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WAR DEPARTMENT TECHNICAL MANUAL

SEMIPERMANENT

HIGHWAY STEEL BRIDGES

30-, 60-, AND 90-FOOT SPANS

WAR DEPARTMENT *27 JUNE 1944*

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WAR DEPARTMENT TECHNICAL MANUAL

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SEMIPERMANENT HIGHWAY STEEL BRIDGES 30-, 60-, AND 90-FOOT SPANS

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PART ONE
DESCRIPTION OF EQUIPMENT

CHAPTER 1
GENERAL

1. Scope of Manual

a. This manual describes and gives erection procedures for three semipermanent highway steel fixed bridges with wood floors. They are the 30-foot I-beam bridge (fig. 1), 60-foot I-beam bridge (fig. 2), and 90-foot truss bridge (fig. 3).

b. This manual is divided into four parts. Part One deals with planning data and description of equipment. Part Two covers erection procedures including reconnaissance, organization of work, construction of abutments and supports, multiple spans, maintenance, repairs, and strengthening. Part Three consists of appendixes giving transportation and logistical data and lists of equipment. Part Four consists of numbered sheets showing general and detailed drawings needed for field erection.

2. Purpose of Bridges

The 30-, 60-, and 90-foot steel highway bridges are semipermanent structures intended primarily to replace tactical (or combat) bridges in lines of communication. The bridges may be used as single spans or may be combined into multiple spans with intermediate supports. Two-way traffic is accommodated by constructing parallel bridges.

3. References

For general information on bridge design and construction see FM 5–10. Typical designs of abutments and piers and construction methods under a variety of stream conditions are given in TM 5–286 (when published).

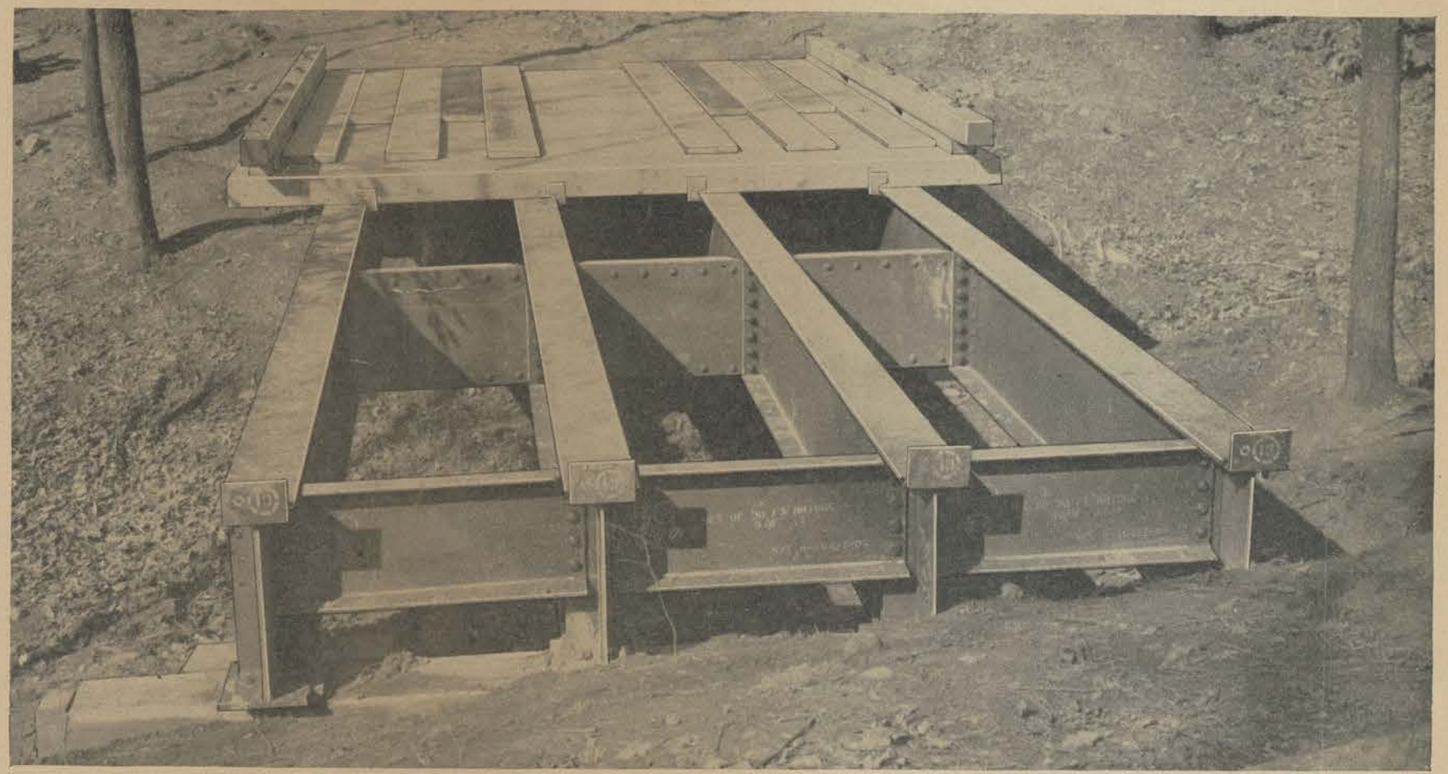


Figure 1. Partly decked 30-foot I-beam bridge showing type of construction. (The end dam on the near end is omitted to show details.)

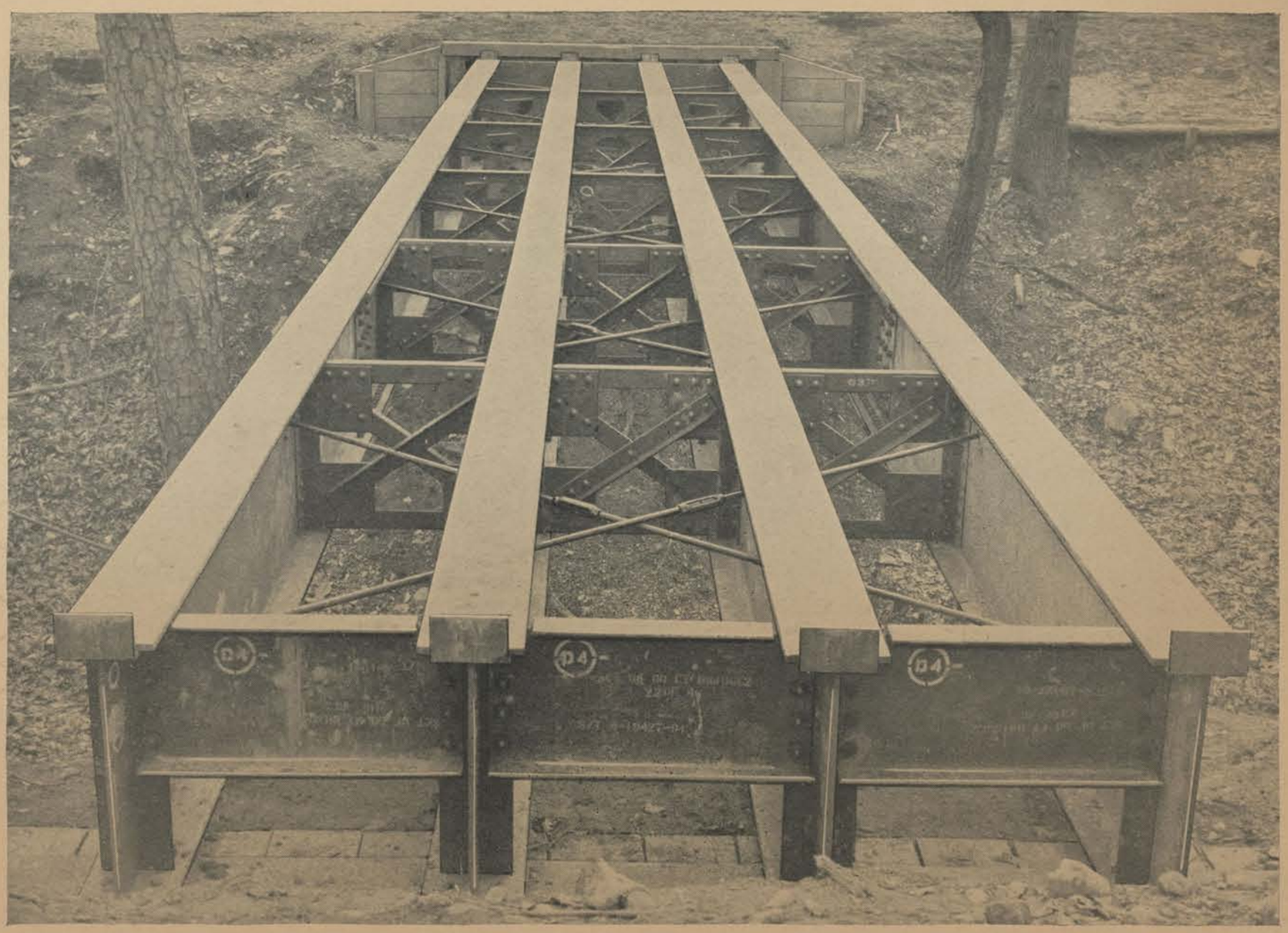


Figure 2. The 60-foot **I***-beam bridge with floor system, curbs, and end dam on near end omitted to show details.*

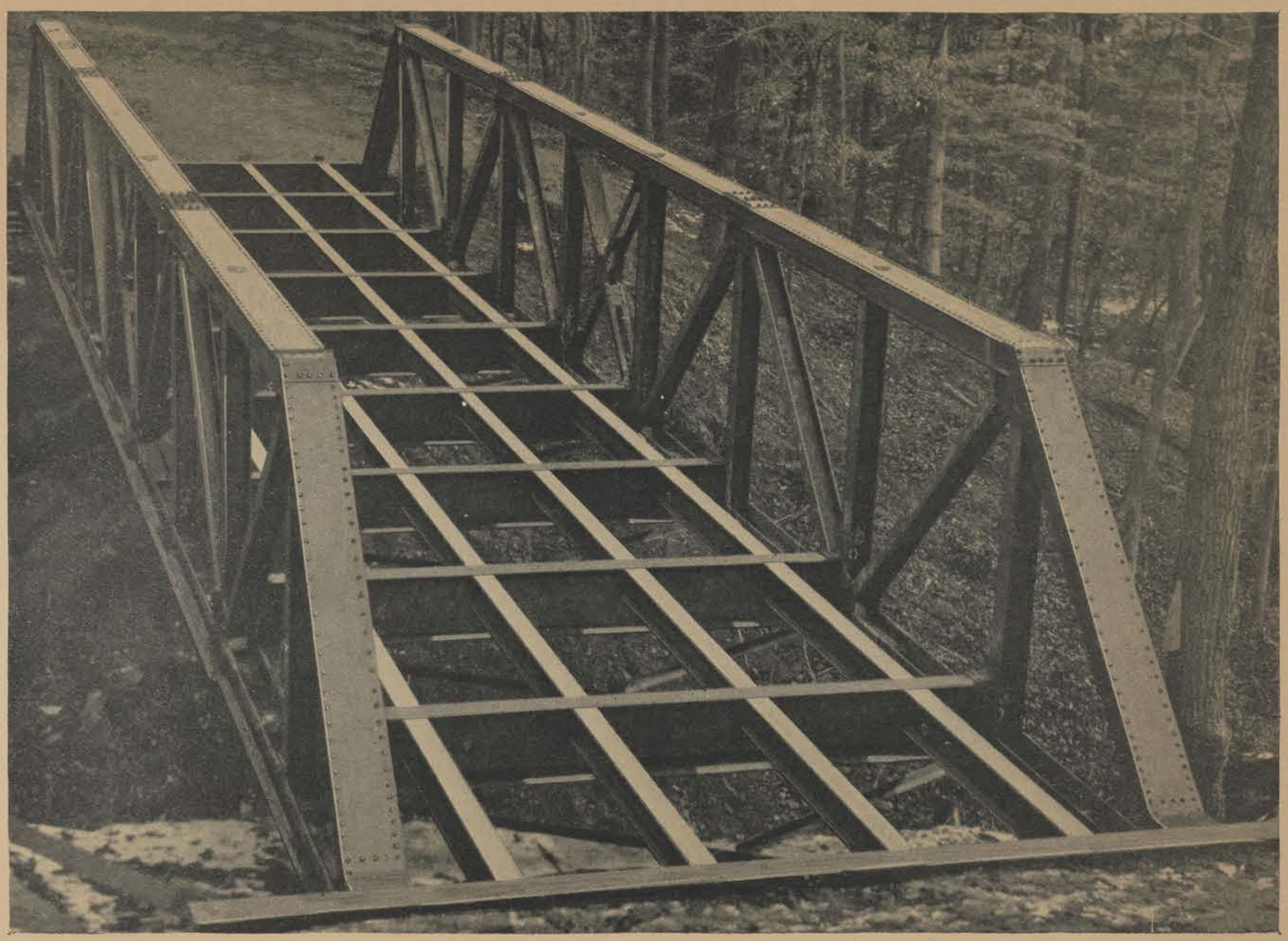


Figure 3. The 90-foot truss bridge with flooring omitted to show details of the floor system. (Figure 50 shows bridge partly floored.)

CHAPTER 2

PLANNING DATA

4. Capacity

a. Posting Bridges. The normal posted capacity of all three bridges is 50 tons. These posted capacities are based on a unit-stress in tension of 24,000 pounds per square inch. It should be noted that these capacities and unit-stresses are considerably higher than the loads and unit stresses used in the *design* of the bridges (par. 11). Capacities are also based on the use of the laminated floor design shown on sheets 4 and 12, part IV.

b. Capacity Table. Table I gives the posted capacity of bridges and the U. S. weight class of vehicles that may cross with caution.

Table I. Capacity of bridges[1]

Bridge	Posted capacity of bridge (tons)	Maximum weight class of vehicle that may cross with caution[2] (tons)
30-foot	50	75
60-foot	50	75
90-foot	50	70

[1] Based on data furnished by Engineer Board.
Criteria used in computing capacity:
Maximum tensile stress in bending 24,000
Maximum compressive stress in bending ..... $24{,}000\text{-}7\frac{1}{2}\left(\frac{L}{h}\right)^2$
Maximum axial stress in tension, net section 24,000
Maximum axial stress in compression ..... $22{,}500\text{-}3\frac{1}{8}\left(\frac{L}{r}\right)^2$

[2] For definition of weight class see FM 5–10. *With caution* means one vehicle on bridge at one time, vehicle keeps on center line of bridge, speed not to exceed 5 mph, no breaking or shifting of gears.

5. Weights and Dimensions

A summary of weights and dimensions for the three bridges is given in table II. Data on packaging of materials is given in tables IV, V, VI.

6. Clearances

The width between curbs or guardrails for all bridges is 12 feet 6 inches, and the over-all width of deck is 14 feet 0 inches. The clearance inside to inside of trusses for the 90-foot bridge is 15 feet 4 inches.

7. Composition and Issue

a. Bridges. These bridges are stocked in depot. The material contained in one bridge set for one span is given in the bills of materials on sheets 1, 5, and 8. It should be noted that the bridge set does not contain lumber for the timber floor. A detailed description of each bridge is given in chapter 3.

b. Erection Equipment. When necessary these bridges can be constructed with the organic equipment of general service regiments. However for expeditious construction it is essential that the equipment and materials listed in tables VII and VIII be drawn from depot. This equipment includes wire rope, wire-rope blocks, driftpins, large wrenches, and similar items for steel assembly. It is particularly important that a crane, preferably a ⅜-yard truck crane, be available for handling steel members.

c. Piers and Abutments. The type and materials used for construction of abutments or piers depends on the site and design selected and varies with local conditions. Material for abutments and piers must be requisitioned separately.

8. Erection Methods, Equipment, and Labor

See tables VII to XIII, inclusive. Additional detailed data and methods are given in part II.

9. Transportation

See table III.

10. Abutments and Piers

a. General. This manual does not give complete details on abutments and piers. Refer to FM 5–10 and TM 5–286 (when published) for this information. The typical designs of abutments and piers for these bridges given in TM 5–286 (when published) can be modified to fit local conditions.

b. Loads. Abutments and piers must be designed to accommodate the loads given in table XIV.

11. Basis of Design

a. Loading. All three bridges were designed for a gross tank weight of 40 tons, assuming a ground-contact length of 13 feet, a track gauge (center to center of tracks) of 6 feet 11 inches, and a track width of 17 inches. In addition to the tank loading, the bridges were designed for the American Association of State Highway Officials (A. A. S. H. O.) H20 loading as given in the Standard Specifications for Highway Bridges, Third Edition, 1941.

b. Material. (1) The design is based on the use of structural carbon steel conforming to A. S. T. M. Specification No. A 7–42, Steel for Bridges and Buildings (table XVII).

(2) The floors of the bridges were designed for creosoted lumber of 1800-pound stress-grade, rough sawn to the dimensions shown in the drawings, Part IV. If lumber of lower quality is used the floor construction must be modified accordingly. See table XLVI, FM 5–10 (1944) for allowable working stresses in American and foreign woods.

c. Working Stresses. (1) The basic working unit-stresses used in designing the bridges are those given in the above-mentioned A. A. S. H. O. specifications increased 25 percent. Principal values used in the design are listed in table XVII.

(2) The basic working unit-stresses used in designing the timber floors are those given in the above-mentioned A. A. S. H. O. specifications. Principal values are given in table XVIII.

d. Curb. The 30- and 60-foot bridges are designed for a timber curb. Lumber for curb construction is not furnished with the bridge set, but the metal fastenings are included. The 90-foot bridge has a positive steel curb called a guardrail. The guardrail and metal fastenings are furnished with the bridge set.

e. Floor. The bridges are designed for a laminated timber floor fastened to the steel structure by metal floor clips. The laminated deck consists of 2- by 6-inch pieces placed on edge. Alternate floor designs are described in TM 5–286 (when published).

f. Bearings. The end bearings are designed for erection on masonry, concrete, or timber supports.

g. Connections. All bridges are shop-fabricated by riveting and welding. All field connections are designed for structural ribbed bolts, with button or countersunk heads and hexagonal self locking nuts.

CHAPTER 3

DESCRIPTION OF BRIDGES

Section I

30-FOOT I-BEAM BRIDGE

12. Main Girders and End Bearings

a. PARTS.

Mark	Description	Weight (pounds)
G1	Girder	2, 554. 0
BP1	Bearing plate	31. 0
AB1	Anchor bolt	4. 3

b. GIRDER. This bridge is built of four girders connected by steel diaphragms to form a rigid box-type structure (fig. 1 and sheet 2). The girders G1 are made of 24-inch, 74-pound wide-flange I-beams, 31 feet 6 inches long.

c. END BEARINGS. End bearings consist of a sole plate and a bearing plate BP1 (fig. 4). The sole plate is riveted to the end of the girder. The bearing plate rests on the sill or abutment seat. The sole plate rests on the bearing plate and during expansion or contraction of the bridge it slides on the bearing plate.

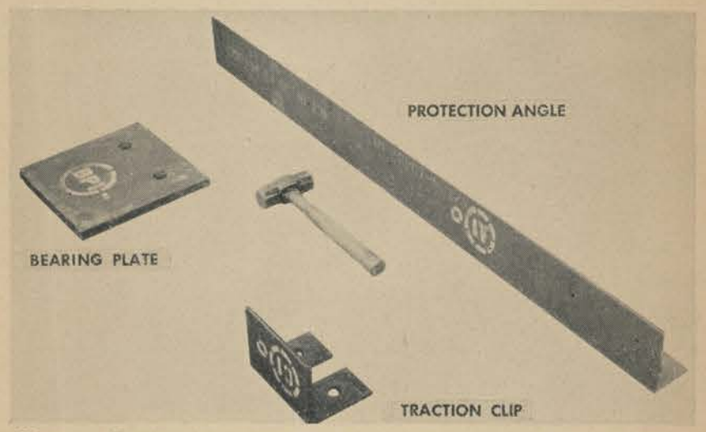
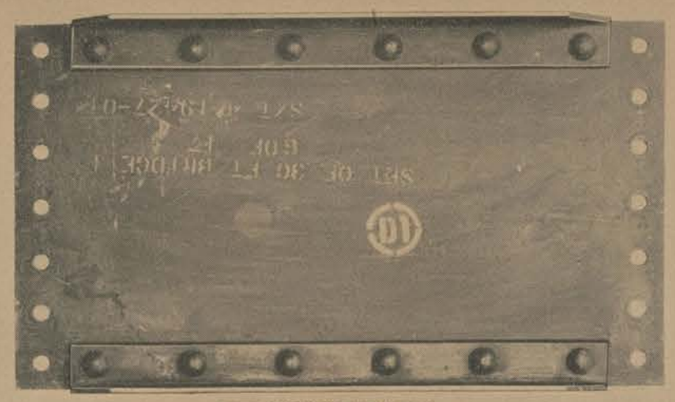


Figure 4. Bearing plate, traction clip, and protection angle for the 30-foot bridge.



INTERMEDIATE DIAPHRAGM



END DIAPHRAGM

Figure 5. Intermediate and end diaphragms for the 30-foot bridge. Diaphragms stiffen the bridge and distribute wheel and track loads. (They are bolted to the girders at 10-foot intervals.)

d. ANCHOR BOLT (fig. 6). The girders are held in place on the sills or abutment seats by anchor bolts AB1, 1 foot 6 inches long. These bolts are imbedded in the sills or abutment seat and extend through close fitting holes in the bearing plate and through slotted holes in the sole plate and lower flange of the girder. The slotted holes permit expansion and contraction of the girders with changes in temperature.

13. Bracing, Splices, and Fasteners

a. PARTS.

Mark	Description	Weight (pounds)
D1	Intermediate diaphragms	128
D2	End diaphragms	105
	Bolts and nuts	Variable

b. DIAPHRAGMS (fig. 5). Diaphragms placed between the girders at the ends of the bridge and at 10-foot intervals make the structure rigid and distribute wheel or track loads among the girders. They serve also as lateral bracing (see sheets 2 and 3).

(1) Intermediate diaphragms D1 are ⅜-inch steel plates to which 3- by 3- by ⅜-inch angles have been shop-riveted at the top and bottom (fig. 5). Connection with the girders is made by field bolting the diaphragm to stiffener angles shop-riveted to the girders.

(2) End diaphragms D2 are 15-inch 33.9-pound channels connected to the girder at the ends of the bridge. Connections are the same as for intermediate diaphragms (fig. 5).

c. BOLTS AND NUTS (fig. 6). (1) Two types of bolts and nuts are used in this bridge:

(*a*) Machine bolts ⅞ inch in diameter with head and nut 1 5/16 inch square are used as erection bolts. They are used to draw parts together in a tight fit while structural ribbed bolts are being placed (fig. 6).

(*b*) Structural ribbed bolts ⅞ inch in diameter with button or countersunk heads and 1 7/16-inch self-locking hexagonal nuts are used for all field connections (fig. 6). A structural ribbed bolt has a diameter slightly larger than the hole. When driven, the ribs on the bolt flatten and fill the hole, giving a tight fit and good bearing.

(2) See sheet 1 for detailed information on bolting.

14. Floor System

a. PARTS.

Mark	Description	Weight (pounds)
A1	Protection angle	42
C1	Traction clip	8
	Flooring	Variable
	Curb	Variable

b. FLOORING. The floor consists of plank treadways as a wearing surface on a laminated timber deck fastened to the girders by floor clips (see sheet 4).

(1) The laminated timber deck consists of 2- by 6-inch pieces 14 feet long set on edge across the girders. The pieces are nailed together with 50d cement-coated nails.

(2) Metal floor clips (fig. 6) fasten the timber deck to the steel girders. The floor clip is a 4- by 5-inch galvanized-steel plate provided with holes for nailing to the deck and notched to fit the flange of the girder (fig. 30).

(3) The treadway consists of 2- by 12-inch planks laid parallel to the direction of traffic.

c. TRACTION CLIP (fig. 4). The traction clip C1 is a 5- by 5- by ⅜-inch angle 7½ inches long bolted to each end of each girder. These clips prevent the timber deck from sliding on the girders.

d. PROTECTION ANGLE (fig. 4). Protection angles A1 are 5- by 3½- by 5/16-inch angles 4′-10″ long. They are installed over the flooring at the ends of the bridge to protect the flooring from excessive wear caused by vehicles passing on and off the bridge.

e. CURB (fig. 30). The curb is a 6- by 6-inch timber placed on 4- by 6-inch blocks and bolted to the deck. The 4- by 6-inch curb blocks are spaced to provide openings for draining surface water from

the floor of the bridge. Curb bolts (fig. 6) are provided for fastening the curb to the timber deck.

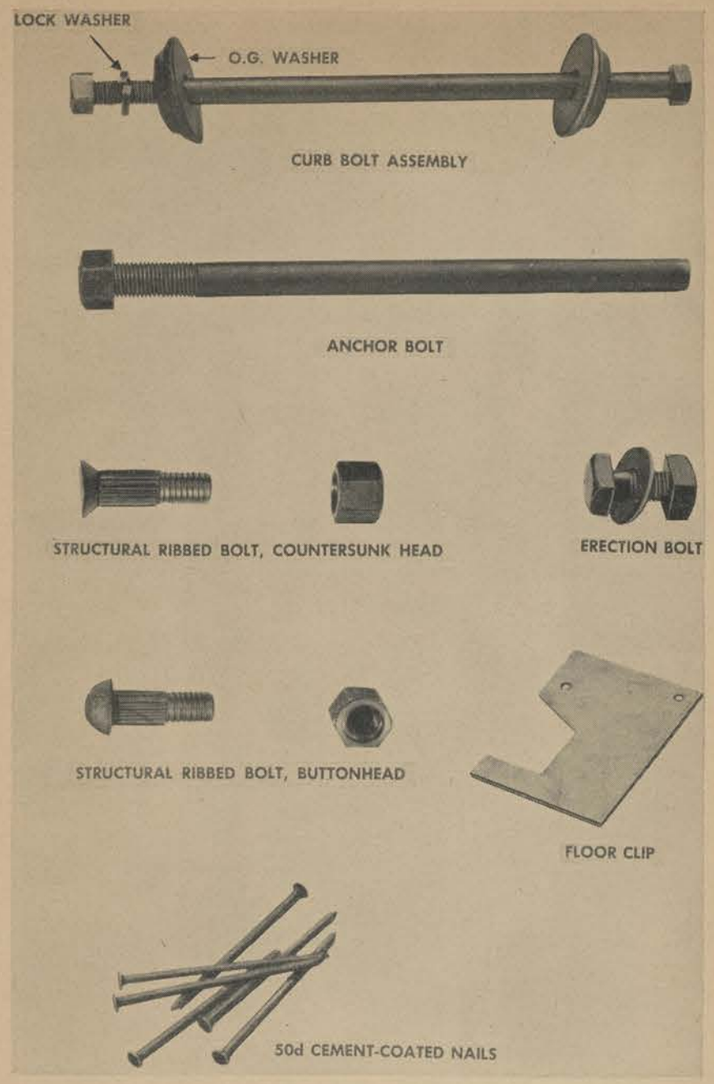


Figure 6. Fasteners for the 30- and 60-foot bridges. These parts are the same for both bridges except for lengths of structural ribbed bolts and dimensions of floor clips.

Section II

60-FOOT I-BEAM BRIDGE

15. Main Girders and End Bearings

a. Parts.

Mark	Description	Weight (pounds)
G2R	End outer girder section (including splice)	3,075
G2L	End outer girder section (including splice)	3,075
G3	Center outer girder section	3,491
G4	End inner girder sections (including splice)	3,065
G5	Center inner girder section	3,495
BP1	Bearing plate	31
AB1	Anchor bolt	4.3

b. Girders. This bridge is built of four girders connected by steel diaphragms to form a rigid box-type structure (fig. 2 and sheet 6). Each outer girder is fabricated in three sections; two end sections, G2R and G2L, and a center section G3. Each inner girder is fabricated in three sections; two end sections G4 and a center section G5. The sections are connected by two field splices (fig. 9). The girder sections are fabricated from 33-inch 132-pound wide-flange I-beams. The over-all length of the completed girders is 61 feet 6 inches.

c. End Bearings. End bearings are the same as for the 30-foot I-beam bridge described in paragraph 12*c*.

d. Anchor Bolt (fig. 6). Girders are held in place on the sills or abutment seats by anchor bolts AB1, described in paragraph 12*d*.

16. Bracing, Splices, and Fasteners

a. Parts.

Mark	Description	Weight (pounds)
D3	Intermediate diaphragm	154
D4	End diaphragm	132
T1	Diagonal lateral bracing	21.6
T2	Diagonal lateral bracing	18.9
	Splices	Included with girder.
	Bolts and nuts	Variable

b. Diaphragms. Diaphragms placed between the girders at the ends of the bridge and at 10-foot intervals make the structure rigid and distribute wheel or track loads among the girders (see sheets 6 and 7). They also serve as lateral bracing.

(1) Intermediate diaphragms D3 consist of four 3½- by 2½- by ⅜-inch angles connected by ⅜-inch gusset plates to form a frame. The frame is bolted to stiffener angles shop-riveted to the girders. Figure 7 shows the fabricated diaphragm and figure 2 shows the diaphragm installed in the bridge.

(2) End diaphragms D4 consist of 18-inch 42.7-pound channels connected to the ends of the girders.

c. Diagonal Lateral Bracing (fig. 8). Diagonal lateral bracing, T1 and T2, consists of 1-inch round rods with turnbuckles. The rods pass through 3-inch holes in the web of the girders (fig. 2).

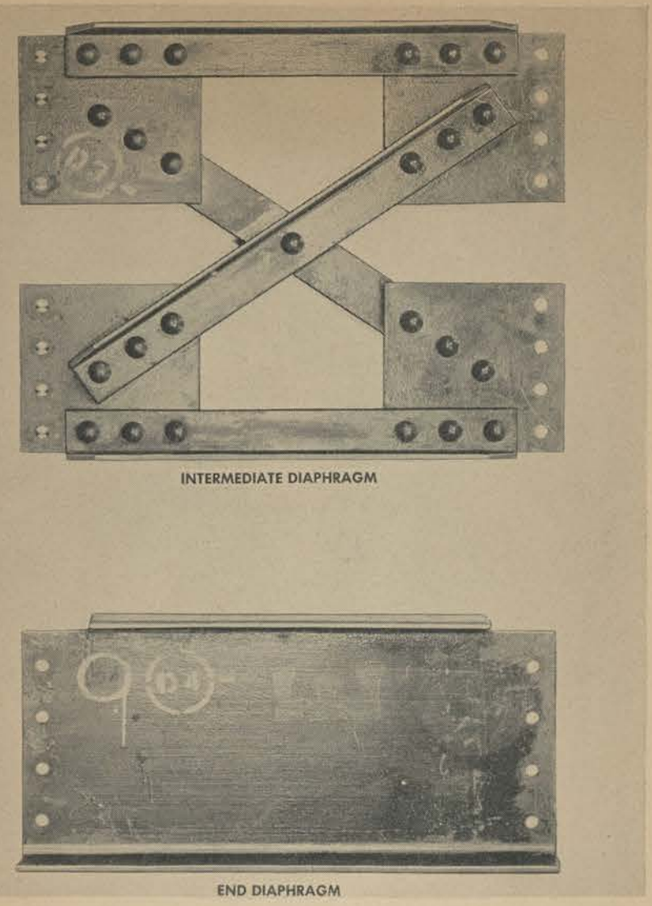


Figure 7. Intermediate and end diaphragms for the 60-foot bridge. Diaphragms stiffen the bridge and distribute wheel and track loads. They are bolted to the girders at 10-foot intervals.

d. Splices (fig. 9). Girder sections are joined by field splices. The webs of the I-beams are spliced with a plate on each side of the webs. The lower flanges are spliced with a plate on the lower side. The upper flanges are spliced with a plate each side of the web on the under side of the flange. Two fill plates, ⅛ and 3/16 inch thick, respectively, are provided with each splice. One or both fill plates may be needed depending on the difference in depths of the two girder sections. The use of one fill plate is shown in figure 33.

e. Bolts and Nuts. Fasteners used in this bridge are similar to those for the 30-foot I-beam bridge. See paragraph 13 and sheets 4 and 5.

17. Floor System

The floor system for this bridge is the same as for the 30-foot I-beam bridge. See paragraph 14.

