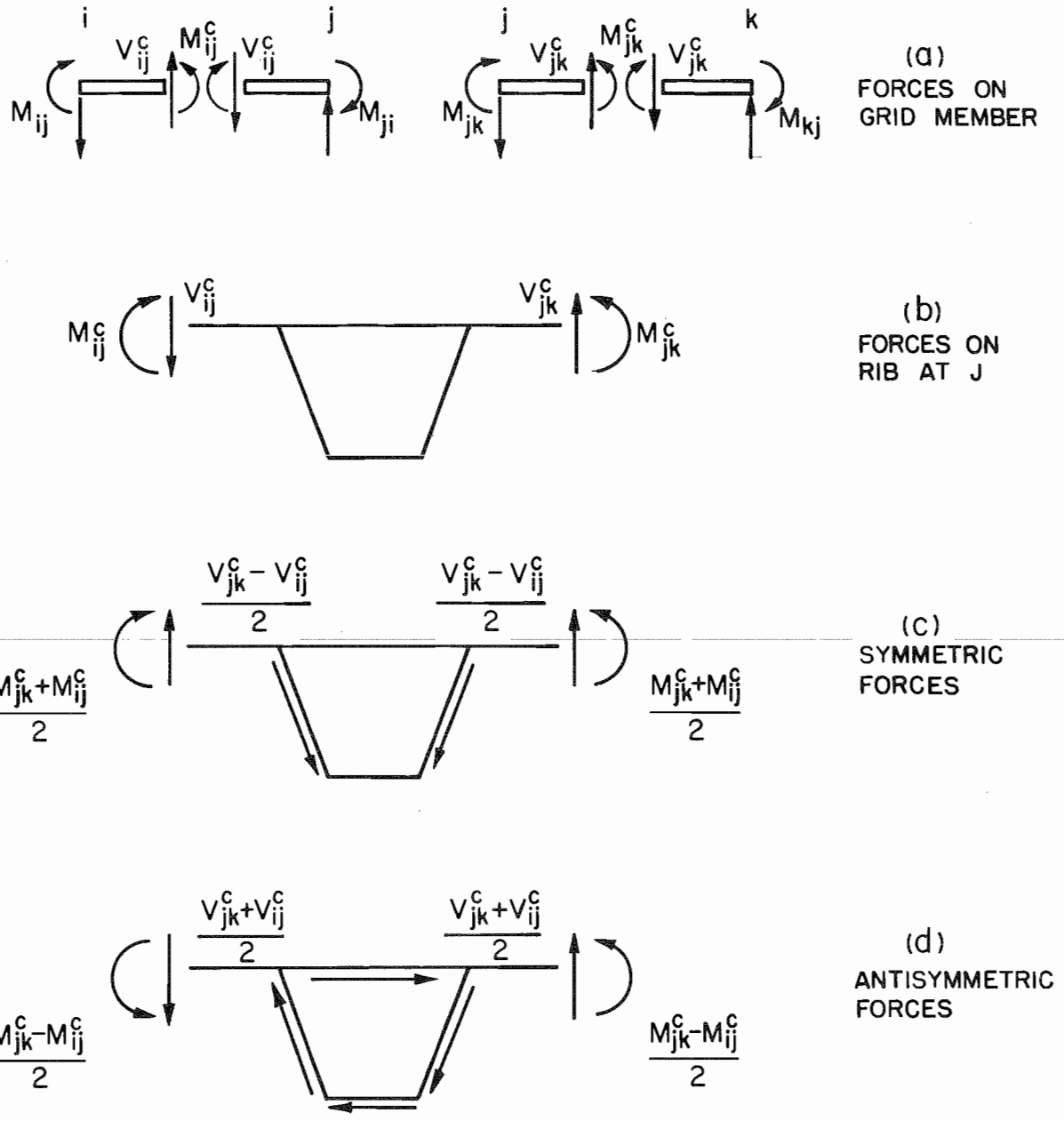


FIG. A 19 CONVERSION FROM GRID ACTIONS TO BENDING MOMENTS IN RIB WALLS

