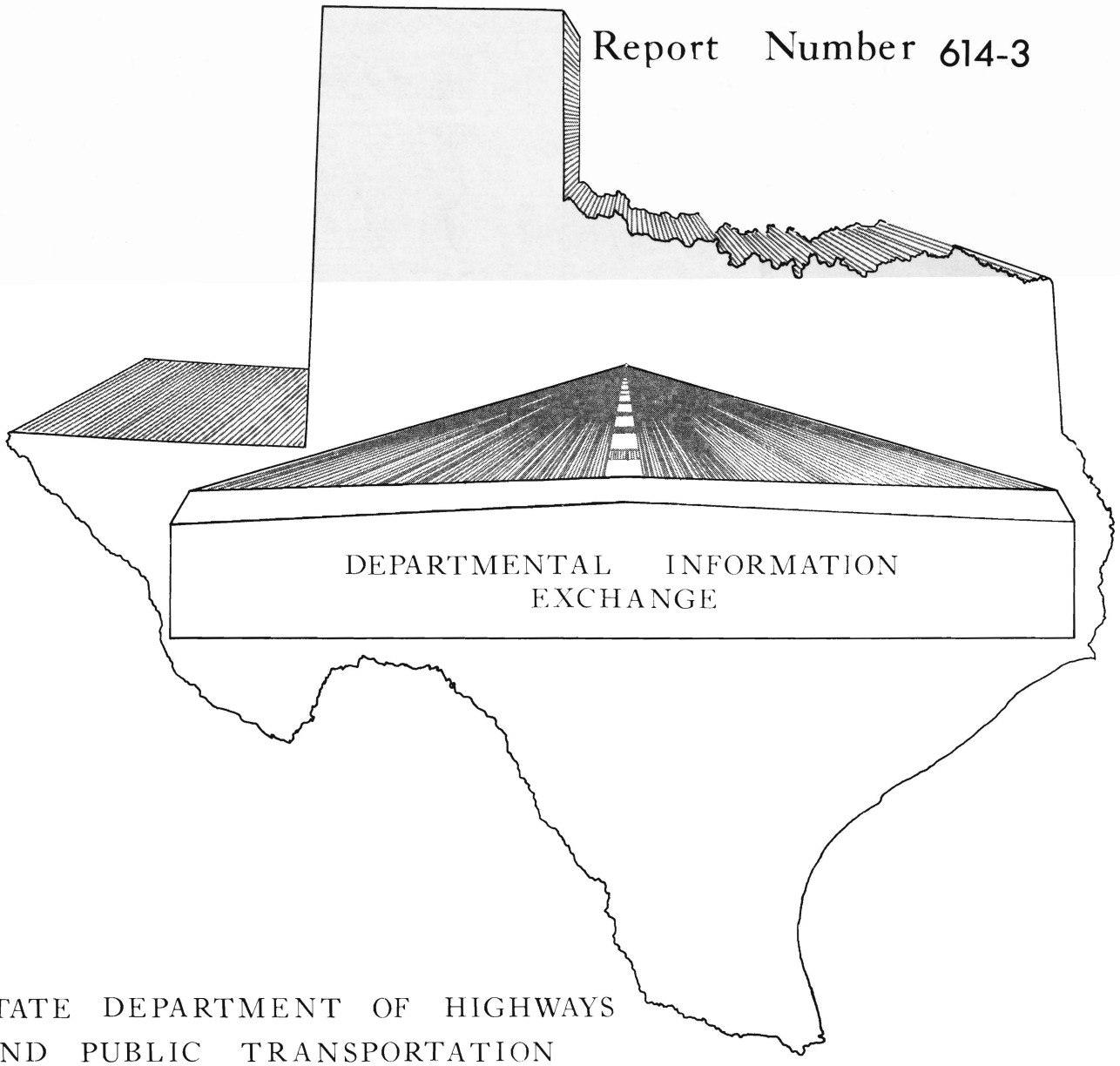
EXPERIMENTAL PROJECTS

POLYMER IMPREGNATED CONCRETE BRIDGE DECK –BIG SPRING, TEXAS

Report Number 614-3



STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

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FHWA Experimental Project No. TX 75-04

16. Abstract

The performance of a polymer impregnated bridge deck was evaluated for a period of five years. Visual inspections and corrosion potential measurements were made annually. Three sections of the deck were left untreated for comparison of durability, resistance to chemical intrusion, and any subsequent corrosion.

The polymer impregnated bridge deck is performing satisfactorily after five years in service. Significant longitudinal slab cracking was observed approximately one year after the bridge was opened to traffic. This cracking has not resulted in any corrosion of the reinforcing steel even though the deck receives 25-30 applications of salt per year. There has been no discernable difference between the performance of the treated and untreated sections.

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POLYMER IMPREGNATED BRIDGE DECK

BIG SPRING, TEXAS

By

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Supervising Office Engineer

State Department of Highways and Public Transportation

Bridge Division

Austin, Texas

Experimental Projects Report No. 614-3

Work done in Cooperation with
U.S. Department of Transportation
Federal Highway Administration

FHWA Experimental Project
No. Tx 75-04

"Polymer Impregnation of
Bridge Deck"

January 1983

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Polymer Impregnated Concrete Bridge Deck
Big Spring, Texas

Chloride induced corrosion of the top mat of reinforcing steel and the resulting deterioration of concrete bridge decks has been, and continues to be, one of the major maintenance problems faced by highway agencies. Numerous methods for protecting concrete bridge decks against chloride intrusion have been tried in the past. The performance of one of these protection methods, partial-depth polymer impregnation, is the subject of this report.

Background

In 1971, the University of Texas' Center for Transportation Research, in cooperation with the Texas State Department of Highways and Public Transportation (SDH&PT) and the Federal Highway Administration (FHWA), began a research study entitled "Polymer Concrete - Highway Applications." One of the results of this study was the development of a method for partial-depth polymer impregnation of a concrete bridge deck. Laboratory tests, combined with a limited amount of field testing, indicated that partial-depth impregnation of concrete with a polymer could significantly increase its ability to resist the intrusion of chlorides and other potentially damaging chemicals.

As the research at the University of Texas was nearing completion, the SDH&PT was designing a railroad overpass in Big Spring, Texas. Big Spring is located in an area that experiences several freeze-thaw cycles per year and bridges may be subjected to numerous applications of deicing salt. Newly constructed bridge decks in this area are generally protected by the Texas Bridge Deck Protection System, a two course asphaltic surface treatment with an asphaltic concrete wearing surface. The bridge in Big Spring, however, is on a relatively steep grade, 4-6.5%, which precluded the use of an asphaltic overlay. After due con-

sideration, it was decided that partial-depth polymer impregnation would be used to seal this deck. Since this method for protecting bridge decks against deicing chemicals had not been approved by the FHWA, the bridge was constructed as an FHWA Category II experimental project.

Objective and Work Plan

The objective of this experimental project was to evaluate and document the construction and performance of a full sized polymer impregnated bridge deck. Three sections of the deck were left untreated to afford a performance comparison of durability, resistance to chemical intrusion, and any subsequent steel corrosion.

The work plan for accomplishing the objectives of this project was as follows:

1. Provide a complete evaluation of the equipment and construction methods used for the polymer impregnation.

2. Obtain cores from the impregnated deck to ascertain the actual depth of polymer impregnation.

3. Make periodic in-depth inspections of the impregnated deck for a period of five years.

4. Make corrosion potential measurements in conjunction with the inspections.

5. Map any significant cracks that occur.

Items 1 and 2 of the work plan were accomplished as a part of Research Study FCIP 1-10-75-508, "Evaluation of Polymer Impregnation of New Bridge Decks." The results of this work were reported in Research

Report No. 508-2F, "Polymer Impregnation of New Concrete Bridge Decks," dated October 1977.

Description of Bridge

The experimental bridge carries Owens Street (Texas State Highway 350) over the Texas and Pacific Railroad in Big Spring, Texas. The 1979 ADT was 8200 vehicles per day at this location. The overall length of the bridge is 751 ft. There is a 296 ft. continuous prestressed concrete beam unit (74ft.-74ft.-74ft.-74ft.) at each end of the bridge with one 50 ft. and one 100 ft. prestressed concrete beam span in the center of the bridge. SDH&PT Type C beams are used in all spans except the 100 ft. span which has SDH&PT Type 54 beams. The slab thickness for all spans is 7 $^{3}/_{4}$ in. The overall width of the bridge is 70 ft.-9 in. with a 64 ft.-0 in. clear roadway width and a 4 ft.-0 in. sidewalk along one side. Only the 64 ft.-0 in. roadway received the polymer impregnation treatment.

Corrosion Potential Surveys

A corrosion potential survey, using a copper sulfate half-cell as the reference electrode, was made each year of the five-year evaluation period. The first survey was made before any salt was applied to the deck. Subsequent surveys did not reveal any indications of active corrosion. The data for all surveys may be found in Appendix A.

Crack Surveys

Crack surveys were made before and soon after polymerization, and the results were reported in FCIP Report 508-2F. A slight increase in cracking was found after polymerization was completed; however, this increase could not be positively related to the polymerization.

Some of the increase in cracking found after polymerization was attributed to longitudinal cracks that had been formed. During the 1978

inspection, approximately one year after the bridge was opened to traffic, a significant increase in longitudinal cracking was observed. A crack survey was made and the plotted results are shown in Appendix B. It can be seen in these plots that most of the cracking is in the longitudinal direction. One cause for this longitudinal cracking might be the lack of a longitudinal joint in the wide deck, 70 ft.-9 in. overall. It could not be determined whether or not this cracking is related to the heat required for drying the concrete and subsequent polymerization of the monomer system. There has been no apparent change in either the amount of cracking or the size of the cracks since the 1978 survey.

Conclusions

Based upon the results of tests and observations made during a five-year evaluation period, the following statements are made:

1. The polymer impregnated concrete bridge deck in Big Spring, Texas continues to perform satisfactorily after five years in service.

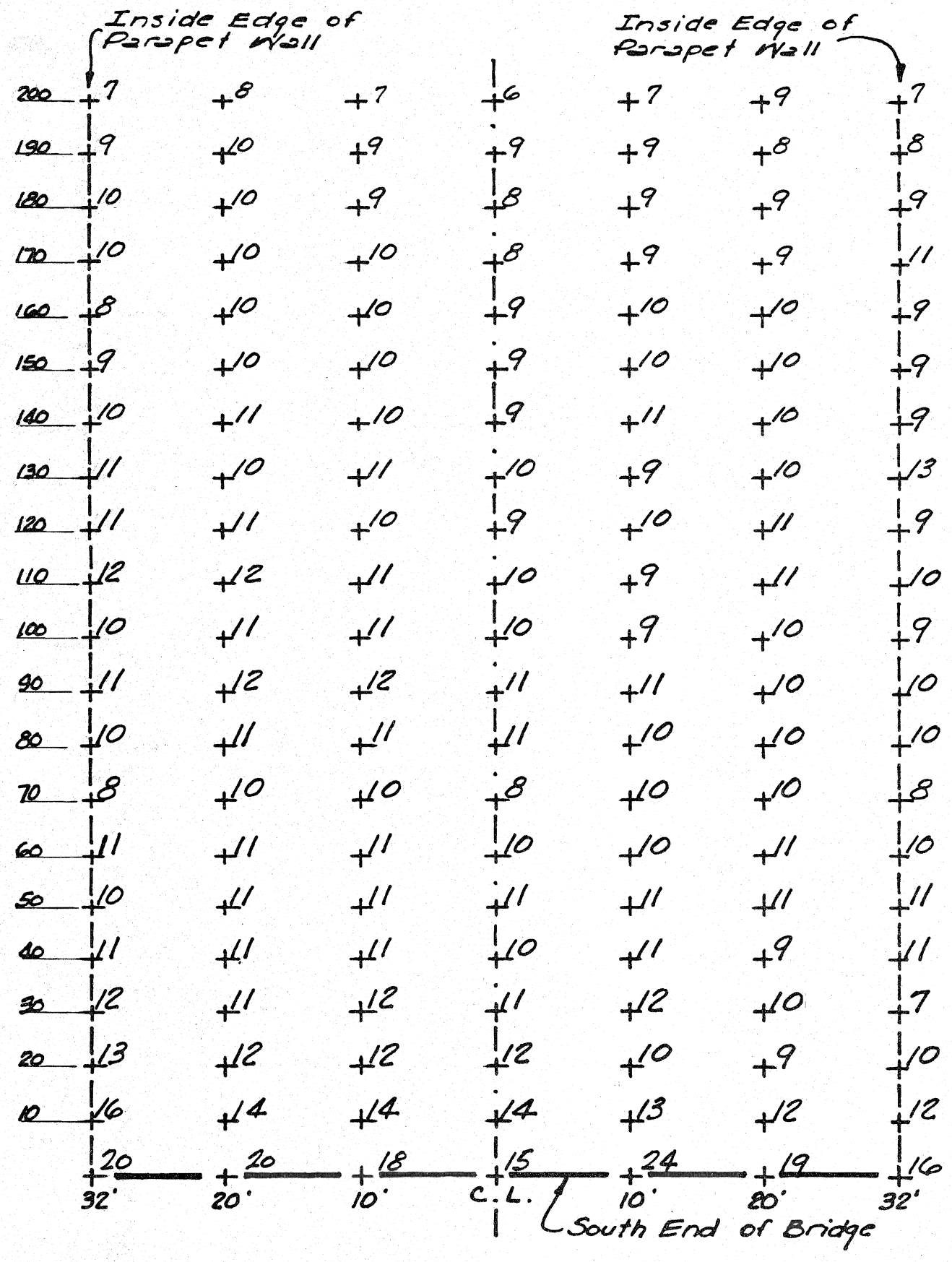
2. There was no evidence of reinforcing steel corrosion found during any of the corrosion potential surveys.

3. The reported increase in concrete tensile strength due to polymer impregnation was not sufficient to prevent cracking of the Owens Street slab.

4. There does not appear to have been any significant increase in the amount of slab cracking since the 1978 crack survey.

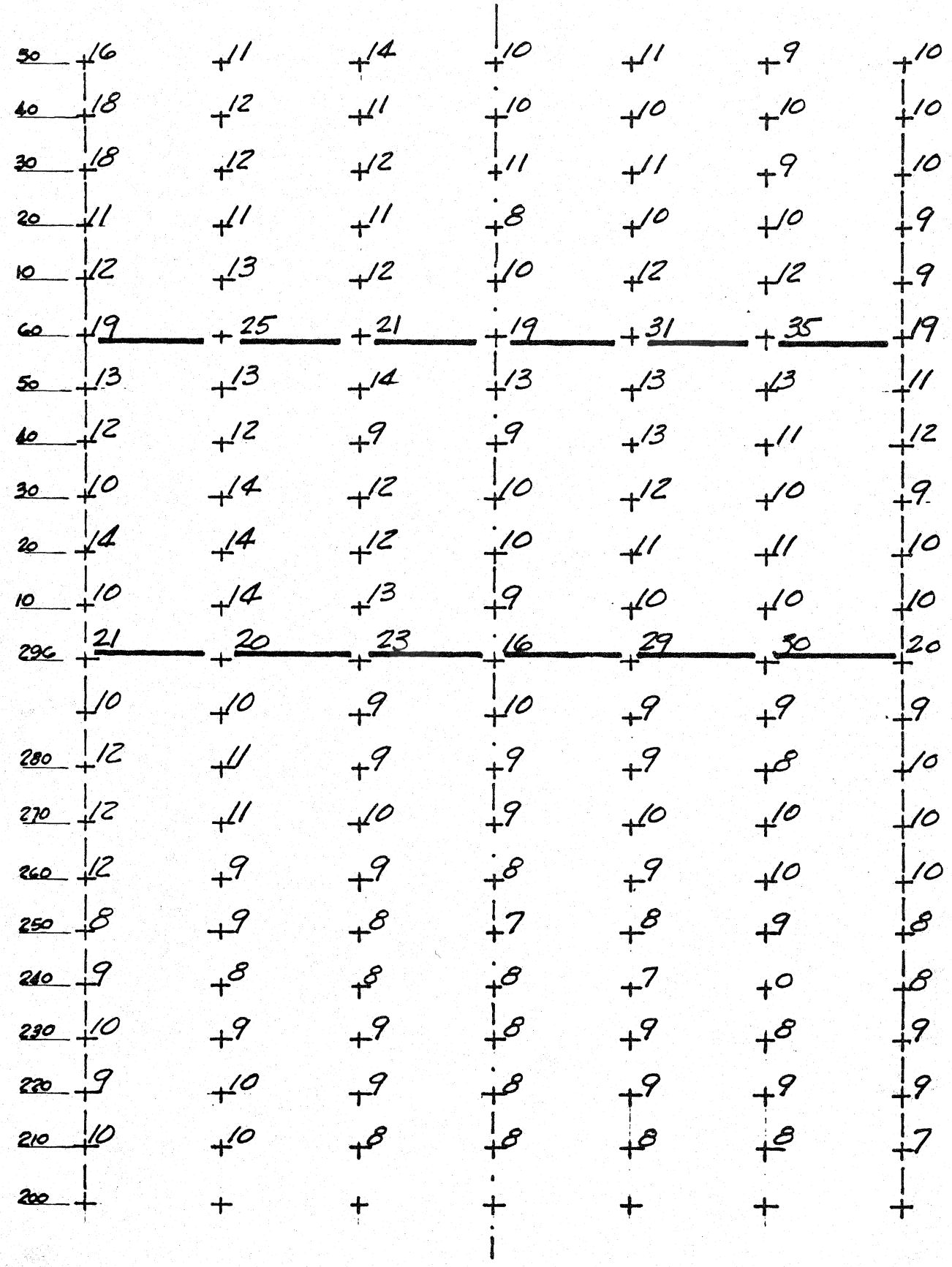
5. There was no discernable difference between the performance of the treated slab and the untreated sections.