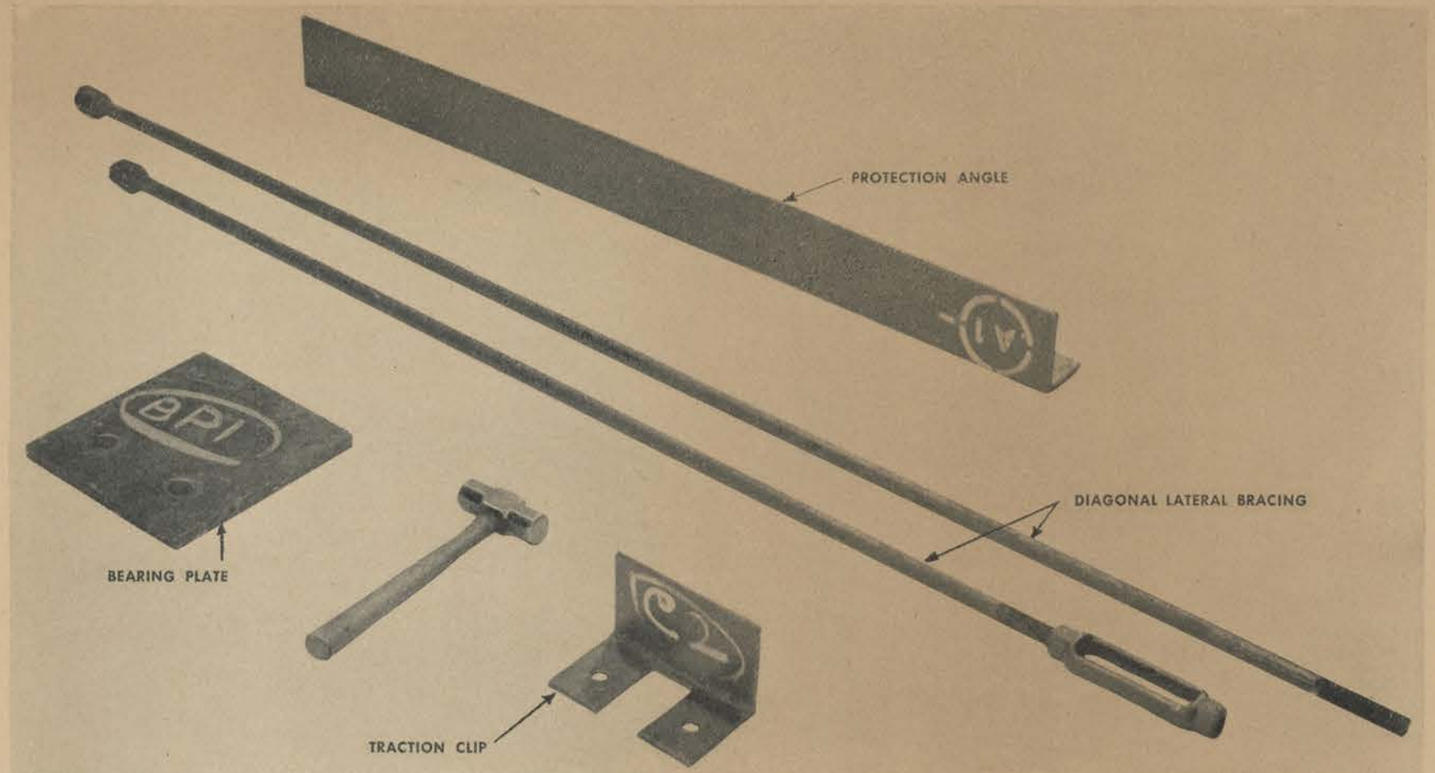


Figure 8. Bearing plate, traction clip, diagonal lateral bracing, and protection angle for the 60-foot bridge.

Section III

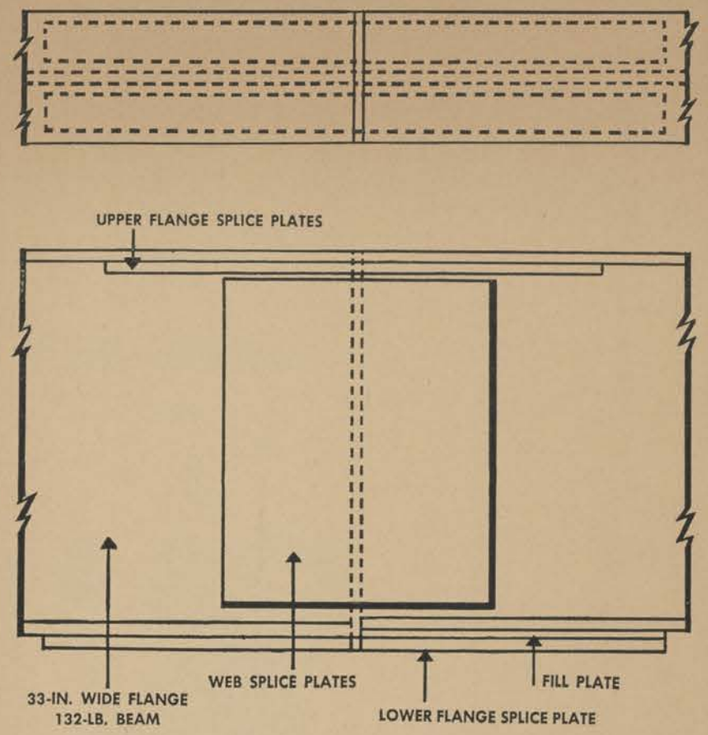
90-FOOT TRUSS BRIDGE

18. Main Trusses and End Bearings

a. PARTS.

Mark	Description	Weight (pounds)
U1R	End post, sloped	740
U1L	End post, sloped	740
U2	End upper chord section	1, 227
U3	Center upper chord section	1, 655
L1R	End lower chord section	1, 129
L1L	End lower chord section	1, 129
L2R	Center lower chord section	1, 589
L2L	Center lower chord section	1, 466
L3R	End lower chord section	1, 129
L3L	End lower chord section	1, 129
P1	Web vertical	293
P2	Web vertical	297
P3	Web vertical	324
W1	Web diagonal	202
W2	Web diagonal	283
W3	Web diagonal	172
W4	Web diagonal	69
W5	Web diagonal	67
BP2	Bearing plate	43
AB1	Anchor bolt	4. 3

b. MAIN TRUSSES (fig. 10). The trusses are shipped knocked down and must be assembled in the field. The upper chord is fabricated in five parts—two end posts and three sections of upper chord. The lower chord is fabricated in four parts. Each web member is fabricated in one piece. Gusset plates are shop-riveted to the chord sections (see sheet 9).



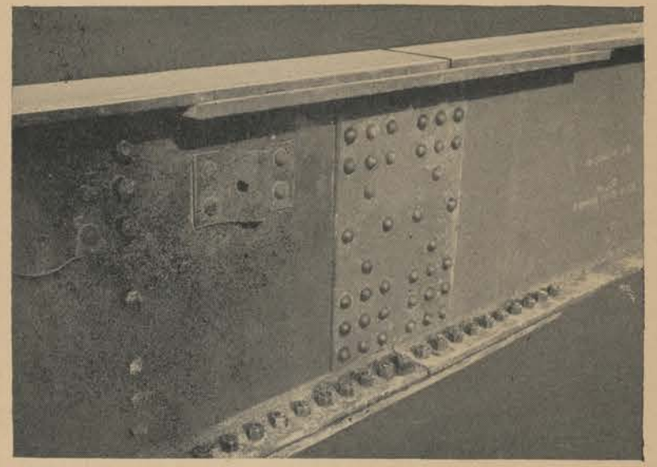


Figure 9. Splice joining girder sections of the 60-foot bridge. The two splice plates on lower side of upper flange provide a level upper flange surface for support of laminated timber decking. Fill plates balance difference in depth of I-beam sections.

(1) End posts, U1R and U1L, and upper chord sections, U2 and U3, are built-up members consisting of two 8-inch 13.75-pound chan-

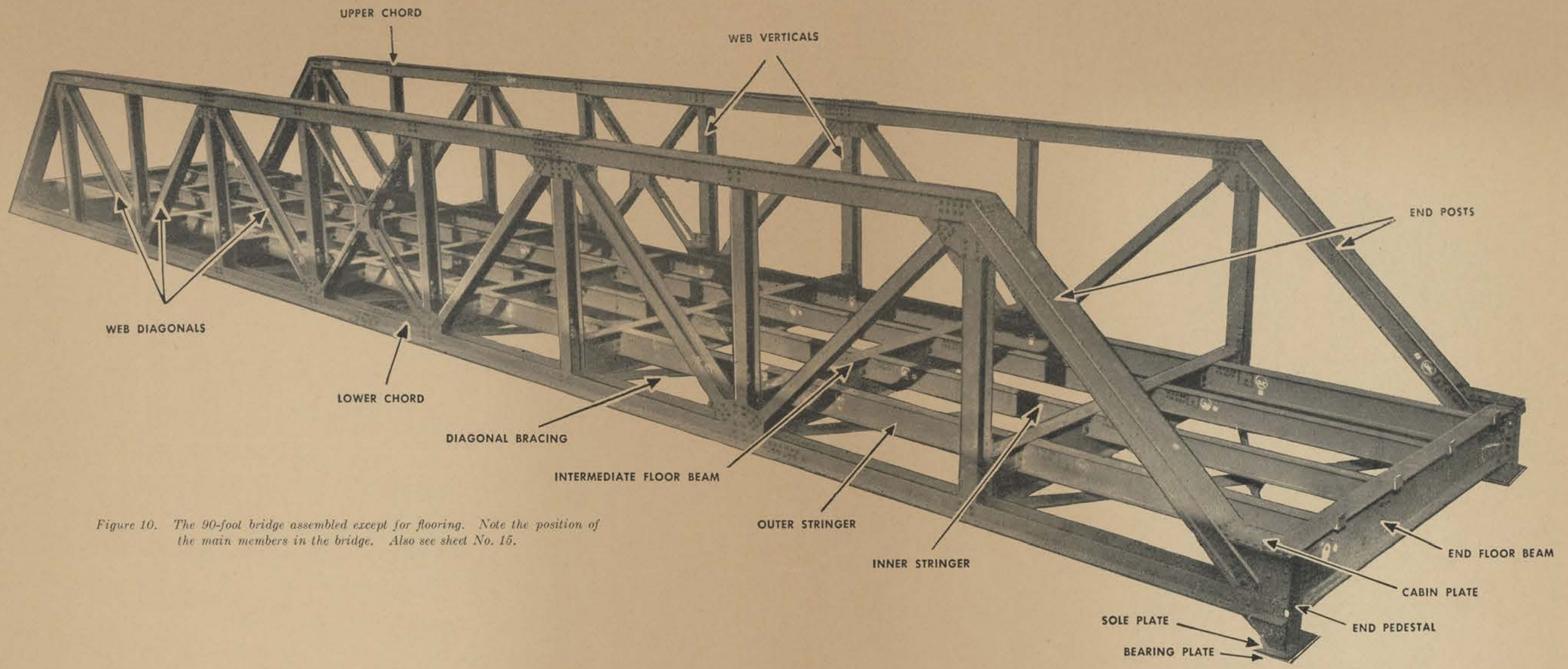


Figure 10. The 90-foot bridge assembled except for flooring. Note the position of the main members in the bridge. Also see sheet No. 15.

nels, one 14- by 5/16-inch cover plate, and stay plates with single lacing bars (fig. 10).

(2) Lower chord sections, L1R and L1L, are built-up members consisting of two 6- by 4- by ½-inch angles, 8⅞ inches back to back, connected by batten plates. Lower chord sections, L2R and L2L, are built-up members consisting of two 6- by 6- by ½-inch angles, 8⅞ inches back to back, connected by batten plates (fig. 10).

(3) Web verticals, P1, P2, P3, are 8-inch 31-pound wide-flange *I*-beam sections fastened to the upper and lower chords by gusset plates.

(4) Web diagonals, W1 and W2, are wide-flange *I*-beam sections, 8-inch 17-pound and 8-inch 24-pound respectively. Web diagonals, W3, W4, W5, are built-up members consisting of two angles 3- by 2½- by ¼-inch held 8 inches back to back by batten plates.

c. End Bearings. End bearings consist of a sole plate and a bearing plate BP2 (fig. 11). The sole plate is riveted to the bottom of the end pedestal. It rests and slides on the bearing plate during expansion and contraction of the bridge. The bearing plate is anchored to the sill or abutment seat.

d. Anchor Bolt (fig. 12). The trusses are held in place on the abutment seats by anchor bolts AB2, 1 foot 6 inches long. They are imbedded in the sill or abutment seat and extend through close fitting holes in the bearing plate and through holes in the sole plate. The sole plate has slotted holes on the expansion end of the truss and round holes on the fixed end.

19. Bracing, Splices, and Fasteners

a. Parts.

Mark	Description	Weight (pounds)
E1	Diagonal lateral bracing	77
E2	Diagonal lateral bracing	37
E3	Diagonal lateral bracing	46
	Bolts and nuts	Variable

b. Bracing. Lateral bracing, E1, E2, E3, consists of 2½-by 3- by ¼-inch angles placed diagonally below the stringers in each panel. They are bolted to gusset plates in the lower chords of the trusses at the panel points (see sheets 9 and 10).

c. Splices. Details of splices of chord sections and connections of members are shown on sheets 9 to 13.

d. Bolts and Nuts. (1) Two types of bolts and nuts are used in this bridge:

(*a*) Machine bolts ¾ inch in diameter with heads and nuts 1⅛-inch square are used as erection bolts. They are used to draw parts together in a tight fit while structural ribbed bolts are being placed (fig. 12).

(*b*) Structural ribbed bolts ¾ inch in diameter with button or countersunk heads and 1¼-inch self-locking hexagonal nuts are used for all field connections (fig. 12). These bolts are described in paragraph 13.

(2) See sheets 1 and 13 for detailed information on bolting.

(3) Bevel washers (fig. 12) are provided for use under nuts bearing on sloping flanges of top chord and floor beams.

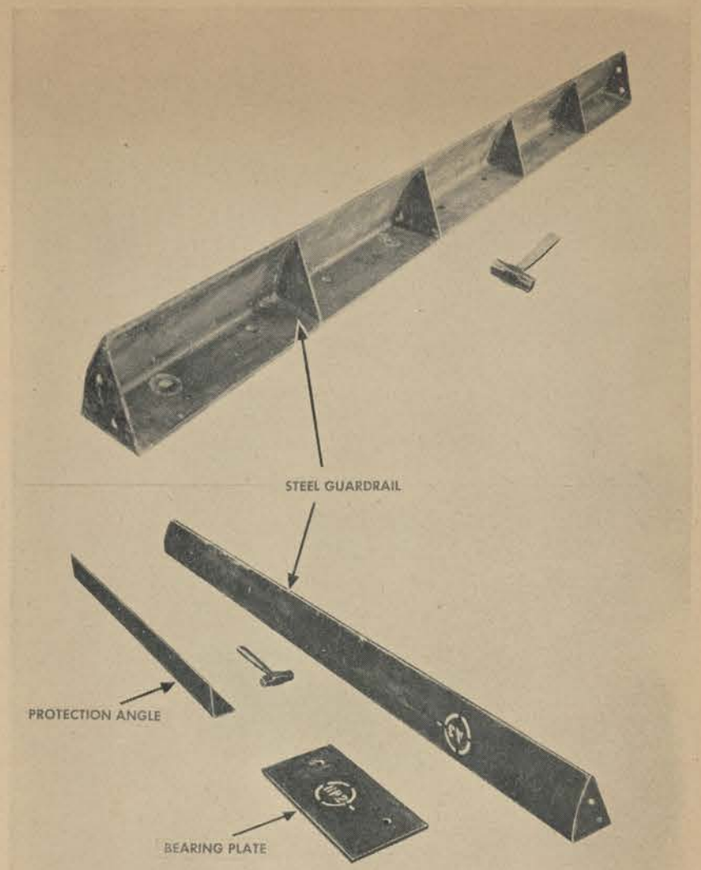


Figure 11. Protection angle, bearing plate, and guardrail for the 90-foot bridge. Note the curved surface of the guardrail. The vertical face of the guardrail angle is stiffened by plate diaphragms welded between the two legs. Figure 50 shows guardrail installed.

20. Floor System

a. Parts.

Mark	Description	Weight (pounds)
B1	End floor beam	1,093
B2	Intermediate floor beam	1,146
S1	Stringer	242
S2	Stringer	278
	Flooring	Variable
A2	Protection angle	52
A3	Guardrail	241

b. Floor Beams. Both end and intermediate floor beams, B1 and B2, are 21-inch 63-pound wide-flange I-beams. They are placed between the trusses at the panel points as shown in figure 10 (see sheets 10 and 11).

c. Stringers. Four lines of stringers are placed between the floor beams (fig. 10). Outer stringers S2 are 12-inch 25-pound wide-flange I-beam sections. Inner stringers S1 are 10-inch 21-pound wide-flange I-beam sections (see sheets 10 and 11).

d. Flooring. The flooring is similar to that for the 30-foot I-beam bridge. See paragraph 14*b* and sheet 12.

e. Protection Angle (fig. 11). The protection angle A2 is a 5- by 3½- by 5/16-inch angle, 5 feet 10 inches long. It has holes for nailing to the timber floor.

f. Guardrail (fig. 11). This bridge has positive steel curbs 8 inches high which serve as guardrails. The guardrail sections are 10 feet long and are bolted end to end. They are also bolted to the deck with guardrail bolts (fig. 12). Bearing spools are provided to increase the bearing area of the bolts on the timber deck.

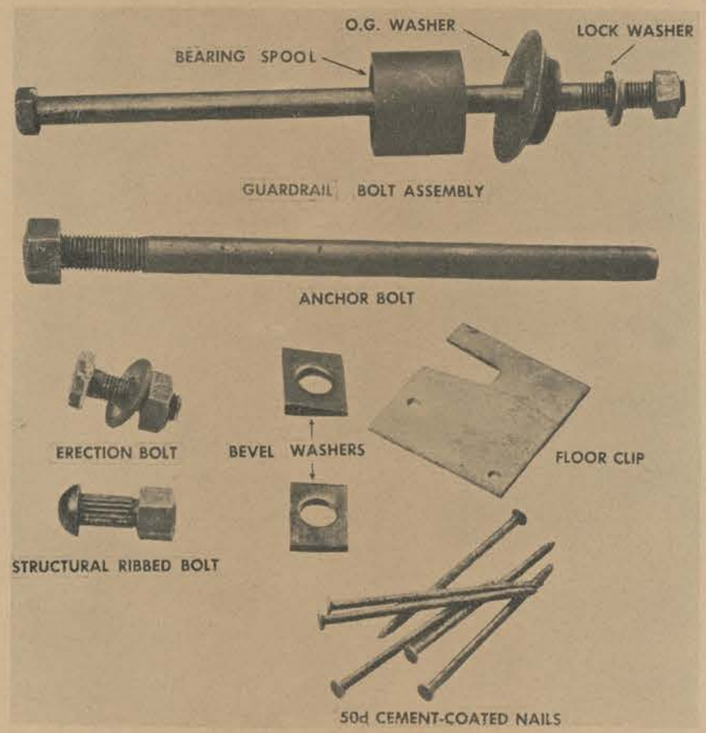


Figure 12. Fasteners for the 90-foot bridge. The bearing spool and O. G. washer increase the bearing area on the timber deck. The anchor bolt can be used in masonry, concrete, or timber. If used in timber it may have to be cut to proper length.

PART TWO

ERECTION

CHAPTER 4

RECONNAISSANCE AND PRELIMINARY PLANNING

21. Reconnaissance Instructions

A ground reconnaissance must be made before construction is started. Instructions to the reconnaissance officer should include the general location of the bridge, traffic requirements, particularly if two-way traffic is required, and time available for construction. For a general discussion of reconnaissance instructions see FM 5–6.

22. Reconnaissance Procedure

a. Preparations. Specific reconnaissance plans should be made before going into the field. This insures obtaining correct and necessary data and avoids wasting time on nonessentials. Preparations include:

(1) Assembly and brief study of all maps and photographs immediately available.

(2) Assembly of necessary surveying instruments, tools, weapons, and transportation. Picks, shovels, bars, mauls, and an earth auger should be included for prospecting and sounding foundations. If available, photographic equipment is desirable to take pictures of sites.

(3) Review of the characteristics of the bridges to assure their proper use in the final plan. See chapter 2 for a summary of data on these bridges.

b. Conduct of Reconnaissance. Reconnaissance methods in general are discussed in FM 5–6. Detailed instructions for bridge reconnaissance are given in FM 5–10 (1944). Because the bridges described in this manual are nontactical, they often replace existing tactical bridges over which traffic must be maintained until the new bridge is complete. However, they are not necessarily built immediately adjacent to the tactical bridges being replaced.

23. Factors Affecting Exact Location

a. General. The general area in which the bridge will be built is limited by the existing road net. The exact location of the center line of the bridge is selected after careful study and analysis of available sites within the area. The following factors and requirements must be considered.

b. Approach and Access Roads. Approach roads having an easy grade and a straight section for at least 150 feet from each end of the bridge are preferable. Their grade line must be above high-water level. Access roads connect the bridge with the main road net.

Consideration must be given to the materials and labor required for their construction.

c. Length of Bridge. An ideal site is one where the crossing can be made with a single span with simple abutments on firm banks. Where such a site cannot be found or other factors make its use impracticable, a single span with earth-fill or timber-trestle approaches or a multiple-span bridge with intermediate piers must be constructed.

d. Clearance. The bridge elevations necessary at various sites to allow passage of floodwater, ice, debris, and river or canal traffic must be considered.

e. Foundations. The condition of the banks and the character and bearing power of the soil for abutments as well as stream-bed conditions for piers must be thoroughly explored. Table XIV gives the loads abutments and piers must carry. Abutment and pier requirements at each site are important factors and must be carefully compared before making the final selection. Where intermediate piers are required, the difficulties of construction and the possibility of damage by scour, debris, and ice must be considered.

f. Scheme of Erection. (1) These bridges may be erected by several methods not equally applicable to all site conditions. Each site should be analyzed to determine the most practicable method of erection, and all sites under consideration should be compared on this basis.

(2) Equipment requirements for the various erection schemes are listed in table VII. The equipment available may be the determining factor. Likewise, it is important to consider the hazards involved in each method in relation to the skill and experience of the troops who will do the work.

(3) Several reliable methods for rapid erection of these bridges are described in chapters 7, 8, 9, and 10. Often it will be necessary to modify them to suit local conditions and sometimes entirely different schemes may be more appropriate.

g. Work Area and Bivouac. The requirements for the work area shown in figure 13 and discussed in paragraph 25 should be considered in selecting the exact bridge location.

h. Materials. The reconnaissance should determine the sources and availability of materials that may be used in constructing the bridge. Important items are timber for abutments, piers, and floors; gravel, crushed rock, or salvaged steel landing mat for road surfacing; and masonry or large stone for riprap.

i. Protection and Concealment. If the bridge is a vital link in a main supply road, the possibilities afforded by each site for concealing and protecting the bridge against aerial attack must be analyzed.

24. Survey

The selected site is surveyed to establish the exact center line of the bridge and to obtain an accurate profile of the crossing along this center line. The survey is extended back from the banks far enough to include all required road construction. The plotted profile is the basis for the bridge plans submitted with the reconnaissance report (par. 25). For details of surveys see TM 5–235 and FM 5–10.

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25. Plans, Estimates, and Schedule

a. General. Plans are gradually evolved as examination of a site proceeds. After all pertinent factors and possible plans have been analyzed, one plan is adopted. Sketch drawings are made showing enough detail so required quantities of work, materials, labor, equipment, and transportation can be estimated. The proposed work organization and time schedule are then prepared.

b. Work Quantities. Amounts of clearing, drainage, excavation, and other work are estimated from the plans or from field measurements.

c. Bills of Materials. (1) Materials required for each bridge are listed on sheets 1, 5, and 8. These include all structural steel parts for each bridge and the necessary bolts, nails, flooring, and fittings. They do not include material needed during construction such as gin poles, cribbing, rope, and drift bolts, or materials for abutments and piers. Separate estimates are made of these requirements from the sketch drawings.

(2) Where the standard design must be modified the bill of materials is changed accordingly. If the site requires a special abutment or pier it must be designed and the bill of material made up for it.

(3) Materials required for constructing the bridges by various methods are listed in table IX. Where erection methods other than these are used special bills of material must be made.

d. Troops. (1) The number of troops required to construct each bridge depends on such factors as equipment available, number of spans, abutments, amount of road construction, and weather conditions.

(2) The normal troop requirement for erecting a single span of each bridge is shown in table X. These data may be used as a basis for estimating troop requirements under varied conditions. To this must be added the labor needed for constructing approaches and doing other work not on the bridge itself.

e. Equipment. The equipment required depends on the method of erection, number of spans, and site conditions. Table VII is a list of equipment required for various methods of erection. Most of the items in the list are organic equipment with engineer units; some are class IV items normally available in depots. Table VIII is a list of special tools required for rapid field assembly of these bridges (figs. 20, 21, 23, and 24). Tools not contained in organic sets of the unit concerned may be drawn from depots. Other equipment needed for road construction, pile driving, excavation, and similar operations must be added to the equipment lists for steel erection.

f. Transportation. Transportation required to move bridge material to the site is given in table III.

g. Work Organization. Careful planning and layout of the work area facilitates construction and eliminates unnecessary work and moving of material. An example of a work-area plan is shown in figure 13. In planning the layout provision must be made for—

(1) Storage of materials so they can be processed, assembled or fabricated, and moved into place in the bridge with minimum interference. Separate storage of materials by classes is desirable.

(2) An assembly area where steel can be assembled preparatory to launching into place on the abutments.

(3) Roads with a drive-through arrangement or ample turn-around equipment and vehicles, especially trucks and trailers, can move in and out without backing up or blocking other activities.

(4) Storage and care of small tools and equipment and dispersion of heavy equipment when not in use.

h. Scheduling. To estimate the time required to build any bridge it is advisable to work out a schedule of operations. Specimen work schedules are shown in tables XI, XII, and XIII. Such a work schedule also is useful during actual construction as an aid in job supervision and control.

26. Reconnaissance Report

a. General. The reconnaissance report summarizes the data obtained and transmits the recommended plan of construction. The report should be concise but must contain all essential facts. The outline below will serve as a check list during the reconnaissance and as a guide in making the report. It should be modified to suit local conditions.

b. Outline of Bridge-Site Reconnaissance Report. (1) Reference and reconnaissance instructions number.

(2) Purpose of reconnaissance.

(3) Date, time, and period of reconnaissance.

(4) Date and time of report.

(5) Factors affecting the problem:

(*a*) Situation-existing facilities for crossing such as bridge, ferry, ford, or bypass.

(*b*) Terrain.

(*c*) Available labor, equipment, materials, and transportation.

(*d*) Time available.

(*e*) Technical considerations—access roads and approaches, length of bridge, clearance, foundations, stream bed, stream characteristics, erection schemes.

(*f*) Concealment and protection.

(6) Proposed plan:

(*a*) General description of site including vicinity sketch and area sketches showing locations of new bridge, existing routes of communications, local materials, work area, and bivouac.

(*b*) Plan, elevation, and cross sections of proposed bridge and supports with explanatory notes covering erection scheme and special features.

(*c*) Bills of materials and summary of labor, equipment, and transportation required.

(*d*) Time schedule.

(7) Recommendation.

(8) Signature, rank, and organization.

(9) Annexes—maps, photographs, sketches.

27. Ordering

a. Structural Steel. The structural steel for each bridge may be ordered as one unit complete or by individual items. The stock numbers are given for the complete unit in the bills of materials on sheets 1, 5, and 8. *It should be noted that the unit complete does not include lumber for floor.*

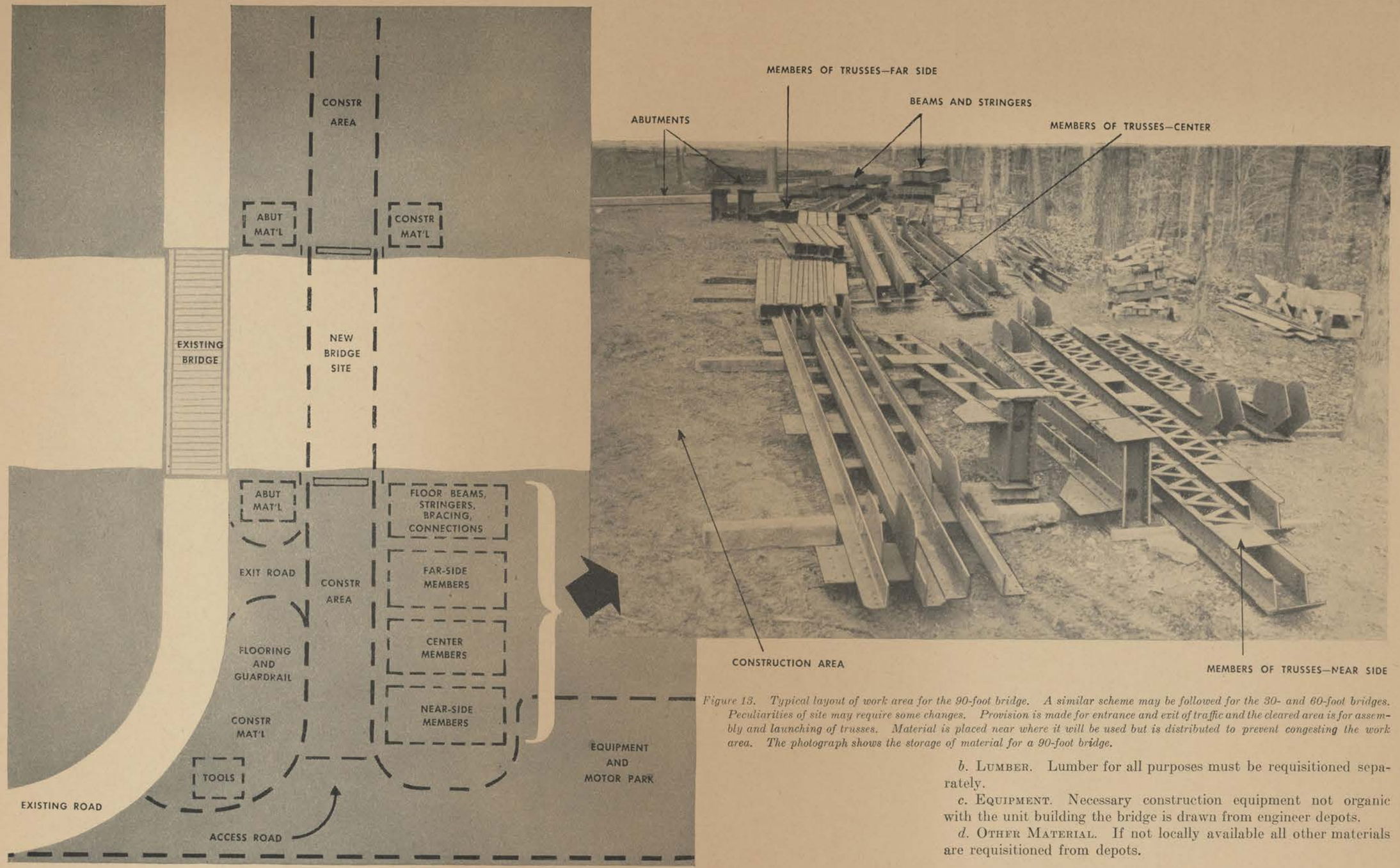


Figure 13. Typical layout of work area for the 90-foot bridge. A similar scheme may be followed for the 30- and 60-foot bridges. Peculiarities of site may require some changes. Provision is made for entrance and exit of traffic and the cleared area is for assembly and launching of trusses. Material is placed near where it will be used but is distributed to prevent congesting the work area. The photograph shows the storage of material for a 90-foot bridge.

b. LUMBER. Lumber for all purposes must be requisitioned separately.

c. EQUIPMENT. Necessary construction equipment not organic with the unit building the bridge is drawn from engineer depots.

d. OTHER MATERIAL. If not locally available all other materials are requisitioned from depots.

CHAPTER 5

ORGANIZATION OF WORK

28. Preliminary

a. Pioneer Work. Troops charged with the construction move up with pioneer tools and dozers to establish security and build pioneer access roads, clear the site, and provide drainage.

b. Access Roads. Existing roads may have to be improved or new roads constructed to provide access to the site. High priority must be given to this work to permit early delivery of equipment and supplies.

c. Preparation of Site. The work area should be prepared in accordance with plans in the approved reconnaissance report (par. 26). Preparation of site includes:

(1) Clearing, leveling, and draining areas for storage of materials, assembly of steel, turn-arounds, tools, and equipment.

