USS

LIGHT-WEIGHT

STEEL FLOORING

FOR BRI... DEWALKS · AND BUILDING CONSTRUCTION

CONTENTS

Ruggedness and great strength combined with light-weight as well as low cost of installation are the outstanding characteristics of the three types of U·S·S Steel Flooring—U·S·S I-Beam-Lok Open Floor... U·S·S I-Beam-Lok Armored Floor... U·S·S T-Tri-Lok....

So satisfactory has been the performance of U·S·S Steel Floorings that since their introduction they have been installed in more than four hundred bridges of every type from the smallest beam and girder spans to huge internationally known crossings, such as the Bronx-Whitestone, Williamsburg, Queensboro and Manhattan Bridges in New York City, as well as many other structures of major importance. These installations aggregate almost 4,000,000 square feet, equivalent to more than 33 miles of standard 22-foot width highway bridge decking.

U·S·S I-Beam-Lok Open Floor is a combination of specially designed load-carrying I-Beams made integral with and forming part of an open roadway surface. Its use is particularly advantageous where dead loads must be kept to an absolute minimum or where snow removal is a serious problem.

U·S·S I-Beam-Lok Armored Flooring consists of a series of alternating steel I-Beams and concrete ribs locked together with notched crossbars passing through the beams and ribs at both top and bottom of the slab. Thus full advantage is taken of the well-known strength and efficiency of the I-Beam.

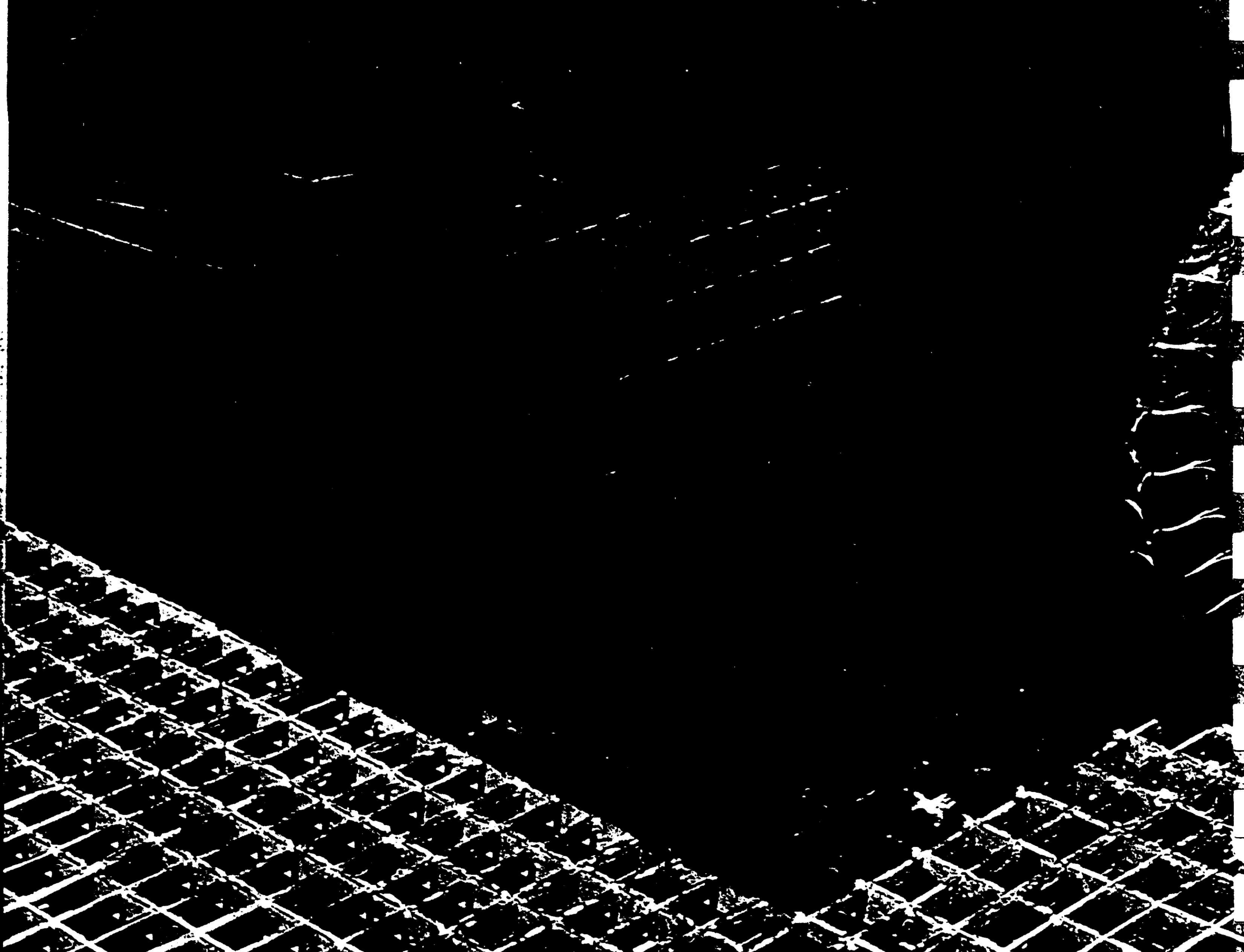
This floor usually is filled with concrete after it is installed on the bridge. It may also be pre-cast—filled with concrete at or near the bridge site before installation on the bridge roadway. This offers important advantages where the floor must be installed on movable bridges or where construction operations must be carried on in freezing weather. Steel form strips which are built in at the factory provide a form for retaining the concrete.

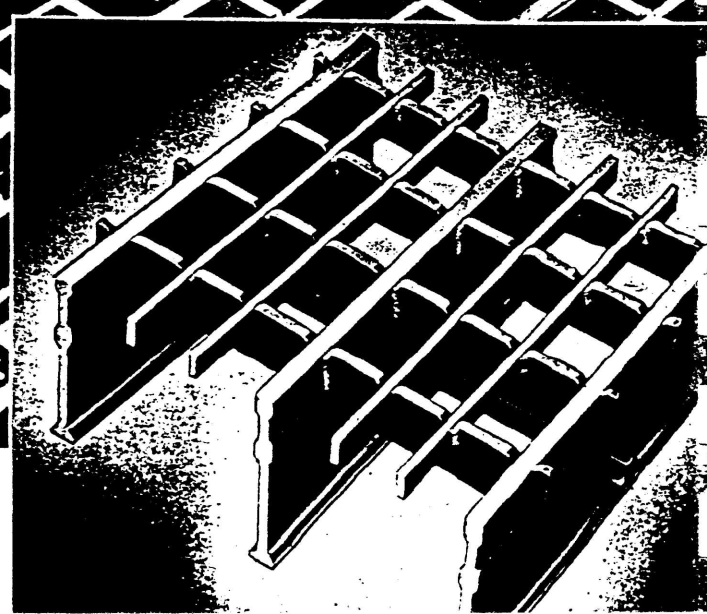
U·S·S T-Tri-Lok is widely used for bridge sidewalks. Instead of the flanges of adjacent Tees touching each other, they are spaced apart similar to the bottom flanges of I-Beam-Lok and the intervening space closed by means of steel form strips.

Ease and speed of erection resulting in earlier completion of a bridge, and a minimum of traffic delays, are among the numerous benefits derived from the use of these three advanced types of U·S·S Steel Flooring for bridge roadway slabs.

Ruggedly constructed to give a long life of satisfactory service, all three types of this floor provide a smooth riding, safe, anti-skid roadway.

We shall be glad to make available without obligation to any interested engineers the knowledge and experience acquired in furnishing the equivalent of 33 miles of light-weight, heavy duty combination steel and concrete bridge slabs or floors.





Unit laid parallel to traffic

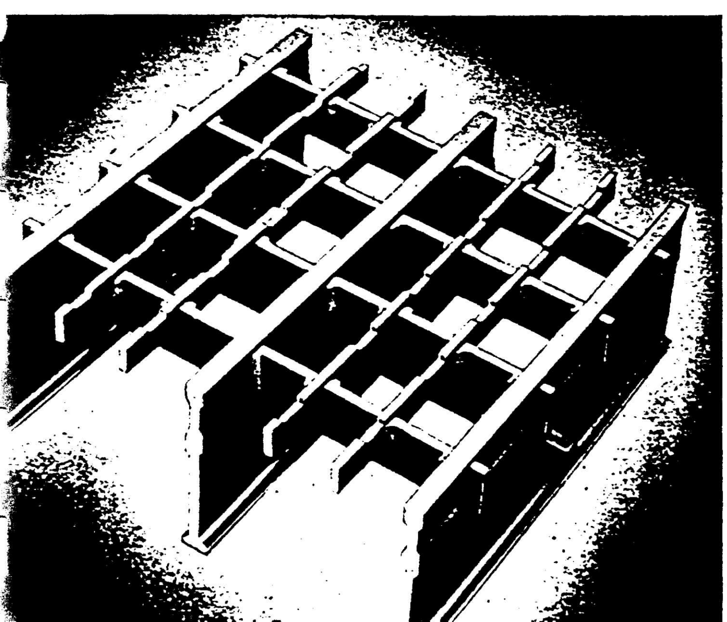
U·S·S I-Beam-Lok OPEN FLOOR

U·S·S I-Beam-Lok Open Floor was developed to produce a strong light-weight open bridge floor adapted to long span structures, vertical lift, bascule, or other types of movable bridges, as well as for the reflooring of existing bridges where a minimum of weight is essential. This new open flooring introduces a new principle in that extra strong and deep carrying beams are combined with and are made an integral part of the upper wearing surface of this open floor construction.

This principle of design which produces great strength of section permits the use of units with main carrying beams either parallel or transverse to the direction of traffic. Two types of open floor units are produced, essentially the same in depth, strength properties, and size of opening, and differing only in the "pattern" of the riding surface. Each type has been designed to insure positive traction, resistance to skidding, and smooth riding without side shimmy or whip.

As shown in the illustrations and details, this new open flooring is similar to the tried and widely used U·S·S I-Beam-Lok Armored Floor in principle and method of assembly. The primary load-carrying members consist of specially rolled 5″ beams, which are intersected at 3″ intervals by main crossbars. These transverse crossbars are notched on the top edge to receive two supplementary bars equally spaced between and parallel to the main carrying beams. The entire assembly produces a steel riding surface with rectangular clear openings approximately 1⅝″x 2¾″.

In the type PL units as detailed on pages 12 and 13, and intended for use when laid with the main carrying beams of the units parallel to traffic, the main crossbar is 1⅝″x ¼″ with the top edge placed approximately ⅛″ above the top of the 5″ carrying beams. The supplementary bars are flush with the top of the load-carrying beams.



For the type TR units, as detailed on pages 14 and 15, for use only when laid transverse to the direction of traffic, the main crossbars are 1½″ x ¼″ and the top edges of these bars are dropped approximately 3/32″ below the top of the main carrying beams. The supplementary crossbars are flush with the tops of the carrying beams, and are rolled with depressions approximately 2″ on centers to provide resistance against skidding sideways.

Actual installations in service have proved that the exceptional anti-skid qualities of both types of units have been achieved by the difference in elevation between the top edges of intersecting component members. Reference to the details will show that in neither type of unit is there a raised bar running in the direction of traffic which might cause any directional effect on moving vehicles, therefore perfectly smooth riding qualities are provided.

In both types of units, raised portions of the riding surface always occur transverse to the direction of moving traffic which provide a series of regularly spaced cleats to improve traction and prevent forward skidding. The specially rolled serrated supplementary bars in the type TR unit, and the slots or notches in the main transverse bar of the type PL unit are especially effective in eliminating any tendency to skid sideways.

The sizes of the main carrying members have been designed so that U·S·S I-Beam-Lok Open Floor can be placed directly on the stringers at normal spacing. Usually no supplementary system of sub-stringers is necessary. Thus total weight of this floor, above the main stringers, in most cases does not exceed 18.6 lbs. per square foot. This extreme light weight has not been obtained by sacrificing durability, since all metal used in the assembly is at least ¼″ thick and is copper bearing steel throughout.

The 5″ U·S·S I-Beam-Lok Open Floor units are furnished in maximum standard widths of 6′-2″ center to center of side splices, although special widths will be supplied where conditions require them. All units are manufactured in any length up to and including 49′-0″, and usually furnished with one dip coat of our own standard specification priming paint. *We will not undertake to apply paint to any other specification.*

Ease and speed of erection, and rapid completion of the floor is facilitated by these large size units, which enable the placing of comparatively large areas of floor in one handling operation. After the units are field welded, as shown on pages 13 and 15, and field painted, the roadway is ready for traffic.

Unit laid transverse to traffic

U·S·S I-BEAM-LOK OPEN FLOOR

Principal Advantages

Economy . . . Large sized units applied directly to standard stringers at normal spacing result in low finished cost of structure. No closely spaced supplementary load distributing beams are necessary under U·S·S I-Beam-Lok Open Flooring: it takes the load directly to the stringers. Therefore there is less exposed area of steel supports below the bottom of the open floor, reducing the possibility of corrosion of main supporting members.

Safety . . . The rectangular openings are effective in giving traction to traffic moving in either direction. The serrated upper surface is particularly effective in preventing skidding. In skid tests made after ice had formed on this flooring, a car was driven at approximately 35 miles per hour and when the brakes were suddenly applied, the car came to a perfect stop. Only a slight skid forward in a straight line occurred and absolutely no skid sideways. There is no tendency for a vehicle to change direction when passing from other surfaces to U·S·S I-Beam-Lok Open Flooring. The open surface and the steel composing the grating are high enough above supporting stringers to prevent accumulated ridges of snow and ice to form above the riding surface. This feature also eliminates rutting or a directional effect on traffic. Snow, of course, falls through the floor and any ice that is formed is quickly broken off by the passage of the first vehicles.

Light Weight . . . U·S·S I-Beam-Lok Open Floor weighs only 18.6 lbs. per square foot. Snow loads are eliminated and thus weight never increases. Due to its light weight, U·S·S I-Beam-Lok Open Floor is particularly advantageous on movable structures, as well as on extremely long span bridges. It also has been used to replace wood floors without sacrificing live load capacity of the bridge, and in some cases an actual increase in live load capacity was achieved.

Rigidity and Strength . . . Because of the high strength properties of U·S·S I-Beam-Lok Open Floor, which are provided by the relatively deep main carrying members and the extremely rigid construction, these units when laid either parallel or transverse to the direction of traffic will safely carry up to and including standard H-20 loadings on stringers or supports not exceeding 4 feet center to center.

For all standard highway loadings up to H-15, a 5-foot maximum spacing of supports is permissible. The results of actual load tests substantiating the claimed strength properties and maximum spacing for supports are discussed at length on pages 16 to 19.

Quiet Surface . . . When vehicles travel over this floor only a quiet purring sound is emitted from the tires and this is in no way objectionable. There is no vibration, nor is there any wabble and whir in the tires.

Open and Self-Cleaning . . . Rectangular openings 1⅝″ x 2¾″ clear have been so designed that U·S·S I-Beam-Lok Open Floor has no crevices nor sharp re-entrant angles to catch dirt, dust or snow. Sweeping or washing is unnecessary. Air currents, suction created by passing vehicles, and rain combine to keep U·S·S I-Beam-Lok Open Floor and supporting members clean.

Uniform Level Roadway . . . Having no cracks, uneven joints, bumps or other irregularities, U·S·S I-Beam-Lok Open Floor is smoothly continuous in all directions. Rigidly welded to supports, sections of U·S·S I-Beam-Lok Open Floor cannot work loose and cause vibration.

Flat Roadway Surface . . . The ideal roadway has a flat, level surface, which is much safer for traffic than a crowned one, because it eliminates the tendency on the part of a vehicle driver to ride the center of the road. U·S·S I-Beam-Lok Open Floor may be laid with a perfectly flat, level surface, eliminating the necessity of providing a crown or other method for draining purposes.

Low Wind Resistance . . . Having approximately 80 per cent of the floor area open, U·S·S I-Beam-Lok Floor when applied to the surface of a lift bridge, greatly reduces wind resistance and pressure when the movable spans are being raised. Consequently, a reduction in initial cost of machinery and floor maintenance expense is effected.

Durable . . . Made of superior corrosion resisting U·S·S Copper Steel, U·S·S I-Beam-Lok Open Floor will last the life of the bridge. Long life is assured, for no section is less than ¼-inch in thickness. This thickness is equivalent to that used in the exposed bracing and lacing members of many parts of the superstructure of the average bridge. In the design of U·S·S I-Beam-Lok Open Floor special attention has been given to the reduction of secondary stresses, eliminating the formation of cracks due to fatigue. The I-Beam webs below the crossbars are thickened approximately 25 per cent to reduce bearing pressures at this point. In addition, the bottom edges of the cross bar and supplementary parallel bars and the corresponding notches into which they fit are half rounds. This feature eliminates sharp corners or points at which fatigue cracks could start. The long life of U·S·S I-Beam-Lok Open Floor is assured even though the floor may be over-loaded or abused in other ways. All members are rigidly interlocked and then securely welded in position. The main reliance for strength is placed on the inter-locking features of the unit. The component parts would stay in position and be effective even though a large percentage of the welding was omitted. The method of assembling guarantees its ruggedness.

Low Cost Maintenance . . . Occasional cleaning and painting is the only maintenance required. This may be easily done from the decking surface. No sweeping or removal of snow is ever necessary. Cracks cannot form, therefore there will be no holes to patch. U·S·S I-Beam-Lok Open Floor is not affected by frost.

Easy Inspection . . . The condition of the floor and the supporting members may be readily determined from the decking surface.

Can Easily Be Installed in All Seasons

Because U·S·S I-Beam-Lok Open Floor comes to the job ready for application, it can be quickly and simply installed, summer or winter. The material is fabricated in standard widths up to 6 feet 2 inches, and lengths up to 49 feet, which effect speedy handling with low erection cost. *Units may be placed so that main carrying beams run either parallel or at right angles to traffic.* Except for the necessary field coat of paint there is nothing to add to the floor after it is welded in position. It is ready immediately for traffic.

Ease and Speed of Installation . . . Completely fabricated units of U·S·S I-Beam-Lok Open Floor come to the bridge ready for installation. Welding to supports is a simple operation. An old bridge may be refloored with a minimum of interruptions to traffic. Equipment may be moved over the units as soon as laid, although they may not be completely field welded, thus forming a working deck from which other operations on the entire job can be speeded up.

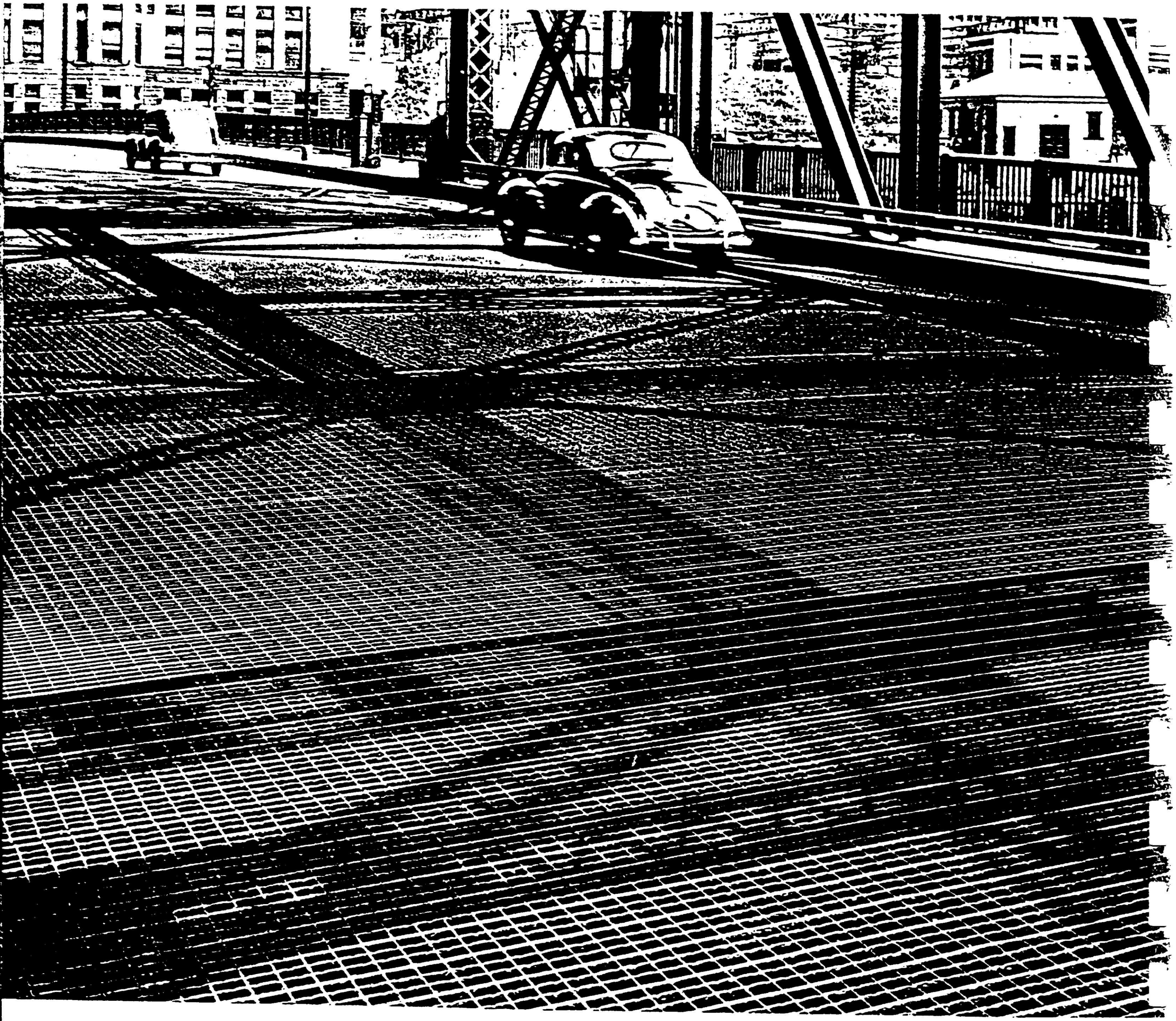
Special Advantages for Lift Bridges . . . U·S·S I-Beam-Lok Open Floor, because of its light weight and low wind resistance, makes possible savings in stringers, floor beams, trusses, foundations, cables, sheaves, counterweights and lifting machinery on all types of movable bridges.

Additional Economies on Long Spans

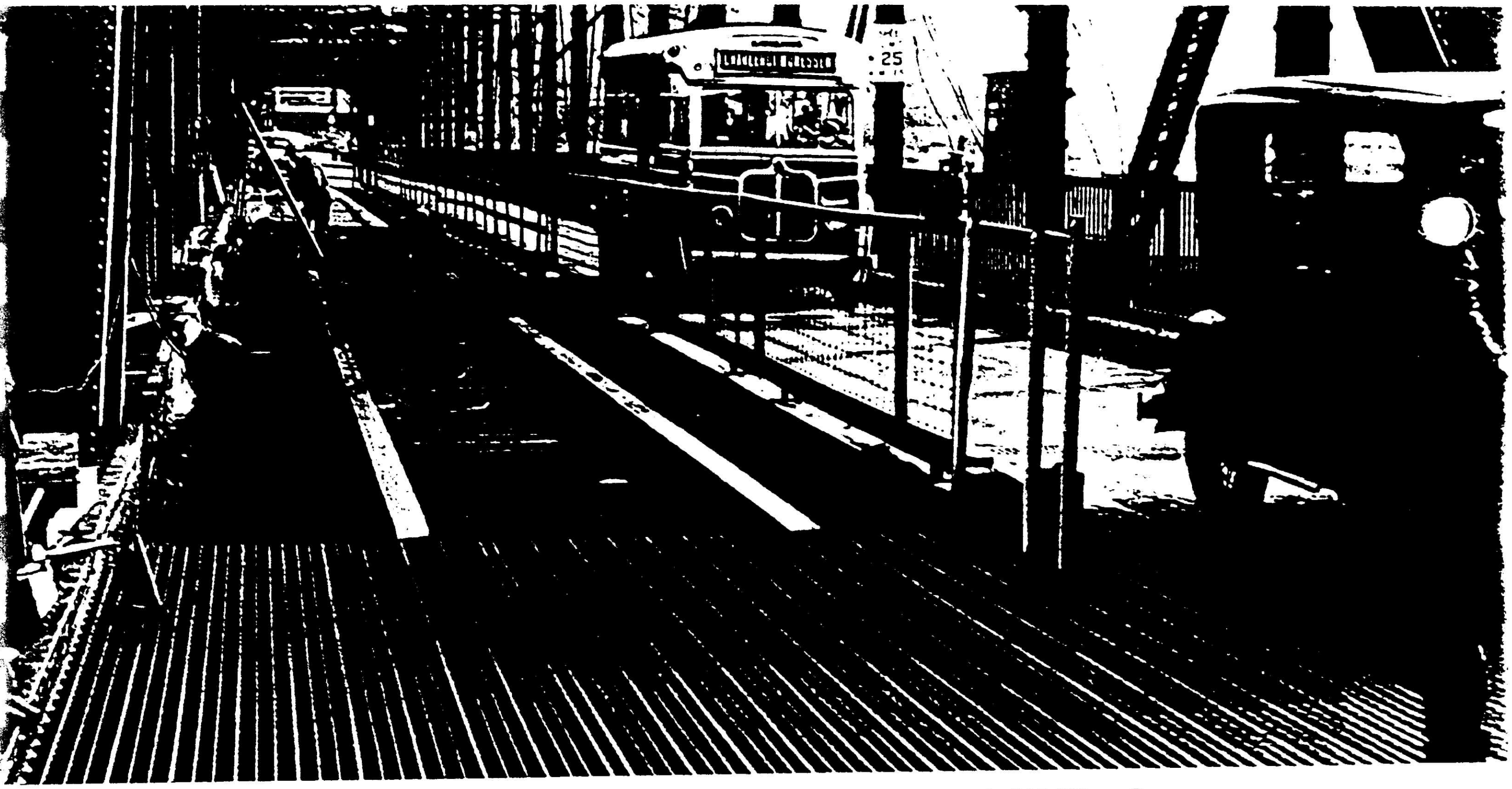
Much dead weight has been eliminated, for U·S·S I-Beam-Lok Open Floor weighs only 18.6 lbs. per square foot. Every pound saved in the floor means proportionately large savings in the trusses and correspondingly smaller foundations. On long span bridges U·S·S I-Beam-Lok Open Floor offers marked economies in design and construction.

Eliminates Fire Hazard . . . Fire hazard is eliminated by the use of this fire-safe incombustible roadway floor.

Quick Delivery . . . Modern and highly efficient equipment, in addition to especially trained personnel, skilled in the production of large quantities of material in limited time, assure quick and speedy delivery of U·S·S I-Beam-Lok Open Floor to the job location. As a result, the motoring public is spared the many inconveniences heretofore a necessary part of bridge construction.

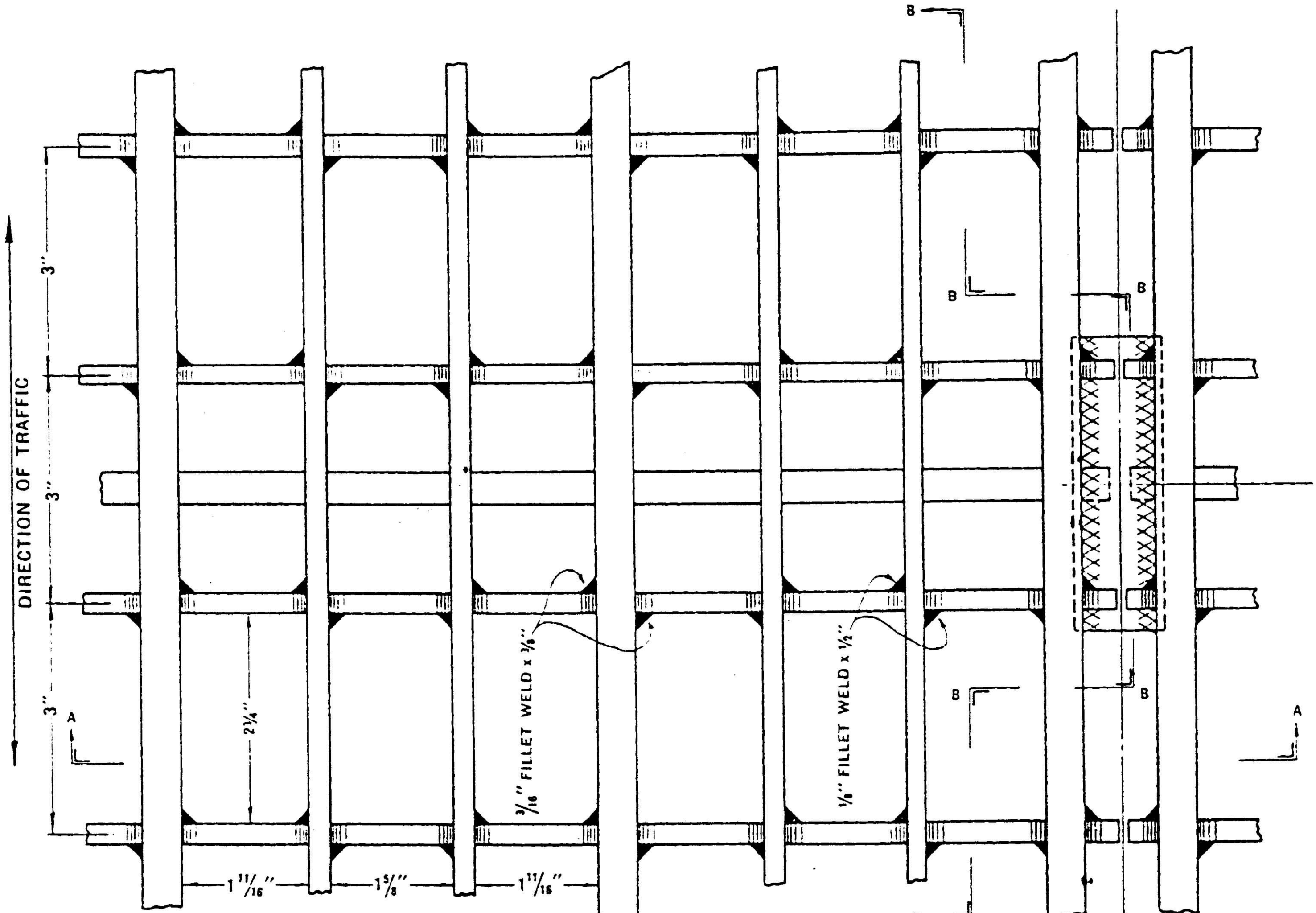


Carter Road Bridge, Cleveland, Ohio. Wilbur J. Watson, Consulting Engineer, and City of Cleveland, Department of Public Service—Division of Engineering and Construction. 9,247 sq. ft. of 5" I-Beam-Lok Open Floor were used

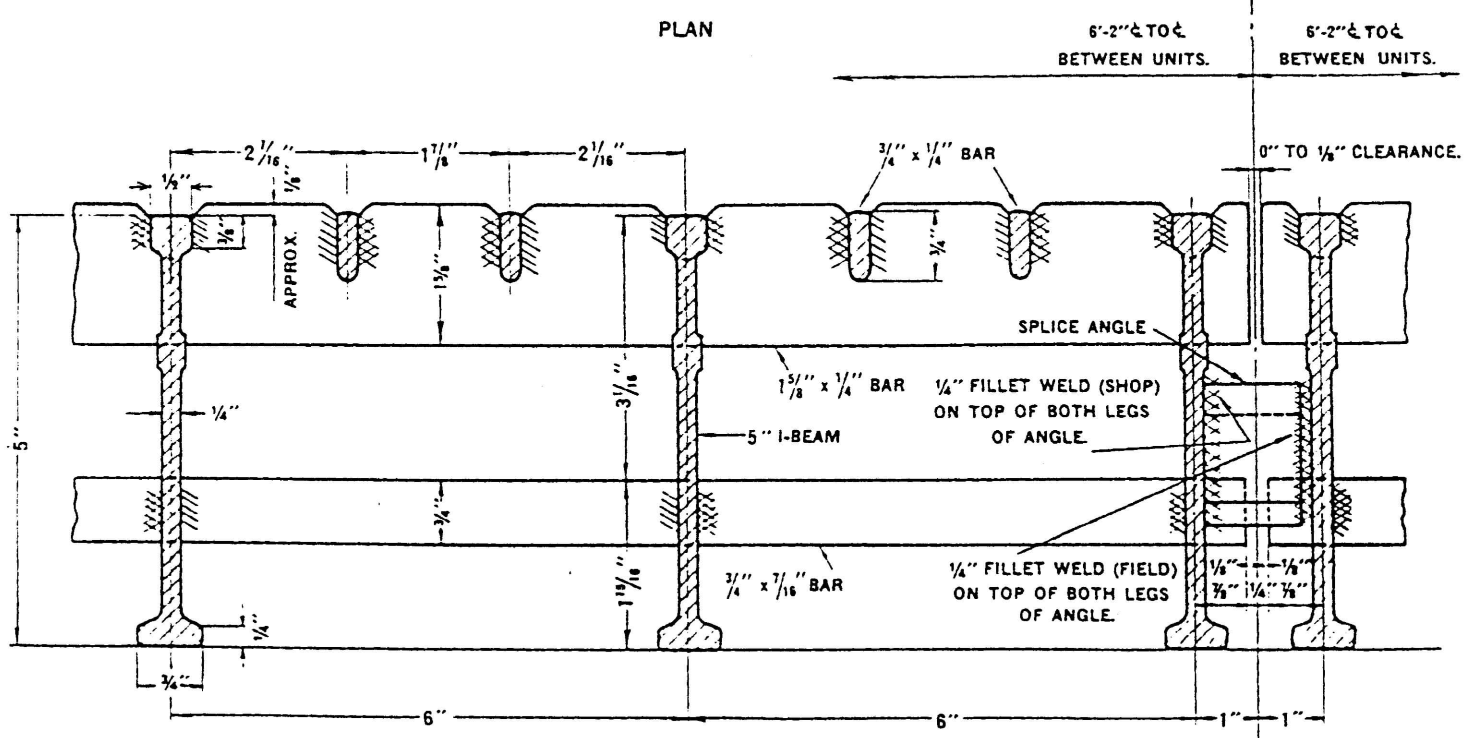


Reflooring Charleroi-Monessen Bridge, Charleroi, Pa., on which a total of 33,862 sq. ft. of 5" I-Beam-Lok Open Floor were used on the main spans and West approach viaduct

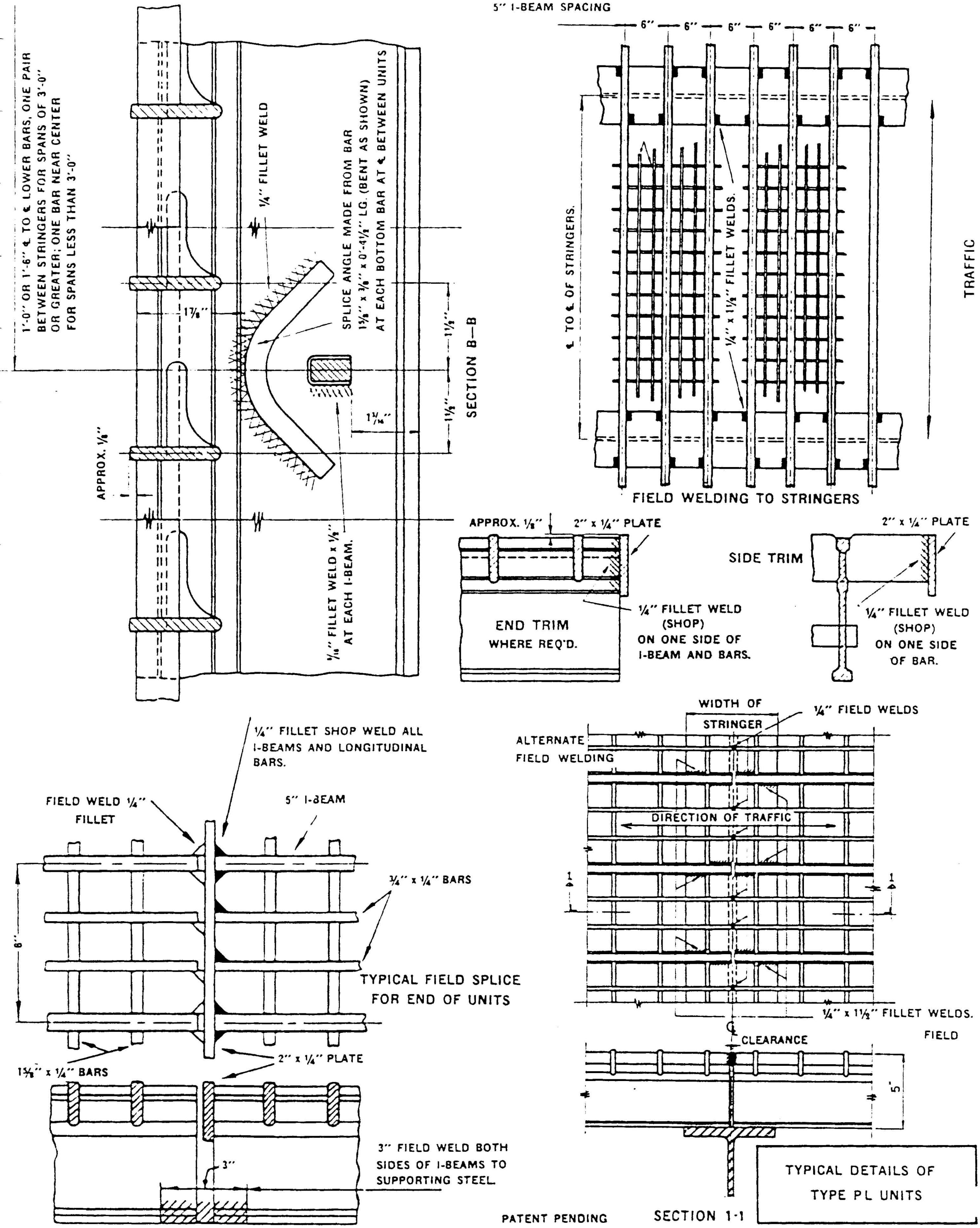
St. Clair Street Bridge, Frankfort, Ky., for the Commonwealth of Kentucky, Department of Highways. Refloored with 9,720 sq. ft. of 5" I-Beam-Lok Open Floor



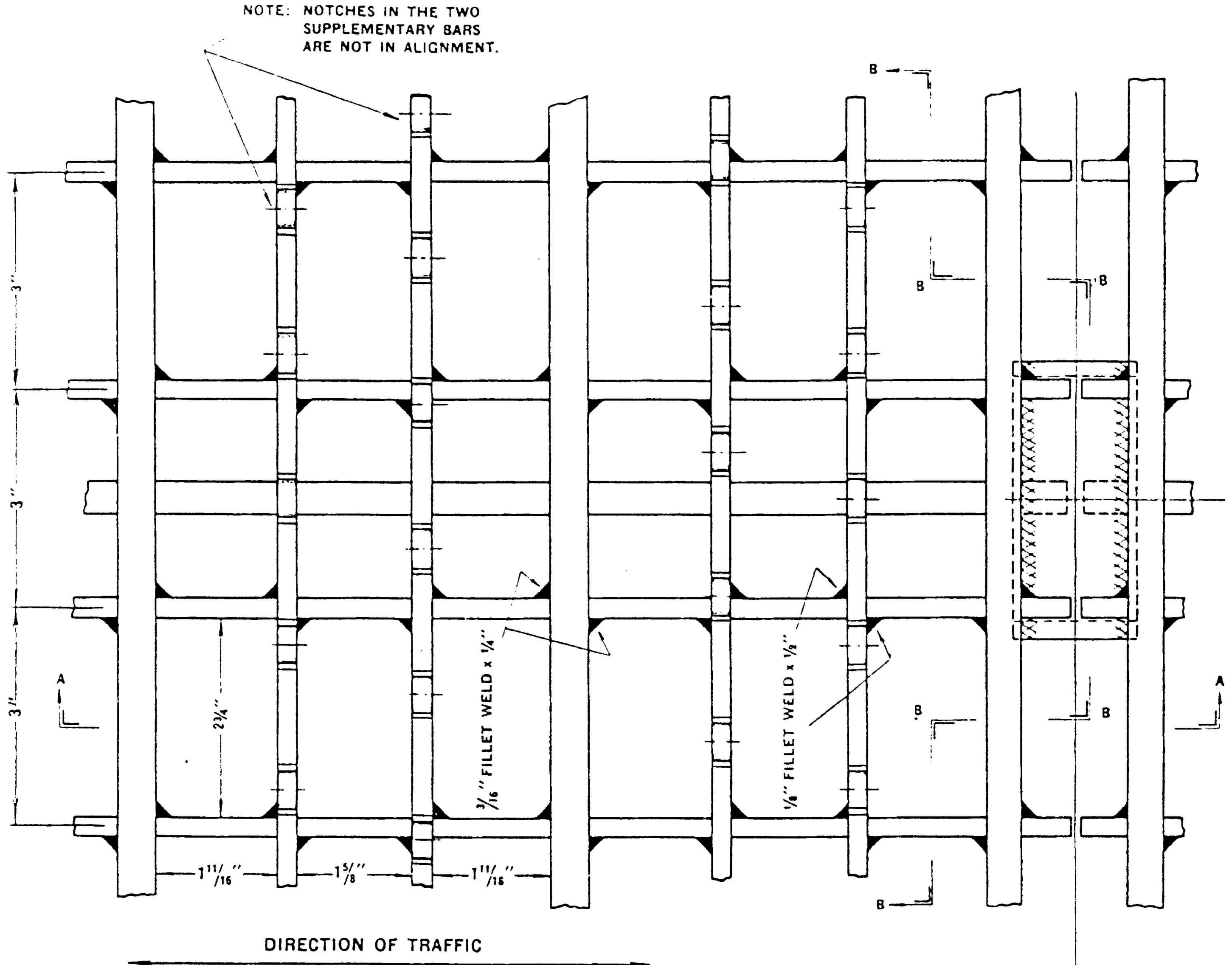
PLAN



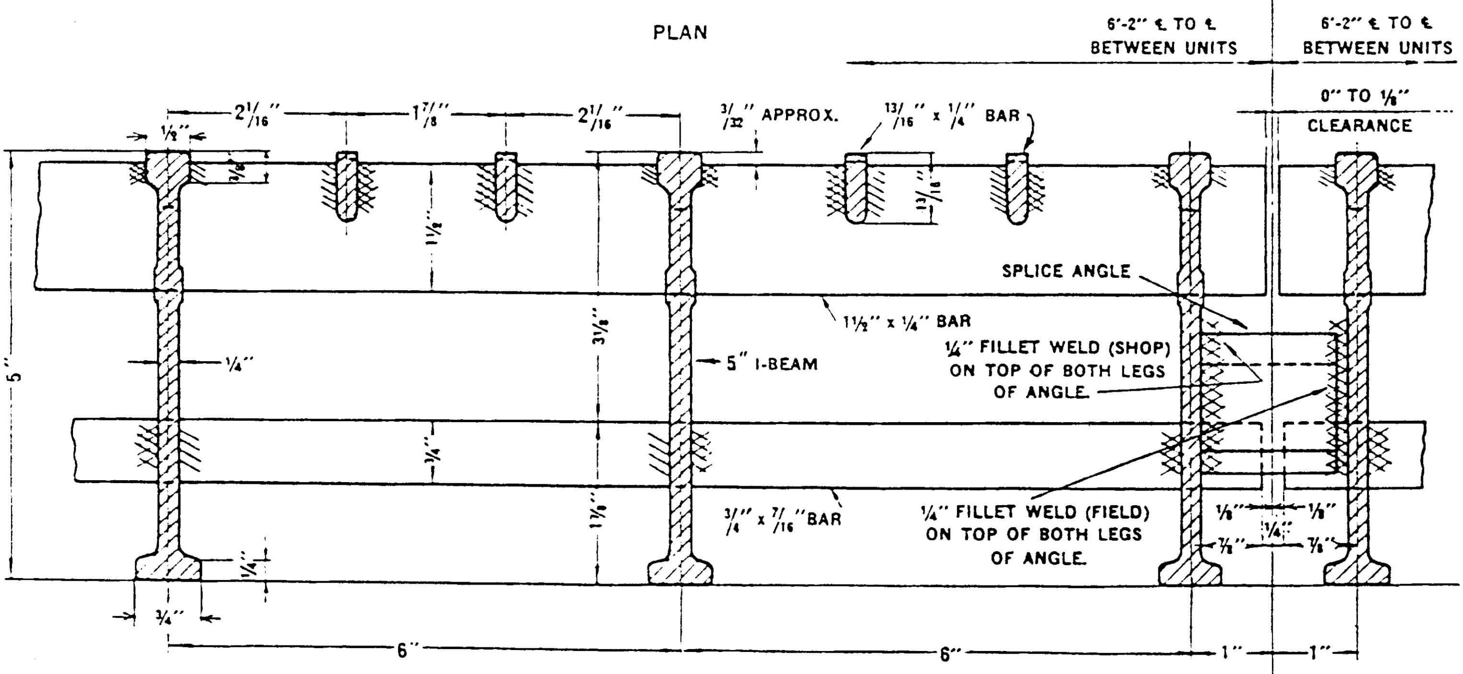
SECTION A–A



TYPICAL DETAILS OF TYPE PL UNITS



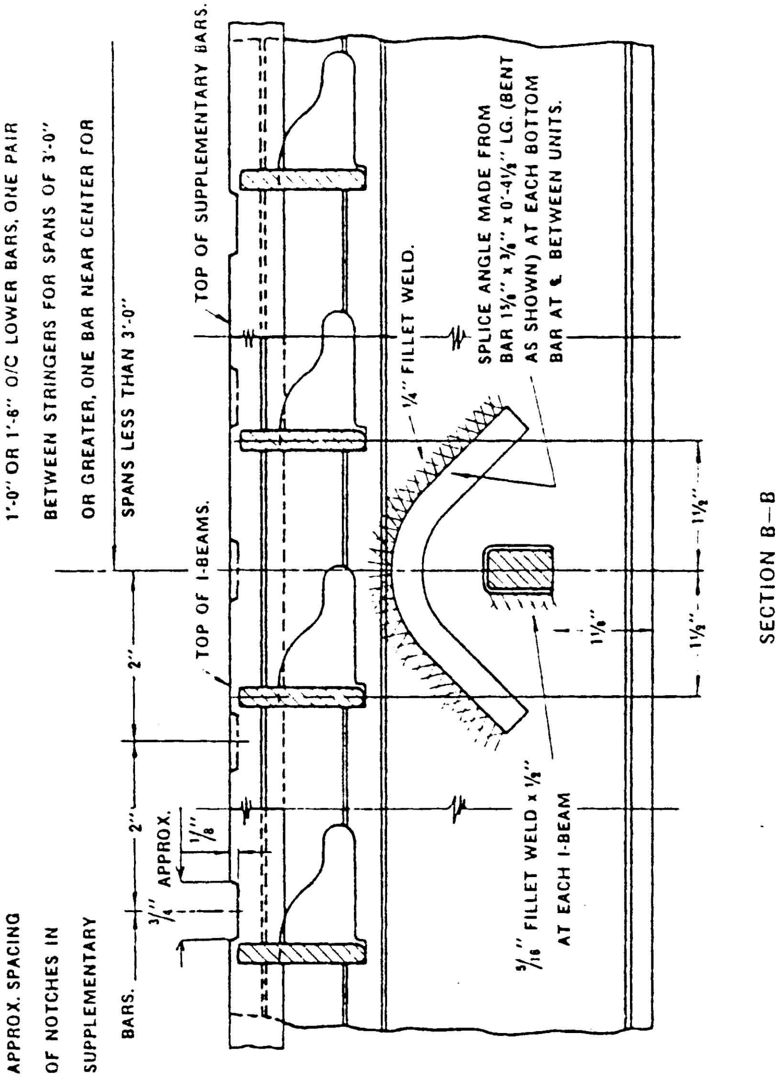
PLAN



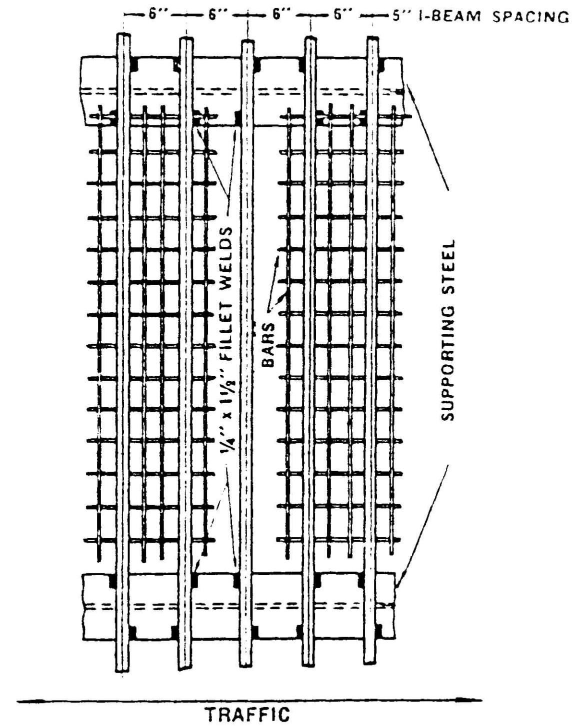
SECTION A—A

℄ BETWEEN UNITS.

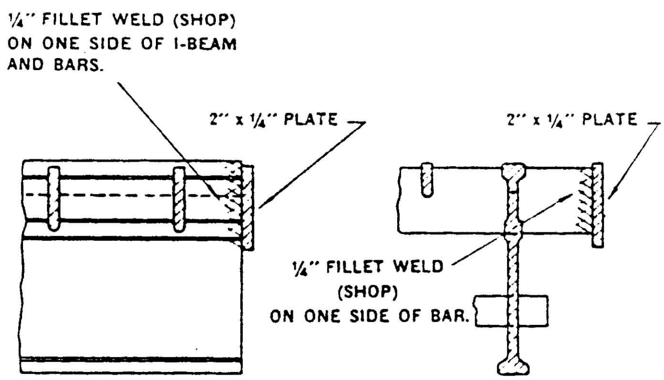
US Steel I-beam LoK
circa 1940



SECTION B—B



FIELD WELDING TO STRINGERS

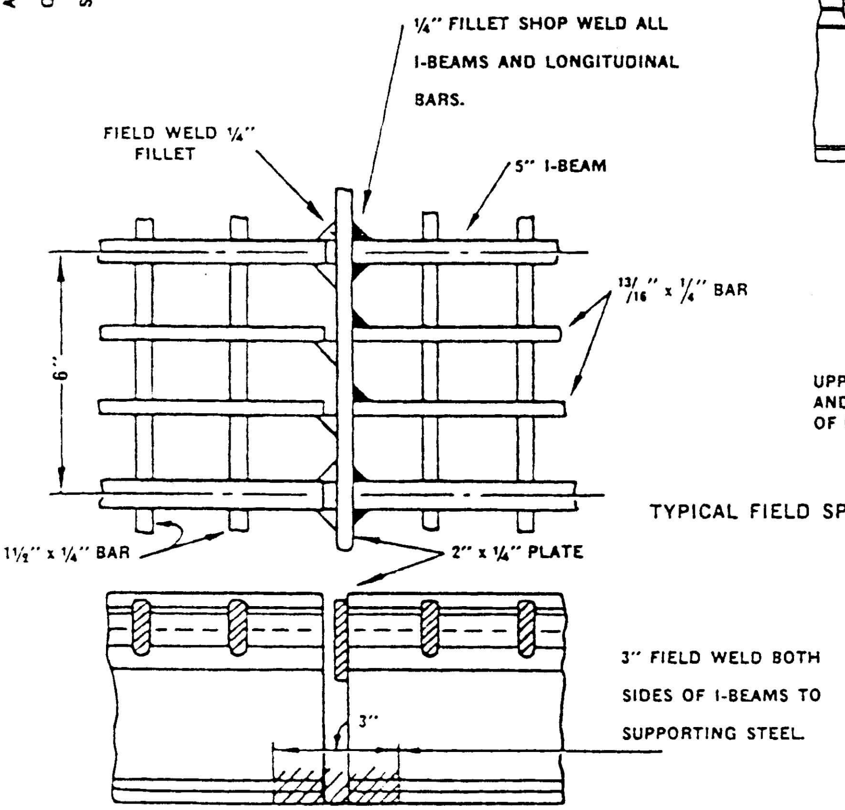


END TRIM
WHERE REQ'D.

SIDE TRIM

NOTE

UPPER EDGES OF UPPER BARS PARALLEL TO I-BEAMS ARE NOTCHED AND, TOGETHER WITH I-BEAMS, EXTEND MATERIALLY ABOVE PLANE OF OTHER MEMBERS IN WEARING SURFACE.



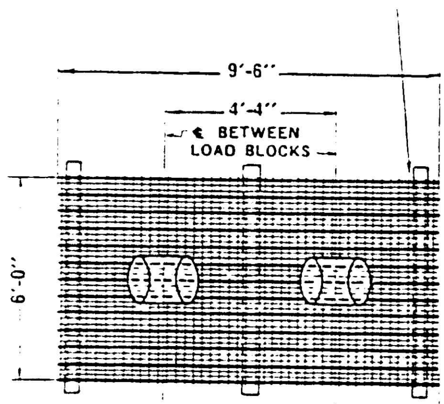
TYPICAL FIELD SPLICE FOR END OF UNITS

USED ONLY WHEN MORE THAN ONE UNIT LENGTH IS NECESSARY TO SPAN ROADWAY WIDTH.

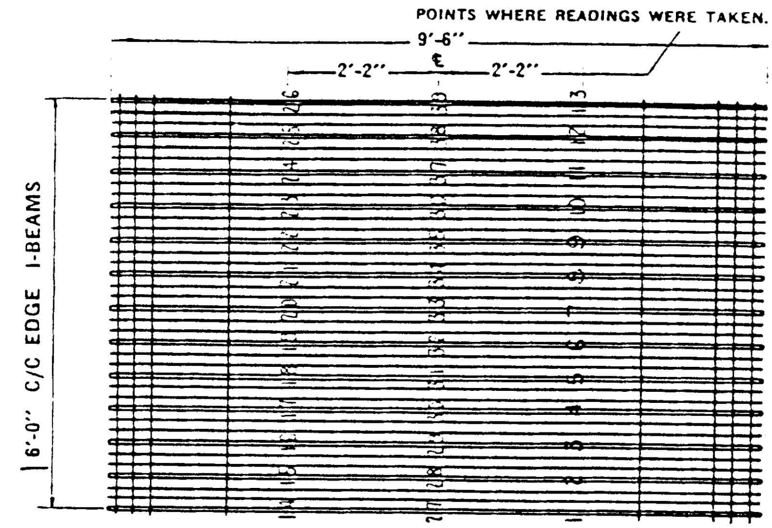
PATENT PENDING

TYPICAL DETAILS OF TYPE TR UNITS

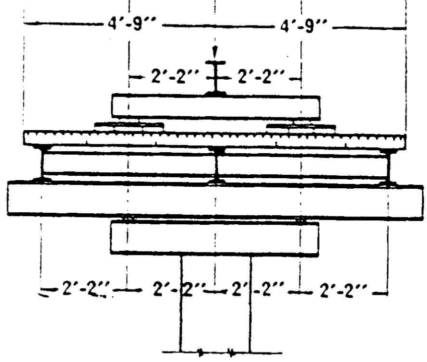
NOTE:—5" I-BEAM-LOK OPEN FLOOR UNIT WELDED TO SUPPORTING STEEL WITH RECOMMENDED STANDARD FIELD WELDS.— TWO 1/4" x 1 1/4" FILLET WELDS FOR EACH I-BEAM TO SUPPORTING BEAMS.



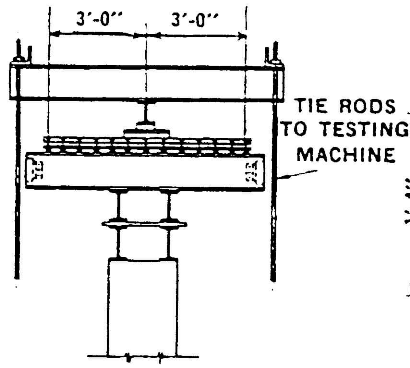
PLAN



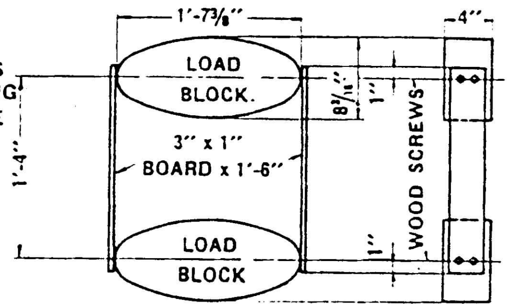
5" OPEN I-BEAM-LOK UNIT.



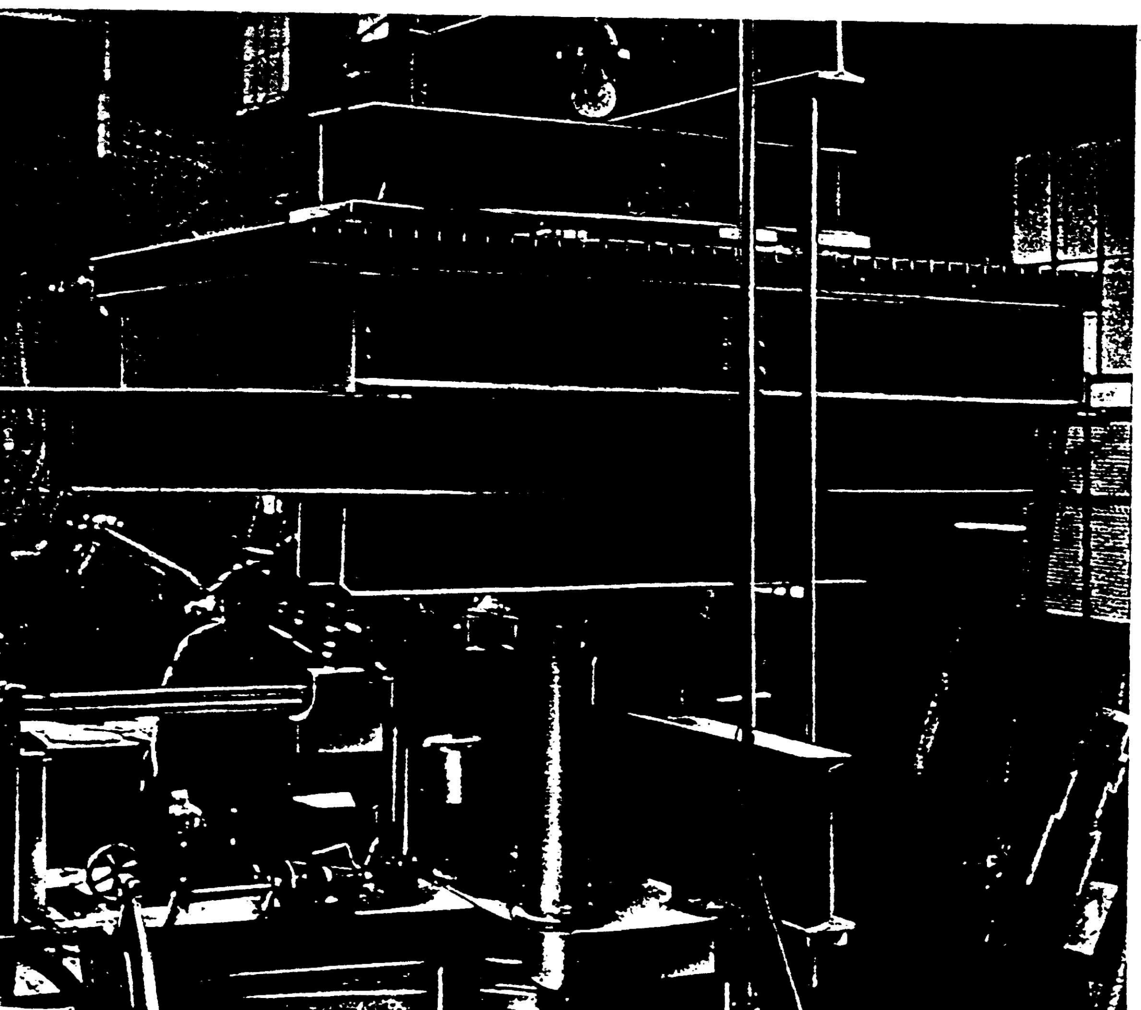
SIDE ELEVATION



END ELEVATION



ASSEMBLY OF LOAD BLOCKS



General view showing arrangement of the equipment and method of applying load to the test specimen

REPORT OF TESTS

on Five-Inch I-Beam-Lok Open Floor Section

On May 25, 1939, a test was made at Pittsburgh Testing Laboratory for the purpose of determining:

1st. The deflection incidental to the application of H-20 loads and whether or not any permanent deflection would occur.

2nd. The maximum stress under H-20 load.

3rd. The moment of inertia, section modulus, and location of neutral axis of the composite unit, including the supplementary bars.

4th. Limiting spans to be recommended with stresses kept within allowable limits.

5th. Load at which the steel would reach elastic limit.

A standard panel of flooring 6′ 1¼″ wide x 9′ 6″ long was made up and welded to three beams CB-142 for supports at each end and the center to make two spans continuous over three supports spaced 4′ 4″ center to center. The floor unit was welded to the supports strictly in accordance with standard recommended field practice. Channel diaphragms were inserted between the supporting beams below the edges of the test slab in such a manner as to stiffen the entire assembly but not to provide edge support for the test piece. These diaphragms were considered necessary in order to simulate the condition of rigidity found under actual service.

The complete shop assembly was supported on two 12″ beams resting on two bars about 3″ wide and 4′ 4″ apart, which were in turn supported by two additional 12″ beams resting on the top of the testing machine. Thus the floor section was supported in such a manner that any deflection of the supporting beams did not affect the deflections or stresses in the test piece.

Loads were applied by means of soft pine load blocks in pairs, each block cut to eliptical shape and of proper size to approximately equal the contact spot of a pneumatic tire used on a 20-ton truck after making an allowance of 40 per cent for impact.

The drawing on page 16 shows the specimen tested and the complete setup used, also a detail of the wood load blocks.

The size and form of the load blocks were determined as follows:

The tire listed for 8000 pounds rated load capacity is 12.75″ x 24″ and requires 90 pounds inflation, over-all diameter 50.2 inches, maximum width loaded 15 inches, height of axle above road when loaded 23.7 inches; hence, length of elliptical contact area equals $2 \times \sqrt{25.1^2 - 23.7^2} = 16.5$ inches

Total area is $\frac{8000}{90} = 88.9$ square inches and short diameter of elipse

$$= \frac{4 \times 88.9}{\pi \times 16.5} = 6.86 \text{ inches}$$

Total area required after adding 40% impact

$$= \frac{11200}{90} = 124.4 \text{ square inches}$$

Increasing 16.5 to 19.4 and 6.86 to 8.2 area becomes

$$\frac{19.4 \times 8.2 \times \pi}{4} = 125 \text{ sq. in.}$$

Description and Results of First Test

Before loading the specimen for test, an initial load of approximately 42,000 pounds was applied to it, thus allowing the loading blocks to seat themselves. The load was then removed. A dial gauge, reading to .001 inch was placed under the center beam of each unsupported section. A load of 44,800 pounds was then applied to the specimen and the deflection readings at the two points were recorded. The load was released and the test specimen was examined for permanent set. The results appear in Table I.

TABLE I

Point Number Center	Deflection Under Load of 44,800 Pounds Inches	Permanent Set After Release of Load Inches
7	.059	0
20	.061	0

Second Test

This test was run in the manner as originally planned, which was loading the specimen in increments and taking stress readings and maximum deflection readings on the I-Beams. Deflections were measured under the center of each unsupported section by using a movable Ames Dial reading to .001 inch.* Points were taken under each I-Beam with the exception of the two outer beams, which were obstructed by the diaphragms, as shown on the drawing referred to in the first paragraph.

Strain gauge readings were taken by placing two sets of holes about ½″ apart in the center of the unsupported section and on the under side of each

*NOTE: The complete test report shows deflection readings at various load increments, viz. 22400, 26880, 31560, 35840, 40320, 44800, 53760, 62720, 71680, 80540, 89600, 119500, and 130000 and stress readings at 22400, 44800, and 71680. For the purpose of this condensed report the deflection and stress readings at 44800 (H-20 Rear Axle load) only are shown. This load was equally distributed to each panel making an equivalent to H-20 wheel load with 40 per cent added to cover impact.

5-inch I-Beam with the exception of the outer two, which were obstructed. The average of these two readings taken on each beam, multiplied by the gauge constant, 695, gives the maximum tensile stress in the I-Beam. Strain gauge readings were taken in the same manner on top of the specimen over the center support, which also gives tension readings.

Strain gauge readings were taken at the start of the test, at two different loads during the test, and again after release of the maximum load. Deflection readings were taken at equal intervals of loading. The accompanying tables give the recorded deflections and strain gauge readings.

The points appearing in the tables refer to the position of the I-Beams and the place of measurement. Points 1 to 13, inclusive, refer to the under side of the I-Beams at the center of one unsupported length, while points 14 to 26, inclusive, refer to the under side of the other unsupported length. Points 27 to 39, inclusive, were located at the top of the 5-inch I-Beams at the center directly over the center support. Points 1, 27 and 14 were located on the same I-Beam, points 2, 28 and 15 on the same beam, etc.