APPENDIX A
CORROSION POTENTIALS
Owens Street Overpass



CORROSION POTENTIAL MEASUREMENTS
OWENS ST. OVERPASS --- BIG SPRING

Aug. 10, 1982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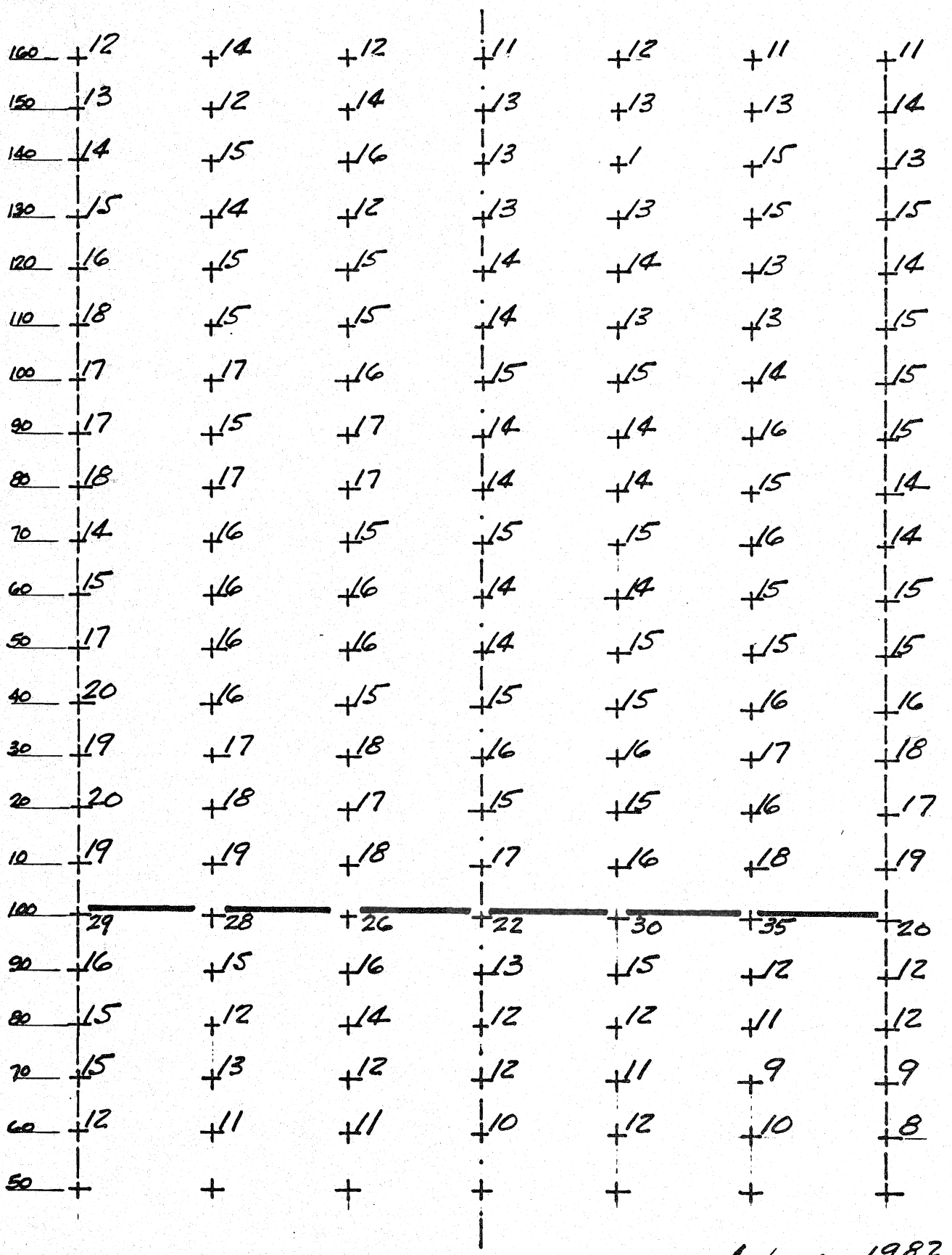
Aug. 10, 1982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100 29 28 26 22 30 35 20
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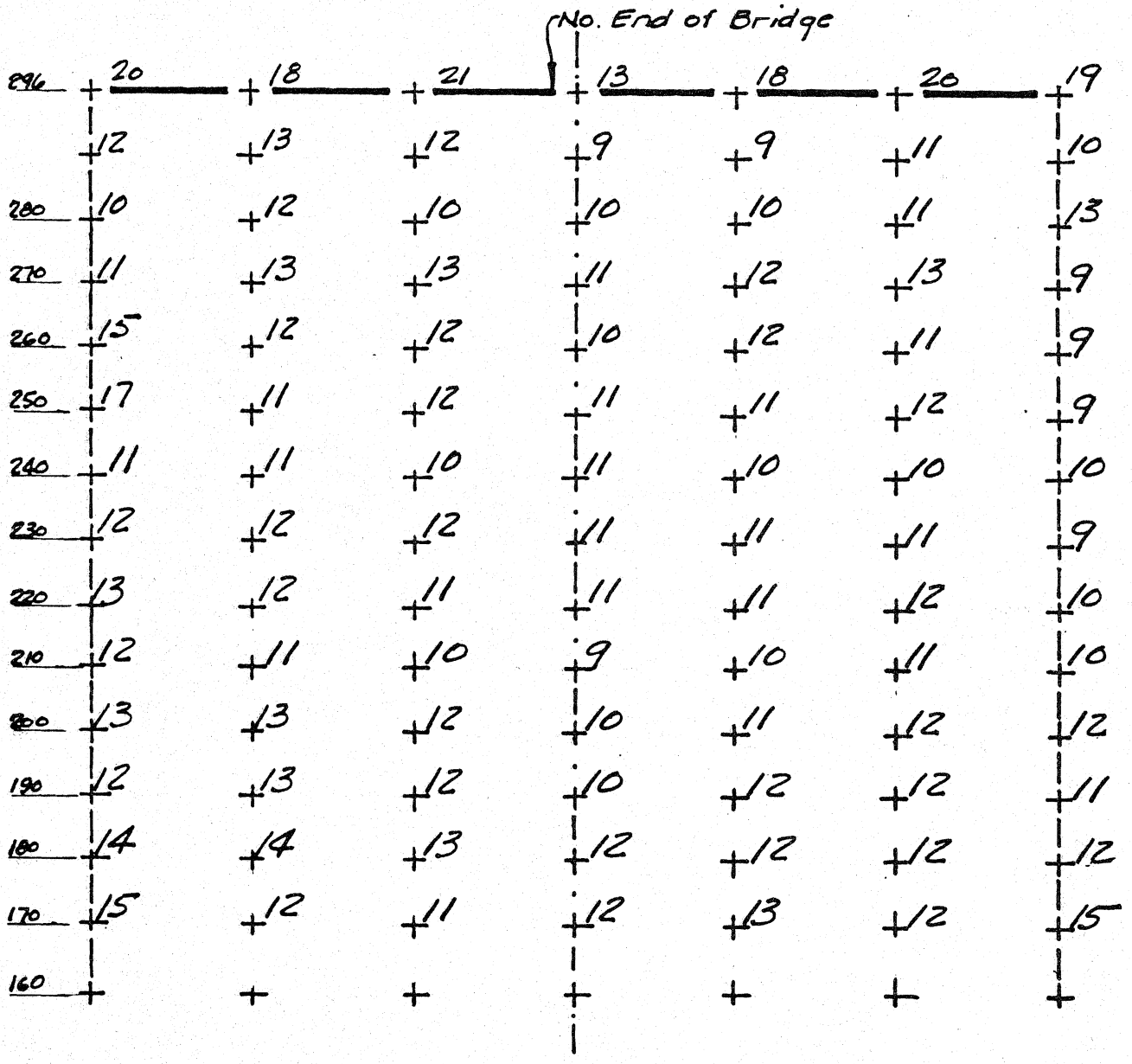
Aug. 10, 1982

NOTE: Disregard high reading's at Armor Joints. Water in Contact with joint.



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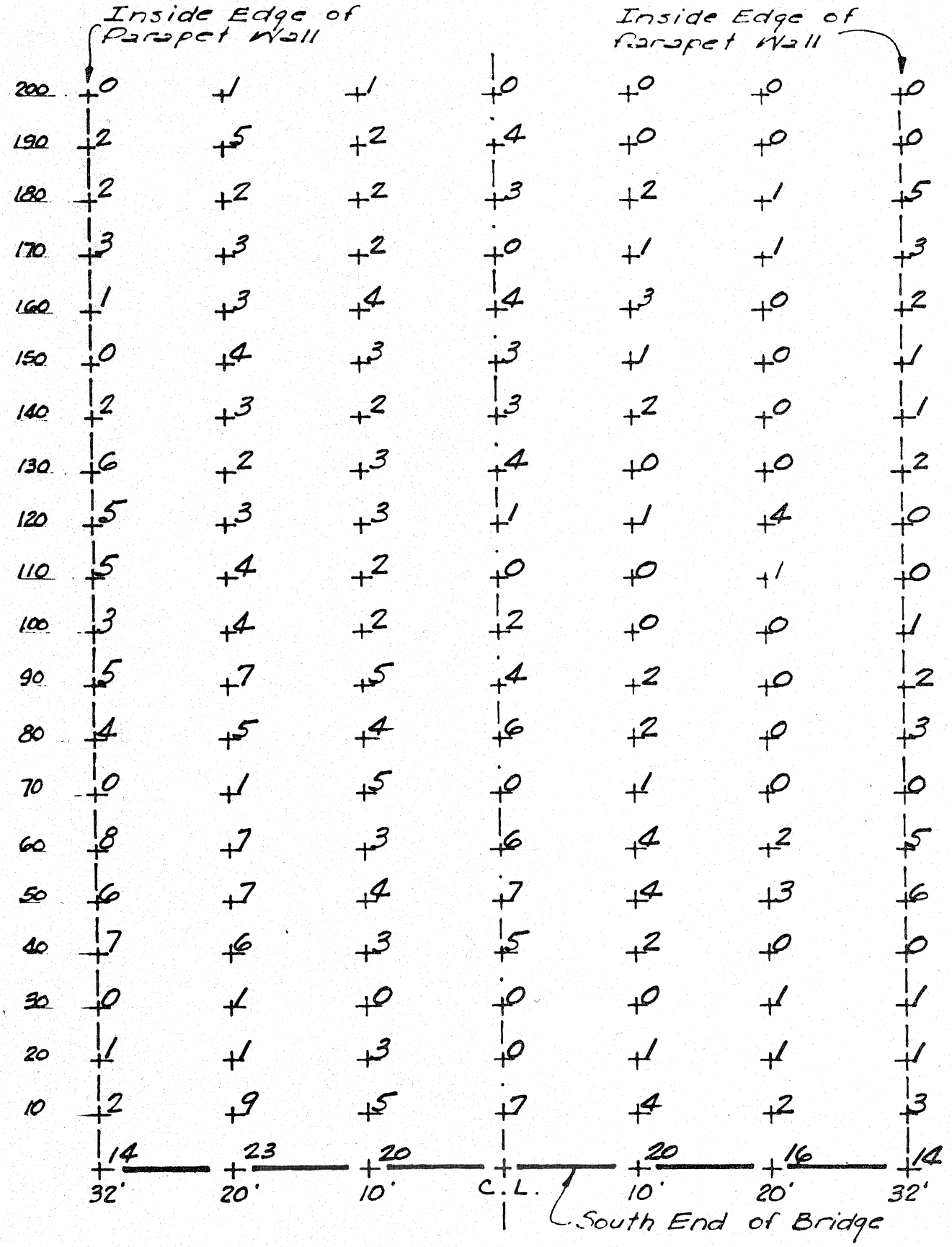
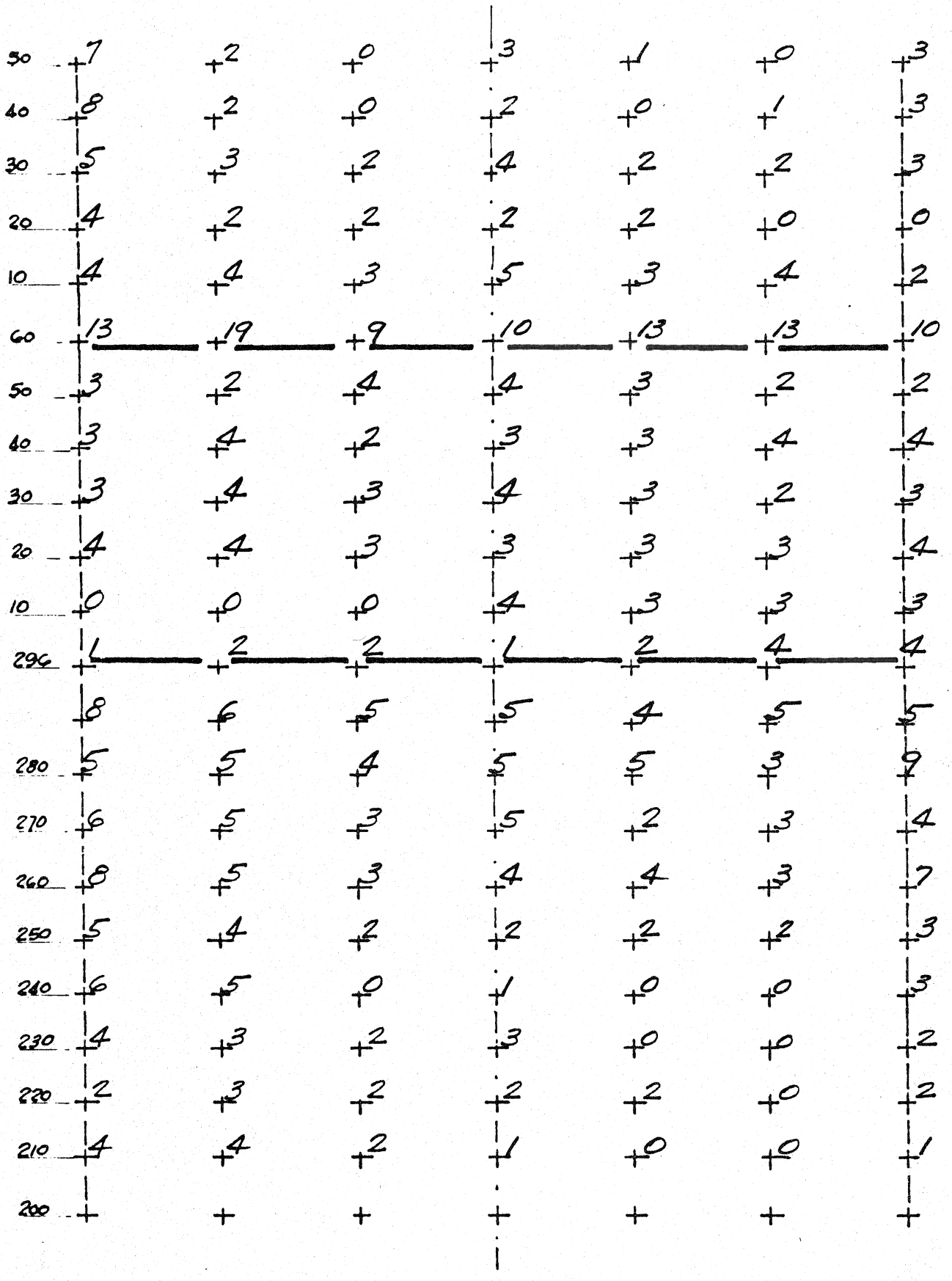