(2) Providing shelter for tools and supplies.

(3) Providing dunnage for storage of materials.

29. Assembly of Equipment

a. General. Tools and equipment needed for construction should be assembled and prepared for use before they are required. Priority should be given to tools and equipment needed in the early stages of construction.

b. Storage. Provision should be made for storing tools under shelter at the site. Vigilant supervision is necessary to make certain tools and equipment are returned to their storage place when not in use.

c. Maintenance. Daily inspection, cleaning, lubrication, and repair are essential if tools and equipment are to be kept in good working order at all times. It is particularly important to check ropes, slings, blocks, winches, brakes, and other equipment carrying heavy loads. This prevents serious accidents and delays.

30. Assembly of Material

a. General. All material required for construction of abutments and piers, for erection of steel, and for the bridges is assembled at the site without delay. Priority is given to securing material needed in the early stages. Assembly of materials is coordinated with the time schedule (par. 25).

b. Blocking for Shipment. Care must be taken in transporting and assembling bridge steel to prevent bending, buckling, or other damage. Vulnerable parts like gusset plates, pedestals, splices, bracing, and diaphragms are protected during shipment from depots by timber bracing and blocking (fig. 14).

c. Storage. Material delivered to the site should be immediately sorted and stored in its proper area (fig. 13). Timber dunnage is used to keep steel parts off the ground. Where steel is stacked dunnage is used between members to facilitate handling (fig. 15). Small parts like bolts, nuts and washers, nails, and floor clips should be stored under cover to protect them from the weather.

31. Transportation

a. Truck-Trailer. All of the bridges can be transported by 8-ton or 16-ton full flat-bed trailers (fig. 16). The number of loads required for each bridge is shown in table III. Other trailers may be used for transportation of material (fig. 17). Trailers should be loaded or unloaded with a truck crane (fig. 15). However, many parts can be unloaded by hand (fig. 17).

b. Rail. Units constructing these bridges ordinarily are not concerned with rail transportation. However, they may be responsible for unloading the bridges at rail sidings. All of the steel members can be carried in single standard-gauge commercial railway cars but some are too long for U. S. standard military railway cars. Where military cars are used the long members are placed so the weight rests on one car, called the load car, and the overhang extends over an adjacent car, called the idler car. It may be necessary to support the overhang in a cradle on the idler car. The number of military and commercial cars required for each bridge is given in table III.

32. Construction Surveys

a. General. (1) Construction surveys with transit, level, and tape are made to stake out work on the ground and to establish accurately the positions and elevations of bearing plates. Surveys are required to fix the locations of center-line of bridge, center line of abutments, elevation of footings and sills, center line of bearing plates, and position of anchor bolts.

(2) Bridge surveys are discussed in FM 5–10 (1944). Instructions on the use of instruments in construction surveys are given in TM 5–235.

(3) The following paragraphs describe construction surveys for a single span with a simple timber abutment. The same methods apply generally to bridges on other abutments and to multiple-span bridges with intermediate piers (fig. 18).

b. Location of Center Line of Bridge and Abutments (fig. 18①). The center line of the bridge is located by stake set with a transit and tape. The position of the center of the end bearings is accurately marked on the bridge center line. Then the center line of each sill is established by turning a 90-degree angle from the bridge center line. Reference stakes for all center lines and a bench mark are set outside the construction area where they will not be disturbed.

c. Elevation of Abutment Footings. The elevation of the bottom of the footings depends on the abutment design. Once the elevation for the top of the bridge floor is established, the elevations of footings and bearing plates is obtained by subtracting the dimensions of intervening material as illustrated in figure 18②.

d. Center Line of Bearing Plates. When the excavation for footings is complete and footing and sill installed, the center line of the bearing plates is laid out on the sill. The location of each bearing plate is obtained by measuring the distances d and d' from the center line of the bridge as shown in figure 18③.

e. Position of Anchor Bolts. Anchor bolts are located by measuring the distance a from the center line of the bearing plate and the distance b from the center line of abutment sill as shown in figure 18④. An alternate method is to use the bearing plate as a template for locating the bolts.

f. Accuracy. Accurate measurements are extremely important to establish correctly the positions of the anchor bolts. Check measurements should be made after the anchor bolts are installed and before launching operations are started.

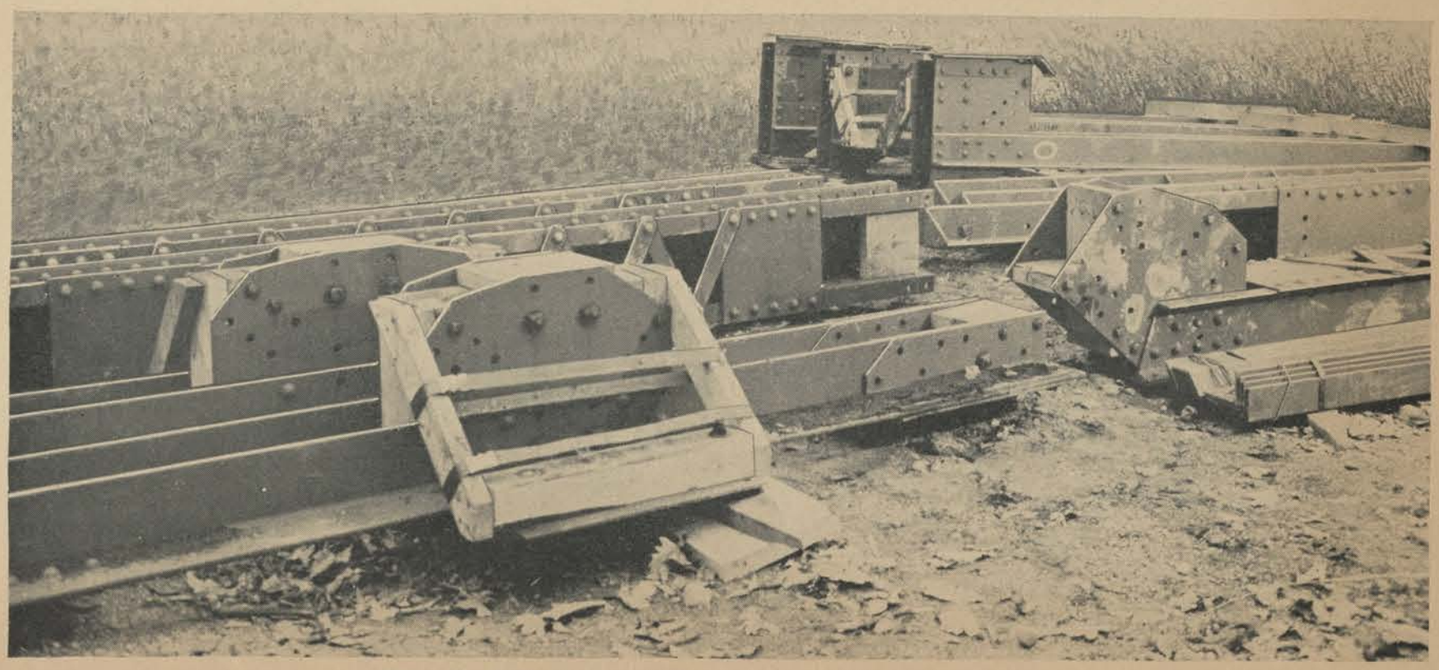


Figure 14. Timber blocking bolted to members to protect them during shipment.

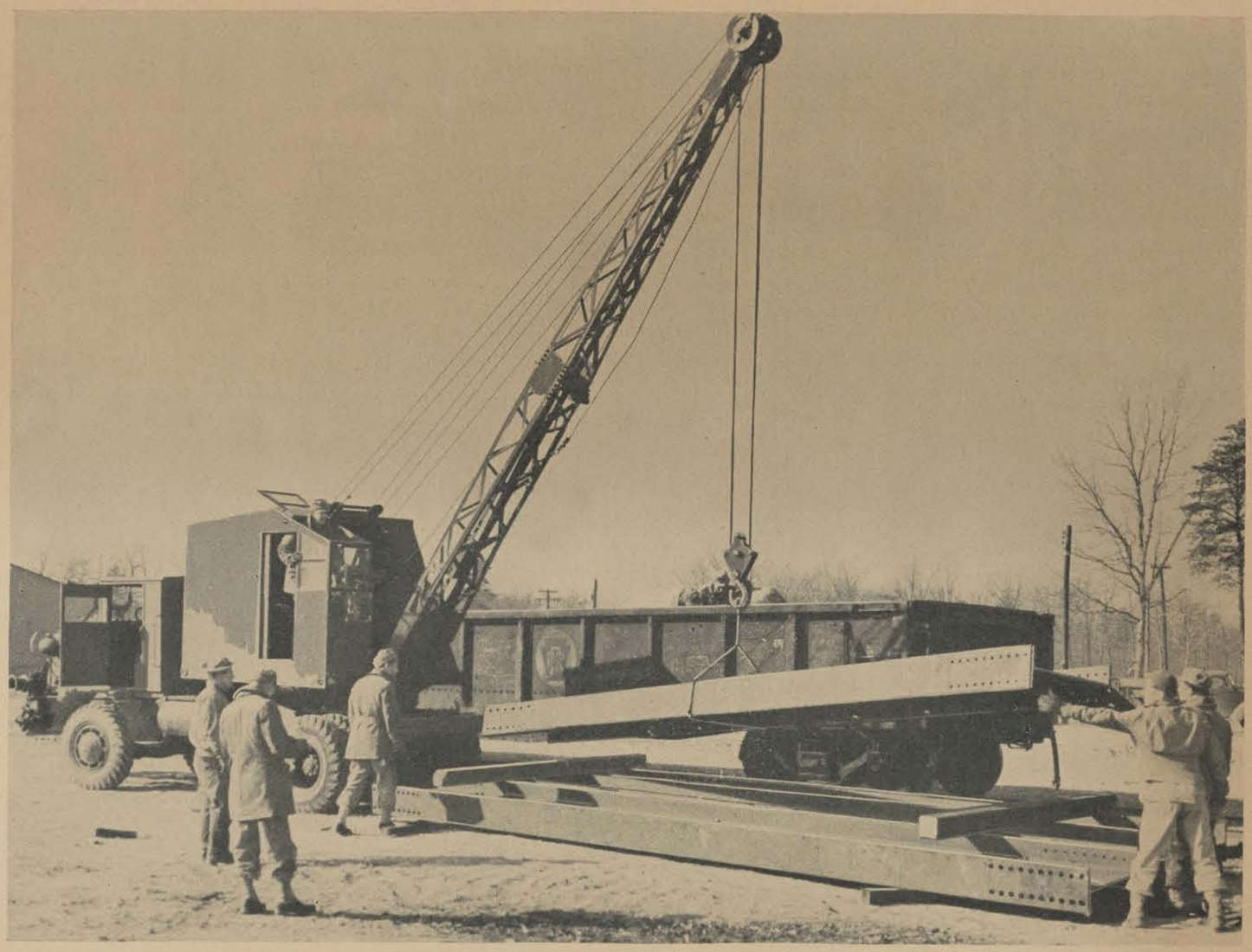
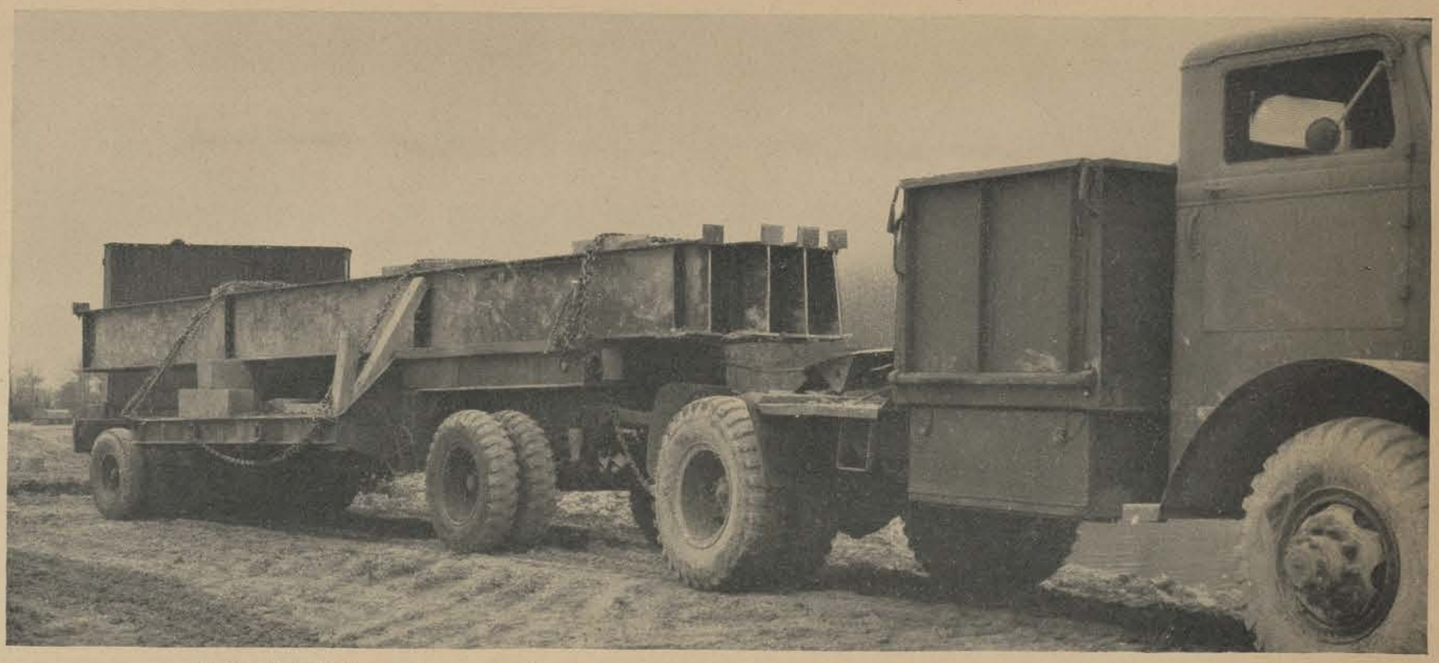


Figure 15. Unloading girder sections of the 60-foot bridge from a railroad car. A ⅜-cubic-yard truck crane is used. The timber dunnage keeps the steel off the ground and facilitates placing wire-rope slings.



① *The 30-foot bridge can be transported in one load. The timbers level the beams and the chains and shoring secure the load.*



② *The 90-foot bridge requires careful loading to reduce number of loads. Note the method of leveling the load. Short sections including floor beams and stringers can be used for this purpose.*

Figure 16. Transporting the 30- and 90-foot bridges with the 16-ton full flat-bed trailer.

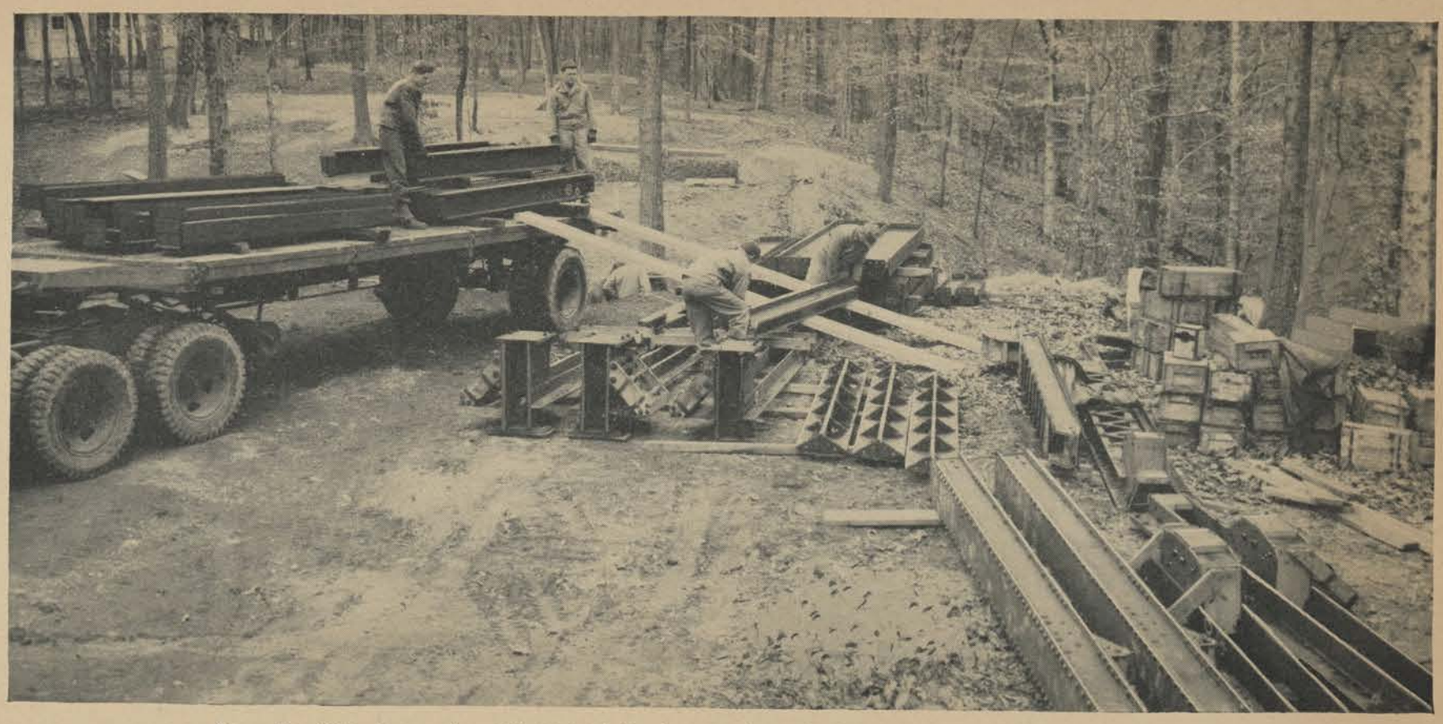
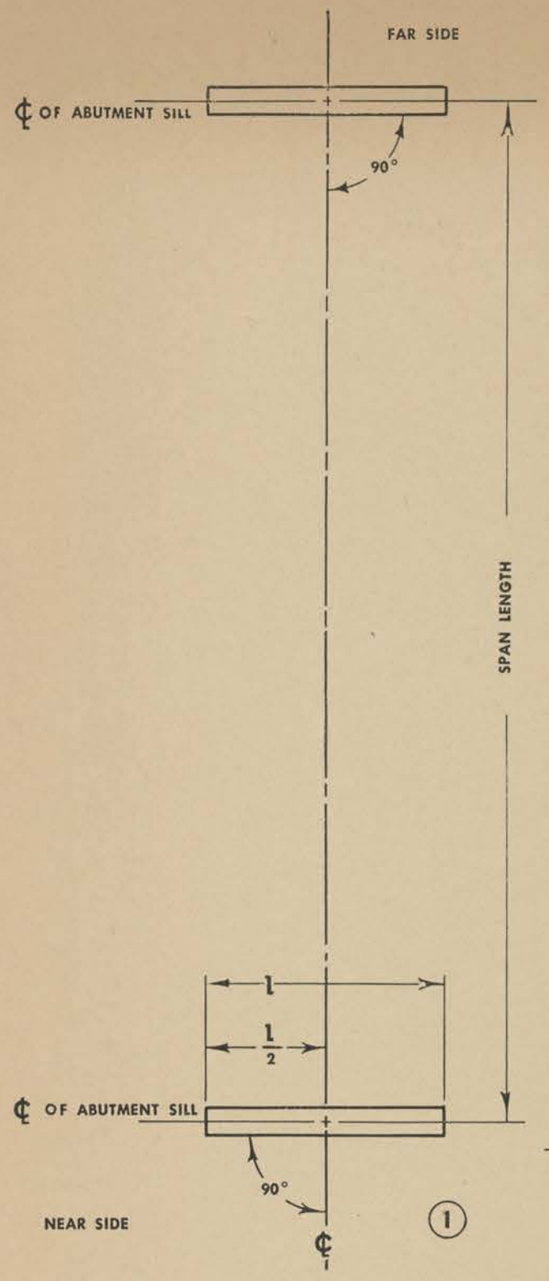
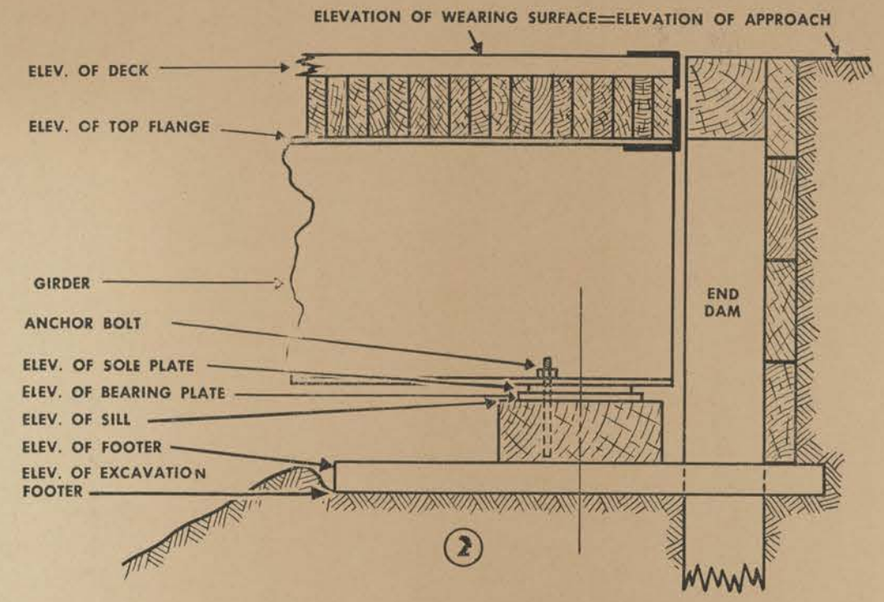
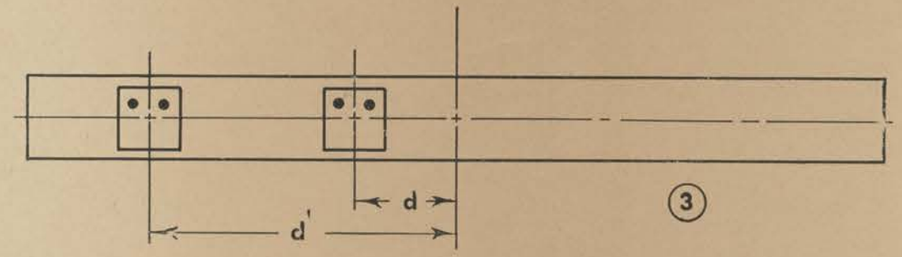
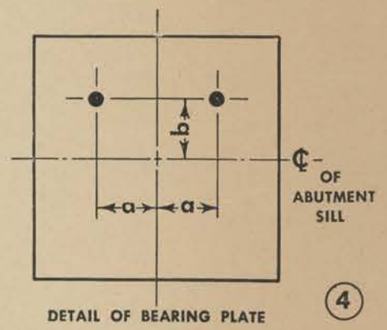


Figure 17. Unloading members of the 90-foot bridge from a trailer. A timber ramp is useful for sliding heavier members.









LEGEND

℄ = CENTERLINE

d = DISTANCE FROM ℄ OF BRIDGE TO ℄ OF BEARING PLATE

a = DISTANCE FROM ℄ OF BEARING PLATE TO ℄ OF ANCHOR BOLTS

l = LENGTH OF SILL

b = DISTANCE FROM ℄ OF ABUTMENT SILL TO ℄ OF ANCHOR BOLTS

① *Location of centerline of bridge and abutments.*
② *Dimensions and elevations to be considered in establishing depth of excavation for footings. Note the difference in elevation between sill and approach.*
③ *Location of bearing plates on sill.*
④ *Location of anchor bolts from centerline of bearing plate and centerline of abutment sill.*

Figure 18. Surveys for construction.

CHAPTER 6

CONSTRUCTION DETAILS COMMON TO ALL BRIDGES

33. General

The following construction details are common to all three bridges. In this discussion, the near abutment is on the bank where the steel is stored and the bridge assembled; the *near end* of the bridge is the end which will rest on the near abutment when the bridge is launched, the *far end* is the end which will rest on the far abutment.

34. Abutments

a. Sills. (1) If timber sills are used they must be set accurately to grade so the bearing plates are at the correct elevation.

(2) About 2 inches should be left between the top of masonry or concrete abutments and the final position of the bearing plates. This space will be filled with portland cement mortar when the plates are laid.

b. Anchor Bolts. (1) Where timber sills are used anchor bolts are cut off so they do not extend through the sill (fig. 19). Holes $1\frac{5}{16}$ inch in diameter are drilled in the sill. Anchor bolts are driven into the holes with a sledge, a wood block being used to protect the threads on the bolts. The tops of the bolts are set 2 inches above the elevation of the top of the bearing plate.

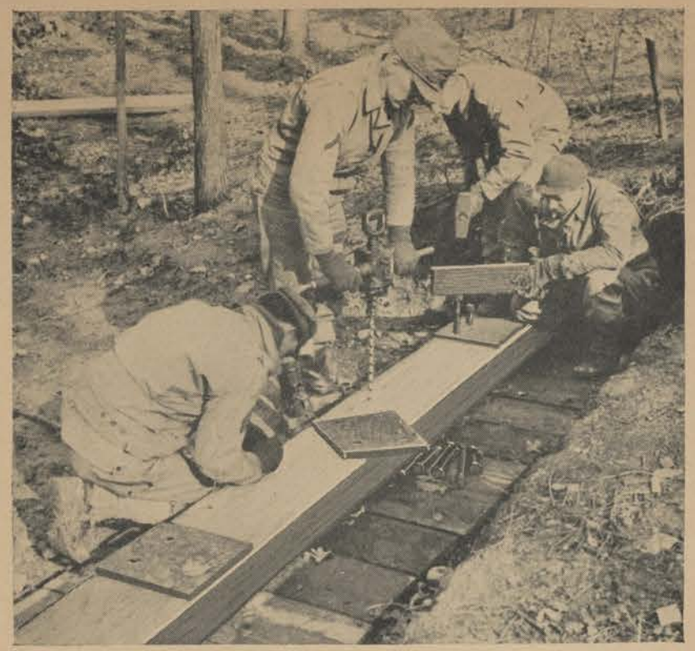
(2) Where concrete seats are used the anchor bolts are set when the concrete is placed. A timber template is recommended for accurate positioning. The bolts should be set to extend 2 inches above the bearing plate.

(3) Where masonry abutments are used holes 1½ inches in diameter are drilled. Anchor bolts are placed in the holes and grouted with portland cement mortar or with melted sulfur. The bolts must not be disturbed until the cement grout sets and hardens. Sulfur hardens when it cools.

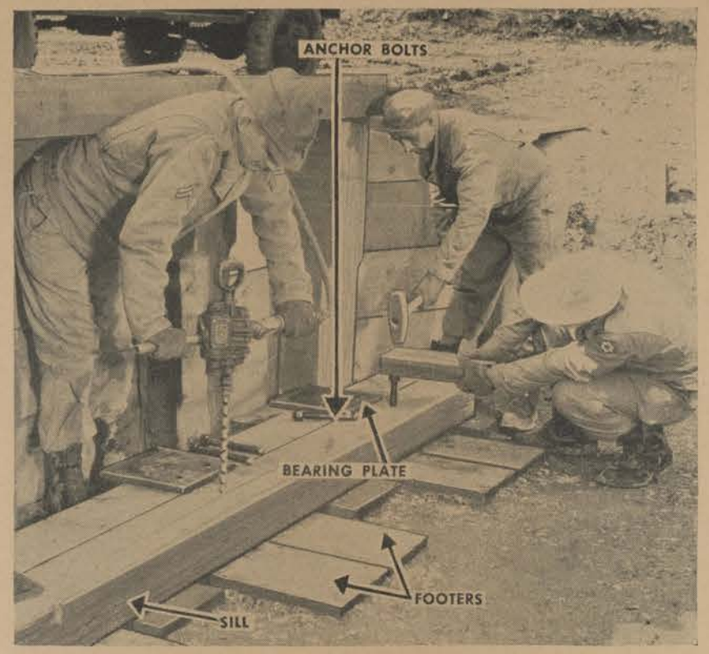
c. Bearing Plates. (1) Bearing plates are set on timber sills by placing them over the anchor bolts (fig. 19).

(2) On concrete seats bearing plates should be grouted to provide a smooth, firm base. In grouting care must be exercised to eliminate air pockets under the bearing plate. One method is to force fluid grout of portland cement, sand, and water under the bearing plate while it is held in position by wedges. Another method is to use a fairly dry mix of cement, sand, and water and to force the plate down upon it to the proper elevation.

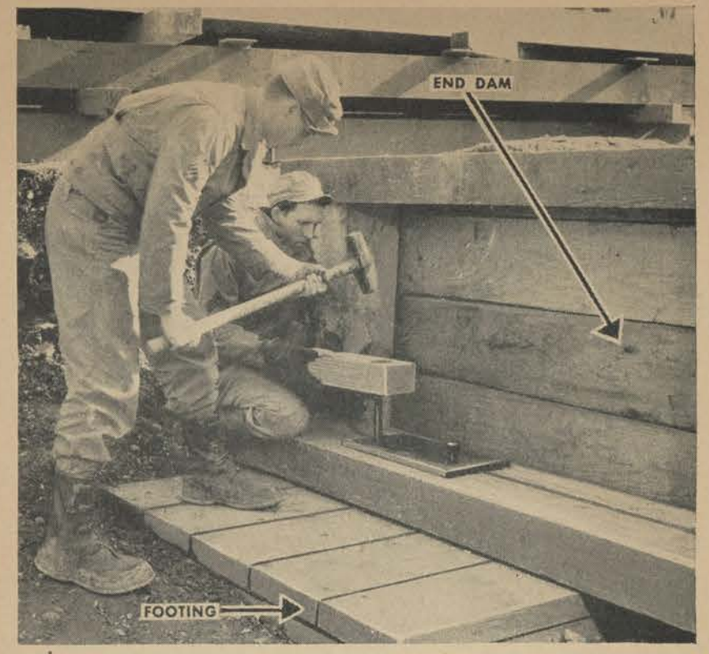
d. Provision for Expansion and Contraction. (1) The sole plates on each end of the girders for the 30- and 60-foot bridges have slotted holes $1\frac{3}{16}$ by $1\frac{3}{4}$ inches. One end of the bridge is "fixed" to the abutment by tightening the anchor bolts nuts securely. On the other



① *Placing anchor bolts and bearing plates for the 30-foot bridge. The anchor-bolt nut and wood block protect the bolt while it is being driven. Anchor bolts are cut off to fit the timber sill.*



② *Construction of abutment for the 60-foot bridge. Footers are 3- by 12-inch plank and the sill is a 6- by 12-inch timber. The end dam consists of 12- by 12-inch posts capped with 6- by 12-inch timber and surfaced with 3- by 12-inch plank.*



③ *Abutment for trial erection of the 90-foot bridge. A spread footing of 3- by 12-inch plank is placed under each truss end bearing point.*

Figure 19. Simple types of timber abutments built for these bridges.

end, which is the expansion end, the nuts are run down on the anchor bolts but not tightened.

(2) The fixed end of the 90-foot truss has round holes in the sole plate through which the anchor bolts project. The expansion end of the bridge has slotted holes. Anchor-bolt nuts are tightened on the fixed end; they are run down but not tightened on the expansion end.

35. Special Erection Tools

a. Driftpins (fig. 20). Steel driftpins with tapered ends are used to align holes in members to be connected.

b. Shackles (fig. 21). Temporary connections to steel members can be made by using a shackle as shown in figure 22. Shackles are also needed to make connections with steel blocks.

c. Ratchet Chain Hoist (fig. 21). The ratchet chain hoist is useful in drawing members into alignment (fig. 22) and in tightening snub lines.

d. Spud Wrench (fig. 20). The spud wrench is a useful combination tool for aligning holes to receive driftpins and for tightening nuts.

e. Slings. Wire-rope slings are needed for handling heavy members and for launching girders and trusses. See figure 23 and TM 5–225.

f. Connecting Bar (fig. 20). The 3-foot connecting bar is useful in alining members and in applying leverage when assembling steel.

g. Pinch Bar (fig. 21). Five-foot pinch bars are needed for guiding members into position and applying leverage during assembly of steel and during launching.