TABLE IB

Deflection and Strain Gauge Readings

Load on Beam Point Number	44800 Lbs. Deflection Inches	44800 Lbs. Stress Lbs./Sq. In.
1	....	.....
2	0	0
3	.001	1180
4	.0125	2225
5	.021	6740
6	.045	10450
7	.055	15450
8	.037	13000
9	.016	8340
10	.011	1875
11	-.006	0
12	-.004	1875
13	....	.....
14	....	.....
15	-.007	2085
16	-.005	6950
17	.007	6390
18	.023	6390
19	.050	14750
20	.060	15640
21	.032	14950
22	.025	12850
23	.013	2225
24	.007	1045
25	.005	486
26	....	.....
27		-1530
28		0
29		0
30		2225
31		9235
32	These points are over center support. No deflection readings possible.	17500
33		22700
34		20650
35		10550
36		3125
37		486
38		-486
39		-1390

Conclusions

In this test every possible effort was made to simulate the actual conditions as they would be found in service. The results show that:

1st. Under normal traffic conditions, H-20 loading will not produce stresses exceeding 20,000 pounds per square inch in any part of the structure for all spans up to 4′ 0″ where the I-Beam-Lok Floor structure is continuous over 2 or more spans. Therefore, engineers and designers may safely use the standard units on 4′ 0″ spans.

2nd. The recorded deflections and stresses indicate the correctness of the assumption that a minimum of 5 I-Beam-Lok beams carry each wheel load and that the design of the 5″ I-Beam-Lok Open Floor unit on this basis is conservative.

3rd. Under normal H-20 loads, no permanent deformation took place, as dial readings showed complete recovery when loads were removed.

4th. Deflection increments were constant under constant load increments until yield point was reached under a center load of 130,000 pounds or 2.9 times the normal H-20 with 40 per cent impact. This was a clear indication that elastic limit of steel was reached at this load.

5th. The 4-foot recommended span does not represent the maximum span that may be used as the test indicates behavior which may be considered satisfactory for spans up to 4′ 4″ center to center of supporting beams.

6th. Owing to physical limitations, the test was set up to equally load two adjacent panels, a condition of loading which could never be found under actual service conditions, in view of the fact that both loaded panels are exterior, while in service each exterior panel would be adjacent to an interior panel. In the conclusion drawn from the test report no effort is made to evaluate the reduction in bending moment due to this fact, except to call attention to the fact that the recorded stresses and deflections are slightly greater than would be the case under normal H-20 loading.

7th. It will be noted that this test covers the condition of main carrying beams laid transverse to direction of traffic. However, an earlier test led to the conclusion that where the beams are laid parallel to the direction of traffic, the resultant stresses are nearly as high, the advantage being so slight that it is considered advisable to recommend the same span limitations for the latter as for the former.

Third Test

For this test the method of supporting the specimen and loading was changed. Instead of it being supported at three places, it was only supported at the ends, leaving the center free to deflect. The load was applied transversely across the width of the specimen through a 20-inch I-Beam. The diaphragms were removed from the sides for this test.

Deflection readings were taken at three points across the width of the specimen, one at either edge and the other at the center. These points were located under the load application midway between supports.

Strain gauge readings were taken both on the top and bottom of the 5-inch I-Beams, the center of gauge points being located 9½ inches from the center of the specimen. It was not possible to get any closer to the center of the span, due to the center I-Beam. In the following table IIA, the readings followed by "L" were taken on the under side and the readings followed by "U" were taken on the top side. Results appear in Tables II and IIA.

TABLE II
Deflection Readings
Specimen on Supports 8′ 8″ Center to Center

Dial Gauge	Load on Beam 30,000 Lbs. Deflection Inches
1	.490
2	.481
3	.495

TABLE IIA
Strain Gauge Readings
Specimen on Supports 8′ 8″ Center to Center

Load on Beam Point Number	30000 Lbs. Stress Lbs.–Sq. In.	Load on Beam Point Number	30000 Lbs. Stress Lbs.–Sq. In.
27L	26400	27U	25000
28L	27200	28U	25800
29L	26400	29U	26100
30L	26400	30U	25800
31L	28800	31U	26500
32L	27900	32U	*
33L	25000	33U	*
34L	24300	34U	24300
35L	29200	35U	28600
36L	29000	36U	26200
37L	30200	37U	27800
38L	28600	38U	26500
39L	23800	39U	29000
Average 27100—Tension		Average 26500—Compression	

*These points varied greatly and were not considered in average.

The supplementary test noted as "Third Test" was run to determine the physical properties of the slab. Load deflection and span determine Moment of Inertia, and the relative stresses determine position of neutral axis.

Under a 30000-lb. load applied, concentrated at the center of span but uniformly across the width of the slab, average deflection was determined at the center to be .4887 inches and at points near the center, average tension was 27100 lbs. and average compression was 26500 lbs.

$$D = \frac{Wl^3}{48\,EI} \text{ hence } I = \frac{W}{D} \times \frac{l^3}{48\,E} = \frac{24.243}{.4887} = 49.61 \text{ inches}^4 \text{ for a}$$

6′ 2″ unit $I = 8.0449$ inches^4 per foot width

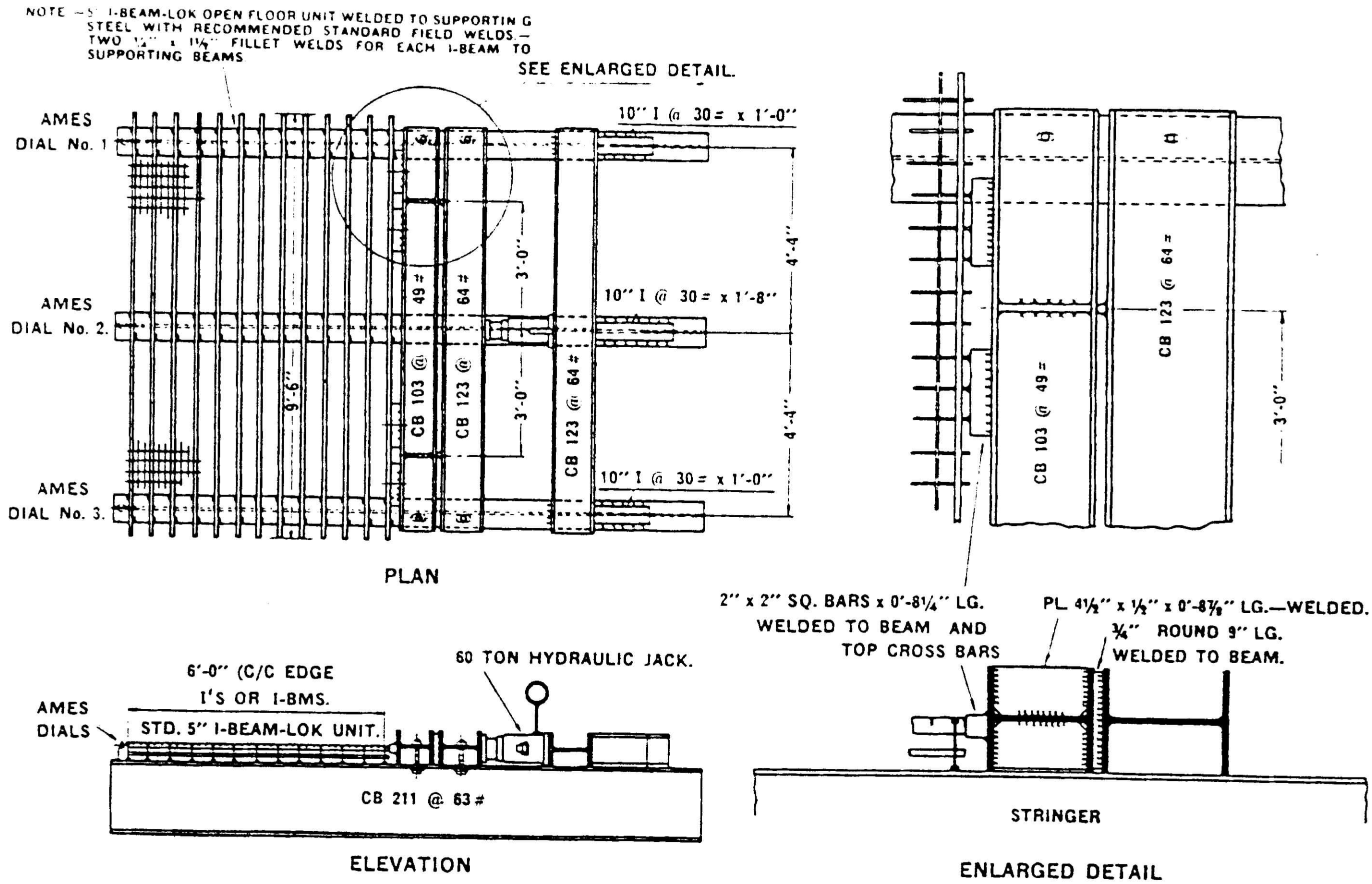
$$\text{Neutral axis is } \frac{5 \times 26500}{53600} = \begin{matrix} 2.47 \text{ inches from the top and} \\ 2.53 \text{ inches from the bottom} \end{matrix}$$

$$\text{Sec. Modulus is } \frac{8.0449}{2.53} = \begin{matrix} 3.18 \text{ inches}^3 \text{ for bottom per foot width} \\ 1.59 \text{ inches}^3 \text{ for bottom per beam} \end{matrix}$$

$$\frac{8.0449}{2.47} = \begin{matrix} 3.26 \text{ inches}^3 \text{ for top per foot width} \\ 1.63 \text{ inches}^3 \text{ for top per beam} \end{matrix}$$

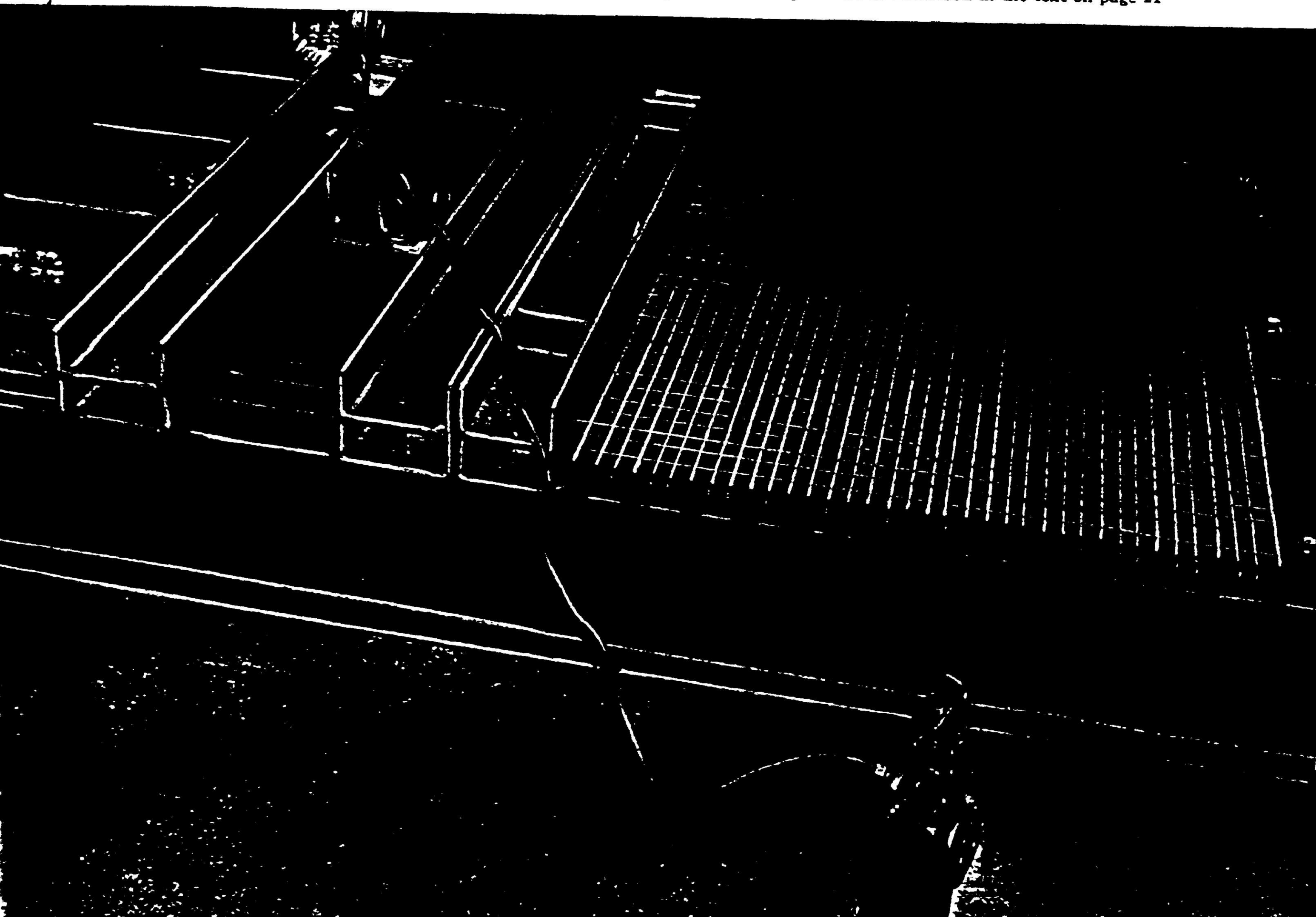
Conclusions

When the 5″ I-Beam-Lok Floor was designed it was considered sound reasoning to assume that the supplementary crossbars would have some restraining effect, thus influencing the position of neutral axis and the resisting moment of the composite structure. In all future computations the values of Section Moduli determined by this test may be used.



Pg 20

General view of equipment and method of applying load to test specimen as described in the text on page 21



RESULT OF TEST of 5-inch I-Beam-Lok Open Floor to Determine Effect of Deceleration or Acceleration

Conducted at McKees Rocks Plant of Carnegie-Illinois Steel Corporation . . . April, 1939

The purpose of this test was to determine whether horizontal loads applied normally to the direction of the main carrying beams would cause any deformation in the structure or tendency to collapse by sidewise movement as, for example, under rapid acceleration or deceleration from sudden application of brakes.

The drawing on page 20 shows the method and the details of the entire test procedure, etc.

As will be noted, the specimen tested was a full standard width unit, mounted on supports 4′ 4″ apart, while the load applications were made simultaneously, spaced 6′ 0″ apart. The beams selected for supporting the test unit are typical of what might be found in actual practice, and the test unit was secured to the supporting beams using standard recommended welding procedure; viz., two ¼″ x 1½″ fillet welds at each intersection. The entire test was made up in such a way as to simulate as nearly as possible actual conditions of load application under ordinary traffic service. Tire manufacturers were consulted to determine the loads which might be expected to act horizontally as a result of sudden acceleration or deceleration. Their estimate indicated that the horizontal force might be as much as sixty per cent of the live load, one-third of which would be applied at the front wheels and two-thirds at the rear wheels. On this basis, the normal force might be as much as 8,000 pounds at each rear wheel, which would require a load of 8 tons at the jack, which was placed midway between the two load applications. Ames dials were used to measure the deformation at various stages of loading.

The following table indicates the various load applications, together with the accompanying deflection, also recovery when load was released. It will be noted that while the 8-ton load at the jack represents the normal maximum tractive force from the 20-ton truck, permanent deformation was not noted until the load application exceeded 25 tons at the jack or 12½ tons per wheel. As a result of this test we feel that the following conclusions are justified.

1. There is sufficient resistance even in a single unit to withstand the entire tractive force of H-20 loading without over-stressing any part of the floor structure.

2. There would be a helpful influence from adjacent units due to the method of splicing at the sides, which would reduce the resultant stresses to such an extent as to present no complication, and therefore these stresses may be disregarded.

TABLE I

Test Load in Tons at Jack*	DEFLECTION IN INCHES		
	Gauge No. 1	Gauge No. 2	Gauge No. 3
5	.004	.0035	.0047
10	.008	.0072	.0100
15	.0135	.0120	.0167
0	.0004	.0	.0
10	.0082	.0075	.0105
15	.0130	.012	.0167
20	.0188	.017	.0235
0	.0005	.0	.0
15	.013	.012	.017
20	.0185	.017	.0235
25	.0245	.022	.0300
0	.0007	.0	.0
10	.009	.008	.0114
20	.019	.0172	.0242
25	.024	.0215	.0300
30	.0309	.0272	.0385
0	.001	.0003	.0012
30	.032	.028	.0400
35	.0400	.0338	.0484
0	.0032	.0015	.0038
15	.017	.0148	.0226
25	.032	.0239	.0351
35	.040	.0338	.0486
40	.0498	.0403	.0591
0	.0065	.003	.0075
45	.0610	.0478	.0720
0	.0100	.005	.0121
60	.1200	.078	.1325
0	.0410	.0168	.0435

*Loads shown in this column represent two times actual wheel loads.

3. The behavior under the test on the single unit was such as to indicate that the normal loads would need to be increased by over 200 per cent before any local permanent deformation would occur, which indicates a factor of safety of three without considering the helpful influence of adjacent panels.

DIMENSIONS OF COMPONENT PARTS

Table A

Type of Unit	I-BEAM SECTIONS								CROSSBARS		
	Depth	Web Thick-ness	Top Flange		Bottom Flange		Area	Weight Per Foot	Top Cross-Bar Size	Top Parallel Bar Size	Bottom Bar Size
			Width	Aver. Thick.	Width	Aver. Thick.					
	In.	In.	In.	In.	In.	In.	In.²	Lbs.	In.	In.	In.
PL	5	.25	.5	.344	.75	.281	1.53	5.2	1⅝ x ¼	¾ x ¼	¾ x 7/16
TR	5	.25	.5	.344	.75	.281	1.53	5.2	1½ x ¼	13/16 x ¼	¾ x 7/16

ELEMENTS OF 5" I-BEAM-LOK OPEN FLOOR

Table B

	Moment of Inertia Inches⁴	X Inches	Y Inches	Section Modulus Inches³	
Calculated Properties of Single 5" Beam only (per 6" width of unit)	3.16	2.12	2.88	1.50	Tension Side
				1.10	Compression Side
Calculated Properties of Cross Section (per 6" width) including supplementary crossbars	5.00	2.70	2.30	1.85	Tension Side
				2.17	Compression Side
Actual Properties of Cross Section (per 6" width) including supplementary crossbars, as derived from test results on page 19*	4.02	2.53	2.47	1.59	Tension Side
				1.63	Compression Side

*This test indicates that actual properties are practically a mean between corresponding calculated gross and net values given in above table.

SAFE LOAD TABLE FOR 5" I-BEAM-LOK OPEN FLOOR

Direction of Units Either Transverse or Parallel to Traffic . . . Maximum Stress in Steel 20,000 lbs. per sq. inch

Table C

Loading	No. of 5" Beams Carrying One Wheel Load	All Spans up to
H-20	5	4'-0"
H-15	5	5'-0"

AVERAGE AMOUNT OF FIELD WELDING REQUIRED TO ATTACH 5" I-BEAM-LOK OPEN FLOOR TO SUPPORTING STEEL INCLUDING EDGE SPLICES BETWEEN UNITS

Units Laid Transverse to Traffic (Unit Length Equal to Roadway Width)

Table D

Roadway Width	LINEAL INCHES OF ¼" FILLET WELD PER SQ. FT. OF FLOOR AREA — STRINGER SPACING						
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-6	5'-0
24'-0	3.50	2.91	2.86		2.21	1.89	
30'-0	3.50	3.04	2.80	2.29	2.03	1.77	
44'-0	3.50	2.87	2.62	2.27	2.09		

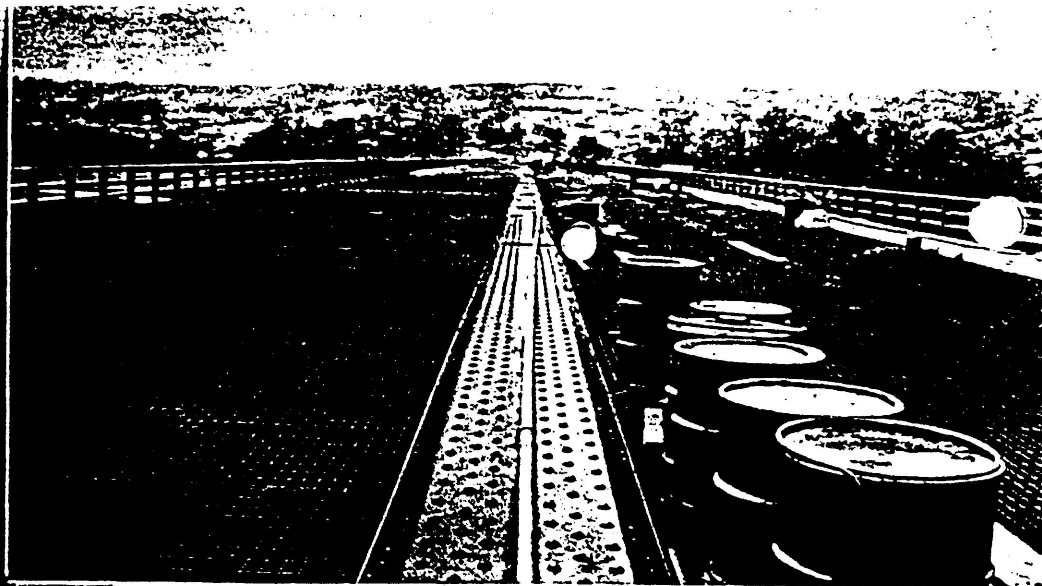
Units Laid Parallel to Traffic

Table E

Roadway Width	LINEAL INCHES OF ¼" FILLET WELD PER SQ. FT. OF FLOOR AREA* — FLOOR JOIST SPACING						
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-6	5'-0
24'-0	3.42	2.74	2.46	2.11	1.85	1.64	1.48
30'-0	3.45	2.76	2.50	2.14	1.89	1.66	1.50
44'-0	3.54	2.82	2.60	2.23	1.95	1.74	1.56

*These quantities do not include field welding for end joint splices, as detailed on pages 13 and 15, and should be increased by the following average amounts for the corresponding lengths of units:

24' to 26' Lengths of Units — 0.43 lineal inches per sq. ft. of floor area
35' to 36' Lengths of Units — 0.30 lineal inches per sq. ft. of floor area
45' to 49' Lengths of Units — 0.225 lineal inches per sq. ft. of floor area

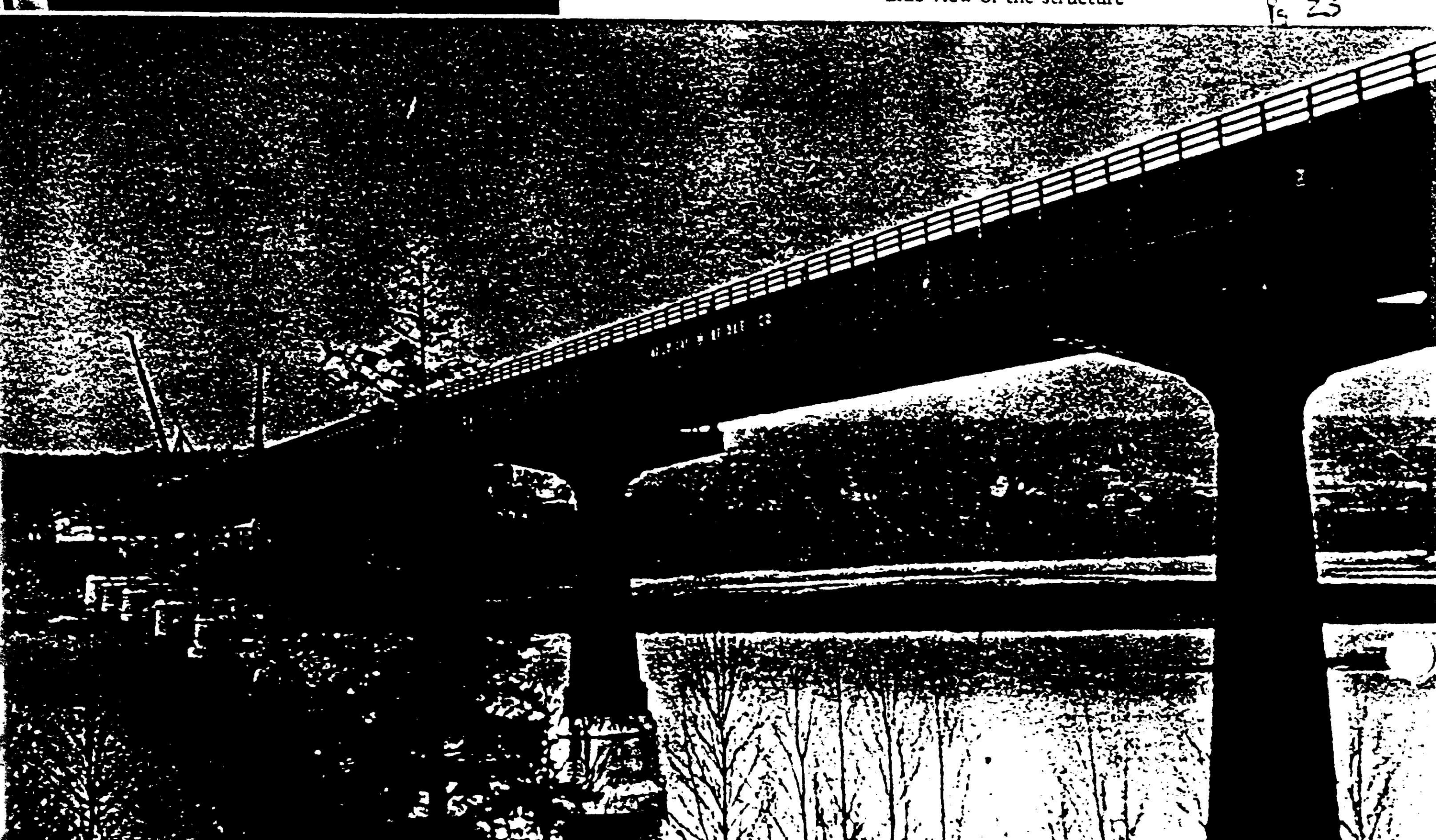


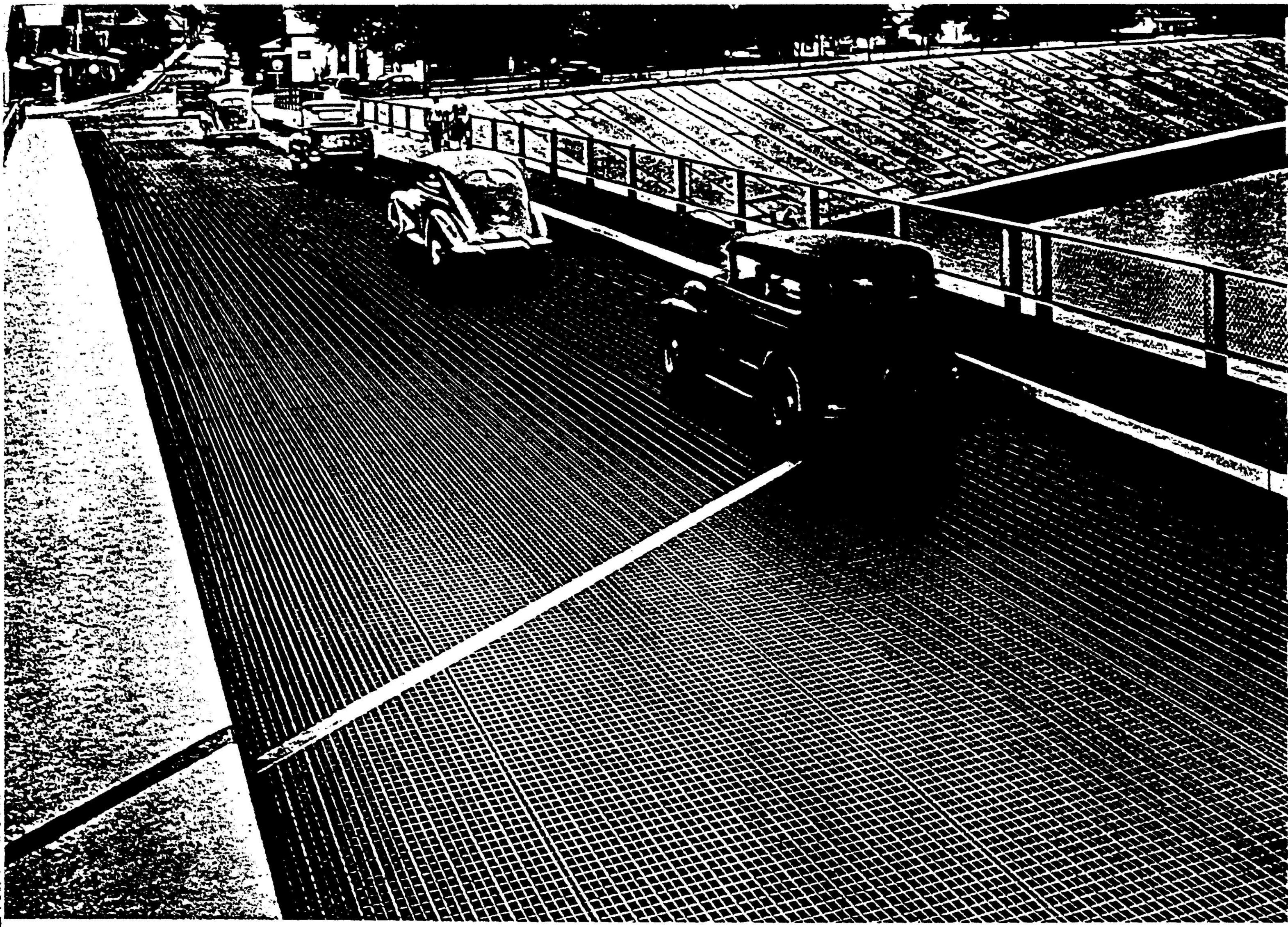
View of roadway during construction

Bridge over Housatonic River on the Wilbur Cross Highway for the Connecticut State Highway Department. 95,000 sq. ft. of 5" I-Beam-Lok were required

Underside view showing arrangement of supporting steel and the large percentage of open area in the floor units

Side view of the structure

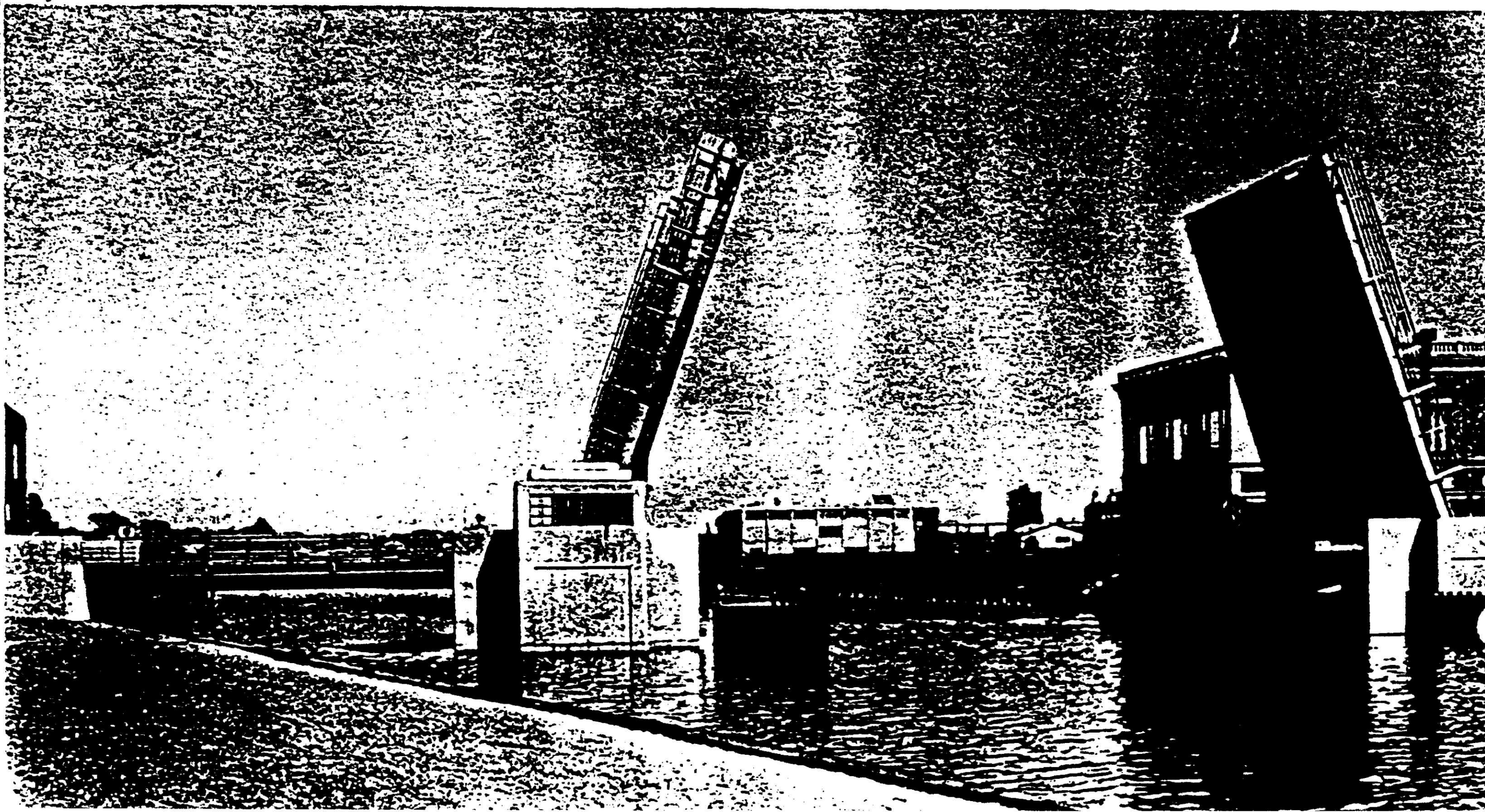


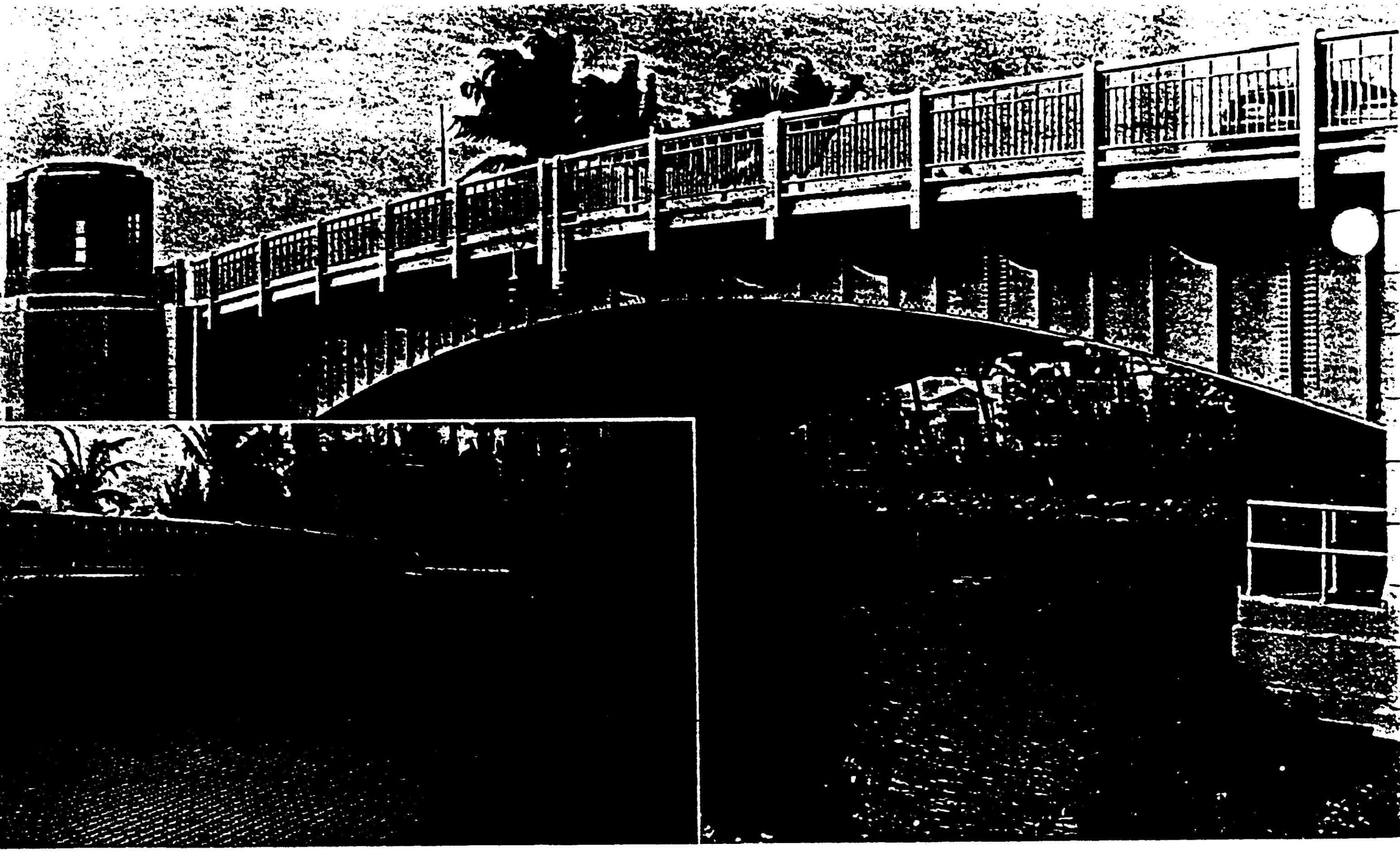


21,400 sq. ft. of 5" I-Beam-Lok Open Floor were used to refloor the roadway of this bridge over the White River at New York Street, Indianapolis, Indiana; designed by the City of Indianapolis, Department of Engineering

Pg 24

Second Avenue Bridge, Alpena Michigan, Clifford E. Paine, Consulting Engineer. 4,800 sq. ft. 5" I-Beam-Lok Open Floor

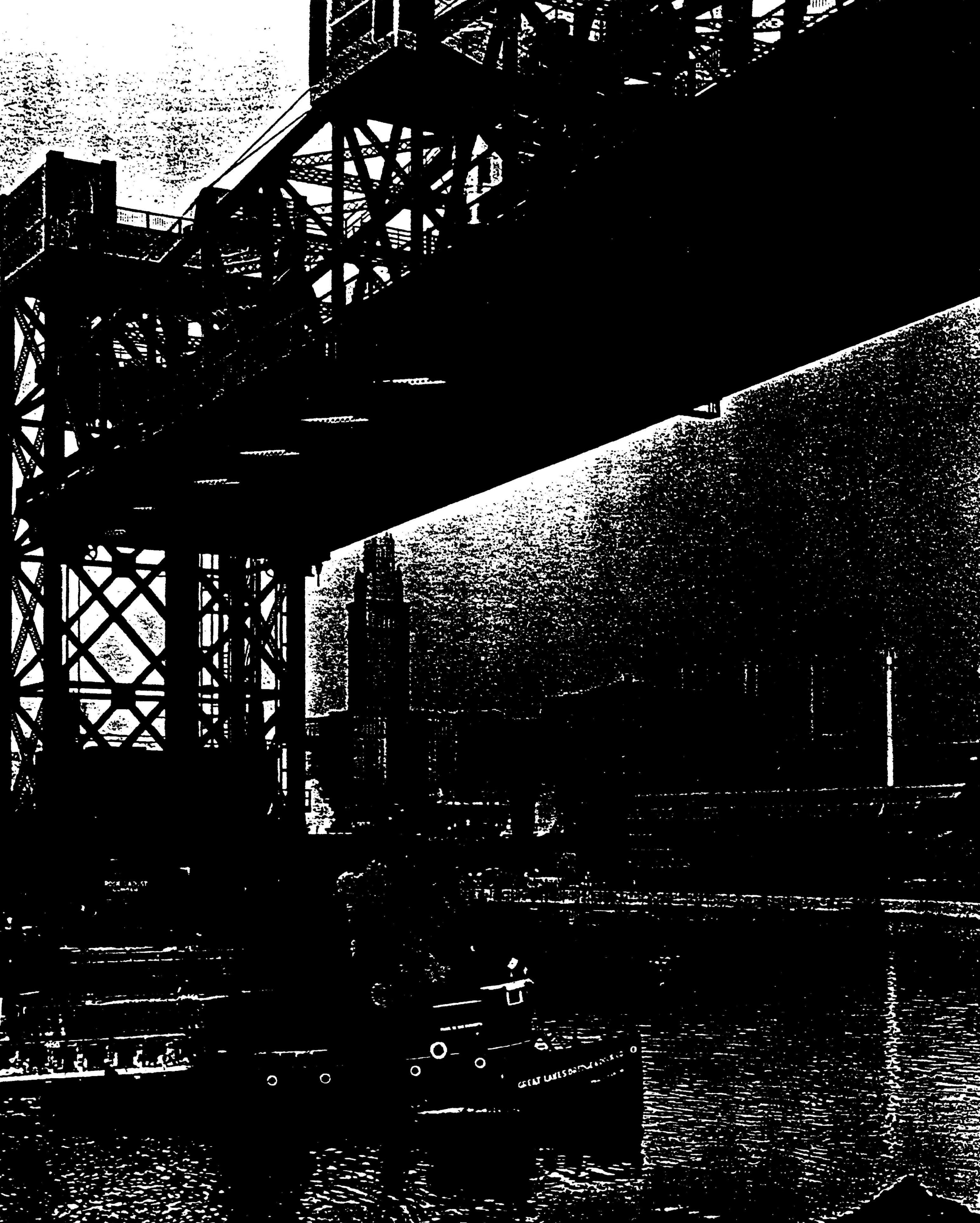




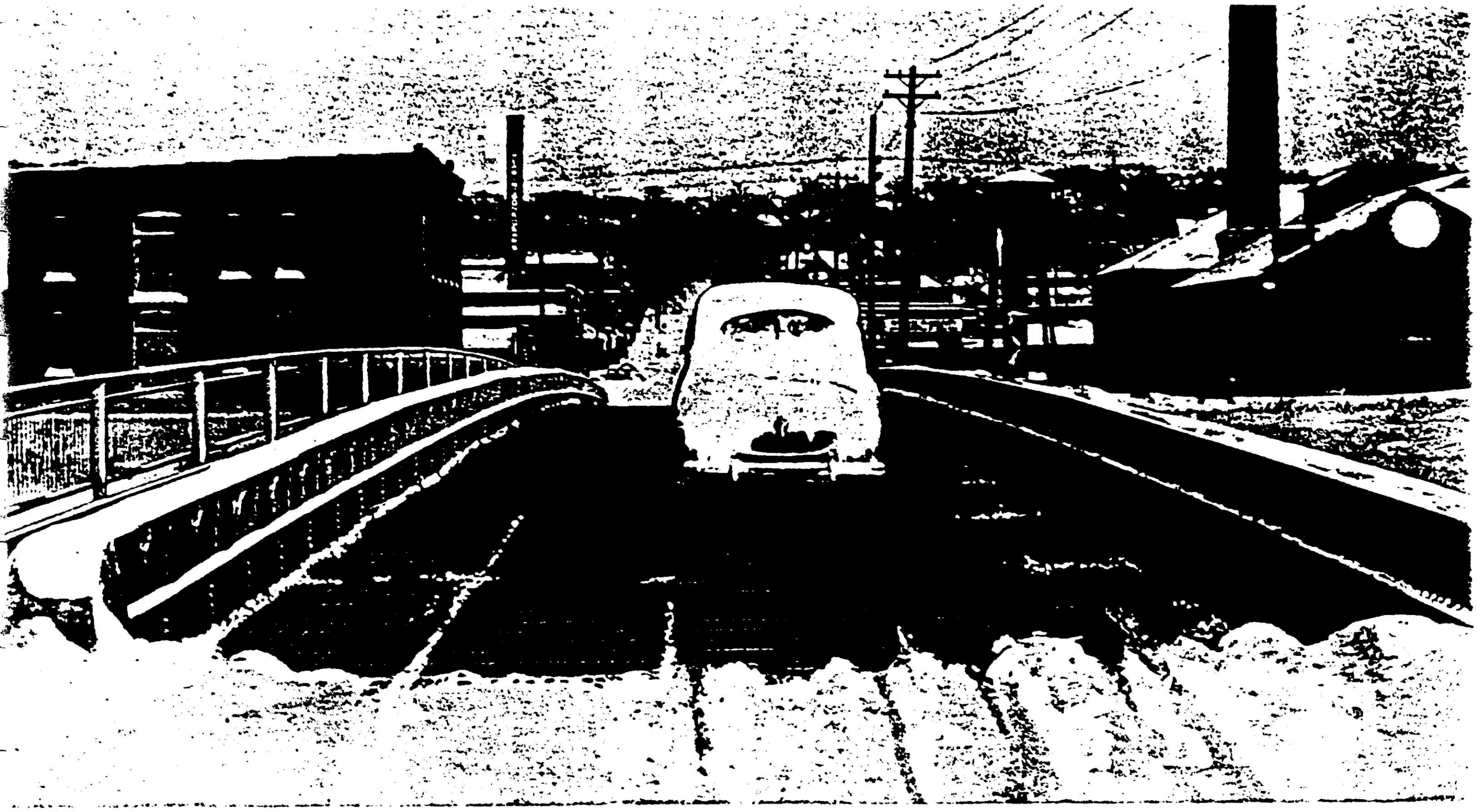
Northwest 27th Avenue Bridge over the Miami Canal, Miami, Florida. Designed by Harrington and Cortelyou, Consulting Engineers. Bridge required 6,300 sq. ft. 5" I-Beam-Lok Open Floor

25

Columbus Road Bridge, Cleveland, Ohio; City of Cleveland, Department of Public Service—Division of Engineering and Construction. Wilbur J. Watson and R. L. Harding, Engineers. 10,300 sq. ft. of 5" I-Beam-Lok Open Floor were used



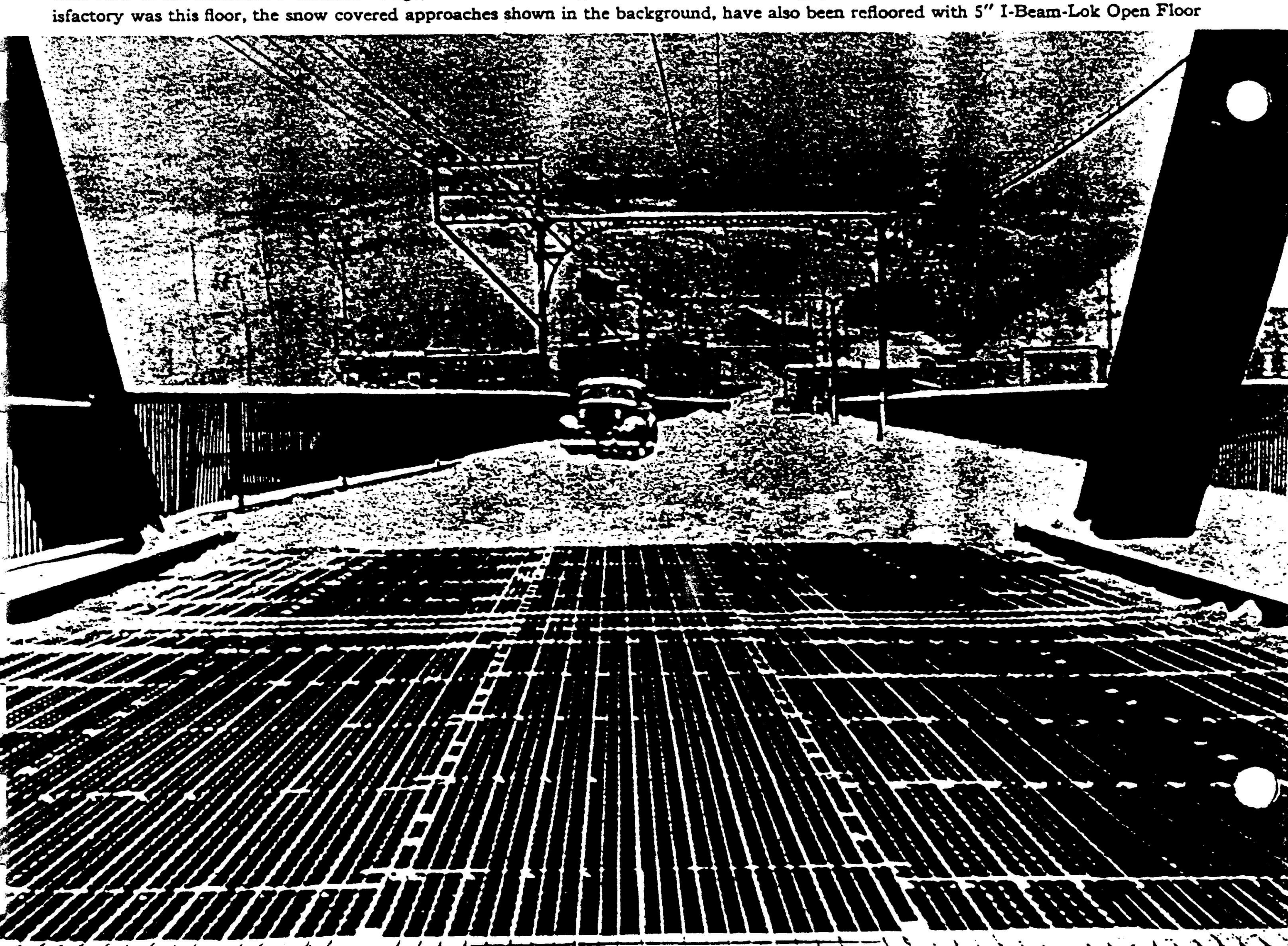
10,300 sq. ft. of U·S·S I-Beam-Lok Open Floor are used on the Roadway of this Columbus Road Bridge; 4,700 sq. ft. of Concrete filled 4¼″ I-Beam-Lok were used on the approaches and towers



27

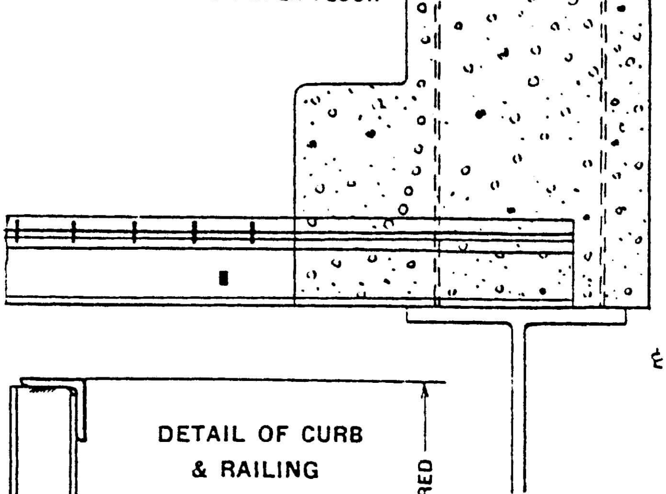
Wappello Street Bridge, Ottumwa, Iowa. Refloored with 4,600 sq. ft. 5″ I-Beam-Lok Open Floor. Note how the roadway is entirely clear of snow although the approaches are covered to considerable depth

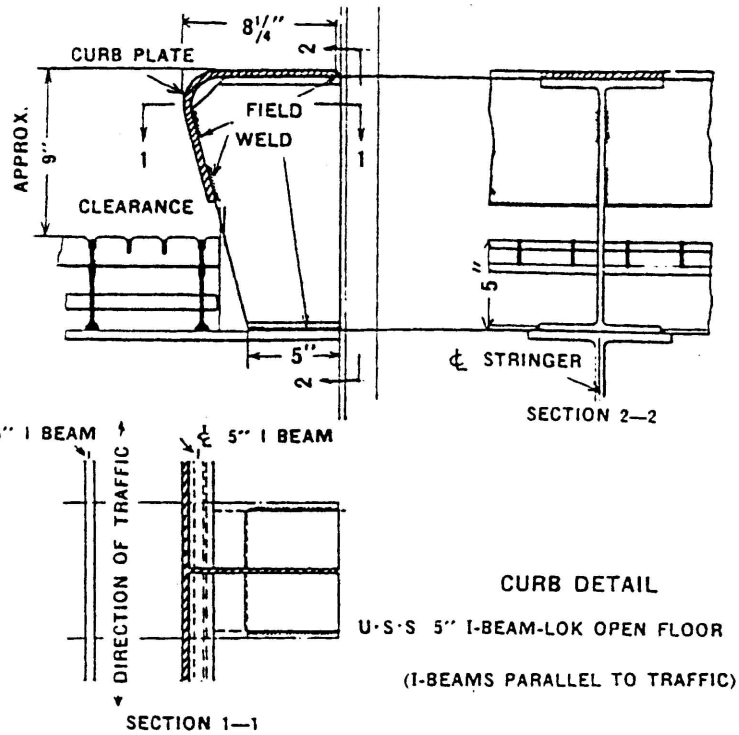
This view of the Charleroi-Monessen Bridge, Charleroi, Penna., illustrates the self-cleaning qualities of 5″ I-Beam-Lok Open Floor. So satisfactory was this floor, the snow covered approaches shown in the background, have also been refloored with 5″ I-Beam-Lok Open Floor



DETAIL OF CURB

U·S·S 5" I-BEAM-LOK OPEN FLOOR



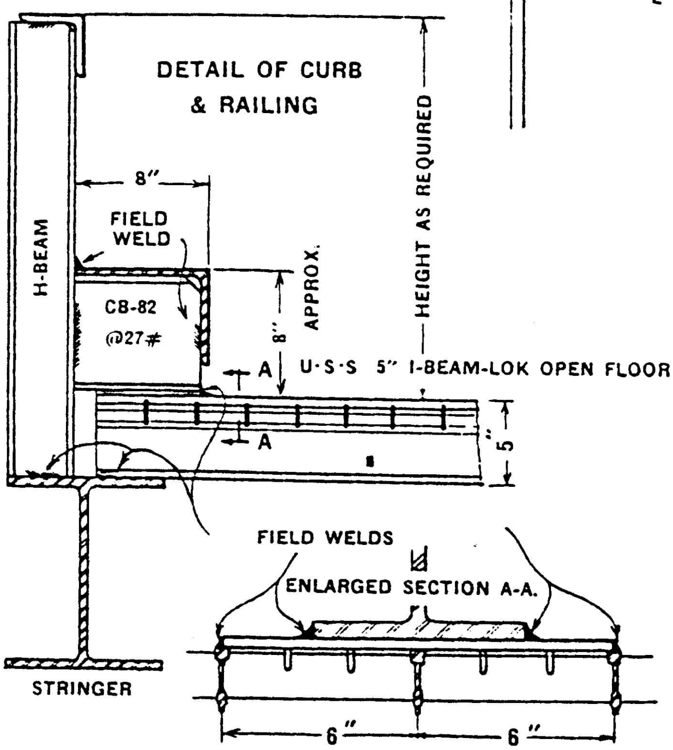


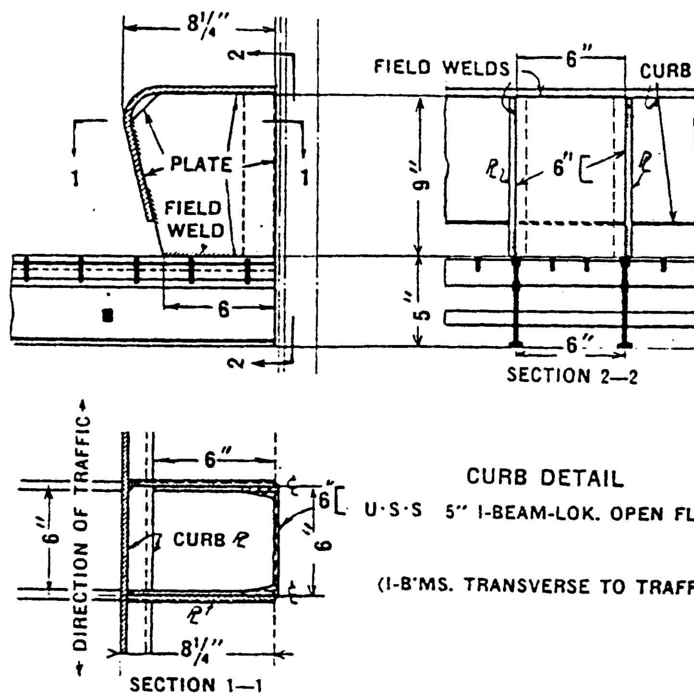
CURB DETAIL

U·S·S 5" I-BEAM-LOK OPEN FLOOR

(I-BEAMS PARALLEL TO TRAFFIC)

DETAIL OF CURB & RAILING

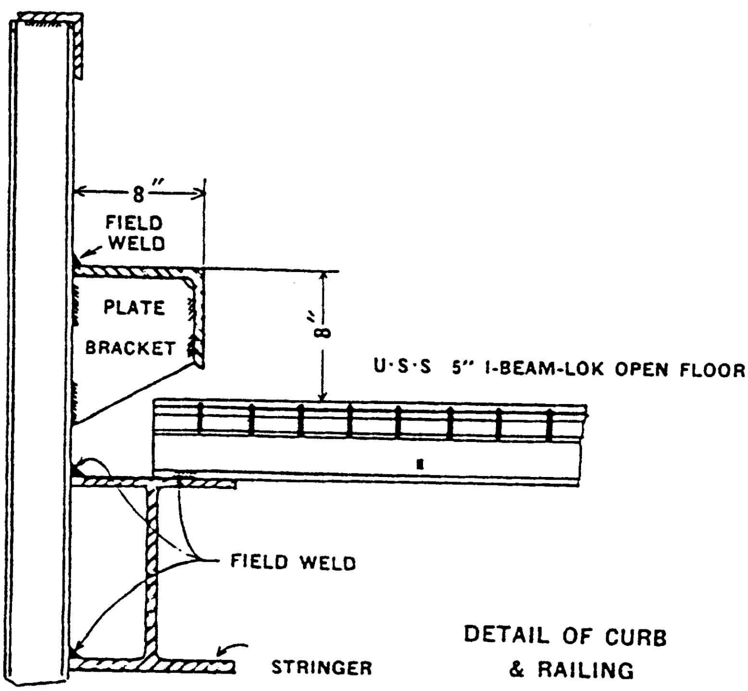




CURB DETAIL

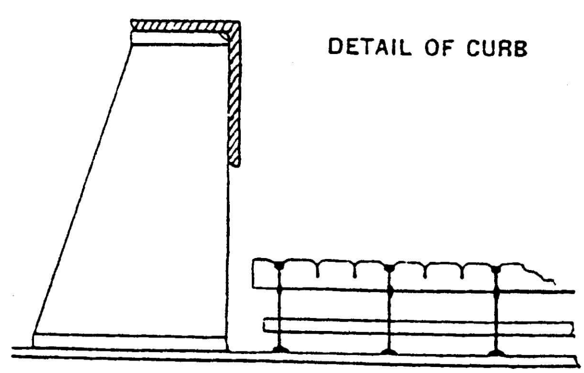
U·S·S 5" I-BEAM-LOK. OPEN FLOOR.

(I-B'MS. TRANSVERSE TO TRAFFIC)

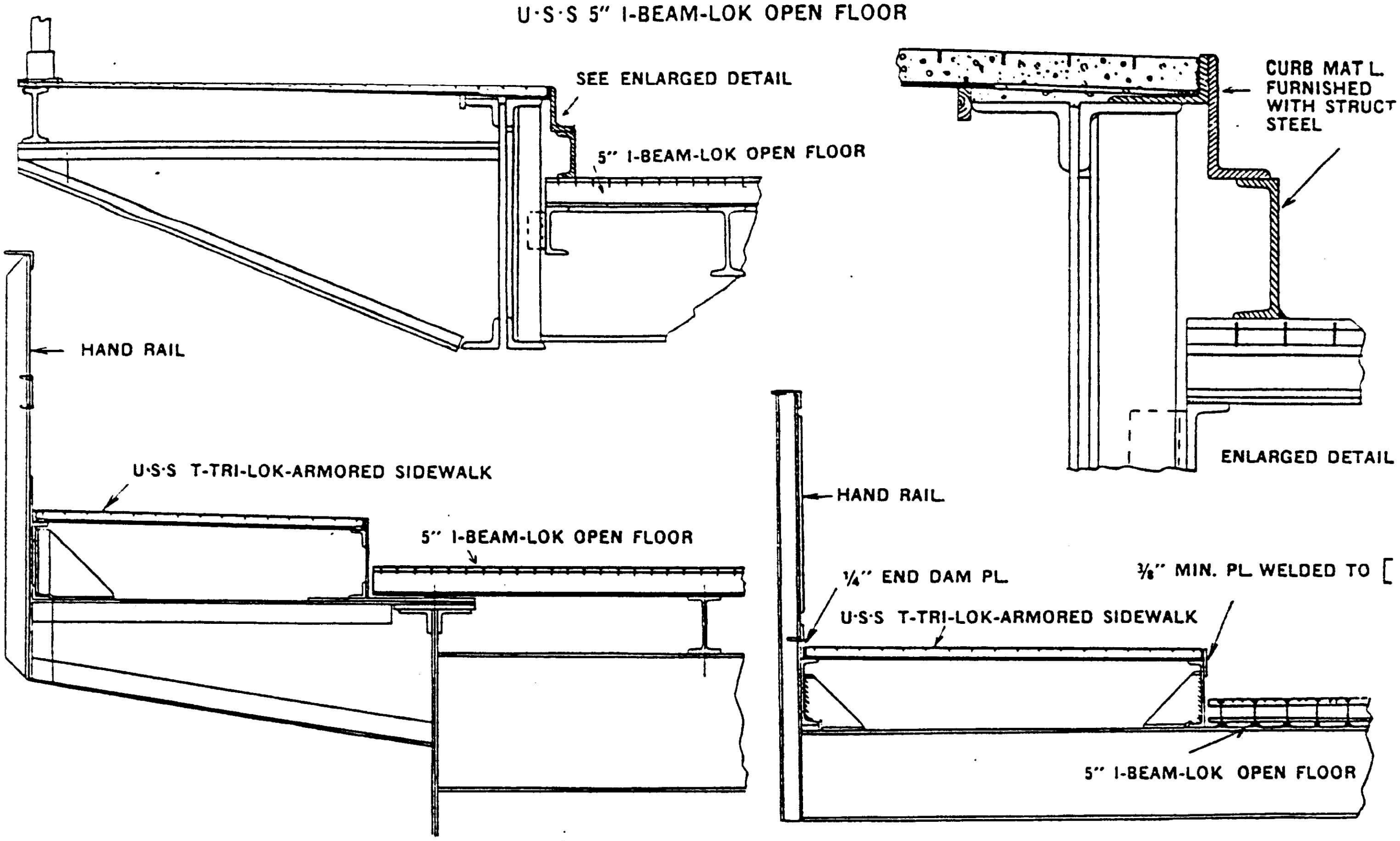


DETAIL OF CURB & RAILING

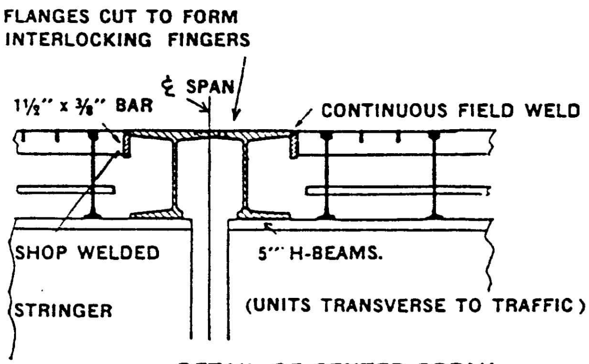
DETAIL OF CURB



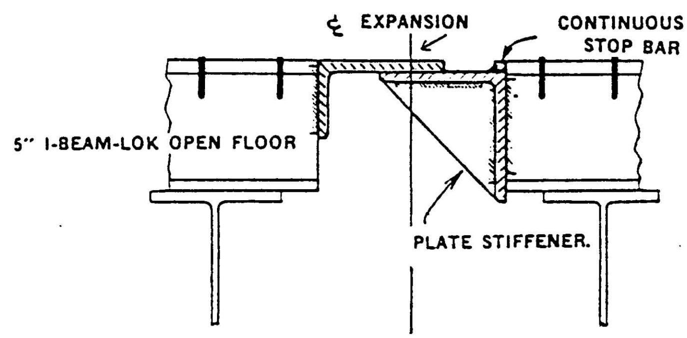
U·S·S 5" I-BEAM-LOK OPEN FLOOR



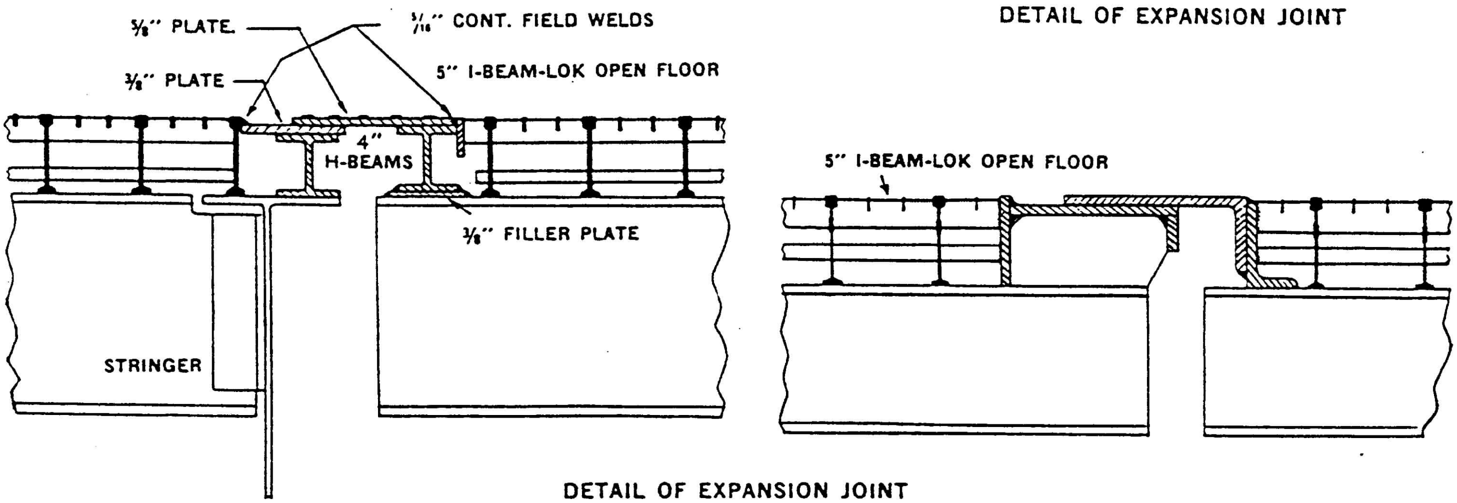
TYPICAL SECTIONS THRU SIDEWALK AND CURB



DETAIL OF CENTER BREAK
BASCULE TYPE BRIDGE

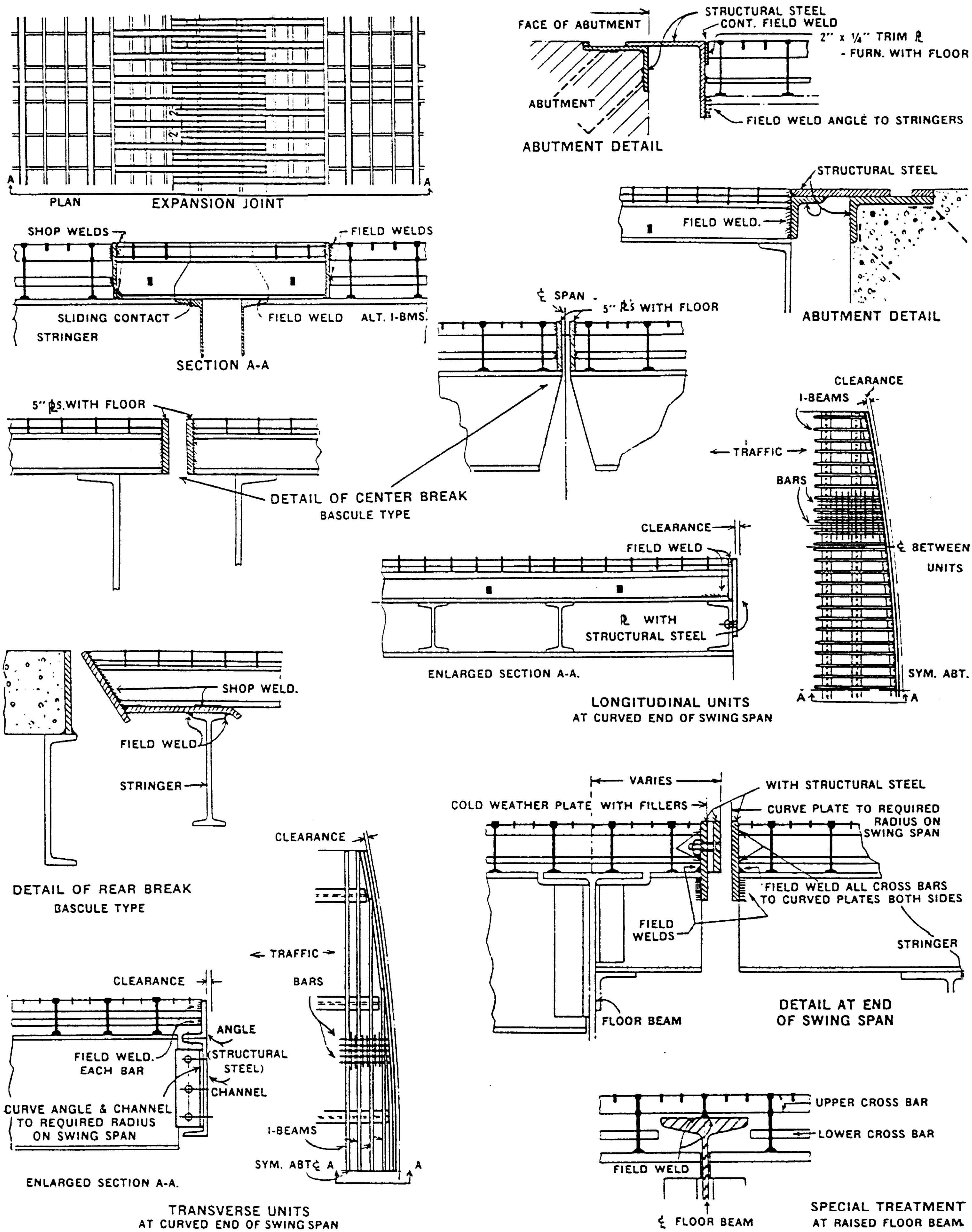


DETAIL OF EXPANSION JOINT



DETAIL OF EXPANSION JOINT

U·S·S 5" I-BEAM-LOK OPEN FLOOR



Specifications

FOR 5-INCH I-BEAM-LOK OPEN FLOOR

Description . . . The bridge floor slab shall be composed of U·S·S I-Beam-Lok Open Floor units, as manufactured by Carnegie-Illinois Steel Corporation, consisting of a combination of specially rolled 5″ carrying beams intersected at right angles by main transverse cross-bars 3″ on centers, which, in turn, support two supplementary longitudinal bars equally spaced between the main carrying beams. The main transverse crossbars shall be securely interlocked with the main carrying beams and each intersection of all component parts of the upper wearing surface shall be rigidly connected with two shop welds, all in accordance with the manufacturers' standard practice and standard details as shown on pages 12 to 15. The depth of the finished floor, dimensions, and weight of component parts shall be as shown on plans and shall be Type . . . . (mention Type, either TR or PL, depending on whether units are laid transverse or parallel to the direction of traffic).