CORROSION POTENTIAL MEASUREMENTS
OWENS ST. OVERPASS --- BIG SPRING

Dec. 1, 1981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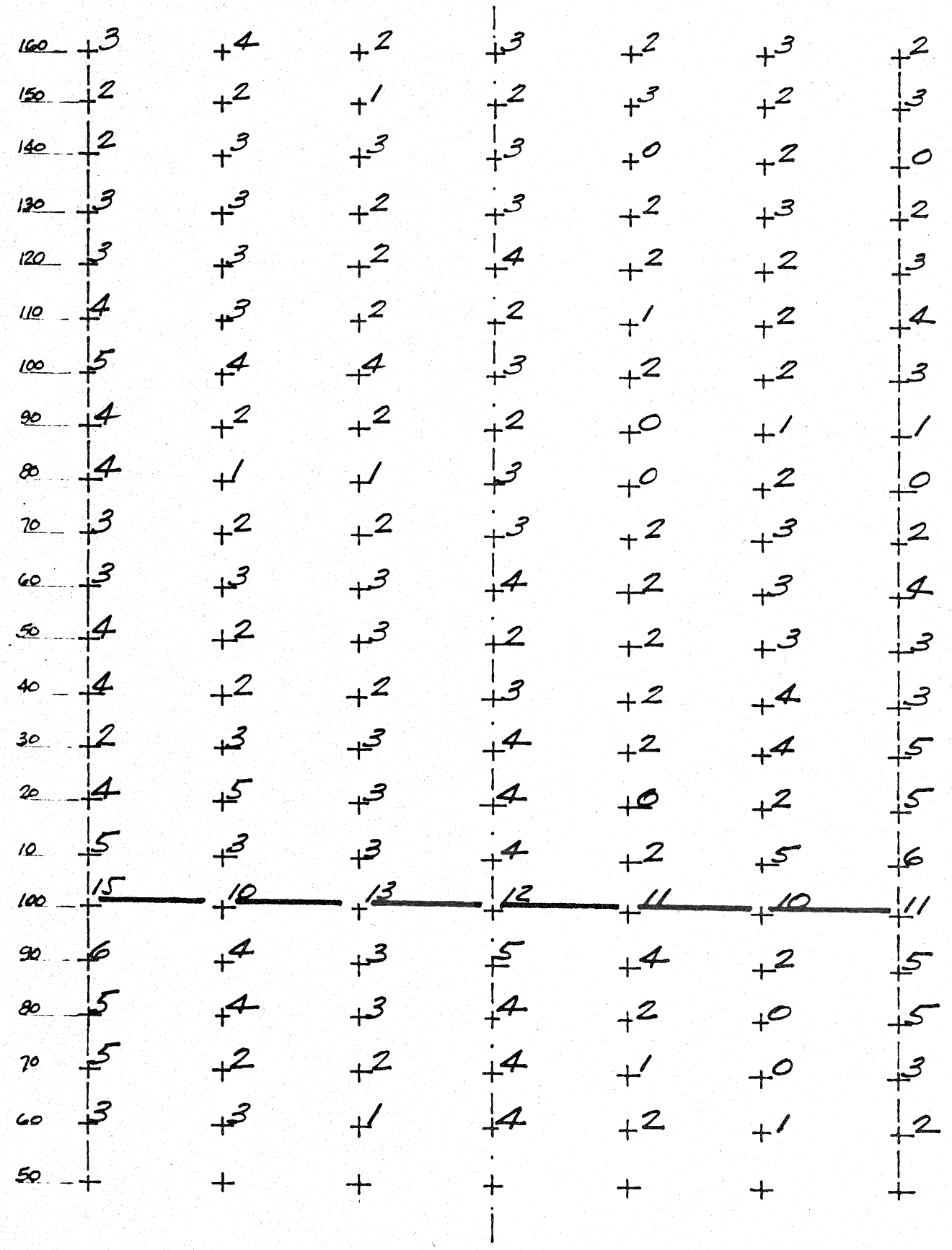
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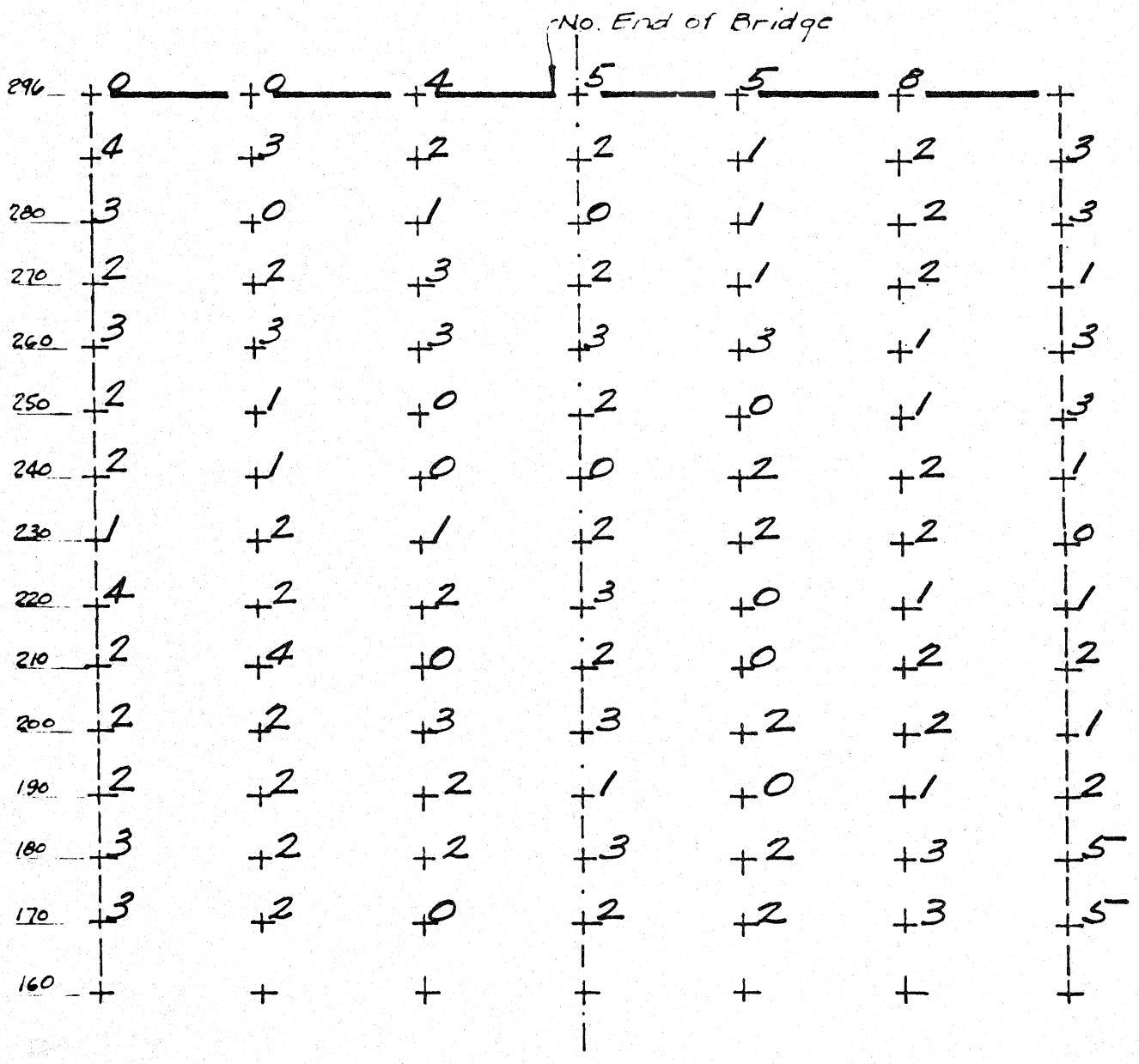
Dec. 1, 1981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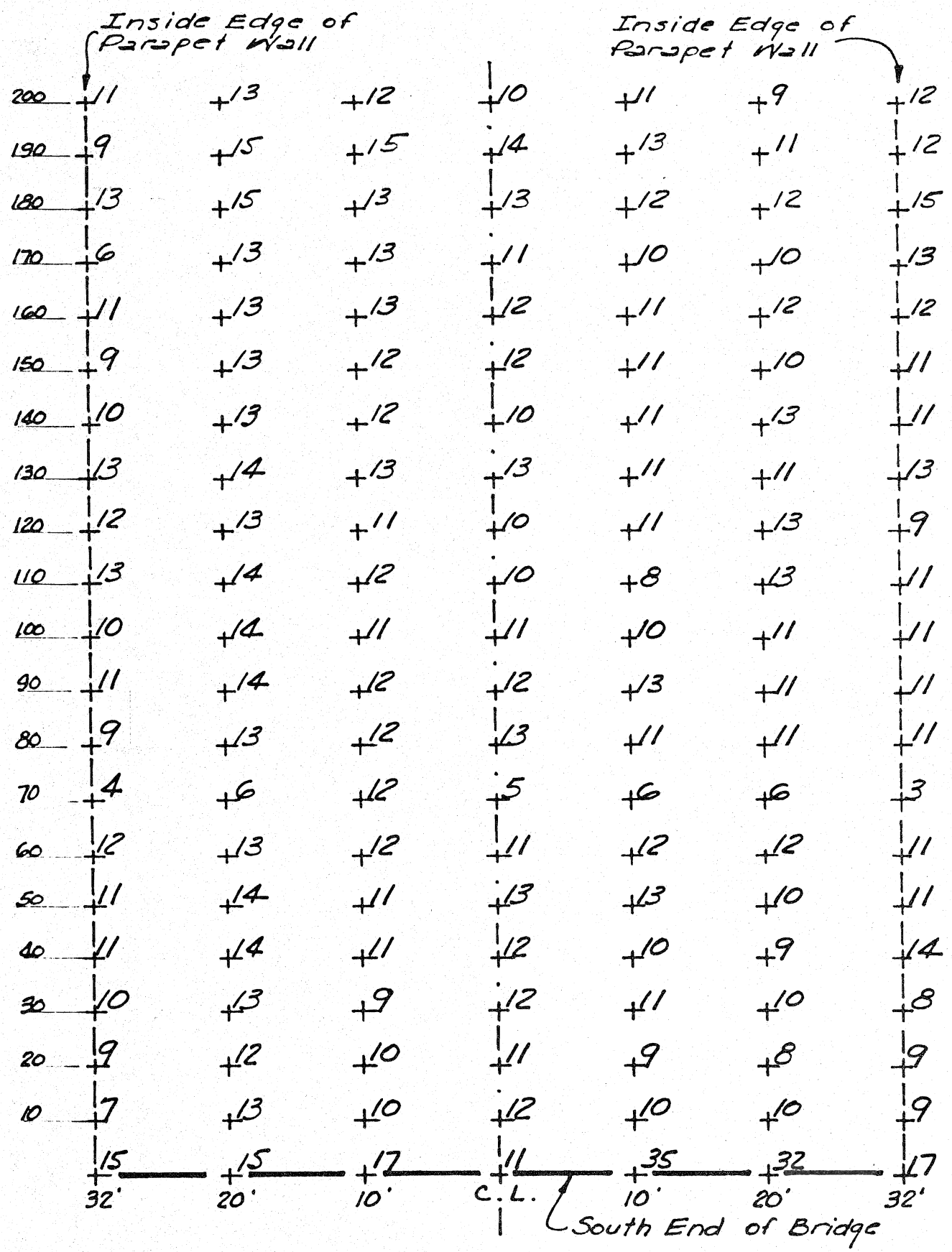
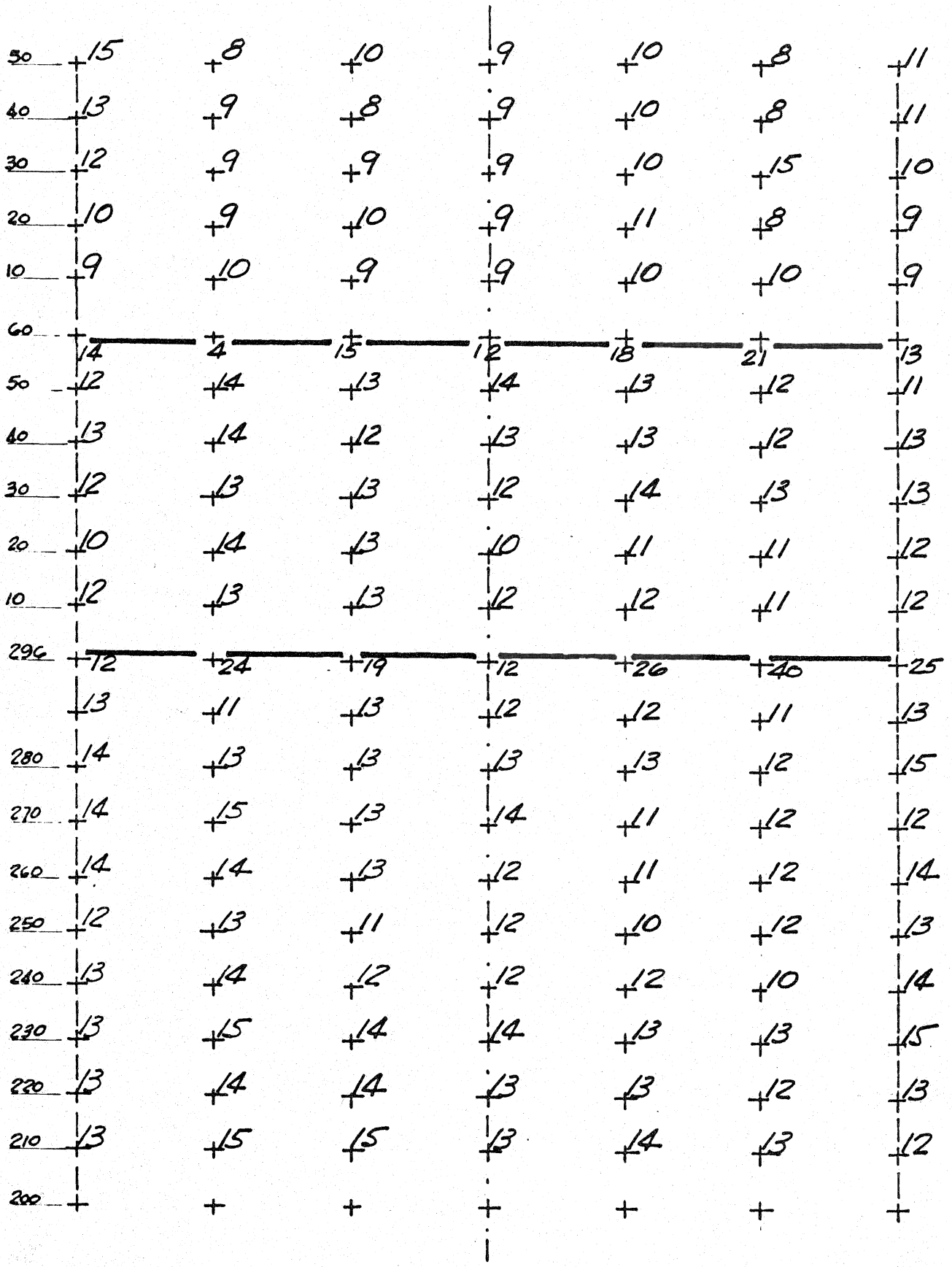
Dec. 1, 1981