36. Assembling Steel Members (fig. 33)

a. Preliminary Bolting. Parts to be connected are brought together in position for bolting. A drift pin driven through every second or third hole aligns the parts and holds them together while erection bolts are placed. Erection bolts are put in every second or third hole and nuts are tightened until the metal parts are drawn tightly together. If plates do not bear tightly together hammer on plates around the bolt head and draw up on the nut at the same time. *The purpose of erection bolts is to draw the parts to a tight fit and hold them until final bolting is completed.*

b. Final Bolting. Final bolting is done with structural ribbed bolts in the following order:

(1) To insure good alignment of bolt holes a drift pin is driven through each hole before the structural ribbed bolt is driven.

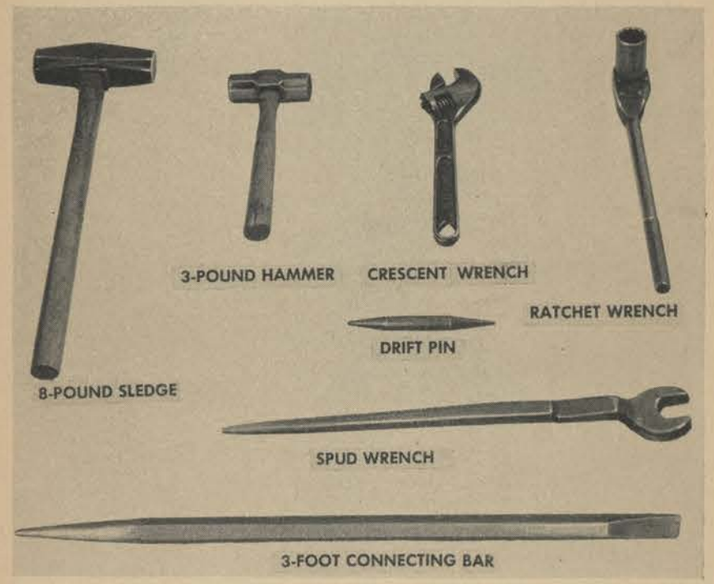


Figure 20. Erection tools for assembling steel members of all three bridges. The offset of the spud wrench permits access to tight places and the tapered end of the handle is used in aligning holes in members to be connected. A ratchet wrench extension is needed to tighten the bolts in the upper chord splice of the 90-foot bridge.

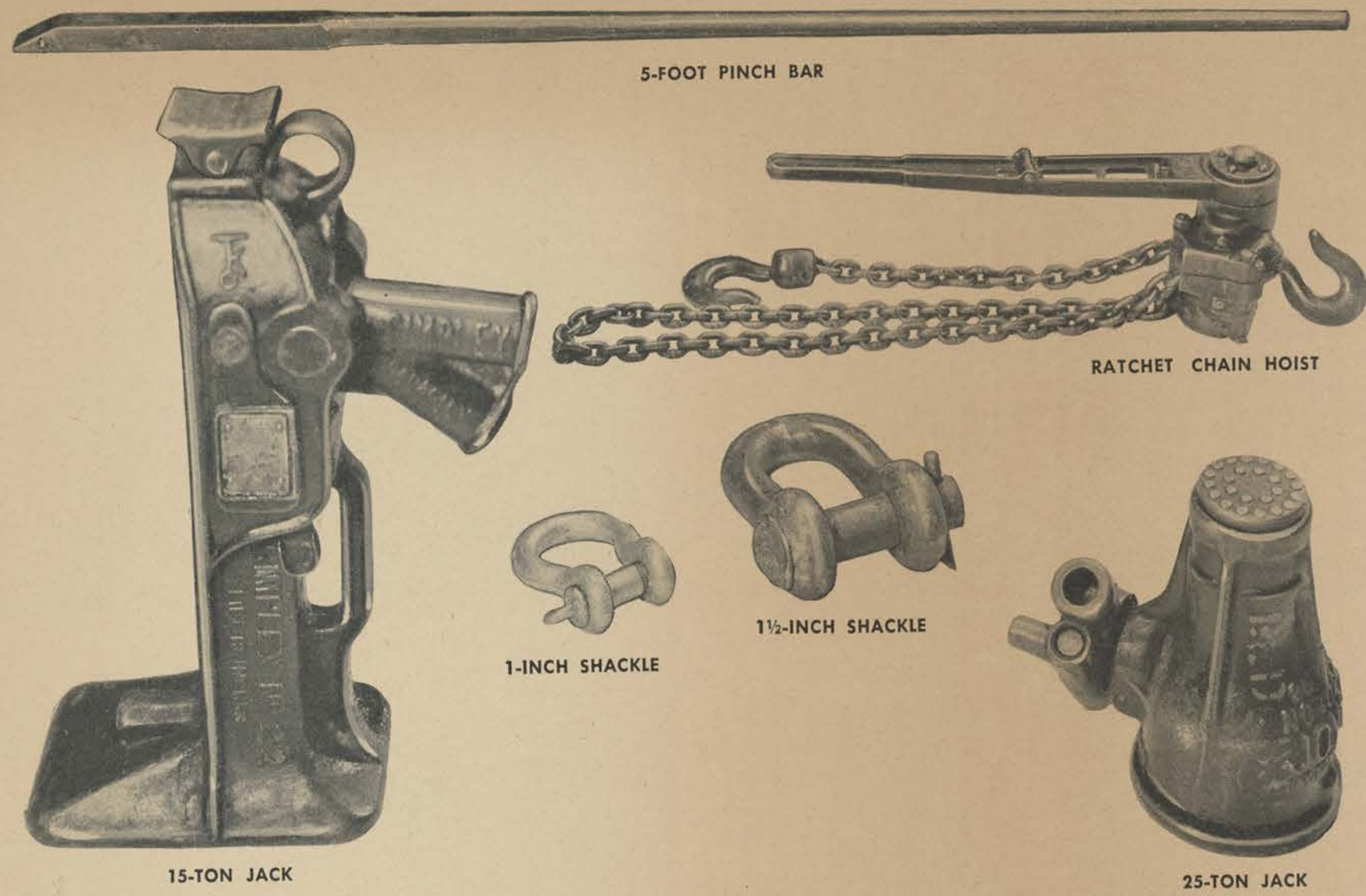


Figure 21. Erection equipment for handling heavy steel members of these bridges. Precautions must be taken when raising or lowering heavy loads to prevent jacks from kicking out.

(2) Structural ribbed bolts are placed first in bolt holes that are not filled with the drift pins or erection bolts described in *a* above.

(3) Structural ribbed bolts are driven with a 6- or 8-pound sledge or a pneumatic hammer. After a bolt is well seated the self-locking nut is run on and tightened to a snug fit.

(4) When all open holes have been filled the remaining drift pins are removed and replaced with structural ribbed bolts; then erection bolts are removed one or two at a time and replaced with structural ribbed bolts.

c. Precautions. (1) An efficient connection is one in which the steel members fit tightly together. To obtain such a fit metal parts must be drawn tightly together with erection bolts and held until structural ribbed bolts have been driven and locked.

(2) Structural ribbed bolts having *correct length and diameter* must be used. They should not be removed and redriven. Sheets 1, 5, and 13 contain information on bolt diameter, length, and position in the bridges.

(3) Structural ribbed bolts *must not* be used for drawing parts together. Threads on the bolts will strip if the nuts are tightened beyond a snug fit.

(4) Structural ribbed bolts are driven whichever direction is easier. If this factor is not decisive always drive towards the heavier member being connected.

37. Rigging

a. General. For general information on rigging see TM 5–225. Specific information for these bridges is given in the following paragraphs.

b. Wire Rope. Wire rope should consist of 6 strands of 19 wires each and should be made of plow steel. The following sizes should be used:

(1) *30-foot bridge.*
1 part ½ inch.

(2) *60-foot bridge.*
Side guys for gin pole—1 part ⅝ inch.
Back guys for gin pole—2 parts ⅝ inch.
Tackle for one girder—2 parts ⅝ inch.
Tackle for two girders—4 parts ⅝ inch.

(3) *90-foot bridge.*
Guys for gin pole—same as for 60-foot bridge.
Tackle for single truss—2 parts ⅝ inch.

c. Steel Blocks (fig. 24). Steel blocks should be used for all rigging where wire rope is required. The strength of the sheave pin and the hook (or shackle) must be sufficient to withstand the loads that will be placed on the block. Size and kind of blocks for each method of erection is given in table VII. Steel blocks equipped for shackle connection are preferable to blocks with hooks.

d. Adjustment of Gin Pole. Gin poles placed on the centerline of the bridge behind the abutment can be used for all work on one bridge. The pole is tilted as required, the rope tackle shown in figure 25 being used to adjust the guy lines. Figure 25 also shows details of rigging at the top of the gin pole.

e. Sling for Climbing Gin Pole (fig. 25). A bowline on a bight as a rope sling is useful in hoisting a rigger up the gin pole to check connections and make changes and adjustments in the rigging.

38. Precautions in Handling Structural Steel

Care must be exercised in transporting, storing, assembling, and erecting structural steel members of these bridges. If members are bent, kinked, or otherwise damaged, the steel may be stressed beyond its elastic limit and fail under critical loads. In addition such damage makes it difficult to connect members. Wood blocks should be placed between slings and members where there is danger of bending flanges of beams or channels.

39. Safety Precautions

The following safety precautions are emphasized:

a. Make sure all connections are secure. This applies to slings, shoring, snubbing, temporary bolting, and wire-rope clips.

b. Make sure equipment is not overloaded.

c. Make sure girders and trusses are adequately shored and tied to prevent their falling when in the upright position.

d. Keep personnel out of line of all cable under stress and away from the underneath side of steel being placed.

e. Make sure winches have positive brakes and efficient clutches so the operator has complete control of loads at all times. This is particularly important in slacking off to lower members into position.

f. Guy lines must be rigged and anchored to take the loads placed on them. The back guy and anchorage takes most of the load when launching by the methods described in chapters 7, 8, 9, and 10. When

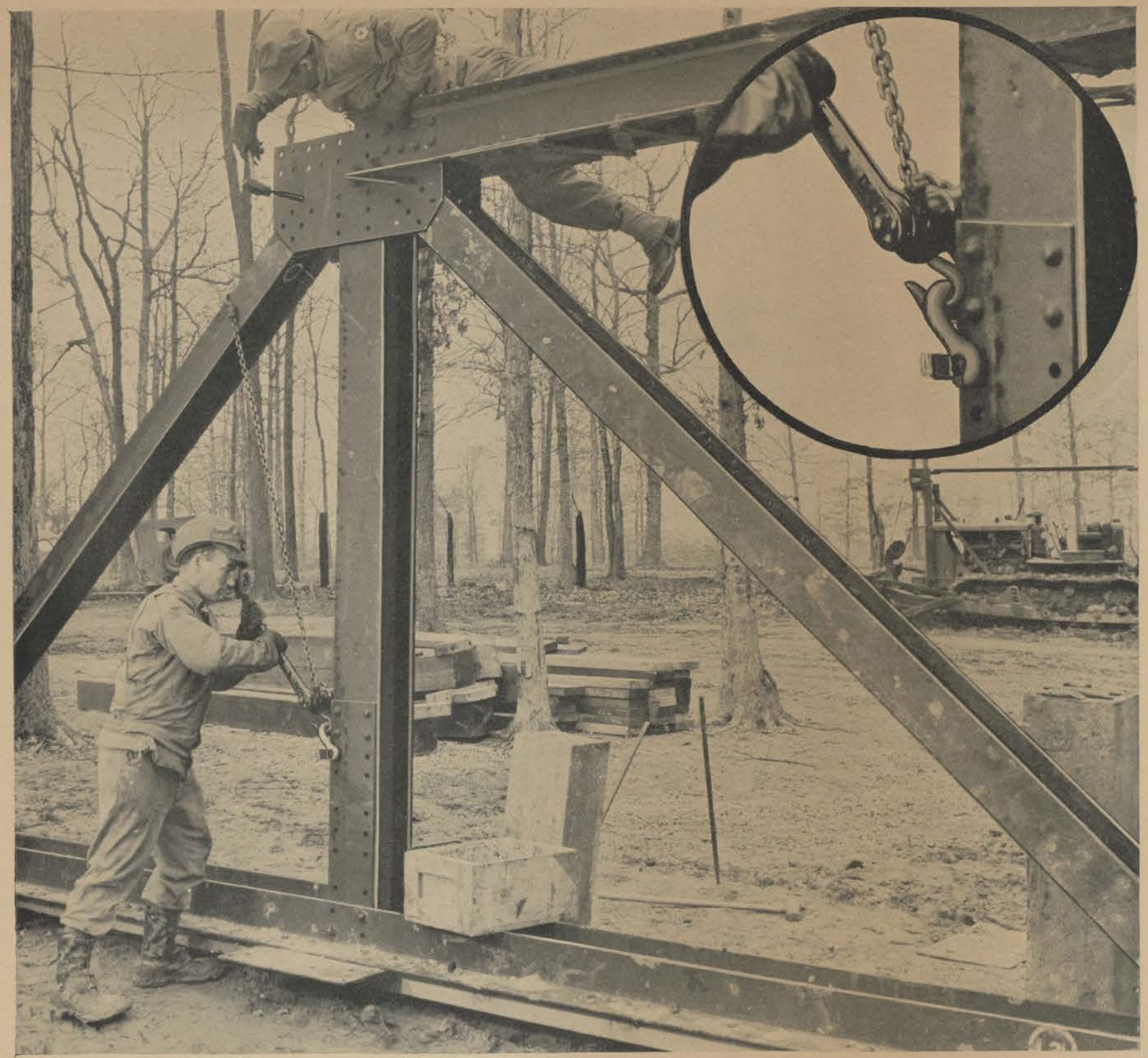


Figure 22. Using the ratchet chain hoist to draw members of the truss together. The connection to the truss member is made with a 1-inch shackle and an erection bolt.

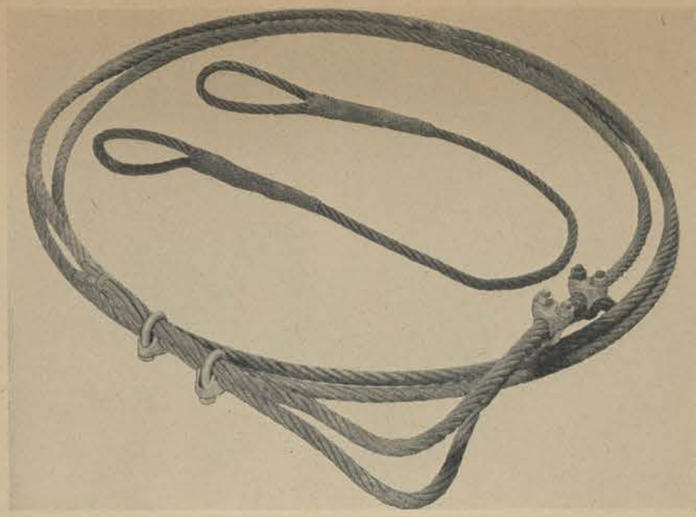


Figure 23. Wire-rope slings used for attaching tackle and lines to heavy steel members

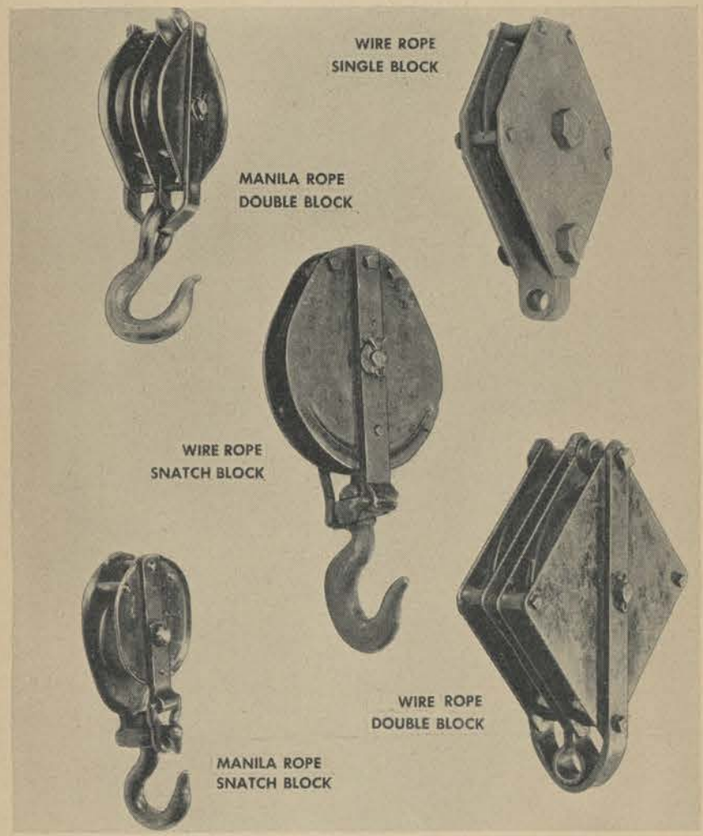
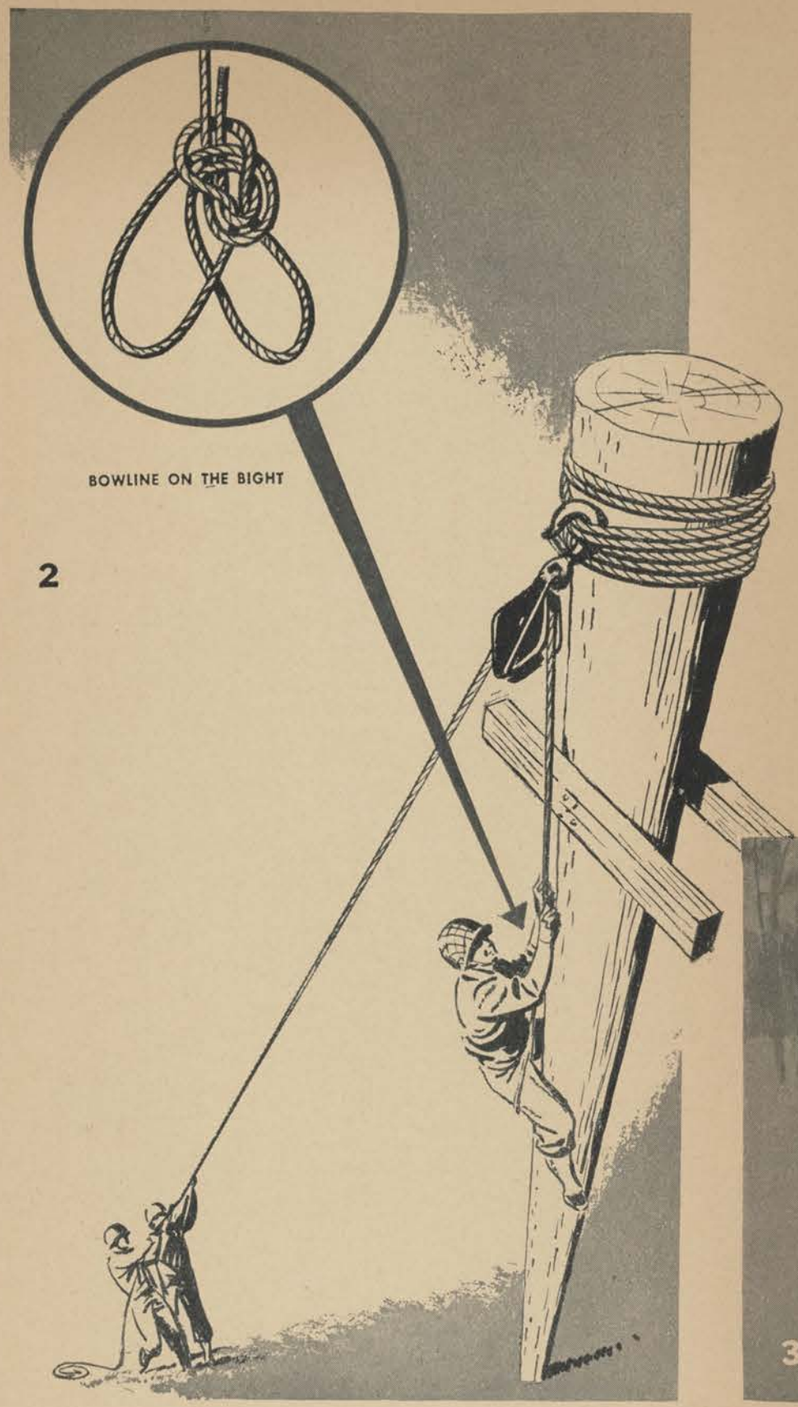
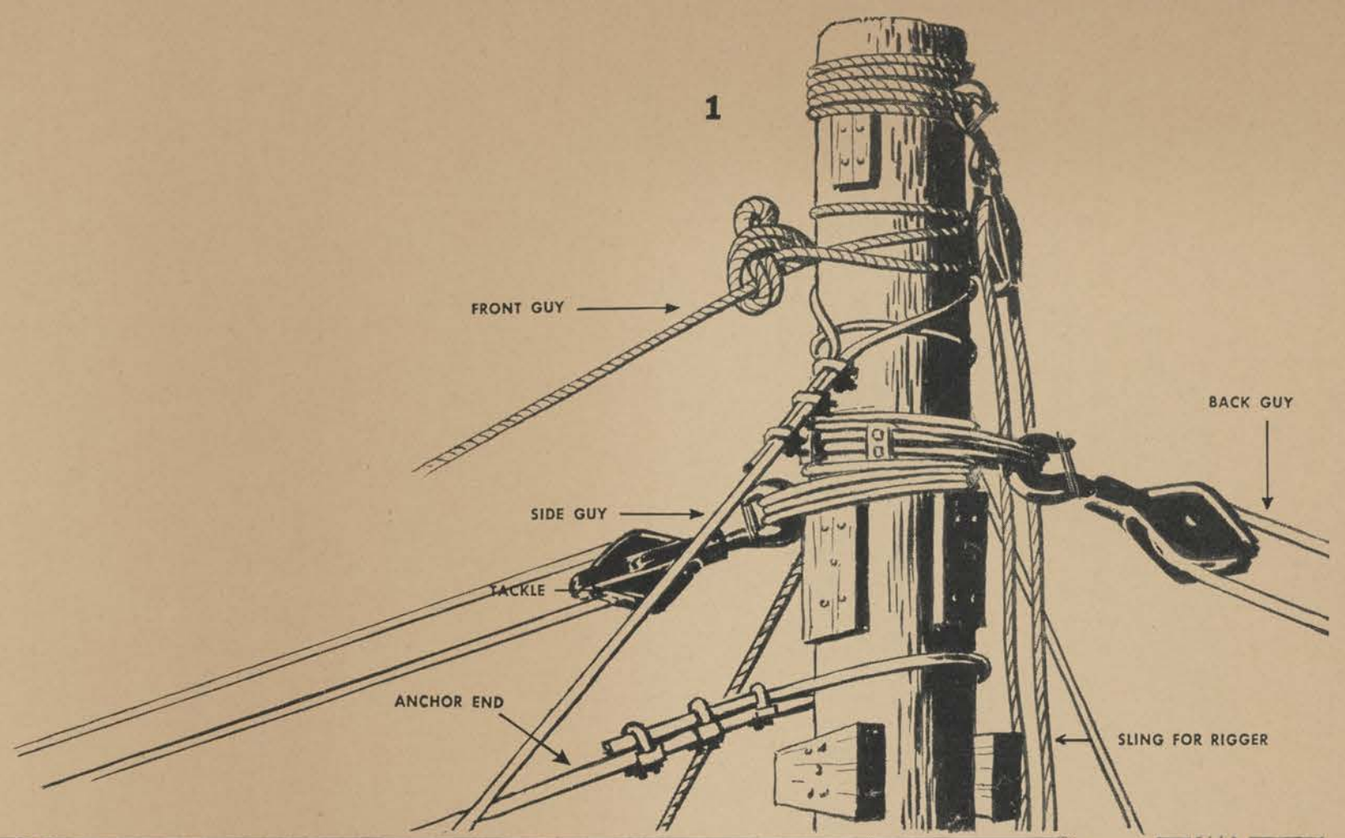


Figure 24. Steel blocks required for launching the bridges by several launching methods.

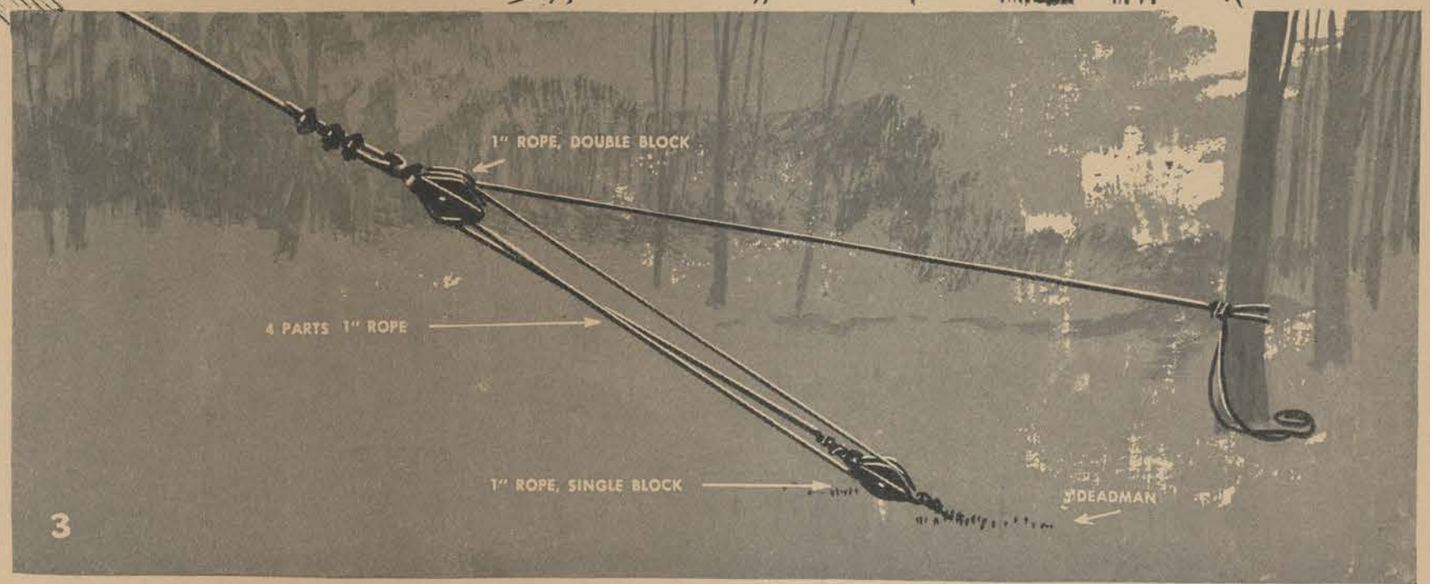
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① *Detail of rigging at top of gin pole.*



② *Sling made with manila rope for hoisting a rigger up the gin pole. Rigging is attached to the gin pole before it is raised but it is sometimes necessary to climb the pole to check connections and make adjustments or changes.*



③ *Tackle of 1-inch manila rope and the double and single manila-rope blocks shown in figure 24. It is used for adjusting guy lines when necessary to tilt the gin pole.*

Figure 25. Gin-pole rigging details.

rigging the gin pole *caution* must be taken to insure the back guy or anchorage will not fail.

g. Before launching girders or trusses, place load on equipment, release, and check all connections and rigging.

h. Before launching girders or trusses, have operator lift and lower the unit several times to "get the feel" of the operation.

i. Make sure the operators of the winches and crane work together and do not overload the equipment. Overloading will be avoided if both ends of the unit being launched are kept level. It is better to have the far end low than high during launching.

j. If girders or trusses are to be lowered to the abutments with jacks and cribbing, precautions must be taken to prevent jacks from "kicking out." This can be prevented by lowering the unit short distances at a time. Do not attempt to lower both ends at once.

CHAPTER 7

ERECTION OF 30-FOOT BRIDGE

40. General

a. DRAWINGS. General and detailed drawings of this bridge are given on sheets 1 to 4 inclusive.

b. EQUIPMENT. Because of their weight, the girders must be unloaded, spotted for assembly, and launched by mechanical means such as cranes and gin poles. Main items of equipment required for each of the several methods of launching are listed in table VII.

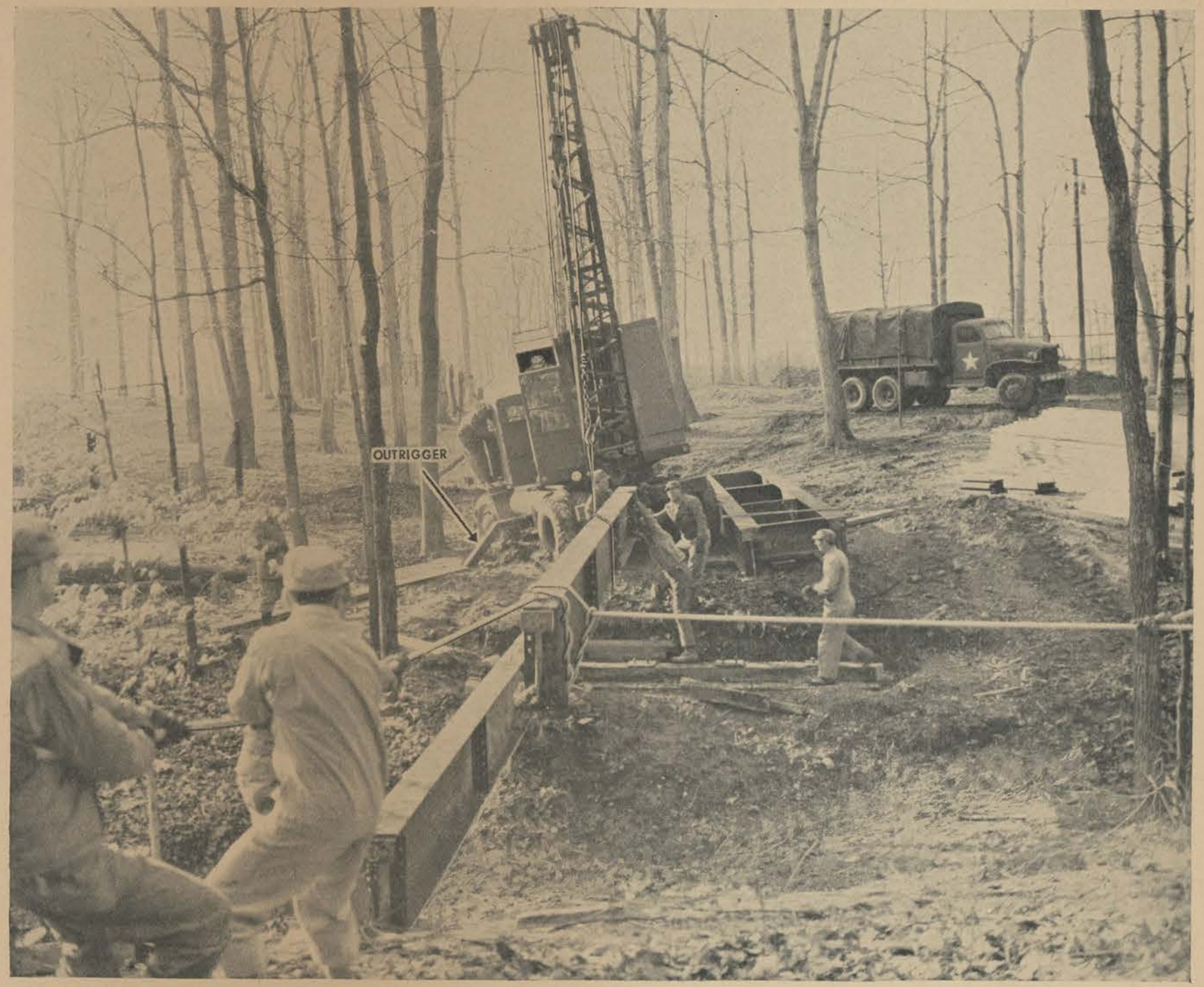
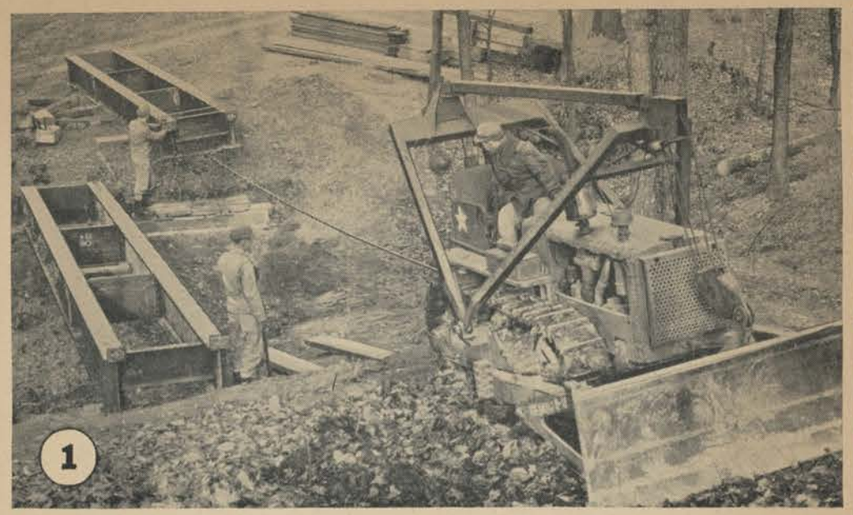


Figure 26. Placing girders for the 30-foot bridge with a ⅜-cubic-yard truck crane. The outrigger prevents crane from tipping. Hand lines guide the girder into place on the bearing plates.