Steel Material . . . All steel for component parts of the bridge floor proper shall be furnished in structural grade of A.S.T.M. standard specification, A7-Latest Revision, with a minimum copper content of 0.20 per cent. All accessories, such as end dams, edge trim, splice bars, expansion joint material, etc., may be mild carbon steel stock material at the discretion of the manufacturer.

Fabrication of Steel . . . All steel shall be commercially straight, and assembled in a workmanlike manner. The main carrying beams shall be 5″ in depth, and placed 6″ on centers, intersected at right angles by main transverse crossbars (state size for PL or TR units, whichever applies) 3″ on centers. In each 6″ space between the 5″ main carrying beams, the main crossbars are to be intersected by two supplementary bars (state size for type of unit to be used) equally spaced between and parallel to the main carrying beams. The top edges of supplementary bars are to be flush with top of main carrying beams.

The main load carrying beams shall be intersected, about 1³⁄₁₆″ up from the bottom of the units, with ¾″ x ⁷⁄₁₆″ crossbars (specify number of bars required for each space between supporting steel, as required by slab spans), all in accordance with details as shown on pages 12 to 15. All bottom crossbars are to be welded to the main carrying beams at each intersection with one shop weld ⁵⁄₁₆″ x ½″. The entire assembly shall be shop welded into rigid units not exceeding 6′ 2″ in width or 49′ 0″ in length, all according to the manufacturers' standard practice to conform to standard details as shown on pages 12 to 15. *Minimum thickness of metal in any component part of the flooring units shall be ¼″.*

The over-all tolerances on the fabricated units shall be plus 0 inch to minus ¼″ for length; plus 0 inch to minus ⅛″ for width.

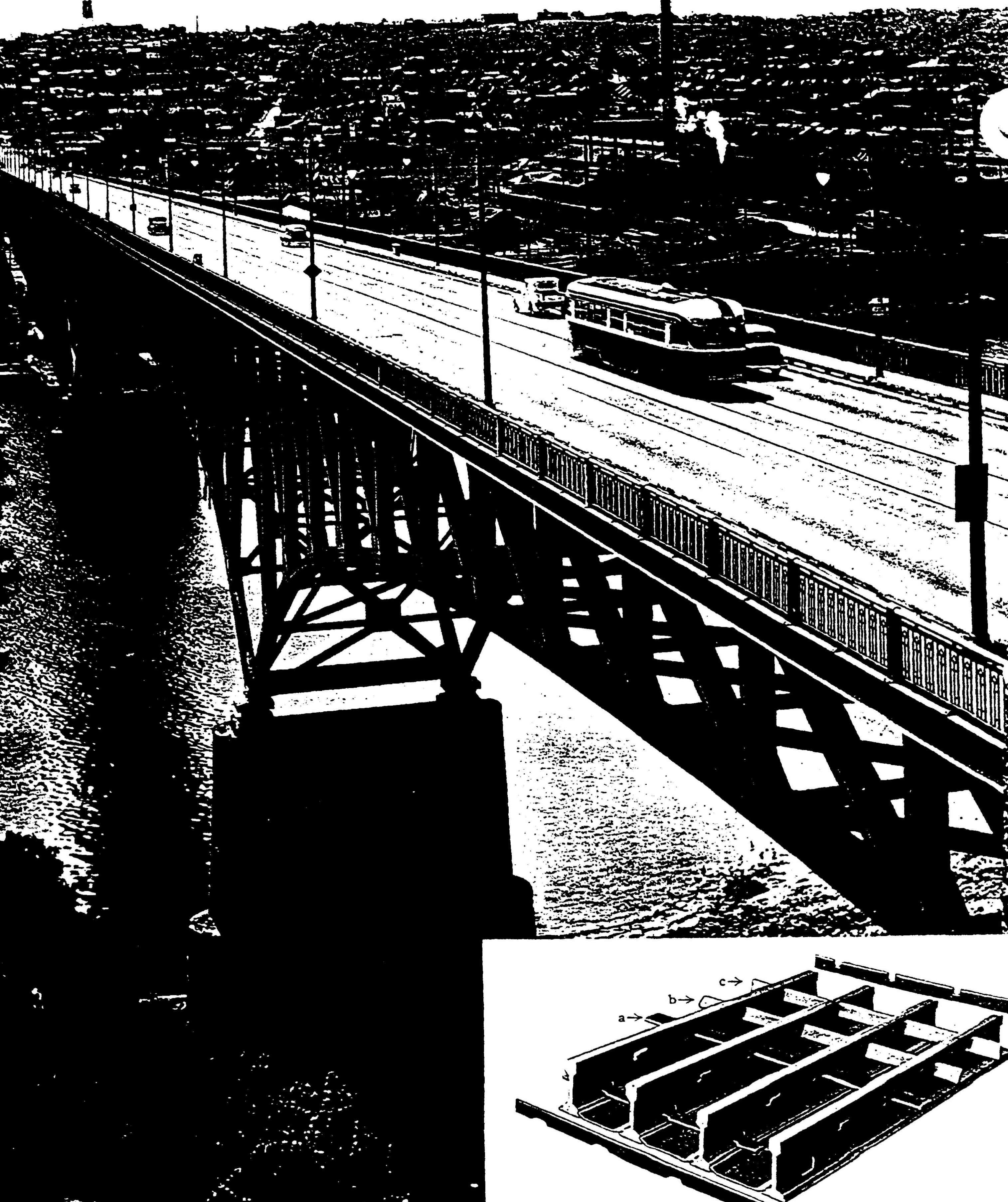
All flooring units are to be furnished with one dip shop coat of red lead priming paint of manufacturers' standard specification.

The Carnegie-Illinois Steel Corporation is not in position to fabricate expansion joints, guard rails, curbs or other accessories not a part of the I-Beam-Lok units. These items should be included in the contract for structural steel with adequate and satisfactory provision being made for field connecting to the I-Beam-Lok units where necessary.

Drawings . . . Shop detail drawings shall be furnished by the manufacturer to the purchaser for approval. Placing drawings shall be furnished to the purchaser for use in assembling and erecting material in the field.

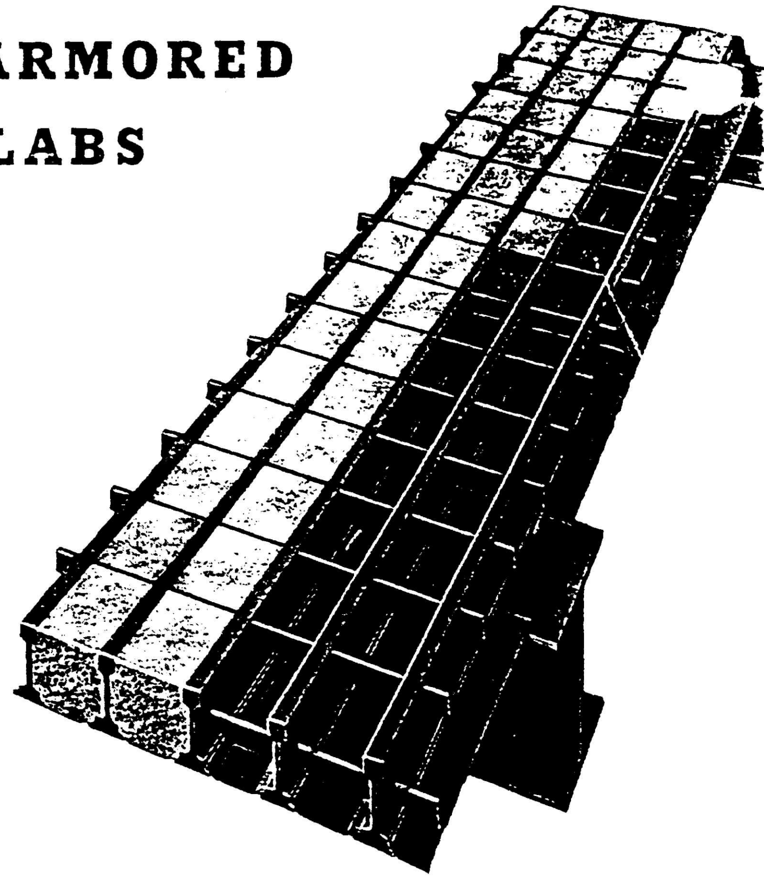
Field Assembly and Welding . . . U·S·S I-Beam-Lok Open Floor units shall be placed by the erector on the supporting steel at the locations indicated on the erection drawings, and each main carrying beam shall be welded to alternate edges of the supporting steel members with two ¼″ x 1½″ fillet field welds. Where TR units are used, transverse to the direction of traffic, they shall be, if possible, in one length to extend the entire roadway width. Otherwise, the ends of units shall be spliced in accordance with details as shown on page 15. If PL units are used, parallel to the direction of traffic, end splices are to be provided as detailed on page 13. All side splice angles, located directly over each bottom crossbar, are to be field welded to the adjacent main carrying beams by means of one fillet weld, approximately ¼″ x 4½″, for each splice angle as detailed on pages 13 and 15.

During the erection of the U·S·S I-Beam-Lok Open Floor units, care should be exercised to place each unit in its proper position, measuring in all cases to some fixed point, as otherwise a cumulative error in spacing is quite likely to appear, making necessary either flame cutting the final units or inserting some additional steel to fill up a gap.



Homestead High Level Bridge over Monongahela River between Homestead and Pittsburgh, Allegheny County, Penna., for the Allegheny County Authority. 114233 sq .ft. 4½" I-Beam-Lok Armored Floor on the entire roadway

U·S·S *I-Beam-Lok* ARMORED BRIDGE ROADWAY SLABS



The construction of U·S·S I-Beam-Lok Armored Floor consists of a series of alternating I-Beams and concrete ribs securely tied and locked together by an adequate number of notched crossbars near both the top and bottom surfaces of the slab. This provides sufficient reinforcement for lateral distribution of loads, and in addition the top bars form a part of the integrally armored surface. The bottom flanges are rolled with a projecting bead at each edge, providing a supporting shelf for the metal form strips. These steel strips, closely fitted between the lower flanges of the I-Beams and carried by the specially formed ledges, provide a form for concrete. They are omitted over the top flanges of supporting beams or girders, permitting the concrete to come directly in contact with the bearing areas. The gap in the form strips over the supports and the open space between the I-Beams facilitate the welding of the I-Beams to stringer flanges. The form strips are welded in position and the unit comes to the job site completely shop assembled, ready for placing.

It will be noted in the *illustration* that *only the webs* of the I-Beams are punched or pierced for the insertion of the crossbars. Both the top and bottom flanges of the I-Beams have a constant cross sectional area throughout their entire length. The slab is so designed as to have approximately constant moment of inertia for resisting both positive and negative bending moment stresses. The notched crossbars are first inserted horizontally in the "L" shaped web holes, then rotated through an arc of 90 degrees and tack-welded in the final position. These bars hold and lock the I's rigidly at uniformly spaced intervals. As shown in the tables, U·S·S I-Beam-Lok Armored units are at present available in four depths. The 2 ½, 3, and 3 ½-inch depths are available in units up to 4 feet wide and 49 feet long. The 4 ¼″ depth is available in units up to 6 feet wide and 49 feet long.

← METHOD OF ASSEMBLY

1. Strips placed on offsets on bottom flanges of I-Beams.
2. Lower locking bars inserted in slots and rotated to vertical position.
   (Note lower locking bar partially inserted.)
3. Upper locking bars inserted in slots and rotated to vertical position.
   (Note upper locking bars (a) inserted, (b) partially rotated, (c) fully rotated to vertical position, thus locking, spacing, and holding I-Beams.)
4. In the final operation the intersections of I-Beams and upper locking bars, also I-Beams, lower locking bars and form strips, are tack-welded into integral solid units.

U·S·S I-BEAM-LOK

Combines All of the Following Features

1. Very light unit weight, thus reducing dead load and the ultimate cost of completed bridge.
2. Substantial saving of time required for completion of structure.
3. Ease of erection, with no concrete forms necessary.
4. Smooth, hard surface for safe, high speed traffic.
5. Stronger when compared with other floors of comparable weight.
6. Greater rigidity of entire roadway. Positive connection between slab and stringers.
7. Low maintenance cost. Easily repaired when necessary.
8. Armored road surface, minimizing wear and skidding.

U·S·S I-BEAM-LOK ARMORED BRIDGE ROAD-WAY SLABS *Principal Advantages*

Lightness . . . When filled flush with ordinary concrete, U·S·S I-Beam-Lok Armored Slabs weigh only 40.2 lbs. per square foot in 2½″ depth, 47 lbs. in 3″ depth, 53.5 lbs. in 3½″ depth, and 55.5 lbs. in 4¼″ depth.

The use of such extremely light-weight slabs permits reduction in sizes of stringers, floor beams, trusses and piers, and these possible cumulative savings are well known to the engineering profession.

The armored floor will not only resist the internal stresses resulting from the most severe traffic conditions, but will at the same time provide an ideal, long-life roadway surface. However, if so desired, an over-fill of concrete, asphalt, or other material may be installed at any time.

In cases where it is desired to keep the appearance of the surface of the bridge floor the same as that of the adjoining concrete pavement, an over-fill of concrete ranging from ½ to ¾″ in thickness is sometimes cast integrally with the concrete filling of the U·S·S I-Beam-Lok Armored unit. Where such over-fills have been used during the past few years the practice has been found satisfactory, and there has been no tendency for the concrete to chip off over the tops of the small I's.

Strength . . . While this construction has strength equal to or greater than other comparable types for the same depth of slab, it requires only 14.4 lbs. of steel per square foot for the 2½″ depth, 15.5 lbs. for the 3″ depth, 16.4 lbs. for the 3½″ depth, and 13.2 lbs. for the 4¼″ depth of slab.

The high ratio of strength to weight of steel is due to the very efficient utilization of steel in the design. The shape of the I-Beams produces a construction which has approximately a constant moment of inertia for resisting both positive and negative bending moment in continuous slabs.

Safety . . . The armored surface of relatively large rectangular blocks of concrete separated by relatively narrow lines of the steel grids provides a smooth, hard, floor of high anti-skid value.

Long Life . . . The inter-laced and inter-locked combination of steel I-Beams, crossbars, and strips of dense concrete provide a structural slab that will carry the desired load regardless of the surface condition of the concrete. As a matter of fact, the unfilled units are capable of safely carrying the designed traffic load without excessive stresses. The steel grid arrangement prevents the development of large, unsightly cracks, and progressive failures over considerable areas of the slab cannot occur. These slabs are universally leak-proof and water-tight.

The concrete is so tightly locked in by the crossbars and projecting shoulder of the I-Beam head, that positive bond and impermeability of the slab are practically assured.

The integral surface armoring of U·S·S I-Beam-Lok Armored Slabs reinforces the surface of the concrete so that wear is retarded to a minimum. Armored types of surfaces installed at various times during the past nine years show little wear. Where it has been deemed advisable to resurface these slabs after some years of trouble-free service, the resurfacing has been accomplished at low cost with minimum interruptions and delays to traffic. These slabs require virtually no maintenance except infrequent painting of the under-surface, which can be done when other portions of the bridge are being field painted.

Economy . . . The economy of U·S·S I-Beam-Lok Armored Flooring, which provides strength with a minimum dead load, has been quite generally recognized by the engineering profession. This is especially true of designs for new fixed truss or suspension spans in excess of 150 to 200 feet and all types of movable bridges of almost every span length.

The needless cost of carrying excessive roadway dead loads can be materially reduced by designing to take advantage of the light-weight feature of U·S·S I-Beam-Lok Armored Flooring. Less dead load permits a reduction of steel in the trusses and floor system, smaller piers and foundations; all contributing to the lower ultimate cost of the entire structure.

Ease of Installation . . . U·S·S I-Beam-Lok Armored Floor reaches the job completely shop fabricated to fit the individual project. The units are all made to proper lengths and widths and, where required, openings are cut out for drains, truss members, and supports. Finish or trimmer angles, and end or edge dams, can also be included, if necessary, as well as skew, curved edge, or irregular sections. Shop details and prints of erection diagrams are always supplied for use in the field.

All these factors make for ease and simplicity of installation. It requires only the placing and adjusting of units to final positions, followed by simple field welding and pouring of concrete filler to provide the finished roadway. Elimination of many costly and complicated operations necessary in other types of construction assures a safe structure of high quality with a minimum of skilled labor.

Speed of Installation . . . With simple lifting and transporting equipment capable of handling single units of U·S·S I-Beam-Lok Armored Flooring, weighing from ½-ton up to a maximum of 2½ tons each, it is possible to place and adjust large areas of flooring per working day. This speed of application offers additional economies in reducing interest and other overhead charges which accrue during the time of any construction project.

Construction Equipment Carried by Unfinished Floor . . . After being placed in position and tack-welded to the stringers, unfilled units of U·S·S I-Beam-Lok Armored Floor provide a temporary working deck over which trucks and other equipment may move. Delivery of material for the bridge, such as curbs, sidewalks, hand rails, tools, and miscellaneous equipment can proceed without interruption. Transit mixer trucks can be driven safely over the unfinished U·S·S I-Beam-Lok Armored Flooring

33,331 sq. ft. of 4¼" I-Beam-Lok were installed on the roadway for the American Crossing, Thousand Island Bridge over the St. Lawrence River, Collins Landing to Wells Island. 29,984 sq. ft. of 4¼" I-Beam-Lok were used on the Canadian Crossing of the same bridge

35

to deliver the concrete for the roadway slabs to the exact spot desired.

Economical and Practical Reflooring While Maintaining Traffic . . . Many bridges have been refloored with U·S·S I-Beam-Lok Armored Slabs while traffic was maintained with little or no interruption. Outstanding examples of such reflooring are the Queensboro Bridge, New York, N. Y., and the Ohio River Bridge, Huntington, West Virginia.

By replacing the old and much heavier roadway slabs on existing bridges with light-weight U·S·S I-Beam-Lok Armored Floor, it is often possible to actually increase the permissible live load capacity of the entire structure. Even where the original floor is timber, only slight changes are necessary to permit the application of U·S·S I-Beam-Lok Armored Floor; thus increasing the live load capacity of the slab, eliminating all fire hazards, and prolonging the life of the bridge.

Pre-Cast Panels Offer Special Advantages . . . U·S·S I-Beam-Lok Armored Floors may be filled with concrete at or within trucking distance of the bridge site before installing on the bridge deck. This offers numerous advantages in the construction of movable spans and in shortening the completion time for any bridge. The advantages of using this type of construction are discussed in detail on pages 49 and 50. Outstanding examples of such use are the two huge Bascule spans on the Outer Drive Boulevard, Chicago, Ill., and the reflooring of the Manhattan Bridge over the East River, in New York, N. Y.

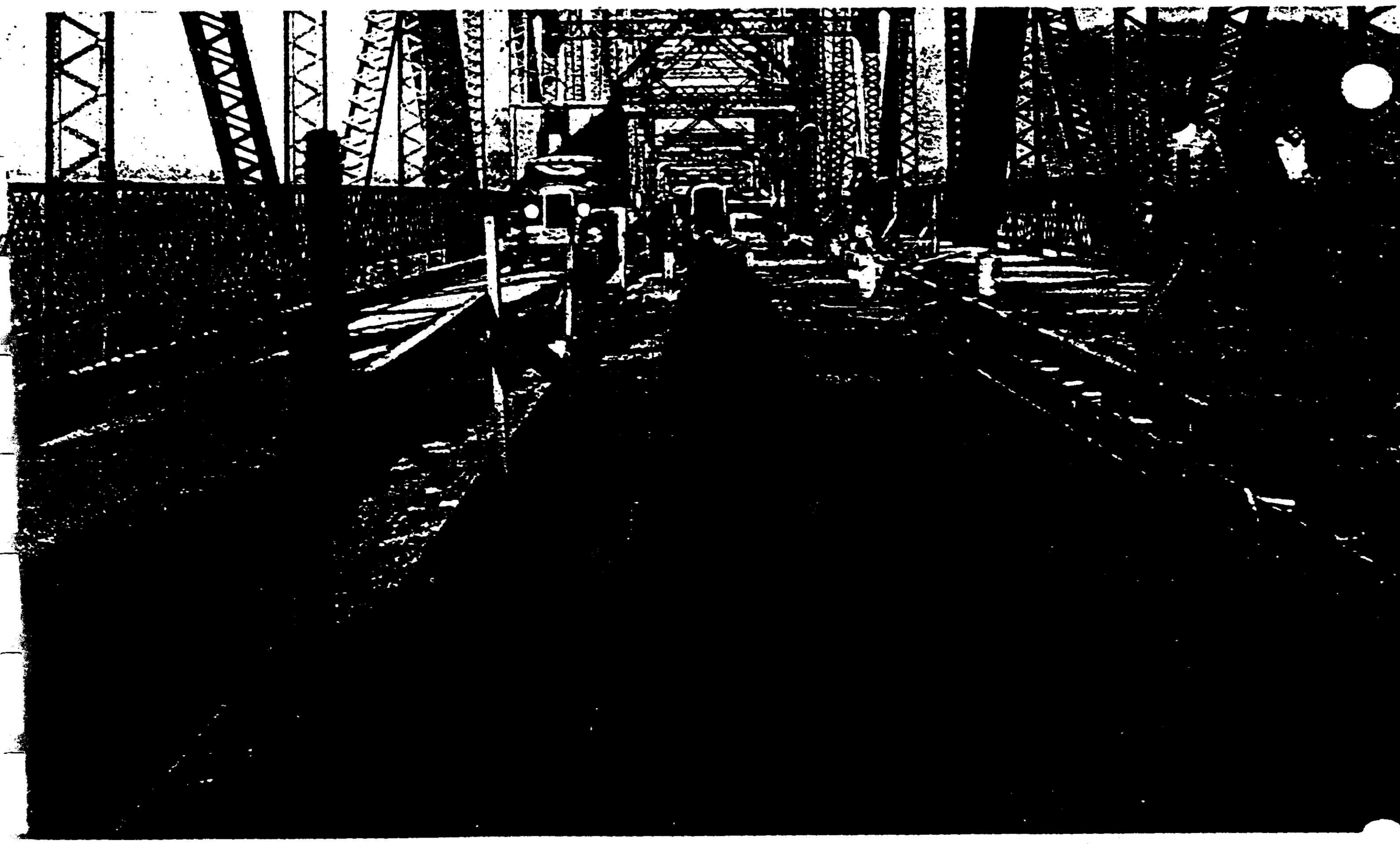
View showing heavy equipment carried by Unfilled I-Beam-Lok Units during construction of the floor on the Market Street Bridge, Harrisburg, Pa. 53,043 sq. ft. of 3" I-Beam-Lok were used. Modjeski & Masters, Consulting Engineers

Smooth Roadway and Rigidity of Construction Reduce Impact Shock . . . Because U·S·S I-Beam-Lok Armored Floor provides a smooth traffic surface, vibration and impact from traffic are reduced and the life of the floor slab, as well as the entire bridge structure, is prolonged considerably. U·S·S I-Beam-Lok Armored construction is anchored so rigidly to the stringers and floor beams by means of welds at relatively close intervals that the floor slabs and the supporting structural beams act as a combined unit and give a positive T-Beam effect. This provides extra rigidity to the entire roadway system, which minimizes the wear and tear caused by excessive vibration, with consequent reduction in the amount of maintenance required.

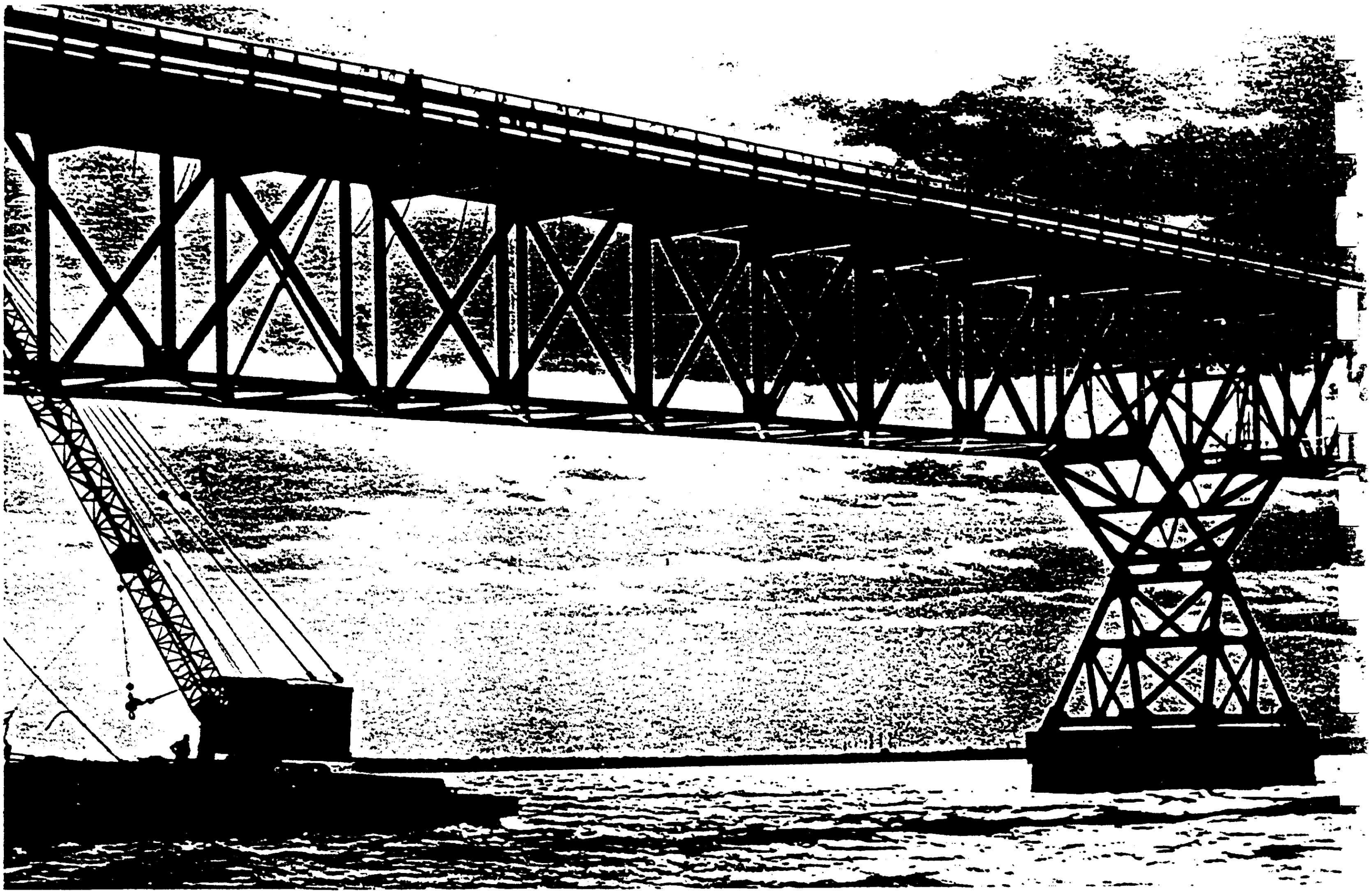
Elimination of All Fire Hazards . . . There is nothing to burn in the make-up of U·S·S I-Beam-Lok Armored Floor Slabs; consequently, the ever present risk of fire, costly delays to traffic and other hazards are eliminated.

Special Advantages on Railroad Bridges . . . U·S·S I-Beam-Lok Armored Floor Slabs have been installed on a number of bridges in railroad service. The reasons for their use are given in detail on pages 45 and 46.

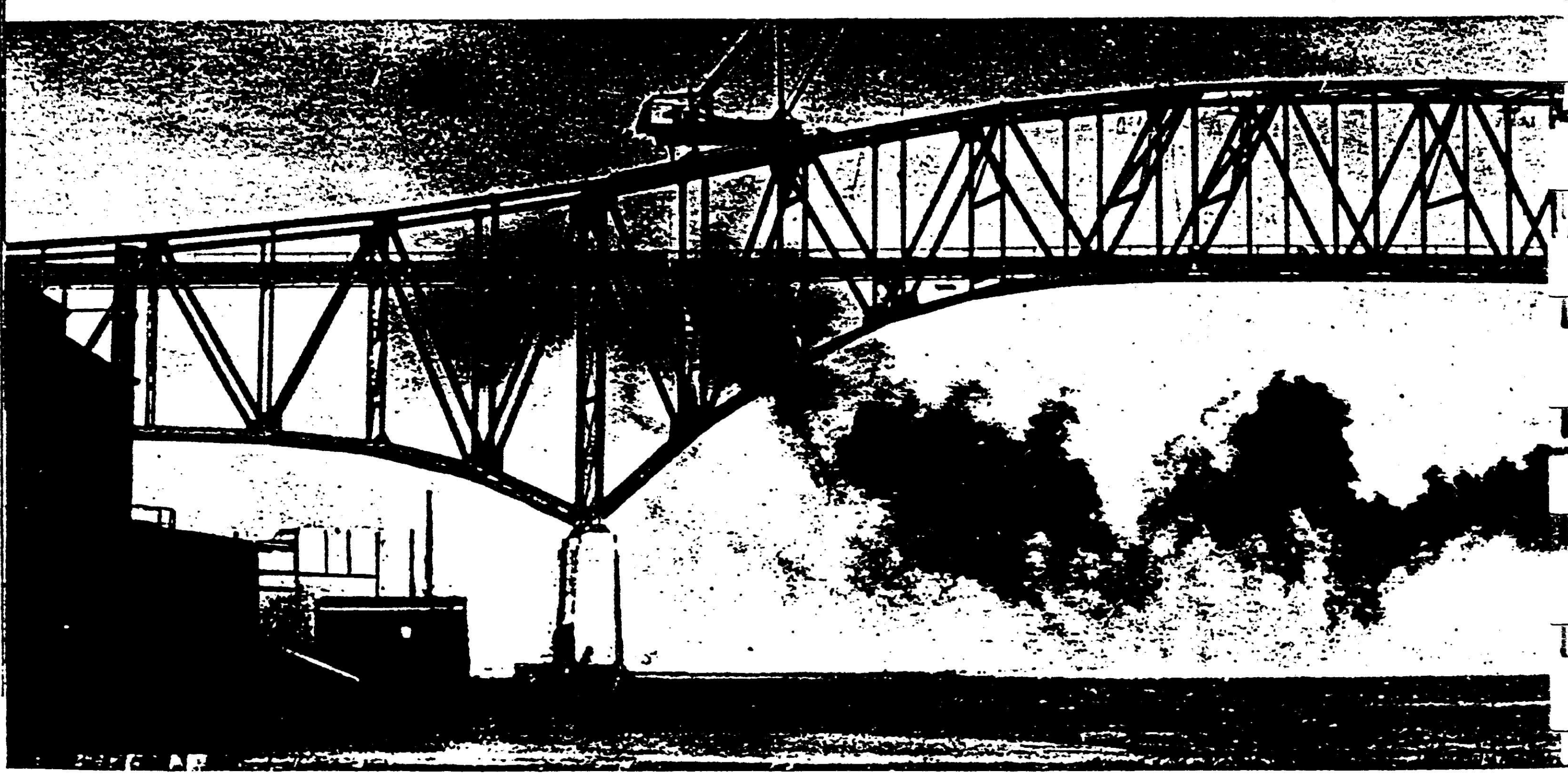
Adaptability . . . U·S·S I-Beam-Lok Armored Slabs have been used in hundreds of varying types of installation. Their utility is unlimited and their use is particularly desirable where exceptionally high strength and ruggedness, combined with relatively light weight, are prime considerations.

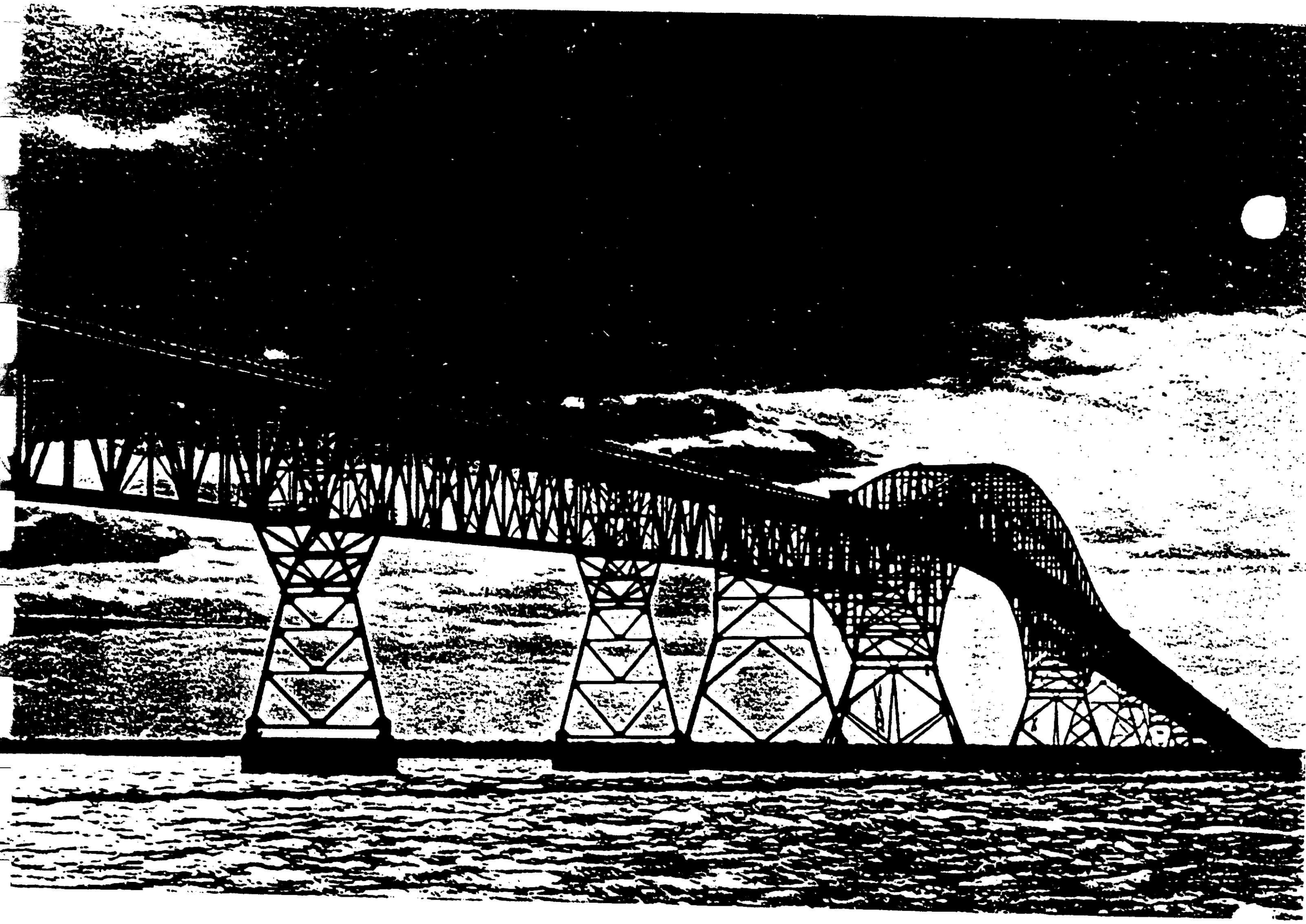


A portion of the reflooring operation on the Huntington and Ohio Bridge over the Ohio River at Huntington, W. Va. Movement of traffic was maintained during the placing of 41,896 sq. ft. of 3" I-Beam-Lok Armored Floor

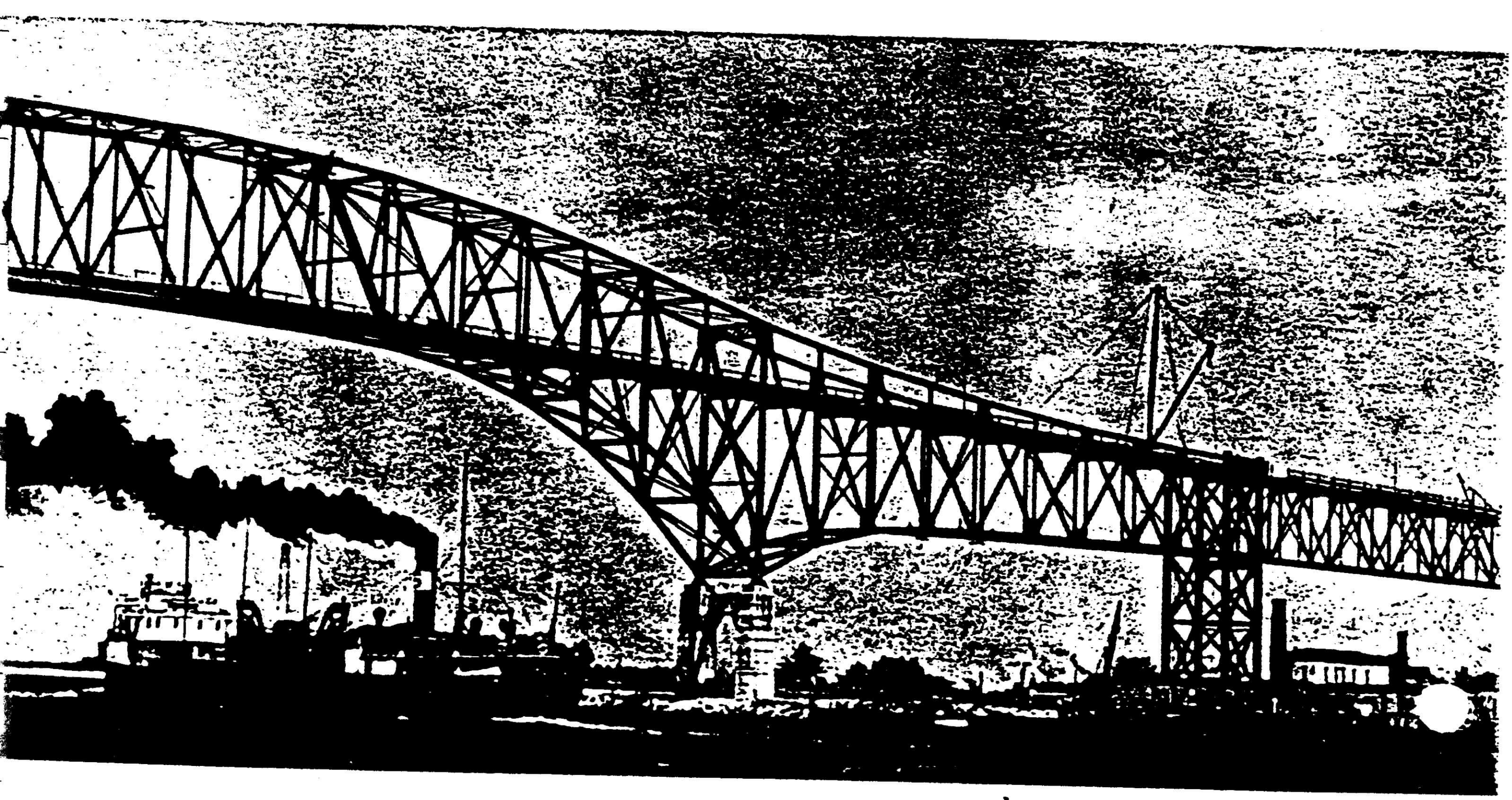


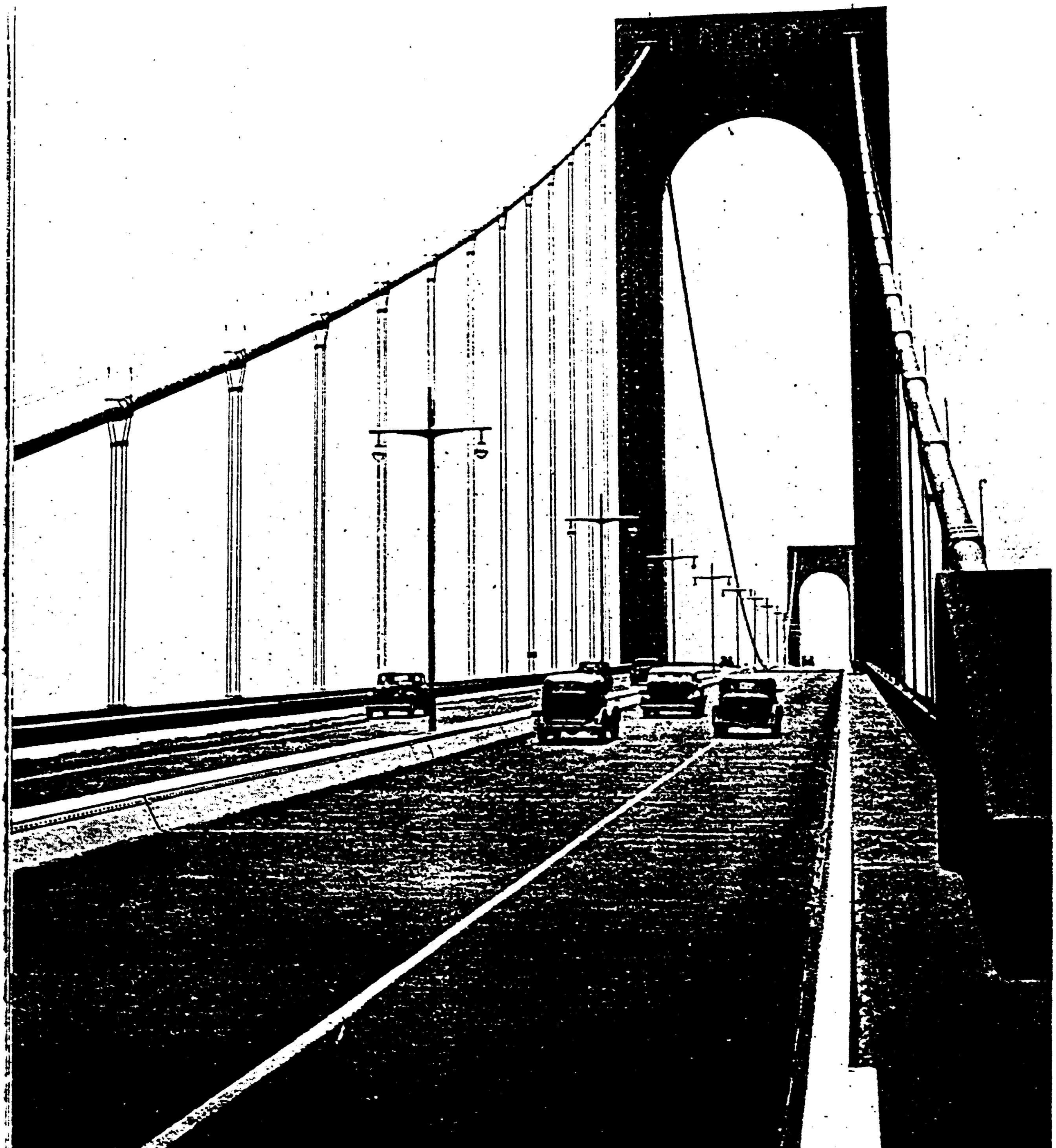
(Above) Potomac River Bridge, crossing the Potomac River at Dahlgren, Va., and Ludlow Ferry, Md. 151,500 sq. ft. of 4¼" I-Beam-Lok Armored Floor were used. State of Maryland, State Roads Commission. J. E. Greiner Company, Consulting Engineers





(Below) International Highway Bridge over St. Clair River, between Port Huron, Michigan, and Point Edward, Ontario, Canada. The roadway on the two cantilever arms and the suspended span required 29,024 sq. ft. of 4¼" I-Beam-Lok Armored Floor. Modjeski & Masters, Consulting Engineers, and Monsarrat & Pratley, Canadian Associates.

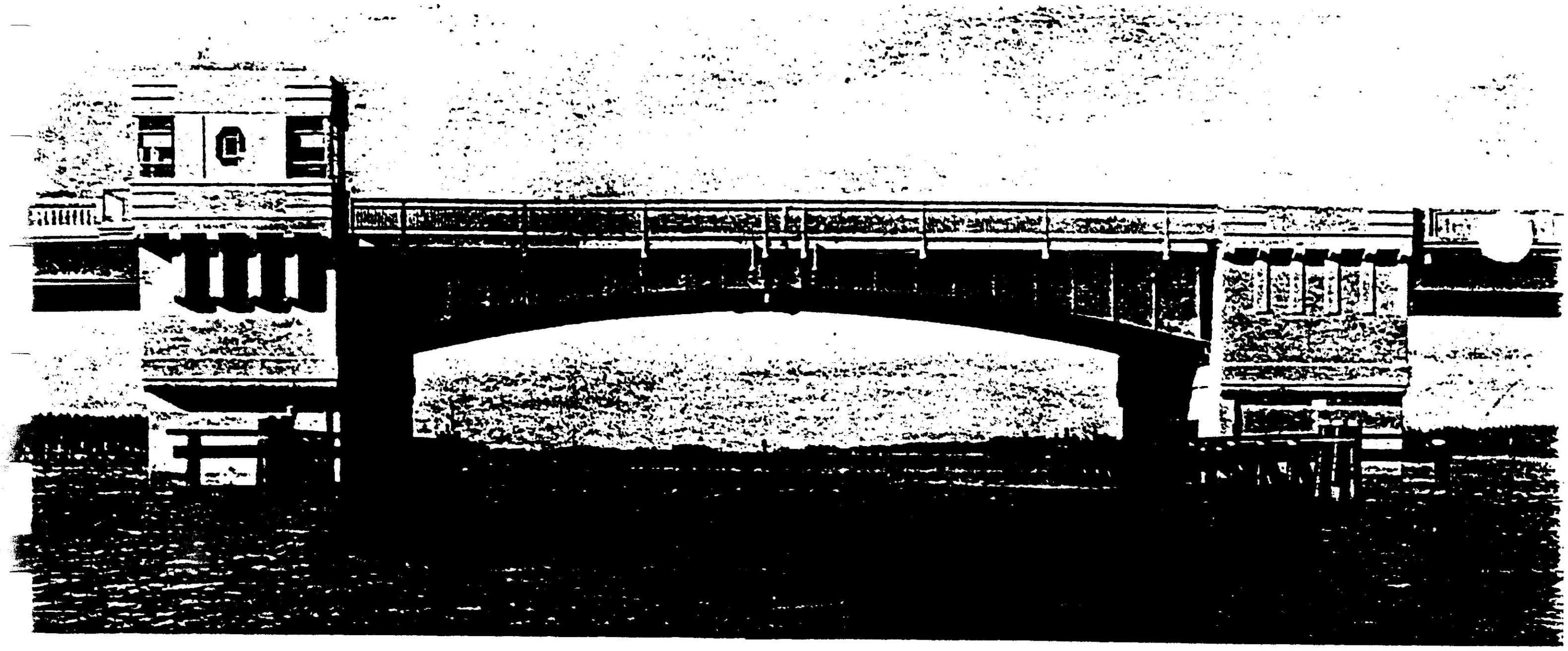




Bronx-Whitestone Bridge, New York City, for the Triborough Bridge Authority. 212,400 sq. ft. 4¼" I Beam-Lok Armored Floor

Torrence Avenue Vertical Lift Bridge, Chicago, Ill. Designed by the City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges. Required 11,385 sq. ft. 3½" I-Beam-Lok Armored Floor

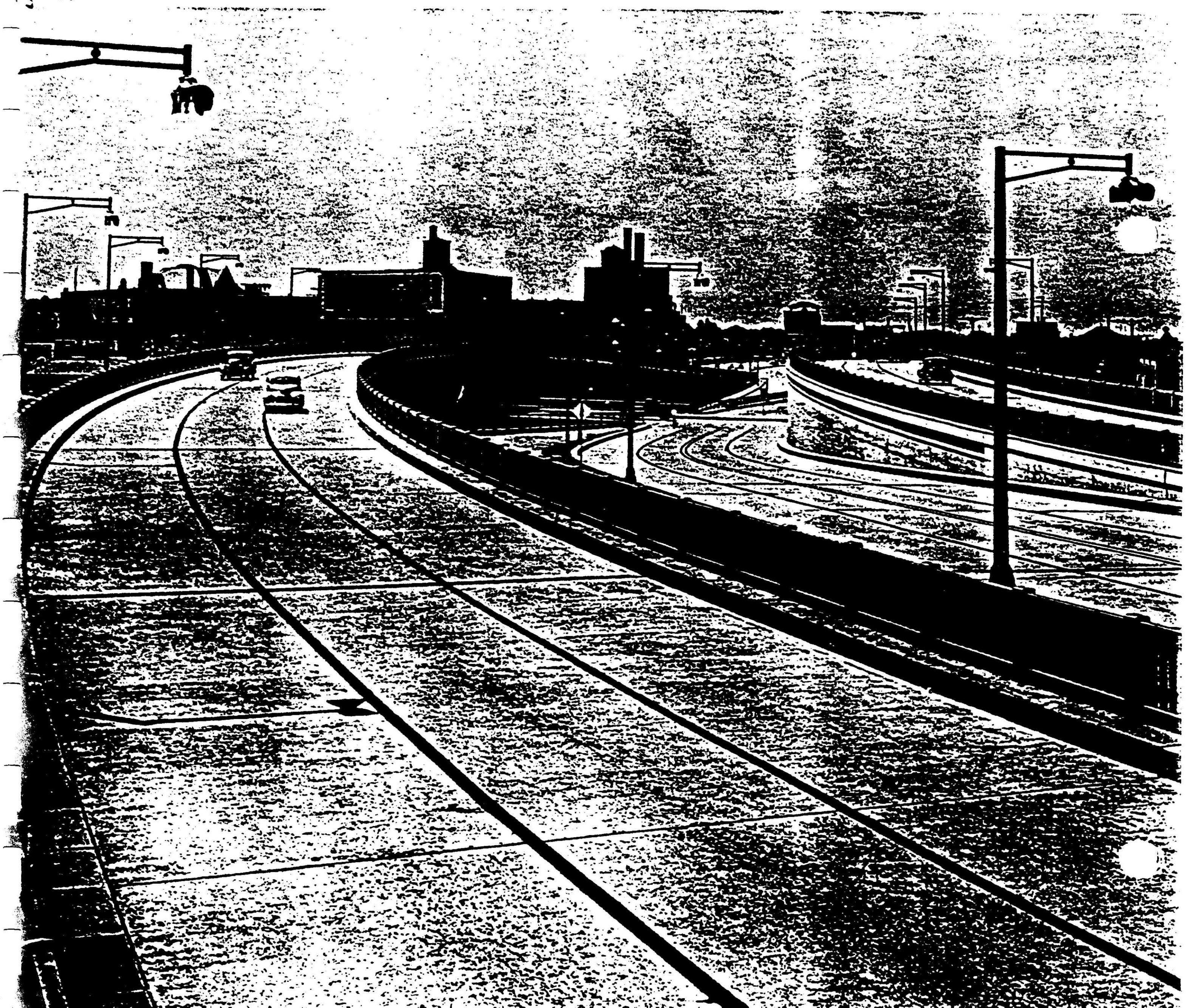
p. 40



Flagler Memorial Bridge, West Palm Beach, Fla. Hazelet & Erdal, Engineers. 4,160 sq. ft. 3½″ I-Beam-Lok Armored Floor used

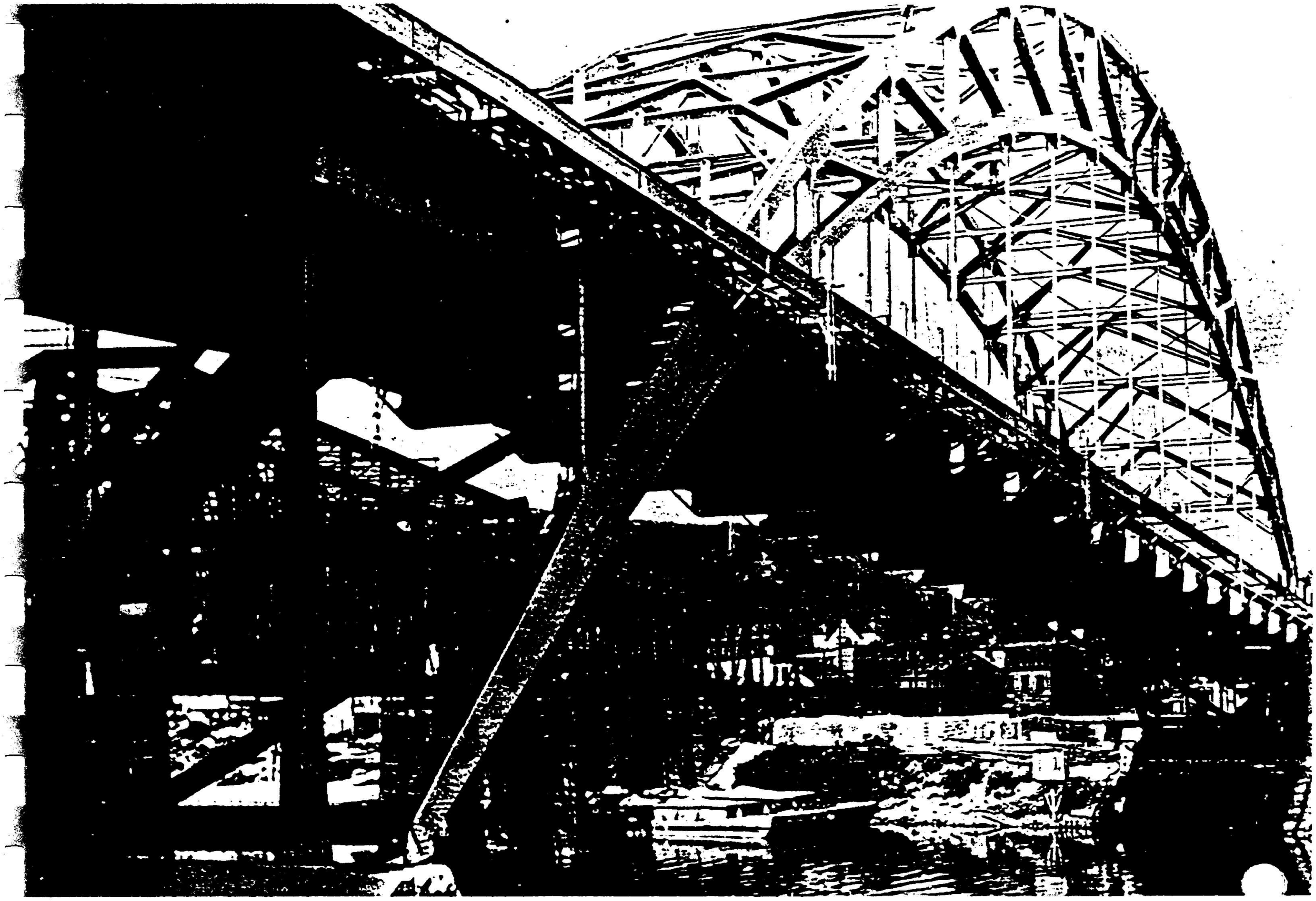
41

West Approach, Main Avenue Bridge, Cleveland, Ohio. 58,000 sq. ft. 4¼″ I-Beam-Lok Armored Floor. East Approach to the same bridge required 73,300 sq. ft. 4¼″ I-Beam-Lok Armored Floor



The 188,450 sq. ft. of 3½" U·S·S Armored I-Beam-Lok Floor that now replaces the original roadway on New York's Manhattan Bridge, was laid in precast floor units. The units from 8' to 9'6" wide and from 15'9" to 19'8" long, weighing approximately 6¼ tons each, were laid, 32 units per night. 82,500 vehicles per day now pass over it. Designed by Department of Public Works, City of New York, Irving V. A. Huie, Commissioner

Pg 42



Jerome Street Bridge over the Youghiogheny River, McKeesport, Pa., for the Allegheny County Department of Works. The entire roadway required 22,272 sq. ft. of 4¼" I-Beam-Lok Armored Floor

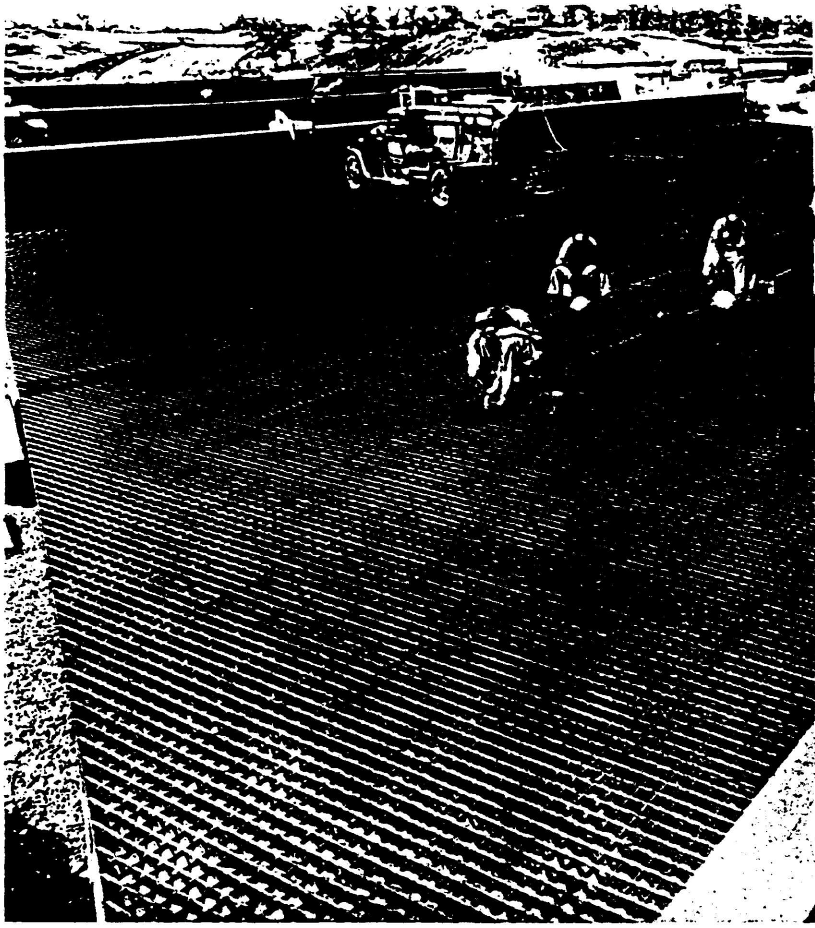
HIGHWAY BRIDGE DESIGN

In designing new bridges the use of these light-weight slabs usually reduces dead loads sufficiently to permit very substantial savings in the cost of the entire structure. Such savings alone often justify inclusion of U·S·S I-Beam-Lok Armored Slabs in the bridge specifications, without considering the further advantages of the certainty of the load carrying capacity of the slabs, ease and simplicity of erection, and the greatly reduced time for completion of the structure.

In reflooring existing structures it is often possible to take out the old heavy floors of a bridge originally designed for low loadings and through the application of the light-weight slabs, the permissible live load capacity of the bridge may be increased to take care of much heavier loadings without any other alterations or modifications in the structure.

In most cases the trusses of existing bridges are adequate, with only slight changes required in the floor beams and stringers in order to bring the bridge capacity up to requirements of present day traffic. Investigation of many bridges will show that U·S·S I-Beam-Lok Armored Slabs, with a presumable ultimate life equivalent to that of the bridge itself, may be used for reflooring even where the original floor may have been of wood.