CORROSION POTENTIAL MEASUREMENTS
OWENS ST. OVERPASS --- BIG SPRING

July 29, 1980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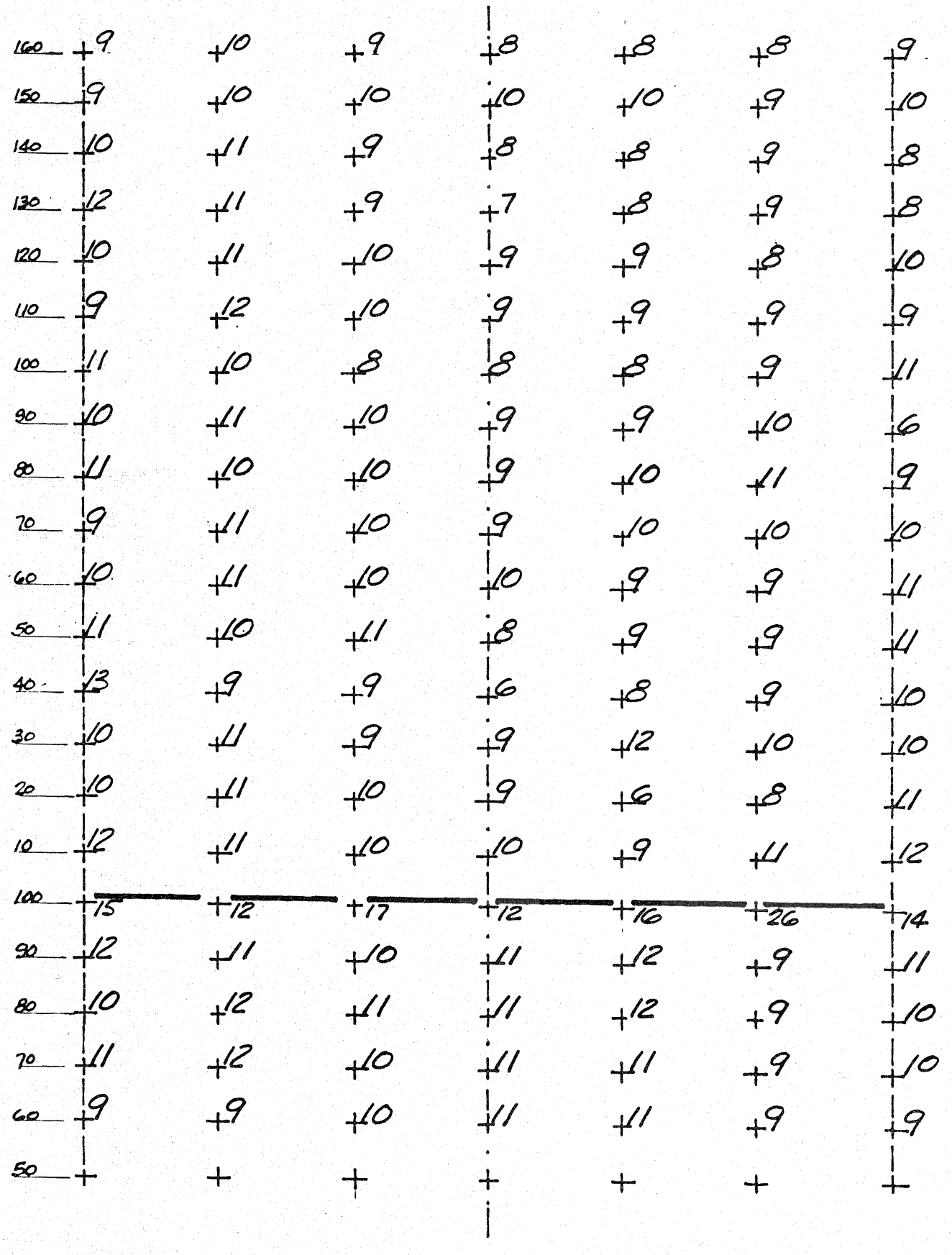
July 29, 1980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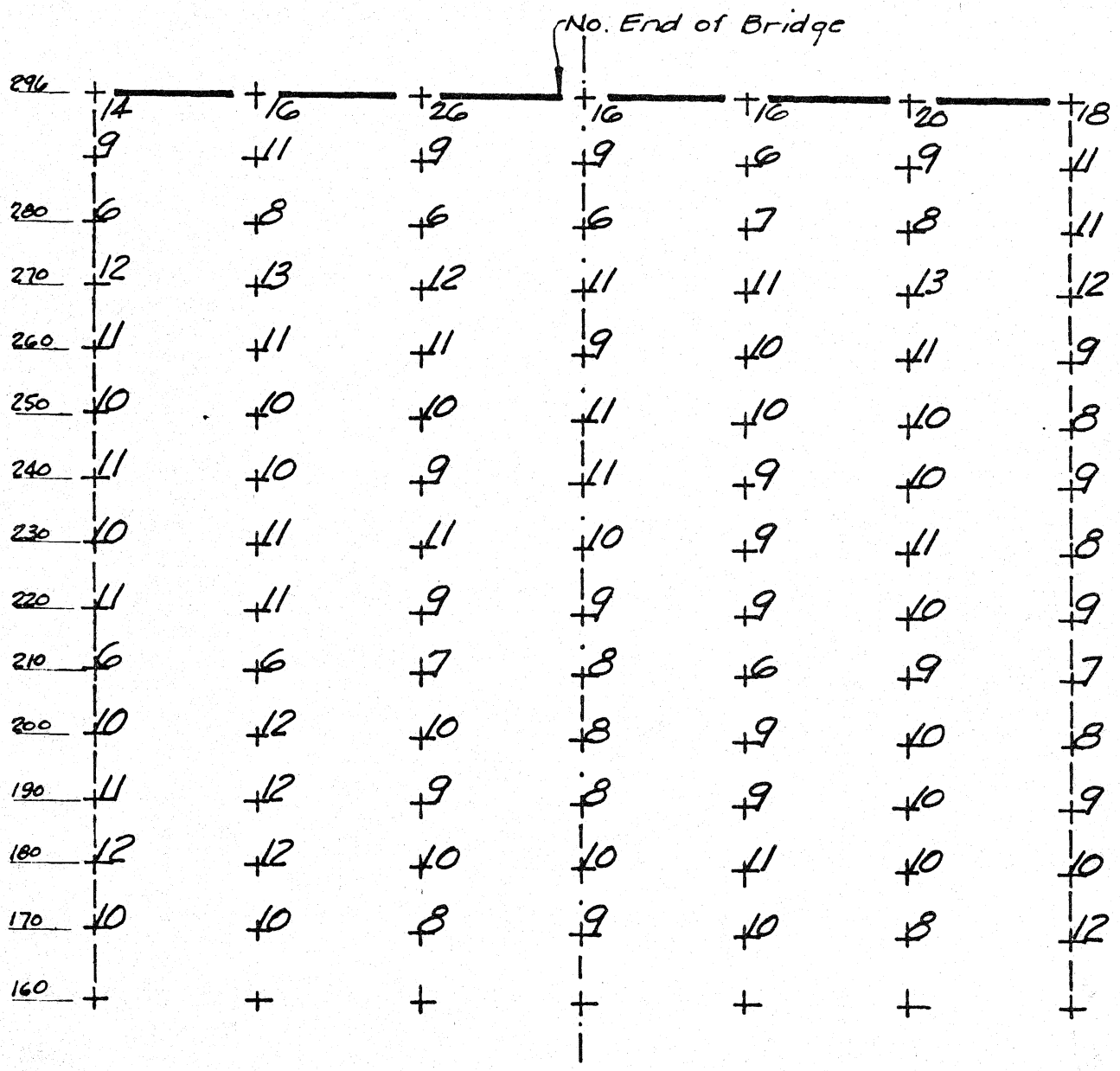
July 29, 1980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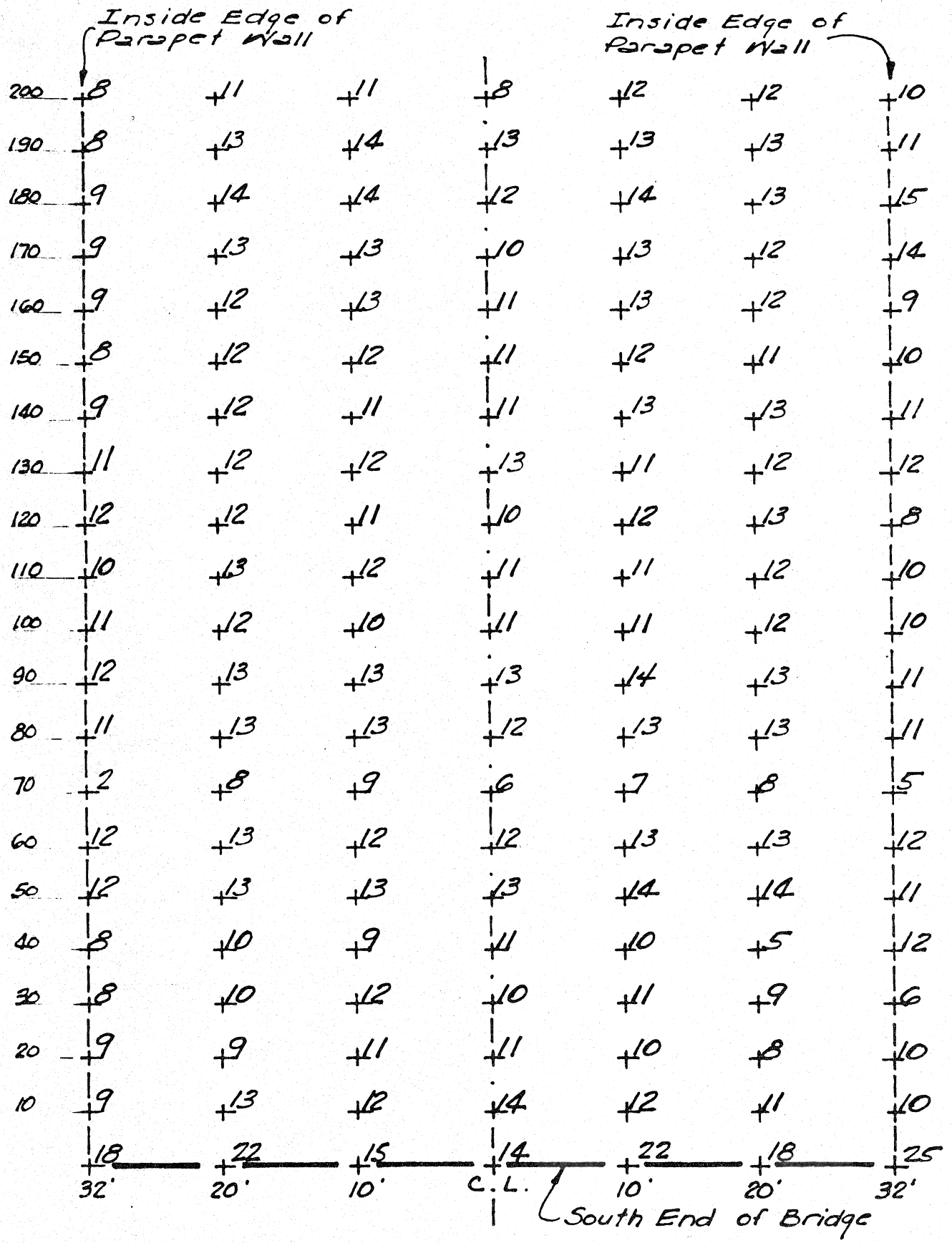
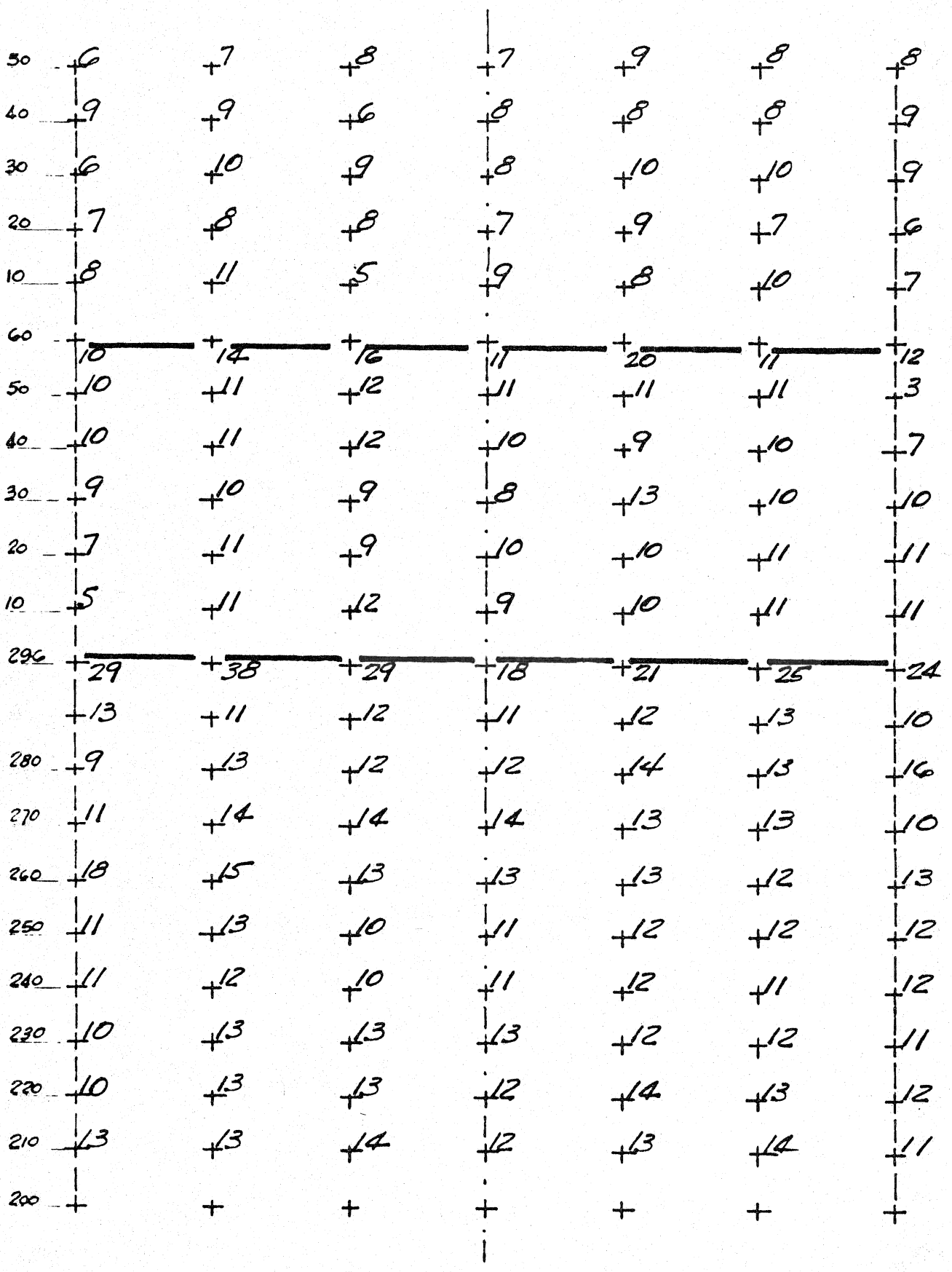
July 29, 1980