① *First phase: Diaphragms are bolted to the girders to connect them in pairs. A cable from the tractor winch is attached and the girders are pulled across the gap.*

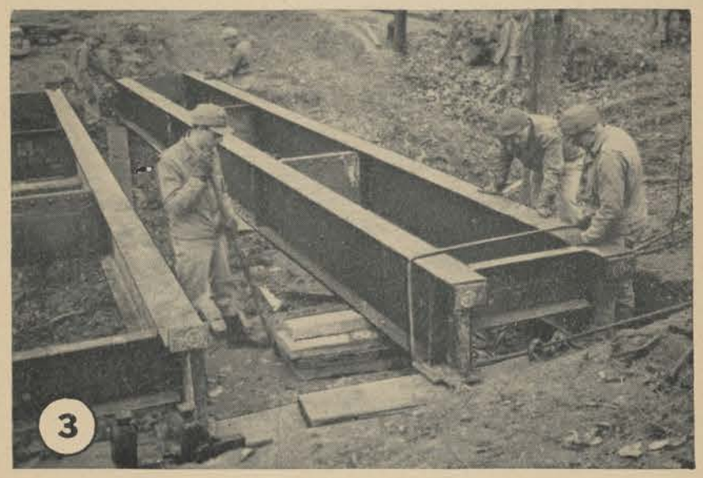
② *Second phase: Plank skids guide the girders into position over the bearing plates.*

③ *Third phase: Girders on blocks in position over the bearing plate.*

④ *Fourth phase: The timber provides enough leverage to lift the end of the girders so blocking can be removed and girders lowered to bearing plates.*

⑤ *Fifth phase: Placing diaphragms between the two sets of girders on the abutments. Note the timber support placed on the lower flanges of the girders.*

Figure 27. Erection of the 30-foot bridge by skidding pairs of girders into place with a tractor.





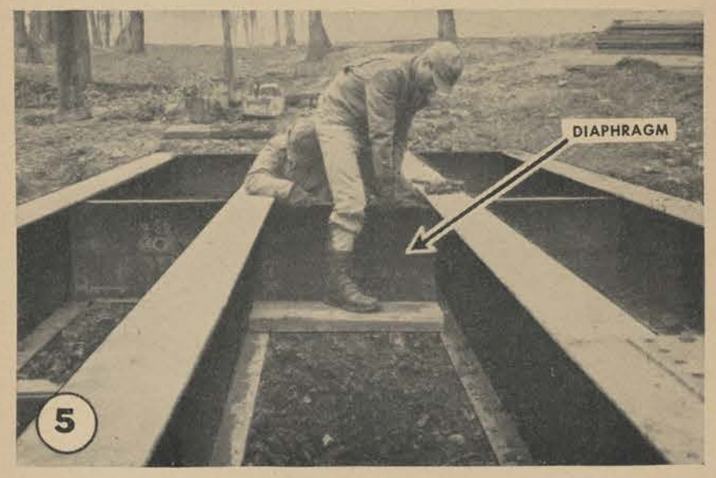




Figure 28. Skidding a girder into place for the 30-foot bridge using a tractor winch for power. Note use of skids. The girder is rotated to the vertical position and placed on the bearing plate by hand. Note the position in which the traction clips are shipped. They must be changed before laying flooring.

The weights to be handled are as follows:

Single girder	2,600 pounds.
Two girders connected	5,700 pounds.

c. Assignment of Tasks. Table XI may be used in setting up a schedule of work and work parties. Construction may be speeded by:

(1) Transporting and unloading material, constructing abutments, and assembling first units during the first stage.

(2) Bolting first unit while second unit is being assembled, at same time placing bolts and bearing plates on the sill.

(3) Launching first unit while bolting of the second unit is being completed.

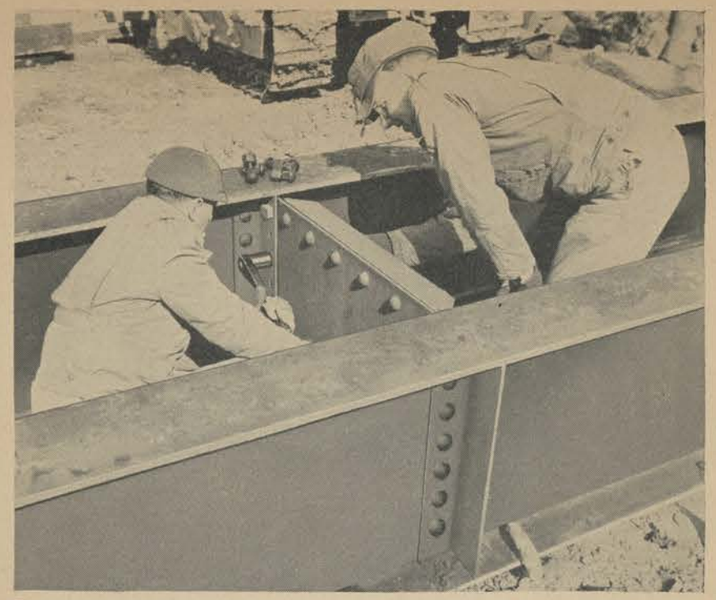


Figure 29. Bolting diaphragms to girders with structural ribbed bolts. Note use of ratchet wrench.

(4) Having one party complete bolting girders which have been placed while a second party begins to lay the floor.

(5) Having other work parties start placing guardrails, wearing surface, and protection angles, while the floor is being laid.

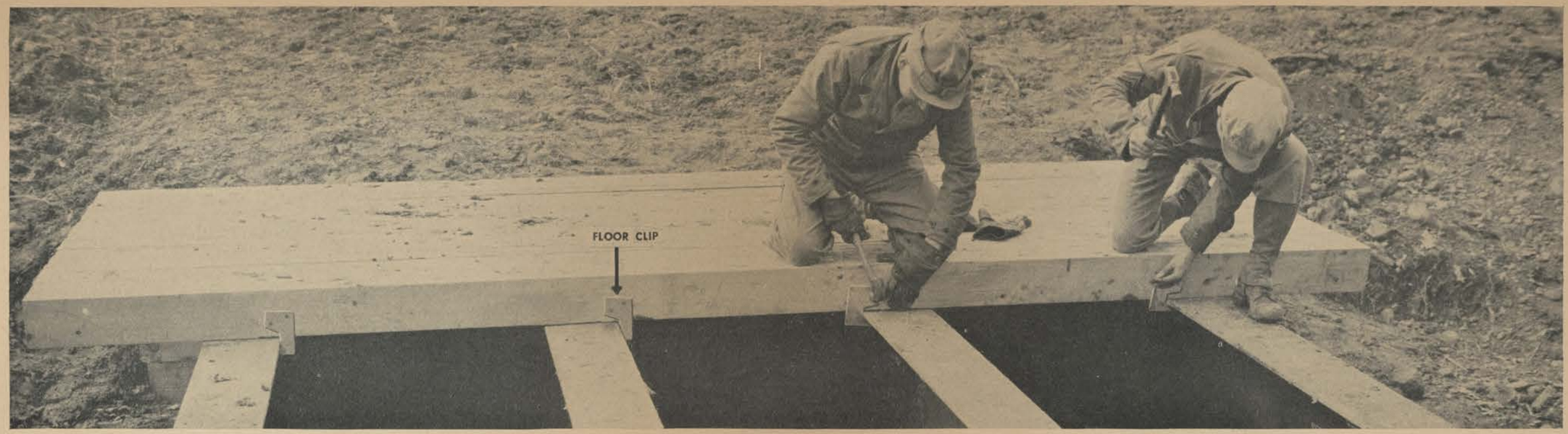
41. Assembly of steel

If beams are placed on the abutments one at a time, no assembly before launching is required since the beams are made in one piece. Traction clips, shipped bolted to beams, are removed and bolted in the correct position. Beams may be launched in pairs in which case assembly consists of bolting end and intermediate diaphragms to the two beams.

42. Launching

a. Truck Crane (see method A, table VII). A truck or tractor crane with a 2,600-pound capacity at a 20-foot radius can pick up the beams and place them on the abutments (fig. 26). Hand lines on the ends of the beam aid in guiding it into position. Two men with pinch bars assist in guiding the beam into its final position over the anchor bolts.

b. Skidding (method B, table VII). Where conditions permit, a simple method of launching is to connect the I-beam in pairs and drag the pair across the gap. Figure 27 shows a tractor placing a pair of beams by this method. Skids are used to guide the beams to a position over the anchor bolts from which they are lowered by hand or jacking. Single beams can be placed by the same method (fig. 28).



① *Placing laminated timber deck. Floor clips are placed so they bear solidly against the edge and under side of the beam flange.*



② *Installing timber curb. The bearing area of the curb bol ton the timber curb and deck is increased by using O. G. washers. Curb blocks provide opening for drainage.*



③ *Laying plank wearing surface.*



④ *Partly decked bridge showing the curb, wearing surface, and protection angle in place. Approach construction not complete.*

Figure 30. Installing timber floor and curb on the 30-foot bridge.

c. Alternate Methods. Any of the methods given in chapter 8 for launching the 60-foot bridge may be used for launching this bridge if conditions warrant the additional work involved.

43. Completion of Bridge

a. Setting Girders. Girders are set with anchor bolts located in the center of the slotted expansion holes. When girders are in place on the bearing plates, they are connected by bolting the diaphragms to the stiffener angles (fig. 29).

b. Installation of Floor (fig. 30). (1) Traction clips are bolted with structural ribbed bolts with countersunk heads.

(2) Two 2- by 6-inch planks are set on edge so they bear against the traction clips. Nails are driven through the planks toward the abutment and clinched. The third plank is placed against the second and nailed. See nailing scheme on sheet No. 4 for spacing of nails.

(3) Floor clips are fastened to the third plank and to each eighth plank thereafter. See scheme for floor clips on sheet No. 4. Make certain that clip bears solidly against under side and edge of girder flange.

(4) The remaining deck planks are placed and nailed. It may be necessary to notch the last plank so it will bear properly against the traction clip.

c. Installation of Curb (fig. 30②). Curb blocks are set at proper intervals and toenailed in place. Curbs are placed on top of blocks and held in place by toenailing. Holes are bored through curb, blocks, and deck. Bolts are driven, washers placed, and nuts tightened.

d. Wearing Surface and Protection Angles. Wearing-surface planking is spiked to the deck (fig. 30③). Protection angles are fastened to wearing surface at ends of bridge (fig. 30④).

44. Removal of Bridge

The procedure for removing this bridge is the reverse of that by which it was assembled and launched.

CHAPTER 8

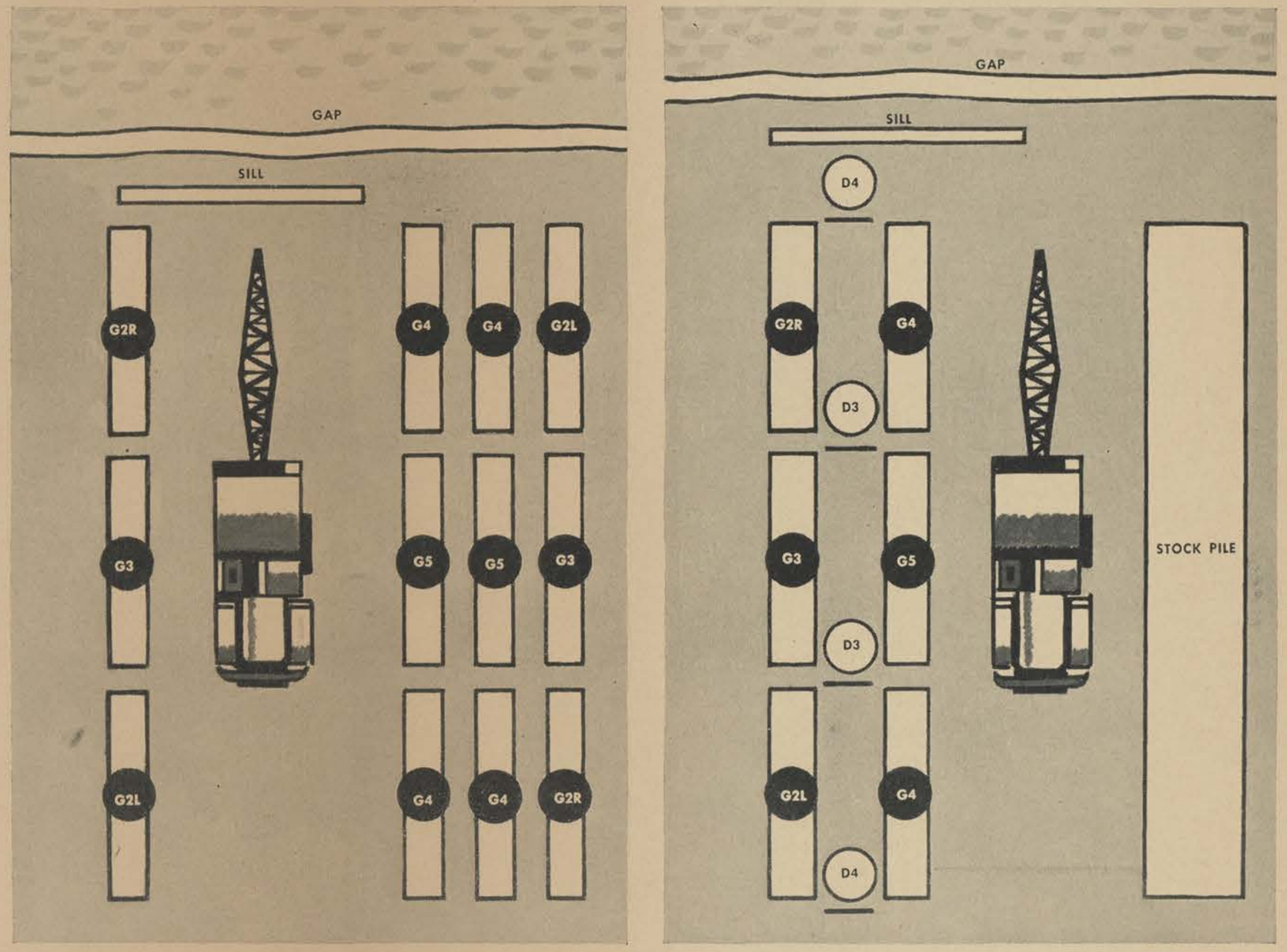
ERECTION OF 60-FOOT BRIDGE

45. General

a. Drawings. General and detailed drawings of this bridge are given on sheets 4 to 7 inclusive.

b. Equipment. Mechanical equipment such as gin poles or cranes is required for handling members of this bridge. See table VII for main items of equipment required for each of the several methods of launching. The weights to be handled are:

Heaviest girder section	3,500 pounds.
One girder complete	10,000 pounds.
Two girders connected	22,000 pounds.



① *Position of girder sections for assembling and launching a single girder.* ② *Position of girder sections for assembling and launching a pair of girders.*

Figure 31. Layout of girder sections for assembly of 60-foot bridge.

c. Assignment of Tasks. Table XII may be used in setting up a work schedule and work parties. The scheme given in paragraph 40*c* for assigning tasks for the 30-foot bridge applies to this bridge as well.

46. Assembly of Girder

a. Single Girder. If girders are to be launched as single units, sections are placed as shown in figure 31① and bolted together at the splices.

b. Double Girder. If girders are to be launched in pairs, sections are placed as shown in figure 31②, the four splices completed, and the diaphragms connected (fig. 32).

c. Position of Sections. All girders should be assembled with the holes for lateral rods toward the top. Outside girders are placed so the angle plate anchor for lateral tie rods is on the outside.

d. Splicing Girders (fig. 33). (1) The sections of the girder to be spliced should be set on blocks at working height and adjusted to proper grade and alignment relative to each other.

(2) Web splice plates are bolted first (fig. 33③).

(3) Upper flange splice plates are placed and bolted next (fig. 33④).

(4) Before bolting the lower flange plates (fig. 33⑤), the girder is placed on its side or is raised high enough to permit driving structural ribbed bolts with the pneumatic hammer. Before bolting, the lower flange should be checked to see if a fill plate is required. Because of slight variations in depth of girder sections, it may be necessary to use one or both of the fill plates furnished with the splice material (figs. 9 and 33⑥). The holes in the webs are located so the top flanges on both sides of the splice are flush when holes are aligned. If no fill plate is required for the bottom flange splice, some of the structural ribbed bolts will be too long. If they are, cut washers provided should be used under the nuts.

47. Launching.

a. General. Girders for this bridge may be launched singly or in pairs. The single-girder method is preferred because of the additional weight involved when launching two at one time. However, if equipment is capable of handling the weight, the two-girder method is quicker and girders are easier to launch because they are less likely to tip.

b. Gin Pole-Crane Method (method C, table VII). A gin pole is erected on solid footing 5 feet behind the center of the far-side abutment. Wire-rope guys with steel blocks are used; a rope tackle (fig. 25) is rigged to each guy line for adjusting the angle of the pole. A line is run from a winch on the near bank to the pole and back to the far end of the girder. The tackle required is determined by the number of girders to be launched, the size of wire rope, and the equipment available (see par. 37, ch. 6). Wire-rope slings are used to fasten the tackle to the girders. A tractor- or truck-mounted crane is snubbed to the near end of the girder as a brake. A line from the crane boom is attached to the near end of the girder to steady it. Power from the winch pulls the girder across the gap. Figure 34 shows a girder being launched by this method. When the near end approaches the abutment, the crane picks it up and lowers it onto the sill. Two girders connected by diaphragms can be launched the same way.



Figure 32. Bolting diaphragms preparatory to launching a pair of girders of the 60-foot bridge.

c. Gin Pole-Tractor Method (method D, table VII). A gin pole is rigged as in method C above and tackle from the pole is attached to the girder. The lead line is powered by a winch on the near bank. A tractor with dozer is snubbed to the girder as a brake. When the girder is in position for lowering to the sill, a sling attaches the girder to the blade of the dozer. The gin-pole tackle lowers the far end and the dozer blade lowers the near end (fig. 35). If two girders are launched at one time they are lowered with jacks or a crane (fig. 36).

d. Alternate Methods. The methods discussed in chapter 9 for launching the 90-foot truss are applicable to this bridge if conditions warrant the additional work involved.

48. Completion of Bridge

a. Setting Girders. Girders should be placed so anchor bolts are in the center of the slotted expansion holes. After girders are in place on bearing plates and nuts on anchor bolts are properly tightened, diaphragms are bolted to girders (fig. 37).

b. Lateral Bracing. When diaphragms are in place the lateral rods are placed (fig. 38). The turnbuckles should be tightened enough to remove the slack and stress the rods slightly but care should be taken to avoid setting up considerable stress in the rods. If the center of the bridge is not in true alignment with the ends, proper adjustment of the laterals will bring the bridge in line.

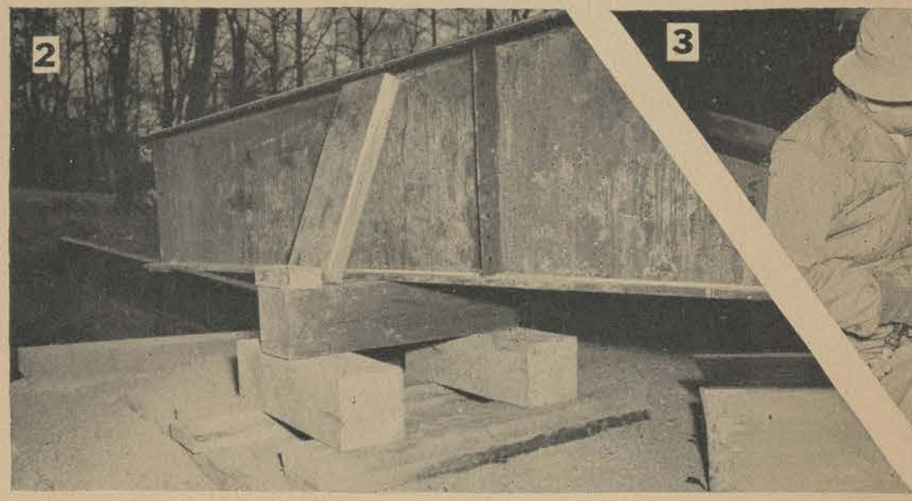
c. Installation of Floor and Curb. Instructions for installation of flooring, curb, wearing surface, and protection angle are identical to those given for the 30-foot bridge described in paragraph 43*b*.

49. Removal of Bridge

The bridge is removed in the reverse manner to that in which it was assembled and launched. Girders are removed singly or in pairs by one of the methods given for launching. If the bridge is to be moved to a new site and erected again, single assembled girders can be transported on a trailer without disconnecting the splices.









① *Assembling girder sections preparatory to splicing. One section being moved with crane. Timber blocks and wedges adjust sections to correct fit.*

② *Support and shoring for girder. The girder is placed on the ground before launching.*

③ *Align bolt holes with driftpins before bolting. Machine bolts are used during erection to hold the members tightly together until structural ribbed bolts are placed. Note the spud wrench and use of the pneumatic hammer for driving the structural ribbed bolts.*

④ *Bolting upper flange splice plates. Driftpins align holes and erection bolts are placed and tightened; then structural ribbed bolts are placed.*

⑤ *Driving structural ribbed bolts in lower flange splice. Note the clearance required under the girder for the pneumatic hammer. If sledges are used for driving bolts the girder is laid on its side. Note use of fill plate.*

Figure 33. Splicing girder sections preparatory to launching girders of the 60-foot bridge.

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① *The girder on the approach preparatory to launching. A line is run from the truck winch to the gin pole (not shown) and back to the far end of the girder. The near end of the girder is supported by the truck crane.*

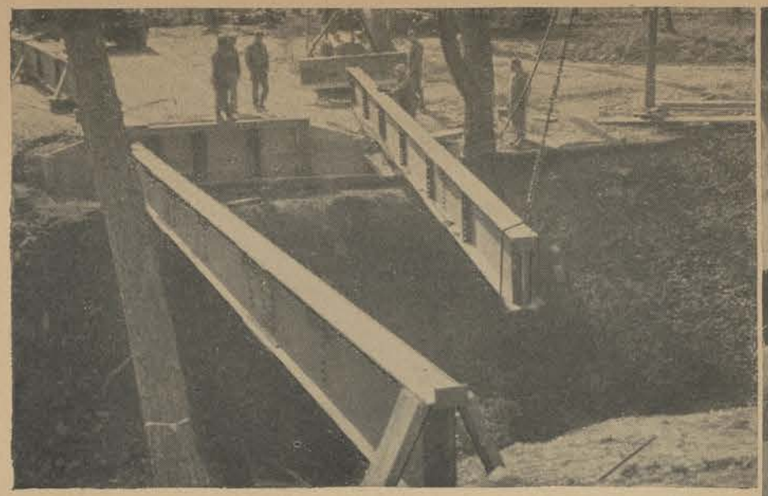


② *Launching the girder. The gin-pole line pulls the girder across the gap. The crane is snubbed to the girder and acts as a brake. The vertical lift given by the crane line helps keep the girder from tipping.*

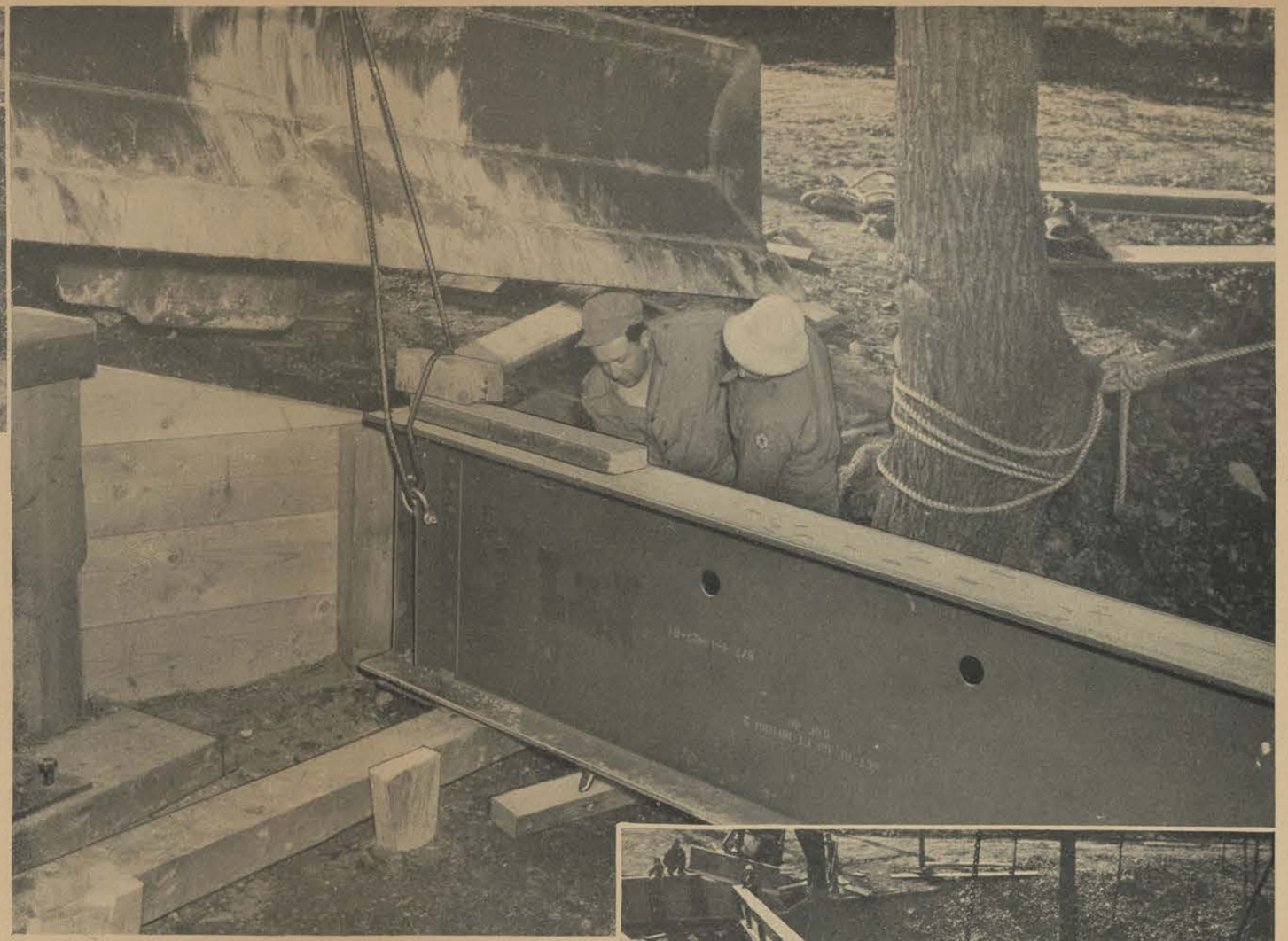


③ *Placing the girder on the abutments. The crane lowers the near end and the gin-pole line lowers the far end. Pinch bars are used to guide the beam into position on the anchor bolts.*

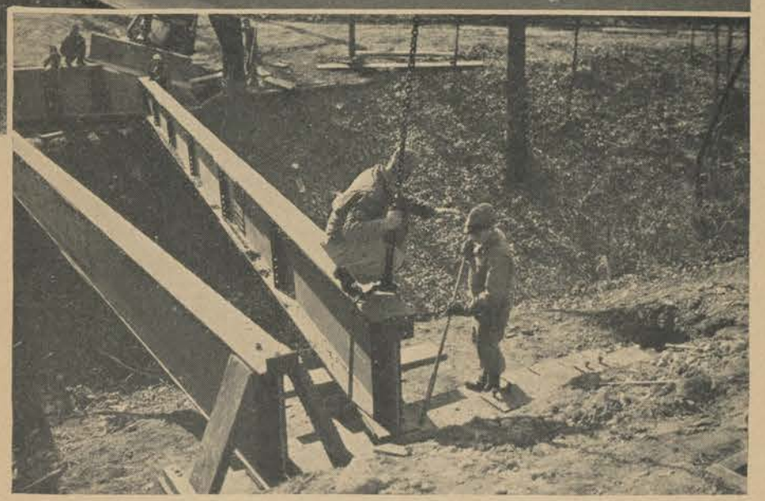
Figure 34. Launching a girder for the 60-foot bridge with a gin pole and ⅜-cubic-yard truck crane.



① *Launching the girder. A line from the gin pole supports and pulls the girder across the gap. The tractor is used as a brake to control the girder.*



③ *Last phase of launching using the dozer blade on a tractor to lower the end of the girder. A pinch bar is used to skid the girder to the bearing plate.*



② *Placing the far end of the girder on the abutment.*

Figure 35. Launching a girder for the 60-foot bridge with a gin pole and tractor.

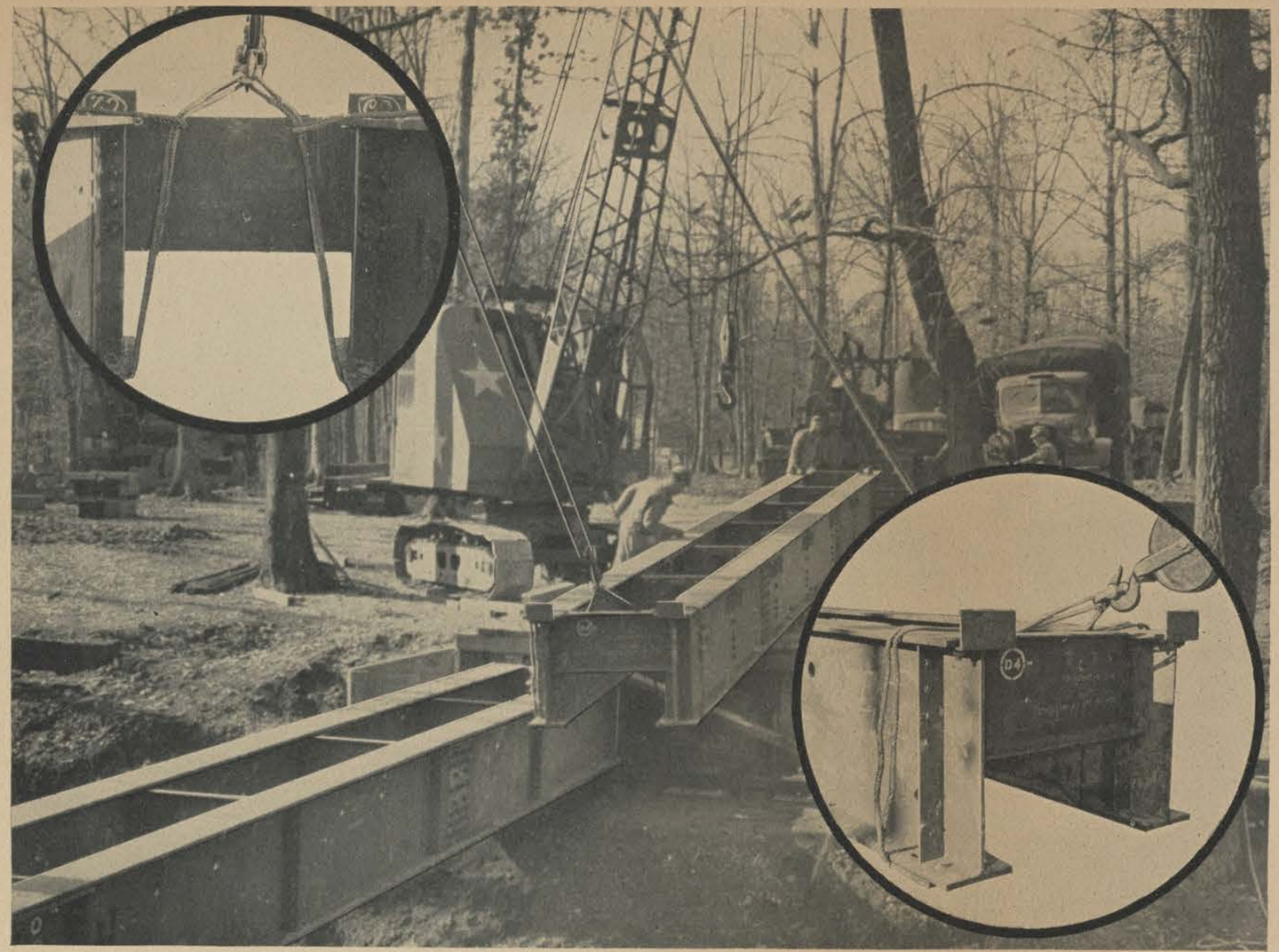


Figure 36. Launching a pair of girders for the 60-foot bridge with gin pole and tractor. The tractor acts as a brake to prevent the girders from sliding too rapidly. The girders are placed on the bearing plate with a crane or if that is not available they are lowered with jacks. Note the method of connecting the tackle to the girders (see inserts).