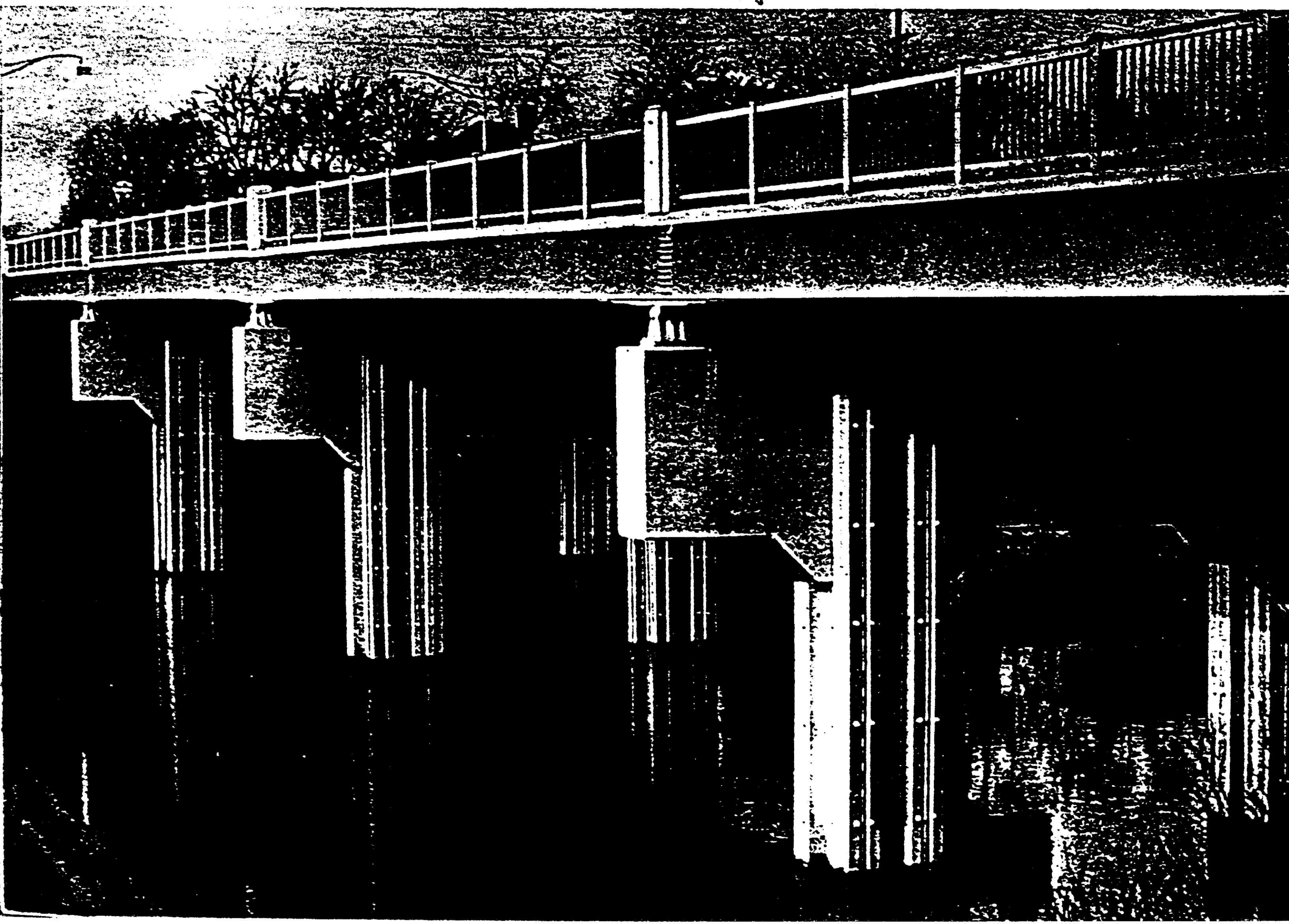
When consideration is given to the tremendous advantage, particularly on long spans, of being able to use a structural floor slab where the weight may be as low as 40.2 lbs. per square foot, it is quite apparent that this light-weight bridge floor construction has proved to be one of the most vitally important developments that has taken place since the beginning of motor transportation.

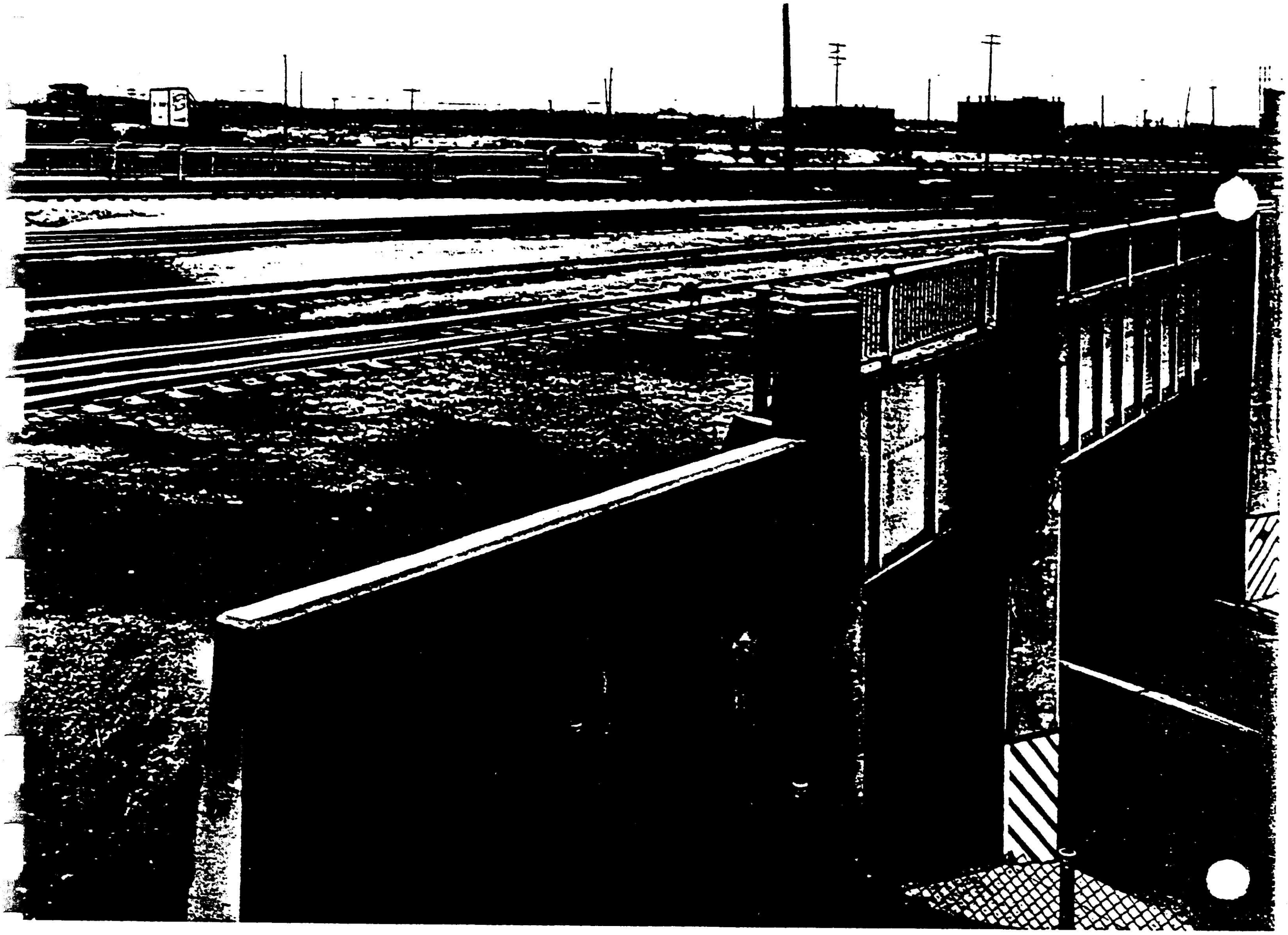


Ballasted Deck Bridge carrying Minneapolis & St. Louis Railroad and Chicago, Milwaukee, St. Paul and Pacific Railway track over Highway Underpass, Minnesota Highway Department. 12,428 sq. ft. of 3½" I-Beam-Lok Armored Floor used in the construction of this bridge

This interesting bridge at Dover, Ohio, incorporates in its construction U·S·S MZ Steel Sheet Piling pier shafts supporting a CB structural steel deck, with a 42-foot roadway of U·S·S I-Beam-Lok Armored Floor, and two 8-foot sidewalks of T-Tri-Lok. This design was estimated by contractors to be 20 per cent cheaper than the conventional type of bridge and pier

Pg 44





Highway Underpass, Terminal Railroad Association of St. Louis, East St. Louis, Illinois. The ballasted deck construction for this bridge required 10,567 sq. ft. of 4¼" I-Beam-Lok Armored Floor

RAILWAY BRIDGE DESIGN

The field of successful and economical installations of U·S·S I-Beam-Lok Armored Floor includes many railroad bridge structures. This light-weight, shallow-depth floor construction offers the following specific advantages which from previous experience have justified its use:

1. Elimination of fire hazard.
2. Sufficient strength to permit spacing of supporting steel greater than is possible with other methods of construction of comparable weight.
3. Solid, water-tight deck.
4. Rigidly braces the entire structure.
5. Reduces vibration and impact.
6. Maintenance reduced to a minimum.

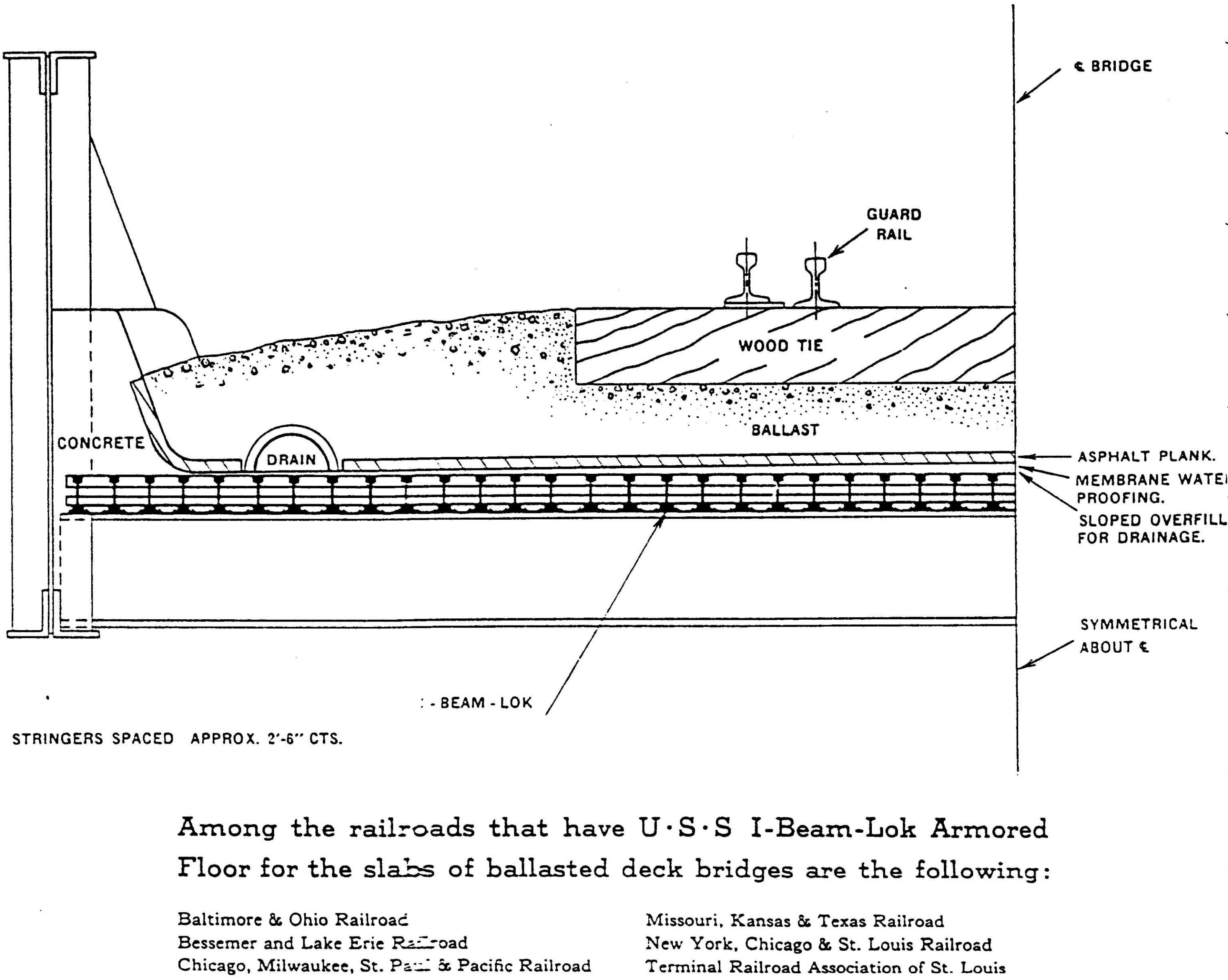
Timber decks, even though treated or protected with sheet metal, present an ever present fire hazard, especially on major railroad lines where uninterrupted, high-speed traffic operation is vitally essential. Entire replacement, as the result of disastrous fires which often occur in spite of all precautions, expense of maintenance, and cost of fire prevention can be practically eliminated by the use of a ballasted deck bridge.

U·S·S I-Beam-Lok Armored Slabs are remarkably well suited to such structures, providing strength, adequate lateral distribution of concentrated loads, a water-tight surface, and speedy installation.

Grade-crossing elimination work has brought about a tremendous increase in the use of ballasted deck bridges of the through plate-girder or simple I-Beam type. These structures, usually spanning a highway underpass, require a solid water-proof slab and a fixed clearance below.

U·S·S I-Beam-Lok Armored Floor will reduce to a minimum the total depth of the floor system, thus reducing the required distance from top of rails to roadway grade below. The saving possible in this type of flooring often amounts to several times that of the initial cost of the U·S·S I-Beam-Lok Armored Floor ballasted deck slab.

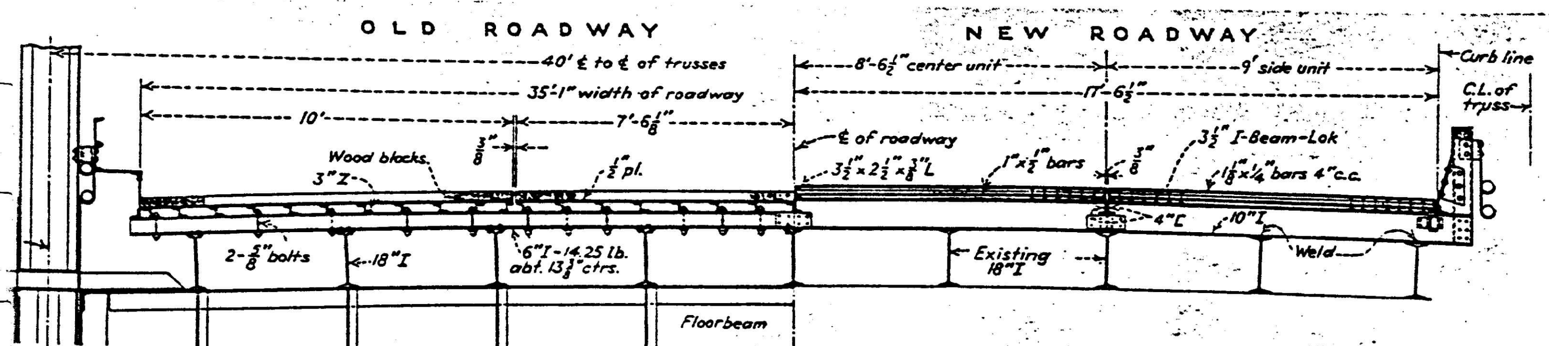
Supporting members of the floor system are usually rolled, wide-flange sections spaced about 2′ 6″ on centers, used either as floor beams or stringers on which U·S·S I-Beam-Lok Armored units are placed and field-welded. The finished slab can be cambered and filled flush, or drainage can be provided by crowning with an over-fill of concrete at the center. The concrete surface may be mopped with a liquid water-proofing or protected by a mastic or membrane seal on which a layer of asphalt block or other wear-resisting surfacing is laid. A typical cross section of a U·S·S I-Beam-Lok Armored Floor installation of this type is given below.



Among the railroads that have U·S·S I-Beam-Lok Armored Floor for the slabs of ballasted deck bridges are the following:

- Baltimore & Ohio Railroad
- Bessemer and Lake Erie Railroad
- Chicago, Milwaukee, St. Paul & Pacific Railroad
- Chicago, Rock Island & Pacific Railway
- Minneapolis and St. Louis Railroad
- Missouri, Kansas & Texas Railroad
- New York, Chicago & St. Louis Railroad
- Terminal Railroad Association of St. Louis
- Union Railroad Company
- Wabash Railway Company

Truck or lower roadway, Manhattan Bridge, over the East River, New York City

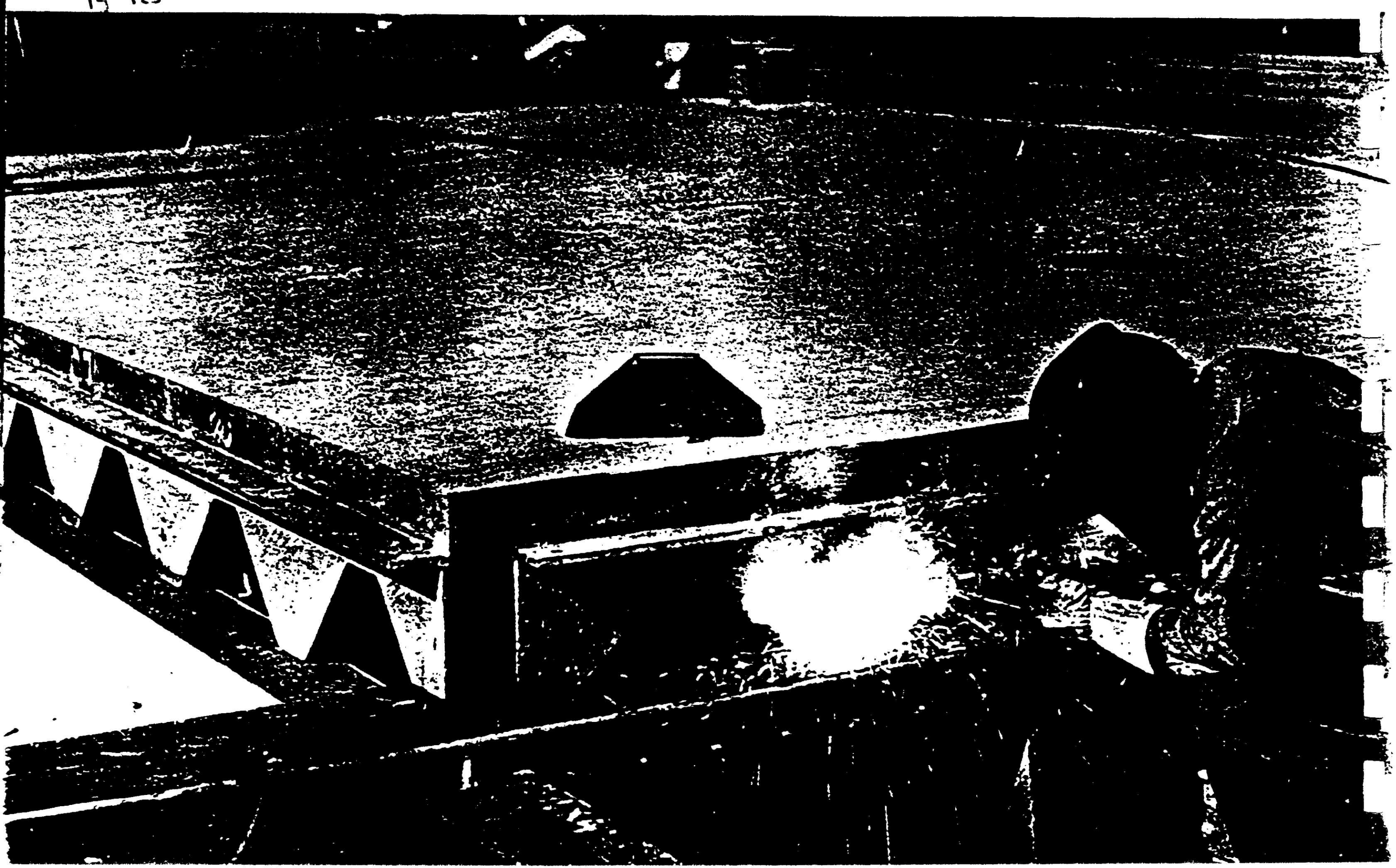


Typical cross-section of the Manhattan Bridge roadway before and after reflooring

Bascule Bridge, Outer Drive Improvement, Chicago Park District

Pg 48

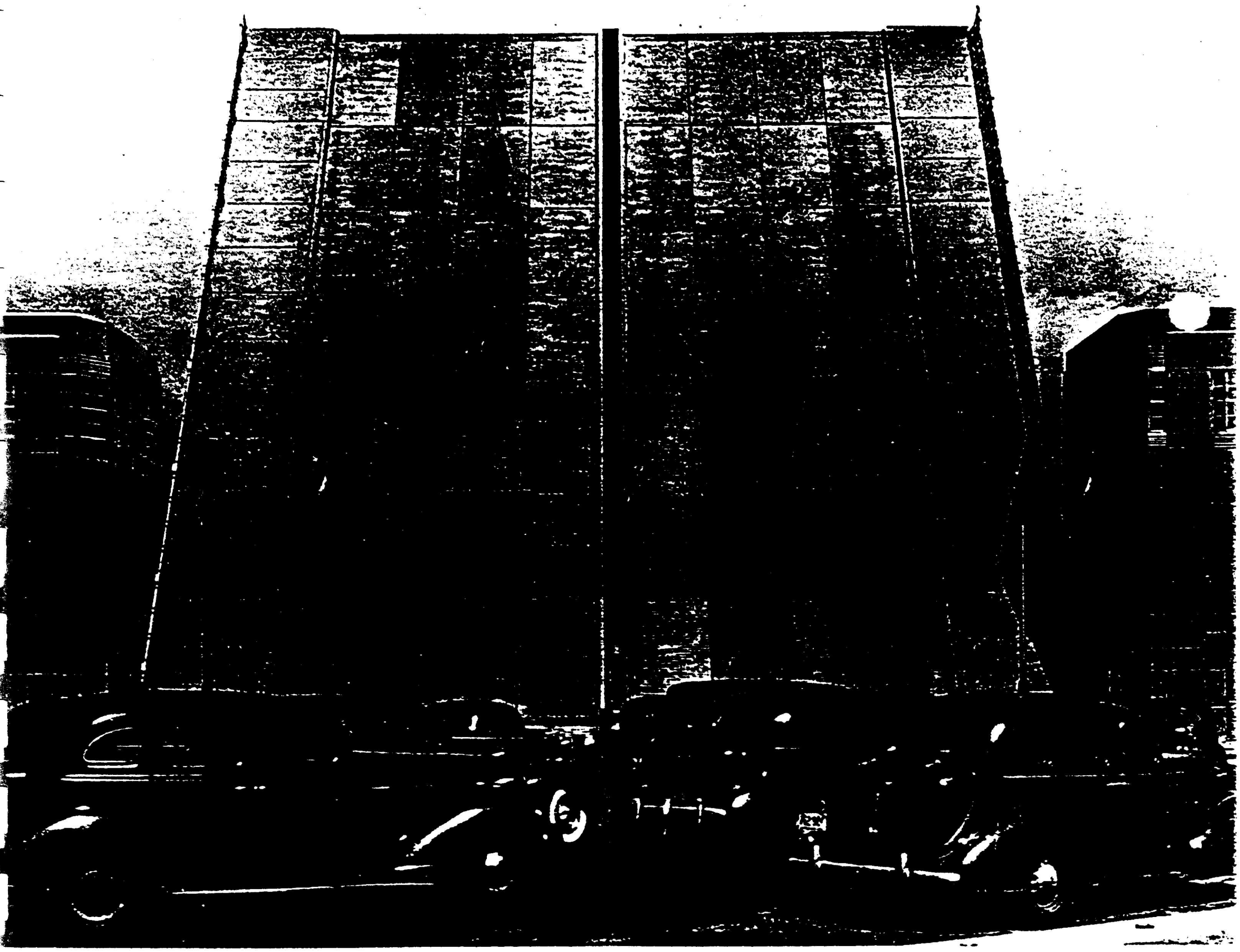
Field welding pre-cast I-Beam-Lok Armored panels to the supporting steel



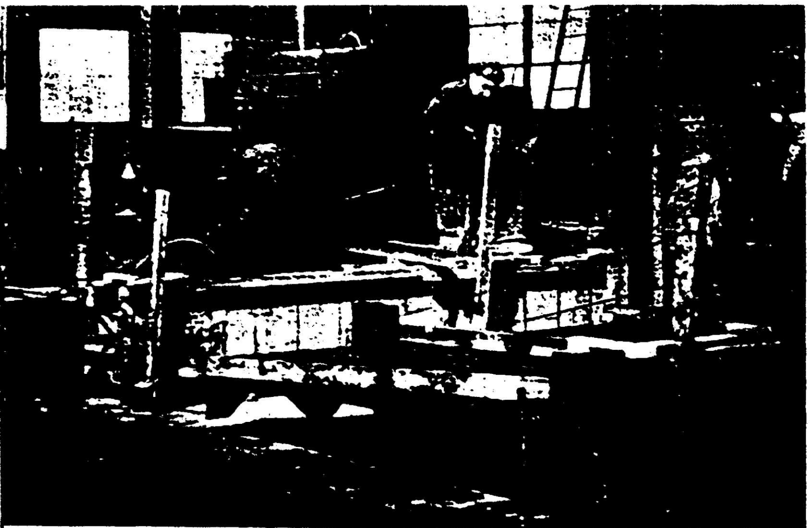
Pre-Cast U·S·S I-BEAM-LOK CONCRETE FILLED SLABS

U·S·S I-Beam-Lok Armored Floor units specially designed for filling with concrete at or near the bridge site so that the finished units can be placed directly on the bridge, have recently met with very favorable reception. Where extreme haste is necessary, and a bridge is urgently needed due to emergencies caused by floods, fires, and other causes, weeks can often be saved in placing a bridge into service by using this method. This type of construction is particularly adaptable where progress on a bridge is such that concreting operations have to be postponed from winter to spring. With Pre-Cast Slabs the bridge can be placed into service almost as soon as the steel work is erected, resulting in a saving of time and money.

Pre-casting of units is almost the only practical solution for the application of slabs on movable



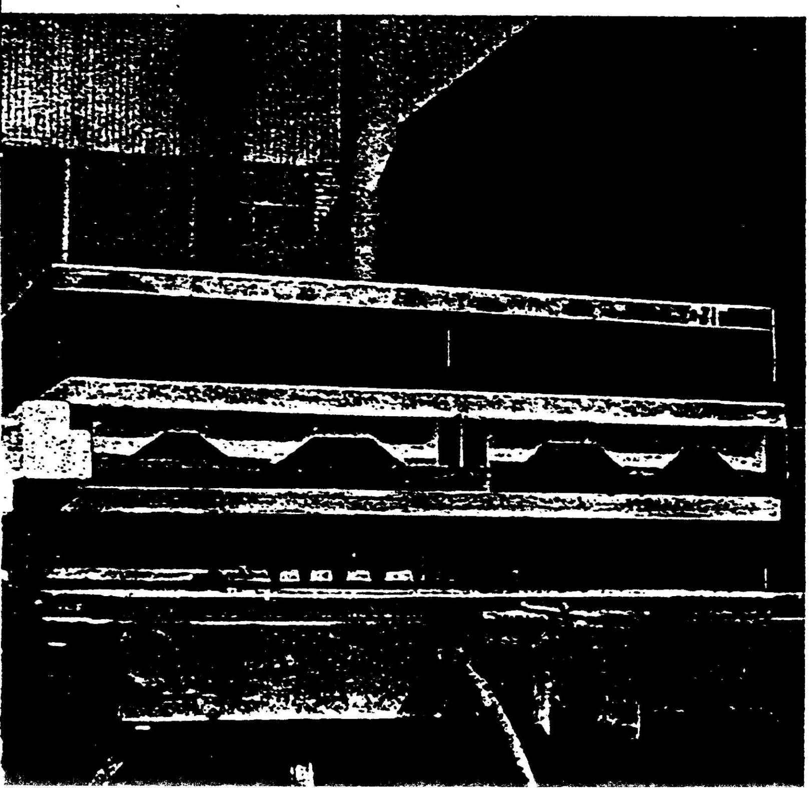
Double Leaf Bascule Bridge over the Chicago River, Outer Drive Improvement, Chicago, Illinois. Designed by the Chicago Park District. 25,486 sq. ft. of 3½" I-Beam-Lok Armored Floor and 6,361 sq. ft. of 2" T-Tri-Lok used in the pre-cast concrete and steel roadway and sidewalk panels



(Top) Mixing and pouring concrete into completely shop-fabricated I-Beam-Lok panels

(Center) Pre-cast panels finished and ready for curing

(Lower) Pre-cast panels with shop attached riser supports loaded for shipment to bridge site



bridges of the Bascule type which must be or are erected advantageously in a vertical position. Outstanding examples of this type of construction are the two Outer Drive bridges at Chicago, Ill., illustrated on pages 48 and 49.

The use of Pre-Cast units also permits the removal of old sections of flooring during the night when traffic is light and immediately replacing them with new Pre-Cast units. There is no consequent interruption or delay to traffic whatsoever during the day or during the peak rush hours. A prominent example of an installation of this type is the use of U·S·S I-Beam-Lok Pre-Cast units for the reflooring of the Manhattan Bridge, New York, N. Y.

The use of Pre-Cast units may also be advantageous in warm weather, in cases where a definite opening date for a bridge has to be met, or where a bridge is being replaced due to having been washed out by a flood, wrecked, or put out of service from other causes. In such cases the concrete can be cast in the U·S·S I-Beam-Lok Armored Steel units and allowed to cure at the bridge site while piers, abutments, and supporting structural steel are being installed.

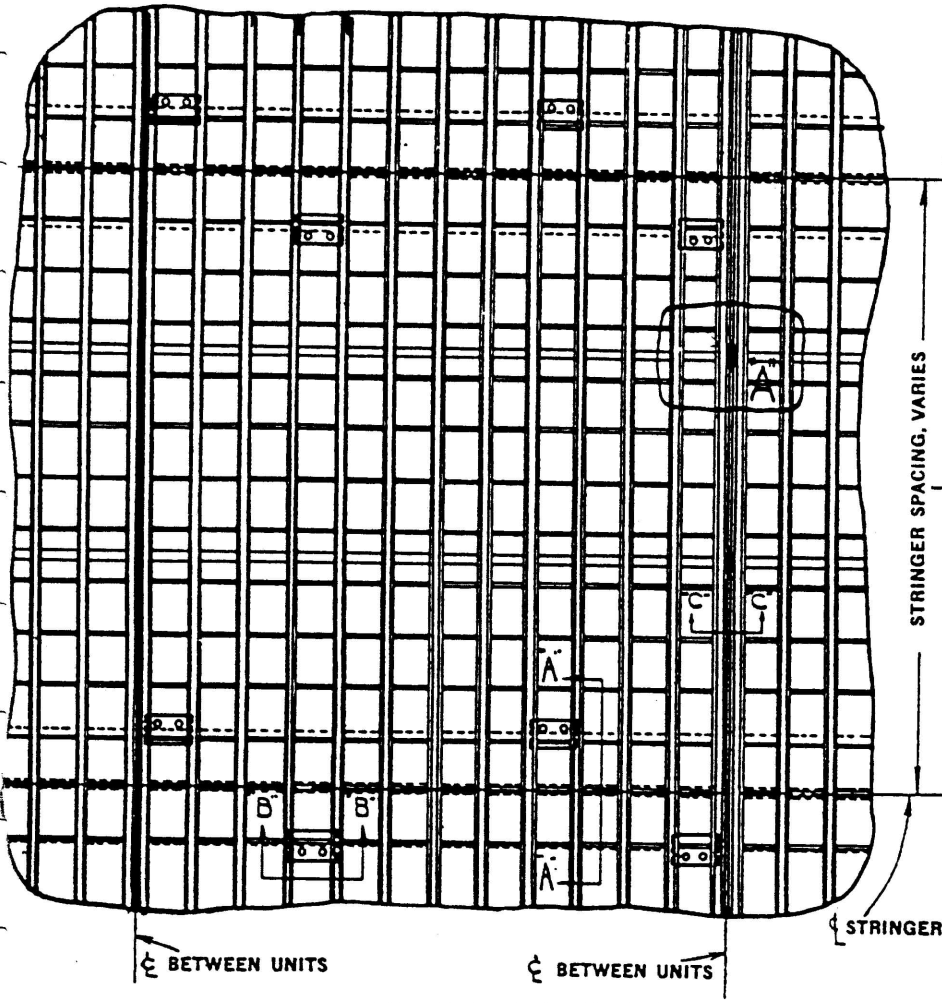
Where a contractor is under a time penalty or where a definite time limit is set for the completion of the bridge, the use of Pre-Cast Slabs may prove of inestimable value. Such projects require special handling and rush fabricating, for which Carnegie-Illinois Steel Corporation has ample facilities.

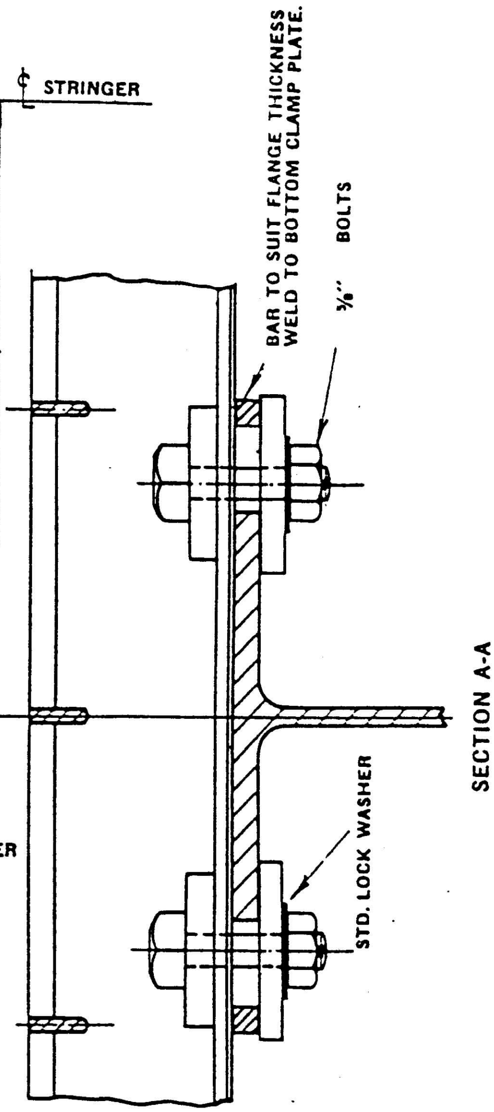
The preparation of U·S·S I-Beam-Lok Armored Floor units for pre-casting involves some additional items of expense such as clamps or other devices to permanently fasten the units to the stringers, or possibly special chairs and supports attached to the under side of the units to provide a method of field welded attachment to the supporting structural steel after placing of units.

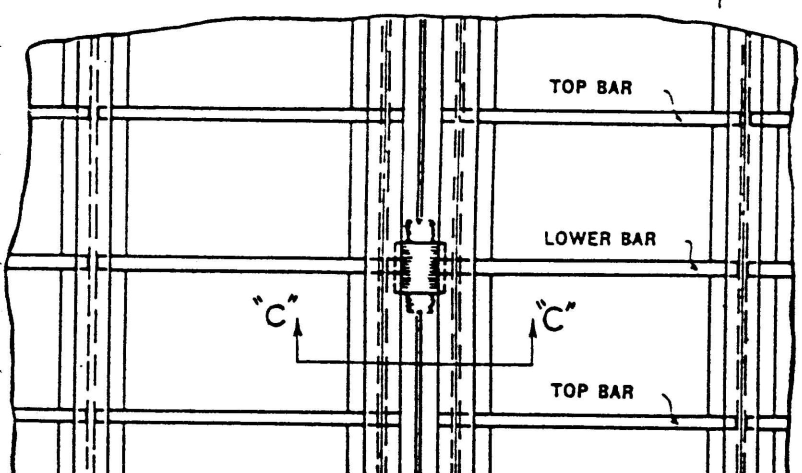
The extra cost of these units can be partially offset by the omission of the usual metal form strips, for which an appreciable credit is allowed. The empty units, without form strips, can be placed on a flat platform near the bridge site and filled with concrete. The platform acts as a solid bottom form for the concrete until it sets, and a means of leveling-up and clamping the unit before pouring.

While the accompanying drawings on page 51 show the use of bolts and clips for fastening the slabs to the bridge, about half of these bolts and clips may be eliminated by substituting field welding. However, some clamps and bolts are necessary to pull the stringers and U·S·S I-Beam-Lok Armored Floor units in contact before welding. Furthermore, a fully-welded connection requires relatively expensive overhead welding.

PART PLAN

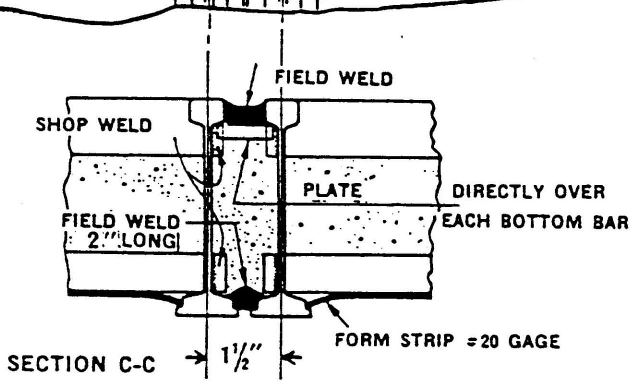




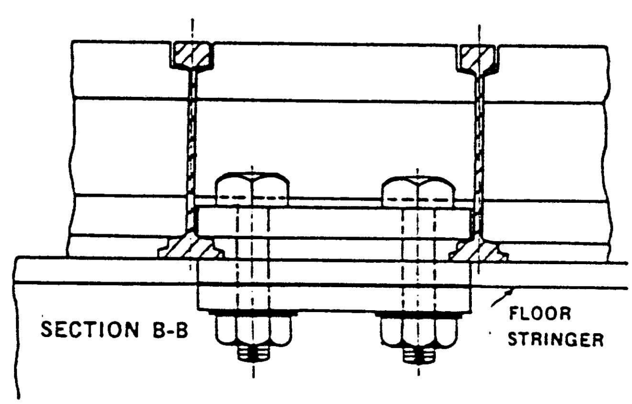


ENLARGED PLAN AT "A"

IF SLABS ARE PRECAST WITHOUT FORM STRIPS, A SOLID CASTING PLATFORM IS NECESSARY. BOLTS AND UPPER PLATES TO BE PROPERLY CENTERED BEFORE POURING CONCRETE. SECTION A-A, IS TYPICAL FOR 4¼" I-B'M-LOK: 2½", 3", & 3½" I-B'M-LOK ARE SIMILAR.



SECTION C-C



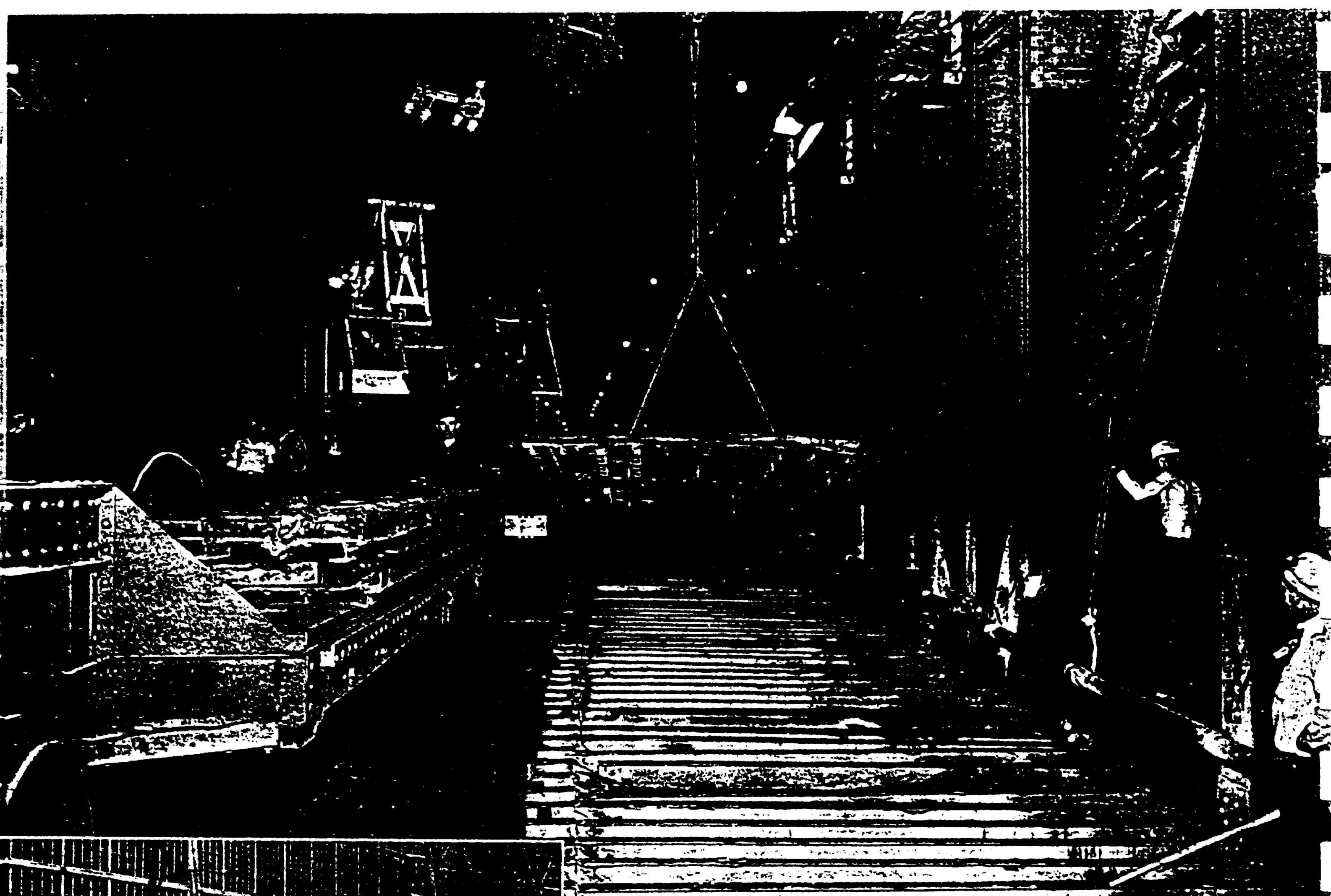
SECTION B-B

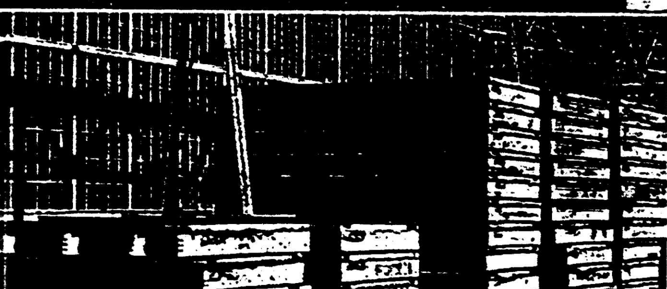
TYPICAL DETAILS

FOR FASTENING PRECAST U·S·S I-BEAM-LOK ARMORED FLOOR

ALSO

FIELD WELDING TO MAINTAIN TRANSVERSE CONTINUITY





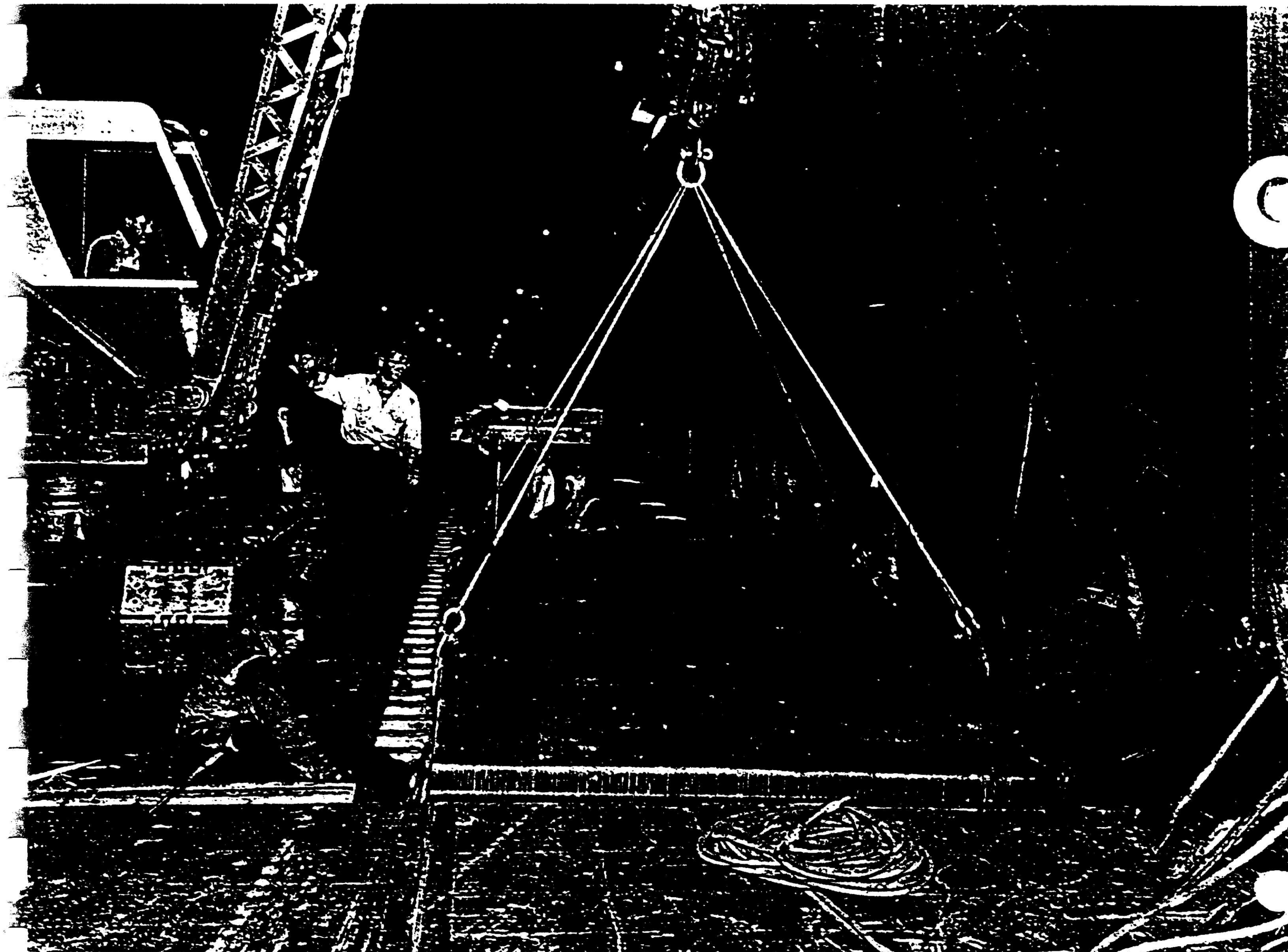
Reconstruction of the main roadway of the Manhattan Bridge, New York City

(Above) Removing the old roadway deck, preparatory to receiving the new pre-cast I-Beam-Lok panels

(Center) Completed pre-cast panels in storage yard ready for shipment to the bridge site

(Lower) Reconditioned supporting steel ready to receive the new pre-cast I-Beam-Lok roadway panels

Pg 52

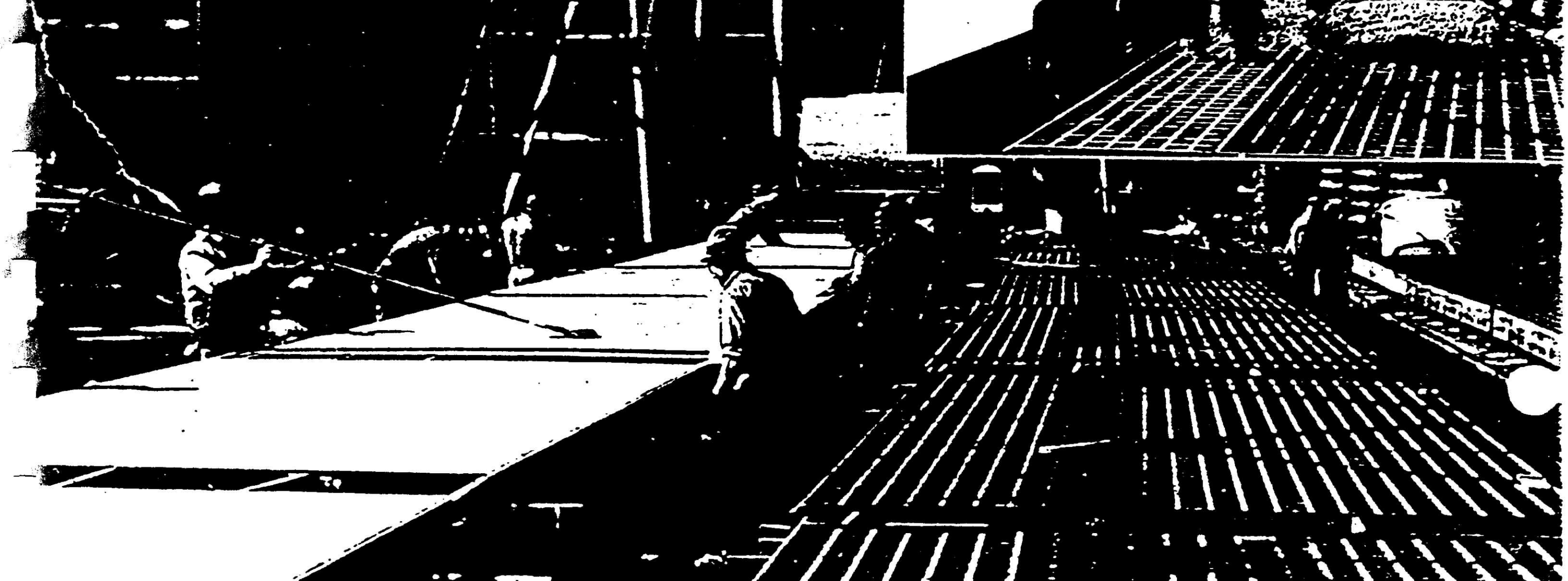


Placing pre-cast I-Beam-Lok panels after removal of the old roadway deck

Reconstruction of the main roadway, Manhattan Bridge, New York City

Pouring and finishing the concrete filled I-Beam-Lok panels

Concrete finishing operation



Engineering FEATURES

Design . . . Utilization of an I-Beam section in which the flanges remain solid the full length of the bar, with the cuts or holes for cross members restricted to the web, results in the retention of the efficiency of the I-Beam. The slab is therefore an arrangement equivalent to a series of steel I-Beams with concrete fillers. The cross members provide the necessary reinforcement for lateral distribution of loads, and at the top of the slab they also form a portion of the armoring system. The construction can be analyzed by commonly accepted methods of calculation, and it is proportioned to resist the full negative as well as the positive moment in continuous slab construction. The form strips are not considered in computing the properties of the slabs. Examination of the tables of properties will reveal that the section moduli for both concrete and steel, for both positive and negative moments, are practically balanced.

Furthermore, the section modulus and moment of resistance of the I-Beams without concrete filling is almost as much as when filled with concrete. The steel I-Beams alone are able to take over 90 per cent of the moment stresses. The concrete is required specifically to assist in lateral distribution of live load, to resist shear, and to provide the roadway wearing surface.

Load Distribution . . . ample lateral distribution of live load is assured in this construction because, in addition to the normal bond of concrete to steel, the rectangular concrete strips are locked mechanically between the flanges of the I-Beams. As previously stated, transverse moment distribution is taken care of by the top and bottom crossbars acting as a system of reinforcement transverse to the direction of the main members.

Rigid Connection to Stringers . . . Solid uniform bearing and full contact with supporting members are secured and the surfaces are protected against corrosion because the concrete is poured monolithic, down to the top of the supports. Uniform bearing on the stringers also eliminates secondary stresses in the top flanges. The form strips between the I-Beams extend only about an inch onto the edges of supports and are omitted over the balance of the width of the support. Ample field welds hold the I-Beams to the stringer flanges.

Impermeability . . . Examination of many U·S·S I-Beam-Lok Armored Floor installations shows them to be universally water-tight. With properly mixed concrete firmly interlocked with steel, especially under the head of the I-Beam, an effective seal is to be expected. When initial corrosion of the surface of the steel beams takes place, iron oxides and salts are formed which combine with the surface of the concrete adjacent to the steel. These oxides and salts are impervious and insoluble, and as they tend to swell or expand slightly, a natural tight seal is formed.

Corrosion Resistance . . . Corrosion is minimized because all component parts of U·S·S I-Beam-Lok Armored Construction are rolled from U·S·S Copper Bearing Steel. As stated before, the form strips between the I's are not considered in computing the properties of the combined sections. They could, therefore, be entirely lost as a result of corrosion, without impairing the strength of the construction. It is well known, however, that No. 20 gauge strip steel, when backed up by concrete and exposed on one side only, has a long life.

With ordinary maintenance by painting, such as is usually given a bridge at regular intervals, it is expected that the entire metal under-surface of the slabs will have a useful life lasting as long as the other component parts of the bridge.

Fire or Rust Proofing . . . Protecting the under-sides of U·S·S I-Beam-Lok Armored Construction against fire and corrosion may be accomplished as illustrated on page 55, by the use of form-work hung ¾" to 1 inch below the I-Beam-Lok units, so that concrete completely encases the bottom of the I-Beams. In this case, the metal form strips are omitted. This saving would offset a substantial portion of the expenditure required to provide the suspended form-work and extra concrete.

Combined T-Beam Action in Reinforced Concrete Construction . . .

As shown in the drawing on page 55, the space between the I-Beams is sufficiently wide to permit the placing of stirrups and the pouring of concrete which forms the stems of the reinforced concrete T-Beams, the U·S·S I-Beam-Lok Armored Floor Slab acting as the flange of the T-Beam. In this case the spans of the slabs can be taken as the clear distance between the sides of the concrete beams.

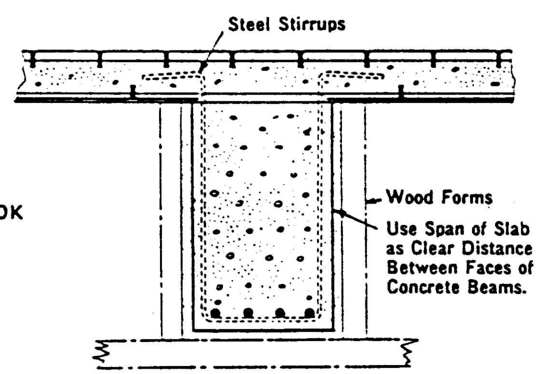
Combined T-Beam Action in Structural Steel Construction . . .

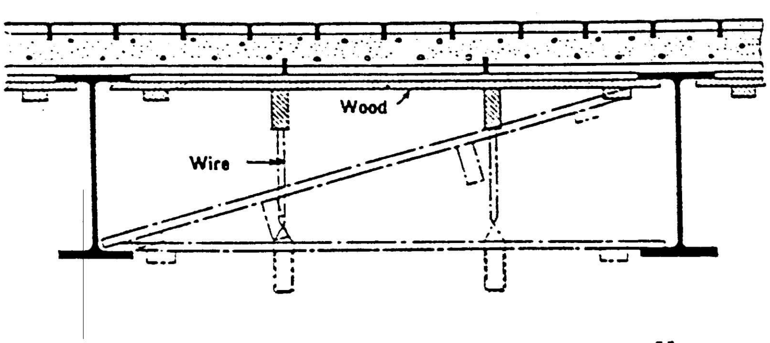
As discussed in detail on page 37, savings in stringer sizes and weights may be made by considering the U·S·S I-Beam-Lok Armored Floor Slab as acting in combination with the stringer, thus forming a composite T-Beam. The general arrangement of U·S·S I-Beam-Lok Armored Floor units makes them particularly adaptable for this purpose.

Factors of Safety . . . The unfilled steel U·S·S I-Beam-Lok Armored Floor units alone are capable of supporting heavy moving loads without being overstressed. This is illustrated by the numerous construction photos in this booklet, which show heavy equipment, such as transit mixers and loaded trucks moving on the unfilled units. It is therefore apparent that the designing engineer need have no doubt as to the ability of U·S·S I-Beam-Lok Armored Floor construction to safely carry the specified design load, regardless of the condition and quality of the concrete filling.

However, the importance of the concrete filling can not be over-emphasized. It is imperative that every precaution should be taken to secure good, sound, dense concrete, as the wearing qualities of the surface are almost entirely dependent upon the quality and grading of materials used in the mix and upon the skill applied during the pouring and finishing operations.

REINFORCED CONCRETE TEE BEAM, POURED MONOLITHIC WITH I-BEAM-LOK FLOOR OR ROADWAY SLAB





SIMPLE FORMWORK FOR ENCASEMENT OF BOTTOM FLANGES OF I-BEAM-LOK MEMBERS TO PROVIDE A SMOOTH ALL-CONCRETE UNDER SURFACE, WHEN STEEL FORM STRIPS ARE OMITTED.

POURING AND FINISHING CONCRETE

No special equipment is required for mixing or depositing concrete. The concrete can be delivered direct to the point of pouring or placing by means of transit mixers, trucks or other conveyances. Prior to the pouring of the concrete the U·S·S I-Beam-Lok Armored units should be cleaned out with compressed air or flushed out thoroughly with water from a hose. The concrete should be poured and leveled off so that it is at least 1¼" above the top of the finished surface prior to vibrating.

In order to assure a good job without voids the use of a vibrator is necessary. A light jack hammer or paving breaker with a steel plate or angle cushion between the hammer head and the I-Beam-Lok unit is satisfactory. Any of the specially designed platform type of mechanical vibrators are also satisfactory. These should be fairly heavy, or of the type which requires at least two men to move them about on the surface of the concrete.

Over-vibrating the concrete should be avoided in order to prevent bringing an excess of fines or laitance to the surface. Sufficient vibration, however, should be given to the structure to eliminate voids. After vibrating, the concrete should be screeded either flush with steel or to the specified thickness above the top of the steel. If the over-fill above the steel is relatively thin, sufficient concrete should be deposited to insure that the required level of the slab is maintained after vibrating and finishing.

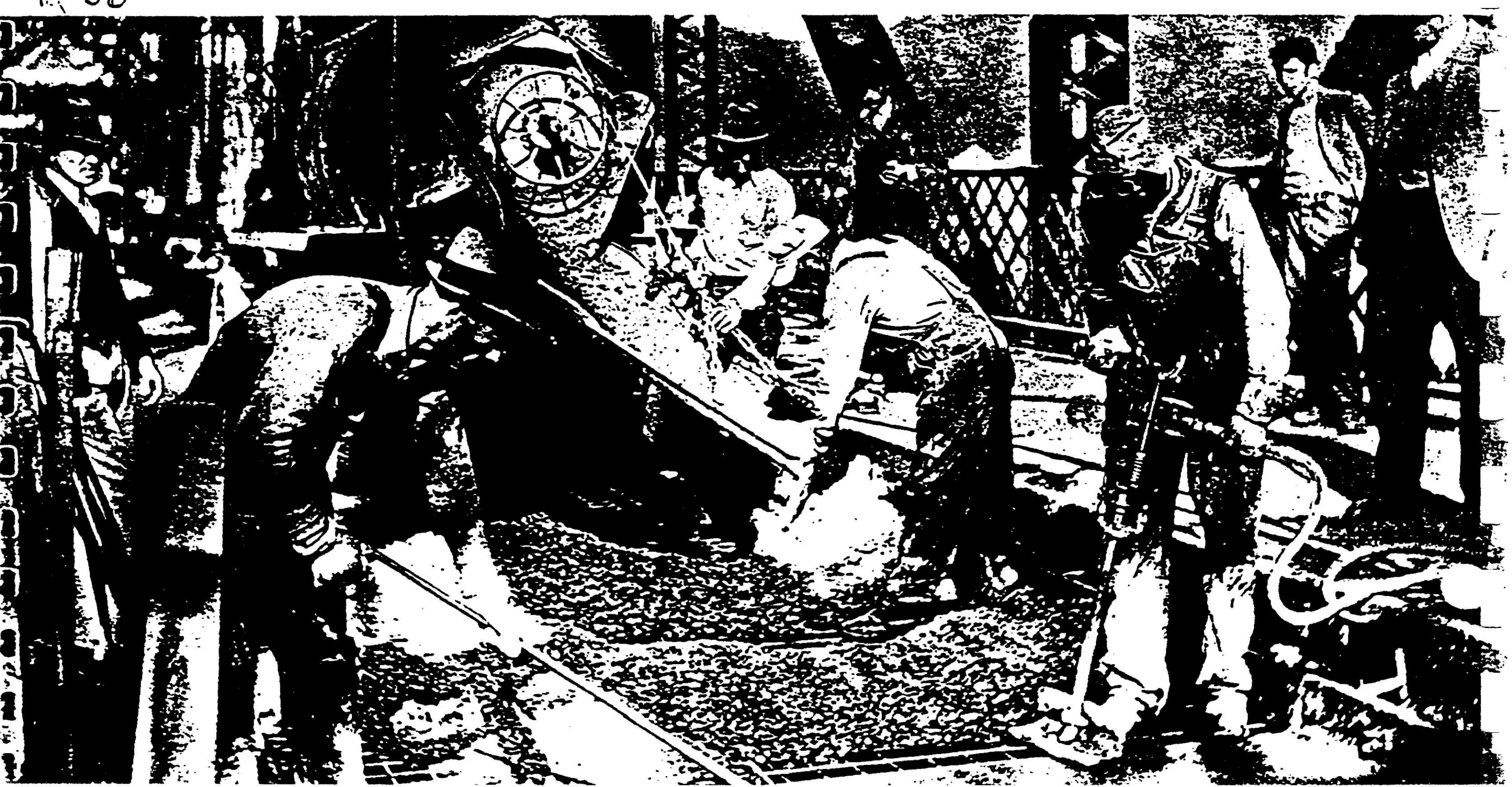
It is essential that ample concrete be deposited so the finish can be worked down to the desired level. Addition of thin layers of concrete to compensate for underfilling may lead to serious difficulties later, such as peeling or chipping of the added layers after a short life under traffic.

While the water-cement ratio must be kept down so as to produce a slump not exceeding four inches, a smooth flowing workable mixture is desirable. The design of the concrete or the proportions of the aggregates should be such that harshness in the concrete is avoided. Harshness, in addition to increasing the difficulties of placing, also has a tendency to reduce the imperviousness of the slab.

The slab should be screeded and floated to a smooth finish as quickly as practicable after pouring. Excessive work on the top surface should be avoided, limiting the finish to that secured by a wooden float.

Any standard approved method can be used for the curing of the concrete. There can be no loss of water through evaporation except from the top surface. The steel forming the bottom and sides of the form work is, of course, unable to absorb any water, consequently almost all the water in the mixture except that lost at the top surface is available for setting of the cement. The use of a sprayed asphalt or resinous coating for curing is increasing in favor and has been satisfactory in connection with U·S·S I-Beam-Lok Armored Floor slabs.

Depositing, vibrating and finishing concrete with small equipment



HANDLING AND ERECTION

U·S·S I-Beam-Lok Armored units are shipped in open cars. The units should always be lifted out of the cars and subsequently handled by means of mechanical equipment. Four-point chain or cable hooks or slings should be used when lifting the units. They should be attached near each edge of the unit at a point about one-fourth of the length of the unit from each end.

The units should not be placed on bare ground, but should always be laid with ample blocking under the lower units of any pile or stack of units. The blocking will prevent stones, lumps or any projections on the surface of the ground from forcing the form strips up out of position. Blocking should be arranged to protect the camber duplicating the blocking in the car.

Before placing the units on the bridge stringers, the location of each unit should be carefully marked to correspond with the location shown on the erection diagram. The best method is to mark the center lines of the splices between units on the stringers for the full length of the bridge. In this way any gain or loss is readily discovered as soon as the units show any tendency to overrun or underrun.

After unloading from railroad cars, the units are usually delivered to the bridge by truck, lifted off, and swung into position with a light crane. The units are then properly aligned and tack-welded into position. As the work progresses towards the other end of the bridge, the unfilled units already laid serve as a rigid working deck on which rubber tired truck cranes can operate without runways.

It is often necessary that the I-Beam-Lok units must conform to a specified camber in order to provide drainage or to match a fixed crown on the approaches. Unless this camber is unusually severe, it will be found in most instances that the units will conform to the desired crown naturally, due to their flexibility. The amount of the natural theoretical deflections to be expected for various unit lengths and depths is shown in the table below. Because of the impossibility of setting supporting structural steel in perfect alignment or to an absolutely true level, a certain amount of pulling down or adjusting will always be required, even in the case of a practically level roadway. A simple hand leverage or screw clamp will usually provide the means of bringing the units into contact with the supporting steel. If a greater force is needed to bring the I-Beam-Lok units down to conform to the crown, this can be accomplished by driving a truck or

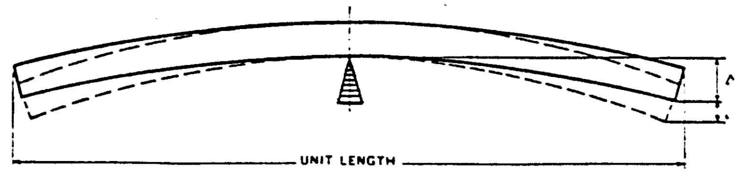
THEORETICAL NATURAL CAMBERS RESULTING FROM DEAD WEIGHT OF I-BEAM-LOK UNITS ON SINGLE CENTER SUPPORT

Unit Length	4 ¼" I-Beam-Lok			3 ½" I-Beam-Lok			3" I-Beam-Lok		
	Natural Camber Δ Inches	Inc. Δ_1 Inches	Inc. Δ_2 Inches	Natural Camber Δ Inches	Inc. Δ_1 Inches	Inc. Δ_2 Inches	Natural Camber Δ Inches	Inc. Δ_1 Inches	Inc. Δ_2 Inches
16′	.06	.091	.008	.085	.161	.013	.118	.235	.019
20′	.14	.178	.015	.206	.315	.026	.285	.460	.038
24′	.29	.309	.026	.429	.545	.045	.594	.795	.066
28′	.54	.489	.041	.79	.865	.072	1.09	1.26	.105
32′	.92	.732	.061	1.35	1.29	.108	1.86	1.88	.157
36′	1.48	1.04	.087	2.16	1.84	.153	2.97	2.68	.224
40′	2.26	1.42	.118	3.30	2.52	.210	4.56	3.70	.308

Inc. $\Delta 1$—Increased camber resulting from application of concentrated load of 600 lbs. at each end.