CORROSION POTENTIAL MEASUREMENTS
OWENS ST. OVERPASS --- BIG SPRING

Aug. 14, 1979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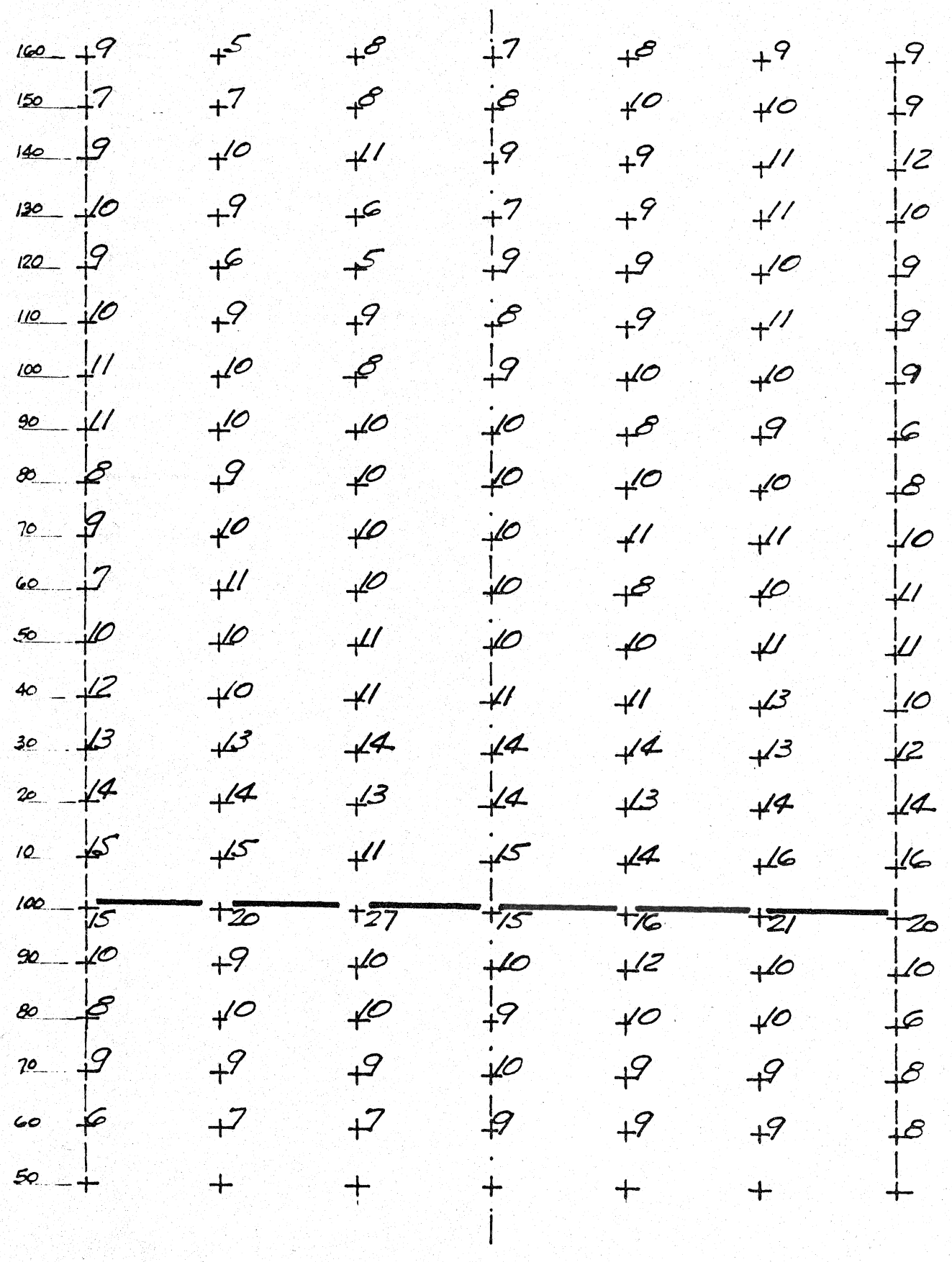
Aug. 14, 1979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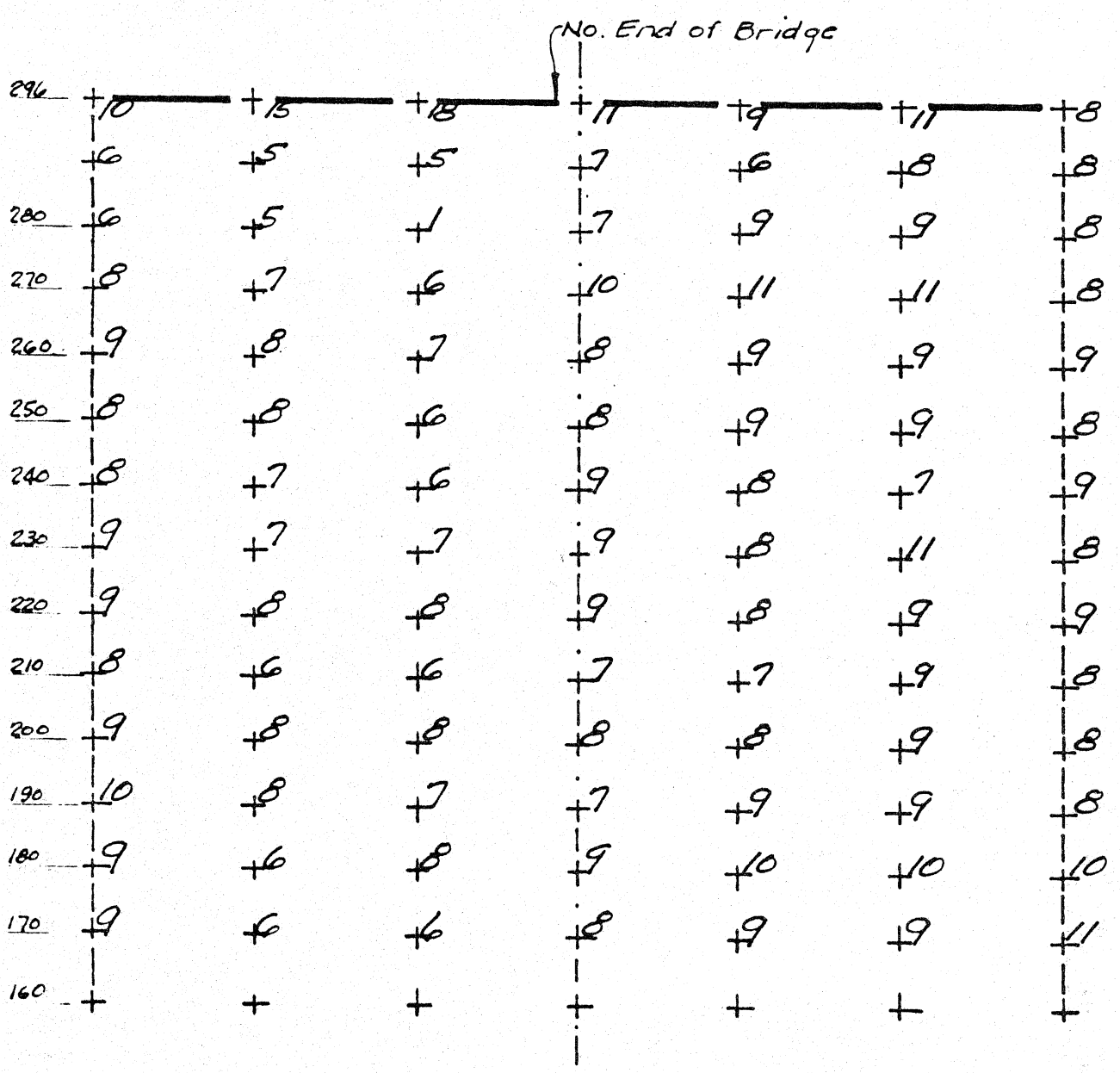
Aug. 14, 1979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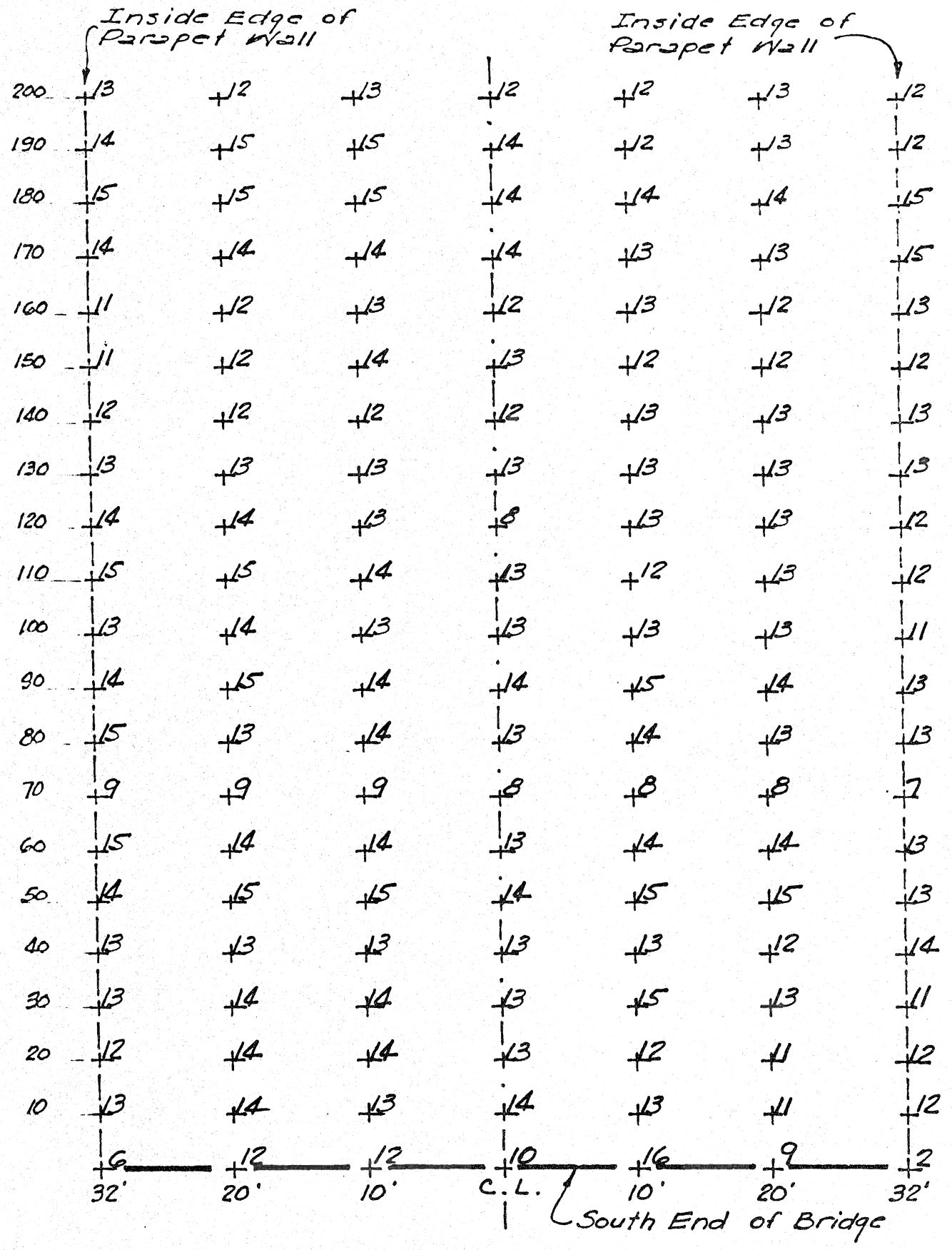
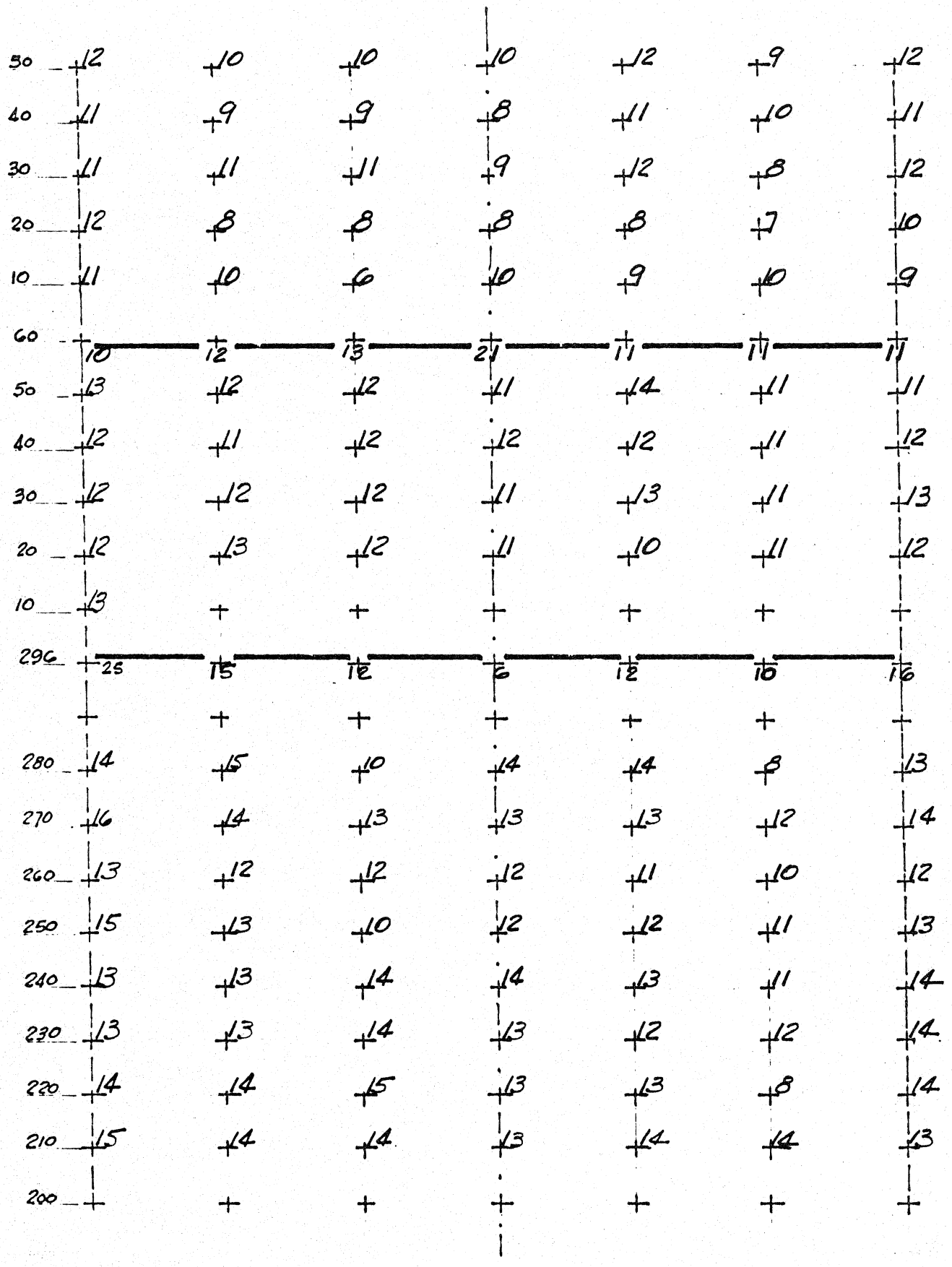
Aug. 14, 1979



CORROSION POTENTIAL MEASUREMENTS
OWENS ST. OVERPASS --- BIG SPRING

Aug. 15, 1978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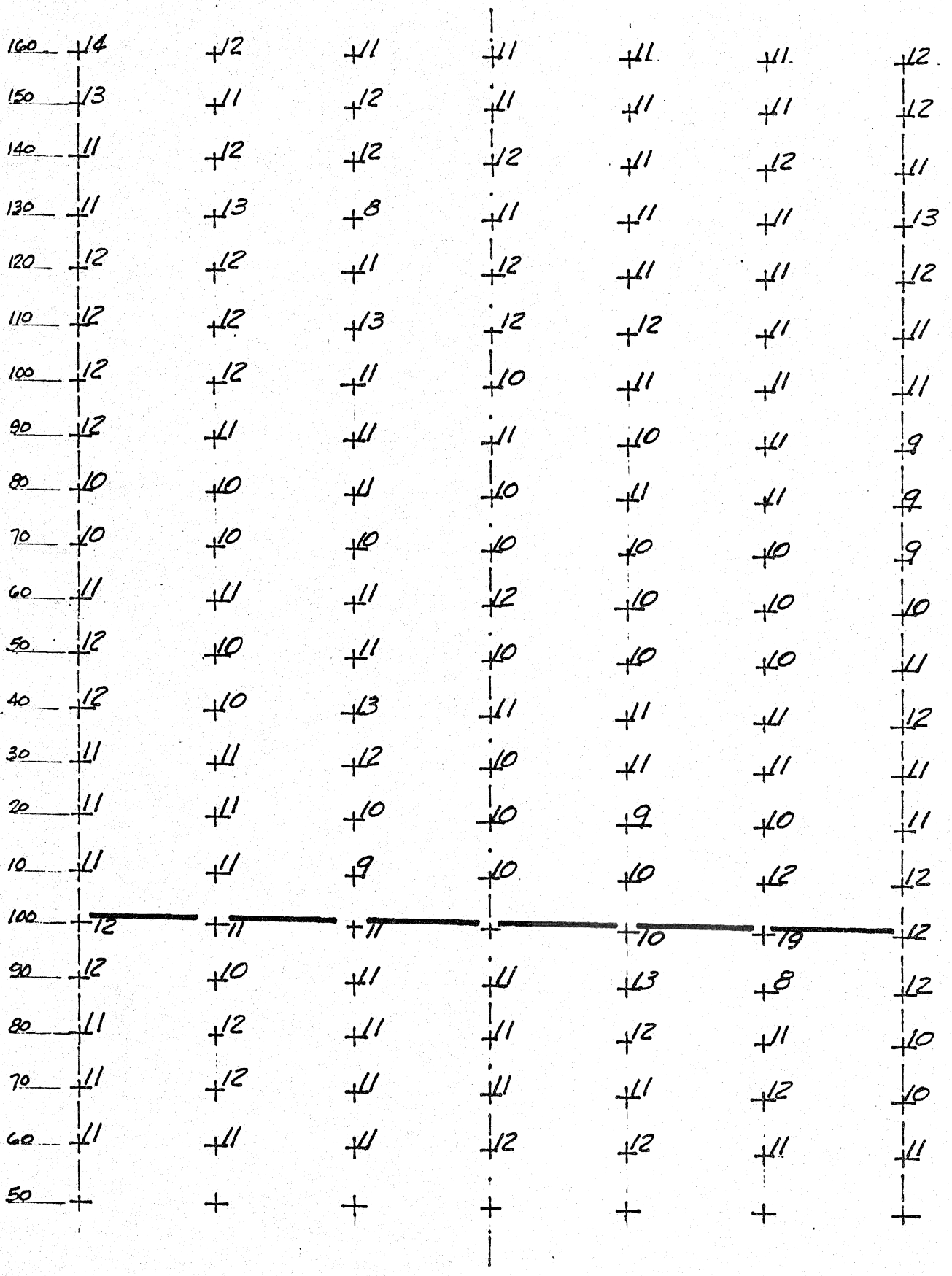
Aug. 15, 1978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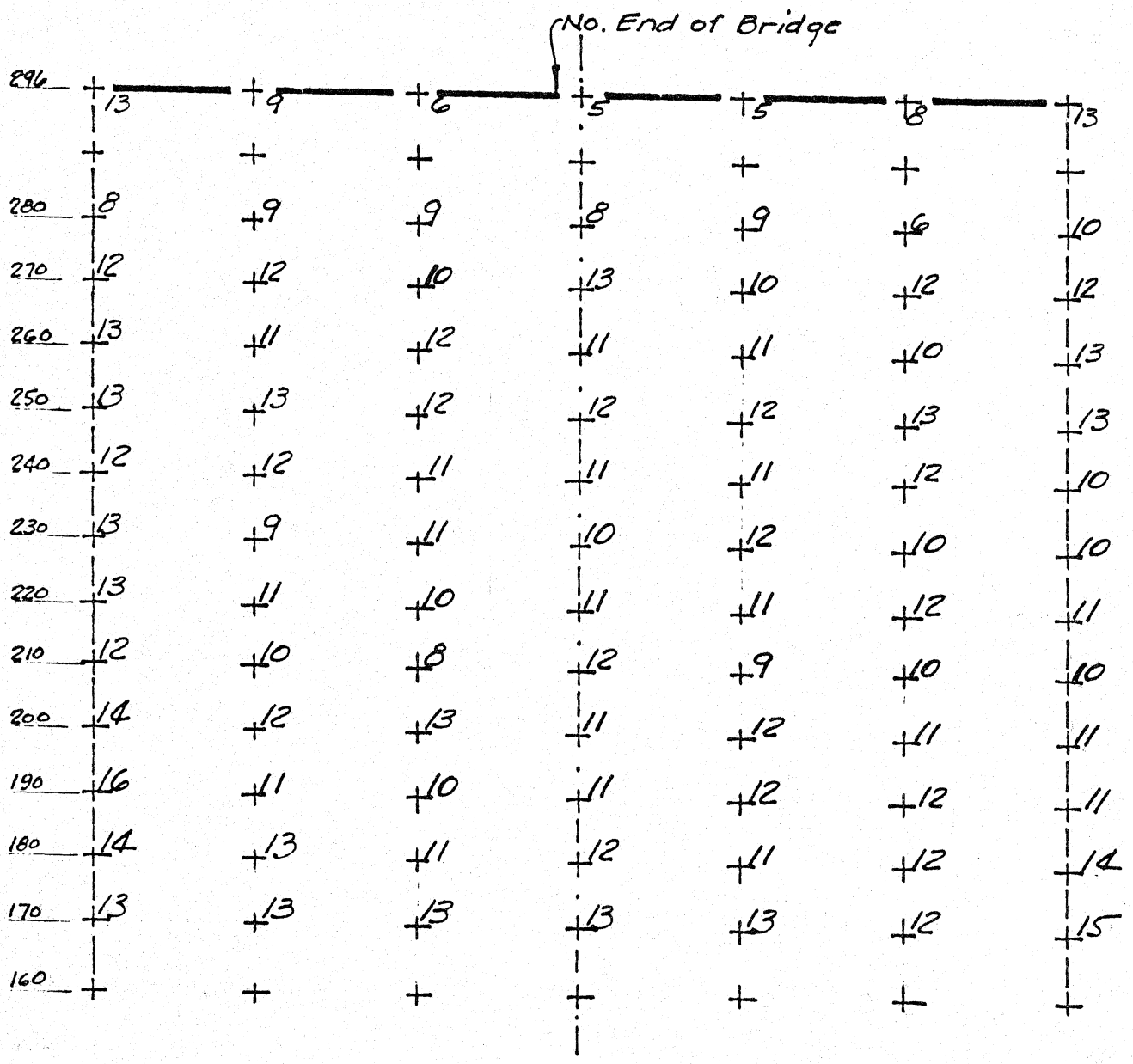
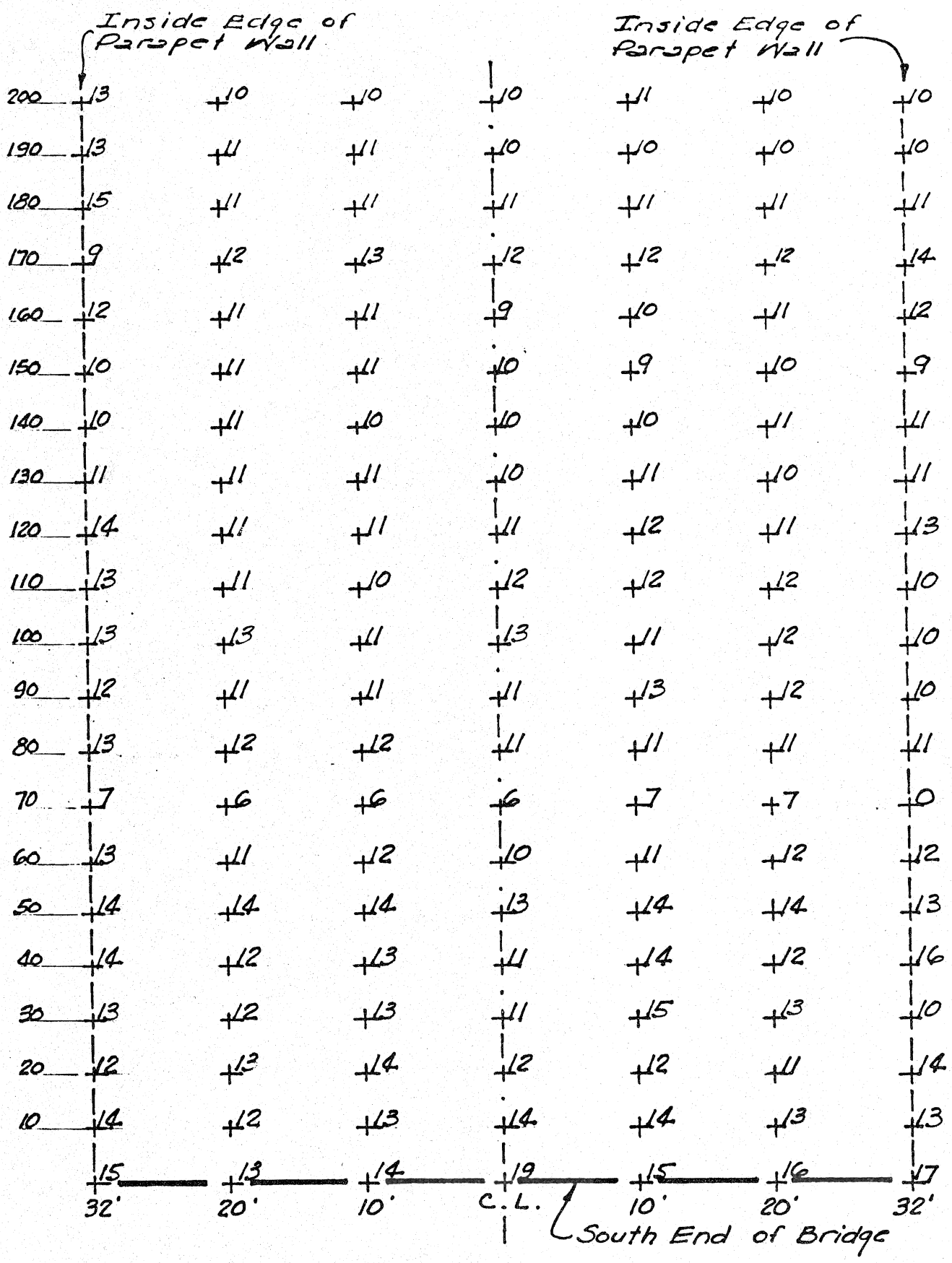
40 +12 +10 +13 +11 +11 +11 +12
30 +11 +11 +12 +10 +11 +11 +11
20 +11 +11 +10 +10 +9 +10 +11
10 +11 +11 +9 +10 +10 +12 +12
100 +12 +11 +11 +10 +10 +12
90 +12 +10 +11 +11 +13 +8 +12
80 +11 +12 +11 +11 +12 +11 +10
70 +11 +12 +11 +11 +11 +12 +10
60 +11 +11 +11 +12 +12 +11 +11
50 + + + + + + +