Figure 37. Placing intermediate diaphragms after girders have been placed. Planks are placed on the lower flanges of the girders to support the men.



Figure 38. Installing diagonal lateral bracing. Tie rods are tightened only enough to bring girders into proper alignment. See figure 2 for completed structural steel work.

CHAPTER 9

ERECTION OF 90-FOOT BRIDGE

Section I.

GENERAL

50. Methods of Erection

a. General. Several practical methods of erecting this bridge have been developed and are described in this chapter. In general the methods are divided into two classes:

(1) Erection by assembling single trusses on the approach, launching trusses one at a time, and building the floor system over the gap.

(2) Erection by assembling the entire bridge on the approach and launching it into place. Where site conditions permit the bridge can be assembled on a raft and floated into place.

b. Factors to be Considered. Single-truss erection is recommended. It is more economical of labor, material, and time. However, peculiarities of site and lack of equipment may warrant the other method.

c. Equipment. Mechanical equipment is required for the erection of this bridge. Table VII lists the principal items of equipment required for each method of erection. Weights to be handled are:

Heaviest truss member	1,650 pounds.
Heaviest floor beam	1,150 pounds.
Single truss	15,000 pounds.
Total structural steel	57,000 pounds.

51. Erection

a. Drawings. General and detailed drawings of this bridge are given on sheets 8 to 13 inclusive.

b. Assignment of Tasks. See table XIII as a guide in setting up a work schedule. Erection can be speeded by working on several tasks at one time. For example, if the bridge is to be built by launching single trusses, work may be done in the following stages:

(1) First Stage. Transporting and unloading material, constructing abutments, assembling first truss, rigging gin pole.

(2) Second Stage. Launching first truss; assembling and launching second truss.

(3) Third Stage. Installing floor beams and stringers; beginning construction of floor.

(4) Fourth Stage. Finishing floor, placing guardrail; removing gin pole, cleaning up area.

c. Assembly of Steel. Assembly of steel members depends on the method of erection used. A procedure for each method is described in sections II and III. Some aids to assembling steel members are listed below:

(1) A ratchet chain hoist and shackle may be used in drawing members together where the fit is close (fig. 22).

(2) The 6- by ⅝- by 8-inch fill plates at joint U2 make it difficult to join members P2 and U2 (fig. 39). This difficulty is overcome by tack welding the fill plates to member U2.

(3) Shore and tie truss on one side only to keep the other side clear for operation of equipment.

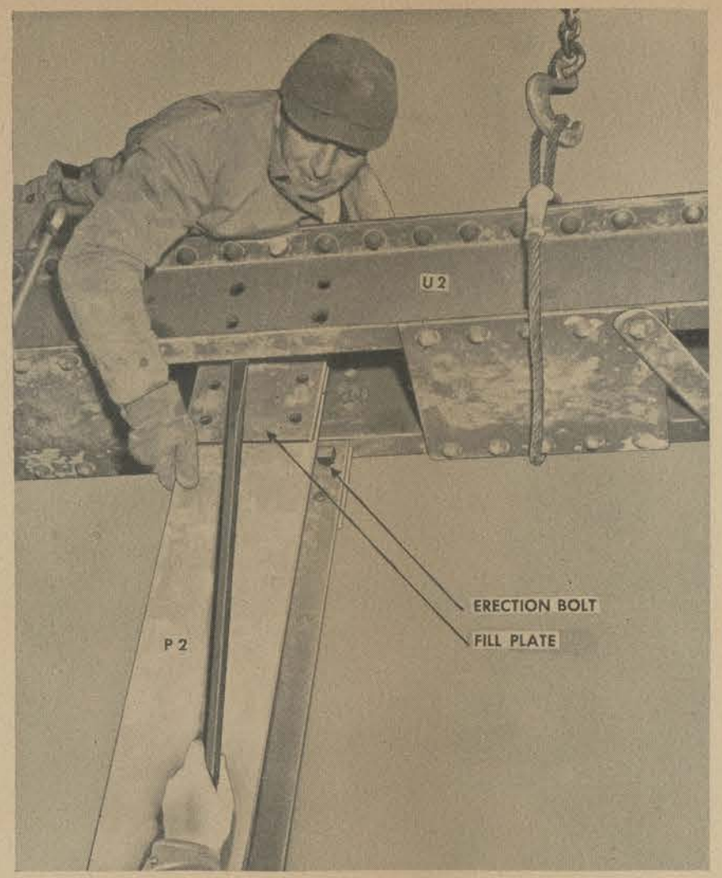


Figure 39. Connecting members U2 and P2. Erection bolts hold the fill plates while member U2 is placed. The connecting bar guides the member into position.

Section II.

ERECTION BY LAUNCHING SINGLE TRUSSES

52. Assembly of Truss

a. Equipment. A small crane or derrick greatly facilitates assembly of trusses. However, assembly can be done with a small gin pole used to lift members into place.

b. Preliminary Preparations. A plank is bolted to the bottom of the lower chord to form a rail for the truss to slide on in launching. Figure 40① shows a method of attaching the plank. A skid is built on the bottom of the near-side pedestal to aid in sliding the truss on the approach (fig. 40②). Cabin plates are removed from end pedestals. Camber blocks are prepared (see sheet 14 for camber diagram).

c. Order of Placing Truss Members (See sheet 14). (1) Sections of the lower chord are spliced and placed on the camber blocks (fig. 41①). The truss should be assembled with expansion end toward far bank.

(2) Far-side web vertical P1, web diagonal W1, and end post U1R are placed.

(3) Far-side web verticals, P2 and P3, and right web diagonals, W1 and W2, are placed.

(4) Upper chord U2 is placed (fig. 41②).

(5) Members listed above are placed on the near-side of the truss (fig. 41③).

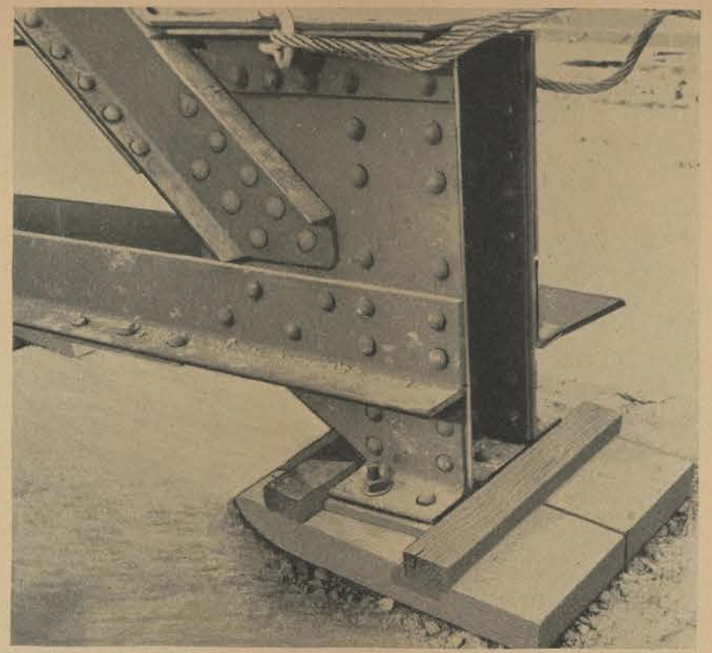
(6) Two center web verticals P2; center web diagonals, W3, W4, and W5; and upper chord center section U3 are placed (fig. 41④).

Note. Member U3 must be placed last because of arrangement of gusset plates on other upper chord members.

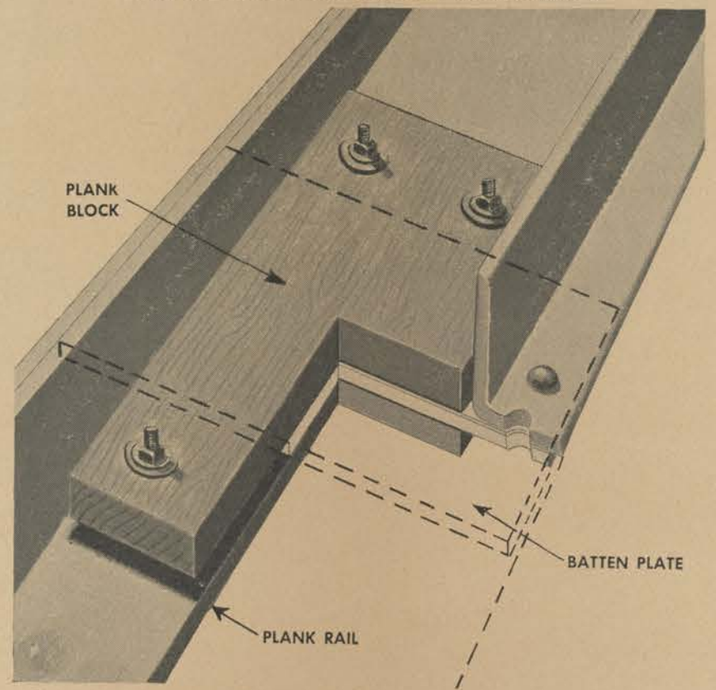
(7) Place cabin plates on end pedestals. Do not bolt until end floor beams have been bolted to trusses.

53. Launching Truss

a. General. Several methods of launching single trusses have been developed. The method with a gin pole and crane is recommended if equipment is available and site conditions permit. Other methods are described to permit selection of a method best suited to conditions on a particular job.



① *Plank bolted to lower chord of truss to act as a launching rail. Note method of bolting on both sides of the batten plate. See also figure 43.*



② *Timber skid built under near end of truss to support it during launching.*

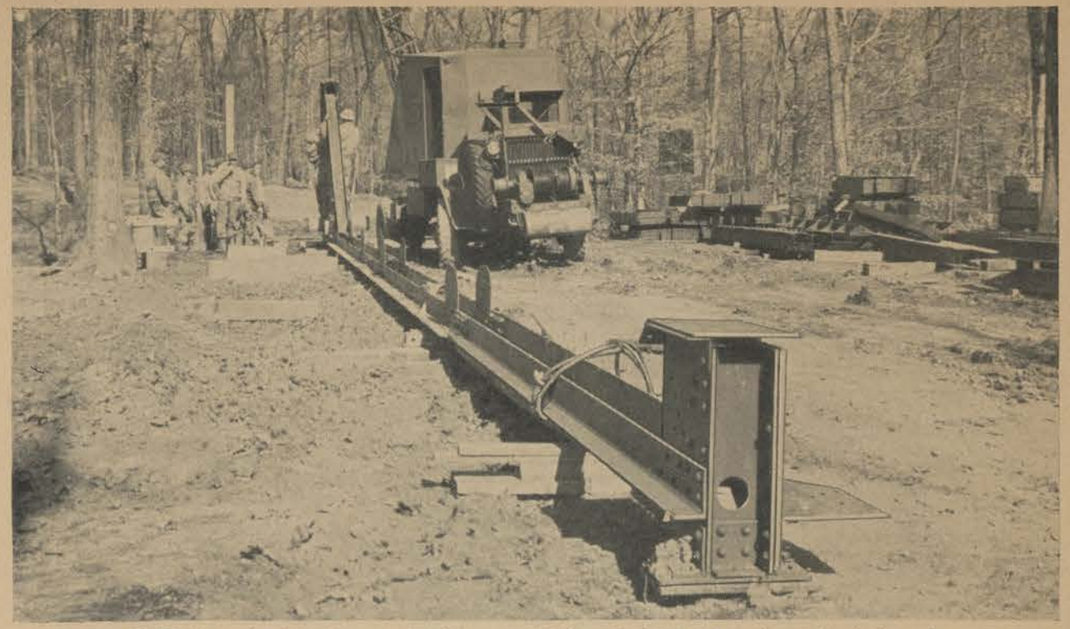
Figure 40. Preparations for launching truss for 90-foot bridge.

b. Gin Pole and Crane (method *E*, table VII and fig. 42). (1) Preparations. A gin pole is erected on solid footing 5 feet behind the center of the far-side abutment. Wire-rope guys are equipped with rope tackle (fig. 25) to facilitate adjustment of the angle of the pole. Tackle consists of wire rope and steel blocks (see chapter 6). A line is run from the winch to the block on the pole, back to the block attached to the top chord of the truss, then to the top of the pole. Tackle is attached at joint U1 on the far end of the truss. A tractor- or truck-mounted crane is snubbed to the near end of the truss to act as a brake (fig. 43). The crane boom line is attached at near-end joint U1. A temporary timber frame is built at the near abutment to aid in keeping the truss upright. It is removed when the truss is near the abutments.

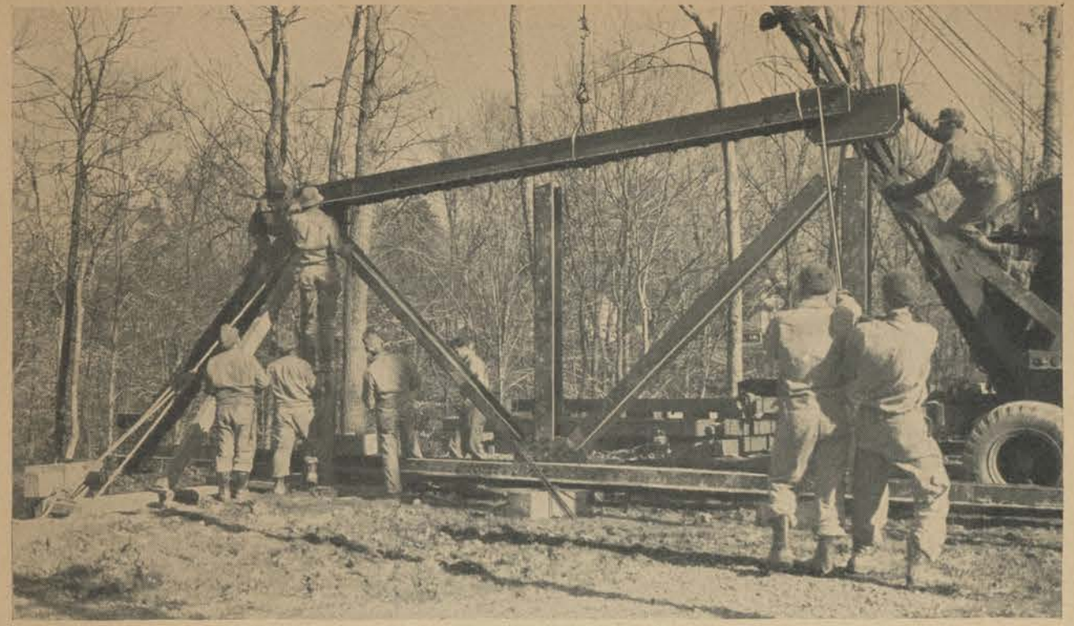
(2) Launching. Power is applied by the winch and the truss is pulled toward the far-side abutment. The crane assists in sliding the truss forward by applying tension on the boom line and also controls forward movement by the snub line. The boom line also assists in keeping the truss upright because of the vertical pull exerted. The crane moves forward with the truss, keeping the snub line taut to prevent too rapid movement. When the truss is near the final position, a second snub line is attached at joint L2 and controlled by a winch on a truck or tractor. The snub line is released from the crane and the truss is swung into position over the abutments by lifting the far end with the gin pole and the near end with the crane. The skid is removed from the pedestal and the near (fixed) end of the truss is lowered to the bearing plate. The far (expansion) end is placed last. Figure 44 shows the truss being launched by this method. ***Caution.*** The ⅜-cubic-yard truck crane, if used, will be near tipping load at the radius required for lowering the truss to the abutment sill. The approach must be level and firm. It may be necessary to anchor the crane chassis. Counterweights may be added to the crane chassis or a tractor may be snubbed to it.

c. Gin Pole Without Crane (method *F*, table VII). This method is similar to the one described above except that a crane is not required. The truss is pulled across in the same manner but without the aid of the crane. There is some danger of the truss tipping sideways with this method since there is no vertical lift on the near end of the truss. Precautions are taken to avoid this by constructing an A-frame skid to support and brace the truss while it is being launched (fig. 45). Guy lines may be used for the same purpose (fig. 46). A brake should be provided by a tractor or truck winch line attached to the near end of the truss. The truss is pulled onto temporary cribbing at the abutments and lowered into final position with jacks.

d. Two Gin Poles (method *G*, table VII). A single truss can be launched using two gin poles, one on the far bank and one on the near bank. Both lines are attached to the far end of the truss. The near end of the truss can be braced by the method given in *c* above. The truss is pulled toward the abutments. When it is near the abutments the line from the near gin pole is changed from the far to the near end of the truss and the truss is lowered to the bearing plates on the abutment sill. The advantage of two gin poles over one is that the load is under better control and there is less danger of the truss



① *The lower chord members are placed on camber blocks and spliced. A truck crane is placing web members in the far end of the truss.*



② *Placing member U2R into position for bolting. Note use of hand lines.*



③ *Assembling web members on near end of truss. Smaller members can be placed by hand.*



④ *Placing member U3 with the truck crane. This member must be placed last because of the position of gusset plates on adjacent members*

Figure 41. Assembling truss on bank before launching. Truck crane is used to handle members. The truss is launched from this position when assembled. The truss is assembled with expansion end toward far bank.

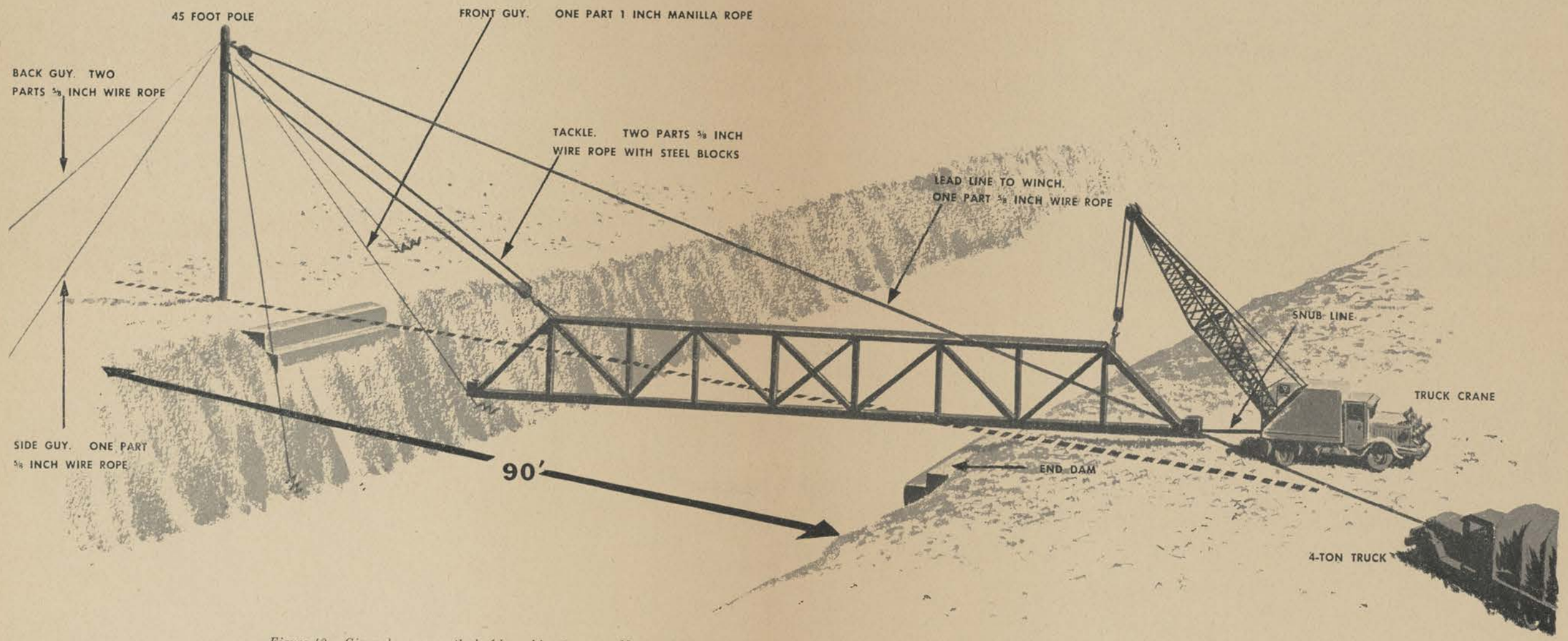


Figure 42. Gin pole-crane method of launching trusses. Note position of gin pole. Both trusses are launched with pole in this position. See figure 25 for rigging details.



Figure 43. Crane in position at near end for launching truss. Note snub line for holding truss back and method of attaching crane line to truss.

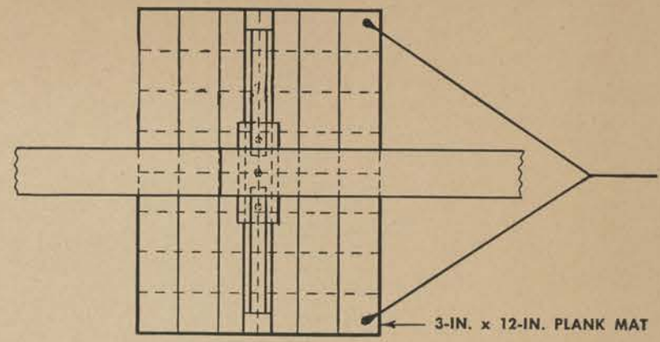


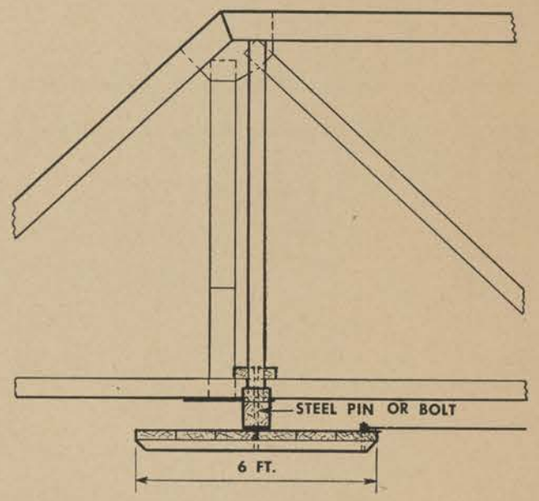
① *View from far bank. Timber frame on abutment end dam holds the truss upright.*

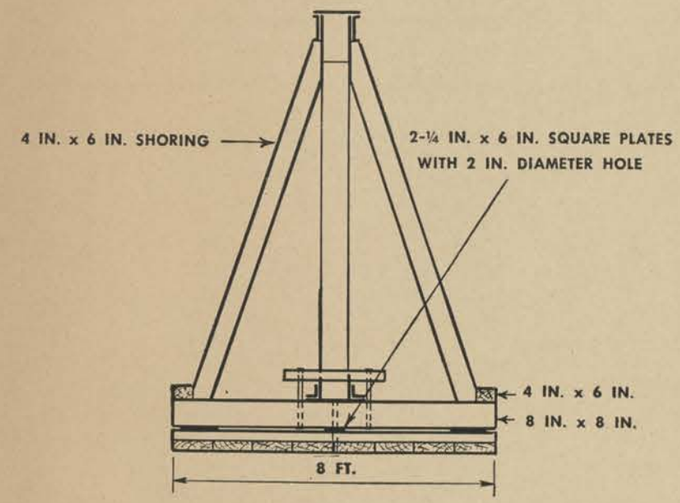


② *View from near bank. The timber frame shown above has been removed so crane can lower truss to abutment sill.*

Figure 44. Launching truss for 90-foot bridge with gin pole and ⅜-cubic-yard truck crane.







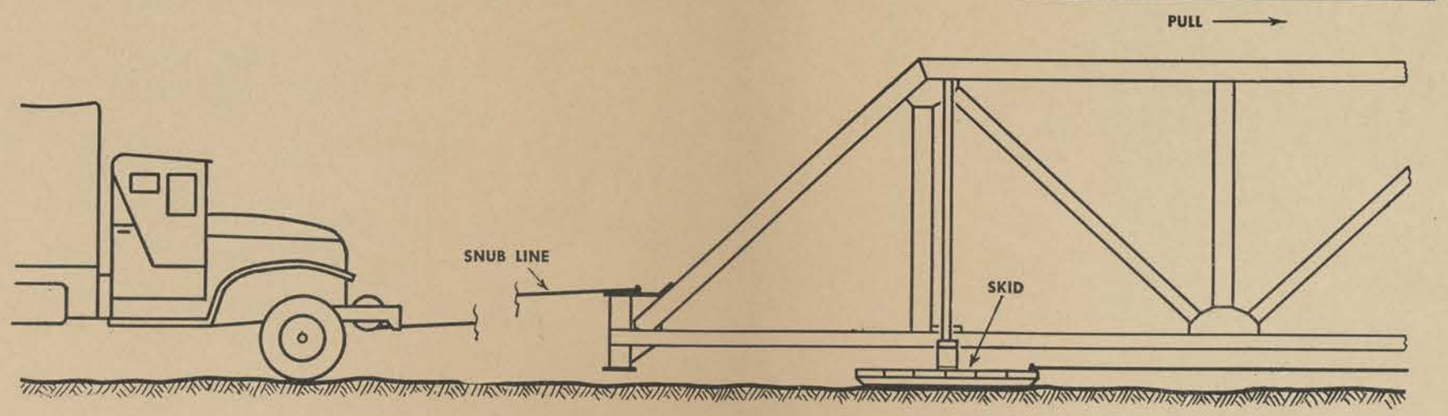
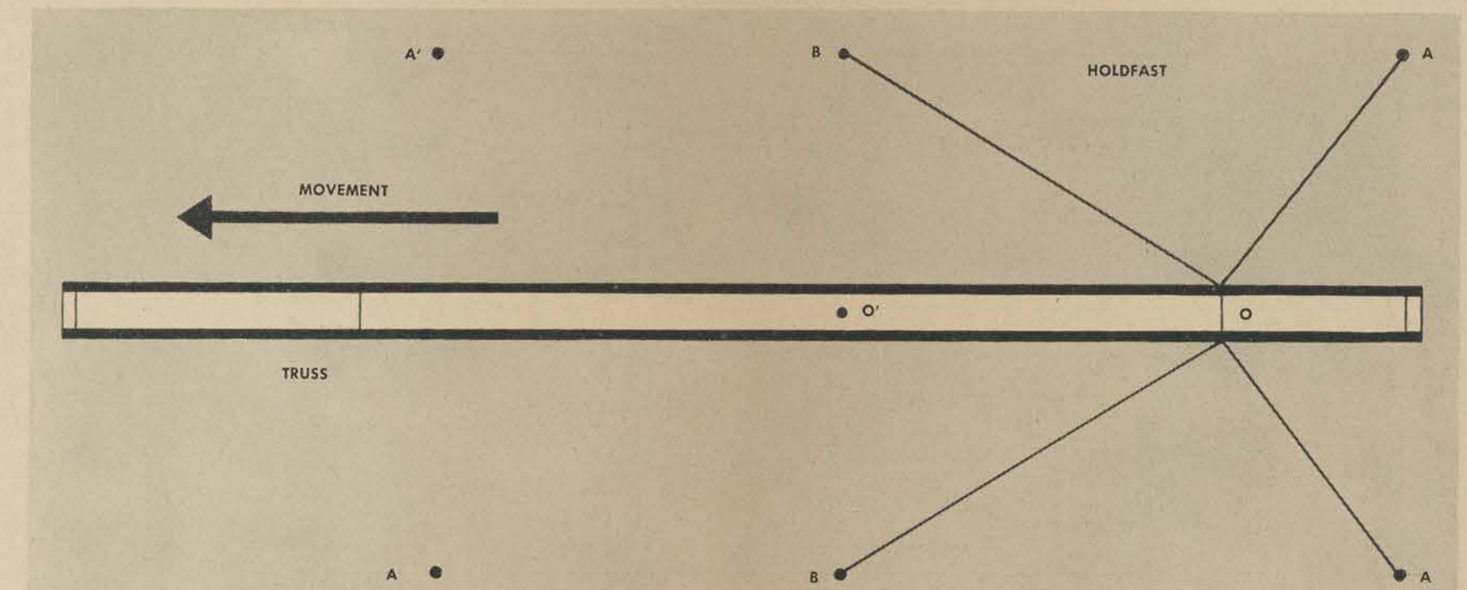


Figure 45. A-frame skid support for shoring. The skid slides with the truss as it is being launched and aids in keeping the truss upright. The pin connection of shoring and skid permits the truss to turn independent of the skid.



NOTE: GUY LINES ATTACHED TO THE UPPER CHORD AND SECURED TO HOLDFASTS SUPPORT THE TRUSS LATERALLY. AS THE TRUSS MOVES FORWARD, LINES A ARE SLACKED OFF AND LINES B ARE TIGHTENED. WHEN THE TRUSS HAS MOVED FORWARD TO POINT O', LINES A BECOME INEFFECTIVE AND LINES B SUPPORT THE TRUSS. STOP MOVEMENT AND MOVE LINES A TO A'. THIS PROCESS IS REPEATED AS OFTEN AS NECESSARY.

Figure 46. Method of attaching guy lines to support truss during launching.

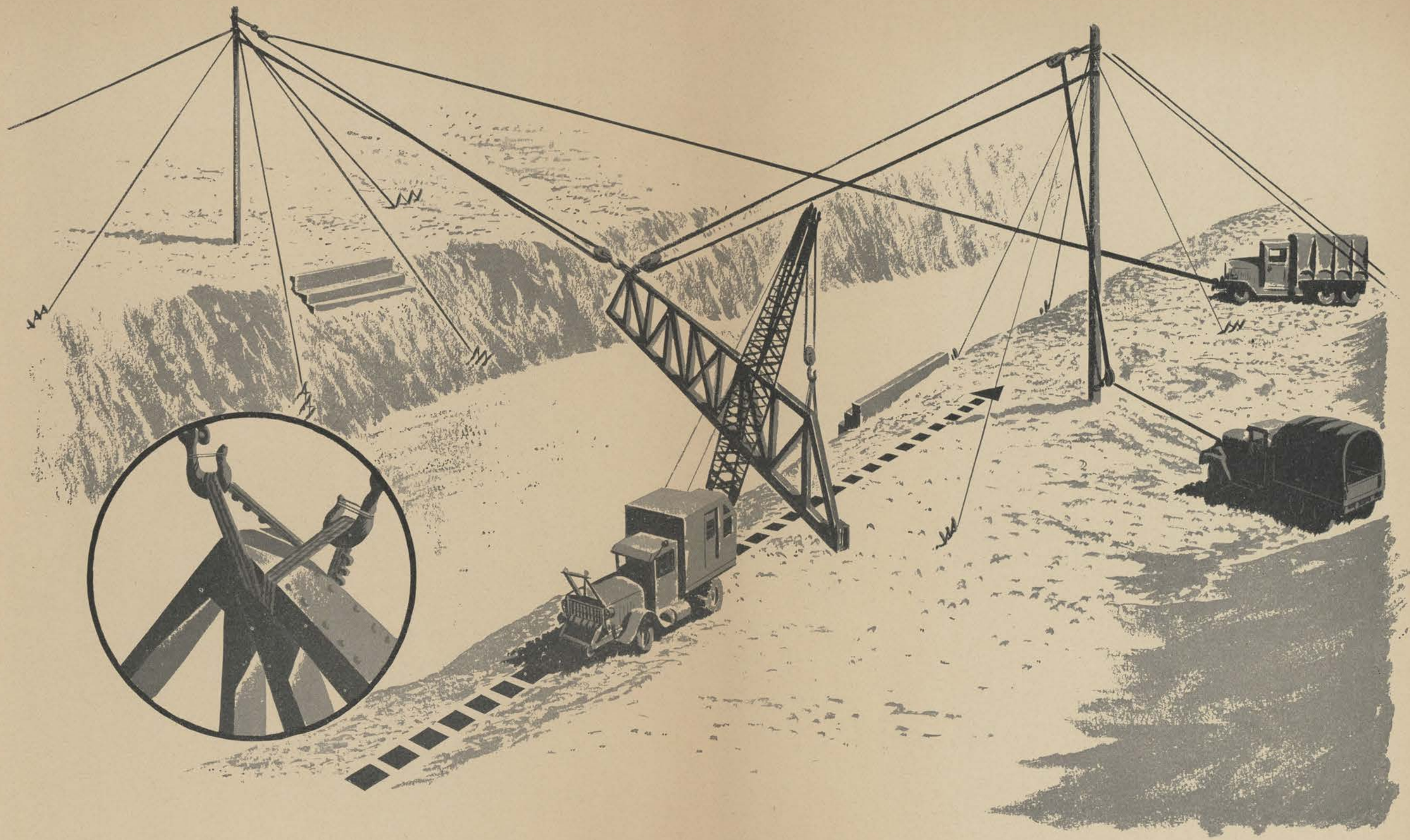


Figure 47. Launching a truss from a position parallel to the bank. The tackle from both poles is attached to the far end of the truss. The crane can be replaced by the skid shown in figure 45.