Inc. $\Delta 2$—Increased camber resulting from application of concentrated load of 50 lbs. at each end.

NOTE: Natural Camber $\Delta = \frac{WL^3}{128\ EI}$ is theoretically correct, but Inc. Δ_1 and Inc. Δ_2 are approximate only and may vary from 1 to 1.6 times the tabular values shown. Therefore, the values in the table are conservative.



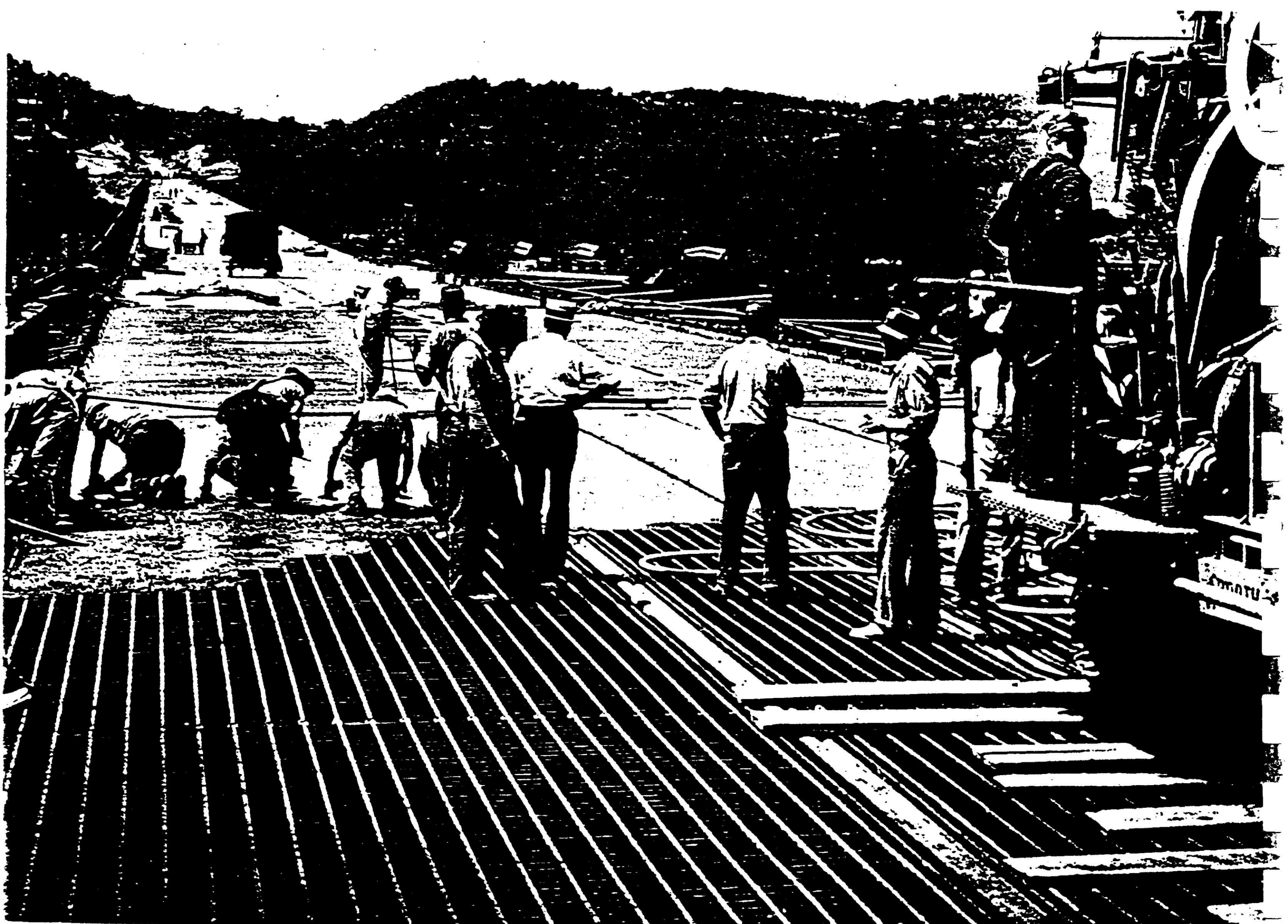
other equipment, such as a heavy weight equipped with rollers, over the units.

After placing of the units has advanced sufficiently to a point where work can be carried on behind the truck crane, the loose form strips which must be installed in the field between units are then placed in position. It is usually the practice to slide the form strips into position lengthwise, which can readily be done.

All of the field welding required by the plans and specifications is next completed. The ends of the lower crossbars are brought into alignment and contact, and welded as required. The abutting ends of the upper crossbars may be welded directly end to end. Another method of forming a splice is to make a horizontal weld on a short splice bar, placed on one side of the crossbars as shown on page 83. Still another method of making a splice between the upper crossbars is to insert lengths of splice bars in the holes adjacent to the crossbars as shown on page 83.

After completion of welding, the unfilled U·S·S I-Beam-Lok Armored Floor units provide a very satisfactory working deck on which persons may walk without difficulty and over which heavy equipment may be readily moved.

Remarkably fast time can be made in erecting and welding these units in position. For example, two bridges each fourteen hundred feet long were made ready to receive concrete in four calendar days. The U·S·S I-Beam-Lok Armored Floor units were placed and preliminary welding for position was done by crews working from each end to the center. This was accomplished in two days, working two eight-hour shifts each day. The final welding was done by six welders and two assistants working twelve hours each day for two additional days.



Typical concreting operation with large paving mixer

SHOP PRACTICE

Size and Manufacture . . . There are four sizes of U·S·S I-Beam-Lok Armored Floor, namely, 2½, 3 and 3½″, manufactured in four-foot widths and 4¼″ depth is manufactured in six-foot widths. Special units may be made in narrower widths. All depths are manufactured in units up to 49-foot maximum lengths. Units shorter than 15 feet or longer than 35 feet are subject to length extras which increase the price slightly.

Tolerances . . . All units are manufactured to length tolerances of +0 to -¼″ and to width tolerances ranging from +0 to -⅛″ for crossbar dimensions. Form strips are detailed so that they will overlap the edges of the supporting steel approximately 1½″. These form strips are reasonably tight but cannot be made entirely leak proof although leakage is not at all serious.

Camber . . . If desired, U·S·S I-Beam-Lok Armored Floor Units can be cambered in the shop to approximate the required crown, which, however, will never entirely eliminate the need for a certain amount of pulling down in the field. An extra charge is made for shop cambering. (See information covering cambering in the field on Page 57.) If excessive camber requirements indicate that shop cambering is necessary care in handling and storing must be taken to protect the camber which otherwise might be lost.

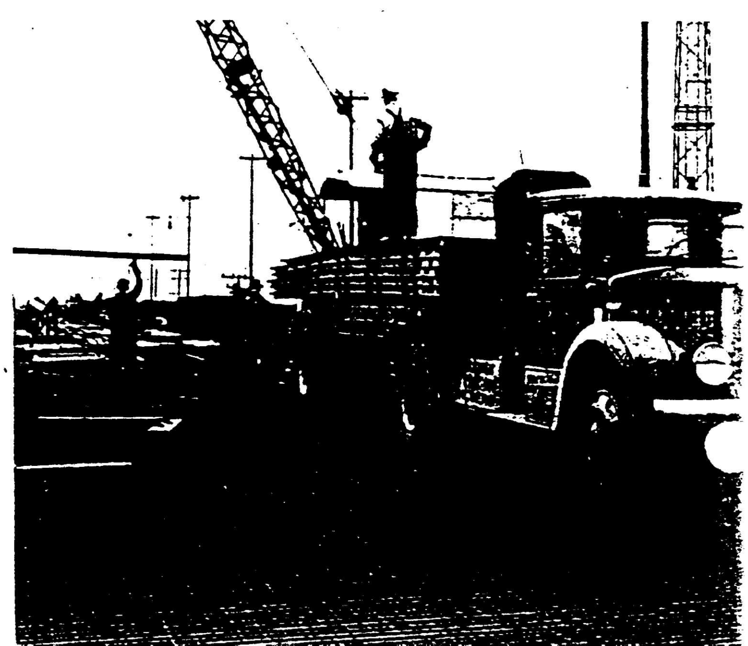
End Dams, Edge Angles, Etc . . . End Dams, Edge Angles, or other trimming materials are welded in the shop to the unit with sizes and lengths of weld in accordance with standard practice as shown on the drawings in this booklet. Special welding in accordance with plans and specifications is estimated and charged for in accordance with material and labor required.

Note—*The Carnegie-Illinois Steel Corporation is not in position to fabricate expansion joints, guard rails, curbs or other accessories not a part of the I-Beam-Lok units. These items should be included in the contract for structural steel with adequate and satisfactory provision being made for field connecting to the I-Beam-Lok units where necessary.*

Skew Ends, Cut-Outs, Etc . . . Where required by the specifications and details, Carnegie-Illinois Steel Corporation will flame cut material in the shop to required dimensions within tolerances ranging from +0 to -¼″ on the theoretical dimension.

Shop Painting . . . Carnegie-Illinois Steel Corporation is equipped to apply brush coating of paint to the entire under-surface of U·S·S I-Beam-Lok Armored units using either standard shop paint or paint as specified. An extra charge is made for this work.

Loading . . . Units are loaded on the cars in the order designated by customer. They are securely blocked and fastened in the cars in order to prevent movement or shifting of the load during transit.



Doremus Avenue Bridge, spanning railroad tracks in Newark, N. J., recently refloored with 33,588 sq. ft. of 3½″ I-Beam-Lok Armored Floor, City of Newark Department of Public Affairs, Transit Bureau. James W. Costello, Chief Engineer, City of Newark

Design DATA

The subject of stresses resulting from wheel load concentrations on bridge floor slabs, and the influence of the distribution of these loads on the moment formulas is one to which intensive study has been given during the past several years. Much of the basic theory which has been adopted was contributed by Prof. H. M. Westergaard, of the University of Illinois, in an article published in Public Roads, Vol. 11, No. 1, March, 1930.

The Westergaard theory insofar as it applied to the equivalent effective width of distribution of wheel loads, applied to simply supported slabs on one span, and was substantiated later by tests made at Ohio State University. It was discussed in an article by Prof. Clyde T. Morris entitled, "Concentrated Loads on Slabs", in the University Bulletin No. 80, published in 1933.

After further study and investigation by the Bureau of Public Roads, United States Department of Agriculture, Washington, D. C., certain modified formulas were developed to simplify the design computations and to provide for conditions not covered by the Westergaard theory.

These modified moment formulas taken from the article, "Distribution of Wheel Loads and Design of Reinforced Concrete Bridge Floor Slabs," published in Public Roads, October, 1937, are the bases of the calculations used in developing the load tables shown on pages 62 to 64. It is believed that this theory is the latest and most authoritative on this subject at the present time and one likely to be generally accepted by the engineering profession. These modified formulas have been developed for two types of moment conditions; first, for bridge floor slabs with main reinforcement parallel to the direction of traffic, which will be termed Case I; and second, main reinforcement transverse to the direction of traffic, designated as Case II. Under both cases are formulas for slabs (1) freely supported, (2) fully restrained, (3) having 75 per cent end restraint, and (4) having 50 per cent end restraint.

In almost every installation of U·S·S I-Beam-Lok Armored Floor bridge floor construction the units are continuous over several supports and firmly welded to tops of stringer flanges to produce a practically fully restrained condition. In order to be conservative and to increase the factor of safety, all of the stresses in the load tables shown on page 67 were calculated by using the moment factors applicable to a monolithic slab condition or a 75 per cent end restraint.

Occasionally, special conditions are encountered requiring use of freely supported slabs for single spans, such as transverse roadway slabs between street car rails. Although moment factors for this condition will be found in the Summary of Formulas shown in Tables 1 and 6 for both Case I and Case II, separate load tables for this condition hardly seem justified and are seldom needed.

The truck loading used in the following analysis and calculations is shown on page 61. It is the same as that adopted in the Standard Specifications for Highway Bridges of the American Association of State Highway Officials, except that each wheel load is assumed to be applied over a circular area with a diameter of 1.25 feet for both H-15 and H-20 loading.

The design of the floor slab itself involves not only the selection of the proper depth of U·S·S I-Beam-Lok Armored Floor for the live loads, direction of main reinforcement, spacing of supports, and allowable stresses for the specified condition, but in addition adequately designed members must be provided to support the outer edges of the slab, capable of resisting live load moment plus impact, and dead load moment. For example, where U·S·S I-Beam-Lok Armored Floor units are laid parallel to the direction of traffic, as in Case I condition, a support is required at both curbs, full length of the roadway slab. The moment factors and live load moments for this condition are shown in the summary of formulas in Table 1 and the resulting moments are given in Tables 4 and 5.

For Case II, with U·S·S I-Beam-Lok Armored Floor laid transverse to the direction of traffic, the outside stringers provide edge support, although at the ends of the roadway slab, at expansion joints, or at any intermediate point where the continuity of the slab is broken, a support must be provided. This support should be capable of resisting two-thirds of the moment produced by the maximum condition of wheel load concentrations, including live load impact, and dead load.

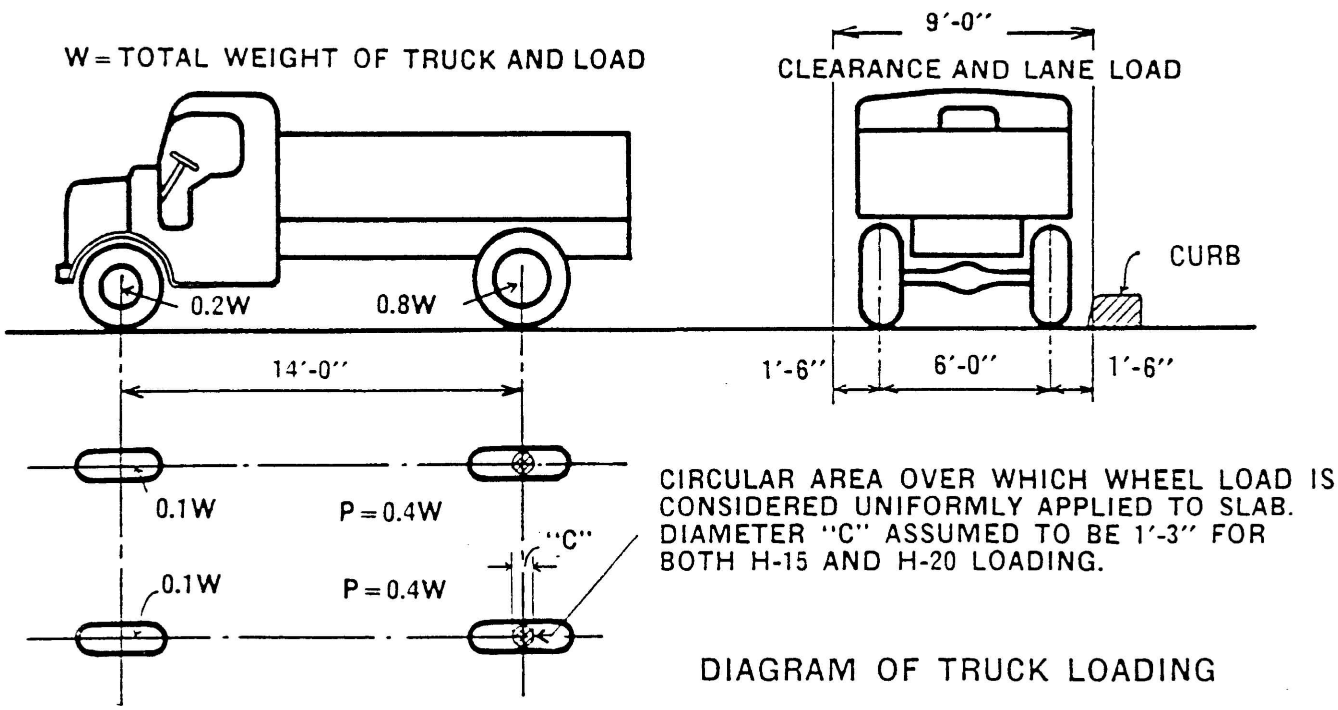
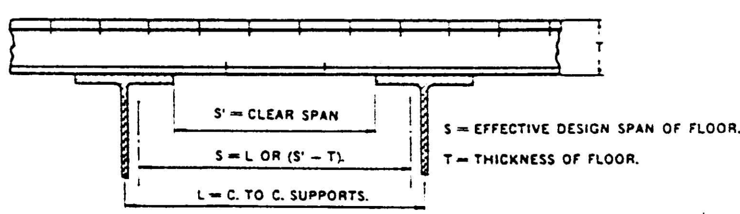


DIAGRAM OF TRUCK LOADING

The position of truck loading to produce maximum moment for this condition will be with rear wheels on the center line of slab for all spans. Load Tables Case 1 and Case 2 on page 67 for a 75 per cent end restraint condition give the resulting steel and concrete stresses in various depths of standard U·S·S I-Beam-Lok Armored Floor slabs for maximum moment conditions, H-15 and H-20 loading, and spacing of supports as indicated.

Values and Notations Used in Formulas

The symbols used in the summary of formulas given in Table 1 and in the moment Tables 2 and 3 are as follows:



S = Effective design span in feet.
W = Dead load per square foot of slab.
P = Wheel load = 12,000 pounds for H-15 and 16,000 pounds for H-20 loading.
I = Impact factor = $\frac{50}{125+S}$
M = Maximum live load moment.
M (1.0+I) = Live load+impact moment.
M_t = Design moment = Dead load moment + M (1.0+I).
M_e = Live load moment in foot pounds distributed to edge support.
M_e (1.0+I) = Live load+impact moment in foot pounds distributed to edge support and is the total live load moment in foot pounds for which the supporting member must be designed.
All moments are in foot pounds per foot width of slab except for M_e (edge support)

Case I U·S·S I-Beam-Lok Armored Floor Units Laid Parallel to the Direction of Traffic

TABLE 1: Summary of moment formulas for Case I

Type of slab	Requirements regarding slab and supports	Percentage of end restraint assumed	Live load moments per foot width of slab, M	Live load moment distributed to edge support, M_e	Dead load moment
Freely supported	Single spans.	0	$\frac{PS}{0.66\,S+12.4}$	$0.01\ PS^2$	$\frac{WS^2}{8}$
Slabs continuous	Slabs bearing on 3 or more supports and continuous over 2 or more panels.	50	$\frac{PS}{0.66\,S+17.05}$	$0.008\ PS^2$	$\frac{WS^2}{10}$
Slabs monolithic	Slabs built monolithic with 3 or more supports and continuous over 2 or more panels.	75	$\frac{PS}{0.66\,S+20.15}$	$0.007\ PS^2$	$\frac{WS^2}{10}$
Fully restrained	Exceptional cases only.	100	$\frac{PS}{0.66\,S+24.8}$	$0.005\ PS^2$	$\frac{WS^2}{12}$

TABLE 2: Live load moments in foot-pounds per foot width of Slab for Case I with U·S·S I-Beam-Lok units laid parallel to direction of traffic.

H-15 loading

P = 12,000 pounds

Condition at support		Freely supported		Slabs continuous, 50 percent end restraint		Slabs monolithic, 75 percent end restraint		Fully restrained	
Slab span S, feet	$I=\frac{50}{125+S}$	$M=\frac{PS}{0.66S+12.4}$		$M=\frac{PS}{0.66S+17.05}$		$M=\frac{PS}{0.66S+20.15}$		$M=\frac{PS}{0.66S+24.8}$	
S	I	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$
2.0	0.394	1,750	2,440	1,310	1,830	1,120	1,560	920	1,280
2.5	.392	2,140	2,980	1,600	2,230	1,380	1,920	1,130	1,570
3.0	.391	2,510	3,480	1,890	2,630	1,630	2,270	1,340	1,865
3.5	.390	2,850	3,960	2,170	3,020	1,870	2,600	1,550	2,150
4.0	.388	3,190	4,430	2,440	3,390	2,100	2,920	1,750	2,430
4.5	.386	3,520	4,880	2,700	3,740	2,330	3,230	1,950	2,700
5.0	.385	3,830	5,300	2,950	4,090	2,560	3,540	2,140	2,965
5.5	.383	4,110	5,680	3,190	4,410	2,770	3,830	2,330	3,220
6.0	.382	4,400	6,080	3,430	4,740	2,990	4,130	2,510	3,470
6.5	.380	4,680	6,460	3,650	5,040	3,190	4,400	2,680	3,700
7.0	.379	4,940	6,810	3,870	5,340	3,390	4,670	2,850	3,930
7.5	.377	5,180	7,140	4,090	5,630	3,590	4,950	3,030	4,170
8.0	.376	5,430	7,460	4,300	5,920	3,780	5,200	3,200	4,400

TABLE 3: Live load moments in foot-pounds per foot width of Slab for Case I with U·S·S I-Beam-Lok units laid parallel to direction of traffic.

H-20 loading

P = 16,000 pounds

Condition at support		Freely supported		Slabs continuous, 50 percent end restraint		Slabs monolithic, 75 percent end restraint		Fully restrained	
Slab span S, feet	$I=\frac{50}{125+S}$	$M=\frac{PS}{0.66S+12.4}$		$M=\frac{PS}{0.66S+17.05}$		$M=\frac{PS}{0.66S+20.15}$		$M=\frac{PS}{0.66S+24.8}$	
S	I	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$
2.0	0.394	2,330	3,250	1,750	2,440	1,490	2,080	1,230	1,710
2.5	.392	2,850	3,970	2,130	2,970	1,840	2,560	1,510	2,100
3.0	.391	3,340	4,640	2,520	3,510	2,170	3,030	1,790	2,490
3.5	.390	3,800	5,280	2,890	4,030	2,490	3,470	2,070	2,870
4.0	.388	4,250	5,900	3,250	4,520	2,800	3,890	2,330	3,240
4.5	.386	4,690	6,500	3,600	4,980	3,110	4,310	2,590	3,600
5.0	.385	5,100	7,060	3,930	5,450	3,410	4,720	2,850	3,950
5.5	.383	5,490	7,580	4,250	5,880	3,700	5,110	3,100	4,290
6 0	.382	5,870	8,110	4,570	6,320	3,980	5,500	3,340	4,630
6.5	.380	6,240	8,620	4,870	6,720	4,250	5,860	3,580	4,930
7.0	.379	6,570	9,080	5,160	7,120	4,520	6,220	3,810	5,240
7.5	.377	6,910	9,520	5,450	7,510	4,790	6,600	4,040	5,560
8.0	.376	7,240	9,940	5,730	7,900	5,040	6,930	4,260	5,860

TABLE 4: Live load moments in foot-pounds distributed to edge supports for Case I with U·S·S I-Beam-Lok units laid parallel to direction of traffic.

H-15 loading P = 12,000 pounds

Condition at support		Freely supported		Slabs continuous, 50 percent end restraint		Slabs monolithic, 75 per cent end restraint		Fully restrained	
Slab span S, feet	$I=\frac{50}{125+S}$	$M_t=0.01\,PS^2$		$M_t=0.008\,PS^2$		$M_t=0.007\,PS^2$		$M_t=0.005\,PS^2$	
S	I	M_t	$M_t \times (1.0+I)$	M_t	$M_t \times (1.0+I)$	M_t	$M_t \times (1.0+I)$	M_t	$M_t \times (1.0+I)$
2.0	0.394	480	670	385	535	335	470	240	335
2.5	.392	750	1,045	600	835	525	730	375	525
3.0	.391	1,080	1,500	865	1,200	750	1,050	540	750
3.5	.390	1,470	2,040	1,175	1,640	1,030	1,425	735	1,020
4.0	.388	1,920	2,665	1,540	2,125	1,345	1,865	960	1,330
4.5	.386	2,430	3,370	1,945	2,700	1,700	2,365	1,215	1,690
5.0	.385	3,000	4,160	2,400	3,325	2,100	2,910	1,500	2,080
5.5	.383	3,630	5,030	2,900	4,025	2,540	3,515	1,815	2,510
6.0	.382	4,320	5,975	3,465	4,775	3,025	4,185	2,160	2,990
6.5	.380	5,070	7,000	4,065	5,600	3,550	4,900	2,535	3,500
7.0	.379	5,880	8,110	4,700	6,475	4,125	5,675	2,940	4,050
7.5	.377	6,750	9,300	5,400	7,440	4,725	6,510	3,375	4,650
8.0	.376	7,680	10,560	6,140	8,450	5,375	7,400	3,840	5,280

TABLE 5: Live load moments in foot-pounds distributed to edge supports for Case I with U·S·S I-Beam-Lok units laid parallel to direction of traffic.

H-20 loading P = 16,000 pounds

Condition at support		Freely supported		Slabs continuous, 50 percent end restraint		Slabs monolithic, 75 per cent end restraint		Fully restrained	
Slab span S, feet	$I=\frac{50}{125+S}$	$M_t=0.01\,PS^2$		$M_t=0.008\,PS^2$		$M_t=0.007\,PS^2$		$M_t=0.005\,PS^2$	
S	I	M_t	$M_t \times (1.0+I)$	M_t	$M_t \times (1.0+I)$	M_t	$M_t \times (1.0+I)$	M_t	$M_t \times (1.0+I)$
2.0	0.394	640	890	510	710	450	625	320	448
2.5	.392	1,000	1,390	800	1,115	700	975	500	695
3.0	.391	1,440	2,000	1,150	1,600	1,005	1,400	720	1,000
3.5	.390	1,960	2,730	1,560	2,180	1,370	1,905	980	1,365
4.0	.388	2,560	3,550	2,050	2,840	1,795	2,490	1,280	1,775
4.5	.386	3,240	4,500	2,585	3,600	2,265	3,150	1,620	2,250
5.0	.385	4,000	5,540	3,200	4,425	2,800	3,875	2,000	2,770
5.5	.383	4,840	6,700	3,875	5,365	3,390	4,690	2,420	3,350
6.0	.382	5,760	7,970	4,610	6,380	4,040	5,585	2,880	3,990
6.5	.380	6,760	9,340	5,410	7,480	4,740	6,540	3,380	4,670
7.0	.379	7,820	10,800	6,250	8,640	5,480	7,560	3,910	5,400
7.5	.377	9,000	12,400	7,200	9,930	6,300	8,670	4,500	6,200
8.0	.376	10,240	14,080	8,200	11,260	7,175	9,850	5,120	7,040

Case II U·S·S I-Beam-Lok Units Laid Transverse to the Direction of Traffic

The symbols used in the summary of moment formulas for this condition are the same as for Case I.

Positions of wheel load concentrations to produce maximum moment are somewhat different than those for Case I in that for exterior spans the maximum moment per foot width of slab will result from one rear wheel on the center line of spans up to ten feet. On interior spans it will be produced by one rear wheel on center line of span for spans up to 5.14 feet and by two rear wheels spaced 3 feet apart for spans 5.14 feet to 10 feet. Moment factors for these two conditions are given in the summary of formulas, Table 6, below.

Maximum live load moments for interior spans given in tables 7 and 8 are always the greater and therefore have been used in calculating the steel and concrete stresses in load tables on page 67, based on a 75 per cent end restraint condition.

TABLE 6: Summary of moment formulas for Case II

Condition of slab at support	Spans (feet)	Live load moments (in foot-pounds per foot width of slab): Exterior spans	Live load moments (in foot-pounds per foot width of slab): Interior spans	Dead load moment
Freely supported.	0 to 4	$M=\frac{P\sqrt{S}}{9.64}$	$M=\frac{P\sqrt{S}}{9.64}$	$\frac{WS^2}{8}$
	4 to 10	$M=\frac{PS}{2.32S+10}$	$M=\frac{PS}{1.32S+14}$	
Slabs continuous 50 per cent end restraint.	0 to 4	$M=\frac{P\sqrt{S}}{9.64}-0.035P$	$M=\frac{P\sqrt{S}}{9.64}-0.035P$	$\frac{WS^2}{10}$
	4 to 10	$M=\frac{PS}{2.32S+10}-0.035P$	$M=\frac{PS}{1.32S+14}-0.035P$	
Slabs monolithic 75 per cent end restraint.	0 to 4	$M=\frac{P\sqrt{S}}{9.64}-0.0525P$	$M=\frac{P\sqrt{S}}{9.64}-0.0525P$	$\frac{WS^2}{10}$
	4 to 10	$M=\frac{PS}{2.32S+10}-0.0525P$	$M=\frac{PS}{1.32S+14}-0.0525P$	
Fully restrained.	0 to 4	$M=\frac{P\sqrt{S}}{9.64}-0.07P$	$M=\frac{P\sqrt{S}}{9.64}-0.07P$	$\frac{WS^2}{12}$
	4 to 10	$M=\frac{PS}{2.32S+10}-0.07P$	$M=\frac{PS}{1.32S+14}-0.07P$	

TABLE 7: Live load moments in foot-pounds per foot width of slab for Case II with U·S·S I-Beam-Lok Armored units laid transverse to direction of traffic.

H–15 loading

P – 12,000 pounds

Condition at support		Freely supported		Slabs continuous, 50 percent end restraint		Slabs monolithic, 75 percent end restraint		Fully restrained	
Slab span S, feet	$I=\frac{50}{125+S}$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$	M	$M\times(1.0+I)$
2.0	0.394	1,760	2,450	1,340	1,870	1,130	1,575	922	1,285
2.5	.392	1,970	2,740	1,550	2,160	1,340	1,865	1,129	1,571
3.0	.391	2,160	3,005	1,740	2,420	1,530	2,130	1,318	1,835
3.5	.390	2,340	3,250	1,920	2,670	1,710	2,380	1,490	2,070
4.0	.388	2,490	3,460	2,070	2,875	1,860	2,580	1,650	2,290
4.5	.386	2,710	3,755	2,290	3,175	2,080	2,880	1,873	2,595
5.0	.385	2,910	4,030	2,490	3,450	2,280	3,160	2,072	2,870
5.5	.383	3,110	4,300	2,690	3,720	2,480	3,430	2,270	3,140
6.0	.382	3,280	4,530	2,860	3,950	2,650	3,660	2,440	3,370
6.5	.380	3,460	4,770	3,040	4,200	2,830	3,900	2,618	3,610
7.0	.379	3,610	4,980	3,190	4,400	2,980	4,110	2,770	3,820
7.5	.377	3,770	5,185	3,350	4,610	3,140	4,320	2,925	4,030
8.0	.376	3,910	5,380	3,490	4,800	3,280	4,510	3,070	4,220

TABLE 8: Live load moments in foot-pounds per foot width of slab for Case II with U·S·S I-Beam-Lok Armored units laid transverse to direction of traffic.

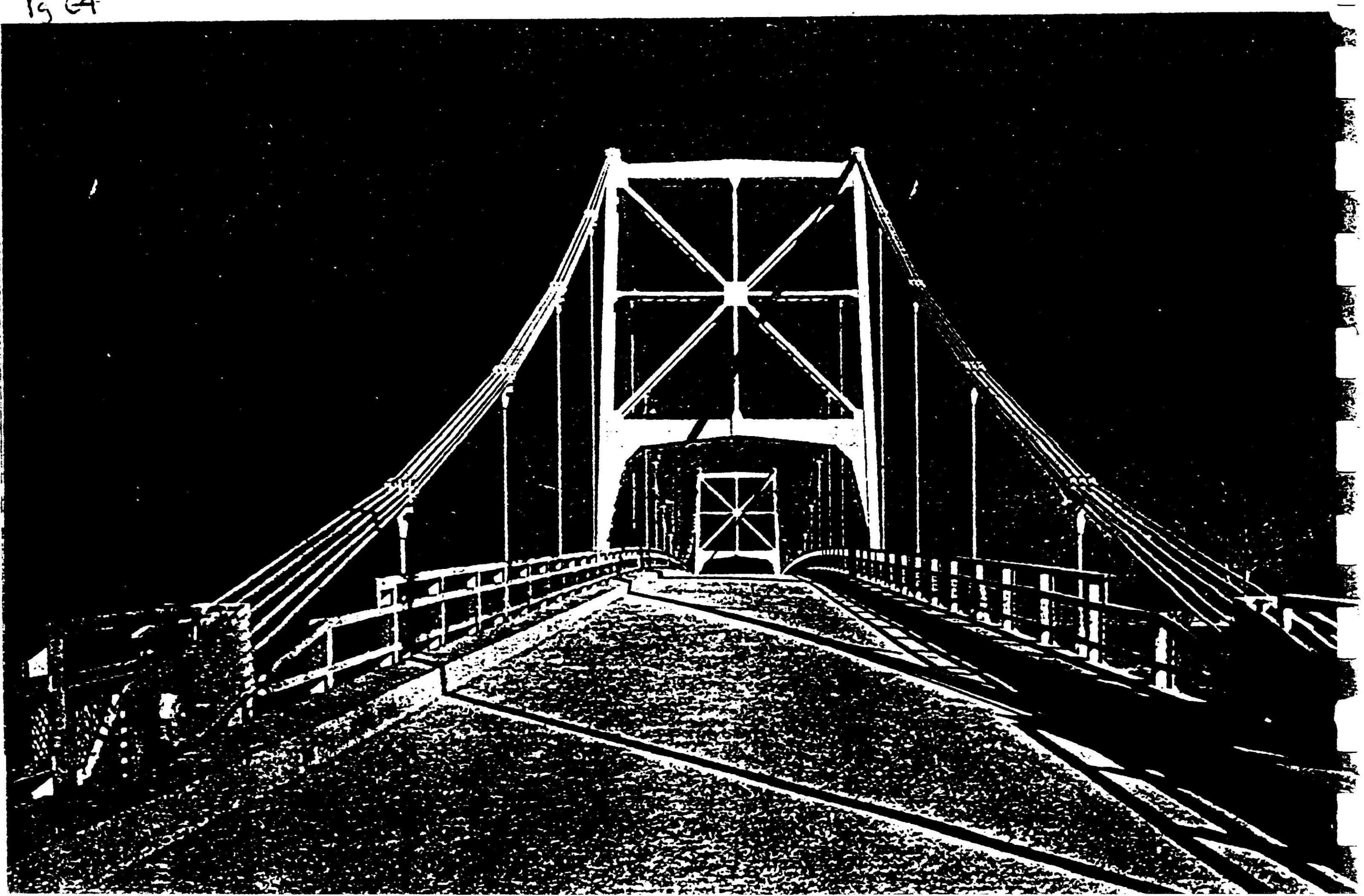
H–20 loading

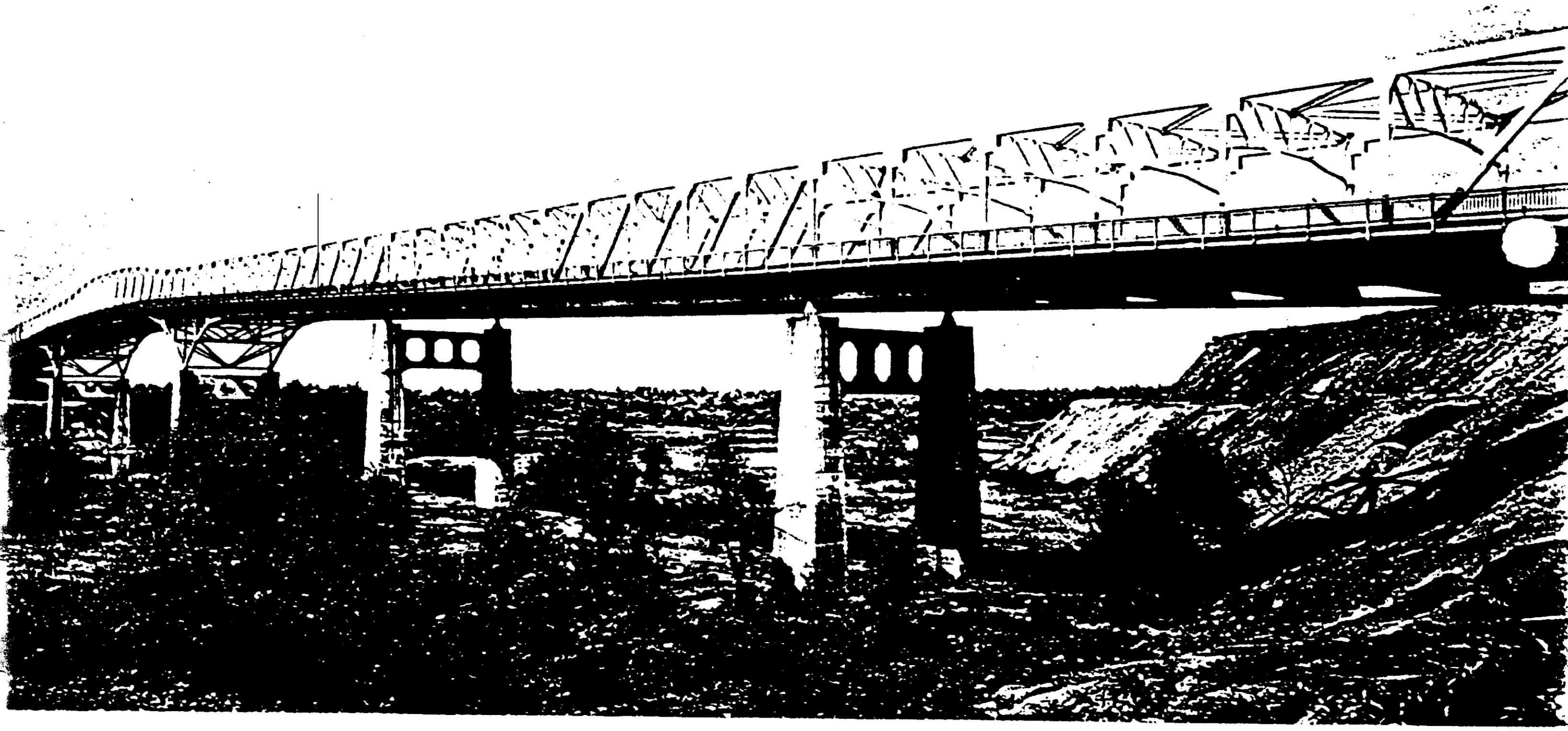
P – 16,000 pounds

Condition at support		Freely supported		Slabs continuous, 50 percent end restraint		Slabs monolithic, 75 percent end restraint		Fully restrained	
Slab span S, feet	$I=\frac{50}{125+S}$	M	$M(1.0+I)$	M	$M(1.0+I)$	M	$M(1.0+I)$	M	$M(1.0+I)$
2.0	0.394	2,340	3,260	1,780	2,480	1,500	2,090	1,230	1,710
2.5	.392	2,620	3,650	2,060	2,870	1,780	2,480	1,505	2,100
3.0	.391	2,880	4,010	2,320	3,230	2,040	2,840	1,760	2,450
3.5	.390	3,110	4,320	2,550	3,540	2,270	3,150	1,985	2,760
4.0	.388	3,320	4,610	2,760	3,830	2,480	3,440	2,200	3,050
4.5	.386	3,610	5,000	3,050	4,230	2,770	3,840	2,497	3,460
5.0	.385	3,880	5,370	3,320	4,600	3,040	4,210	2,765	3,830
5.5	.383	4,150	5,740	3,590	4,970	3,310	4,580	3,028	4,190
6.0	.382	4,380	6,050	3,820	5,280	3,540	4,890	3,250	4,490
6.5	.380	4,610	6,360	4,050	5,590	3,770	5,200	3,490	4,820
7.0	.379	4,820	6,650	4,260	5,880	3,980	5,490	3,690	5,090
7.5	.377	5,030	6,930	4,470	6,160	4,190	5,770	3,900	5,370
8.0	.376	5,210	7,170	4,650	6,400	4,370	6,020	4,090	5,630

Hutsonville Bridge over the Wabash River, Hutsonville, Illinois. Robinson & Steinman, Consulting Engineers. 21,075 sq. ft. 4¼" I-Beam-Lok Armored Floor

fig 64

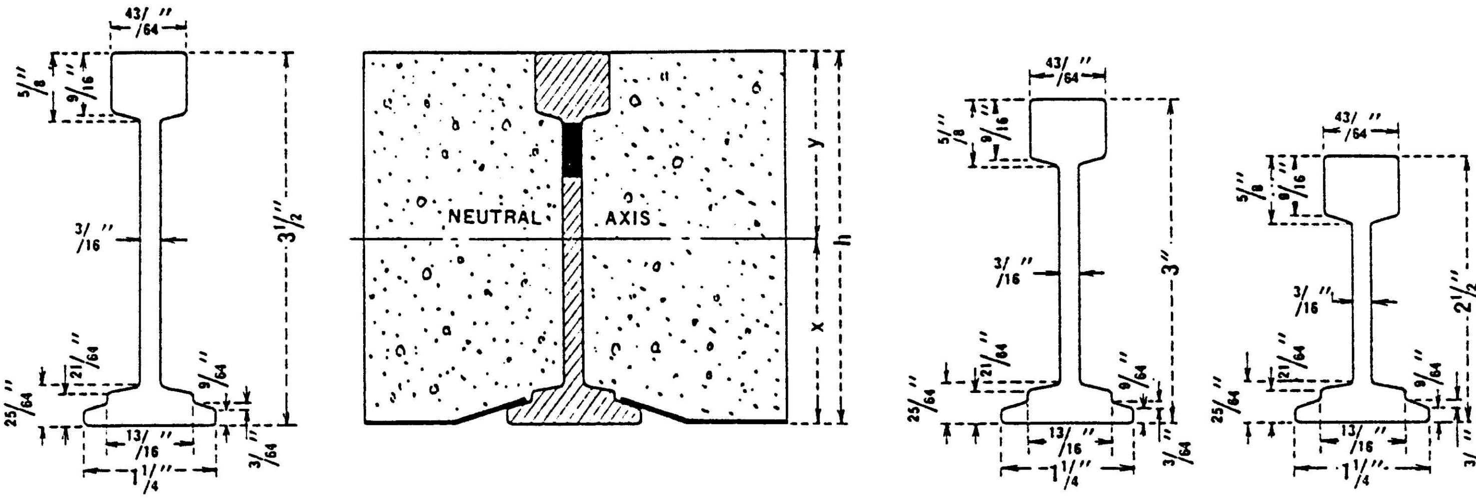




Two views of the East 21st Street Bridge, Lorain, Ohio. Wilbur J. Watson, Consulting Engineer. 72,000 sq. ft. of 4¼″ I-Beam-Lok Armored Floor were used

Pg 65

PROPERTIES OF I-BEAM-LOK ARMORED SLABS



ELEMENTS OF I-BEAM-LOK SLABS

Depth	Average Weight of Steel Per Sq. Ft.	Total Weight of Slab Per Sq. Ft. Ordinary Concrete	I Per Foot of Slab Width	X	Y	Section Modulus Per Foot of Slab Width: Compression Concrete	Section Modulus Per Foot of Slab Width: Tension Steel	Moment
In.	Lbs.	Lbs.	In.⁴	In.	In.	In.³	In.³	
4 1/4"	13.2	55.5	139.9 113.6	2.36 1.67	1.89 2.58	74.0 68.0	3.95 2.93	Positive Negative
3 1/2"	16.5	53.5	107.3 99.5	1.88 1.43	1.62 2.07	66.4 71.5	3.80 3.20	Positive Negative
3"	15.5	47.0	72.5 67.3	1.60 1.23	1.40 1.77	51.8 56.3	3.02 2.54	Positive Negative
2 1/2"	14.4	40.2	45.5 39.9	1.32 1.04	1.18 1.46	38.5 39.8	2.30 1.82	Positive Negative

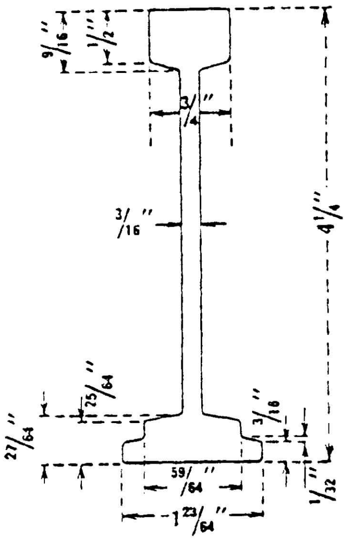
One cubic yard of concrete will fill approximately
- 92 Sq. ft. of 4 1/4" I-Beam-Lok
- 105 Sq. ft. of 3 1/2" I-Beam-Lok
- 124 Sq. ft. of 3" I-Beam-Lok
- 152 Sq. ft. of 2 1/2" I-Beam-Lok

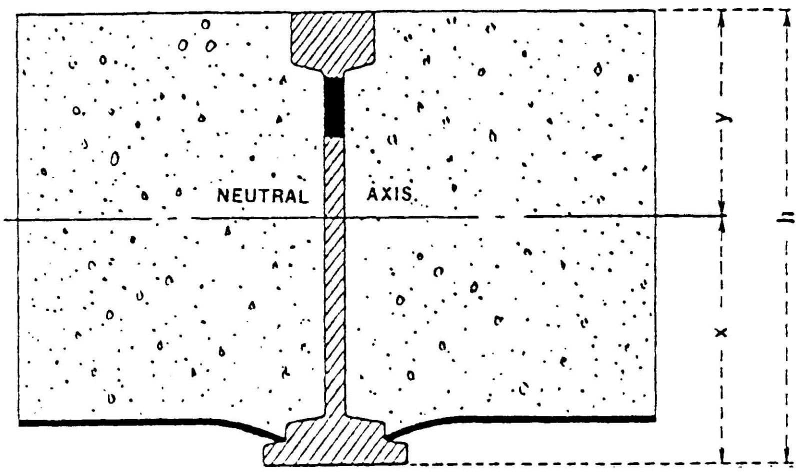
Areas of form strips are not included in computations. Areas of upper slots in I-Beams are deducted. Areas of lower slots are not deducted as they do not occur in zones of maximum stress. Concrete disregarded in tension area. Ratio, n = 15.

Section Modulus of I-Beam-Lok, Steel without concrete 4 1/4" = 2.94 per foot of width.
Section Modulus of I-Beam-Lok, Steel without concrete 3 1/2" = 3.14 per foot of width.
Section Modulus of I-Beam-Lok, Steel without concrete 3" = 2.50 per foot of width.
Section Modulus of I-Beam-Lok, Steel without concrete 2 1/2" = 1.90 per foot of width.

DIMENSIONS OF COMPONENT PARTS

I-BEAM SECTIONS								CROSSBARS		
Depth	Web Thickness	Top Flange: Width	Top Flange: Average Thickness	Bottom Flange: Width	Bottom Flange: Average Thickness	Area	Wt. Per Foot	Top Bar Size	Bottom Bar Size	Form Strips Size
In.	In.	In.	In.	In.	In.	In.²	Lbs.	In.	In.	In. B.W.G.
4 1/4	.188	.75	.525	1.358	.396	1.49	5.1	1 1/16 x 3/16	3/4 x 7/16	4 13/16 x No. 20
3 1/2	.188	.675	.612	1.25	.365	1.25	4.21	1 1/8 x 3/16	1 x 5/16	3 1/16 x No. 20
3	.188	.675	.612	1.25	.365	1.16	3.94	1 1/8 x 3/16	1 x 5/16	3 1/16 x No. 20
2 1/2	.188	.675	.612	1.25	.365	1.07	3.62	1 1/8 x 3/16	3/4 x 7/16	3 1/16 x No. 20





LOAD TABLES FOR CASE 1

Unit Stresses in Steel and Concrete—Without Over-fill . . . In Pounds Per Square Inch
I-Beam-Lok Units Parallel to Direction of Traffic

Span	H-20 Loading								H-15 Loading							
	4 1/4"		3 1/2"		3"		2 1/2"		4 1/4"		3 1/2"		3"		2 1/2"	
	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs
2'-0	340	6385	380	6635	485	8340	650	10920	255	4805	285	4995	365	6275	490	8215
2'-6	420	7885	470	8190	600	10290	805	13470	315	5940	355	6170	450	7745	605	10135
3'-0	500	9355	555	9720	710	12210	955	15980	375	7050	420	7320	535	9190	720	12020
3'-6	575	10750	640	11165	820	14015	1095	18340	435	8105	480	8420	615	10560	825	13805
4'-0	645	12085	720	12555	920	15755			490	9140	545	9490	695	11900	930	15555
4'-6	715	13435	800	13955	1020	17505			540	10155	605	10540	770	13215	1030	17260
5'-0	790	14760	875	15330	1120	19220			595	11175	665	11600	850	14535		
5'-6	855	16035	950	16650					650	12145	720	12605	920	15785		
6'-0	925	17315	1030	17975					700	13155	780	13650	995	17085		
6'-6	990	18515							750	14080	835	14610	1065	18275		
7'-0	1055	19720							800	15015	890	15575				
7'-6	1120	21000							855	15985	950	16580				
8'-0	1180	22130							900	16875	1000	17500				

These tables are figured for 75% end restraint condition for interior spans.

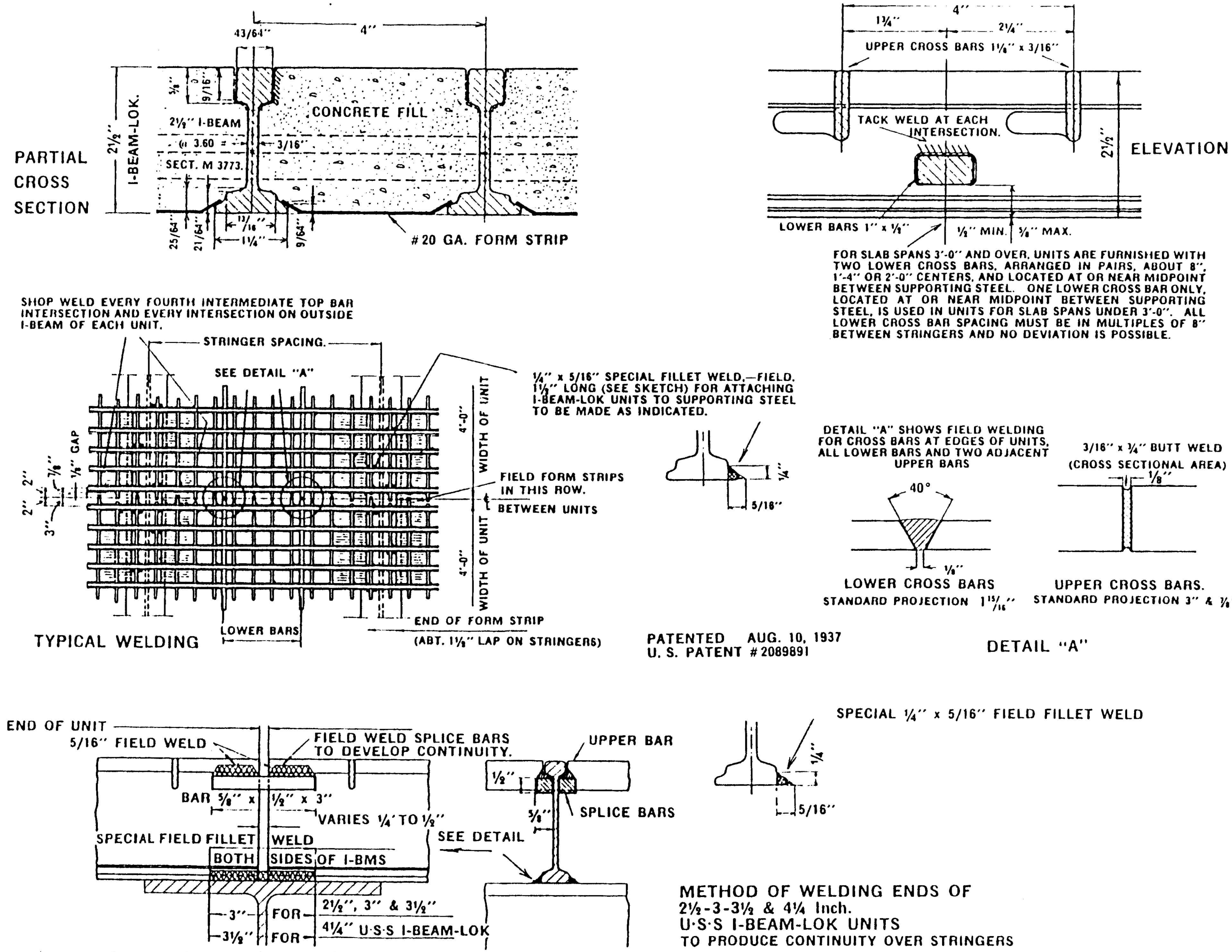
LOAD TABLES FOR CASE 2

Unit Stresses in Steel and Concrete—Without Over-fill . . . In Pounds Per Square Inch
I-Beam-Lok Units Transverse to Direction of Traffic

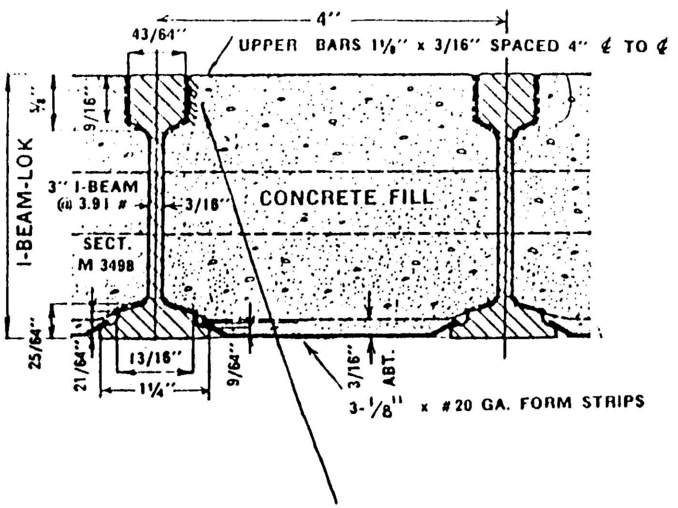
Span	H-20 Loading								H-15 Loading							
	4 1/4"		3 1/2"		3"		2 1/2"		4 1/4"		3 1/2"		3"		2 1/2"	
	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs	fc	fs
2'-0	345	6420	385	6670	490	8380	655	10975	260	4855	290	5040	370	6335	495	8290
2'-6	410	7640	455	7940	580	9970	780	13055	310	5770	345	5995	440	7530	590	9850
3'-0	470	8780	520	9120	670	11455	895	14990	355	6625	395	6880	505	8630	675	11290
3'-6	525	9780	580	10155	745	12745	995	16670	395	7440	440	7725	565	9685	755	12660
4'-0	575	10720	640	11135	815	13970	1090	18260	435	8110	480	8420	615	10550	825	13780
4'-6	640	12010	715	12470	915	15635			485	9090	540	9440	690	11820	925	15435
5'-0	705	13215	785	13720	1005	17195			535	10020	595	10400	760	13025	1020	16995
5'-6	770	14425	860	14975					585	10930	650	11345	830	14195		
6'-0	825	15465	920	16050					625	11725	695	12170	890	15215		
6'-6	880	16510							670	12560	745	13030	950	16285		
7'-0	935	17505							710	13315	790	13810	1005	17250		
7'-6	985	18480							750	14075	835	14595				
8'-0									790	14780	875	15325				

These tables are figured for 75% end restraint condition for interior spans.
Maximum moments for spans up to 4'-0" are identical whether spans are exterior or interior.
Maximum moments for spans over 4'-0" are for interior span condition only.

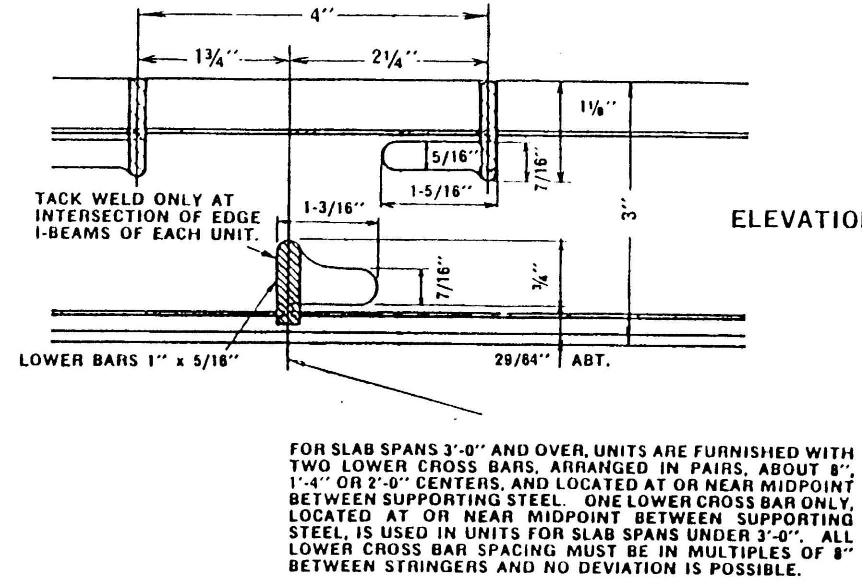
STANDARD 2½" U·S·S I-BEAM-LOK ARMORED FLOOR SLAB



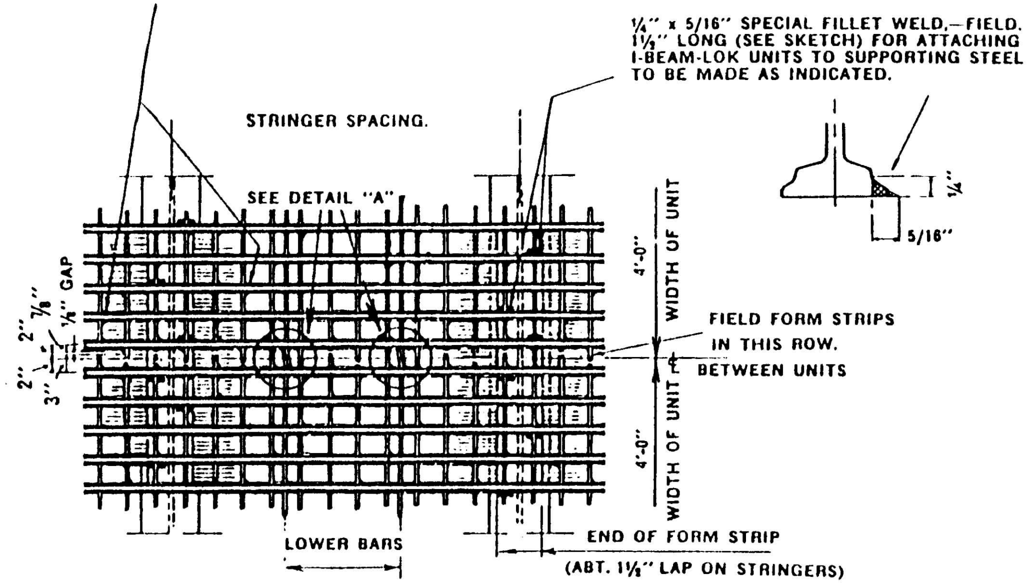
STANDARD 3" U·S·S I-BEAM-LOK ARMORED FLOOR SLAB



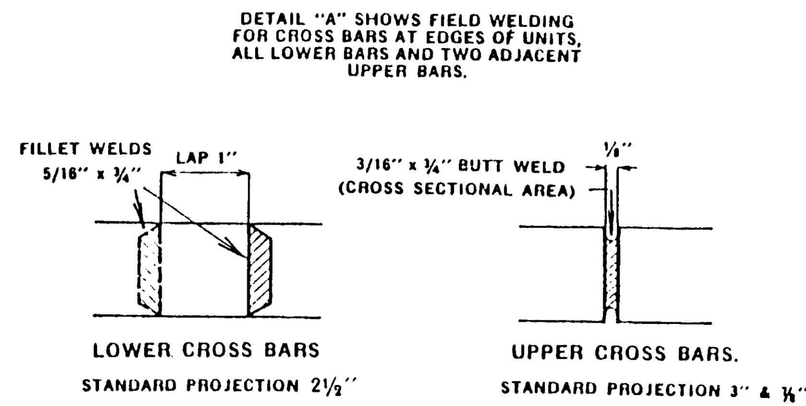
PARTIAL CROSS SECTION



ELEVATION



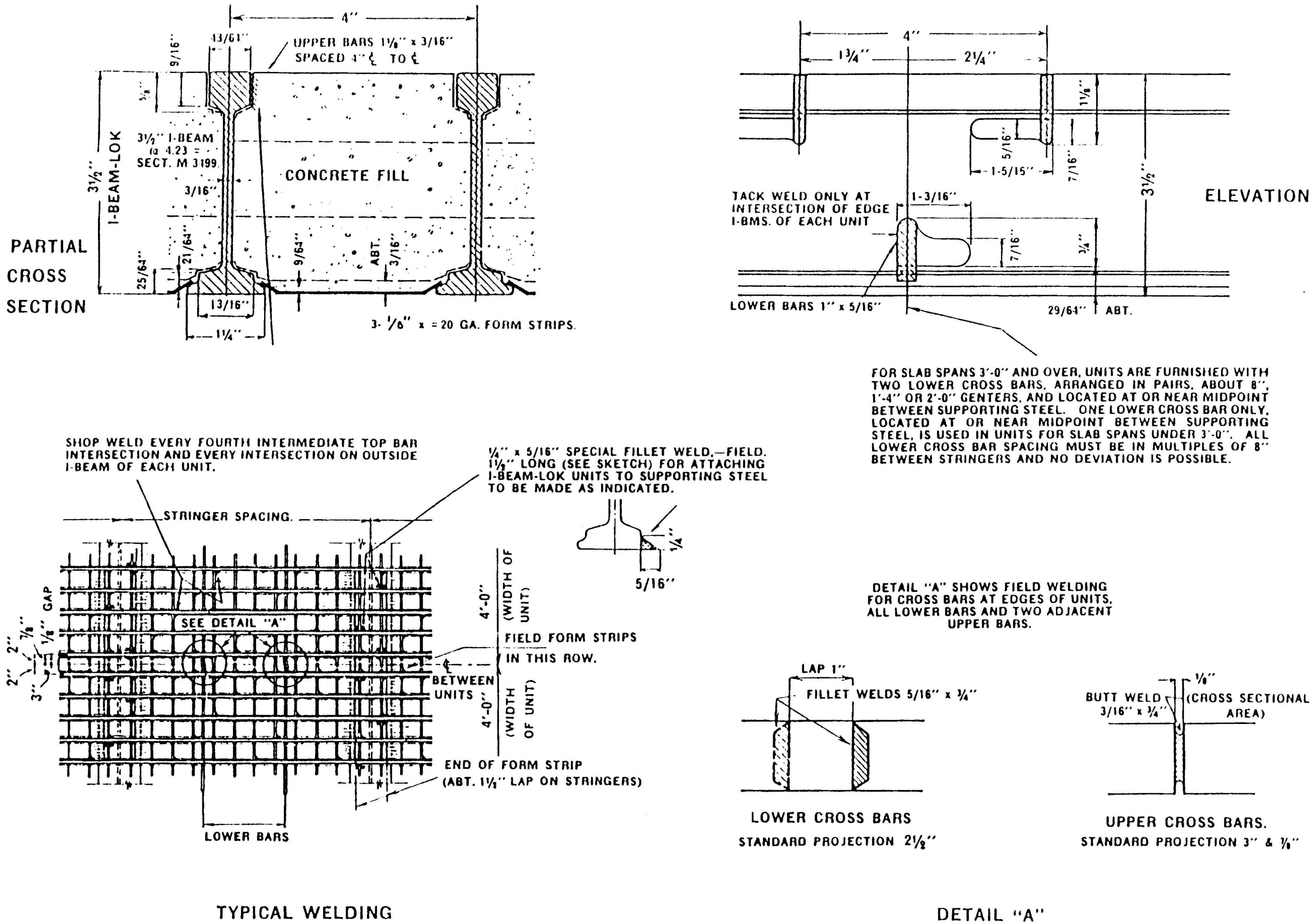
TYPICAL WELDING



DETAIL "A"

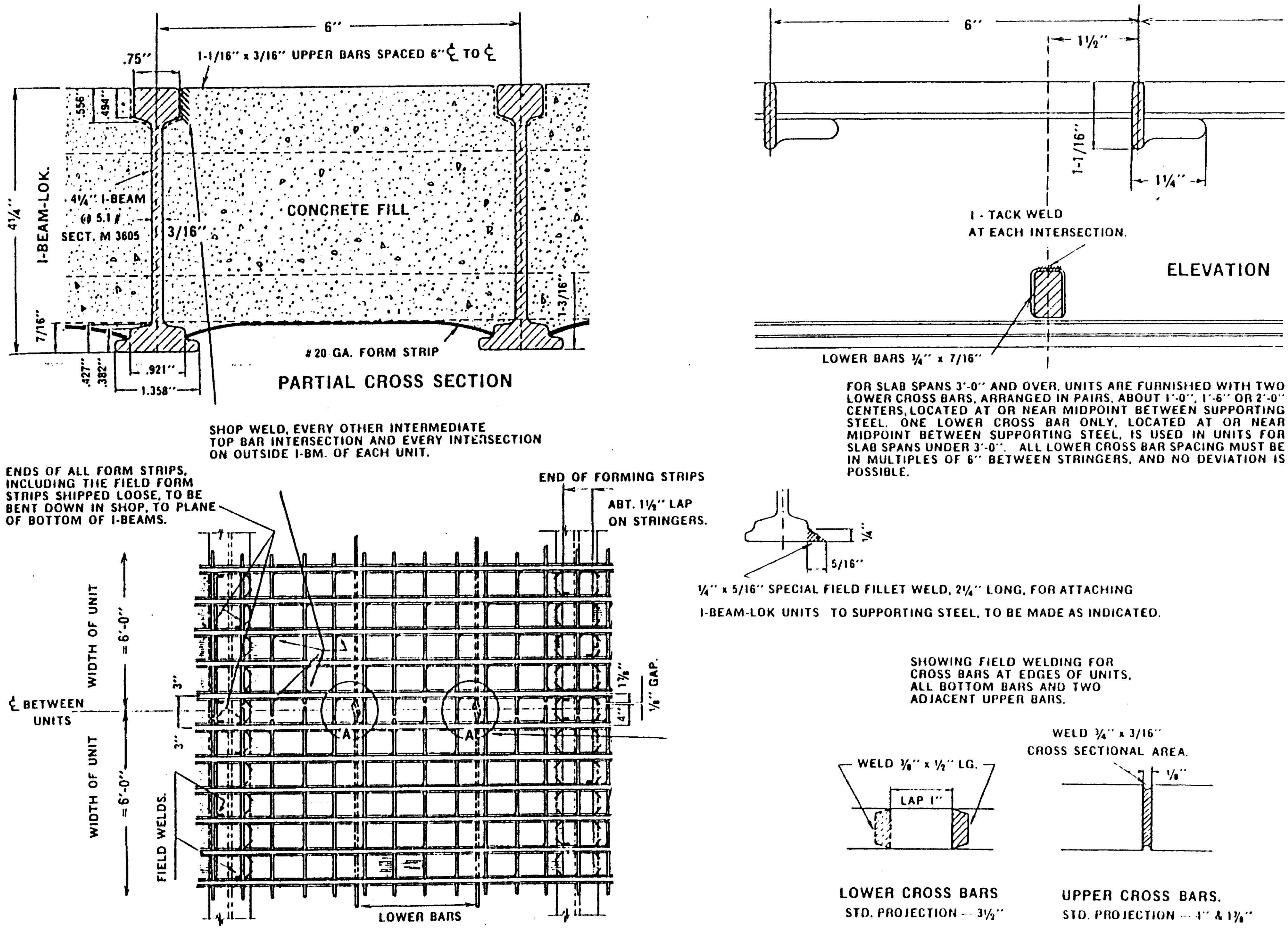
PATENTED AUG. 10, 1937. U. S. PATENT #2089891.