Aug. 15, 1978

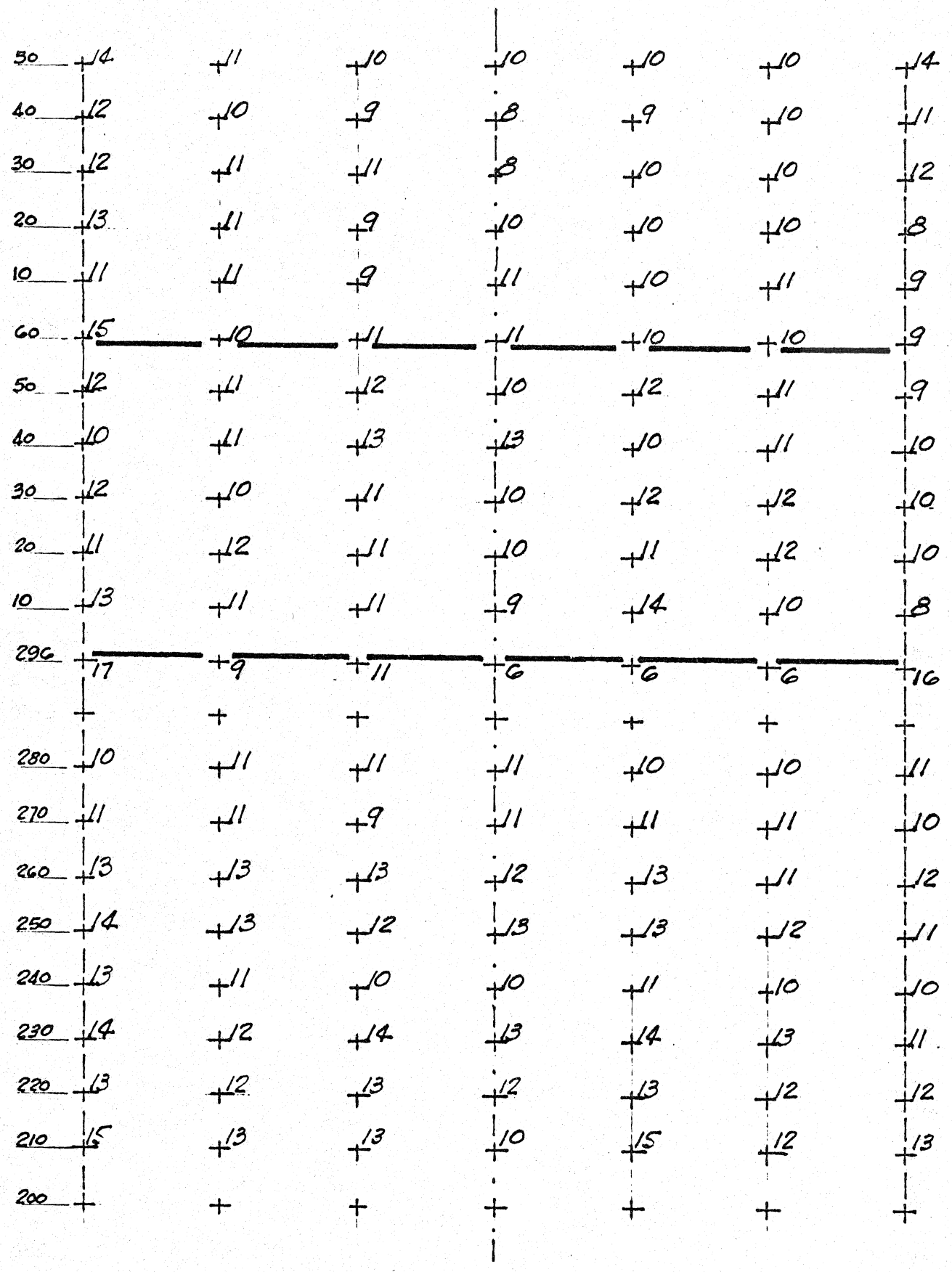

No. End of Bridge
296
280
270
260
250
240
230
220
210
200
190
180
170
160
13 9 6 5 5 8 13
8 9 9 8 9 6 10
12 12 10 13 10 12 12
13 11 12 11 11 10 13
13 13 12 12 12 13 13
12 12 11 11 11 12 10
13 9 11 10 12 10 10
13 11 10 11 11 12 11
12 10 8 12 9 10 10
14 12 13 11 12 11 11
16 11 10 11 12 12 11
14 13 11 12 11 12 14
13 13 13 13 13 12 15

Aug. 15, 1978



CORROSION POTENTIAL MEASUREMENTS
OWENS ST. OVERPASS --- BIG SPRING

Nov. 2. 1977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40 12 10 9 8 9 10 11
30 12 11 11 8 10 10 12
20 13 11 9 10 10 10 8
10 11 11 9 11 10 11 9
60 15 10 11 11 10 10 9
50 12 11 12 10 12 11 9
40 10 11 13 13 10 11 10
30 12 10 11 10 12 12 10
20 11 12 11 10 11 12 10
10 13 11 11 9 14 10 8
296 17 9 11 6 6 6 16
280 10 11 11 11 10 10 11
270 11 11 9 11 11 11 10
260 13 13 13 12 13 11 12
250 14 13 12 13 13 12 11
240 13 11 10 10 11 10 10
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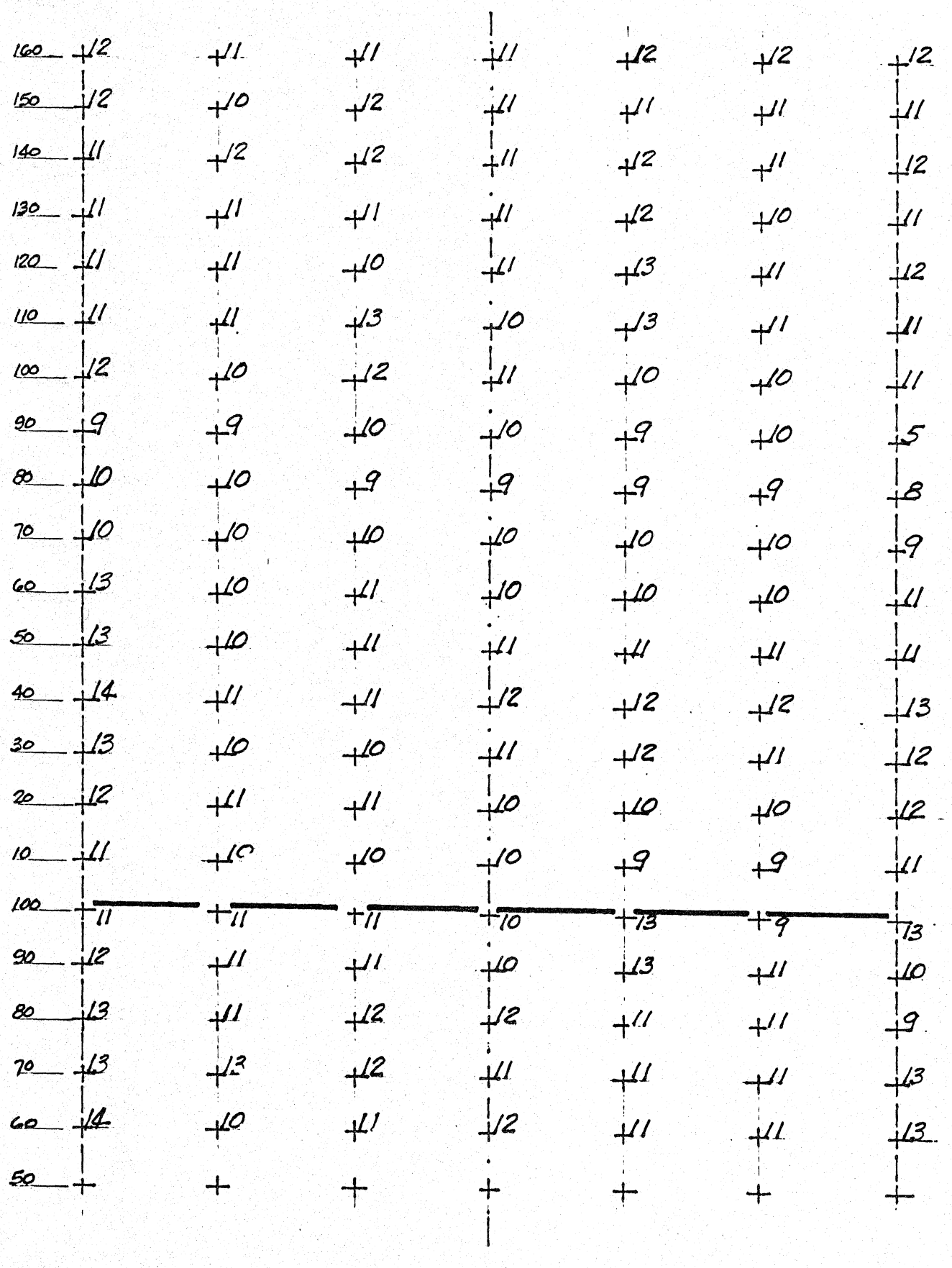
220 13 12 13 12 13 12 12
210 15 13 13 10 15 12 13
200

Nov. 2, 197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150 12 10 12 11 11 11 11
140 11 12 12 11 12 11 12
130 11 11 11 11 12 10 11
120 11 11 10 11 13 11 12
110 11 11 13 10 13 11 11
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90 9 9 10 10 9 10 5
80 10 10 9 9 9 9 8
70 10 10 10 10 10 10 9
60 13 10 11 10 10 10 11
50 13 10 11 11 11 11 11
40 14 11 11 12 12 12 13
30 13 10 10 11 12 11 12
20 12 11 11 10 10 10 12
10 11 10 10 10 9 9 11
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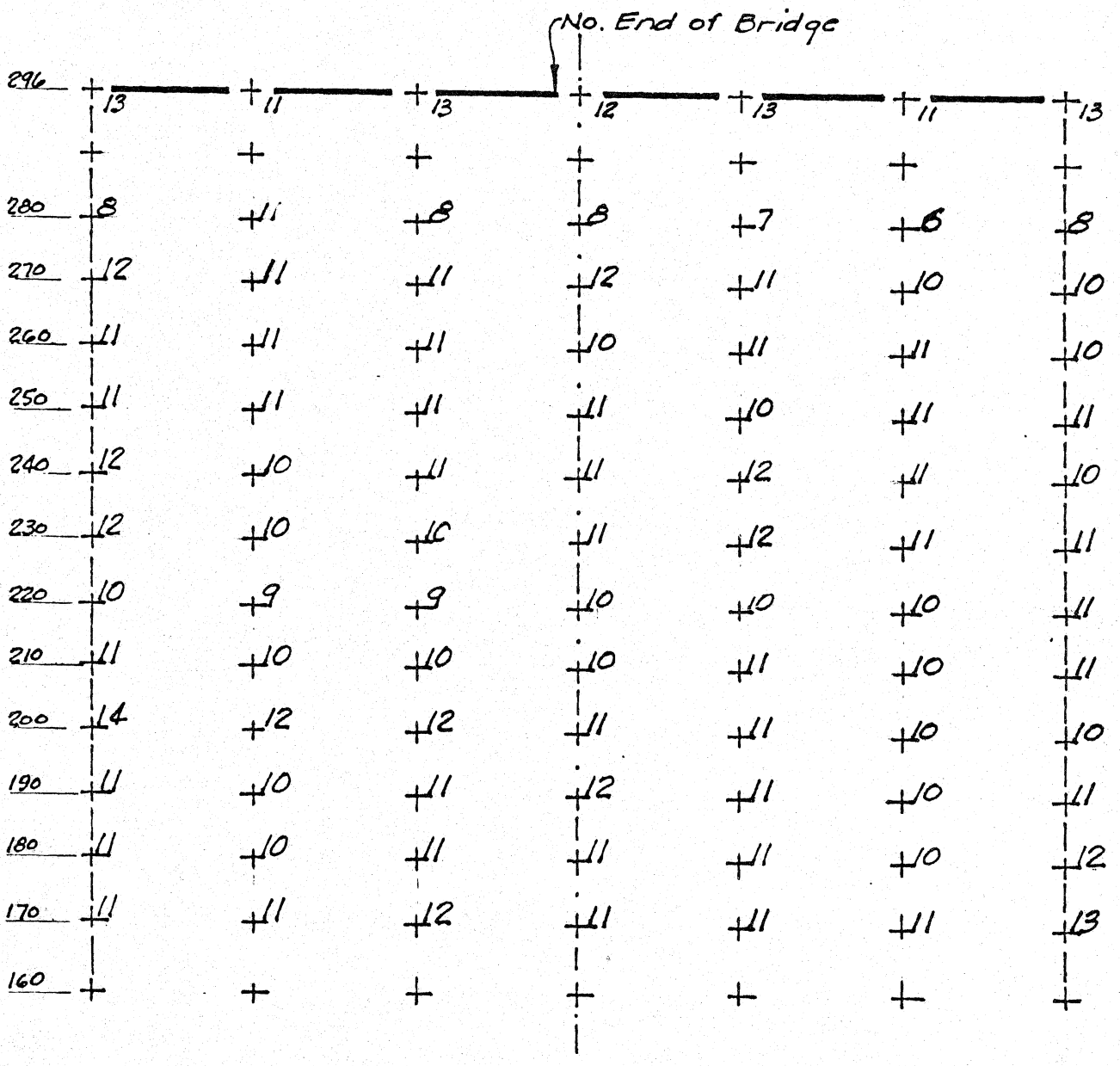
70 13 13 12 11 11 11 13
60 14 10 11 12 11 11 13
50