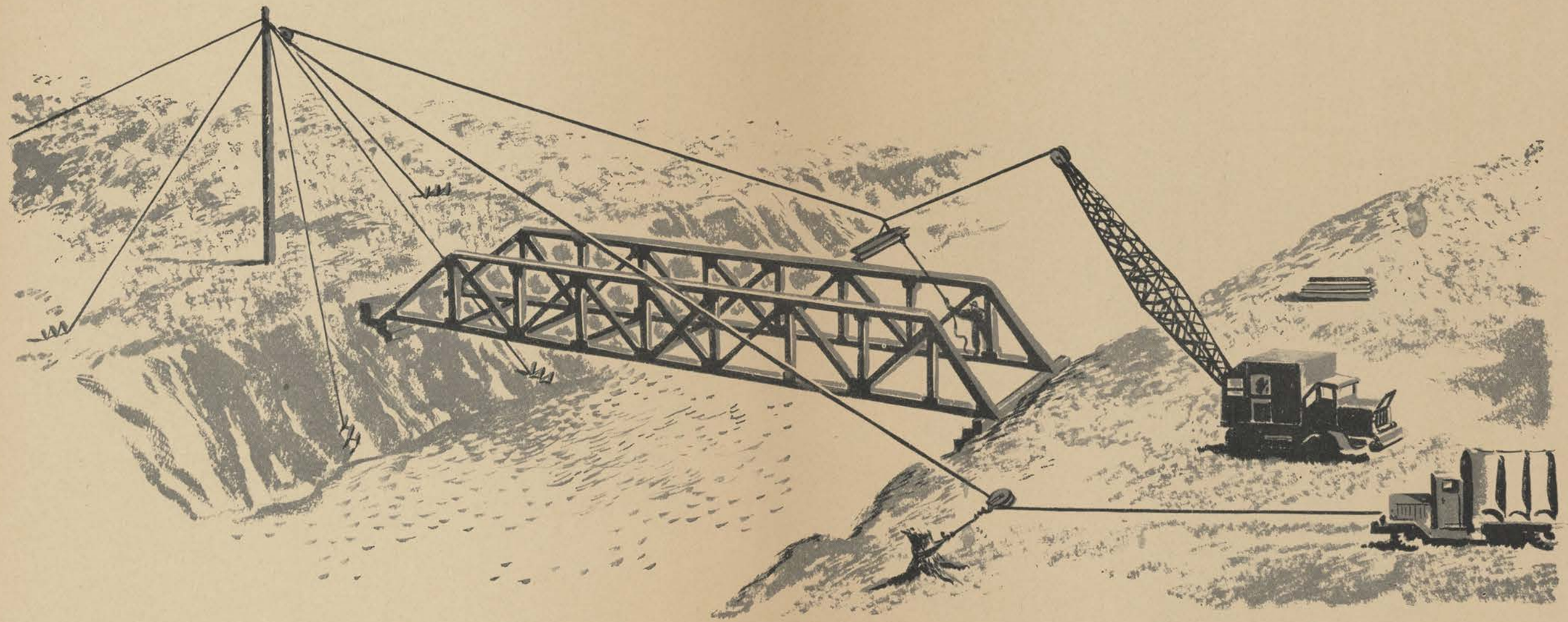


Figure 48. Method of "telegraphing" heavy members into place. A line is attached to the member from both the gin pole and the crane. The member is placed by taking up line on the gin pole and paying out on the crane line.



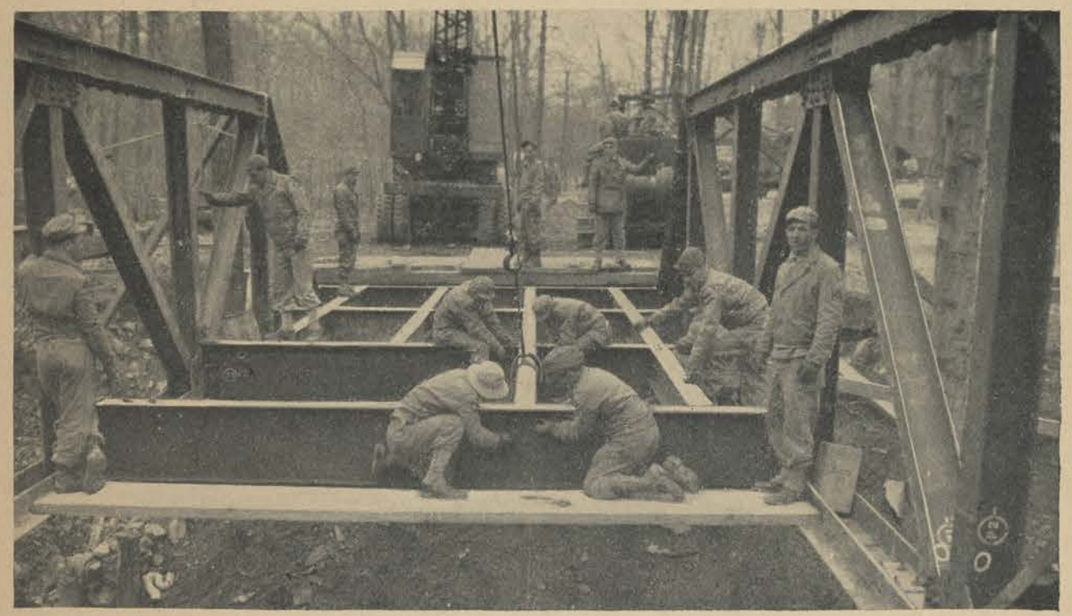
① *Placing a floor beam by "telegraphing". Note hand line for guiding the beam.*



② *Placing a floor beam between the trusses. A jack spreads the trusses slightly to allow the beam to slide into position. The hand line retrieves the tackle so it can be used to place the next member.*



③ *Installing diagonal lateral bracing after floor beams are placed. Planks are placed between floor beams to support the men at work.*



④ *Placing stringers after floor beams and bracing are installed. Planks are placed between lower chords as a work platform.*

Figure 49. Placing floor system for 90-foot bridge. The floor system is erected in place over the gap after the trusses have been launched.

buckling since there are two vertical components of lift in addition to the horizontal components.

e. Launching From a Position Parallel to Bank (method *H*, table VII). If conditions at the site are such that the trusses cannot be assembled directly behind the abutment, they can be assembled and launched from a position parallel to the bank. Figure 47 illustrates this method of launching. The equipment consists of a gin pole on each side of the stream and a truck- or tractor-mounted crane. Tackle from both gin poles is attached to the far end of the truss, on the top chord, at joint U1 and the crane picks up the near end. The crane is attached to the end post at joint U1. The truss is swung across the gap by taking up the far-pole line, slacking off on the near-pole line, and at the same time moving the near end toward the abutment with the truck crane. The far end of the truss moves on a line between poles and since the truss is suspended from the top chord it remains upright. The A-frame skid described in paragraph *c* and shown in figure 66 may be used in place of the crane. If the A-frame skid is used it should be pulled towards the near side gin pole as the truss is launched. The gin pole is moved to the left after launching the first truss to provide clearance for launching the second truss.

f. Launching by Floating Single Truss. If conditions at the site permit, a single truss can be assembled on a raft and floated into position (fig. 55). Lower chord members are placed on camber blocking high enough so the end bearings are several inches above the elevation of the abutment sill. Blocks should be placed at panel points to avoid bending stresses in lower chord members. A crane working from the bank places members in position for bolting. When assembled, shored, and tied, the truss is floated to position over the sills. It is lowered to the bearing plate by jacking, or by flooding pontons if a ponton raft is used.

g. Precautions. (1) A single truss has little stiffness in a horizontal direction. Unless precautions are taken during launching, it may buckle. Vertical lift lines to the ends of the upper chord tend to overcome this tendency to buckle. Another precaution that may be taken is to lash heavy timbers to the upper chord to stiffen it.

(2) Trusses in place on abutments should be held by shoring and ties until the floor system is completed.

(3) Blocks on which trusses are assembled should be placed only under panel points (joints) to avoid bending stresses in the lower chord angles.

(4) The fixed end of the truss should be placed on the anchor bolts first because it is more difficult to seat. As normally assembled the fixed end is also the near end. When a crane is used for launching the truss, placing the near end first also relieves it of its critical load without delay.

54. Construction of Floor (see sheet 14 and fig. 49)

a. Placing Floor Beams and Stringers. When trusses have been bolted to the abutments, floor beams and stringers are placed, beginning at the far end of the bridge and working towards the near

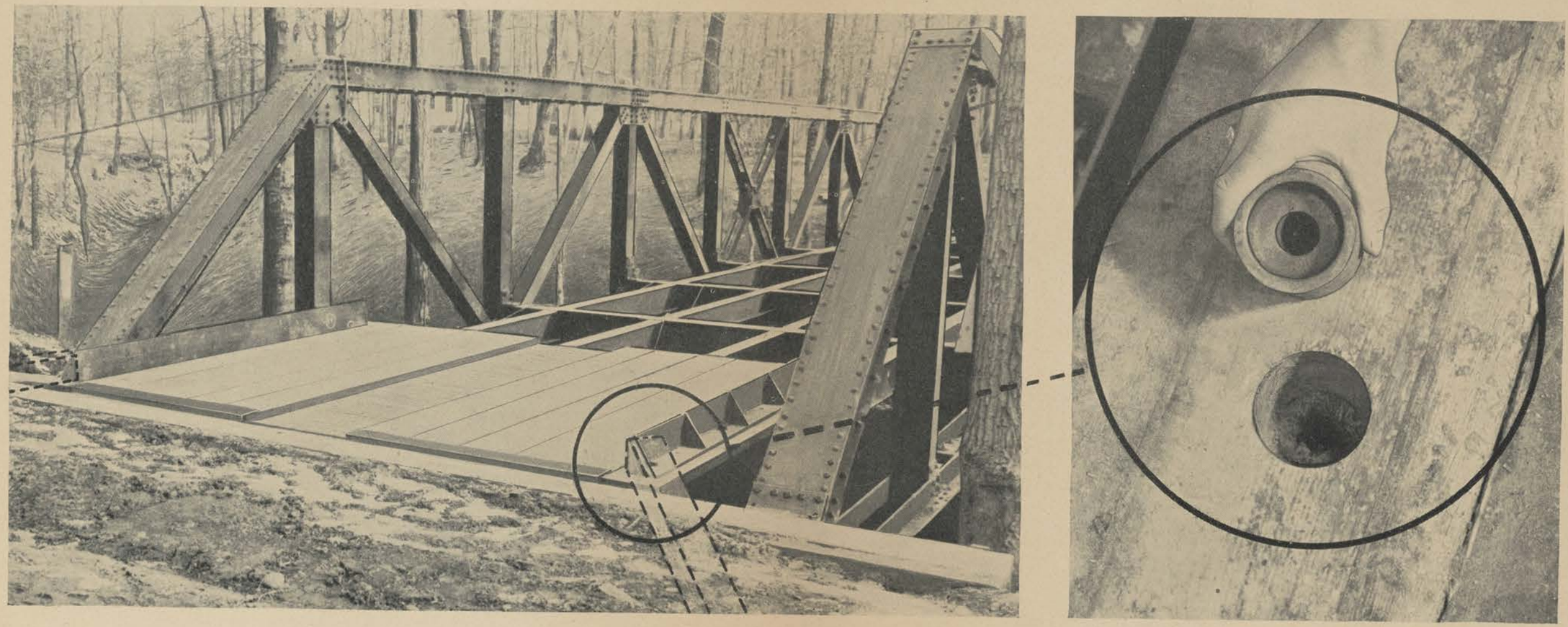


Figure 50. A 90-foot bridge partly floored. Timber approach guides should be placed as indicated to guide vehicles onto the bridge. These guides are not a part of the bridge and must be provided separately. Note the bearing spool and hole to receive it (insert).

end. By this method work parties can lay the timber floor without having steel carried over them. Other methods may be used if conditions warrant.

b. "Telegraphing" Beams and Stringers into Place. Floor beams and stringers are handled over the gap and placed in position by a method known to steel erectors as "telegraphing" (fig. 48). The crane moves the member from the stock pile to a position behind the abutment. A line from the gin pole on the far bank is attached above the hook supporting the member. The member is picked up and placed by taking up on the gin pole line and slacking off on the crane line. Figure 49① shows a floor beam being swung across the gap by this method and figure 49② shows a beam being placed. A jack is used to spread the trusses slightly so the beam does not have to be forced into position. ***Caution:*** Personnel should keep out of line of cables to members being placed. A failure of either cable would throw the member into anyone in line with the cable that held.

c. Placing Diagonal Lateral Bracing. Bracing is installed before stringers are placed. A plank laid between floor beams is used for support in connecting E2 and E3 to E1 (fig. 49). It is possible to bolt the bracing on the bank and place it as a unit.

d. Connecting Stringers to Floor Beams. Stringers cannot be placed between floor beams that have been bolted in place because of the beam flanges and the connection angles on the stringers. This difficulty may be overcome by leaving one end of one floor beam loose so it can be rotated slightly to permit swinging stringers into place (see fig. 49 and sheet 14). Stringers and beams should not be permanently bolted until stringers and beams have been placed in the two succeeding bays.

e. Installation of Floor. The procedure for laying the floor is the same as for the 30-foot bridge except that the guardrail is placed on the wearing surface. See paragraph 43*b* and sheet 12.

f Wearing Surface and Protection Angle. The Wearing-surface planking is spiked to the deck. Protection angles are placed at the ends of the bridge.

g. Installation of Guardrail. Steel guardrails are set in place, centers of bolt holes are marked, and guardrails moved aside. Holes 3 inches in diameter and 3 inches deep are bored. Holes 1 inch in diameter are bored through the remainder of deck. Bearing spools are driven into the 3-inch holes, guardrails set in place, and the guardrail bolt is driven. The O. G. washer is placed on the bolt on the underside of the deck and the nut tightened. The partly floored bridge with one unit of guardrail installed is shown in figure 50.

Section III.

ERECTION BY LAUNCHING ASSEMBLED BRIDGE

55. General

Erection by this method consists of assembling the bridge complete except for timber floor and launching it as a single unit (fig. 10). A straight section of nearly level approach at least 90 feet long and on the center line of the bridge is required if this method is to be used. An alternate method is to assemble the bridge on a raft and float it into place.

56. Assembly of Bridge

The bridge may be assembled by any of several schemes. The plan outlined on sheet 15 may be used.

57. Launching from the Bank

a. Preliminary. Preparations for launching include building skids, building cribbing, erecting a center support, and preparing rigging. Details are shown on sheets 16 and 17.

b. Procedure. The bridge is pulled over the gap until the far end reaches the center support. The overhang is supported by cantilever



Figure 51. Removal of 90-foot truss using two gin poles and truck crane. Tackle from both poles is attached to far end of truss. Note the shoring and ties on the truss still in position.

action. The bridge is pulled to a position directly over the abutments, the overhang again supported by cantilever action. The bridge is then blocked up on cribbing, the center support cribbing removed, and the bridge lowered to the bearing plates on the abutment sills with jacks. Placing of floor is described in section II.

58. Launching by Floating into Position

a. Preliminary. This method requires water deep enough to permit assembling the bridge on a raft and floating the raft into position. This method is practical only for a site which requires low pier construction. Preparations include building the raft and cribbing, and assembling the bridge.

b. Procedure. A raft is built with capacity sufficient to support the assembled bridge and cribbing. It is located where a crane working on the shore can place members on the raft for assembly. The bridge is assembled on cribbing high enough so it will float at an elevation slightly higher than the top of the anchor bolts on the abutments or piers. When the bridge is assembled it is floated into position and lowered to the bearing plates on the abutment sills with jacks. The tide may be used for lowering the truss if the site is on tidewater. If a ponton raft is used to float the bridge, it can be lowered by flooding the pontons (see ch. 10).

Section IV.

REMOVAL OF BRIDGE

59. General

The bridge may be removed by disassembling the floor system and taking out the assembled trusses one at a time.

60. Removing Floor System

The floor is removed in the reverse order of that in which it was assembled. Trusses must be well-shored and tied before floor beams and stringers are removed.

61. Removing Trusses

A recommended procedure for removing trusses is to use a gin pole on each bank and a crane on the near bank. The tackle from both poles is attached to the far end of the truss. This insures good control since the near-pole winch is taking up slack while the far-pole winch is slacking off. The near end of the truss is picked up by the crane. The truss can then be moved to the bank (fig. 51). This method is similar to method *H* discussed in paragraph 53*e* except that the procedure is reversed.

CHAPTER 10

MULTIPLE SPANS

62. General

The 30-, 60-, and 90-foot bridges may be built in any combination and number of units to form a multiple-span bridge. Such use is limited to a site permitting intermediate-pier construction and maximum single spans of 90-feet. No alterations or special devices are required for adapting the bridges to multiple-span construction. Figure 52 shows a multiple-span bridge built with 60-, 90-, and 30-foot bridges (also see sheet 18).

63. Pier Construction

Typical designs of intermediate piers suitable for these bridges are contained in TM 5–286 (when published). Details of a test pier are discussed below.

a. Layout of Pier. This pier was designed to support the 60- and 90-foot bridges and consisted of timber piling, caps, and sills. Because of the different dimensions and spacing of the end bearings of each bridge a special arrangement of sills is necessary. The design of the pier is shown on sheet 18.

b. Construction of Pier. The method of construction depends on the design of the pier and the condition of the site. The test pier was built in water on a mud bottom. Thirty-foot timber piling was driven using a ½-cubic-yard shovel with standard pile-driving attachment (fig. 53①). See TM 5–286 (when published) for information on piles and pile driving. Piles are cut off at the proper elevation, capped, and sills placed. Caps and sills are held in place with drift bolts.

c. Construction of Bridge Seat (fig. 53②). The bridge seat consists of bearing plates anchored to a timber sill with anchor bolts. Two factors to be considered in placing the sill are discussed below:

(1) Elevation of Floor in Adjacent Spans. Because of the difference in depth of girders and floor beams, adjustment of sill elevations must be made to bring the adjacent floor surfaces to the same elevation. Sheet 18 shows factors to be considered in computing final elevation of sills. Adjustment is made by cutting piles at proper elevation and bolting blocks to caps to bring sills to correct elevation.

(2) Provision for Expansion. One-inch clear space between protection angles of adjacent spans must be provided to permit expansion (sheet 18). Piers and sills are spaced accordingly.

64. Launching Methods

a. Crane. One or more spans of the 30-foot bridge can be placed with a crane (fig. 53 ④). When one span has been placed it is floored and the next span is placed from it.

b. Crane-Gin Pole. The 60- and 90-foot bridges can be placed by the crane-gin pole method described in chapters 8 and 9. In most cases this method requires placing the gin pole on an intermediate pier. Various methods of using the gin pole follow:

(1) On Intermediate Pier. For the 60-foot bridge a 15-foot gin pole can be placed on the center of the pier (fig. 53 ③). Side guy lines are anchored to the pier with back guy line anchored to another pier or to the far bank. Launching the 90-foot trusses requires ar least a 30-foot gin pole, which can be placed on the pier with side guy lines anchored to special piling and back guys anchored to another pier or to the far bank.

(2) Lashed to Pier. If conditions permit the gin pole can be placed on the stream bottom. If the site is dry the gin pole is set on the ground in the usual manner. However, if under water, the gin pole must be placed on a mud shoe and the shoe lashed to the bottom of the pole.

(3) On Completed Span. If the bridge consists of two or three spans and it is possible to build from both sides, the gin pole is placed on a completed span (fig. 54). Side and back guys are anchored to the bank or to piling.

c. Floating. If site conditions permit, a practical method of erection is to assemble the bridge on a raft and float it into position. The 30- and 60-foot bridges can be erected by placing one, two, or four girders at a time. The 90-foot bridge can be erected by placing one truss at a time (figs. 55 and 56) or by assembling and floating the entire bridge into place. If a ponton raft is used the bridge can be lowered to the abutment seats by flooding the pontons.

d. Temporary Intermediate Support. The method of launching given in section III, chapter 9, may be used for erecting units of a multiple-span bridge.

65. Floor Construction

The floor design remains unchanged when the bridges are used to form multiple spans. Alternate floor designs are described in TM 5–286 (when published).

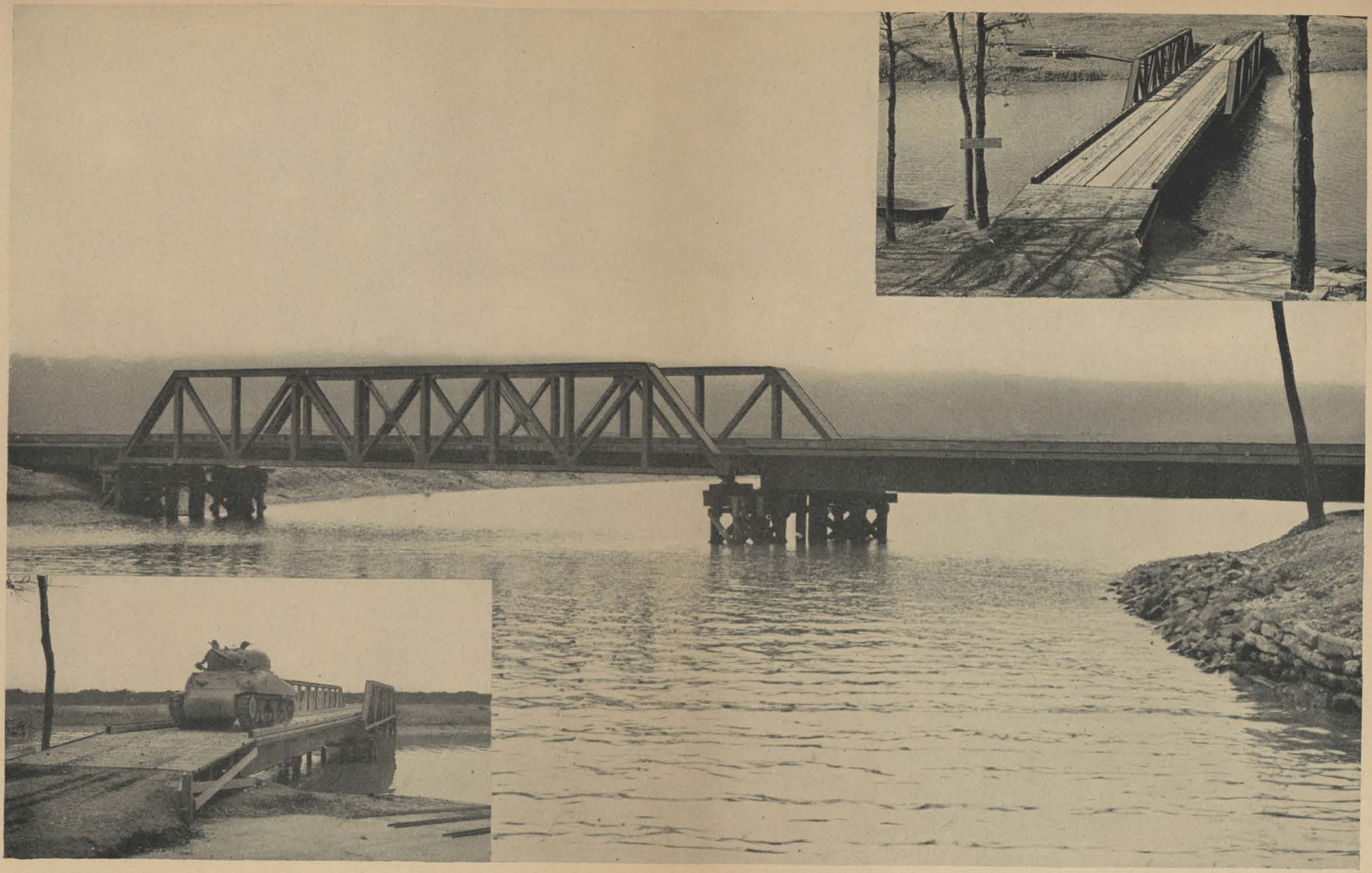


Figure 52. Completed multiple-span bridge consisting of the 60-, 90-, and 30-foot bridges.

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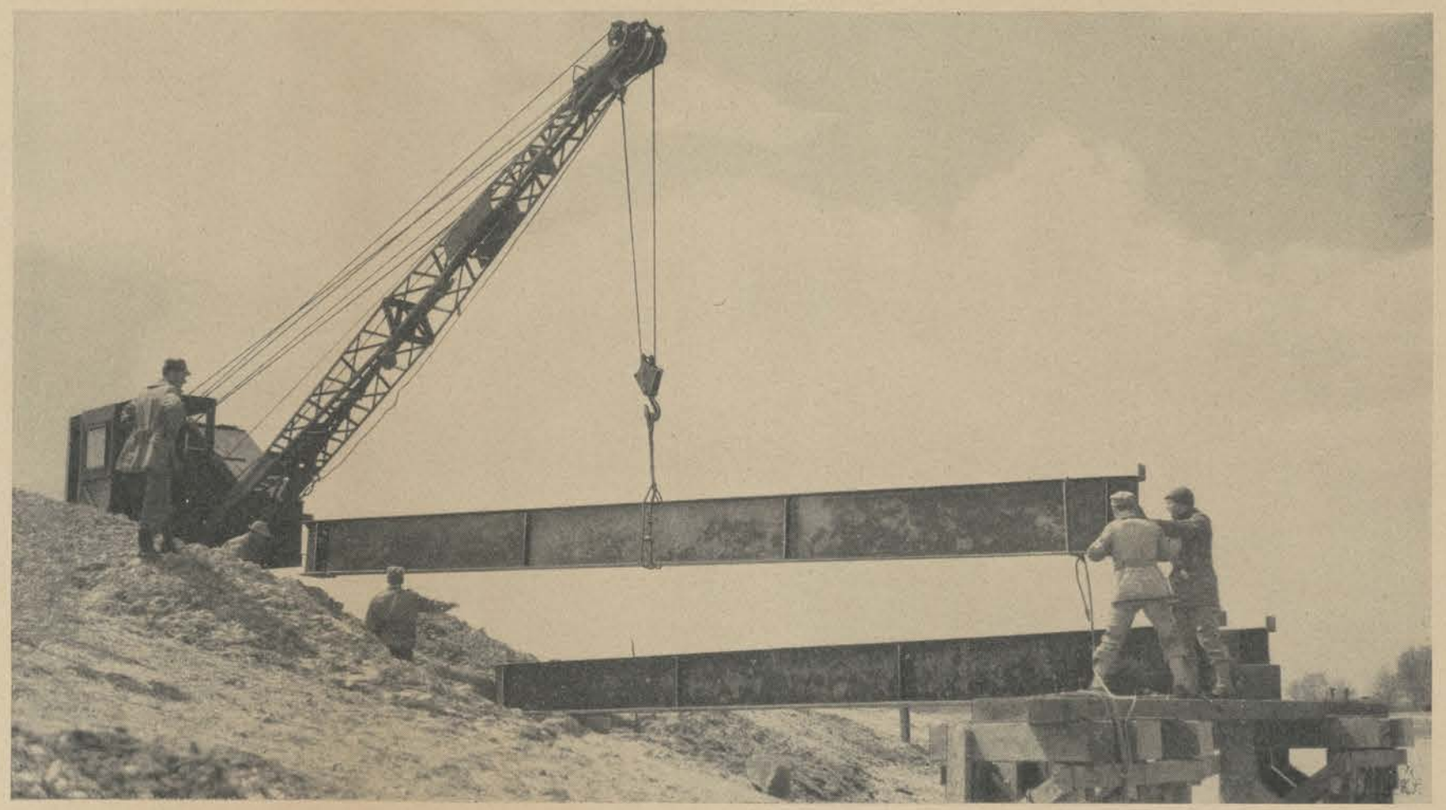
① *Driving pile for intermediate pier of multiple-span bridge using standard pile-driving attachments. The ponton raft supports the pile-driving equipment.*



② *Placing sills and anchor bolts on intermediate pier.*



③ *Launching 60-foot girder of three-span bridge with crane and gin pole. Note pole on intermediate pier and side guys to same pier.*



④ *Placing girders for 30-foot span of three-span bridge with ½-cubic-yard shovel. Note intermediate pile pier.*

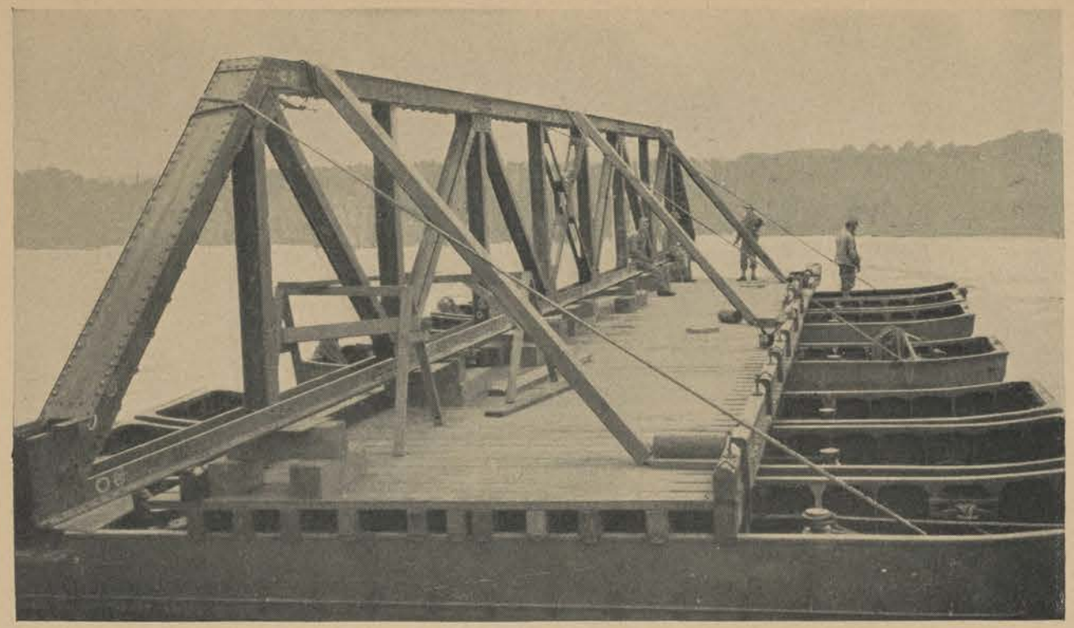
Figure 53. Erection of multiple-span bridge.



Figure 54. Launching 90-foot truss for the center span of multiple-span bridge. Crane is on near approach span and gin pole on far-side approach span.