STANDARD 3½" U·S·S I-BEAM-LOK ARMORED FLOOR SLAB



PATENTED AUG. 10, 1937. U. S. PATENT # 2089891

STANDARD —4¼" U S S I-BEAM-LOK ARMORED FLOOR SLAB



PATENTED AUG. 10, 1937, U. S. PATENT #2089891.

Design for Combined T-Beam Action of Steel Stringers and U·S·S I-Beam-Lok Armored Slabs

Stringers are usually proportioned for carrying full live and dead loads without assistance from other component parts of the structure.

U·S·S I-Beam-Lok Armored Slabs permit the concrete to come in direct contact with the stringer flanges and the bottom flanges of the transverse I-Beams may be adequately welded to the stringers. With U·S·S I-Beam-Lok Armored Slabs, the welds may be proportioned so as to resist all horizontal shear between the top flanges of stringers and roadway slabs when they are considered as a composite structure. This warrants full consideration with respect to T-Beam action which will reflect substantial savings in weight of stringers and cost of structures even after considering the extra welding required.

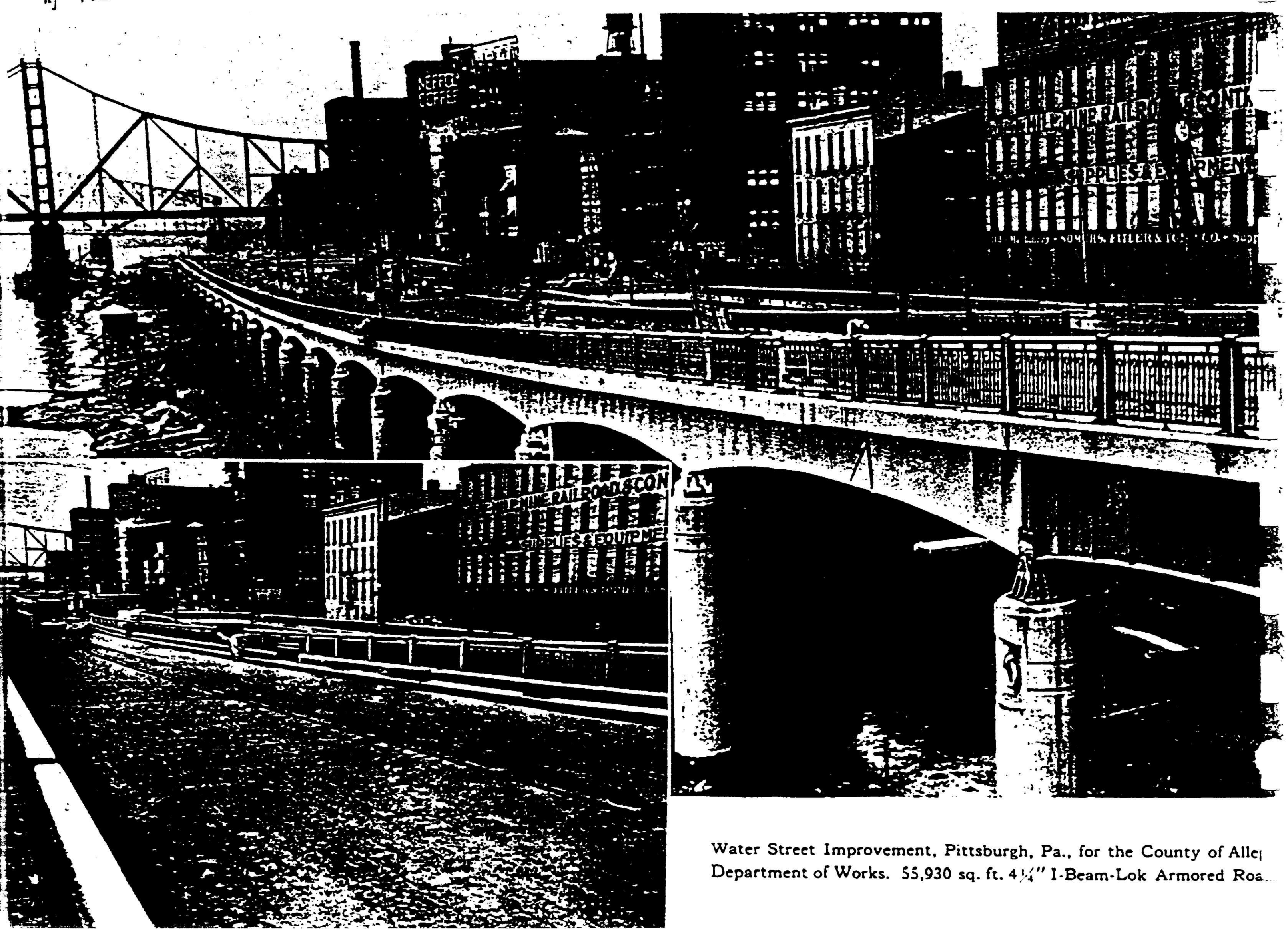
Should the engineer desire to take advantage of this refinement of design, the following procedure is recommended:

1st. Determine the stress in stringer due to dead load only.

2nd. Assume as top flange of the composite T-Beam a width of slab equivalent to 12 times the thickness, but not to exceed ¾ of the stringer spacing for interior stringers or ⅜ of the stringer spacing plus the outside overhang for exterior stringers. Consider that portion of slab which is assumed to act as the top flange to be entirely of concrete and compute properties of composite section by replacing the concrete by the equivalent area of steel, taking $n = 15$.

3rd. Determine stresses in the composite T-Beam due to live load only.

4th. Adjust stringer size and spacing so that the sum of live and dead load stresses does not exceed the maximum allowable values.



Water Street Improvement, Pittsburgh, Pa., for the County of Alle
Department of Works. 55,930 sq. ft. 4¼" I-Beam-Lok Armored Roa

Specifications FOR STEEL UNITS

Description . . . The bridge floor slab shall be composed of U·S·S I-Beam-Lok Armored Bridge Roadway Slab units, as manufactured by Carnegie-Illinois Steel Corporation, consisting of a combination of I-Beams, with metal form strips between and rest- on the projections at the lower edges of the I-Beam flanges, and with rectangular crossbars inserted through slots in the upper and lower portions of the webs of the I-Beams and secured into final positions as shown by manufacturers' standard details. The entire assembly shall be tack welded into rigid units. The depth of the finished floor and the dimensions and weight of the I's and crossbars shall be as shown on the plans. After the units are erected and welded to the supporting members, they shall be filled with concrete and finished flush with the tops of the I-Beams and crossbars to form an armored wearing surface, or finished to a predetermined height above the top of the steel units as specified or shown on the drawings.

Steel Material . . . All steel for the component parts of the bridge floor proper shall be furnished in structural grade of A.S.T.M. standard specification A7, latest revision, and shall have a minimum copper content of 0.20 per cent. All accessories, such as end dams, edge angles, splice bars, clamps, bolts, scuppers, and expansion dam material, may be mild carbon steel stock material at the discretion of the manufacturer. Sheets for form strips shall be regular copper bearing, hot rolled, soft sheet grade.

Fabrication of Steel . . . All steel shall be commercially straight and be assembled in a workmanlike manner. The I-Beams shall be placed 4 inches on centers for the 2½, 3, and 3½-inch depth with 20 gauge form strips between flanges at the bottom to form units approximately 4 feet wide but not exceeding 49 feet long. In the case of 4¼" depth the I-Beams shall be placed 6 inches on centers with 20 gauge form strips between flanges at the bottom to form units approximately 6 feet wide but not exceeding 49 feet long. The form strips are to be placed in short lengths so as to extend only about 1½ inches beyond the edge of each support.

Upper crossbars shall be spaced 4 inches center to center at right angles to the top flanges of the I-Beam in 2½, 3 and 3½-inch depth and 6 inches center to center for 4¼" depth. When the upper crossbars are turned into final position in the slots, the tops of the bars shall be within a tolerance ranging from flush to 1/16" above the tops of the I-Beams. Over-all tolerances on the fabricated units shall be +0 inch to -¼" for length; and +0" to -⅛" for width; and to +½" from specified camber for each twenty-foot length of unit. The upper crossbars shall have the ends projecting through the webs of the outside I-Beams of the units alternately long and short, in order to produce staggered joints between units. Lower crossbars shall be placed, in pairs or singly, at approximately the mid-spans of the slab. See plan of typical arrangement on pages 68 to 71. See note page 56.

Drawings . . . Shop detail drawings shall be furnished by the manufacturer to the purchaser for approval. Erection drawings shall be furnished to the purchaser for use in the field when assembling and erecting slab units.

Field Assembly and Welding . . . U·S·S I-Beam-Lok Armored units shall be placed by the erector at points indicated on the erection diagram, and alternate I-Beams welded to alternate edges of supports, with ¼" x 5/16" special fillet welds of length shown on typical drawing. Where units are placed with I-Beams transverse to the direction of traffic they shall be, if possible, of a length to cover the entire roadway. Otherwise, the ends of I-Beams shall be spliced in accordance with details shown on the plans, or as indicated on page 68 of this booklet. Where the I-Beams in the units are parallel to the direction of traffic, the ends of abutting units shall be spliced as detailed on the plans to provide continuity. Each pair of upper crossbars lying directly above the lower crossbars shall be spliced in the field, to maintain continuous crossbar steel at both top and bottom of the slab in the zone of the lower crossbars. The upper crossbars may be spliced by a weld between the abutting ends, by a horizontal weld laid along a splice bar placed at the side of the crossbar, or by inserting splice bars in the holes adjacent to the upper bars and bending down the ends of the splice bars. These splices are to be made in accordance with details as shown on the drawings. The lower bars must be lapped and welded in the field in accordance with details shown on pages 68 to 71.

During erection care must be exercised to place each unit in the proper position, measuring in all cases to some fixed point. Otherwise a cumulative error in spacing, overrun or underrun, is quite likely to occur, with attendant necessity for either flame cutting the final units or inserting some additional steel to fill up the resulting gap.

The units should be handled in a horizontal position and care taken to see that edges of the units are not permitted to drag or rub over any obstructions and bend the ends of the projecting bars out of position.

Average amount of field welding required to attach 3" and 3½" standard I-Beam-Lok to the supporting steel, including splices on center line between units, according to recommended practice shown on pages 69 and 70.

Units Laid Parallel to Traffic . . . Lineal Inches of Field Weld Per Sq. Ft. of Floor Area*

24'-0 Roadway

Type of Weld	Stringer Spacing												
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-6	5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0
To Stringer ¼"x 5/16"x1½"	1.31	1.05	0.88	0.75	0.66	0.58	0.53	0.48	0.44	0.40	0.38	0.35	0.33
Top Bar 5/16"x¾"	0.156	0.125	0.21	0.179	0.156	0.139	0.125	0.114	0.104	0.096	0.089	0.083	0.078
Bottom Bar 5/16"x¾"	0.156	0.125	0.21	0.179	0.156	0.139	0.125	0.114	0.104	0.096	0.089	0.083	0.078
Total	1.622	1.300	1.30	1.108	0.972	0.858	0.780	0.708	0.648	0.592	0.558	0.516	0.486

30'-0 Roadway

Type of Weld	Stringer Spacing												
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-6	5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0
To Stringer ¼"x 5/16"x1½"	1.32	1.06	0.88	0.76	0.66	0.59	0.53	0.48	0.44	0.41	0.38	0.35	0.33
Top Bar 5/16"x¾"	0.175	0.14	0.23	0.20	0.175	0.156	0.14	0.127	0.117	0.108	0.10	0.093	0.088
Bottom Bar 5/16"x¾"	0.175	0.14	0.23	0.20	0.175	0.156	0.14	0.127	0.117	0.108	0.10	0.093	0.088
Total	1.670	1.34	1.34	1.16	1.010	0.902	0.81	0.734	0.674	0.626	0.58	0.536	0.506

44'-0 Roadway

Type of Weld	Stringer Spacing												
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-6	5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0
To Stringer ¼"x 5/16"x1½"	1.31	1.05	0.88	0.75	0.66	0.58	0.52	0.48	0.44	0.40	0.37	0.35	0.33
Top Bar 5/16"x¾"	0.17	0.136	0.23	0.195	0.17	0.152	0.136	0.124	0.114	0.105	0.098	0.091	0.085
Bottom Bar 5/16"x¾"	0.17	0.136	0.23	0.195	0.17	0.152	0.136	0.124	0.114	0.105	0.098	0.091	0.085
Total	1.65	1.322	1.34	1.140	1.00	0.884	0.792	0.728	0.668	0.610	0.566	0.532	0.500

NOTE: The average amount of field welding for standard 2½" U·S·S I-Beam-Lok is practically the same as shown in the above tables. It is identical, except for the bottom crossbar welding which is a V-weld instead of 5/16" x ¾" fillets.

* These quantities do not include field welding for end joint splices, as detailed on page 68, and the following average amounts for the corresponding lengths of units should be added to the quantities shown in above tables, and also apply to welding quantities for 2½" I-Beam-Lok:

24' to 26' Lengths of Units — 1.33 lineal inches per sq. ft. of floor area
35' to 36' Lengths of Units — 0.95 lineal inches per sq. ft. of floor area
45' to 49' Lengths of Units — 0.71 lineal inches per sq. ft. of floor area

Average amount of field welding required to attach 3" and 3½" standard I-Beam-Lok to the supporting steel, including splices on center line between units, according to recommended practice shown on pages 69 and 70.

Units Laid Transverse to Traffic . . . Unit Length Equal to Roadway Width
Lineal Inches of Field Weld Per Sq. Ft. of Floor Area

24'-0 Roadway

Type of Weld	Stringer Spacing											
	2'-0	2'-6	3'-0	3'-8	4'-0	4'-6	5'-0	5'-6	6'-0	6'-6	7'-4	8'-0
To Stringer ¼"x 5/16"x1½"	1.31	1.10	0.99	0.77	0.77	0.66		0.55	0.55		0.44	0.44
Top Bar 5/16"x¾"	0.17	0.14	0.25	0.19	0.19	0.16		0.13	0.13		0.10	0.10
Bottom Bar 5/16"x¾"	0.17	0.14	0.25	0.19	0.19	0.16		0.13	0.13		0.10	0.10
Total	1.65	1.38	1.49	1.15	1.15	0.98		0.81	0.81		0.64	0.64

30'-0 Roadway

Type of Weld	Stringer Spacing											
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-8	5'-0	5'-8	6'-0	6'-6	7'-0	7'-6
To Stringer ¼"x 5/16"x1½"	1.31	1.14	0.96	0.79	0.70	0.61	0.61	0.53	0.53		0.44	0.44
Top Bar 5/16"x¾"	0.175	0.150	0.25	0.20	0.175	0.15	0.15	0.125	0.125		0.10	0.10
Bottom Bar 5/16"x¾"	0.175	0.150	0.25	0.20	0.175	0.15	0.15	0.125	0.125		0.10	0.10
Total	1.660	1.440	1.46	1.19	1.050	0.91	0.91	0.780	0.780		0.64	0.64

44'-0 Roadway

Type of Weld	Stringer Spacing											
	2'-0	2'-6	3'-0	3'-6	4'-0	4'-8	5'-3	5'-6	6'-0	6'-6	7'-0	
To Stringer ¼"x 5/16"x1½"	1.31	1.07	0.90	0.78	0.72	0.60	0.54	0.54	0.48		0.42	
Top Bar 5/16"x¾"	0.179	0.145	0.24	0.20	0.187	0.153	0.136	0.136	0.12		0.10	
Bottom Bar 5/16"x¾"	0.179	0.145	0.24	0.20	0.187	0.153	0.136	0.136	0.12		0.10	
Total	1.668	1.360	1.38	1.18	1.094	0.906	0.812	0.812	0.72		0.62	

NOTE: The average amount of field welding for standard 2½" U·S·S I-Beam-Lok is practically the same as shown in the above tables. It is identical, except for the bottom crossbar welding which is a V-weld instead of 5/16" x ¾" fillets.

Average amount of field welding required to attach 4¼″ standard I-Beam-Lok to the supporting steel, including splices on center line between units, according to recommended practice shown on page 71.

Units Laid Parallel to Traffic . . . Lineal Inches of Field Weld Per Sq. Ft. of Floor Area*

24′-0 Roadway

Type of Weld	Stringer Spacing												
	2′-0	2′-6	3′-0	3′-6	4′-0	4′-6	5′-0	5′-6	6′-0	6′-6	7′-0	7′-6	8′-0
To Stringer ¼″x5/16″x2¼″	1.31	1.05	0.88	0.75	0.66	0.58	0.53	0.48	0.44	0.40	0.38	0.35	0.33
Top Bar 3/16″x¾″	0.094	0.075	0.125	0.107	0.094	0.083	0.075	0.068	0.063	0.058	0.054	0.050	0.047
Bottom Bar ⅜″x½″	0.063	0.050	0.083	0.071	0.063	0.056	0.050	0.046	0.042	0.038	0.036	0.033	0.031
Total	1.467	1.175	1.088	0.928	0.817	0.719	0.655	0.594	0.545	0.496	0.470	0.433	0.408

30′-0 Roadway

Type of Weld	Stringer Spacing												
	2′-0	2′-6	3′-0	3′-6	4′-0	4′-6	5′-0	5′-6	6′-0	6′-6	7′-0	7′-6	8′-0
To Stringer ¼″x5/16″x2¼″	1.31	1.05	0.885	0.750	0.66	0.58	0.53	0.48	0.44	0.40	0.38	0.35	0.33
Top Bar 3/16″x¾″	0.10	0.08	0.133	0.114	0.10	0.089	0.080	0.073	0.067	0.062	0.057	0.053	0.050
Bottom Bar ⅜″x½″	0.067	0.053	0.089	0.076	0.067	0.059	0.053	0.049	0.045	0.041	0.038	0.036	0.033
Total	1.477	1.183	1.107	0.940	0.827	0.728	0.663	0.602	0.552	0.503	0.475	0.439	0.413

44′-0 Roadway

Type of Weld	Stringer Spacing												
	2′-0	2′-6	3′-0	3′-6	4′-0	4′-6	5′-0	5′-6	6′-0	6′-6	7′-0	7′-6	8′-0
To Stringer ¼″x5/16″x2¼″	1.31	1.04	0.87	0.75	0.65	0.58	0.52	0.48	0.44	0.40	0.37	0.35	0.33
Top Bar 3/16″x¾″	0.12	0.096	0.16	0.14	0.12	0.11	0.096	0.087	0.080	0.074	0.068	0.064	0.060
Bottom Bar ⅜″x½″	0.08	0.064	0.106	0.091	0.080	0.071	0.064	0.058	0.053	0.049	0.046	0.043	0.040
Total	1.51	1.200	1.136	0.981	0.850	0.761	0.680	0.625	0.573	0.523	0.484	0.457	0.430

* These quantities do not include field welding for end joint splices, as detailed on page 68, and the following average amounts for the corresponding lengths of units should be added to the quantities shown in the above tables:

24′ to 26′ Lengths of Units — 0.93 lineal inches per sq. ft. of floor area
35′ to 36′ Lengths of Units — 0.66 lineal inches per sq. ft. of floor area
45′ to 49′ Lengths of Units — 0.50 lineal inches per sq. ft. of floor area

Average amount of field welding required to attach 4¼″ standard I-Beam-Lok to the supporting steel, including splices on center line between units, according to recommended practice shown on page 71.

Units Laid Transverse to Traffic . . . Unit Length Equal to Roadway Width Lineal Inches of Field Weld Per Sq. Ft. of Floor Area

24′-0 Roadway

Type of Weld	Stringer Spacing											
	2′-0	2′-6	3′-0	3′-8	4′-0	4′-6	5′-0	5′-6	6′-0	6′-6	7′-4	8′-0
To Stringer ¼″x5/16″x2¼″	1.31	1.10	0.99	0.77	0.77	0.66		0.55	0.55		0.44	0.44
Top Bar 3/16″x¾″	0.11	0.09	0.17	0.13	0.13	0.11		0.08	0.08		0.06	0.06
Bottom Bar ⅜″x½″	0.08	0.06	0.10	0.09	0.09	0.07		0.05	0.05		0.04	0.04
Total	1.50	1.25	1.26	0.99	0.99	0.84		0.68	0.68		0.54	0.54

30′-0 Roadway

Type of Weld	Stringer Spacing											
	2′-0	2′-6	3′-0	3′-6	4′-0	4′-8	5′-0	5′-8	6′-0	6′-6	7′-0	7′-6
To Stringer ¼″x5/16″x2¼″	1.31	1.14	0.97	0.79	0.70	0.61	0.61	0.53	0.53		0.44	0.44
Top Bar 3/16″x¾″	0.117	0.10	0.167	0.133	0.117	0.10	0.10	0.083	0.083		0.067	0.067
Bottom Bar ⅜″x½″	0.078	0.07	0.111	0.089	0.078	0.067	0.067	0.056	0.056		0.045	0.045
Total	1.505	1.31	1.248	1.012	0.895	0.777	0.777	0.669	0.669		0.552	0.552

44′-0 Roadway

Type of Weld	Stringer Spacing											
	2′-0	2′-6	3′-0	3′-6	4′-0	4′-8	5′-3	5′-6	6′-0	6′-6	7′-0	
To Stringer ¼″x5/16″x2¼″	1.31	1.07	0.90	0.78	0.72	0.60	0.54	0.54	0.48		0.42	
Top Bar 3/16″x¾″	0.12	0.097	0.16	0.136	0.125	0.102	0.091	0.091	0.080		0.068	
Bottom Bar ⅜″x½″	0.08	0.064	0.106	0.091	0.083	0.068	0.061	0.061	0.053		0.046	
Total	1.51	1.231	1.166	1.007	0.928	0.770	0.692	0.692	0.613		0.534	

Specifications FOR CONCRETE

Experience gained with the installation of light-weight armored floors indicates that concrete placed under intelligent supervision is of the utmost importance. It is suggested that the following specifications be used for securing best results:

Proportions . . . The concrete shall be composed of one (1) part of Portland cement and five (5) parts of fine and coarse aggregate approximating a 1:2:3 mix proportioned as follows: One (1) part of Portland cement, not more than two (2) parts of fine aggregate and not less than three (3) parts of coarse aggregate. The design of the concrete mixture should be such as to produce a smooth flowing 3,000 pound concrete having the specified slump.

Fine Aggregate . . . Sand shall consist of clean, hard, durable, uncoated grains, free from injurious amounts of dust, lumps of clay, organic matter, loam or other deleterious substances.

The grading shall be from fine to coarse with the coarser particles predominating. After being thoroughly dried, the sand shall meet the following requirements by weight:

Three-eighths (3/8) inch screen circular opening passing	100 per cent
No. 4 Sieve passing	85 to 100 per cent
No. 16 Sieve passing	45 to 80 per cent
No. 50 Sieve passing	5 to 30 per cent
No. 100 Sieve passing	0 to 6 per cent
Clay and silt removed by decantation test	Not over 3 per cent
Coal	Not over 2 per cent

Coarse Aggregate . . . Gravel or crushed stone shall be graded 3/8″ to 3/4″, 95 to 100 per cent passing 3/4″ mesh and 0 to 8 per cent passing 3/8″ mesh.

Gravel . . . Gravel shall be clean, washed, free from clay or coating of any character and shall be tough and durable. Flat or elongated particles, soft stone, or shell or run of the bank gravel will not be permitted.

Crushed Stone . . . Crushed stone, if used as the coarse aggregate, shall be clean, sound, of uniform quality, and free from thin and elongated pieces. If obtained from gravel, only that portion shall be crushed which has been retained upon a screen with 2″ or larger openings.

Water . . . The amount of water for mixing shall be approximately 5 to 6 gallons, including the surface water in the aggregate, for each sack of cement weighing 94 pounds. The amount of water used shall be limited in order to produce a slump of 3 inches and not to exceed 4 inches.

Mixing . . . The mixer shall not be charged until it is entirely emptied of the previous batch. Rotation of mixer shall be 18 to 20 revolutions per minute. Timing shall not begin until all materials, including water, are in mixer, and shall continue for at least 1 1/2 minutes if mixer is equipped with automatic discharge lever locking time device, or 2 minutes if mixer is not so equipped. No concrete shall be used which has been left in the drum of the mixer more than 10 minutes after the water has been added.

Pouring or Placing . . . The concrete from the mixer shall be deposited uniformly in the U·S·S I-Beam-Lok Armored Floor units to a height of at least 1 1/4 inches above the top of the steel, or the top of the plane of the finished surface. It shall then be vibrated until all material is well settled and in close contact with the steel. Vibrating shall not be carried to the point where excess fines and/or water are brought to the surface. After vibrating there must be at least 1/2″ of concrete remaining above the top of the steel or above the top of the level of the finished surface. The concrete shall then be screeded to a uniform surface so that the top surface is roughly 1/8 to 1/4″ above the level of the top of the steel or in cases where over-fill is specified, the screeding shall be to the level of the finished surface of the slab. A slight over-fill of from 1/8″ to 1/4″ above the top of the steel is required to assure that the top of the finished concrete surface will not be below the steel due to subsequent settlement and shrinkage while setting and curing.

The vibrating should preferably be done by rapid impact on the I-Beams by means of a light jack-hammer or paving breaker with a blunt ended tool hammering against a small distributor plate or angle in contact with the I-Beams. The concrete may also be vibrated by means of a heavy small area vibrating platform moved over the surface of the concrete.

If concrete is poured at a time when the temperature is 40° F. or lower, special care shall be taken to prevent freezing. The steel floor as well as the concrete shall be preheated to a temperature of 70° F.

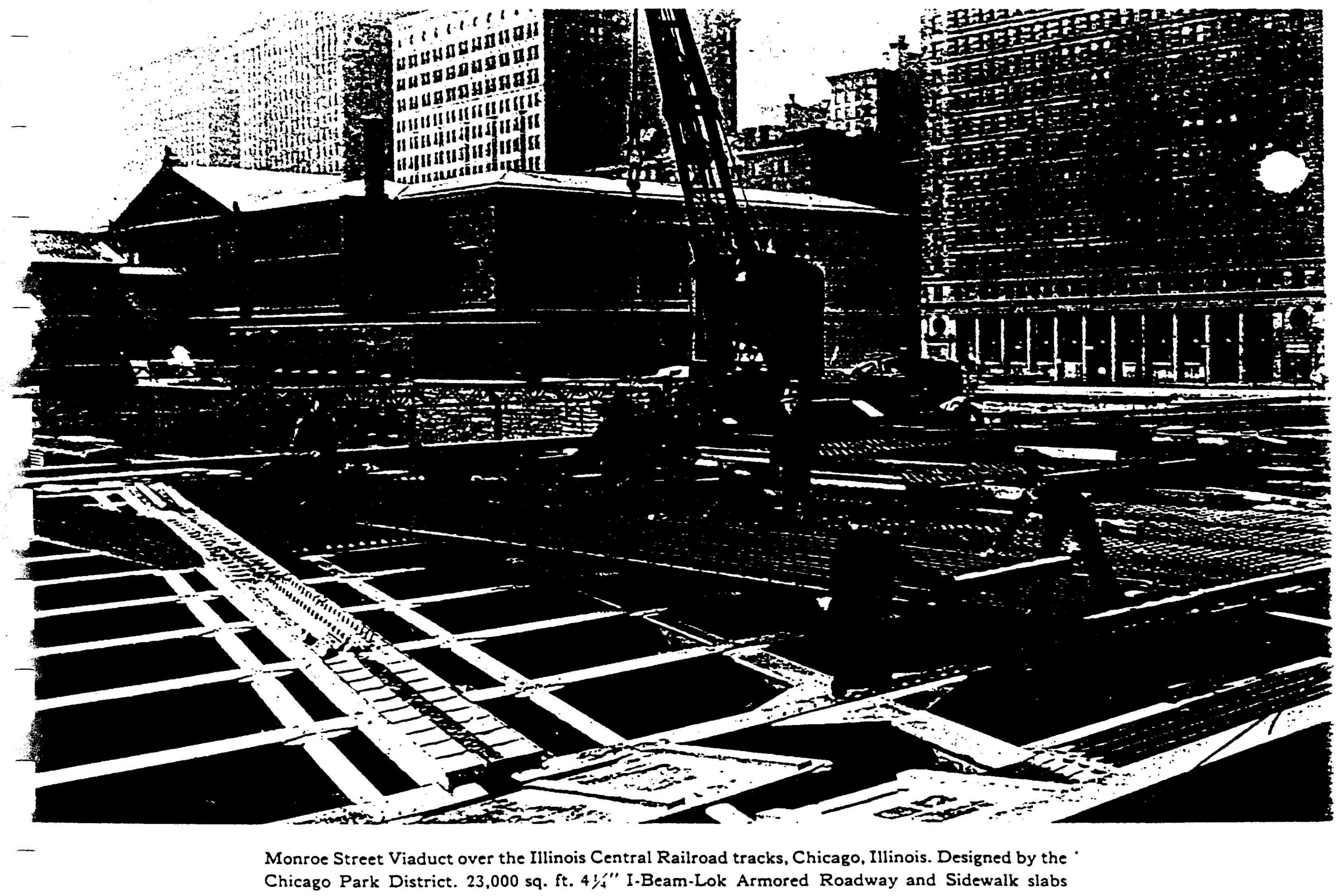
The contractor when so ordered by the engineer shall furnish and maintain a sufficient number of steam coils or other suitable heating devices together with tarpaulin to supply an adequate amount of moist heat.

Finishing . . . Float at once, bringing surface to proper level as quickly as possible and then avoid further work, being particularly careful to avoid unnecessary lateral movement of the mixture at the surface. Do not attempt to secure a smooth finish by floating the finer aggregate to the surface. Allow as much coarse aggregate as possible to remain at the top which will immediately become part of the wearing surface.

Curing . . . The slab shall be cured by means of a double thickness of burlap spread over the entire surface and kept moist during the entire curing period, or by other means at the discretion of the engineer, such as emulsified asphalt sprayed on immediately after concrete is placed.

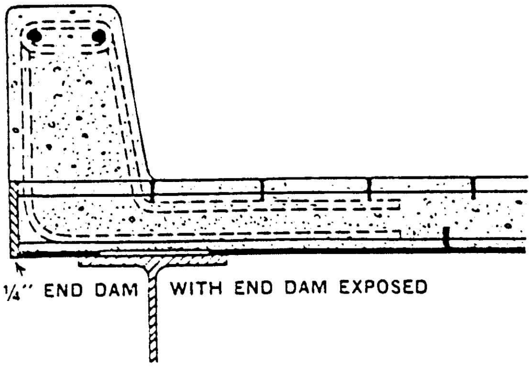
VOLUME OF CONCRETE REQUIRED TO FILL STANDARD U-S-S I-BEAM-LOK ARMORED UNITS FLUSH WITH TOP OF STEEL (NET VOLUME AFTER DEDUCTING CONCRETE DISPLACED BY STEEL)

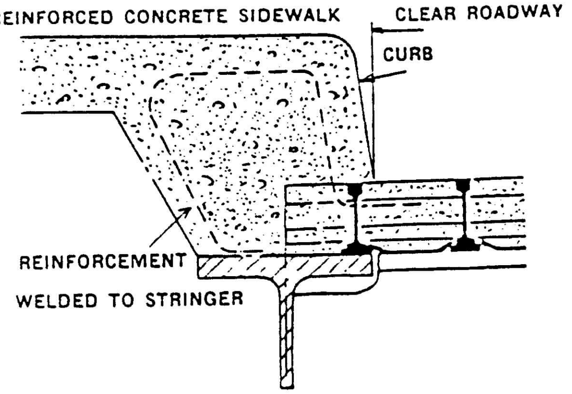
Depth of I-Beam-Lok	2½″	3″	3½″	4¼″
Cubic Feet Per Sq. Ft.	.178	.218	.258	.296
One Cu. Yd. Fills	152 sq. ft.	124 sq. ft.	105 sq. ft.	92 sq. ft.



Monroe Street Viaduct over the Illinois Central Railroad tracks, Chicago, Illinois. Designed by the Chicago Park District. 23,000 sq. ft. 4¼″ I-Beam-Lok Armored Roadway and Sidewalk slabs

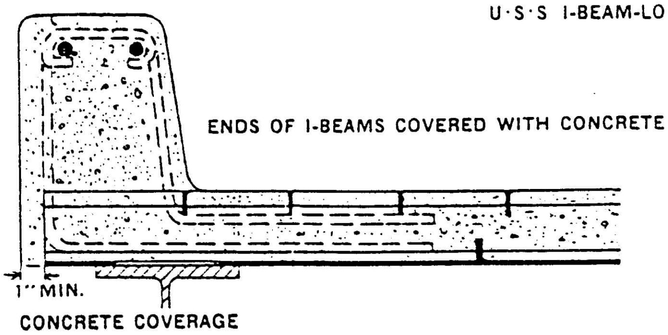
U·S·S I-BEAM-LOK ARMORED FLOOR

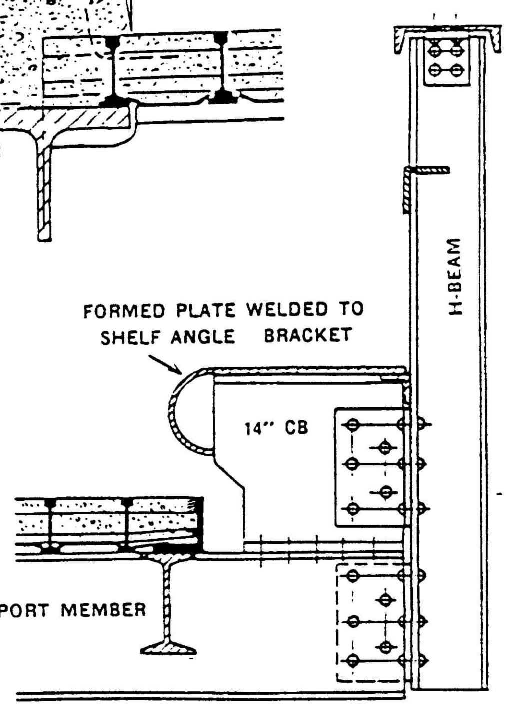




TREATMENT AT CURB

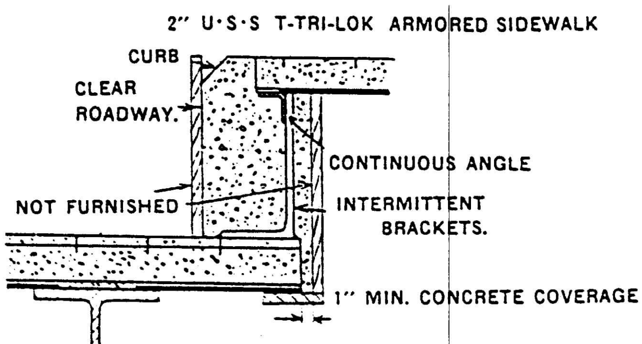
U·S·S I-BEAM-LOK ARMORED FLOOR

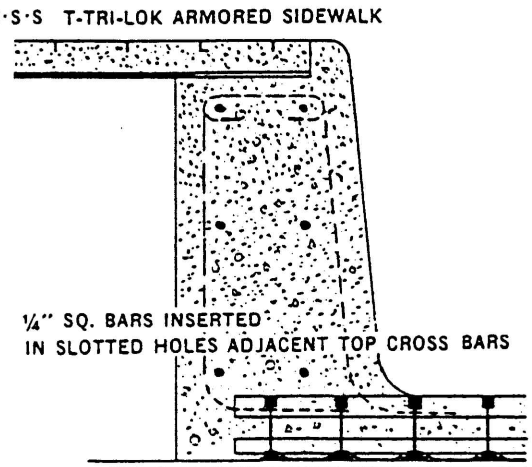




TREATMENT AT CURB

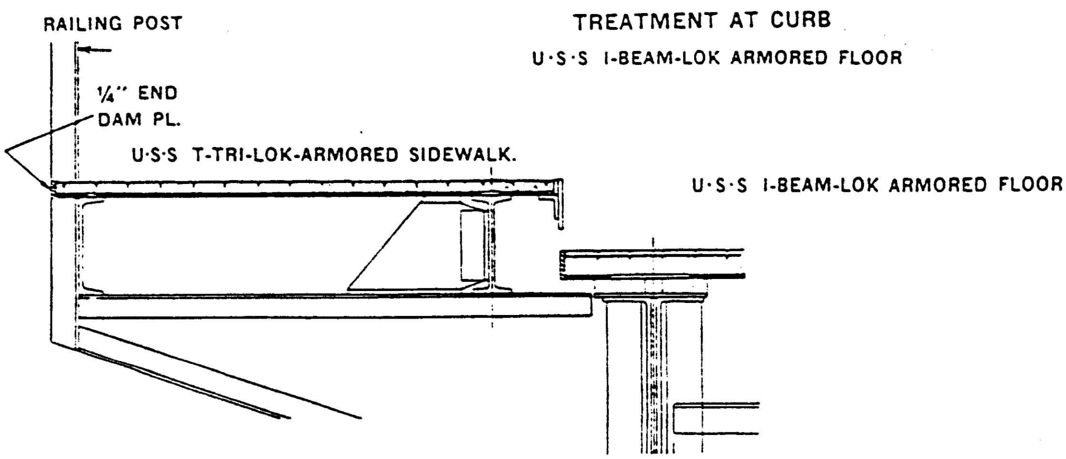
U·S·S I-BEAM-LOK ARMORED FLOOR



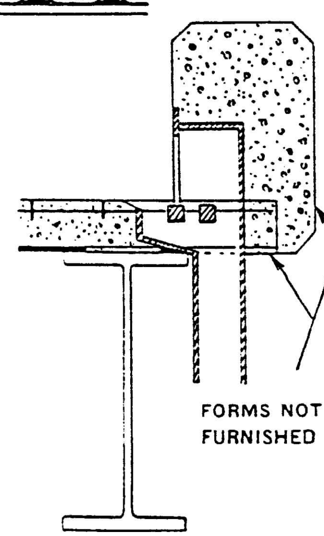


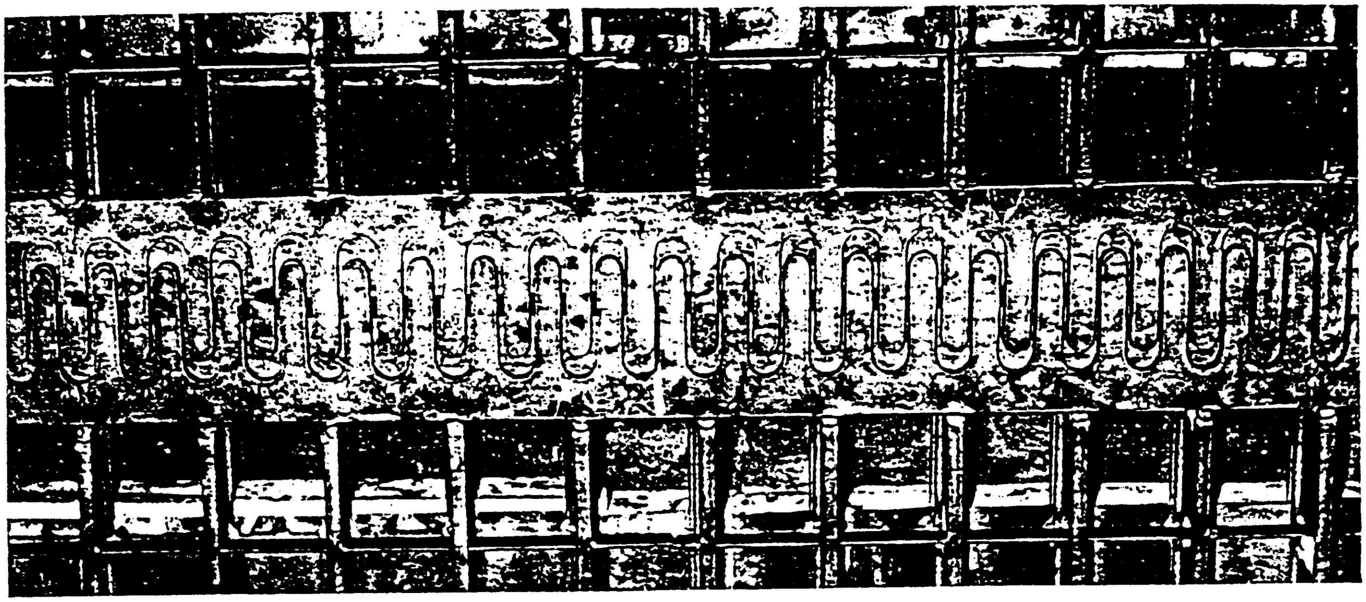
TREATMENT AT CURB

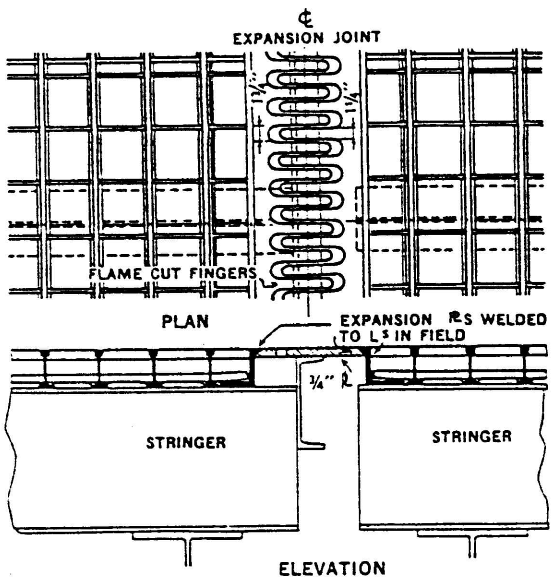
U·S·S I-BEAM-LOK ARMORED FLOOR

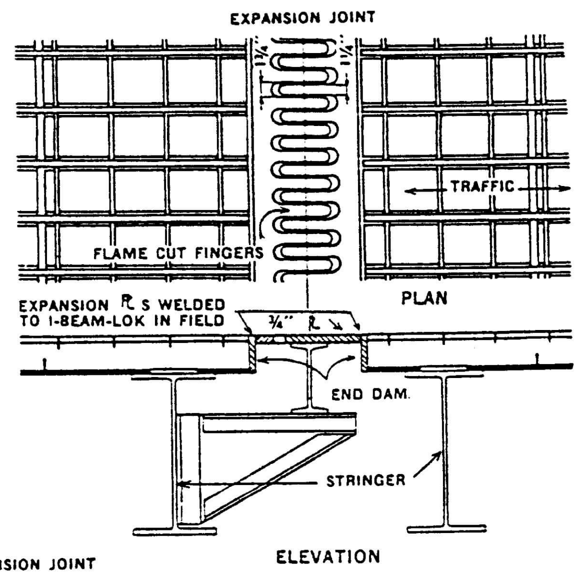


TYPICAL SECTION THRU SIDEWALK AND CURB

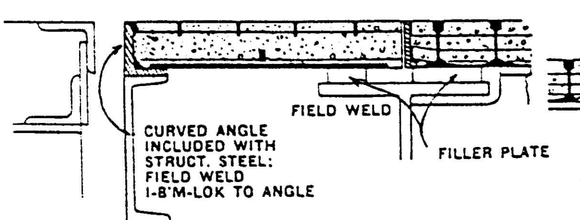




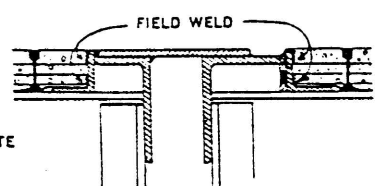




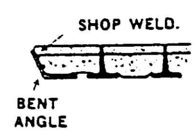
FINGER TYPE EXPANSION JOINT
U·S·S I-BEAM-LOK ARMORED FLOOR



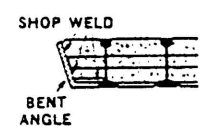
AT CURVED END OF SWING SPAN



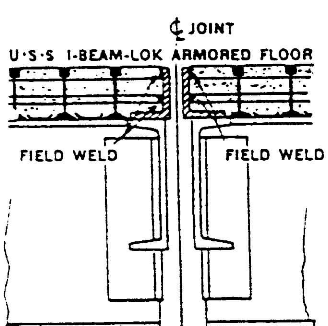
EXPANSION JOINT



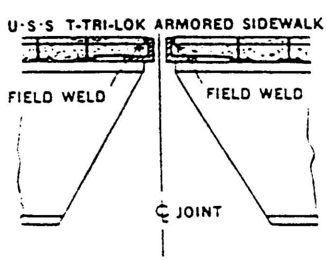
TYPICAL END
FOR SIDEWALK
ON LIFT SPAN



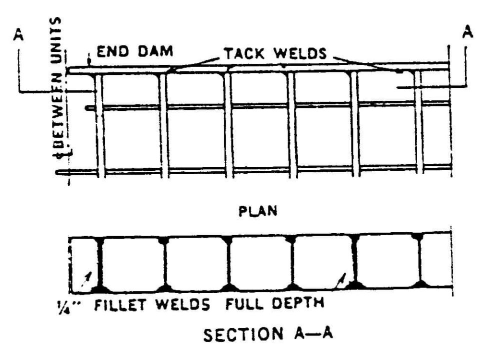
TYPICAL END
FOR FLOORING
ON LIFT SPAN



TYPICAL JOINT FOR FLOORING
ON LIFT SPAN

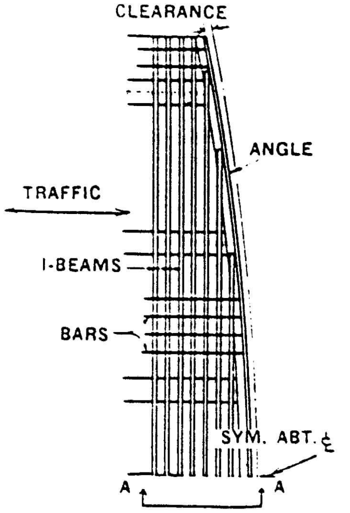


TYPICAL JOINT FOR SIDEWALK
ON LIFT SPAN

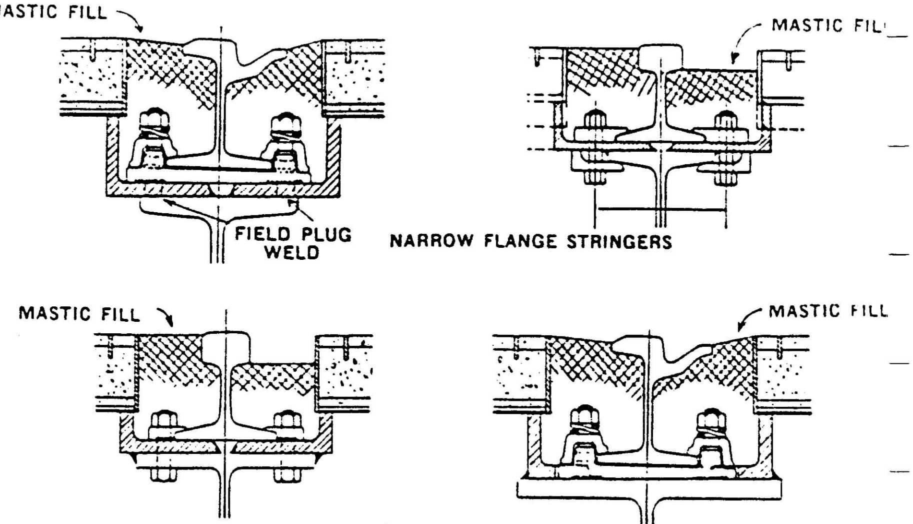


TYPICAL SHOP WELDING OF END DAMS

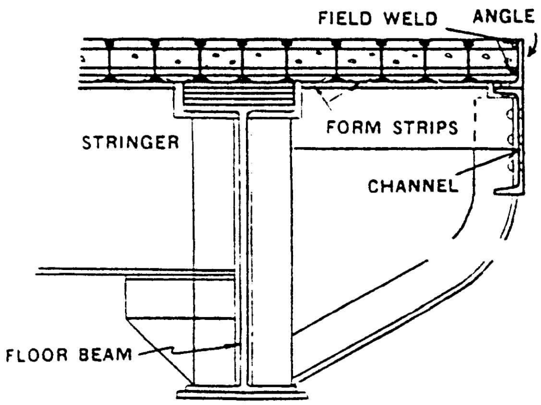
U·S·S I-BEAM-LOK ARMORED FLOOR



PLAN



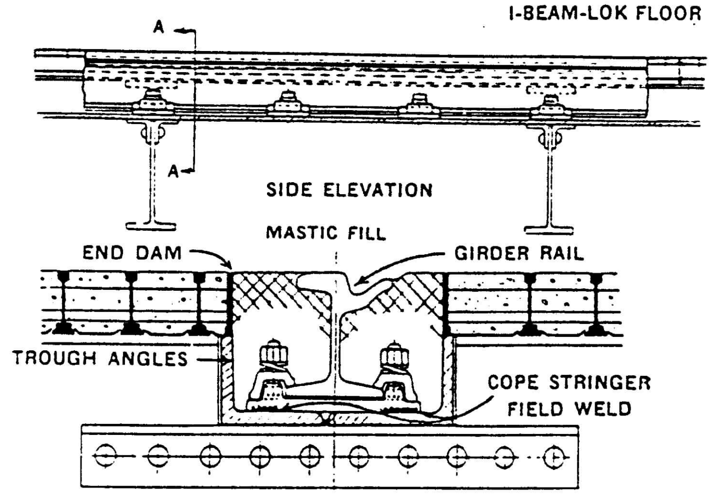
WIDE FLANGE STRINGERS



SECTION A-A

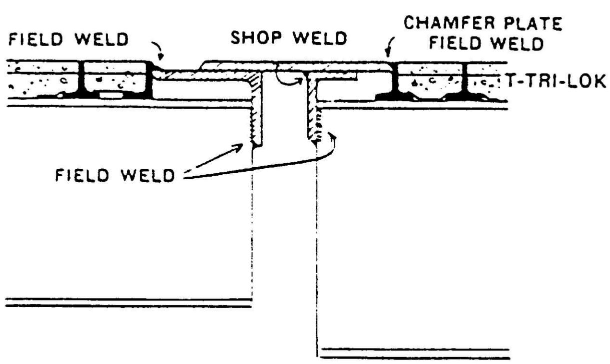
AT CURVED END OF SWING SPAN

I-BEAM-LOK FLOOR

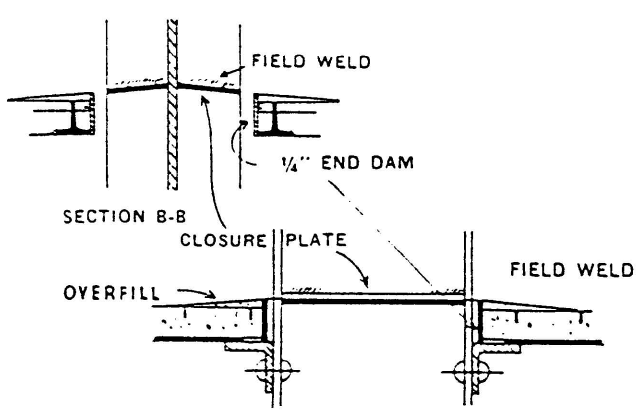


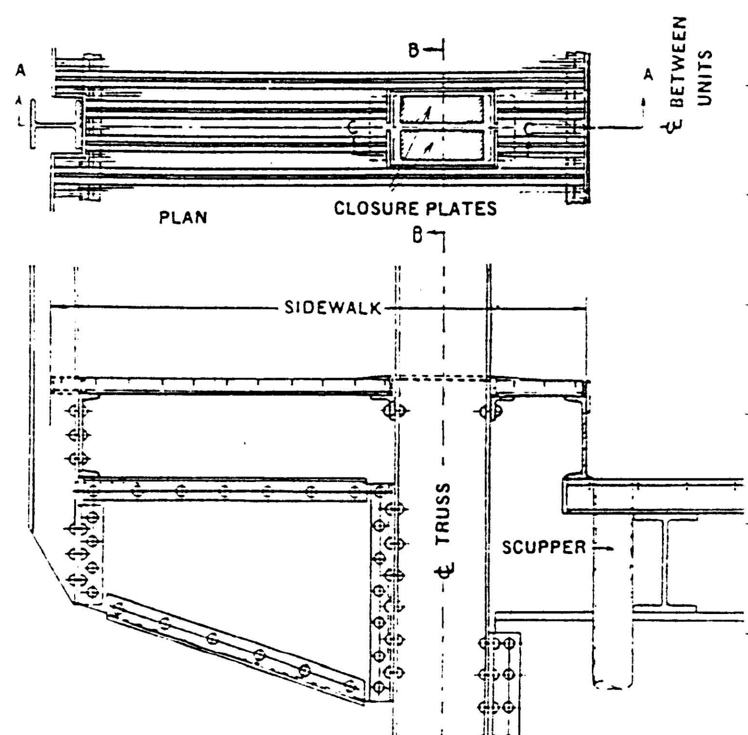
SECTION A. A.

METHOD OF SUPPORTING RAILS AND I-BEAM-LOK



EXPANSION JOINT

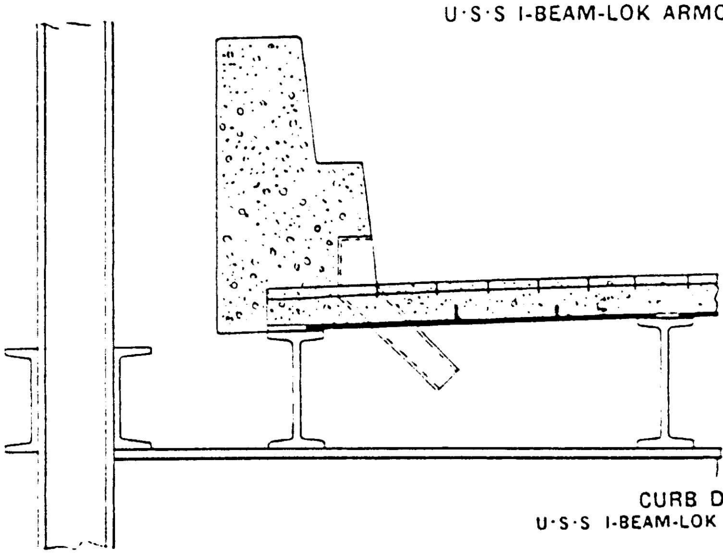


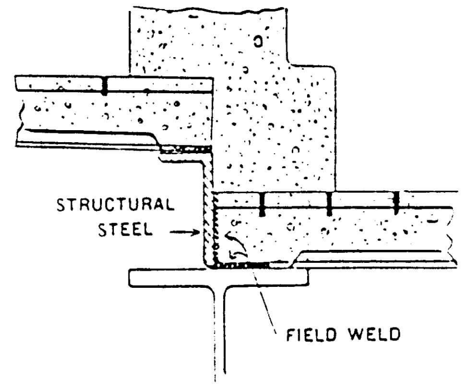


T-TRI-LOK SIDE WALK

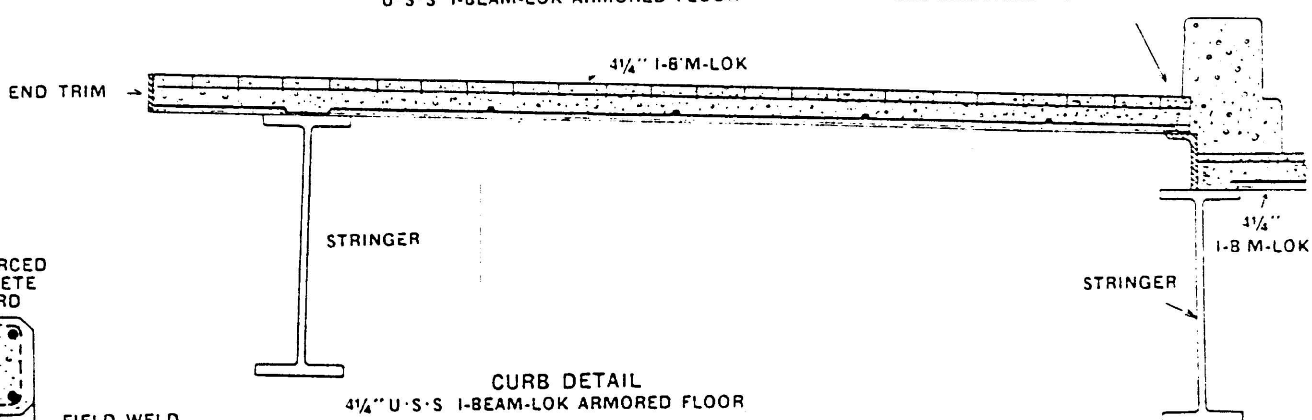
SHOWING RAILING POST AND TRUSS CUT-OUTS

U·S·S I-BEAM-LOK ARMORED FLOOR



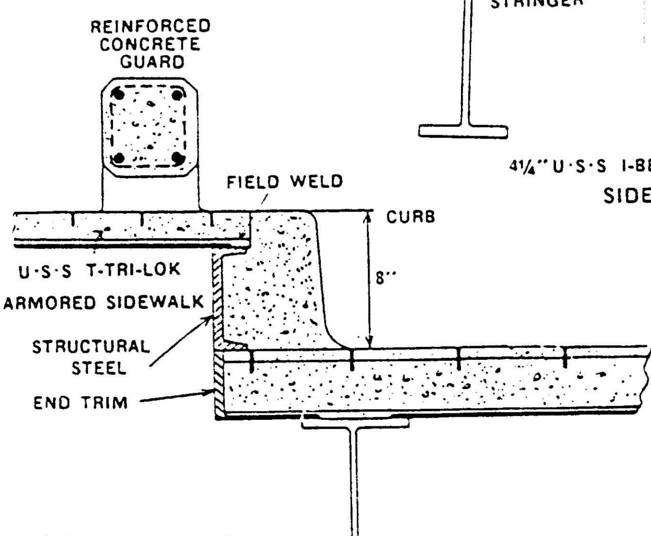


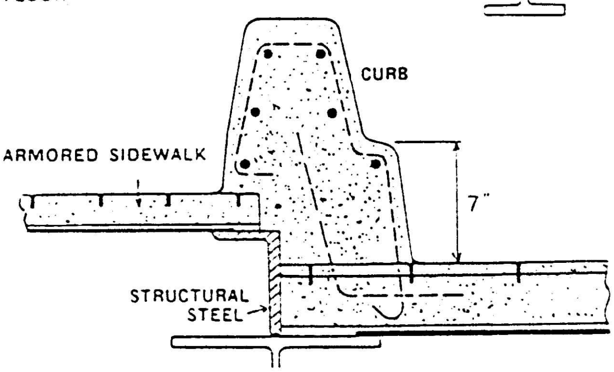
CURB DETAIL
U·S·S I-BEAM-LOK ARMORED FLOOR



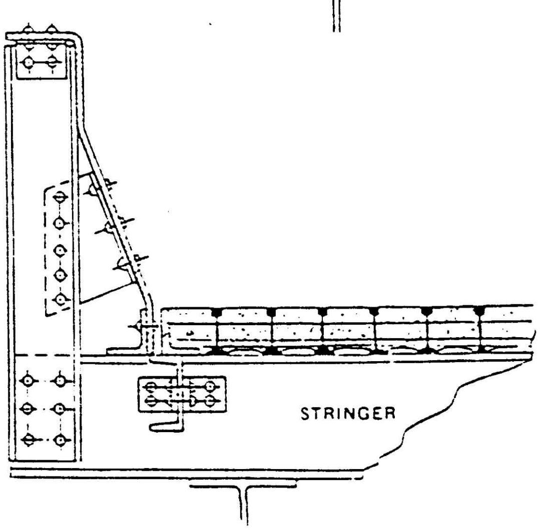
CURB DETAIL
4¼" U·S·S I-BEAM-LOK ARMORED FLOOR