Nov. 2, 1977


No. End of Bridge
296
280
270
260
250
240
230
220
210
200
190
180
170
160
13 11 13 12 13 11 13
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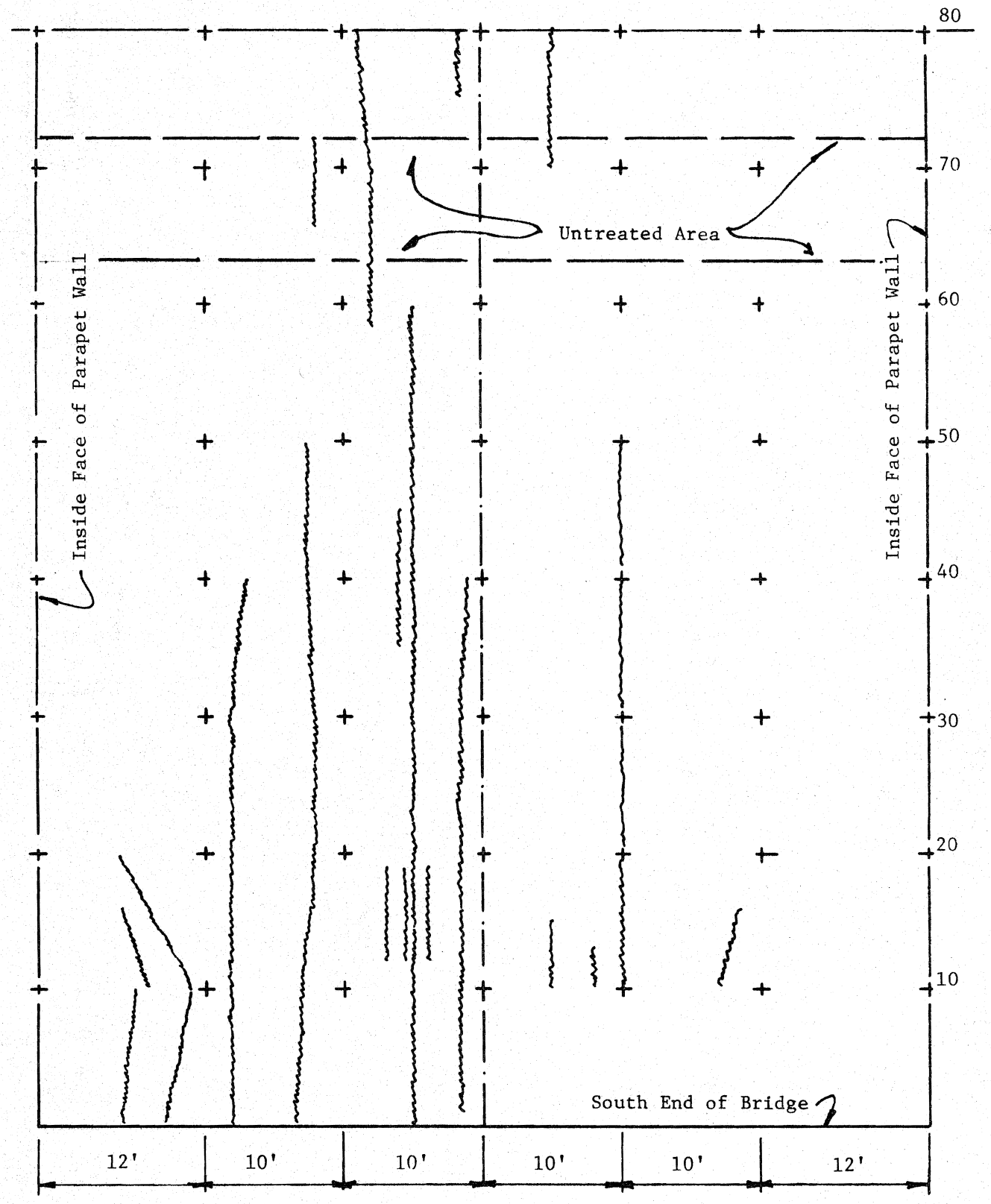
12 11 11 12 11 10 10
11 11 11 10 11 11 10
11 11 11 11 10 11 11
12 10 11 11 12 11 10
12 10 10 11 12 11 11
10 9 9 10 10 10 11
11 10 10 10 11 10 11
14 12 12 11 11 10 10
11 10 11 12 11 10 11
11 10 11 11 11 10 12
11 11 12 11 11 11 13