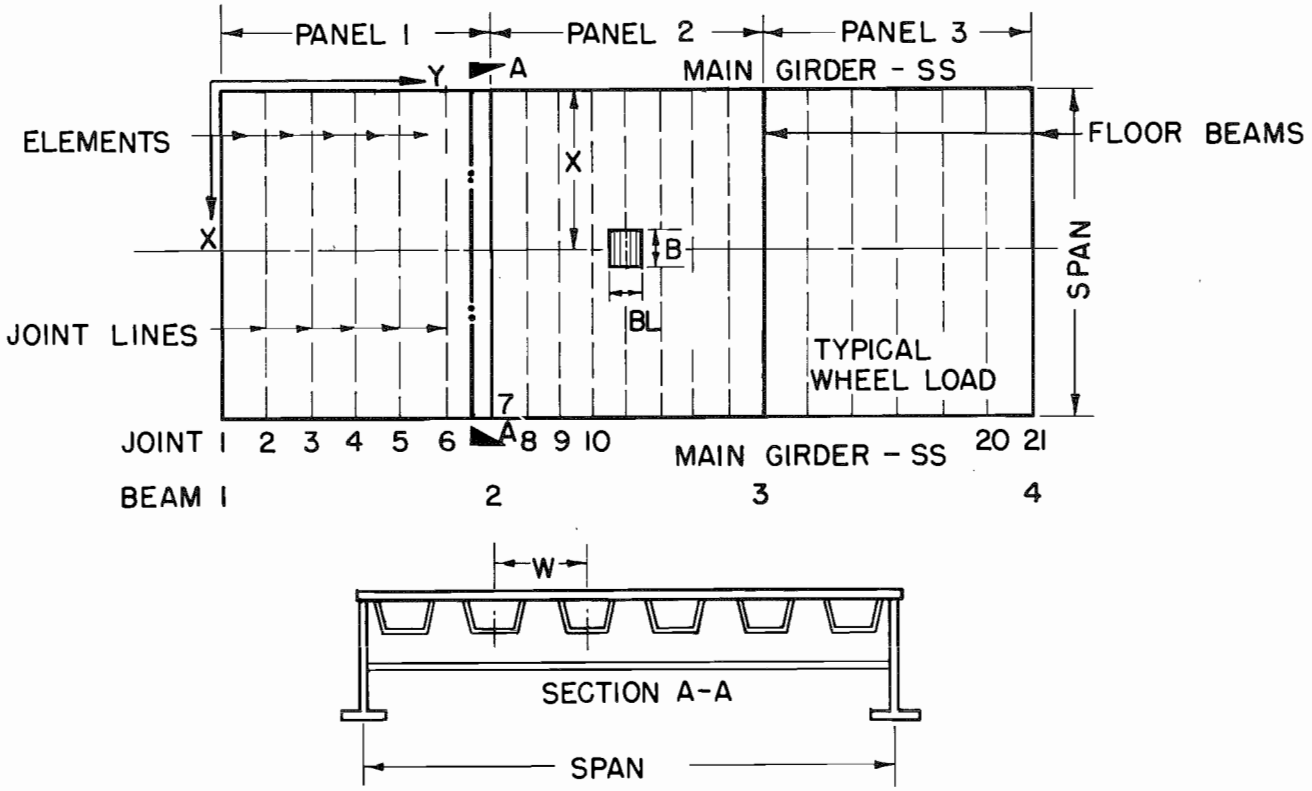


FIG. D1 STRUCTURE IDEALIZATION

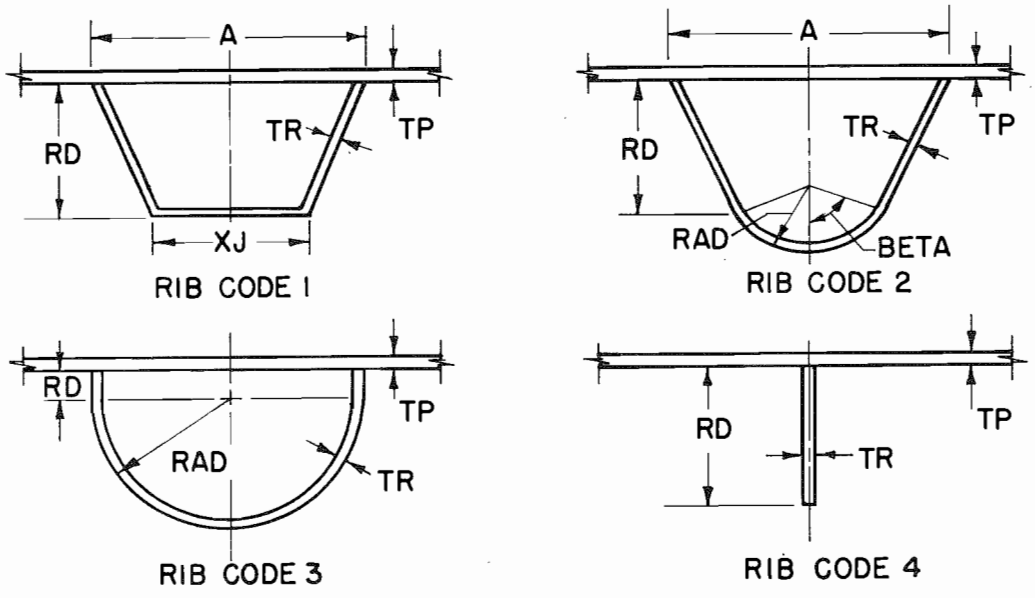


FIG. D2 RIB TYPES