SIDEWALK & CURB

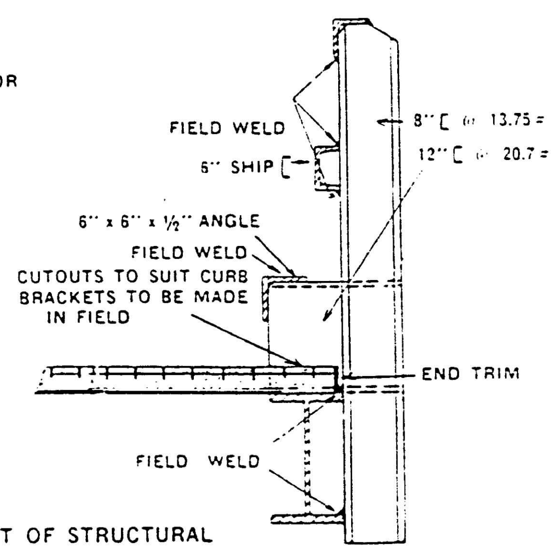




CURB DETAIL
U·S·S I-BEAM-LOK ARMORED FLOOR

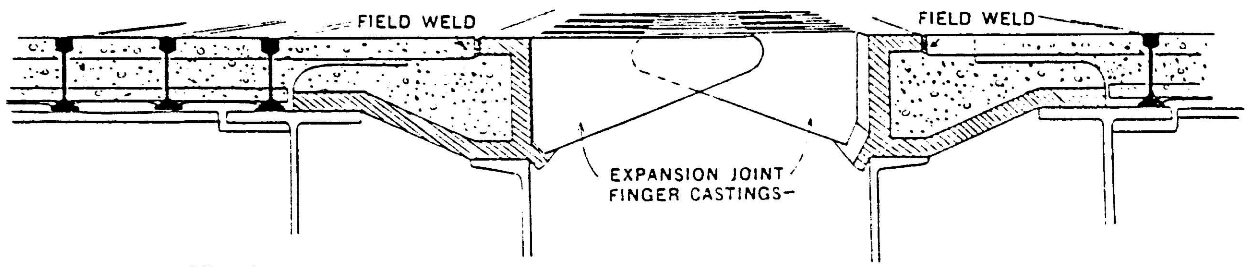


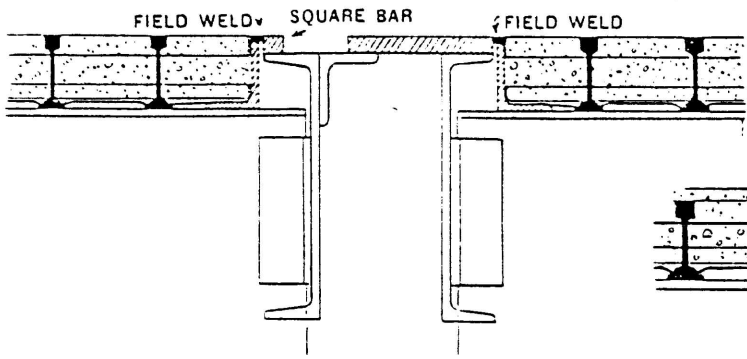
STEEL CURB AND GUARD RAIL
U·S·S I-BEAM-LOK ARMORED FLOOR

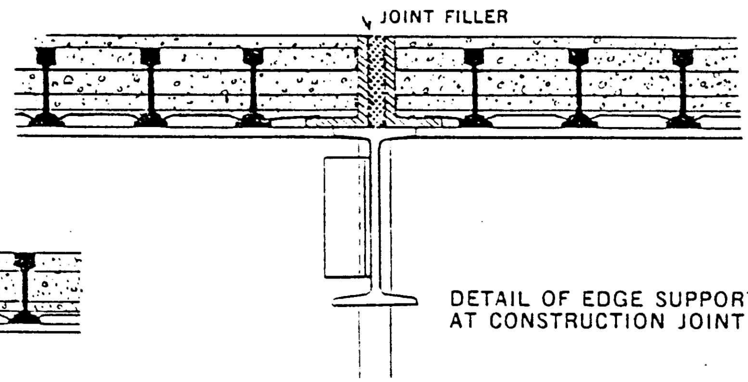


TREATMENT OF STRUCTURAL
GUARD RAIL & POST

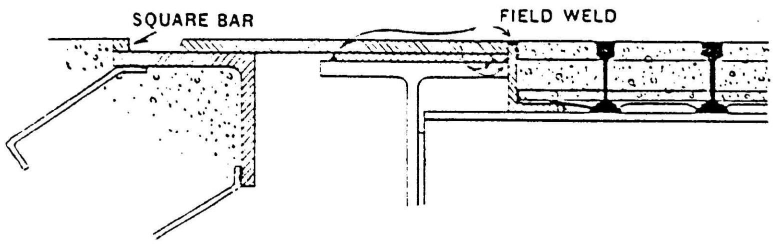
DETAILS OF EXPANSION JOINTS, ETC. U·S·S I-BEAM-LOK ARMORED FLOOR

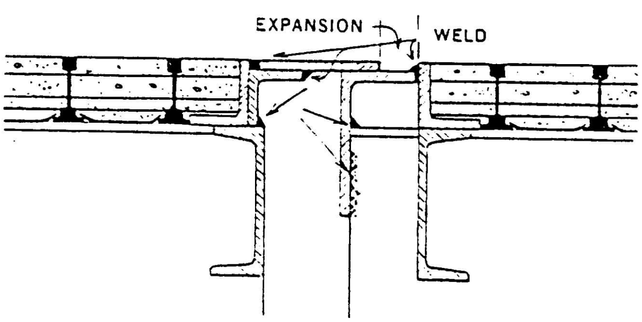


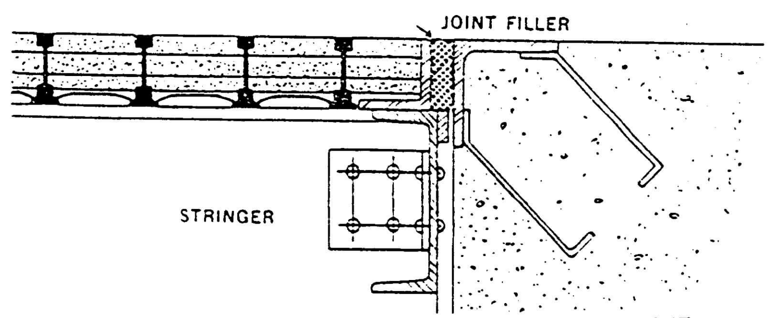




DETAIL OF EDGE SUPPORT AT CONSTRUCTION JOINT

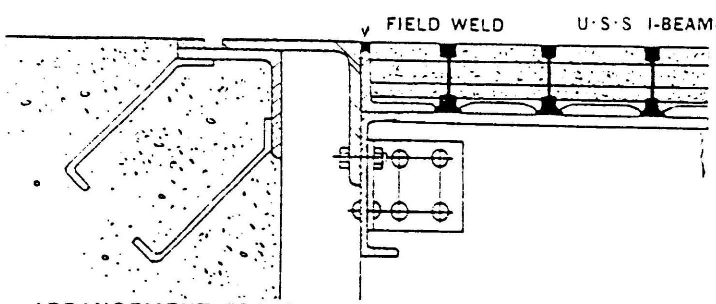




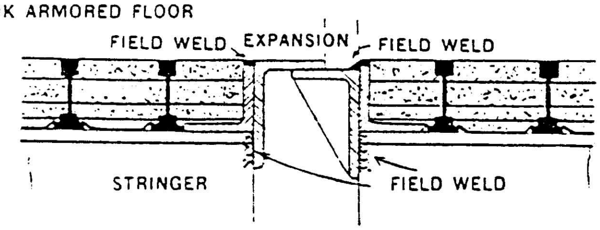


ARRANGEMENT OF FIXED END AT ABUTMENT

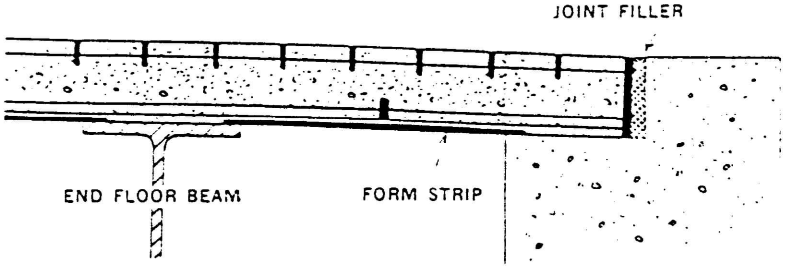
U·S·S I-BEAM-LOK ARMORED FLOOR



ARRANGEMENT FOR EXPANSION AT ABUTMENT

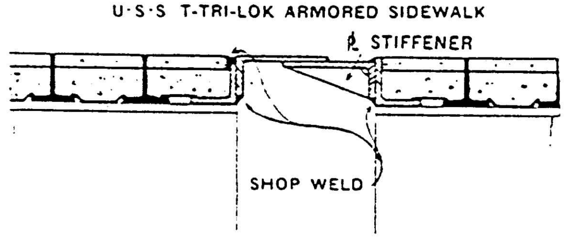


EXPANSION JOINT

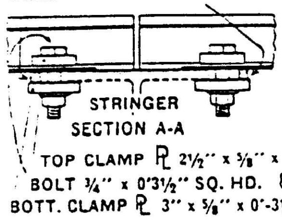


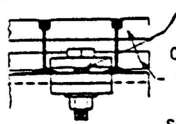
TREATMENT AT ABUTMENT

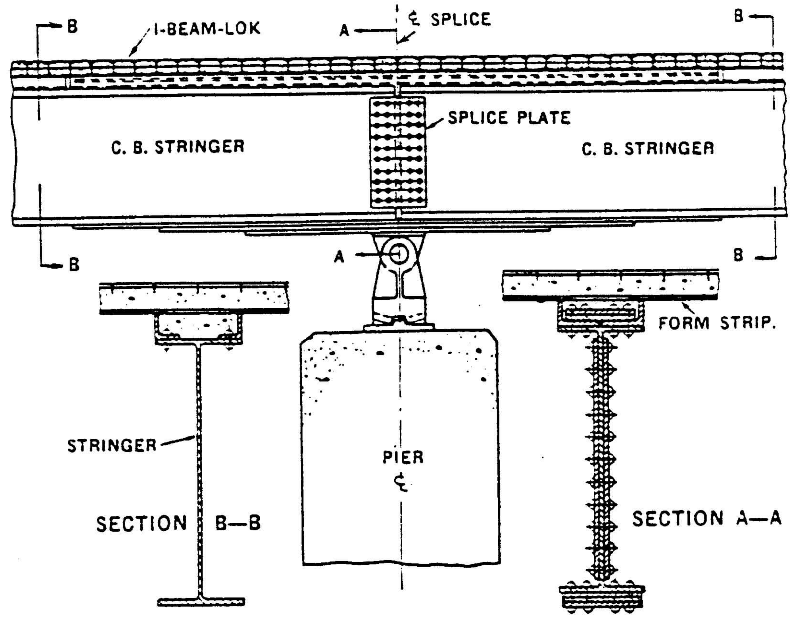
U·S·S T-TRI-LOK ARMORED SIDEWALK



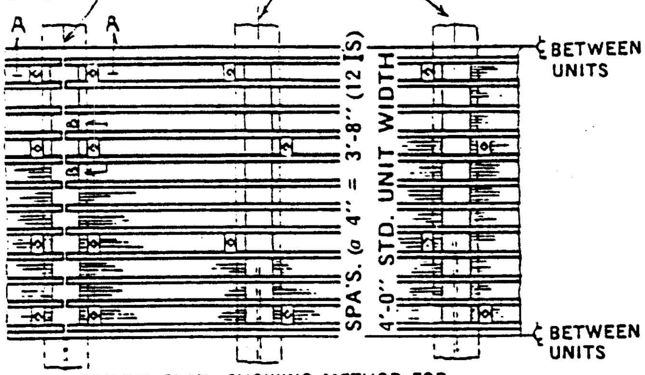
SIDEWALK EXPANSION DETAIL



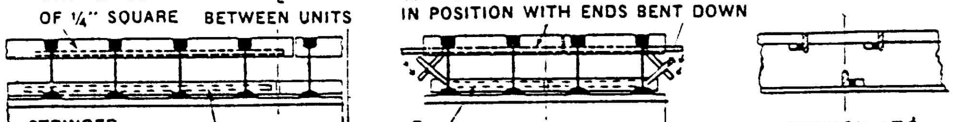




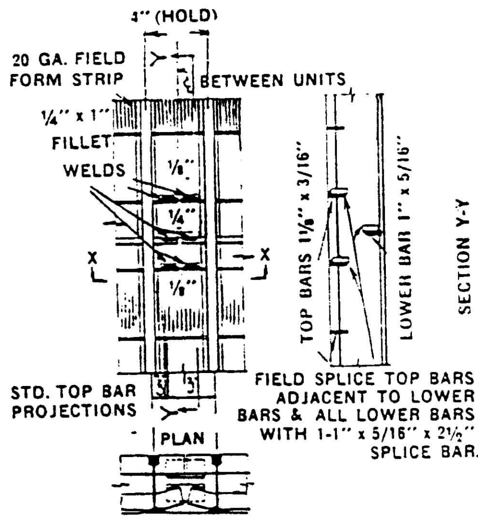
DESIGN SUGGESTIONS OF STRINGER SPLICE
FOR CONTINUITY AND SUPPORT
U. S. S. I-BEAM-LOK ARMORED FLOOR



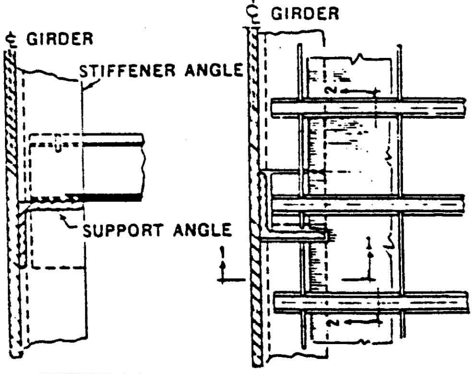
PARTIAL PLAN SHOWING METHOD FOR
ATTACHING I-BM-LOK UNITS TO STRINGERS IN FIELD
BY USING CLIPS AND BOLTS

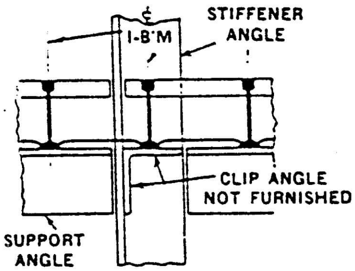


ALTERNATE METHOD OF SPLICING UNITS

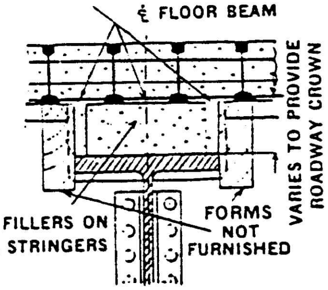


ALTERNATE METHOD
OF FIELD WELDING
AT JOINT BETWEEN UNITS.

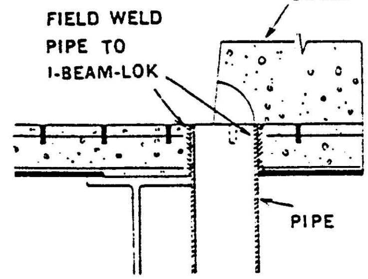




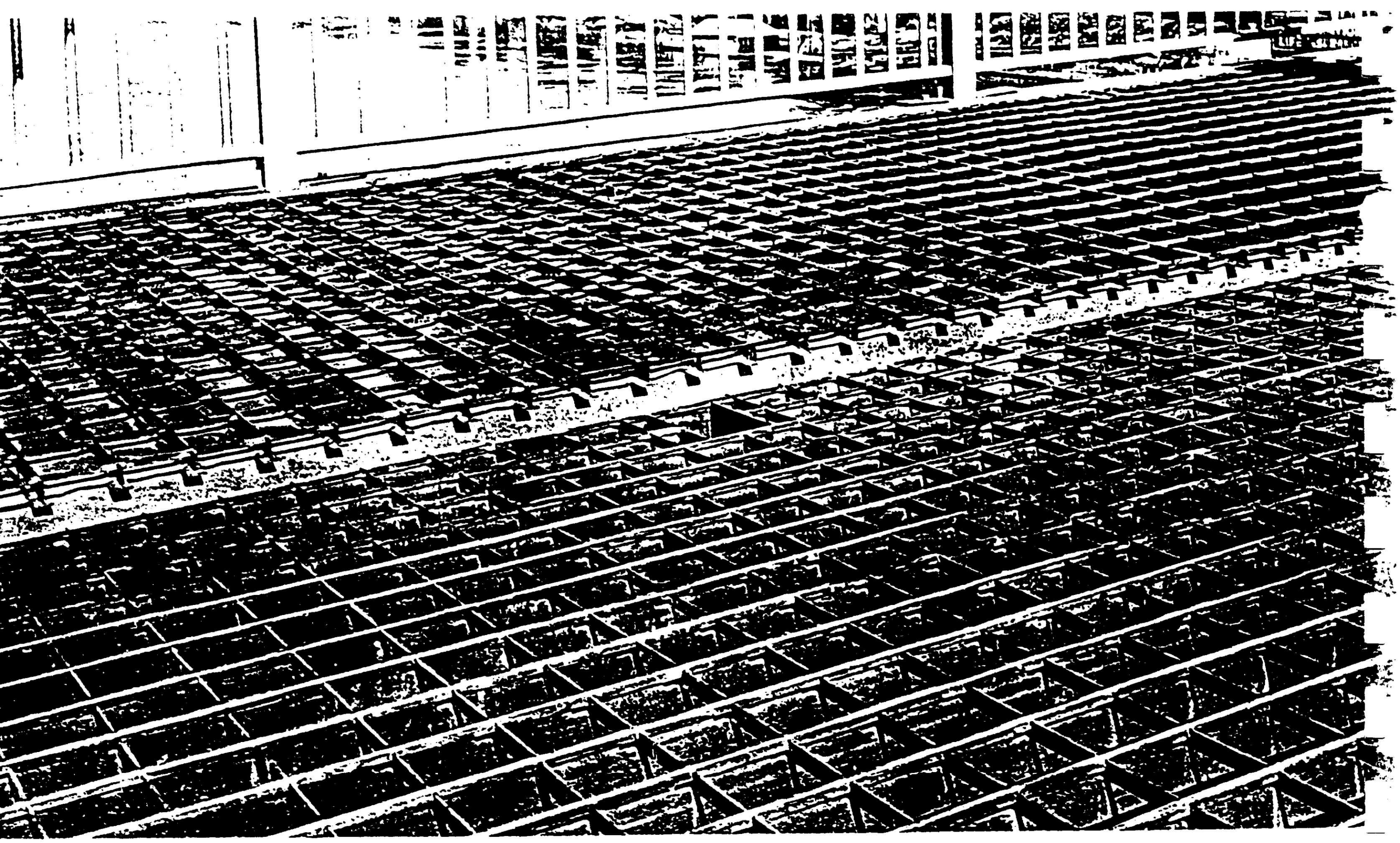
SUPPORT AT GIRDER



TREATMENT AT FLOOR BEAM
['S TRANSVERSE TO TRAFFIC.

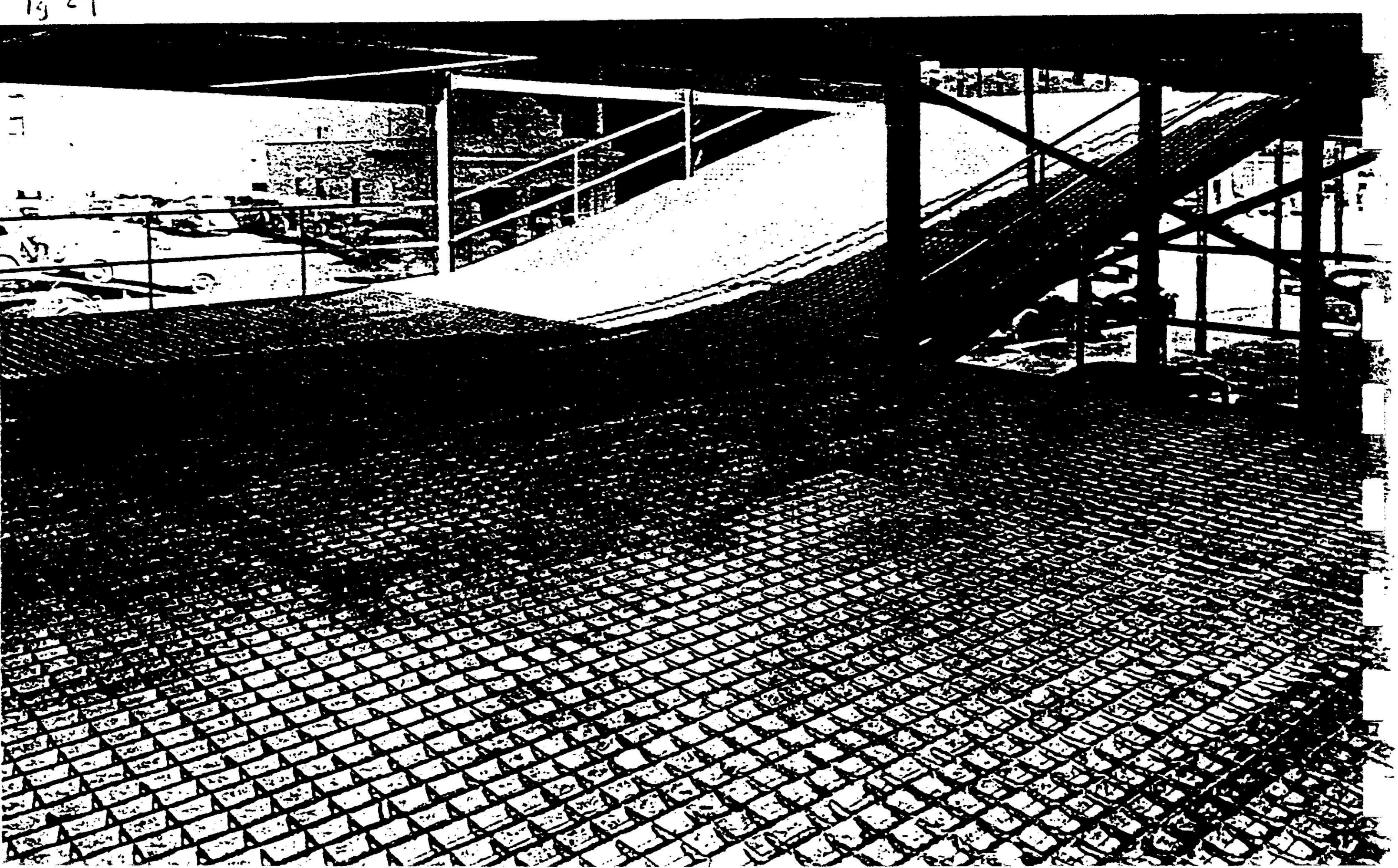


SECTION THRU
FLOOR DRAIN



Typical installation of T-Tri-Lok bridge sidewalk construction and I-Beam-Lok bridge roadway unit in place ready for concrete

Curved ramp leading to deck over parking lot constructed of standard 2" T-Tri-Lok



U·S·S *T-Tri-Lok* BRIDGE SIDEWALK AND BUILDING FLOOR CONSTRUCTION

For use where the strength of regular U·S·S I-Beam-Lok is excessive, but where extreme light-weight with relatively high strength is required, such as in the sidewalks of bridges, floors of garages or parking spaces, industrial buildings, 2″ U·S·S T-Tri-Lok construction is recommended.

This relatively light construction offers a non-combustible, integrally armored slab to meet the requirements for comparatively light loads such as are encountered in sidewalks or building services.

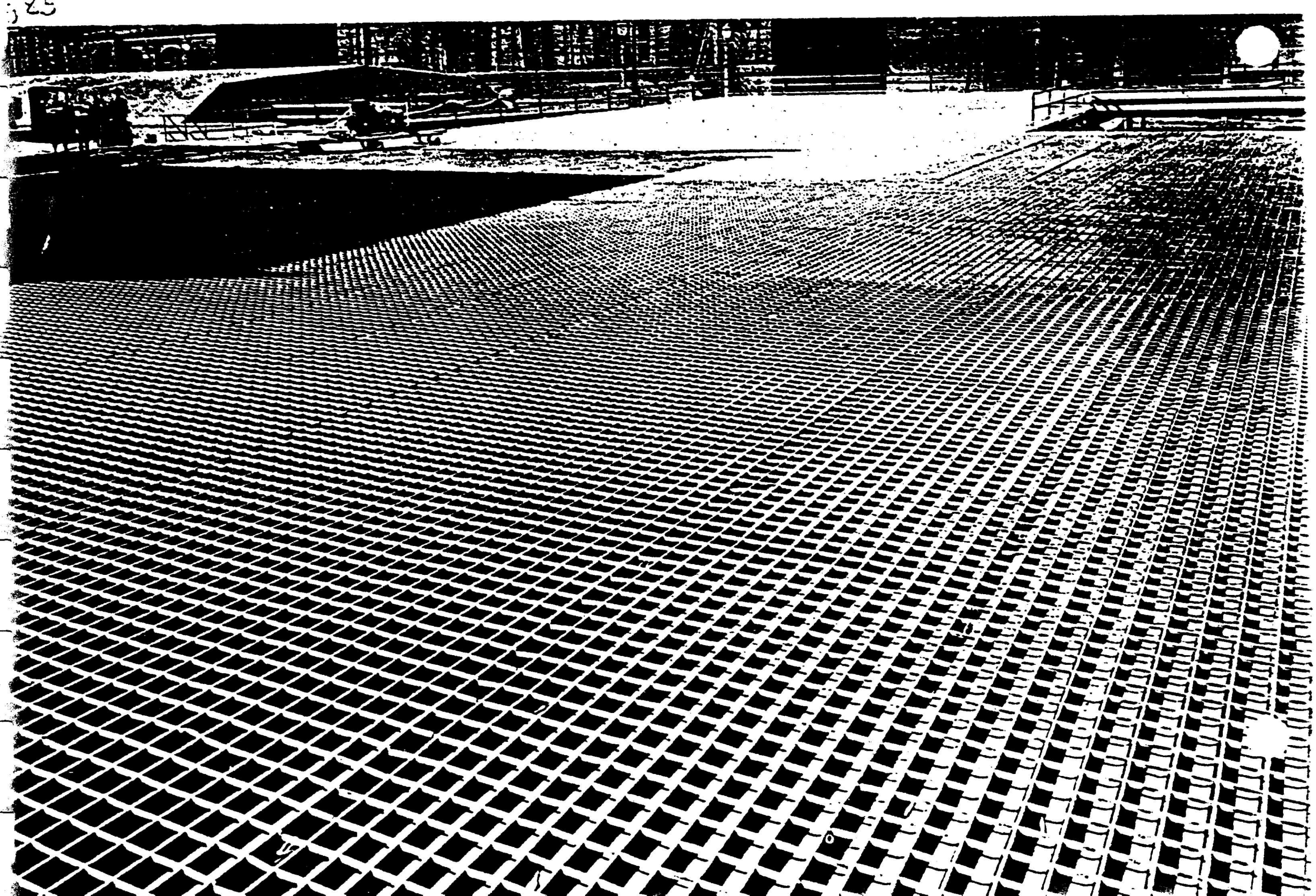
It is offered in two types, both 2 inches in over-all depth, but in one the tees are spaced 6 inches on centers, Type L, and in the other 4 inches on center, Type H. All steel has a copper content of .2 per cent minimum.

The slabs with 6-inch spacing of tees have an unfilled weight of steel of 7.3 lbs. per square foot or a weight when filled with concrete of 29.2 lbs. The tees are 2″ deep with $1\frac{1}{2}$″ flange width and $\frac{3}{16}$″ metal thickness. The space between the edges of the tee flanges is filled in by a 20 gauge steel form strip, tack-welded into position. The top crossbars are $\frac{9}{16}$″ x $\frac{3}{16}$″ and are spaced 4 inches on center.

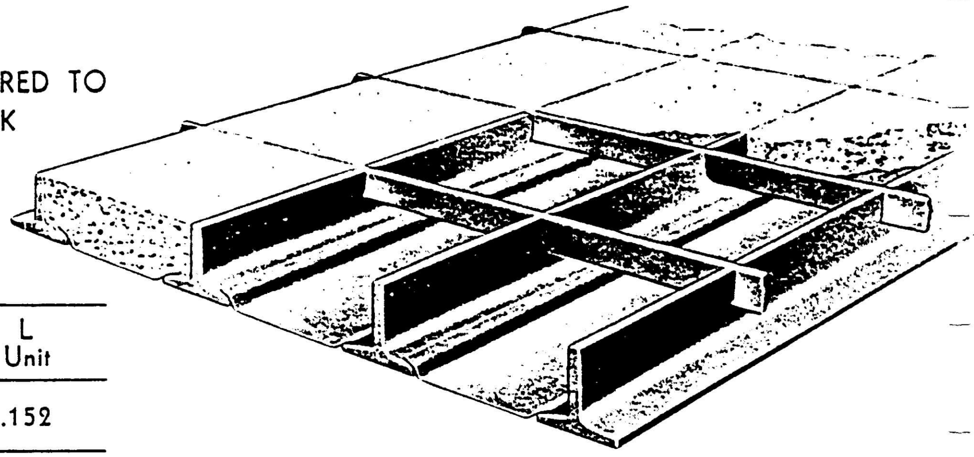
The slab with 4-inch spacing of tees has an unfilled weight of 12.6 lbs. per square foot of steel and weighs 32.9 lbs. per square foot when filled with concrete. The tees are 2 x 2 x $\frac{1}{4}$″ and the crossbars are $\frac{9}{16}$″x $\frac{3}{16}$″. Both tees and crossbars are spaced on 4-inch centers. The opening between the edges of the tee flanges is filled by No. 20 gauge steel form strip, welded into position.

The steel units are shipped completely fabricated and when filled with concrete flush with the top of the tees, produce a rigid armored slab similar to the heavier bridge and roadway floors.

Standard 2″ T-Tri-Lok provides light weight, heavy duty slab for parking deck



VOLUME OF CONCRETE REQUIRED TO FILL STANDARD U·S·S 2" T-TRI-LOK UNITS FLUSH WITH TOP OF STEEL. (Net Volume After Deducting Concrete Displaced by Steel)



Type	H Unit	L Unit
Cubic Feet Per Sq. Ft.	.141	.152
One Cu. Yd. Fills	191 sq. ft.	177 sq. ft.

Field welding 2" T-Tri-Lok sidewalk unit to the supporting steel

SPECIFICATIONS FOR U·S·S 2″ T-Tri-Lok CONSTRUCTION

Description . . . The floor slabs shall consist of U·S·S 2″ T-Tri-Lok units, as manufactured by Carnegie-Illinois Steel Corporation. These units shall be a combination of T-shaped members, with metal form strips between and resting on the projecting lower flanges of the tees, and rectangular crossbars pressed into slots in the stems of the tees to form rigid units. The depth of the finished floor is to be 2″, and the dimensions and weights of the tees and crossbars shall be as shown on the plans. After these units are erected and welded to the supporting members, the entire U·S·S 2″ T-Tri-Lok structure shall be filled with concrete and finished flush with the tops of the stems of the tees and crossbars, forming an armored wearing surface.

Steel Material . . . All steel for the T-Tri-Lok proper shall be furnished to the structural grade of A.S.T.M. standard specification A7, latest revision, except that the crossbars shall have a tensile strength of 50,000 to 60,000 pounds per square inch and shall have a minimum copper content of 0.20 per cent. All accessories, such as end dams, edge angles, clamps, bolts, scuppers, and expansion dam material, may be mild carbon steel stock material at the discretion of the manufacturer. Sheets for form strips shall be regular copper bearing, hot rolled, soft sheet grade.

Fabrication of Steel . . . All steel shall be commercially straight and assembled in a workmanlike manner. The tees shall be spaced 4 inches or 6 inches center to center (specify type of unit to be used) to form units with maximum widths of 4′ 0″ or 6′ 0″, and in lengths not exceeding 30′ 0″ for the Type "H" unit and 20′ 0″ for the Type "L" unit. The space between the edges of adjacent tees shall be filled with No. 20 gauge form strip, placed in short lengths so as to extend only about 1 ½ inches beyond the edge of the supporting steel.

Crossbars shall be spaced 4 inches center to center at right angles to the stems of the tees, and when pressed into final position in the slots the tops shall be approximately flush with the tops of the stems of the tees. The crossbars shall have the ends projecting through the stems of the outside tees of the unit alternately long and short, so as to produce staggered joints between units. Tees shall be cut to tolerances for length of plus 0″ to minus ¼″, and crossbars plus 0″ to minus ⅛″. See plan of typical arrangement as shown on page 89 of this booklet.

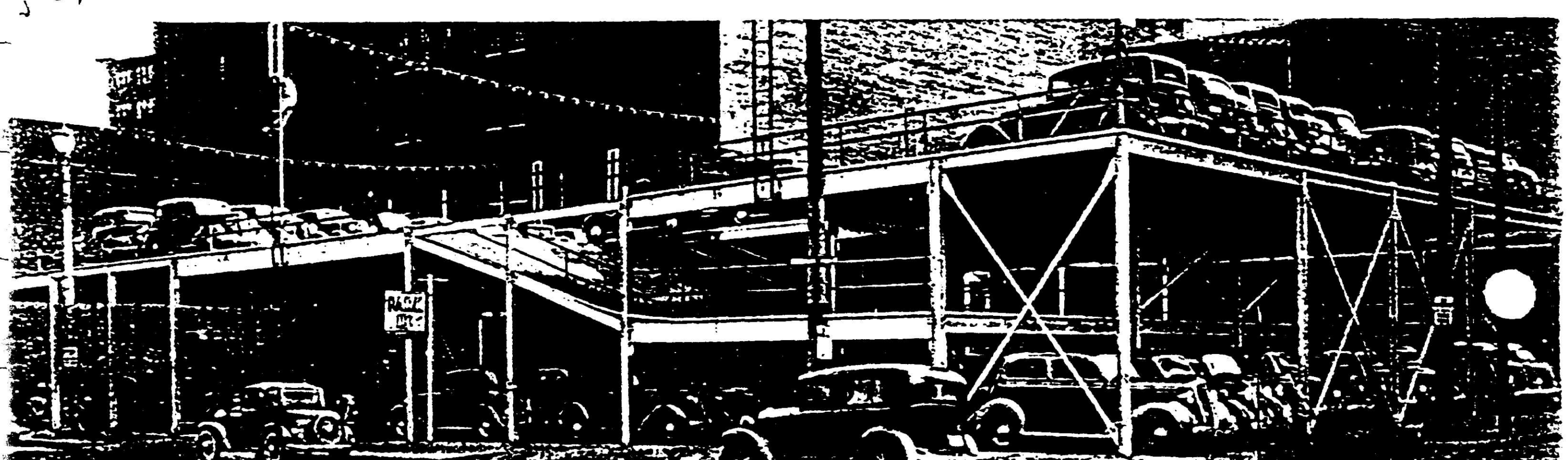
The Carnegie-Illinois Steel Corporation is not in position to fabricate expansion joints, guard rails, curbs or other accessories not a part of the T-Tri-Lok units. These items should be included in the contract for structural steel with adequate and satisfactory provision being made for field connecting to the T-Tri-Lok units where necessary.

Drawings . . . Shop detail drawings shall be furnished by the manufacturer to the purchaser for approval. Placing drawings shall be furnished to the purchaser for use in the field when assembling and erecting slab units.

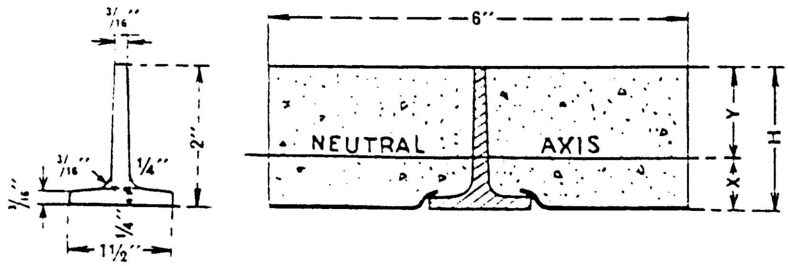
Field Assembly and Welding . . . The U·S·S 2″ T-Tri-Lok units shall be placed by the erector as indicated on the erection diagram, and field welded to the supporting steel in accordance with the manufacturers' recommended standard practice shown on page 89.

Concrete . . . The specifications given on pages 76 and 77 of this booklet for concrete deposited in U·S·S I-Beam-Lok will also apply for concrete to be used in U·S·S 2″ T-Tri-Lok units.

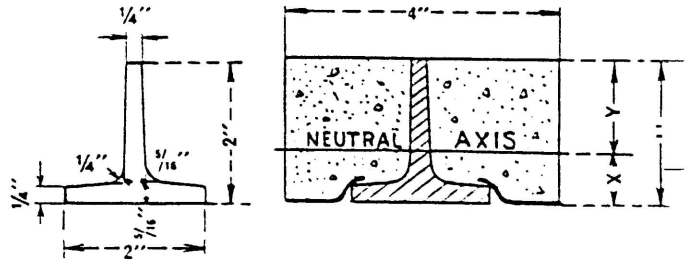
Ramp and deck over parking lot at Delmar Boulevard and Eighth Street, St. Louis, Mo. 20,475 sq. ft. of concrete filled 2″ T-Tri-Lok used in the construction. A. A. Aegerter, Architect, St. Louis, Mo.



PROPERTIES OF 2″ T-TRI-LOK



TYPE L UNIT



TYPE H UNIT

DIMENSIONS OF COMPONENT PARTS

Type	Size of Tee: Flange	Size of Tee: Stem	Minimum Thickness: Flange	Minimum Thickness: Stem	Area of Tee	Weight of Tee Per Lineal Ft.	Size or Crossbars	Form Strips
H	2	2	¼	¼	1.05	3.56	9/16 x 3/16	2¾ x 20 Ga.
L	1½	2	3/16	3/16	.72	2.45	9/16 x 3/16	4 15/16 x 20 Ga.

ELEMENTS OF 2″ T-TRI-LOK SLABS

Type	Depth	Av. Wt. Sq. Ft. Steel Only	Total Wt. Sq. Ft. Finished Slab	I Per Ft. Width	X	Y	Section Mod. Per Ft. Width: Comp. Conc.	Section Mod. Per Ft. Width: Tension Steel
	In.	Lbs.	Lbs.	$In.^4$	In.	In.	$In.^3$	$In.^3$
H	2	12.6	32.9	25.5	.78	1.22	20.9	2.18
L	2	7.3	29.2	14.7	.95	1.05	14.0	1.03

LOAD TABLE FOR TYPE H SLABS — UNIFORMLY LOADED SIMPLE SPANS

Allowable Superimposed Live load* Lbs. Per Sq. Ft.	SPAN IN FEET 4′-0″ fc	4′-0″ fs	4′-6″ fc	4′-6″ fs	5′-0″ fc	5′-0″ fs	5′-6″ fc	5′-6″ fs	6′-0″ fc	6′-0″ fs	6′-6″ fc	6′-6″ fs	7′-0″ fc	7′-0″ fs	8′-0″ fc	8′-0″ fs	9′-0″ fc	9′-0″ fs
100	150	1430	190	1810	234	2235	283	2704	337	3218	395	3771	459	4381	599	5722	758	7241
150	207	1978	262	2503	324	3090	392	3739	467	4450	548	5222	635	6065	829	7910		
200	265	2534	335	3208	414	3960	501	4792	596	5702	700	6692	811	7761				
250	321	3091	406	3912	501	4830	606	5844	721	6955	847	8163						
300	378	3629	479	4593	591	5670	715	6861	851	8165								
400	493	4742	625	6002	771	7410	933	8966										

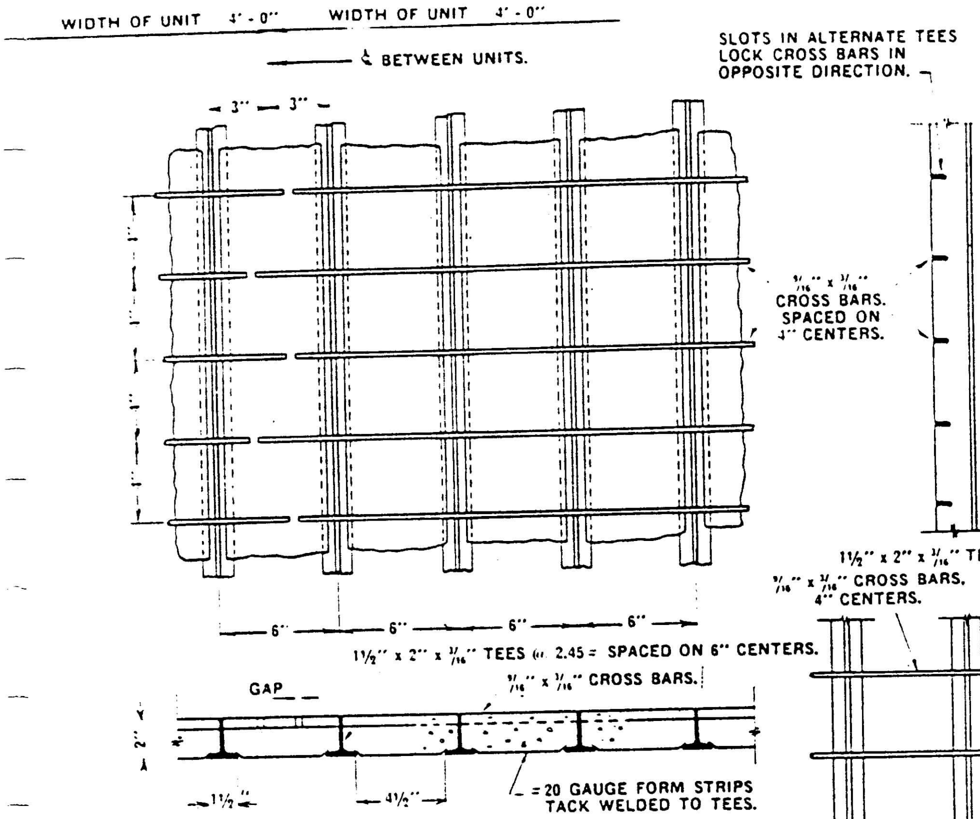
* Stresses indicated, result from live+dead loads.

LOAD TABLE FOR TYPE L SLABS — UNIFORMLY LOADED SIMPLE SPANS

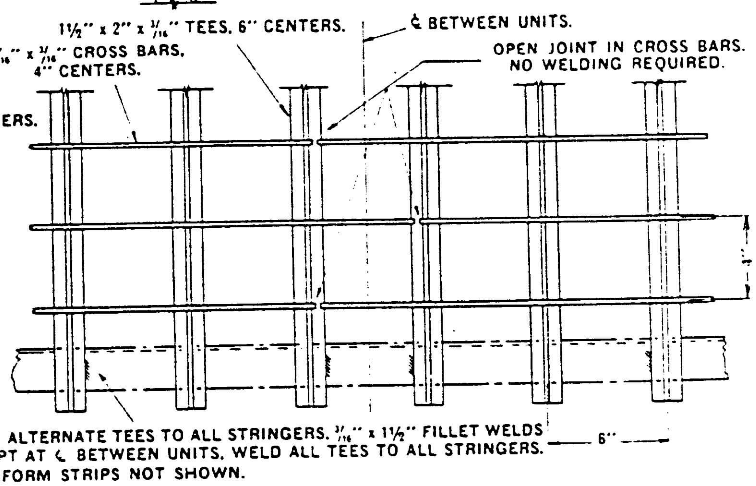
Allowable Superimposed Live load* Lbs. Per Sq. Ft.	SPAN IN FEET 4′-0″ fc	4′-0″ fs	4′-6″ fc	4′-6″ fs	5′-0″ fc	5′-0″ fs	5′-6″ fc	5′-6″ fs	6′-0″ fc	6′-0″ fs	6′-6″ fc	6′-6″ fs	7′-0″ fc	7′-0″ fs	8′-0″ fc	8′-0″ fs	9′-0″ fc	9′-0″ fs
100	223	3034	282	3839	348	4740	421	5735	501	6826	588	8011	682	9290	891	12134		
150	309	4186	391	5297	483	6540	584	7913	696	9418	816	11055						
200	394	5357	498	6780	615	8370	744	10128	886	12053								
250	480	6528	608	8262	750	10200	908	12342										
300	566	7680	717	9720	885	12000												
400	737	10022	933	12685														

* Stresses indicated, result from live+dead loads.

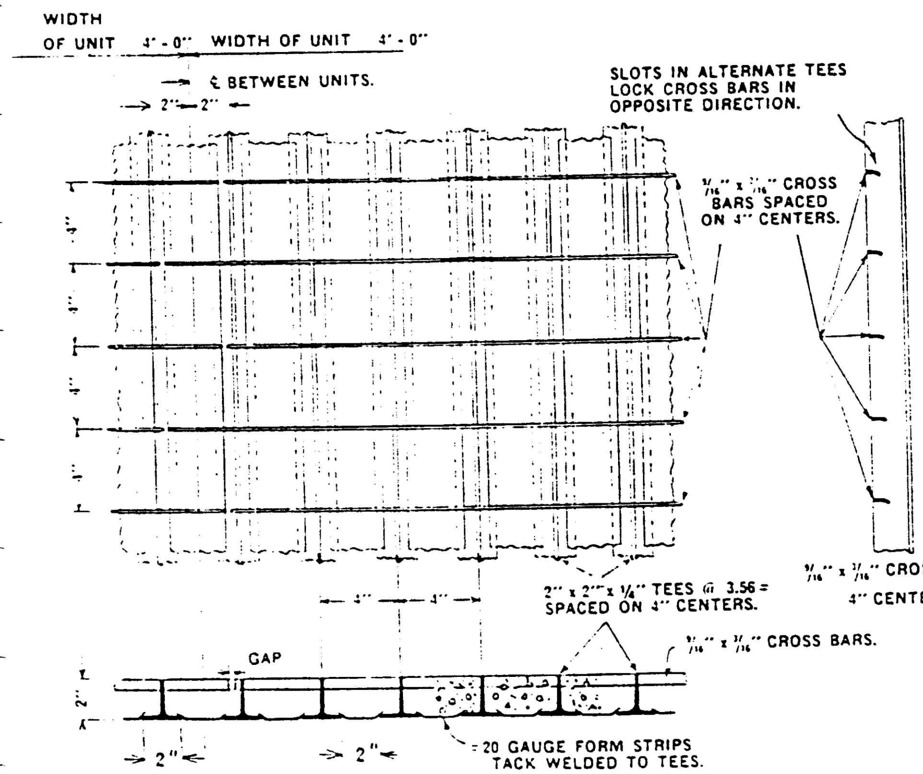
Typical Details of T-Tri-Lok Construction



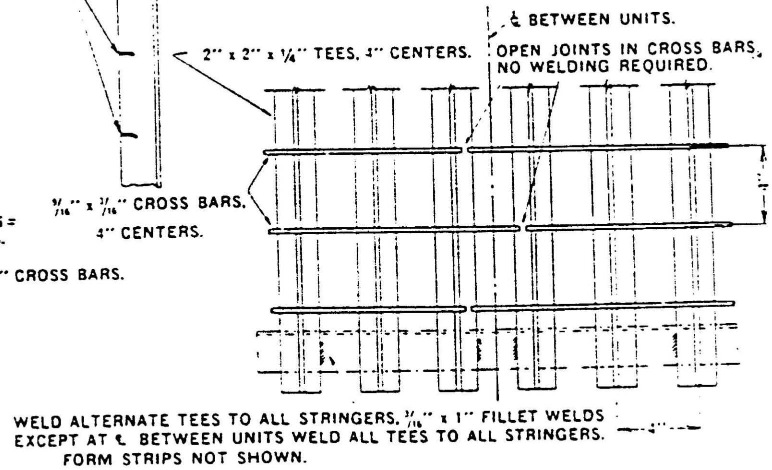
TYPICAL DETAILS 2" T-TRI-LOK
TYPE L UNITS



PLAN VIEW SHOWING RECOMMENDED
FIELD WELDING TO SUPPORTING STEEL.
TYPE L UNITS



TYPICAL DETAILS 2" T-TRI-LOK
TYPE H UNITS



PLAN VIEW SHOWING RECOMMENDED
FIELD WELDING TO SUPPORTING STEEL.
TYPE H UNITS

5″ I-BEAM-LOK OPEN

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Nepaug River Bridge	New Hartford, Conn.	Connecticut State Highway Department	5″	1975	16	Nov. 1938
Pleasant Valley Bridge	Barkhamsted, Conn.	Connecticut State Highway Department	5″	7005	115	Dec. 1938
Bridge over the Housatonic River on the Wilbur Cross Hwy.	Milford-Stratford, Connecticut	Connecticut State Highway Department	5″	95000	885	Jan. 1939
Hillsboro River Bridge	Tampa, Florida	State of Florida, State Road Department	5″	3320	32	Sept. 1938
McGirts Creek Bridge	Ortega, Duval County, Florida	State of Florida, State Road Department	5″	2230	21	May 1939
Miami Canal Bridge at Northwest 27th Avenue	Miami, Florida	Harrington & Cortelyou, Consulting Engineers	5″	6300	59	Jan. 1939
Main St. Bridge over St. Johns River	Jacksonville, Florida	State of Florida, State Road Department	5″	15420	143	March 1940
Little Manatee River Bridge	Hillsboro County, Florida	State of Florida, State Road Department	5″	4295	40	May 1940
St. Johns River Bridge	Green Cove Springs, Florida	State of Florida, State Road Department	5″	3066	28	June 1940
Indian River Bridge	Cocoa, Brevard County, Florida	State of Florida, State Road Department	5″	5323	50	July 1940
Indian River Bridge	Ft. Pierce, St. Lucie County, Florida	State of Florida, State Road Department	5″	5018	47	July 1940
Bridge over Ortega River	Near Jacksonville, Fla.	State of Florida, State Road Department	5″	2786	27	Dec. 1940
Bridge over Banana River	Cocoa, Florida	Florida State Road Department	5″	4135	38	1941
Billy's Creek Bridge	Fort Meyers, Lee County, Florida	Florida State Road Department	5″	954	9	1941
Bridge over Inland Waterway	Sunniland, Florida	Florida State Road Department	5″	5620	52	1941
Rocky Ford Bridge	Oakwood Township, Illinois	Illinois Department of Public Works and Buildings	5″	5310	49	1941
Jefferson Street Bridge	Joliet, Illinois	State of Illinois, Department of Public Works and Buildings, Division of Highways	5″	6492	62	July 1940
Cass Street Bridge	Joliet, Illinois	State of Illinois, Department of Public Works and Buildings, Division of Highways	5″	7405	71	July 1940
Bridge over White River at New York Street	Indianapolis, Ind.	City of Indianapolis, Department of Engineering	5″	21400	200	Jan. 1939
Lyons-Fulton Bridge	Clinton, Iowa	Private Plans	5″	24650	237	Feb. 1939
Wappello St. Bridge	City of Ottumwa, Ia.	City of Ottumwa	5″	4600	43	Feb. 1939
St. Clair St. Bridge	Frankfort, Ky.	Commonwealth of Kentucky, Department of Highways	5″	9720	90	Jan. 1939
Martin Point Bridge over Presumpscot River	Portland, Maine	State of Maine, State Highway Commission, Bridge Division	5″	4026	37	1941
Cambridge Creek Bridge	Cambridge, Md.	State of Maryland, State Roads Commission	5″	2300	22	March 1939
Hanover Street Bridge	Baltimore, Md.	City of Baltimore, Department of Public Works, Bureau of Highways—Bridge Division. H. F. Lucke, Associate Engineer	5″	9400	90	May 1940
Reflooring Green River Bridge	Greenfield, Mass.	Commonwealth of Massachusetts, Department of Public Works	5″	4000	36	1941
Kernwood Bridge over Danvers River	Salem and Beverly, Mass.	Moore & Haller, Incorporated, Consulting Engineers, and County of Essex	5″	4339	40	Sept. 1938
Bridge B-248 Hubbardston Road, Burnshirt River	Barre Plains, Mass.	Commonwealth of Massachusetts, Department of Public Works	5″	2175	20	April 1939
Bridge on Commercial Avenue, over Lechmere Canal	Cambridge, Mass.	Cleverdon, Varney & Pike	5″	1778	17	Aug. 1939
Drawbridge at Eel Pond	Falmouth, Mass.	Commonwealth of Massachusetts, Department of Public Works	5″	962	9	Feb. 1940

FLOOR CONTRACTS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Quincy Avenue Bridge	Weymouth, Mass.	Commonwealth of Massachusetts, Department of Public Works	5"	1900	18	June 1940
Genesee Ave. Bridge over Saginaw River	Saginaw, Mich.	Michigan State Highway Department	5"	4212	40	Nov. 1937
Second Ave. Bridge	Alpena, Mich.	Clifford E. Paine	5"	4800	45	March 1939
Center Street Bridge	Saginaw, Michigan	Hazelet & Erdal	5"	4653	90	April 1940
Bascule Bridge	Cheboygan, Mich.	Michigan State Highway Department	5"	2100	25	June 1940
Bridge 4698	Crookston, Minn.	State of Minnesota, Department of Highways	5"	6202	58	March 1938
Service Bridge, Arkabutla Dam	Cold Water River, Miss.	United States Engineers, Vicksburg, Mississippi	5"	1530	14	Dec. 1940
Reflooring Bridge No. 065/137	Claremont, N. H. to Ascutney, Vt.	State of New Hampshire Highway Department	5"	10227	94	1941
Bridge	Freedom-Effingham, New Hampshire	State of New Hampshire Highway Department	5"	1591	15	1941
Bridge over Sagamore Creek	Portsmouth, N. H.	State of New Hampshire Highway Department	5"	10281	96	1941
Bridge No. SNFAP-203-V(2)	Troy, N. H.	State of New Hampshire	5"	3879	36	1941
Bridge over Connecticut River	Piermont, N. H.	State of New Hampshire Highway Department	5"	7282	67	May 1940
Bridge over Connecticut River	West Stewartstown, N. H.	State of New Hampshire Highway Department	5"	4675	43	May 1940
Grade Crossing Elimination, Mascoma Valley U. S. No. 4	Between Enfield and Canaan, N. H.	State of New Hampshire Highway Department	5"	792	7	Sept. 1940
PRR Bridge	Buffalo, N. Y.	Pennsylvania Railroad	5"	3300	30	1941
Bridge	Heuvelton, N. Y.	St. Lawrence County, Department of Highways	5"	1364	12	Nov. 1938
Ramps—Tonawanda Incinerator	Tonawanda, N. Y.	Nichols Engineering and Research Corporation	5"	2388	22	Nov. 1939
Central Hudson Gas & Elec. Co. Bridge	Poughkeepsie, N. Y.	Private Plans	5"	2133	20	Oct. 1940
Fassett Street Bridge	Toledo, Ohio	City of Toledo, Department of Public Service, Forster Wernert & Taylor, Engineers	5"	24000	223	March 1938
Kellogg Avenue Bridge over Little Miami River	Cincinnati, Ohio	Department of Public Works, City of Cincinnati, Division of Highways	5"	12150	115	Dec. 1938
Carter Road Bridge	Cleveland, Ohio	Wilbur J. Watson, City of Cleveland	5"	9247	86	Sept. 1939
Columbus Road Bridge	Cleveland, Ohio	City of Cleveland, Department of Public Service—Division of Engineering and Construction, Wilbur J. Watson & R. L. Harding, Regional Engineers	5"	10300	95	Sept. 1939
Summit Street Bridge over Swan Creek	Toledo, Ohio	City of Toledo, Department of Public Service, Division of Bridges	5"	5540	51	Sept. 1939
Erie Avenue Bridge	Lorain, Ohio	Wilbur J. Watson, Consulting Engineer	5"	14800	140	Sept. 1939
Bridge over Mill Creek on Carthage-Hamilton Road	Springfield Township, Ohio	Hamilton County Engineers	5"	6190	57	June 1940
Charleroi-Monessen Bridge	Charleroi, Pa.	Private Plans	5"	22800	212	Sept. 1939
West Approach Viaduct, Charleroi-Monessen Bridge	Charleroi, Pa.	Private Plans	5"	11062	104	April 1940
Bridge No. 5 over Miller's Run	Near Treveskyn, Pa. South Fayette Twp.	Allegheny County	5"	1500	13	Dec. 1940
Bridge No. 6 over Miller's Run	Near Treveskyn, Pa. South Fayette Twp.	Allegheny County	5"	1500	13	Dec. 1940
Ferry Slip (State Project 367-4-6—Galveston County)	Port Bolivar, Texas	Texas State Highway Department	5"	784	7	1941
Portable Steel Highway Bridge	Fort Belvoir, Va.	Sverdrup & Parcel, Consulting; Corps of Engineers, U.S.A.	5"	1680	16	1941
Double Swing Span, Miraflores Locks	Panama Canal, Canal Zone Schedule 4650		5"	12000	120	1941

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Grade Separation at Intersection of Chicago Rock Island and Pacific Railway and U. S. Highway No. 71, Underpass	0.2 miles west of Abbott, Ark.	Chicago, Rock Island and Pacific Railway and Arkansas State Highway Commission	3½″	1642	13	July 1936
Grade Separation at Intersection of Chicago Rock Island and Pacific Railway & U. S. Highway State Job 6206. Highway Underpass	Little Rock, Arkansas	Chicago, Rock Island and Pacific Railway and Arkansas State Highway Commission	3½″	1946	16	Jan. 1937
Intersection C. R. I. & P. Ry. & Hwy. No. 67-E Bridge Job No. 6203 Hwy. Underpass	1 mile east of Tie Plant, Arkansas	Chicago, Rock Island and Pacific Railway and Arkansas State Highway Commission	3½″	585	4	Oct. 1936
Grade Separation Intersection of Chicago Rock Island and Pacific Railway and State Route No. 10 Highway Underpass	Near Waveland, Arkansas	Chicago, Rock Island and Pacific Railway and Arkansas State Highway Commission	3″	527	8	April 1936
Bridge 1322 over E. 3rd St.	North of Little Rock, Arkansas	Chicago, Rock Island and Pacific Railway	3″	1200	10	March 1938
St. L. SW. Underpass, Grade Separation Hwy. Underpass	Near Buckner, Arkansas	Arkansas State Highway Commission and St. Louis-Southwestern Railway	3½″	804	7	Sept. 1939
West Brand Boulevard Bridge over Verdugo Wash (1)	Glendale, California	United States War Department—Los Angeles Flood Control District	3½″	2952	24	March 1937
West Brand Boulevard Bridge over Verdugo Wash (2)	Glendale, California	United States War Department—Los Angeles Flood Control District	3½″	2936	24	Dec. 1937
Mountain Street Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	3484	28	June 1936
Concord Street Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	4050	33	July 1936
Kenilworth Avenue Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	3848	32	Aug. 1936
Pacific Avenue Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	4370	36	Aug. 1936
Glenoaks Boulevard Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	3285	27	Sept. 1936
Central Avenue Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	4496	37	Sept. 1936
Jackson Street Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	3285	27	Sept 1936
Geneva Street Bridge over Verdugo Wash	Los Angeles, California	United States War Department—Los Angeles Flood Control District	3½″	3512	29	Dec. 1937
Bridge—Improvement of Beech St. at Yerba Buena Ave.	Oakland, California	City of Oakland, California	3½″	981	8	Feb. 1940
Congress Street Bridge Reconstruction over Poquonnock River	Bridgeport, Connecticut	Connecticut State Highway Department	3″	6022	47	Sept. 1937
Commerce Street Bridge	Hartford, Conn.	Connecticut State Highway Department	4¼″	3647	24	1941
Quinnipiac River Bridge	Meriden, Conn.	Connecticut State Highway Department	3″	2390	19	July 1935
Bridge over Connecticut River	Between Middletown and Portland, Conn.	Connecticut State Highway Department	3½″	27990	228	Sept. 1936
Washington Bridge	Stratford, Conn.	Connecticut State Highway Department	3″	8391	65	June 1936
Bridge at Indian Neck Avenue	Branford, Conn.	City of Branford, Connecticut	3″	1702	13	July 1938
Broad Street Bridge	Seymour, Conn.	Connecticut State Highway Department	3″	1861	13	Jan. 1939
Connecticut River Bridge	East Hartford to Hartford, Conn.	Connecticut State Highway Department, Robinson & Steinman, Consulting Engineers	4¼″	42000	267	Nov. 1940
Chas. W. Cullen Bridge	Near Dover, Del.	Harrington & Cortelyou, Consulting Engineers	3½″	4412	36	Feb. 1939
180-Foot Swing Span	Twenty Mile Bend, Florida	State of Florida, State Road Department	3½″	4633	38	Sept. 1936

LOK CONTRACTS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
West Palm Beach Canal Bridge	Twenty Mile Bend, Florida	State of Florida, State Road Department	3½"	819	8	Sept. 1936
Flagler Memorial Bridge	West Palm Beach, Florida	Hazelet & Erdal, Consulting Engineers, J. M. Boyd, County Engineer	3½"	4160	34	May 1937
Bridge over Gulf County Canal	Port St. Joe, Fla.	State of Florida, State Road Department	3"	2640	20	Sept. 1938
Bridge over Oconee River	Wheeler & Treutlen Counties, Ga.	State Highway Board, Georgia Bridge Department	3"	6312	49	May 1939
Buoy Aha Bridge	Haiti	American Bridge Company	3"	1100	9	1941
Camp Coq Bridge	Haiti	American Bridge Company	3"	1100	9	1941
Bridge over Mississippi River	Chester, Illinois	Sverdrup & Parcel	4¼"	30400	208	1941
North Pulaski Road Bridge	Chicago, Illinois	State of Illinois, County of Cook, Department of Highways	3½"	1050	9	1941
North State Street Bridge	Chicago, Illinois	City of Chicago, Department of Public Works	3½"	15050	131	1941
Nickle Plate Railroad Bridge No. 319.39 State Street Subway Hwy. Underpass	Charleston, Illinois	New York, Chicago and St. Louis Railroad, Office of Chief Engineer—Cleveland, Ohio	3½"	702	6	April 1936
Torrence Avenue Bridge	Chicago, Illinois	City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges	3½"	11385	97	July 1936
Outer Drive Improvement-Bridge over the Chicago River	Chicago, Illinois	Chicago Park District	3½"	25486	230	Aug. 1936
Outer Drive Improvement-Bridge over Michigan Canal	Chicago, Illinois	Chicago Park District	3½"	9341	86	Nov. 1936
West Main Street Bridge—Grade Separation	Decatur, Illinois	Wabash Railway Company	3½"	1560	13	Dec. 1936
Oakland Avenue Bridge — Grade Separation	Decatur, Illinois	Wabash Railway Company	3½"	1624	13	Dec. 1936
Eads Bridge, South Side of East Approach	East St. Louis, Illinois	Terminal Railroad Association of St. Louis	3"	19205	163	Sept. 1934
Eads Bridge, North Side of East Approach	East St. Louis, Illinois	Terminal Railroad Association of St. Louis	3"	22100	171	June 1936
Highway Underpass at Broadway between Third and Johns Streets	East St. Louis, Illinois	Terminal Railroad Association of St. Louis	4¼"	11000	73	July 1937
Baltimore and Ohio Railroad Bridge	Olney, Illinois	Baltimore and Ohio Railroad, Engineer of Bridges, Baltimore, Maryland	3½"	550	5	April 1935
Monroe Street Viaduct	Chicago, Illinois	Chicago Park District	4¼"	23000	162	Sept. 1938
South Shore Drive at 67th Street Ramp Type Passerelle	Jackson Park, Chicago, Illinois	Chicago Park District	4¼"	367	2	Oct. 1938
Bridge Proj. FAGH-172-1 Hwy. Underpass	Lake Zurich, Ill.	Illinois State Highway Department and Elgin, Joliet & Eastern Railway	3"	2772	22	Feb. 1939
Highway Underpass	3.1 miles west of Libertyville, Ill.	Chicago, Milwaukee, St. Paul & Pacific Railway and Illinois State Highway Department	3½"	2070	17	May 1939
Chicago Great Western Under Crossing MP 45.21	Lily Lake, Ill.	Chicago Great Western Railway Company	4¼"	2028	14	Jan. 1939
South Damen Avenue Improvement W. 74th St. to W. 29th St.	Chicago, Illinois	City of Chicago Board of Local Improvement, Bureau of Design	3½"	3736	31	Aug. 1939
Hwy. Underpass—42nd & St. Clair Avenue	East St. Louis, Ill.	Alton & Southern Railroad Company	3"	3967	31	Oct. 1939
Sidewalk for Passerelle — Lincoln Park	Chicago, Illinois	Chicago Park District	4¼"	2346	15	May 1940
Reconstruction of Subway Bridge No. 1043-A	North of Orland Park, Illinois	State of Illinois, Department of Public Works and Buildings, Division of Highways	3½"	2840	23	Aug. 1940
Sullivan-Hutsonville Bridge across Wabash River	Hutsonville, Ind.	Robinson & Steinman Engineers	4¼"	21075	137	Dec. 1938
Grade Separation at Intersection of Chicago, Rock Island and Pacific Railway and Secondary Hwy. Sec. 17 & 18 Underpass	2 miles west of Davenport, Iowa	Chicago, Rock Island and Pacific Railway and State of Iowa State Highway Commission	3"	1072	9	July 1936

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
University Avenue Underpass	Des Moines, Iowa	Iowa State Highway Commission	3½″ 4¼″	1530 3162	13 21	1941 1941
Bridge over Iowa River (FAS-521-B)	Richland Township, Tama County, Iowa	Iowa State Highway Commission	3″	3095	24	1941
Grade Separation at Intersection of Chicago, Rock Island and Pacific Railway and U. S. Hwy. No. 169—Hwy. Underpass	Livermore, Iowa	Chicago, Rock Island and Pacific Railway and State of Iowa State Highway Commission	3″	570	4	June 1936
Minneapolis and St. Louis Railroad Bridge over West Summit Street—Hwy. Underpass	Northwest of Marshallton, Iowa	Minneapolis and St. Louis Railroad and State of Iowa State Highway Commission	3½″	960	8	Nov. 1936
Grade Separation Undergrade Crossing Proj. WPGM-485-Hwy. Underpass	Millerton, Iowa	Chicago, Rock Island and Pacific Railway and State of Iowa State Highway Commission	3″	1168	9	Dec. 1936
Grade Separation at Intersection of Chicago, Rock Island and Pacific Railway & U. S. Hwy. No. 6 Hwy. Underpass	Newton, Iowa	Chicago, Rock Island and Pacific Railway and State of Iowa State Highway Commission	3½″	1472	13	July 1936
Undergrade Crossing U. S. Highway No. 34 & Burlington St.	Fairfield, Iowa	Chicago, Rock Island and Pacific Railway and State of Iowa State Highway Commission	3½″	4100	35	April 1938
Undergrade Crossing Road No. 1	Washington, Iowa	Chicago, Rock Island and Pacific Railway and State of Iowa State Highway Commission	4¼″	4329	31	July 1938
Hwy. Bridge over A. T. & S. F. R.R. Kansas State Project WPGM-447-C	Chanute, Kansas	State Highway Commission of Kansas	3″	15290	118	May 1936
Underpass C. R. I.—Pac. Rwy. & U. S. Hwy. No. 183 Bridge No. 183-90-0.2 Hwy. Underpass	Selden, Kansas	Chicago, Rock Island and Pacific Railway	3″	696	5	June 1938
Bridge over Ohio River	Owensboro, Ky.	Modjeski & Masters	4¼″	32220	213	Jan. 1939
Reflooring Tukey's Bridge over Back Bay	Portland, Maine	State of Maine State Highway Commission, Bridge Division	4¼″	15880	105	March 1940
Potomac River Bridge	Dahlgren, Va.—Ludlow Ferry, Md.	State of Maryland, State Roads Commission and J. E. Greiner, Consulting Engineers	4¼″	151500	1200	Oct. 1939
Apponaganset River Bridge	Dartmouth, Mass.	Commonwealth of Massachusetts Highway Bridge Department	3″	3100	24	Dec. 1935
Reflooring Haverhill Lower Bridge over Merrimack River	Haverhill, Mass.	County of Essex	3″	3818	30	March 1937
Watershops Pond Bridge	Springfield, Mass.	Harrison G. White, Designing Engineers	4¼″	8580	59	Feb. 1937
Kernwood Bridge over Danvers River	Salem and Beverly, Massachusetts	Moore & Haller, Incorporated, Consulting Engineers and County of Essex	3″	1192	9	Sept. 1938
Foot Bridge, Old Harbor Village	Boston, Mass.	City of Boston, Public Works Department	4¼″	960	6	1941
Repairs to Span No. 4, Bridge No. 0.87—Summer Street	Boston, Mass.	New York, New Haven & Hartford Railroad Company	3″	13412	105	1941
Bridge on Commercial Avenue, over Lechmere Canal	Cambridge, Mass.	Cleverdon, Varney & Pike	3″	720	6	Aug. 1939
Quincy Ave. Bridge	Weymouth, Mass.	Commomwealth of Massachusetts Highway Bridge Department	3″	1133	9	June 1940
Plum Island Bridge	Newbury, Mass.	County of Essex, Engineers Office	3″	341	3	Sept. 1940
Albion Street Bridge	Albion, Mich.	City of Albion	3″	1950	15	Dec. 1936
Clinton Street Bridge	Albion, Mich.	City of Albion	3″	2730	21	Sept. 1936
Belinda Street Bridge over Saginaw River	Bay City, Mich.	Hazelet and Erdal, Consulting Engineers	3″	12300	101	July 1937
East Grand Boulevard Viaduct (Grand Trunk Railroad Portion)	Detroit, Mich.	City of Detroit, Department of Grade Separation	3″	17371	132	June 1934
East Grand Boulevard Viaduct (Grand Trunk Railroad Portion)	Detroit, Mich.	Grand Trunk Western Railroad	3′	6801	48	July 1934
Belle Isle Bridge Replacement	Detroit, Mich.	City of Detroit	4¼″	2850	18	Aug. 1937
State Bridge Project on Route M-28 over S. Branch of Ontonagon River	Ewen, Michigan	Michigan State Highway Department	3″	8151	63	Oct. 1936
Michigan Avenue Bridge	Lansing, Michigan	City of Lansing, Office of City Engineer.	3½″	18099	149	May 1935