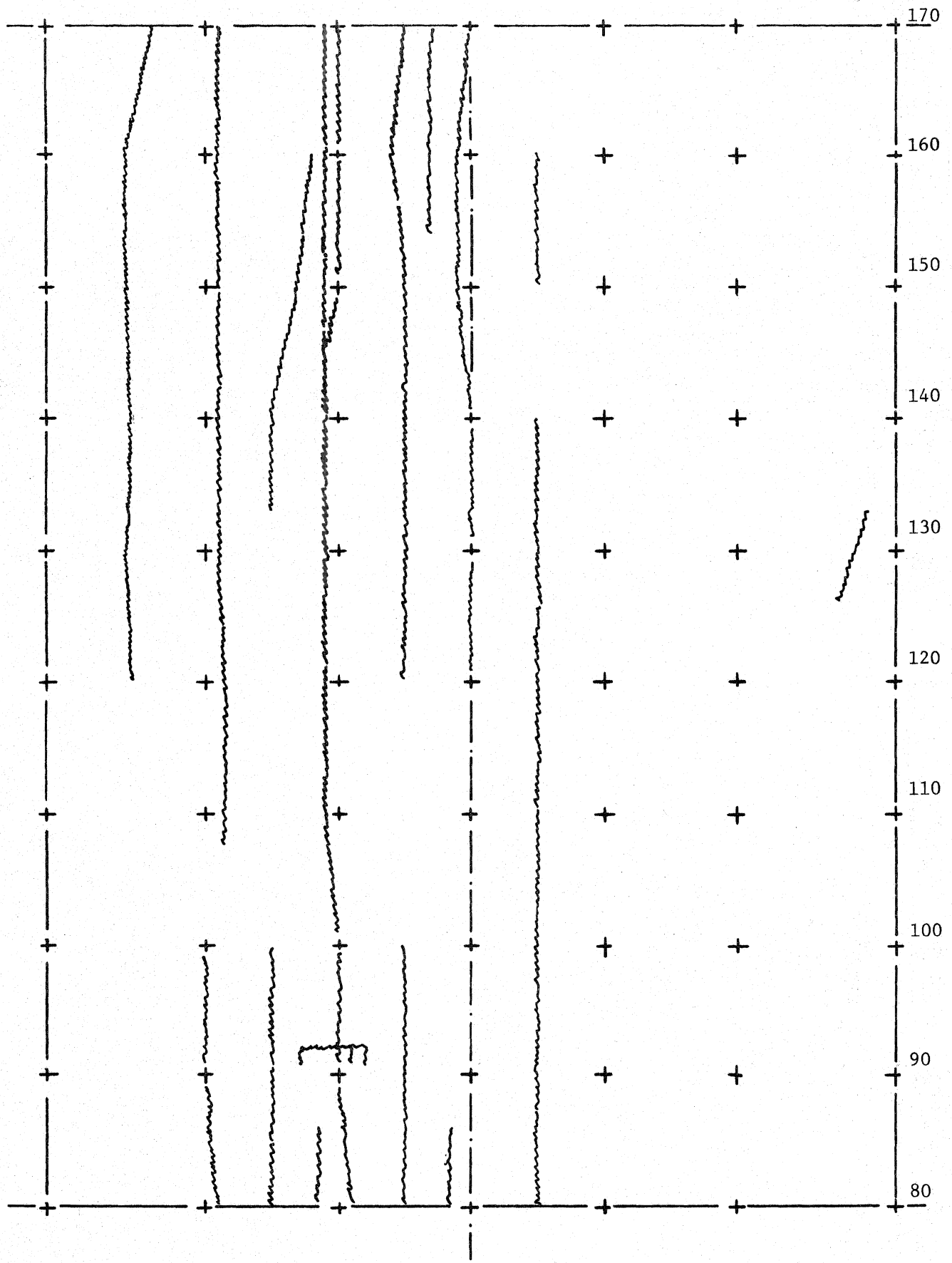
Nov. 2, 1977

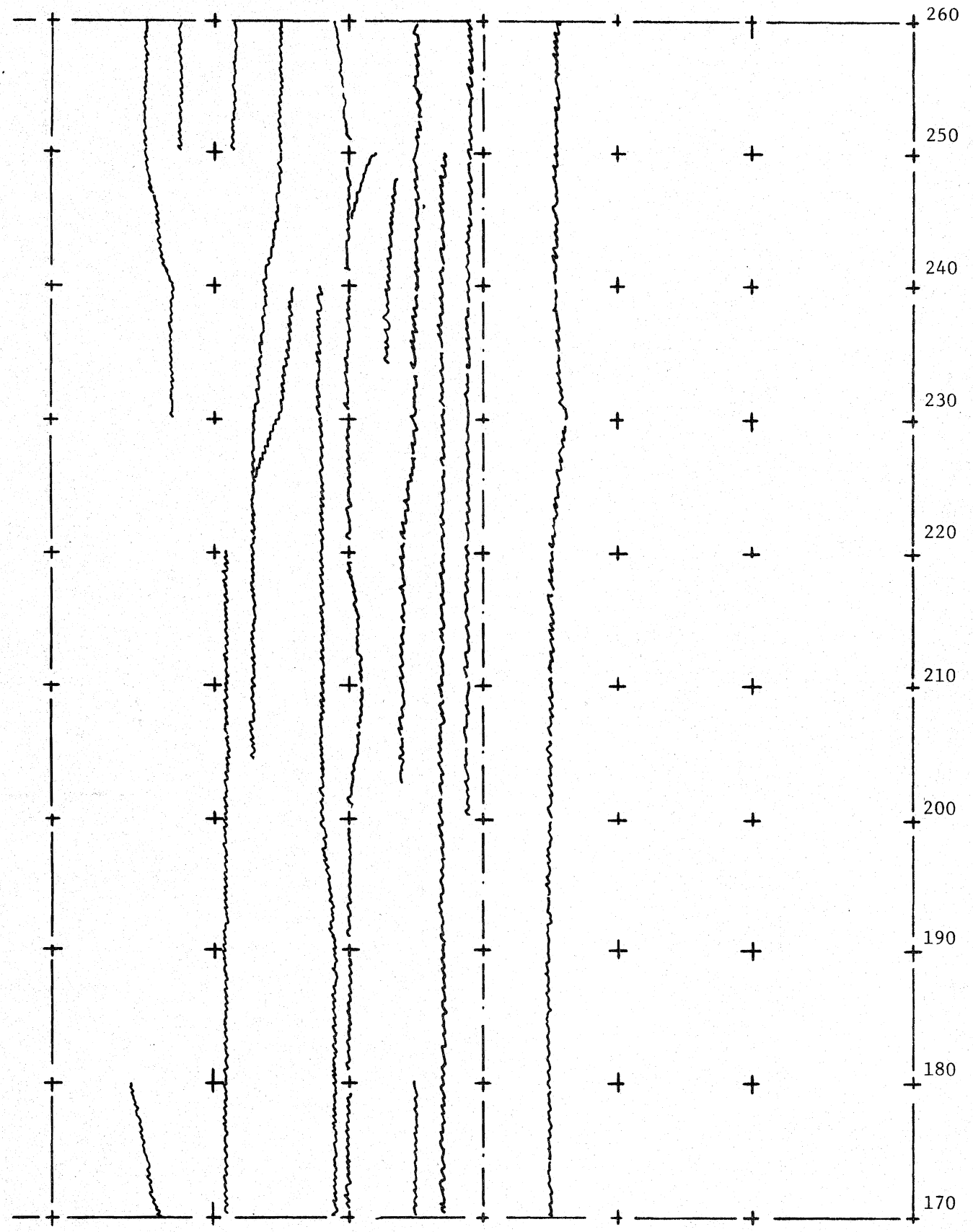
APPENDIX B

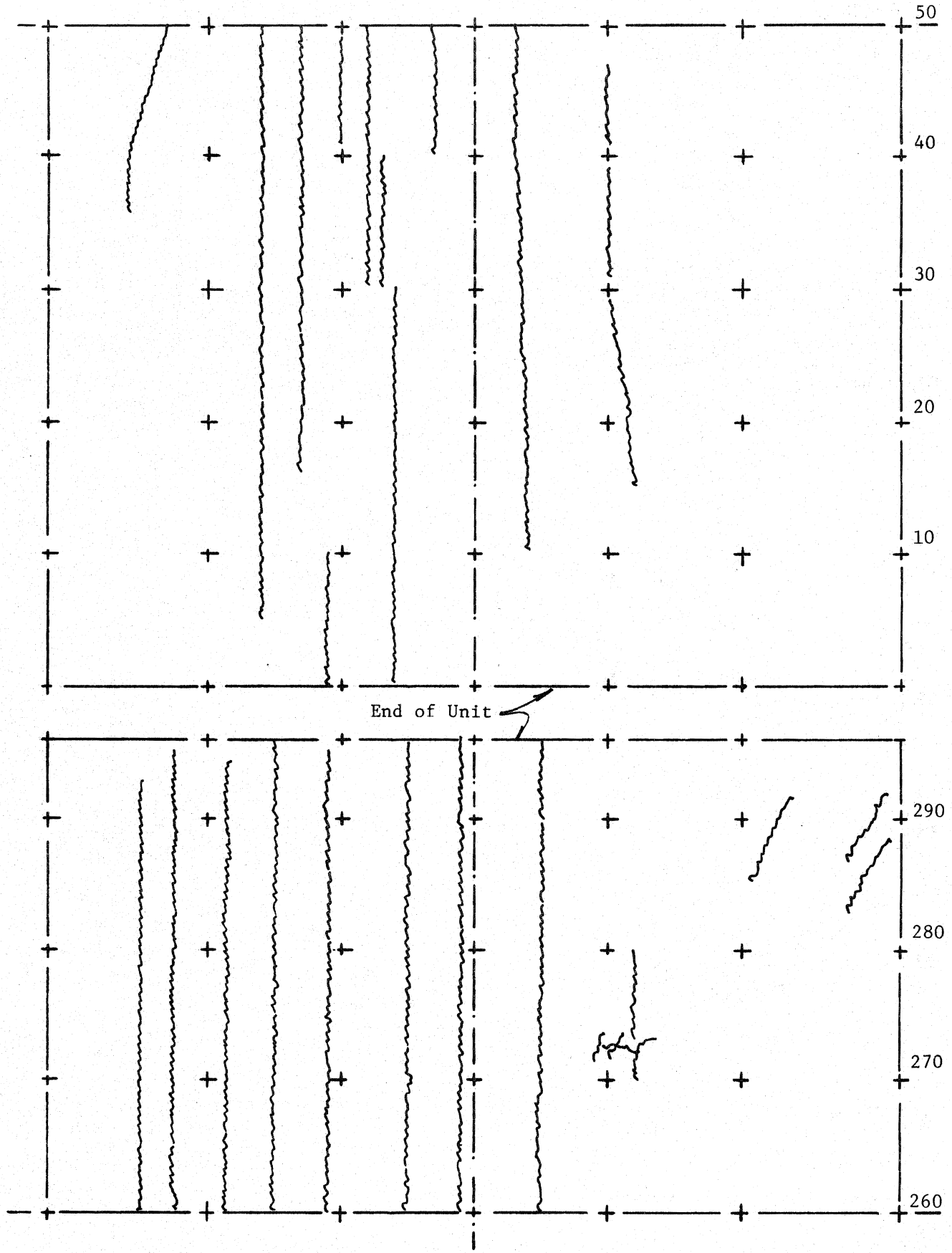
MAP OF MAJOR CRACKS

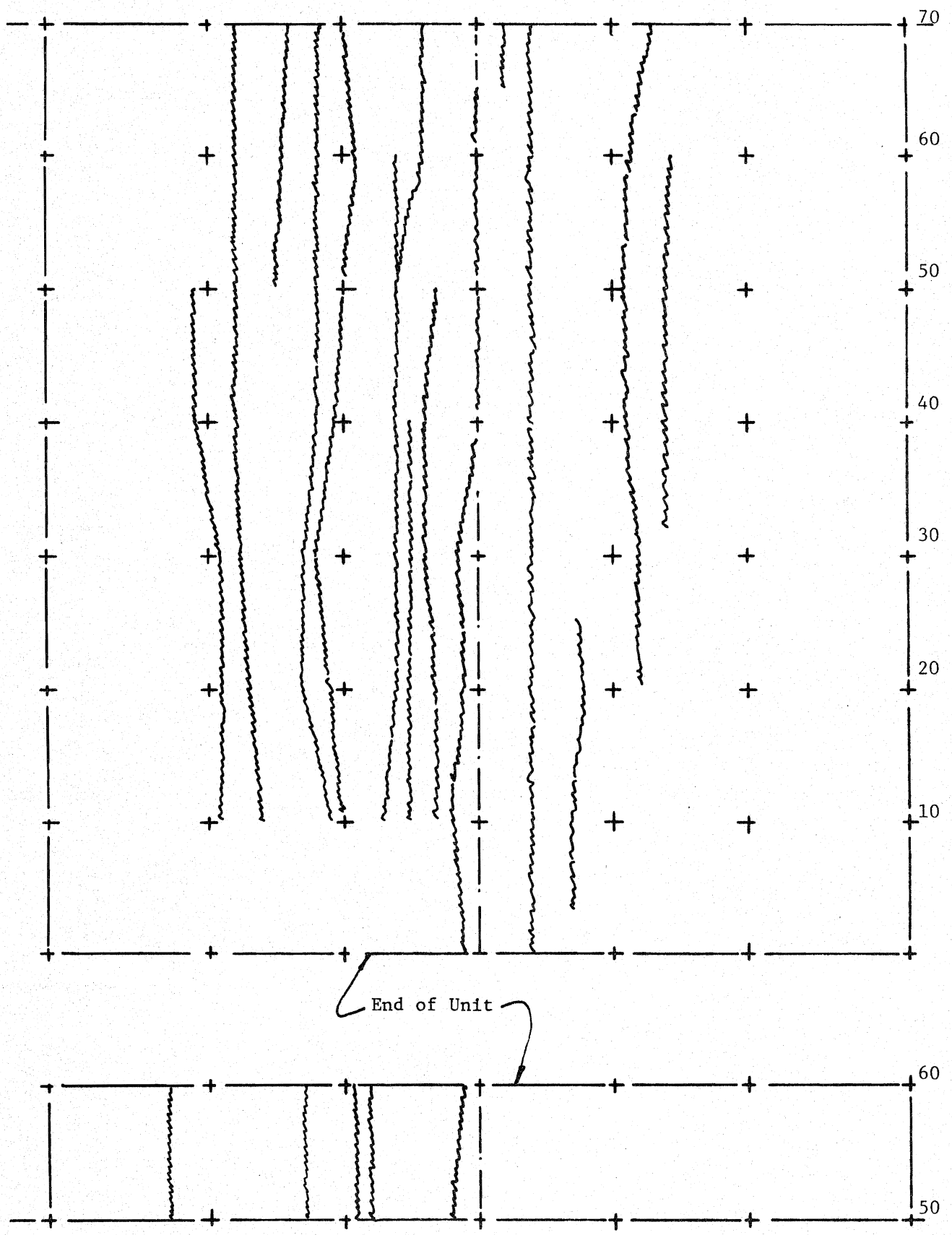
Owens Street Overpass
August 15, 1978

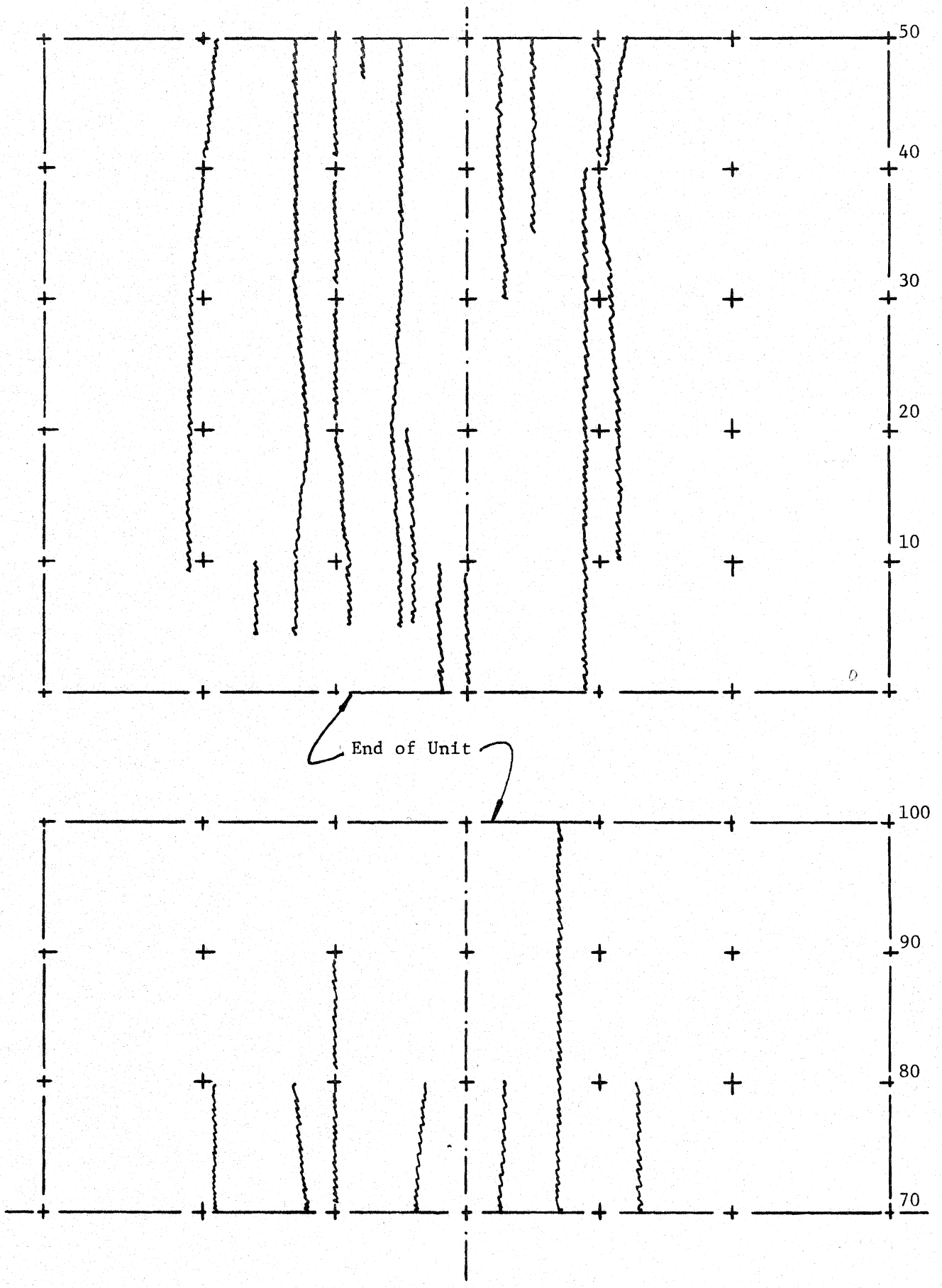

80
70
60
50
40
30
20
10
Untreated Area
Inside Face of Parapet Wall
Inside Face of Parapet Wall
South End of Bridge
12'
10'
10'
10'
10'
12'

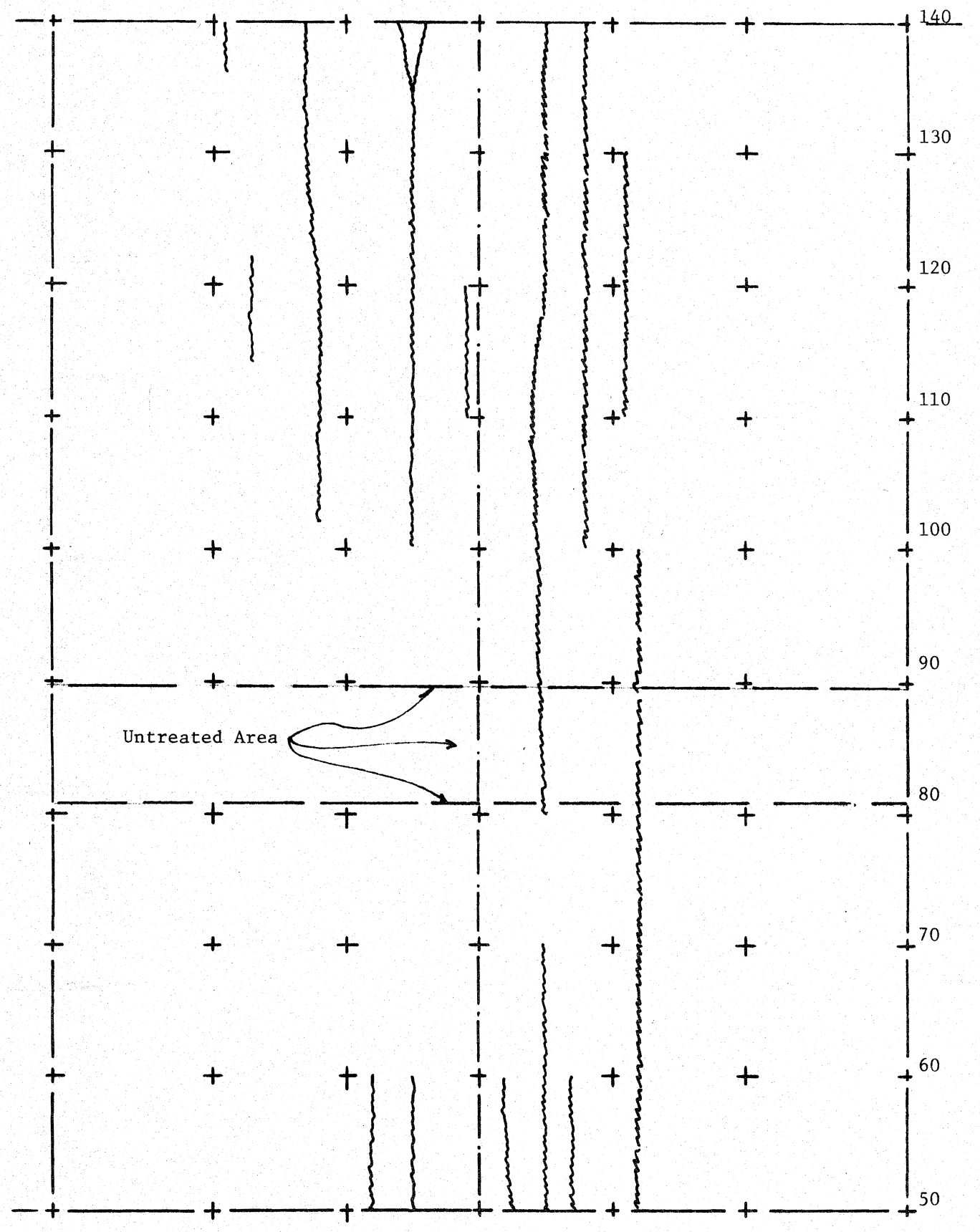

170
160
150
140
130
120
110
100
90
80

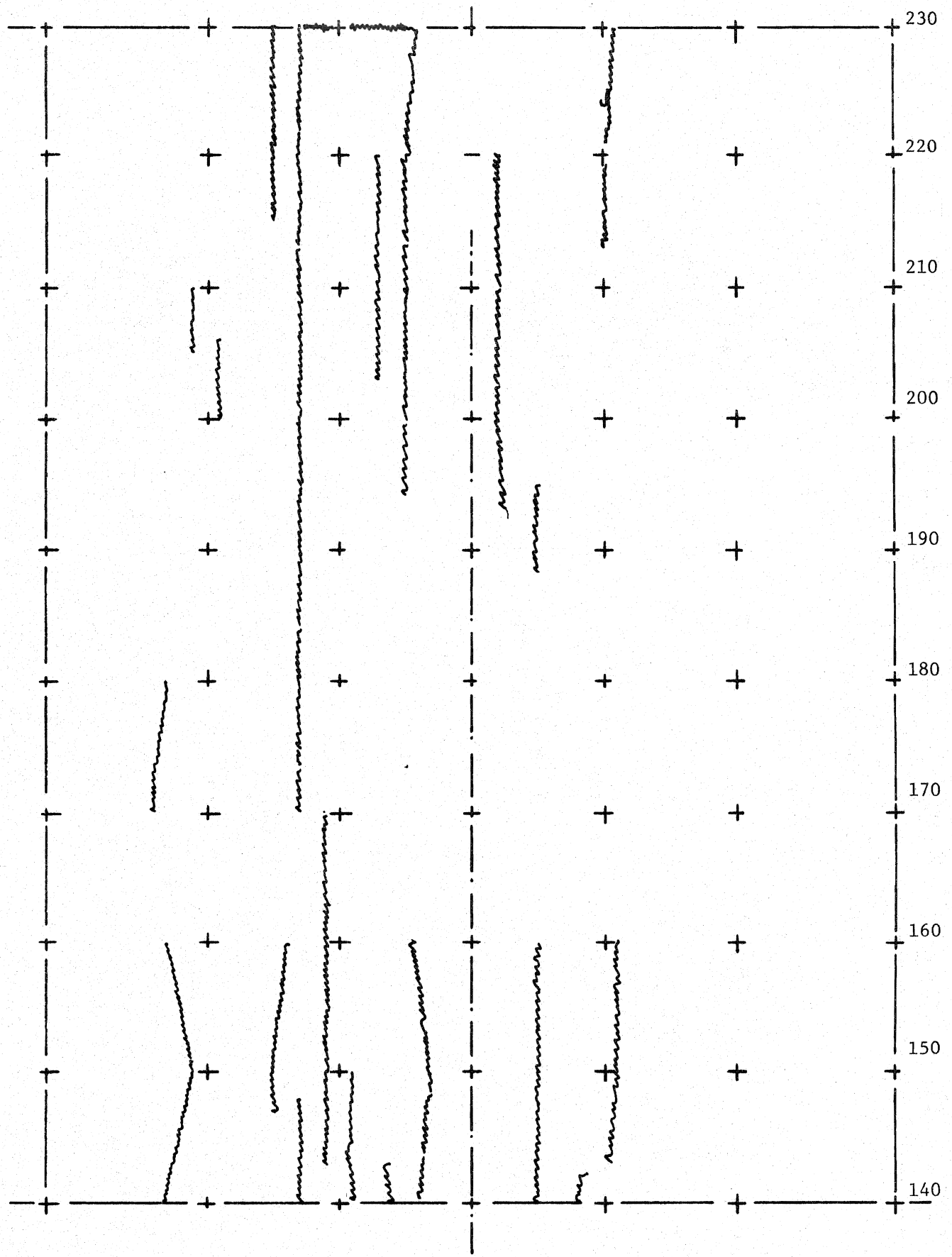

260
250
240
230
220
210
200
190
180
170

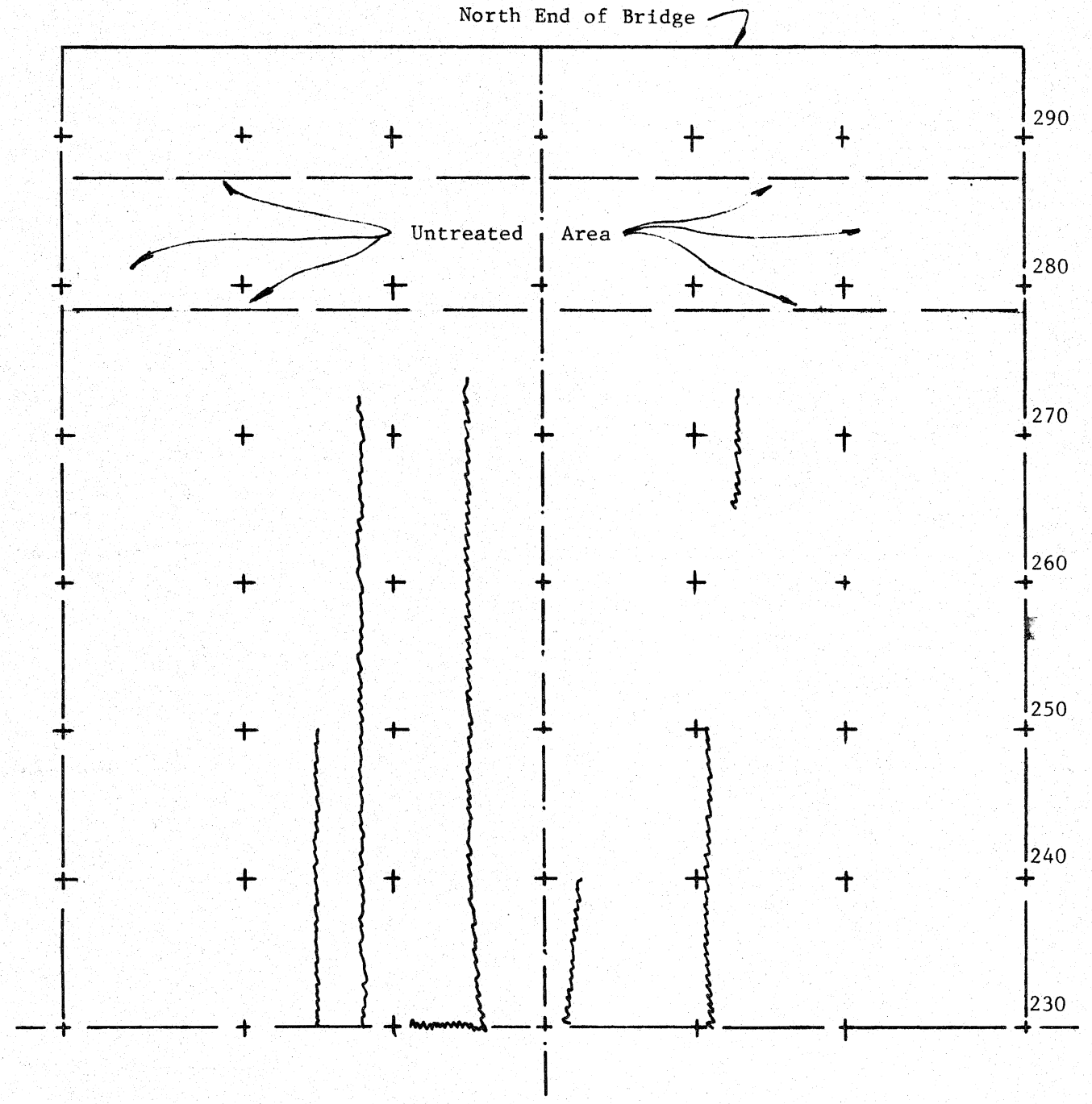

50
40
30
20
10
End of Unit
290
280
270
260


70
60
50
40
30
20
10
End of Unit
60
50


50
40
30
20
10
End of Unit
100
90
80
70


140
130
120
110
100
90
80
70
60
50
Untreated Area


230
220
210
200
190
180
170
160
150
140


North End of Bridge
290
Untreated
Area
280
270
260
250
240
230