LOK CONTRACTS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Dakin Street Bridge	Lansing, Michigan	City of Lansing, Office of City Engineer.	3"	2016	16	Aug. 1936
Bridge across Sturgeon River	1 mile east of Namha Junction, Mich.	Michigan State Highway Department.	3"	2632	20	Jan. 1936
Grade Separation over M. C. R. R.	Vassar Twp., Tuscola County, Mich.	Michigan State Highway Department.	3½"	575	5	Dec. 1940
International Bridge	Port Huron, Mich., & Point Edward, Ont.	Modjeski-Masters & Case	4¼"	29043	195	Jan. 1938
Bridge B1 of 31-10-1 Crossing Portage Canal	Hancock, Mich.	Michigan State Highway Department.	3"	953	7	March 1938
Bridge on M-64 over Ontonagon River	Ontonagon, Mich.	Michigan State Highway Department.	3½"	2850	24	Sept. 1939
Bridge M-8-9-4	Angora, Minn.	St. Louis County Engineer	3½"	1871	31	Nov. 1934
Bridge N-1-29-1	Angora, Minn.	St. Louis County Engineer	3½"	1871	31	Nov. 1934
Bridge 5374	Austin, Minn.	State of Minnesota, Department of Highways	3½"	6374	53	Dec. 1936
Bridge No. 5741	Austin, Minn.	State of Minnesota, Department of Highways	3"	1888	14	Oct. 1937
Red Lake River Bridge No. 5365	East Grand Fork, Minnesota	P. A. Helseth, Consulting Engineer, Minneapolis, Minnesota	3"	5128	40	Oct. 1936
Bridge H-8-2-1	Forbes, Minn.	St. Louis County Engineer	3½"	3935	32	Nov. 1934
Grade Separation-Hwy. Underpasses-Bridges No. 5309 & 5308, Minneapolis and St. Louis and Chicago, Milwaukee, St. Paul, and Pac. Rwys.	St. Louis Park, Minn.	State of Minnesota, Department of Highways, and Chicago, Milwaukee, St. Paul and Pacific Railway	3½"	12428	105	Oct. 1936
Bridge over Mississippi River	Minneapolis, Minn.	City of Minneapolis, Minnesota	3"	13731	109	1941
Springfield Bridge No. 5755	Springfield, Minn.	State of Minnesota, Department of Highways	3"	2198	16	Sept. 1937
Gooseberry River Bridge	Northeast of Two Harbors, Minn.	State of Minnesota, Department of Highways	3"	8370	61	March 1937
Bridge No. M-6-4-1	Virginia, Minn.	Office of the County Highway Engineer, St. Louis County, Minnesota	4¼"	1785	12	March 1939
Bridge No. N-2-32-1	Ely, Minnesota	Office of the County Highway Engineer, St. Louis County, Minnesota	4¼"	1046	7	Dec. 1940
Bridge over Cow Creek	Lauderdale County, Mississippi	Mississippi State Highway Department	3½"	2404	20	July 1937
Repairs to Bridge at St. Charles, Mo.	St. Charles, Mo.	Missouri State Highway Department	3½"	3030	25	June 1935
Lafayette Bridge, Forest Park	St. Louis, Mo.	City of St. Louis	3"	3400	23	May 1935
Grade Separation Bridge Project WPGM-350-E, Missouri, Kansas, and Texas and Missouri Pacific Railroad Underpass	Sedalia, Missouri	Missouri State Highway Department and Missouri, Kansas, and Texas Railway	3"	1479	12	Oct. 1936
Bridge over Missouri River	.25 mile east of Weldon Springs, Mo.	Missouri State Highway Department	3½"	88296	810	Jan 1936
Bridge, Project 26-B	Wahoo, Saunders County, Nebraska	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	3027	28	July 1937
Bridge, Little Muddy Creek, Project 208-A-(2)-1	Richardson County, Nebraska	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	2643	20	June 1938
Bridge, Whiskey Run, Project 208-B-(2)-1	Richardson County, Nebraska	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	2384	18	June 1938
Bridge, Muddy River, Project 208-E-(2)-1	Nemaha County, Nebr.	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	1956	15	June 1938
48th St. Underpass FAGM-425-B	Lincoln, Nebr.	Chicago, Rock Island and Pacific Railway and State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges-Dobin & Robinson	3½"	1900	15	Jan. 1939
Bridge on Road No. 3, Project FAP-118-B (4)	Fairbury, Nebr.	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	3156	21	Jan 1939

ARMORED I-BEAM-

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Bridge Reconstruction Fairmont-Osceola Road	Stromsburg, Nebr.	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	1567	12	Feb. 1939
Fed. Aid Projects 211 (3), 250-A (2) and 250-B (1)	Wymore, Gage Co., Nebraska	State of Nebraska, Department of Roads and Irrigation, Bureau of Roads and Bridges	3"	1598	12	Aug. 1939
Bridge, Franklin Pierce Highway	Chesterfield, N. H., Brattleboro, Vt.	State of New Hampshire, State Highway Department	3"	10212	80	Nov. 1936
Repairs to Arch Span over Connecticut River	NorthWalpole, N. H., to Bellows Falls, Vt.	State of New Hampshire, State Highway Department	3"	11517	89	Nov. 1936
Orford-Fairlee Bridge	Orford, N. H. to Fairlee, Vt.	State of New Hampshire, State Highway Department	3"	10215	80	March 1937
Bridge over Pemigewasset River	Bridgewater-Ashland, New Hampshire	State of New Hampshire, State Highway Department	3"	11470	89	April 1938
Kentucky Bridge No. 1077	Salem, N. J.	County of Salem, New Jersey	3"	392	3	Oct. 1935
Repairs to Bridge No. 1217	Salem, N. J.	County of Salem, New Jersey	3"	360	3	July 1937
Doremus Ave. Bridge	Newark, N. J.	City of Newark, Department of Public Affairs, Transit Bureau	3½"	33588	275	Jan. 1939
Grade Separation Chicago, Rock Island, and Pacific Railway, Highway Underpass	Logan, N. M.	Chicago, Rock Island and Pacific Railway	3"	750	6	Feb. 1936
Pecos River Bridge	Ft. Sumner, N. M.	New Mexico State Highway Department	3"	16172	128	Feb. 1939
Andover-Alfred Bridge No. 5	Alfred, N. Y.	State of New York, Department of Public Works, Division of Engineering	3"	2070	16	June 1936
Bridge No. 111, Kayaderosseras Creek	Milton, New York	County of Saratoga, Department of Highways	3½"	2108	17	Aug. 1937
Bridge No. 119.1 Kayaderosseras Creek	Milton, New York	County of Saratoga, Department of Highways	3"	2156	17	April 1937
Deforest Street Bridge	Binghamton, N. Y.	City of Binghamton	3"	8525	65	Oct. 1934
Floor of Dumping Pier No. 1 of Wallabout Basin	Brooklyn, New York	City of New York, Department of Docks	4¼"	18000	119	Aug. 1937
Floor of Dumping Pier at West 52nd Street	Brooklyn, New York	City of New York, Department of Docks	4¼"	17000	112	Oct. 1937
Madison County Bridge	Canastota, N. Y.	Private Plans	3"	1796	14	Jan. 1936
Rip Van Winkle Bridge	Catskill, N. Y.	State of New York, Department of Public Works, Division of Engineering	3½"	1829	15	Feb. 1936
Forge-Ellensburg Bridge	Clinton County, N. Y.	State of New York, Department of Public Works, Division of Engineering	3"	1966	15	April 1935
150-Foot Through Truss Bridge	Cooperstown, N. Y.	Private Plans	3"	3600	28	Aug. 1936
Cape Vincent—Watertown Bridge	Dexter, N. Y.	State of New York, Department of Public Works, Division of Engineering	3"	3200	24	Oct. 1935
Bridge No. 261	Elnora, N. Y.	County of Saratoga, Department of Highway	3"	615	4	May 1936
Bridge No. 5	Gee Brook-Willet, New York	State of New York, Department of Public Works, Division of Engineering	3½"	1423	12	Feb. 1936
Chenango County Bridge RC-3716-17	Greene, N. Y.	State of New York, Department of Public Works, Division of Engineering	3"	1100	9	Dec. 1936
Bridge No. 122	Greenfield, N. Y.	County of Saratoga, Department of Highways	3"	1072	9	April 1937
Bridge Project No. 73	Harrisville, N. Y.	St. Lawrence County, Department of Highways	3"	1857	14	Oct. 1937
Bridge Project No. 74	Lawrenceville, N. Y.	St. Lawrence County, Department of Highways	3"	1512	12	Sept. 1936
Bridge Project No. 79	Heuvelton, N. Y.	St. Lawrence County, Department of Highways	3"	4108	32	Oct. 1937

LOK CONTRACTS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Ilion Village Bridge No. 1 Herkimer County	Ilion, New York	State of New York, Department of Public Works, Division of Engineering	3½″	2300	19	Sept. 1936
Leonardsville Bridge	Leonardsville, N. Y.	Private Plans	3″	1676	13	Oct. 1936
Bascule Bridge over Flushing River Southerly Unit	New York, N. Y.	City of New York, Department of Plants and Structures	3″	2750	23	Nov. 1937
Bronx-Whitestone Bridge Contract WB-5	New York, N. Y.	Triborough Bridge Authority	4¼″	212400	1606	Dec. 1937
Queensboro Bridge	New York, N. Y.	City of New York, Department of Plants and Structures	3½″	109210	977	Sept. 1936
Youngstown-Olcott Bridge	Niagara County, New York	State of New York, Department of Public Works, Division of Engineering	3½″	4040	45	April 1935
Deer River Project No. 74	North Lawrence, New York	St. Lawrence County, Department of Highways	3″	1458	11	Sept. 1936
Bridge at Hinmansville	Oswego County, New York	State of New York, Department of Public Works, Division of Canals and Waterways	3″	1984	16	Oct. 1934
Bridge No. 2	Oxford-McDonough, New York	State of New York, Department of Public Works, Division of Engineering	3½″	898	8	July 1936
Rockwell Mills Bridge	Rockwell Mills, New York	State of New York, Department of Public Works, Division of Engineering	3½″	1230	10	April 1936
Saratoga County Highway Bridge No. 270	Round Lake, N. Y.	County of Saratoga, Department of Highways	3″	658	5	May 1935
Rouses Point Bridge	Rouses Point, N. Y., Alburg, Vermont	Fay, Spofford and Thorndike, Consulting Engineers	4¼″ 3″	6660 115	45 1	Aug. 1936
Bridge	Ballston Spa, N. Y.	County of Saratoga, Department of Highways	3″	769	6	July 1935
Bridge No. 32 over Fish Creek, Victory Mills	Saratoga, N. Y.	County of Saratoga, Department of Highways	3″	1330	10	May 1937
Spencer Village Bridge No. 1	Spencer, N. Y.	State of New York, Department of Public Works, Division of Engineering	3″	1575	13	Dec. 1934
Bridge	Syracuse, N. Y.	Private Plans	3″	601	5	April 1936
Onandaga Creek Bridge	Syracuse, N. Y.	State of New York, Department of Public Works, Division of Engineering	3″	1028	8	Oct. 1934
Stearns Farm Bridge	Syracuse, N. Y.	State of New York, Department of Public Works, Division of Canals and Waterways	3½″	1293	11	Sept. 1936
Thousand Island Bridge over St. Lawrence River	American Crossing, Watertown, N. Y.	Robinson and Steinman	4¼″	34700	229	Dec. 1937
Thousand Island Bridge over St. Lawrence River	Canadian Crossing, Leeds County, Ontario	Robinson and Steinman	4¼″	45000	280	May 1937
Manhattan Bridge-New Floors at Exp. Jts. & Towers	New York	City of New York, Department of Plants and Structures	3½″	511	5	Nov. 1937
Pittsford-Palmyra Bridge	Wayne County, N.Y.	State of New York, Department of Public Works, Division of Engineering	3″	3462	26	March 1935
Westchester Ave. Bridge	Bronx, New York	City of New York, Department of Plants and Structures	3½″	750	6	Jan. 1938
Williamsburg Bridge Reconstruction of Outer Roadways	Manhattan, N. Y.	The City of New York, Department of Public Works	3½″	48244	450	Feb. 1938
Reconstruction of Main Roadway of Manhattan Bridge	New York, N. Y.	City of New York, Department of Public Works	3½″	185256	1563	April 1938
Bascule Bridge over Flushing River, Northerly Unit	New York, N. Y.	City of New York, Department of Plants and Structures	3″	2750	23	May 1938
Muskrat Creek Bridge	Auburn, N. Y.	Cayuga County Highway Department	3½″	704	6	May 1938
Bridge	Auburn, N. Y.	Cayuga County Highway Department	3½″	350	3	July 1938
Project 83, Bridge No. 1	Winthrop, N. Y.	St. Lawrence County, Department of Highways	4¼″	964	7	July 1938

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Project 84, Bridge No. 3	Madrid, N. Y.	St. Lawrence County, Department of Highways	4¼"	390	3	July 1938
Project 84, Bridge No. 4	Madrid, N. Y.	St. Lawrence County, Department of Highways	4¼"	846	6	July 1938
West Milton Bridge No. 113	Town of Milton, N. Y.	Saratoga County Engineers	3"	1091	9	1941
Project 87, Bridge No. 1	Emerysville, N. Y.	St. Lawrence County, Department of Highways	4¼"	390	3	July 1938
Bucks Bridge over Grass River	Madrid, N. Y.	St. Lawrence County, Department of Highways	4¼"	6084	40	July 1938
Two Bridges	Town of Milton, and Town of Charlton, N. Y.	County of Saratoga, County Department of Highways	3" 3"	2616 2616	20 20	July 1938 July 1938
Queensboro Bridge (Upper Roadway)	New York, N. Y.	City of New York, Department of Plants and Structures	2½"	83750	581	Aug. 1938
Bridge No. 142	Livingston Manor, New York	Sullivan County Highway Department	3"	921	7	Sept. 1938
Steuben County Bridge	Corning, N. Y.	Steuben County Highway Department	4¼"	962	7	Sept. 1938
Madison Ave. Bridge over Chemung River	Elmira, N. Y.	Robinson & Steinman, Engineers	4¼"	23215	150	May 1939
Brasher Landing Bridge	Near Helena, N. Y.	St. Lawrence County, Department of Highways	4¼"	4607	30	Nov. 1939
Bridge No. 190 (Paul Creek)	Town of Day, N. Y.	County of Saratoga, County Department of Highways	3"	931	7	Sept. 1939
Bridge	Near Auburn, N. Y.	Cayuga County Highway Department	3½"	760	6	April 1940
Kayaderosseras Creek Bridge	Saratoga Springs, N.Y.	County of Saratoga, County Department of Highways	3"	1130	9	May 1940
Bridge No. 193 Daly Creek	Town of Day, N. Y.	County of Saratoga, County Department of Highways	3"	1658	13	June 1940
Bennet Street Bridge Approaches	Hornell, N. Y.	U. S. Engineers-Binghamton, N. Y.	3½"	1502	12	June 1940
River Street Bridge	Hornell, N. Y.	U. S. Engineers-Binghamton, N. Y.	3½"	3952	24	June 1940
Bridge	Near Auburn, N. Y.	Cayuga County Highway Department	3½"	484	4	Aug. 1940
Bridge	Near Auburn, N. Y.	Cayuga County Highway Department	3½"	706	6	Aug. 1940
Reconstruction Bridge No. 141-½	Livingston Manor, N. Y.	New York, Ontario & Western Railway	3"	2558	19	Sept. 1940
Albemarle Sound Bridge	Washington-Chowan Counties, N. C.	State of North Carolina, State Highways and Public Works Commission	3"	7550	59	Feb. 1937
Highway Bridge	Coinjock, N. C.	U. S. Engineers, Norfolk, Va.	3"	6631	52	Sept. 1939
Subway under Northern Pacific Railway Track on Tenth Street	Fargo, N. D.	North Dakota Department of Highways	3½"	3060	25	June 1937
Loveland-Maderia Road Bridge No. 28	Allendale, Ohio	Hamilton County Engineers Office	3"	1680	13	April 1935
Columbia Avenue Bridge	Cincinnati, Ohio	Department of Public Works of the City of Cincinnati, Division of Highways	3½"	5230	42	Jan. 1936
Bridge No. 462/1A on Akron-Chicago Division	Cleveland, Ohio	The Baltimore and Ohio Railroad, Office of Engineer of Bridges	3½"	5832	48	April 1937
Lake Front Boulevard Bridges over CEI Co's Plant	Cleveland, Ohio	State of Ohio, Department of Highways	3½"	21960	183	May 1937
Bridge No. 857	Defiance, Ohio	Wabash Railroad Company	3"	1743	14	May 1936
Bridge at Cadiz, Ohio	Harrison County, O.	Harrison County	3½"	1089	8	June 1935
Old State Road Bridge	Norwalk, Ohio	Huron County	3"	924	8	Oct. 1935
Charles Mill Reservoir Bridge	Near Pavonia, Ohio	U. S. Engineers, Muskingum Conservancy District, Zanesville, O.	3"	2814	20	Sept. 1936
Unionvale Bridge	Unionvale, Ohio	Harrison County	3"	1659	13	July 1936
Bridge No. GR-68-134 over Massie Creek	Xenia, Ohio Green County	State of Ohio, Department of Highways	3½"	3362	28	March 1938
Bellview Bridge	Adena, Ohio	Harrison County	4¼"	1769	11	April 1938

LOK CONTRACTS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Wooster Avenue Bridge	New Philadelphia—Dover, Ohio	Tuscarawas County	4¼″	12998	86	Oct. 1938
East 9th St. Bridge over NYC and PRR	Cleveland, Ohio	Cuyahoga County	3″	13500	105	Oct. 1938
Main Ave. Bridge, East Approach	Cleveland, Ohio	County of Cuyahoga, Bridge Department	4¼″	73300	485	Nov. 1938
Main Avenue Bridge, West Approach	Cleveland, Ohio	County of Cuyahoga, Bridge Department	4¼″	58000	364	Nov. 1938
Main Ave. Bridge, Lake Front Ramp of East Approach	Cleveland, Ohio	County of Cuyahoga, Bridge Department	4¼″	54500	360	April 1939
Reconstruction of Bridge on E. Market St. at College St.	Akron, Ohio	City of Akron, Ohio Department of of Public Service, Division of Highways	4¼″	6688	45	Jan. 1939
Main Ave. Bridge, East Approach W9th to W6th Sts.	Cleveland, Ohio	County of Cuyahoga, Bridge Department	4¼″	4300	28	Jan. 1939
Carter Road Bridge	Cleveland, Ohio	Wilbur J. Watson, Consulting Engineer, and City of Cleveland	4¼″	17082	113	Sept. 1939
Upton Avenue Bridge over Ten Mile Creek	Toledo, Ohio	City of Toledo, Department of Public Service, Division of Bridges	4¼″	2375	15	July 1939
General Ulysses Grant Bridge	Portsmouth, Ohio	Dravo Corporation, Modjeski and Masters	3″	50282	332	Oct 1939
Columbus Road Bridge	Cleveland, Ohio	City of Cleveland, Department of Public Service, Division of Engineering and Construction, Wilbur J. Watson & R. L. Harding, Engineers	4¼″	4700	30	Sept. 1939
Wilson Ave. Bridge over Dry Run	Youngstown, Ohio	Mahoning County Engineers Office	3″	1740	14	Sept. 1939
Upper West 3rd Street Bridge	Cleveland, Ohio	Wendell P. Brown, Consulting Engineer	4¼″	12200	80	Sept. 1939
Reflooring Silver Bridge	Point Pleasant, W. Va. to Gallipolis, Ohio	J. E. Greiner Co., Consulting	3″	32094	249	1941
Erie Avenue Bridge	Lorain, Ohio	Wilbur J. Watson, Consulting Engineer	4¼″	33900	225	Sept. 1939
East 21st Street Bridge	Lorain, Ohio	Wilbur J. Watson, Consulting Engineer	4¼″	72000	465	Sept. 1939
Avery Road Bridge over Chippewa Creek, Bridge No. 77	Broadview Heights Village, Ohio	Cuyahoga County, Bridge Department	4¼″	3800	24	Jan. 1940
East 9th Street Underpass at Lakefront Hwy.	Cleveland, Ohio	City of Cleveland, Department of Public Service, Division of Engineering and Construction	3½″	5200	43	May 1940
Bridge No. PR-127-209 over Price Creek	Preble County	State of Ohio, Department of Highways, Bureau of Bridges	3″	1890	15	June 1940
Mahoning Ave. Bridge-Bridge No. 49 over Mill Creek	Youngstown, Ohio	Mahoning County Engineers Office	3½″	40100	310	Aug. 1940
Bulkley Blvd. Imp. FAP-131-A-(1)	Cuyahoga County, Ohio	State of Ohio, Department of Highways, Bureau of Bridges (CU-6-127)	4¼″ 2½″	6880 2030	46 15	Oct. 1940
Fairmont Blvd. Bridge No. 189	Chagrin Falls, Ohio	County of Cuyahoga, Bridge Department	4¼″ 2½″	10800 2700	65 20	Oct. 1940
Hwy. Underpass at Intersection of Chicago, R. I. & Pac. Ry. & U. S. Highway No. 270	Near Hilltop, Okla.	Chicago, Rock Island and Pacific Railway & Oklahoma State Highway Commission	3″	1070	9	June 1936
Undergrade Crossing State Highway 33-Broadway	Kingfisher, Oklahoma	Chicago, Rock Island and Pacific Railway & Oklahoma State Highway Commission	4¼″	3925	26	July 1937
Chicago, Rock Island & Pacific Railway Highway Underpass	Oklahoma City, Oklahoma	Chicago, Rock Island and Pacific Railway & Oklahoma State Highway Commission	3½″	1050	8	Nov. 1935
Chicago, Rock Island & Pacific Railway Highway Underpass	Calvin, Oklahoma	Chicago, Rock Island and Pacific Railway & Oklahoma State Highway Commission	3″	1501	12	June 1936
Overpass over CRI&P Ry. Walnut Avenue	Oklahoma City, Oklahoma	Chicago, Rock Island and Pacific Railway & Oklahoma State Highway Commission	4¼″	11580	76	Aug. 1937

ARMORED I-BEAM-

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
15th Street Hwy. Underpass	Tulsa, Oklahoma	Oklahoma State Highway Department, Wood & Witten Consulting Engineers	3"	900	7	Nov. 1936
Midland Valley & 11th Street Underpass	Tulsa, Oklahoma	Oklahoma State Highway Department	3½"	1270	10	Jan. 1937
Market Street Bridge	Harrisburg, Pa.	Modjeski, Masters & Case	3"	53043	434	March 1935
Jefferson County Bridge, Route 33052	Henderson Township, Pa.	Commonwealth of Pennsylvania, Department of Highways	3½"	1690	14	April 1937
Lehigh County Bridge R-39062	Lowhill Township, Pennsylvania	Commonwealth of Pennsylvania, Department of Highways	3½"	1375	12	Feb. 1937
Jerome Street Bridge	McKeesport, Pa.	Allegheny County Authority	4¼"	24900	196	Sept. 1936
Crooked Lane Crossing-Hwy. Overpass, Phila. & Western Ry.	Millbourne Mills, Upper Darby, Pa.	Stone and Webster Engineering Corporation	3"	1026	8	Aug. 1936
Grade Separation	North Bessemer, Pennsylvania	Bessemer and Lake Erie Railroad	3½"	1700	14	Sept. 1937
Port Perry Bridge over Monongahela River, Union Railroad Company	Port Perry, Munhall, Pa.	Private Plans	3½"	20250	175	Feb. 1936
Grade Separation	Russellton, Pa.	Bessemer and Lake Erie Railroad	3½"	1440	12	July 1936
Warren County Bridge R-95	Warren, Pa.	Commonwealth of Pennsylvania, Department of Highways	3"	5051	40	April 1936
Granville Bridge, Pike Run No. 5	Washington County, Pennsylvania	Washington County	3½"	890	7	Oct. 1937
Crawford County Bridge R-20108	Cussewago Township, Pa.	Commonwealth of Pennsylvania, Department of Highways	3½"	1512	12	Aug. 1937
Pittsburgh-Homestead High Level Bridge	Allegheny County	Allegheny County Authority	4¼"	107500	850	June 1936
Bridge over Kiskimenetas River	Avonmore, Pa.	Commonwealth of Pennsylvania, Department of Highways	3"	11310	87	March 1937
Bridge on Route R-183, Montour Twp., Columbia County	Catawissa, Pa.	Commonwealth of Pennsylvania, Department of Highways	3"	23760	184	Dec. 1937
Pennsylvania Highway Bridge	Delaware County, Chichester Township, R-599, Pa.	Commonwealth of Pennsylvania Department of Highways	3½"	1188	9	1941
Repairs to Spring Hill Township Bridge	Fayette County, Pennsylvania	Commonwealth of Pennsylvania, Department of Highways	3"	1166	9	Aug. 1937
Washington County Bridge	Frye Station, Pa.	Chaney Engineering Company	3½"	1962	16	Sept. 1935
Overhead Bridge, Cheswick and Harmar RR	River Valley, Pa.	Bessemer & Lake Erie Railroad Company	3½"	620	5	Jan. 1938
Through Truss Bridge on R-43081	Sharpsville, Mercer County, Pa.	Commonwealth of Pennsylvania, Department of Highways	3"	4515	35	Sept. 1938
Adamsburg Overpass of Route 120 over Route 118 Spur	Irwin, Pa.	Commonwealth of Pennsylvania, Department of Highways	3½"	2575	21	Sept. 1938
Bridge on Route 271	Union City, Erie County, Pa.	Commonwealth of Pennsylvania, Department of Highways	3"	2809	22	Nov. 1938
Prospect Viaduct over PRR	Johnstown, Pa.	City of Johnstown, Bureau of Engineering, Department of Streets and Public Improvements	3"	19225	154	Dec. 1938
Boals Bridge No. 25	Jackson Township	Venango County Engineers	3½"	1702	14	Oct. 1939
Bridge on Route 03054	South Bend & Plum Creek Twsps., Pa.	Commonwealth of Pennsylvania, Department of Highways	3½"	3442	28	Aug. 1939
South Franklin St. Bridge	Titusville, Pa.	Crawford County Engineer	3"	6171	48	Aug. 1939
South Main St. Hwy. Overpass	Greenville, Pa.	Commonwealth of Pennsylvania, Department of Highways and Bessemer & Lake Erie Railroad	3½"	1345	11	Dec. 1939
Highway Bridge over P&LE RR	Hillsville, Pa.	Pittsburgh Limestone Company	3"	730	6	1941
Reflooring Bridge on R-118	Speers & Belle Vernon Boroughs, Pa.	Commonwealth of Pennsylvania Department of Highways	3"	19139	150	1941
Bridge on R-187-6-B	Wilkins & Patton Townships, Pa.	Commonwealth of Pennsylvania Department of Highways	4¼"	42230	280	1941

LOK CONTRACTS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Water Street Imp.	Pittsburgh, Pa.	County of Allegheny, County Department of Works	4¼″	55930	488	Sept. 1939
Bridge on Route 61033	Sheffield Twp., Pa.	Commonwealth of Pennsylvania, Department of Highways	3″	1990	15	Sept. 1939
Munhall Arch Replacement	Munhall, Pa.	Union Railroad Company	4¼″	48654	370	Jan. 1940
Dookers Hollow Bridge	Between E. Pgh. and North Braddock Boro., Pennsylvania	County of Allegheny, County Department of Works	4¼″	25935	237	May 1940
Bridge on R-166 Monroe County	Stroudsberg, Pa.	Commonwealth of Pennsylvania, Department of Highways	3″	9807	76	June 1940
Bridge on R-02226	Trafford, Pa.	Commonwealth of Pennsylvania, Department of Highways	3½″	1732	14	Aug. 1940
Bridge on R-20011	Adamsville, Pa.	Commonwealth of Pennsylvania, Department of Highways	3½″	2272	14	Dec. 1940
Savannah River Bridge	Allendale, S. C. and Sylvia, Ga.	South Carolina State Highway Department	4¼″	5145	37	Oct. 1937
Bridge over Wateree River on Route 76	Richland-Sumter Counties, S. C.	South Carolina State Highway Department	3″	8636	67	Oct. 1939
Bridge over Cheyenne River	Wasta, South Dakota	South Dakota State Highway Commission	4¼″	25909	178	Jan. 1940
Haraham Bridge	Memphis, Tenn.	State of Tennessee, Department of Highways and Public Works	2½″	2951	23	July 1940
Grade Separation at Buchanan St., Chicago, Rock Island and Pacific Railway and Ft. Worth and Denver City Hwy. Underpass	Amarillo, Texas	Chicago, Rock Island and Pacific Railway and Texas State Highway Department	3″ 3½″	2546 4187	20 35	Aug. 1936
Grade Separation at West 6th St., Chicago, Rock Island and Pacific Railway, Hwy. Underpass	Amarillo, Texas	Chicago, Rock Island and Pacific Railway and Texas State Highway Department	3½″	2468	21	July 1937
Virgin River Bridge	North of Hurricane, Utah	State of Utah, State Road Commission	3½″	10323	84	Nov. 1936
Norfolk-Portsmouth Bridge	Norfolk, Virginia	Harrington & Cortelyou, Consulting Engineers	3″	5512	43	Aug. 1939
South Side Bridge	Charleston, W. Va.	City of Charleston, West Virginia, Col. C. P. Fortney, Consulting Engineer	4¼″	34500	230	June 1936
Goff Plaza Bridge	Clarksburg, W. Va.	The State Road Commission of West Virginia	3″ 3½″	11538 2162	89 18	Sept. 1935
Huntington and Chesapeake Bridge	Huntington, W. Va.	Private Plans	3″	41891	315	Sept. 1935
Guyandot River Bridge	Logan, W. Va.	The State Road Commission of West Virginia	3″	718	6	April 1937
Montgomery Bridge No. 1034	Montgomery, W. Va.	The State Road Commission of West Virginia	3″	15728	122	Dec. 1934
Bridge No. 1462 over Ohio River (Repairs) (Fire Burned Area)	Williamstown, W.Va., Marietta, Ohio	The State Road Commission of West Virginia	3″	11400	88	Jan. 1940
Marietta Approach of Williamstown Bridge No. 1462	Williamstown, W.Va., Marietta, Ohio	The State Road Commission of West Virginia	3″	12000	97	Sept. 1940
Walnut Street Bridge	Morgantown, W. Va.	The State Road Commission of West Virginia	3″	9960	77	Dec. 1935
Bridge No. S-1566	Luke, Md. and Piedmont, W. Va.	West Virginia State Road Commission	3″	5350	41	1941
Fifth Street Bridge over Little Kanawha River	Parkersburg, W. Va.	The State Road Commission of West Virginia, Col. C. P. Fortney, Consulting Engineer	3½″	14350	117	Feb. 1936
Point Lick Bridge, Campbell Creek	Tad, W. Va., Kanawha County	The State Road Commission of West Virginia	3″	900	7	June 1935
Kanawha Blvd. Bridge over Elk River	Charleston, W. Va.	City of Charleston, Col. C. P. Fortney, Consulting Engineer	4¼″	24812	172	March 1938
Bridge No. 1406	Hinton, W. Va.	The State Road Commission of West Virginia	3″	22000	170	April 1938

2″ T-TRI-LOK INSTALLATIONS F

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Kenilworth Avenue Bridge over Verdugo Wash	Los Angeles, California	United States War Department, Los Angeles Flood Control District	2″	1235	8	Aug. 1936
Pacific Avenue Bridge over Verdugo Wash	Los Angeles, California	United States War Department, Los Angeles Flood Control District	2″	1104	7	Aug. 1936
Glenoaks Boulevard Bridge over Verdugo Wash	Los Angeles, California	United States War Department, Los Angeles Flood Control District	2″	1080	7	Sept. 1936
Central Avenue Bridge over Verdugo Wash	Los Angeles, California	United States War Department, Los Angeles Flood Control District	2″	1294	8	Sept. 1936
Jackson Street Bridge over Verdugo Wash	Los Angeles, California	United States War Department, Los Angeles Flood Control District	2″	1080	7	Sept. 1936
West Brand Boulevard Bridge over Verdugo Wash (1)	Glendale, California	United States War Department, Los Angeles Flood Control District	2″	576	4	March 1937
West Brand Boulevard Bridge over Verdugo Wash (2)	Glendale, California	United States War Department, Los Angeles Flood Control District	2″	570	4	Dec. 1937
Geneva Street Bridge over Verdugo Wash	Los Angeles, California	United States War Department, Los Angeles Flood Control District	2″	1188	8	Dec. 1937
Bridge—Improvement of Beech St. at Yerba Avenue	Oakland, California	City of Oakland, California	2″	481	3	Feb. 1940
Pasadena Bridge	Pasadena, California	City of Pasadena, California	2″	2020	13	June 1940
Porch Floor, Broadmoor Hotel	Colorado Springs, Col.	O. O. Phillips	2″	3875	24	March 1938
Grand Stands, Will Rogers Stadium	Colorado Springs, Col.	Private Plans	2″	15689	69	April 1938
Commerce Street Bridge	Hartford, Conn.	Connecticut State Highway Department	2″	1155	7	1941
Quinnipiac River Bridge	Meriden, Conn.	Connecticut State Highway Department	2″	520	3	July 1935
Operator's House Floor	East Haddon, Conn.	Connecticut State Highway Department	2″	450	2	July 1937
Bridge over Connecticut River at Windsor Locks	Windsor, Conn.	Connecticut State Highway Department	2″	8962	34	Sept. 1937
Broad Street Bridge	Seymour, Conn.	Connecticut State Highway Department	2″	304	1	Jan. 1939
Chas. W. Cullen Bridge	Near Dover, Del.	Harrington & Cortelyou, Consulting Engineers	2″	960	6	Feb. 1939
Flagler Memorial Bridge	West Palm Beach, Florida	Hazelet & Erdal, Consulting Engineers, J. M. Boyd, County Engineer	2″	830	6	May 1937
Hillsboro River Bridge	Tampa, Florida	State of Florida, State Road Department	2″	1050	4	Sept. 1938
Bridge over Gulf County Canal	Port St. Joe, Florida	State of Florida, State Road Department	2″	412	3	Sept. 1938
Miami Canal Bridge at Northwest 27th Avenue	Miami, Florida	Harrington & Cortelyou, Consulting Engineers	2″	1750	12	Jan. 1939
Chicago Northwestern Bridge	East Rockford, Ill.	Chicago Northwestern Railway	2″	980	9	April 1936
Torrence Avenue Bridge	Chicago, Ill.	City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges	2″	4576	32	July 1936
Outer Drive Improvement, Bridge over the Chicago River	Chicago, Ill.	Chicago Park District	2″	6361	43	Aug. 1936
Outer Drive Improvement, Bridge over Michigan Canal	Chicago, Ill.	Chicago Park District	2″	2178	15	Nov. 1936
Wash House Floor for Lewin Metals Corp.	Monsanto, Ill.	St. Louis Structural Steel Company	2″	1270	8	Jan. 1937
Central Park Ave. Pumping Station	Chicago, Ill.	City of Chicago, Department of Public Works	2″	1388	9	June 1939
Bridge over Central Park Avenue	Chicago, Ill.	Wendnagel & Company	2″	663	2	Aug. 1939
89th St. Viaduct, CIL South Wks.	Chicago, Ill.	Private Plans	2″	5397	38	Sept. 1939
Bridge over White River at New York Street	Indianapolis, Ind.	City of Indianapolis, Department of Engineering	2″	10300	39	Jan. 1939
Cambridge Creek Bridge	Cambridge, Md.	State of Maryland, State Roads Commission	2″	700	4	March 1939

SIDEWALKS, WAREHOUSES, ETC.

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Foot Bridge	Holyoke, Mass.	Raymond Palmer, Engineer	2″	1288	8	Dec. 1933
Apponaganset River Bridge	Dartmouth, Mass.	Commonwealth of Massachusetts, Highway Bridge Department	2″	600	4	Dec. 1935
Becket Bridge, Westfield River	Becket, Mass.	Department of Public Works, Boston	2″	357	2	July 1936
Boiler House Floor	Pittsfield, Mass.	General Electric Company	2″	550	3	Sept. 1938
Drawbridge at Eel Pond	Falmouth, Mass.	Commonwealth of Massachusetts, Highway Bridge Department	2″	586	2	Feb. 1940
Quincy Avenue Bridge	Weymouth, Mass.	Commonwealth of Massachusetts, Highway Bridge Department	2″	1127	4	June 1940
Michigan Avenue Bridge	Lansing, Mich.	City of Lansing, Office of City Engineer	2″	8181	53	May 1935
State Bridge Project on Route M-28 over South Branch of Ontonagon River	Ewen, Michigan	Michigan State Highway Department	2″	1066	4	Oct. 1936
Genessee Avenue Bridge over Saginaw River	Saginaw, Michigan	Michigan State Highway Department	2″	1540	10	Nov. 1937
Dakin Street Bridge	Lansing, Michigan	City of Lansing	2″	664	4	April 1939
Second Avenue Bridge	Alpena, Mich.	Clifford E. Paine	2″	2080	10	March 1939
Bascule Bridge	Cheboygan, Mich.	Michigan State Highway Department	2″	700	4	June 1940
Foot Bridge Mississippi Lock and Dam No. 5	Minneiska, Minn.	United States Engineers, St. Paul, Minnesota	2″	353	2	Dec. 1936
Gooseberry River Bridge	Northeast of Two Harbors, Minn.	State of Minnesota, Department of Highways	2″	2565	17	March 1937
Bridge 4698	Crookston, Minn.	State of Minnesota, Department of Highways	2″	4368	27	March 1938
Bridge 4433	Hinckley, Minn.	State of Minnesota, Department of Highways	2″	487	2	Aug. 1938
Bridge	Preston Township, Filmore County, Minn.	State of Minnesota, Department of Highways	2″	942	3	Sept. 1940
Overhead Deck Parking Lot Glueck Realty Co.	St. Louis, Mo.	A. A. Aegerter, Architect	2″	20528	131	July 1936
Add'n. Mat'l. for Parking Lot	St. Louis, Mo.	A. A. Aegerter, Architect	2″	1564	10	April 1938
Repairs to Arch Span over Connecticut River	North Walpole, N. H. to Bellows Falls, Vt.	State of New Hampshire, State Highway Department	2″	2473	9	Nov. 1936
Granite Street Bridge	Manchester, N. H.	State of New Hampshire, State Highway Department	2″	3765	25	May 1937
Doremus Avenue Bridge	Newark, N. J.	City of Newark, Department of Public Affairs, Transit Bureau	2″	7364	46	Jan. 1939
Bridge No. 32 over Fish Creek Victory Mills	Saratoga, N. Y.	County of Saratoga, Department of Highways	2″	385	2	May 1937
Bridge No. 111 Kayaderosseras Creek	Milton, N. Y.	County of Saratoga, Department of Highways	2″	463	4	Aug. 1937
Manhole Covers Underground Conduit	New York, N. Y.	New York World's Fair 1939 Inc., Department of Construction	2″	700	5	Feb. 1938
Sidewalk Grating (Central Hudson Gas & Electric Corp.)	Poughkeepsie, N. Y.	Central Hudson Gas & Electric Corp.	2″	34	543	1941
Building—(2nd Floor)	Fulton, N. Y.	Peter Cailler Kohler Chocolates Company, Incorporated	2″	3720	14	Jan. 1940
Building—(3rd Floor)	Fulton, N. Y.	Peter Cailler Kohler Chocolates Company, Incorporated	2″	8584	31	July 1940
Columbia Avenue Bridge	Cincinnati, Ohio	Department of Public Works of the City of Cincinnati, Division of Highways	2″	1300	8	Jan. 1936
Wooster Avenue Bridge	New Philadelphia-Dover, Ohio	Tuscarawas County	2″	5468	34	Oct. 1938
East 9th Street Bridge over N.Y.C. & P.R.R.	Cleveland, Ohio	Cuyahoga County	2″	2500	26	Oct. 1938
Phelps Street Foot Bridge	Youngstown, Ohio	City of Youngstown	2″	1057	7	Nov. 1938
East 21st Street Bridge	Lorain, Ohio	Wilbur J. Watson, Consulting Engineer	2″	17000	115	Sept. 1939

2″ T-TRI-LOK INSTALLATIONS

PROJECT	LOCATION	ENGINEERS	SECTION	SQ. FEET	TONS	DATE
Erie Avenue Bridge	Lorain, Ohio	Wilbur J. Watson, Consulting Engineer	2″	11400	72	Sept. 1939
Carter Road Bridge	Cleveland, Ohio	Wilbur J. Watson, City of Cleveland	2″	10200	62	Sept. 1939
Upper West 3rd Street Bridge	Cleveland, Ohio	Wendell P. Brown, Consulting Engineer	2″	5600	32	Sept. 1939
Columbus Road Bridge	Cleveland, Ohio	City of Cleveland, Department of Public Service—Division of Engineering and Construction—Wilbur J. Watson and R. L. Harding, Engineers	2″	2100	11	Sept. 1939
General Ulysses Grant Bridge	Portsmouth, Ohio	Dravo Corporation—Modjeski & Masters	2″	12600	76	Oct. 1939
Avery Road Bridge over Chippewa Creek Bridge No. 77	Broadview Heights Village, Ohio	Cuyahoga County Bridge Department	2″	1100	4	Jan. 1940
East 9th Street Underpass at Lakefront Highway	Cleveland, Ohio	City of Cleveland, Department of Public Service—Division of Engineering and Construction	2″	1500	9	May 1940
Chicago, Rock Island & Pacific Railway—Highway Underpass	Oklahoma City, Oklahoma	Chicago, Rock Island & Pacific Railway and Oklahoma State Highway Commission	2″	175	1	Nov. 1935
South 10th Street Bridge	Pittsburgh, Pa.	Allegheny County Bridge Department	2″	17662	102	July 1932
Macbeth Evans Glass Co., Floor	Charleroi, Pa.	Chain Belt Company	2″	2035	13	Aug. 1935
Building Floor	Lancaster, Pa.	Pennsylvania Power and Light Co.	2″	5941	38	Aug. 1935
Building Floor	Lancaster, Pa.	Pennsylvania Power and Light Co.	2″	8646	57	May 1936
Bridge over Kiskimenetas River	Avonmore, Pa.	Commonwealth of Pennsylvania, Department of Highways	2″	3860	23	March 1937
Bridge over Oil Creek	Oil City, Pa.	Karl Miller, Engineer	2″	1850	6	July 1937
Porter Street Foot Bridge	Meadville, Pa.	City of Meadville	2″	828	3	Aug. 1937
Prospect Viaduct over P.R.R.	Johnstown, Pa.	City of Johnstown, Bureau of Engineering, Department of Streets and Public Improvements	2″	7260	28	Dec. 1938
South Franklin Street Bridge	Titusville, Pa.	Crawford County Engineers	2″	2730	10	Aug. 1939
Center Street Bridge	Oil City, Pa.	Venango County Engineers	2″	3397	12	Jan. 1940
East Shipping Runway	Lock Haven, Pa.	Castanea Paper Company	2″	8422	31	Sept. 1940
Transformer Vault Covers	Chattanooga, Tenn.	Electric Power Board of Chattanooga, Tennessee	2″	2240	9	Jan. 1939
Transformer Vault Covers	Chattanooga, Tenn.	Electric Power Board of Chattanooga, Tennessee	2″	68	1	April 1940
Transformer Vault Covers	Chattanooga, Tenn.	Electric Power Board of Chattanooga, Tennessee	2″	102	2	Nov. 1940
Spillway Operating Deck, Piers 1 to 10, Kentucky Dam	Gilbertsville, Ky.	Tennessee Valley Authority	2″	2067	8	Oct. 1940
Grade Separation at West 6th St., Chicago, Rock Island & Pacific Railway, Highway Underpass	Amarillo, Texas	Chicago, Rock Island and Pacific Railway and Texas State Highway Department	2″	685	4	July 1937
Portland Street Bridge	St. Johnsbury, Vt.	City of St. Johnsbury	2″	1237	8	Dec. 1933
South Side Bridge	Charleston, W. Va.	City of Charleston, West Virginia, Col. C. P. Fortney, Consulting Engineer	2″	17400	62	June 1936
Building Floor, Alloy Steam Station	Alloy, W. Va.	Electro Metallurgical Company	2″	562	4	May 1937
Kanawha Blvd. Bridge over Elk River	Charleston, W. Va.	City of Charleston, West Virginia, Col. C. P. Fortney, Consulting Engineer	2″	7680	52	March 1938
Foot Bridge—Mississippi Lock and Dam No. 4	Alma, Wisconsin	United States Engineers, St. Paul, Minnesota	2″	353	3	Sept. 1936

Principal Subsidiary Manufacturing Companies of

UNITED STATES STEEL CORPORATION

American Bridge Company

General Offices: Frick Building, Pittsburgh, Pa.

Fabricators and Erectors of Steel Structures of all classes, particularly bridges, buildings, transmission towers, substations, turn-tables, barges, hulls for floating equipment and electric (Heroult) furnaces.

American Steel & Wire Company

General Offices: Rockefeller Building, Cleveland, Ohio

Manufacturers of Wire and Wire products, manufacturing wires, wire rope, electrical wires and cables, cold rolled strip steel, springs, welding wire, wire fabric reinforcement, highway guard rail, cold finished steel bars, rail bonds, telephone, telegraph wire and strand, aerial tramways, wire nails, wire hoops, bale ties, wire fencing, steel posts, steel gates, barbed wire, tacks, U·S·S Stainless and Heat-Resisting cold rolled strip steel, wire and wire products, and U·S·S High Tensile Steel wire products.

Carnegie-Illinois Steel Corporation

General Offices: Carnegie Building, Pittsburgh, Pa.
and 208 South La Salle Street, Chicago, Ill.

See page 106 for List of Products.

Columbia Steel Company

General Offices: Russ Building, San Francisco, Calif.

Manufacturers of Rolled Steel Products, black and galvanized steel sheets, tin plate, castings, wire rope, standard and miscellaneous wire products. Also, distributors for Pacific Coast territory of products of the other manufacturing subsidiaries of United States Steel Corporation.

Cyclone Fence Company

General Offices: Waukegan, Illinois

Manufacturers of Chain Link fence and gates, steel picket fence and gates, lawn fence and gates, wire screen cloth, hardware cloth, rubbish burners, wire belting, partition work and window guards. Maintains field organizations throughout the country to handle installation of fences.

National Tube Company

General Offices: Frick Building, Pittsburgh, Pa.

Manufacturers of butt and lap welded pipe, direct seamless, rotary rolled seamless, electric welded, and hammer welded steel tubular products; standard pipe, copper steel pipe, line pipe, casing, oil well tubing, drive pipe, rotary drill pipe, galvanized and special dipped and coated pipe, Duroline (cement lined) pipe, line poles, trolley poles, couplings, cylinders, boiler tubes, seamless mechanical tubing, aircraft tubing, seamless alloy tubing, U·S·S Stainless and Heat-Resisting Steel pipe and tubes, and U·S·S High Tensile Steel pipe and tubes.

Oil Well Supply Company

General Offices: Dallas, Texas

Manufacturers of Oil Field equipment. Distributors of National Tube Company products. Branch stores in all oil fields. Export and domestic distributors.

Tennessee Coal, Iron & Railroad Company

General Offices: Brown-Marx Building, Birmingham, Ala.

Manufacturers of Pig Iron and of Rolled and Forged Steel Products; shapes, plates, bars, strip, black and galvanized sheets, wire products, axles, forgings, rails and track materials, and U·S·S High Tensile Steel products.

Scully Steel Products Company

Warehouse Distributors—General Offices: 1319 Wabansia Avenue, Chicago, Ill.

Operates group of Warehouses in strategic manufacturing and shipping centers to facilitate prompt service. Steel products direct from warehouse stocks.

Universal Atlas Cement Company

General Offices: 208 South La Salle Street, Chicago, Ill.
135 East 42nd Street, New York, N. Y.

Manufacturers of Atlas Portland cement, Universal Portland cement, Atlas White and Atlas Waterproofed White Portland cement, and Atlas Lumnite cement.

PRINCIPAL PRODUCTS MANUFACTURED BY CARNEGIE-ILLINOIS STEEL CORPORATION

PITTSBURGH, PA. CHICAGO, ILL.

ROLLED, FORGED, and CAST STEEL PRODUCTS

C B Sections
Structural Shapes
Plates
Bars
U·S·S Concrete Reinforcing Bars
Flats
Slack and Tight Barrel Hoops

Column Base Plates
U·S·S Multigrip Floor .. .ate
I-Beam-Lok Bridge Floor Construction
T-Tri-Lok Bridge Floor Construction
U·S·S Steel Sheet Piling
U·S·S Bearing Piles
U·S·S Steel Mine Timber
Rails, Heavy and Light
GEO Track Material

Splice Bars
Tie Plates
Track Bolts
Track Spikes
Cross Ties
U·S·S Wrought Steel Axles and Forgings
U·S·S Wrought Steel Wheels—
  Car and Locomotive
U·S·S Carillco Piglets
Billets
Ferro-Manganese
Coke
Coke By-Products

U·S·S Carilloy Alloy Steels
U·S·S Stainless and Heat-Resisting Steels
U·S·S High Tensile Steels

SHEET and TIN MILL PRODUCTS

U·S·S —
- Black Sheets —
  - Box Annealed
  - Blue Annealed
  - Cold Rolled
- Strip Steel —
  - Hot Rolled
  - Cold Rolled
- Special Sheets —
  - Electrical Sheets
  - Automobile Sheets
  - Metal Furniture Sheets
  - Vitreous Enameling Sheets
  - Stainless and Heat Resisting Steel Sheets
  - High Tensile Steel Sheets
- Blue Sheets —
  - Wellsville Polished
  - Blued Stove Pipe Stock

U·S·S —
- Long Terne Sheets
- Galvannealed Sheets
- Galvanized Sheets —
  - Zinc Coated

- Copper Steel
  - Corrugated Sheets —
    - Formed Roofing and Siding Products
- Bright Tin Plates —
  - Cokes
  - Charcoals
- Terne Plates —
  - Old Style Ternes
  - Eagle Ternes
  - Fire Door Ternes
  - Long and Short Ternes
- Tin Mill Black

CARNEGIE-ILLINOIS STEEL CORPORATION

General Offices, Pittsburgh, Pa. . . . . Carnegie Building
CHICAGO DISTRICT: Chicago, Ill. . . . . 208 South La Salle Street
LORAIN DIVISION: Johnstown, Pa. . . . . 545 Central Avenue

DISTRICT SALES AND SUB-OFFICES

Birmingham . . . . Brown-Marx Building, 2000 First Avenue North
New Orleans, La. . . . . Maison Blanche, 921 Canal Street
Boston . . . . Statler Office Building, 20 Providence Street
Hartford, Conn. . . . . 36 Pearl Street
Chicago . . . . 208 South La Salle Street
Davenport, Iowa . . . . 128 Hillcrest Ave.
Des Moines, Iowa . . . . 339 West 49th St. Place
Peoria, Ill. . . . . 502 West Maywood Avenue
Rockford, Ill. . . . . 2126 Oxford Street
South Bend, Ind. . . . . 1151 Hillcrest Road
Cincinnati . . . . Union Trust Building, Fourth and Walnut Streets
Columbus, Ohio . . . . American Insurance Union Building, 50 West Broad St.
Dayton, Ohio . . . . 233 Wisteria Drive
Louisville, Ky. . . . . 1222 Audubon Parkway
Cleveland . . . . Rockefeller Building, 614 Superior Avenue, N. W.
Buffalo, N. Y. . . . . Liberty Bank Building, 424 Main Street
Rochester, N. Y. . . . . 119 Hampshire Drive, Brighton Sta.
Denver . . . . First National Bank Building, 17th and Stout Streets
Detroit . . . . General Motors Building
Grand Rapids, Mich. . . . . 905 Giddings Ave., S. E.
Toledo, Ohio . . . . Toledo Club, 14th Street and Madison Avenue
Houston . . . . P. O. Box 159
Dallas, Texas . . . . 703 Praetorian Building
Indianapolis . . . . Chamber of Commerce Building, 320 North Meridian St.
Milwaukee . . . . Bankers Building, 208 East Wisconsin Avenue
New York . . . . 71 Broadway
Syracuse, N. Y. . . . . 112 Highland Avenue
Philadelphia . . . . Broad Street Station Building, 1617 Pennsylvania Boulevard
Wilkes-Barre, Pa. . . . . P. O. Box 1242, Kingston
York, Pa. . . . . 1501 First Avenue
Pittsburgh . . . . Frick Building, 437 Grant Street
Bluefield, W. Va. . . . . P. O. Box 865
Parkersburg, W. Va. . . . . P. O. Box 648
Youngstown, Ohio . . . . 803 Union National Bank Building
St. Louis . . . . Mississippi Valley Trust Building, 506 Olive Street
Kansas City, Mo. . . . . 2111 Fidelity Building, 911 Walnut Street
Little Rock, Ark. . . . . P. O. Box 1980
Tulsa, Okla. . . . . 1208 Philtower Building
St. Paul . . . . First National Bank Building, 334 Minnesota Street
Washington . . . . 703 Normandy Bldg., 1626 K Street, N. W.
Baltimore, Md. . . . . 2103 Baltimore Trust Building
Richmond, Va. . . . . 27 West Lock Lane

LORAIN DIVISION

Birmingham . . . . Brown-Marx Building, 2000 First Avenue North
Chicago . . . . 208 South La Salle Street
Cleveland, Ohio . . . . Rockefeller Building, 614 Superior Avenue, N. W.
Denver . . . . First National Bank Building, 17th and Stout Streets
Houston . . . . P. O. Box 159
Johnstown . . . . 545 Central Avenue
New York . . . . 71 Broadway
Philadelphia, Pa. . . . . Broad Street Station Building, 1617 Pennsylvania Boulevard

Export Distributors:

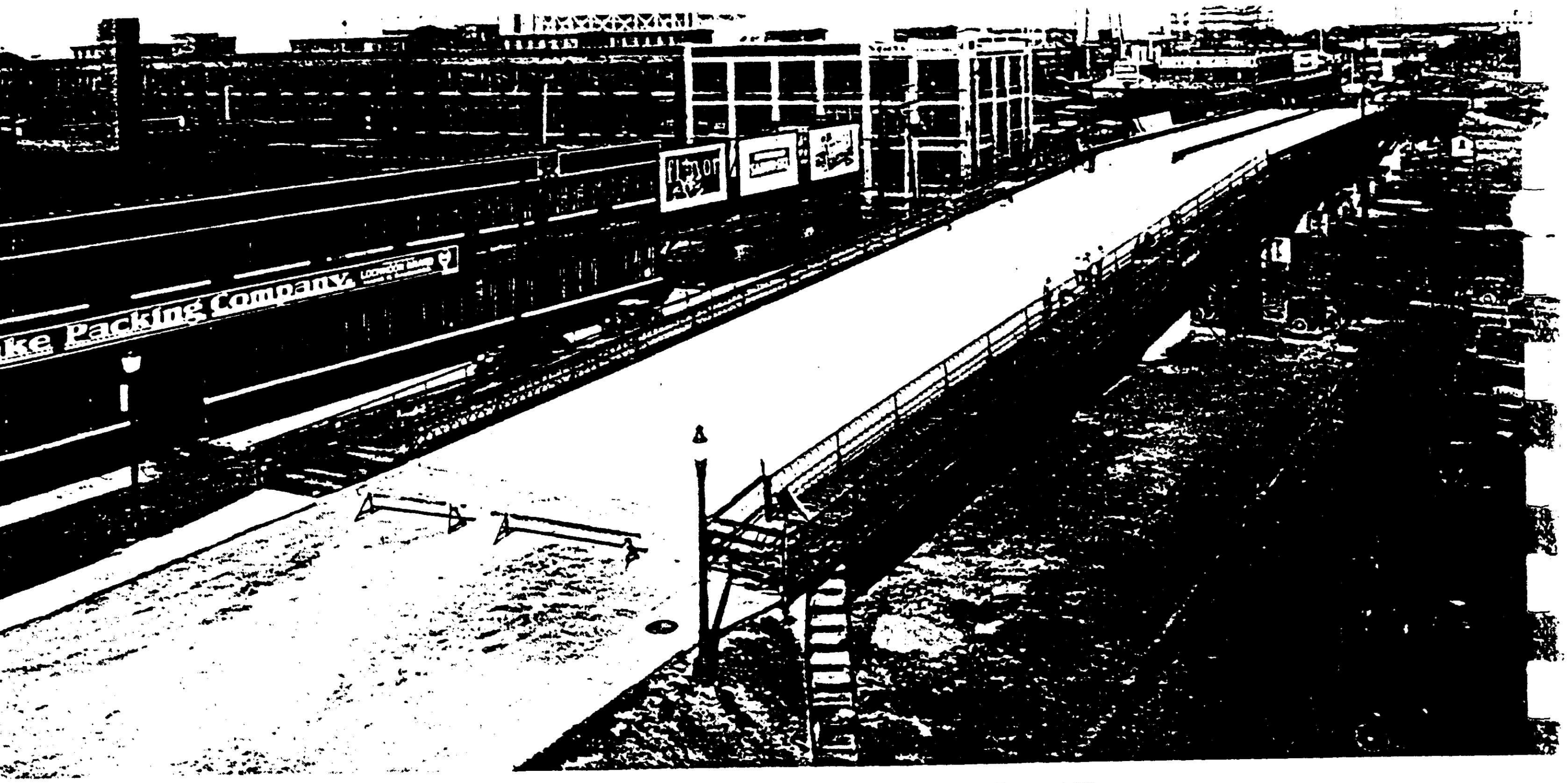
UNITED STATES STEEL EXPORT COMPANY

New York . . . . Hudson Terminal Building, 30 Church Street

Pacific Coast Distributors:

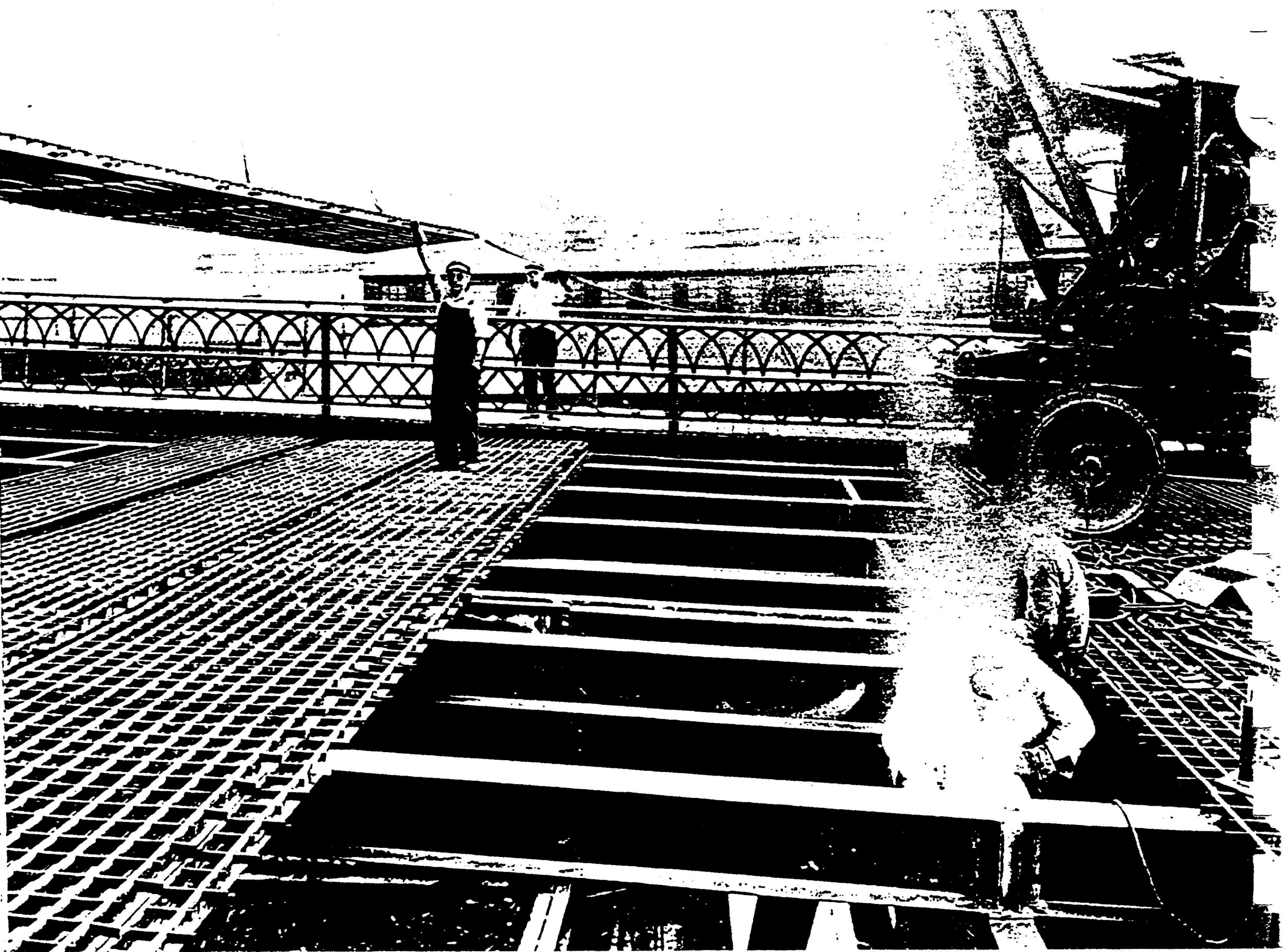
COLUMBIA STEEL COMPANY

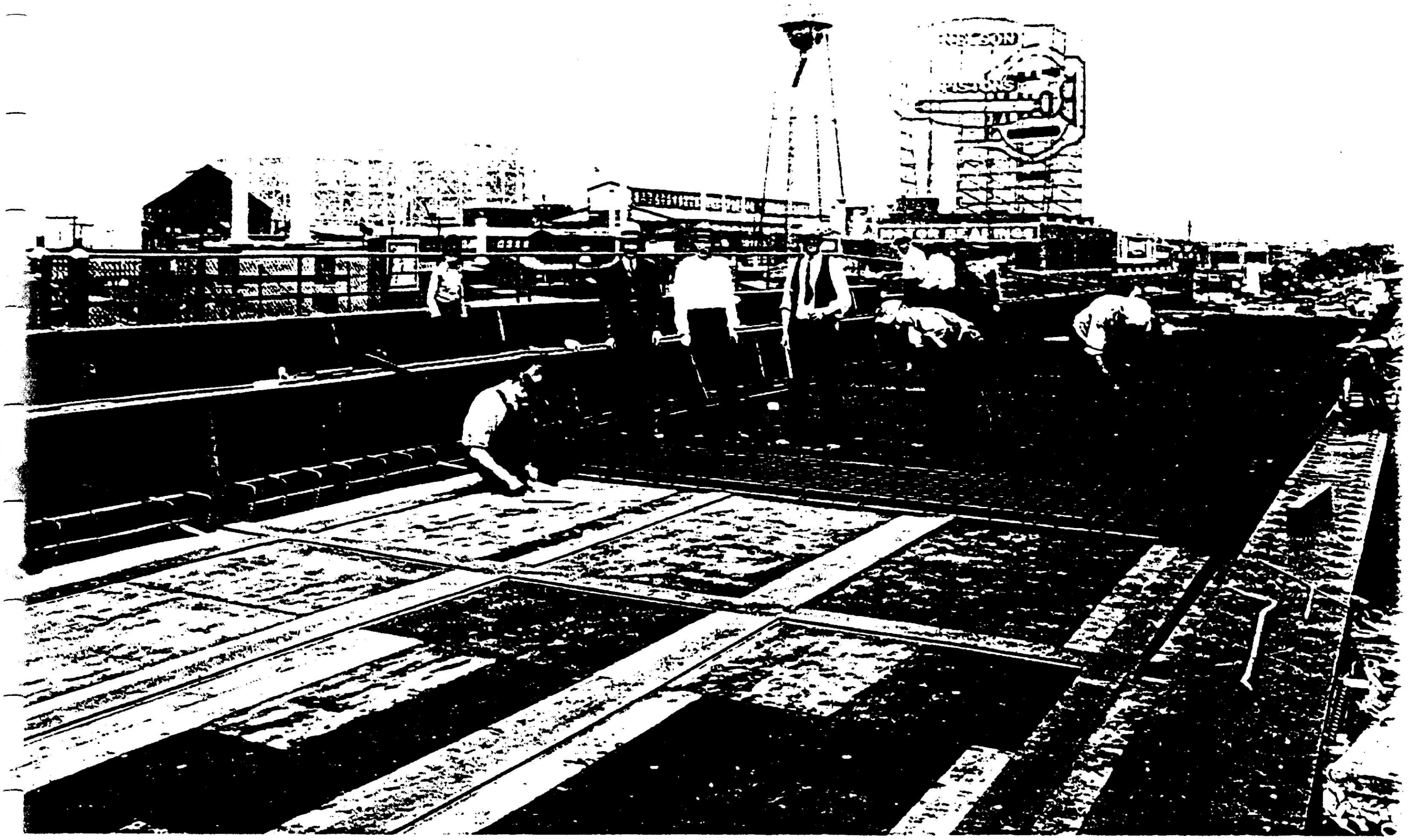
San Francisco . . . . Russ Building, 235 Montgomery Street
Los Angeles . . . . 2087 East Slauson Avenue
Portland . . . . 2345 N. W. Nicolai Street
Salt Lake City . . . . Walker Bank Building
Seattle . . . . Fourth Avenue South and Connecticut Street



East Grand Boulevard Viaduct, Detroit, Michigan, General View

East Grand Boulevard Viaduct, Detroit, Michigan, during erection.
Note crane wheels bearing directly on unfilled 3″ I-Beam-Lok units





East Grand Boulevard Viaduct, Detroit, Michigan. Steel form strips omitted over railroad tracks. Wood form placed 3" below I-Beam-Lok steel to secure concrete cover

Pg 56

East Grand Boulevard Viaduct, Detroit, Michigan. Pouring, vibrating and finishing concrete

This U·S·S Symbol represents the finest in steel quality
—a guide to those who purchase steel products.

ADV-16135—10M-10-41

Printed in U S A