① *Assembling truss on ponton raft. A ½-cubic-yard shovel working from the bank places members in position for bolting. When assembled, the truss is floated into position over the supports.*



② *The assembled truss ready to float into position.*

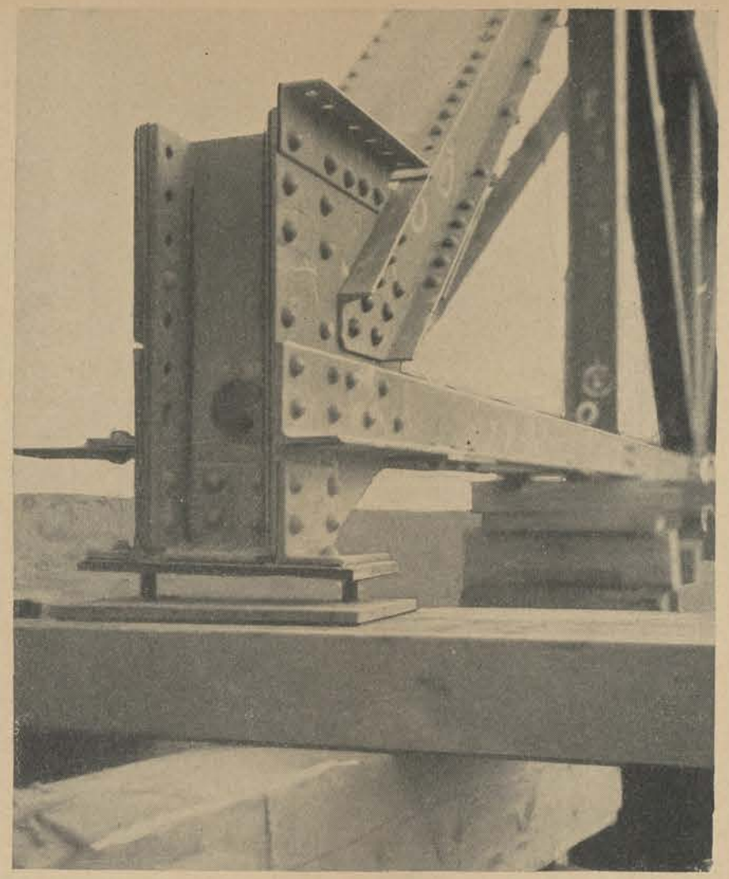


③ *Truss on ponton raft floated into position ready for lowering onto the pier sills. The truss will be lowered by flooding the pontons.*

Figure 55. Launching a truss for the center span by floating it into position on a ponton raft. The entire 90-foot bridge can be assembled and placed in one operation by this method.



① *Truss in position directly over the bearing plate and anchor bolts. The required clearance is provided by timber supports on which the truss is assembled (fig. 55).*



② *Lowering the truss over the anchor bolts. Pontons are flooded uniformly. The fixed end must be set first.*

Figure 56. Last phase of launching truss on ponton raft.

CHAPTER 11

MAINTENANCE, REPAIRS, AND STRENGTHENING

66. General

For general information on maintenance, repairs, and strengthening see FM 5–10. Specific information for these bridges is given below.

67. Maintenance

Maintenance of these bridges consists primarily of periodic inspections of the entire structure, including examination for loose nuts, and brushing and painting rust spots on the structural steel. Steel should be thoroughly cleaned by brushing with a steel wire brush. All loose rust and scale and all dirt must be removed. After cleaning, paint the spots with red lead. Bridges affected by salt spray or high humidity require continuous maintenance.

68. Repairs

a. Abutments and Piers. Periodic inspection should be made to determine evidence of—

(1) Scour of banks that may endanger abutments and scour of bottom that may weaken piers. Where this condition exists repairs should be made to reduce the tendency to scour by one of the following methods:

(*a*) Riprap.

(*b*) Dumping large stones into the stream.

(*c*) Channel improvements.

(2) Failure of structural timbers used for footings, abutments, piers, or floors. This may be caused by decay, rot, excessive load, or structural defects. Repairs should be made by replacing the members.

b. Structural Steel. Only damage caused by accidents is cause for repairs.

c. Timber Floor. Repairs consist mainly of replacing the wearing surface. This should be done before traffic damages the laminated deck.

69. Strengthening

There are no special provisions for strengthening or reinforcing these bridges.

PART THREE
APPENDIX
TABLES II TO XVIII

Table II. Weights and dimensions

Bridge	Structural steel							Connections				Lumber			
	Total weight in pounds	Weight of one girder in pounds	Weight of one truss in pounds	Cubage		Maximum length of one piece	Maximum weight of one piece in pounds	Total weight in pounds	Cubage		Number of boxes	Total quantity in 1,000-feet board measure	Cubage		Maximum length of one piece
				Cubic feet	Ship tons				Cubic feet	Ship tons			Cubic feet	Ship tons	
30-foot	12, 172	2, 600	------	292. 17	7. 31	31′–6″	2, 554	745	9. 5	0. 24	6	3. 868	322. 3	8. 05	16′–0″
60-foot	42, 686	10, 000	------	781. 54	19. 55	25′–1¾″	3, 495	3, 102	30. 5	0. 76	20	7. 544	628. 7	15. 70	16′–0″
90-foot	56, 927	------	15, 000	1, 896. 56	47. 40	29′–11 1/16″	1, 655	4, 727	46. 5	1. 16	31	10. 608	884. 0	22. 10	16′–0″

Table III. Transportation

(Structural steel, fasteners, and fittings only)

Method	30-foot bridge	60-foot bridge	90-foot bridge
Vehicle: Trailer, full, flat-bed, 8-ton with prime mover. Number of loads	2	4	7
Vehicle: Trailer, full, flat-bed, 16-ton with prime mover. Number of loads	1	3	5
Rail: [1] Standard U. S. freight car—military.	Two 20-ton flat.	Three 20-ton flat.[2]	Four 20-ton flat.[2]
Rail: Standard U. S. freight car—commercial.	One 50-ton gondola.[3]	One 50-ton gondola.[3]	One 70-ton gondola.

[1] Length of members requires placing the load on one car with the overhang extending over an idler car.
[2] Car loading for the 60- and 90-foot bridges depends on method of loading. Bulk, not weight, is the determining factor.
[3] The 30- and 60-foot bridges can be transported together in one 70-ton gondola.

TABLE IV. *Packaging of materials for 30-foot* I-*beam bridge* [1]

Description of unit	Mark	How packed	Number			Weight (pounds)			Cubage [2] (cubic feet)	
			Units per span	Units per package	Packages per span	Per unit	Per package	Per span	Per package	Per span
Girder	G1	Loose	4	1		2,554		10,216		
Plate, bearing	BP1	[3]	8	2	4	31	2,632	248	67.5	270.00
Clip, traction	C1	[3]	8	2		8		64		
Diaphragm, intermediate	D1	Bundle	6	2	3	128	256	768	4.93	14.78
Diaphragm, end	D2	Bundle	6	2	3	105	210	630	2.16	6.48
Angle, protection	A1	Bundle	4	4	1	42	168	168	0.91	0.91
Clip, floor		Box	130	130	1	0.71	130	92	1.50	1.50
Bolt, erection, rough, ⅞″ diameter by 2″ long, thread 1½″, square head, 1 square nut.			50	50		0.96		48		
Washers, cut, for ⅞″ diameter bolt		Box	75	75	1	0.13	136	10	1.50	1.50
Bolt, anchor, 1″ diameter by 1′-6″ long			16	16		4.30		78		
Bolt, structural, ribbed, ⅞″ diameter by 2 1/16″ long, buttonhead, 1 hexagon nut.			160	160		0.95		152		
Bolt, structural, ribbed, ⅞″ diameter by 2¼″ long, countersunk head, 1 hexagon nut.		Box	20	20	1	0.98	172	20	2.00	2.00
Bolt, standard, ⅞″ diameter by 1′-7½″ long, threaded 3″, hexagonal head, 1 hexagon nut. 2 O. G. washers 1⅜″ diameter SAE lock washer.		Box	30	30	1	6.6	198	198	1.50	1.50
Nails, 50d, cement-coated		Box	3,600	1,800	2	0.0625	112½	225	1.50	3.00
Total					17			12,917	[4]	301.67

[1] Does not include lumber (3868 b.m., bill of material, sheet 1). Requisition lumber separately.
[2] Over-all total cubage may be slightly reduced by properly stacking bridge pieces.
[3] Bolted to G1.
[4] Add 100 pounds for weight of boxes.

TABLE V. *Packaging of materials for 60-foot* I-*Beam bridge* [1]

Description of unit	Mark	How packed	Number			Weight (pounds)			Cubage [2] (cubic feet)	
			Units per span	Units per package	Packages per span	Per unit	Per package	Per span	Per package	Per span
Girder, section, outer end	G2R	Loose		1		3,075				
Plate, bearing	BP1			1		31				
Splice plate, flange		Bolted to G2R	2	3	2		3,115	6,230	52.5	105.0
Splice plate, web				2						
Plate, fill				2						
Clip, traction	C2			1		9				
Girder, section, outer, end	G2L	Loose		1		3,075				
Plate, bearing	BP1			1		31				
Splice plate, flange		Bolted to G2L	2	3	2		3,115	6,230	52.5	105.0
Splice plate, web				2						
Plate, fill				2						
Clip, traction	C2			1		9				

See footnotes at end of table.

TABLE V. *Packaging of materials for 60-foot* **I-*Beam bridge*** [1]—Continued.

Description of unit	Mark	How packed	Number			Weight (pounds)			Cubage [2] (cubic feet)	
			Units per span	Units per package	Packages per span	Per unit	Per package	Per span	Per package	Per span
Girder, section, inner, end	G4	Loose	4	1	4	3,065	3,105	12,420	52.5	210.0
Plate bearing	BP1			1		31				
Splice plate, flange	------	Bolted to C4		3		------				
Splice plate, web	------	------		2		------				
Plate, fill	------	------		2		------				
Clip, traction	C2	------		1		9				
Girder, section, outer, center	G3	Loose	2	1	2	3,491	3,491	6,982	73.2	146.4
Girder, section, inner, center	G5	Loose	2	1	2	3,495	3,495	6,990	73.2	146.4
Diaphragm, intermediate	D3	Bundle	14	2	7	154	308	2,310	7.37	51.59
Diaphragm, intermediate	D3	Loose	1	1	1	154	154		3.61	3.61
Diaphragm, end	D4	Bundle	6	2	3	132	264	792	3.08	9.24
Bolt, standard, ⅞″ diameter by 1′–7½″ long, threaded 3″, hexagonal head, 1 hexagonal nut, 2 O. G. washers, 1⅞″ diameter SAE lock washer.	------	Box	54	27	2	6.6	178	356	1.50	3.00
Bolt, anchor, 1″ diameter by 1′–6″ long	AB1	Box	18	18	1	4.3	78	78	1.80	1.80
Washer, cut, for ⅞″ diameter bolt	------		720	720		0.13	94	94		
Turnbuckle (spare)	------		2	2		2.50	5	5		
Nut, 1″ diameter (spare)	------		14	14		0.423	6	6		
Nails, 50d, cement-coated	------	Box	6,400	1,600	4	0.0625	100	400	1.50	6.00
Total	------	------	------	------	46	------	------	[3] 45,788	------	812.04
Angle, protection	A1	Bundle	4	4	1	42	168	168	0.90	0.90
Bracing, lateral, diagonal	T1	Bundle	12	12	1	21.6	259	259	1.80	1.80
Bracing, lateral, diagonal	T2	Bundle	12	12	1	18.9	227	227	1.60	1.60
Clip, floor	------	Box	230	230	1	0.85	196	196	1.70	1.70
Bolt, erection, rough, ⅞″ diameter by 3″ long, threaded 2½″, square head, 1 square nut.	------	Box	425	142	3	1.12	159	476	1.50	4.50
Bolt, structural, ribbed, ⅞″ diameter by 2 1/16″ long, buttonhead, 1 hexagon nut.	------	Box	330	165	2	0.95	157	314	1.50	3.00
Bolt, structural, ribbed, ⅞″ diameter by 2⅝″ long, buttonhead, 1 hexagon nut.	------	Box	400	200	2	1.04	208	416	1.50	3.00
Bolt, structural, ribbed, ⅞″ diameter by 2 1/16″ long, countersunk head, 1 hexagon nut.	------	Box	20	20	1	1.01	229	229	1.50	1.50
Bolt, structural, ribbed, ⅞″ diameter by 3″ long, countersunk head, 1 hexagon nut.	------	Box	190	190	1	1.10	229	229	1.50	1.50
Bolt, structural, ribbed, ⅞″ diameter by 3 3/16″ long, countersunk head, 1 hexagon nut.	------	Box	540	135	4	1.13	152.5	610	1.50	6.00

[1] Does not include lumber (7544 bm, bill of material, sheet 5). Requisition lumber separately.
[2] Over-all total cubage may be slightly reduced by properly stacking bridge pieces.
[3] Add 250 pounds for weight of boxes.

TABLE VI. *Packaging of materials for 90-foot truss bridge* [1]

Description of unit	Mark	How packed	Number			Weight (pounds)			Cubage [2] (cubic feet)	
			Units per span	Units per package	Packages per span	Per unit	Per package	Per span	Per package	Per span
Post, end, sloped	U1R	Loose	2	1	2	740	740	1,480	28.95	57.90
Post, end, sloped	U1L	Loose	2	1	2	740	740	1,480	28.95	57.90
Chord section, upper, end	U2	Loose	4	1	4	1,227	1,227	4,908	41.72	166.88
Chord section, upper, center	U3	Loose	2	1	2	1,655	1,655	3,310	44.59	89.18
Chord section, lower, end	L1R	Loose	1	1	1	1,129	1,129	1,129	101.43	101.43
Chord section, lower, end	L1L	Loose	1	1	1	1,129	1,129	1,129	101.43	101.43
Chord section, lower, center	L2R	Loose	2	1	2	1,589	1,589	3,178	96.06	192.12
Chord section, lower, center	L2L	Loose	2	1	2	1,466	1,466	2,932	95.40	190.80
Chord section, lower, end	L3R	Loose	1	1	1	1,129	1,129	1,129	101.43	101.43
Chord section, lower, end	L3L	Loose	1	1	1	1,129	1,129	1,129	101.43	101.43
Vertical, web	P1	Loose	4	1	4	293	293	1,172	3.98	15.92
Vertical, web	P2	Loose	8	1	8	297	297	2,376	4.27	34.16
Vertical, web	P3	Loose	4	1	4	324	324	1,296	4.45	17.80
Diagonal, web	W1	Loose	8	1	8	202	202	1,616	5.22	41.76
Diagonal, web	W2	Loose	4	1	4	283	283	1,132	5.20	20.80
Diagonal, web	W3	Loose	2	1	2	172	172	344	15.04	30.08
Diagonal, web	W4	Loose	2	1	2	69	69	138	1.26	2.52
Diagonal, web	W5	Loose	2	1	2	67	67	134	1.22	2.44
Beam, floor, end	B1	Loose	2	1	2	1,093	1,093	2,186	28.83	57.66
Beam, floor, intermediate	B2	Loose	8	1	8	1,146	1,146	9,168	25.26	202.08
Bracing, lateral, diagonal	E1	Bundle	9	9	1	77	693	693	4.43	4.43
Bracing, lateral, diagonal	E2	Bundle	9	9	1	37	333	333	2.16	2.16
Bracing, lateral, diagonal	E3	Loose	9	1	9	46	46	414	2.35	21.15
Angle, protection	A2	Bundle	4	4	1	52	208	208	1.40	1.40
Guardrail	A3	Bundle	18	2	9	241	482	4,338	6.60	59.40
Plate, bearing	BP2	Bolted to chord sec.	4	1		43		172		
Stringer	S1	Loose	18	1	18	242	242	4,356	5.57	100.44
Stringer	S2	Loose	18	1	18	278	278	5,004	6.77	121.86
Clip, floor		Box	330	330	1	0.71	234	234	1.50	1.50
Bolt, anchor, 1″ diameter by 1′,–6″ long	AB1	Box	10	10	1	4.30	208.0	43.0	1.50	1.50
Washer, cut, for ¾″ diameter bolt			975	975		0.111		108.0		
Washer, bevel (2 sizes)			220	220		0.27		57.0		
Spool, bearing		Box	186	62	3	3.70	229	688	1.50	4.50
Nails, 50d, cement-coated		Box	11,200	1600	7	0.0625	100.0	700	1.50	10.50
Bolt, erection, rough, ¾″ diameter by 2½″ long, threaded 2¼″, square head, 1 square nut.		Box	650	217	3	0.74	160	481	1.50	4.50
Bolt, structural, ribbed, ¾″ diameter by 1½″ long, buttonhead, 1 hexagonal nut.			40	40		0.588		24		
Bolt, structural, ribbed, ¾″ diameter by 2⅛″ long, buttonhead, 1 hexagonal nut.		Box	70	70	1	0.657	128	46	1.50	1.50
Bolt, structural, ribbed, ¾″ diameter by 2⅝″ long, buttonhead, 1 hexagonal nut.			80	80		0.726		58		
Bolt, structural, ribbed, ¾″ diameter by 1 11/16″ long, buttonhead, 1 hexagonal nut.		Box	780	260	3	0.611	159	477	1.50	4.50
Bolt, structural, ribbed, ¾″ diameter by 1⅞″ long, buttonhead, 1 hexagonal nut.		Box	310	310	1	0.634	197	197	1.50	1.50
Bolt, structural, ribbed, ¾″ diameter by 2¼″ long, buttonhead, 1 hexagonal nut.		Box	370	185	2	0.680	126	252	1.50	3.00
Bolt, structural, ribbed, ¾″ diameter by 2 7/16″ long, buttonhead, 1 hexagonal nut.		Box	350	175	2	0.703	123	246	1.50	3.00
Bolt, structural, ribbed, ¾″ diameter by 2 13/16″ long, buttonhead, 1 hexagonal nut.		Box	280	280	1	0.749	210	210	1.50	1.50
Bolt, standard, 1″ diameter by 11″ long, threaded 3″, hexagonal head, 1 hexagonal nut, 1 O. G. washer, 1″ diameter SAE lock washer.		Box	186	31	6	5.1	158.0	949	1.50	9.0
Total					150			[3] 61,654		1,943.06

[1] Does not include lumber (10,608 bm, bill of material, sheet No. 8). Requisition lumber separately.
[2] Over-all total cubage may be slightly reduced by properly stacking bridge pieces.
[3] Add 450 pounds for boxes.

Table VII. *Erection methods and equipment.*

Method A: 30-Foot Bridge

Crane or derrick

(Exclusive of construction of abutments, piers, or approaches)

Equipment			Remarks
Quantity	Minimum safe capacity	Description	
1	1½ tons at 20 ft.	Crane or derrick	⅜-cu.-yd. Quickway crane is adequate (see table XV).

Method B: 30-Foot Bridge

Skidding (Single or double girder)

1	5,000 lb	Truck or tractor winch	4-ton cargo truck with winch or D4 tractor with winch.
2	5 tons	Jacks	
		Erection lumber	See table IX.

Method C: 60-Foot Bridge

Gin pole—crane (single or double girder)

1	10 tons	30-ft. gin pole	
1	5 tons at 10-ft. radius.	Crane or derrick	⅜-cu.-yd. Quickway crane is adequate (see table XV).
1	15,000 lb	Truck or tractor winch	4-ton cargo truck with winch or D4 tractor with winch.
1		Air compressor	With attachments. 105 cfm min.
500 ft	2½ tons	⅝-in. wire rope	6 x 19 plow steel.
3	10 tons	⅝-in. steel single block	
48		⅝-in. wire-rope clip	
500 ft	1 ton	1-in. manila rope	
3	4 tons	1-in. rope, double block	
3	4 tons	1-in. rope, single block	
		Tools for steel erection	See table VIII.
		Erection lumber	See table IX.

Table VII. *Erection methods and equipment*—Continued.

Method D: 60-Foot Bridge

Gin pole (single or double girder)

Equipment			Remarks
Quantity	Minimum safe capacity	Description	
1		Tractor	D4 or larger.
2	5 tons	Jack	For lowering girder (or girders).
		See method C	Other equipment same as method C except for elimination of crane.

Method E: 90-Foot Bridge

Gin pole—crane (single truss)

1	10 tons	45-ft. gin pole	30-ft. pole can be used.
1	5 tons at 15 ft.	Crane, truck, or tractor	⅜-cu.-yd. Quickway is adequate if used with caution.
2	15,000 lb	Truck or tractor winch	4-ton cargo truck or D4 tractor.
1		Air compressor	With attachments. 105 cfm min.
900 ft	2½ tons	⅝-in. wire rope	6 x 19 plow steel.
3	10 tons	⅝-in. steel single block	
48		⅝-in. wire-rope clip	
500 ft	1 ton	1-in. manila rope	
3	4 tons	1-in. rope, double block	
3	4 tons	1-in. rope, single block	
		Tools for steel erection	See table VIII.
		Erection lumber and hardware.	See table IX.

Table VII. *Erection methods and equipment*—Continued.

Method F: 90-Foot Bridge

Gin pole—(single truss)

Equipment			Remarks
Quantity	Minimum safe capacity	Description	
1	10 tons	45-ft. gin pole	
2	15, 000 lb	Truck or tractor winch	4-ton cargo truck or D4 tractor.
1		Air compressor	With attachments. 105 cfm min.
900 ft	2½ tons	⅝-in. wire rope	6 x 19 plow steel.
3	10 tons	⅝-in. steel single block	
48		⅝-in. wire rope clip	
500 ft	1 ton	1-in. manila rope	
3	4 tons	1-in. rope, double block	
3	4 tons	1-in. rope, single block	
		Tools for steel erection	See table VIII.
		Erection lumber and hardware.	See table IX.
2	5 tons	Jacks	

Method G: 90-Foot Bridge

Two gin poles—(single truss)

Same as method F except rigging is doubled.

Method H: 90-Foot Bridge

Restricted approach—(single truss)

Same as method G plus truck or tractor crane.

Method I: 90-Foot Bridge

Assembled bridge—(two trusses and floor system)

800	2½ tons	⅝-in. wire rope	6 x 19 plow steel.
1	10 tons	⅝-in. double block (steel).	
1	10 tons	⅝-in. single block (steel).	
24		⅝-inch wire rope clip	
1	15,000 lb.	Winch	
4	12 tons	Jack	
		Erection lumber and hardware.	Will depend on site. See sheets 16 and 17.

Table VIII. Tools for steel erection[1]

30-Foot I-Beam Bridge

Name	Size	Number required	Remarks
Spud wrench	24 in. by 1 5/16 in.	6	For erection bolts.
Ratchet socket wrench.	24 in. by 1 7/16 in.	4	For ribbed bolts.
Crescent wrench	15 in.	2	
Driftpins	15/16-in. dia	12	6 in. long.
Sledge	8 lb	2	
Hammer	3 lb	2	
Shackle	1 in.	6	
Connecting bar	3 ft	4	
Sling	7 ft	3	¾-in. wire rope.
Jack	10 ton	2	
Pinch bar	5 ft	2	

60-Foot I-Beam Bridge

Spud wrench	24 in. by 1 5/16 in.	8	For erection bolts.
Ratchet socket wrench	24 in. by 1 7/16 in.	6	For ribbed bolts.
Crescent wrench	15 in.	8	
Stillson wrench	24 in.	2	For installing lateral bracing.
Driftpins	15/16-in. dia	60	
Sledge	8 lb	6	6 in. long.
Hammer	3 lb	6	
Shackle	1 in.	6	
Connecting bar	3 ft	4	
Sling	10 ft	4	⅞-in. wire rope.
Jack, track	10 ton	2	Simplex type.
Pinch bar	5 ft	2	

90-Foot Truss Bridge

Spud wrench	24 in. by 1⅛ in.	18	For erection bolts.
Ratchet socket wrench	24 in. by 1¼ in.	9	For ribbed bolts.
Crescent wrench	15 in.	6	
Driftpins	13/16 in.	100	6 in. long.
Sledge	8 lb	6	
Hammer	3 lb	6	
Connecting bar	3 ft	8	
Shackle	1 in.	6	
Sling	4 ft	3	⅜-in. wire rope.
Sling	8 ft	3	¾-in. wire rope.
Chain hoist	1 ton	2	
Jack, journal	15 ton	2	
Jack, track	10 ton	2	
Pinch bar	5 ft	2	

[1] Supplemented by organic equipment normally required for construction.

Table IX. Bill of material for erection [1]

30-Foot I-Beam Bridge

Method	Size	Quantity	Board feet	Remarks
A and B	3″ x 12″ x 14′ –0″	6 ea.	252	Used for skidding stringers, blocking, and bracing.

60-Foot I-Beam Bridge

C and D	3″ x 12″ x 14′ –0″	12 ea.	504	For blocking and bracing.
	10″ x 10″ x 16′ –0″	3 ea.	399	

90-Foot Truss Bridge

E, F, G, and H	3″ x 12″ x 14′ –0″	20 ea.	840	For blocking, bracing, and erection frames.
	6″ x 6″ x 16′ –0″	8 ea.	288	
	10″ x 10″ x 16′ –0″	3 ea.	399	
	½″ carriage bolts 6½″ long.	30	------	
	60d spikes	100 lb	------	

[1] Based on average conditions.

Table X. Normal troop requirements [1]

Bridge	Noncommissioned officers	Units	Drivers		Operators		Average man-hours	Remarks
			No.	Equipment	No.	Equipment		
30-foot	1 S Sgt 1 Sgt 1 Cpl	1 squad	1 1 1 1	4-ton cargo truck 2½-ton cargo truck Compressor Crane	1 1	Tractor Crane	453	
60-foot	1 S Sgt 2 Sgts 2 Cpls	2 squads	1 2 1 1	4-ton cargo truck 2½-ton cargo truck Compressor Crane	1 1	Tractor Crane	1,042	May need pile driver or earth auger for abutments. One squad can build bridge but will take longer.
90-foot	1 S Sgt 3 Sgts 3 Cpls	1 platoon	1 3 1 1	4-ton cargo truck 2½-ton cargo truck Compressor Crane	1 1	Tractor Crane	1,929	Two squads can build bridge by increasing number of work days.

[1] Conditions: (a) Includes work in unloading, construction of simple abutments, and erection.
(b) Quantities based on average site and working conditions and troops with little experience in steel erection.
(c) Extra men are used during some periods to expedite work. See tables XI, XII, and XIII.

Table XI. Specimen work sheet—30-foot bridge [1]

Subdivision of work	Totals				Distribution of labor [2]																Remarks
	NCO	EM	Total hours	Total man-hours	First day				Second day				Third day				Fourth day				
					0800 1000	1000 1200	1300 1500	1500 1700	0800 1000	1000 1200	1300 1500	1500 1700	0800 1000	1000 1200	1300 1500	1500 1700					
Unloading steel at site	1	4	1	5	◐																
Survey for abutment location	1	4	2	10	●																
Construction of timber abutments [3]	2	12	10	140		●	●	●	●	●											6 men on each abutment.
Placing girders with crane	1	4	1	5							◐										2 men on each end.
Placing and bolting diaphragms	1	12	2	26							◑	◐									3 two-man erection bolt details.
Constructing laminated timber deck	1	8	6	54								◑	●	●	◐						3 two-man ribbed bolt details. 4 men carrying 2- by 6-inch plank.
Constructing curbs	1	8	2	18											●						4 men nailing 2- by 6-inch plank. 3 men on each curb drilling holes and placing bolts.
Laying wearing surface	1	8	1	9												◐					1 two-man detail sawing, carrying and placing timbers. 2 men carrying 2- by 12-inch plank.
Installing protection angles	1	4	1	5												◑					3 men on each side nailing plank.
Final clean-up of construction area	1	12	1	13												◑					2 men each end.
Supervision of job	1		22	22	●	●	●	●	●	●	●	●	●	●	●	●					
Tool corporal	1		22	22	●	●	●	●	●	●	●	●	●	●	●	●					Senior NCO.
Tractor operator		1	22	22	●	●	●	●	●	●	●	●	●	●	●	●					
Crane operator		1	16	16	●	●	●	●	●	●	●	●	●	●	●	●					
Drivers		4	22	88	●	●	●	●	●	●	●	●	●	●	●	●					Crane released after girders have been launched.

[1] Data in this table is based on the following conditions: (a) Troops have had little experience in steel erection but are supervised by experienced NCO's; (b) Work is done in single 8-hour day time shifts; (c) Weather conditions are favorable.
[2] Spare men are used for special tasks not shown in the table.
[3] Data are based on construction of simple timber abutment. If other types are built the data may vary considerably. Site conditions may effect these data.
◐—First hour.
◑—Second hour.
●—Full time.

Table XII. Specimen work sheet—60-foot bridge [1]

Subdivision of work	Troops				Distribution of labor [2]																				Remarks
					First day				Second day				Third day				Fourth day				Fifth day				
	NCO	EM	Total hours	Total man-hours	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	
Unloading steel at site	1	4	2	10	●																				
Survey for abutment location	1	4	2	10	●																				
Construction of timber abutments [3]	2	12	12	168		●	●	●	●	●	●														6 men on each abutment.
Assembly of gin pole	1	4	6	30	●	●	●																		
Erection of gin pole	1	8	2	18				●																	
Assembly of girders	2	12	12	168		●	●	●	●	●	●														3 four-man bolting details.
Launching girders	2	6	8	64								●	●	●	●										3 men at each end.
Removing gin pole	1	6	3	21												●	◐								
Placing & bolting diaphrams	1	6	6	42										●	●	●									3 two-man bolting details.
Placing lateral bracing	1	6	2	14												◑	◐								2 three-man details.
Constructing laminated deck	1	8	10	90													●	●	●	●	●				4 men carrying, 4 nailing.
Constructing curbs	1	8	3	27																	●	◐			2 men constructing timber curb.
																									3 men bolting each curb.
Laying wearing surface	1	8	3	27																	◑	●			2 men men carrying.
																									2 three-man nailing details.
Placing protection angles	1	4	1	5																			◐		2 men each end.
Final clean-up of area	4	24	1	28																			◐		
Supervision of job	1	-----	37	37	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐		Senior NCO.
Tool corporal	1	-----	37	37	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐		
Tractor operator	-----	1	37	37	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐		
Crane operator	-----	1	24	24	●	●	●	●	●	●	●	●	●	●	●	●									Crane released after girders have been launched.
Drivers	-----	5	37	185	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐		

[1] Data in the table are based on the following conditions:
Troops have had little experience in steel erection but are supervised by experienced noncommissioned officers.
Work is done in single 8-hour daytime shifts.
Weather conditions are favorable.
Crane-gin pole method of launching girder is used.
[2] Spare men are used for special tasks not shown in the table.
[3] Data are based on construction of simple timber abutment. If other types are built the data may vary considerably. Site conditions may effect these data.

◐—First hour.
◑—Second hour.
●—Full time.

Table XIII. Specimen work sheet—90-foot bridge [1]

Subdivision of work	Troops				Distribution of labor [2]																												Remarks
					First day				Second day				Third day				Fourth day				Fifth day				Sixth day				Seventh day				
	NCO	EM	Total hours	Total man-hours	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	0800-1000	1000-1200	1300-1500	1500-1700	
Unloading steel at site	1	6	6	42	●	●	●																										
Survey for abutment location	1	4	2	10	●																												
Construction of timber abutment [3, 4]	2	12	16	224		●	●	●	●	●	●	●	●																				
Assembly of gin pole	1	4	6	30	●	●	●																										
Erection of gin pole	1	8	2	18				●																									
Assembly of first truss [5]	2	12	16	224				●	●	●	●	●	●	●	●																		
Assembly of second truss [5]	2	12	16	224								●	●	●	●	●	●	●															
Launching of first truss [6]	2	12	4	56												●	●																
Launching of second truss [6]	2	12	4	56																●	●												
Erection of floor system [7]	1	9	10	100																		●	●	●	●	●							
Bolting floor system [8]	1	12	10	130																	◑	●	●	●	●	◐							
Removal of gin pole	1	6	3	21																						◑	●						
Construction of laminated deck [9]	1	8	14	126																					●	●	●	●	●	●	●		
Placing wearing surface [10]	1	8	5	45																										●	●	◐	
Placing guard rail [11]	1	12	4	52																											●	●	
Placing protection angles [12]	1	4	1	5																												◑	
Final clean-up of area	2	12	1	14																												◑	
Supervision [13]	1	-----	56	56	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Tool corporal	1	-----	56	56	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Tractor operator	-----	1	56	56	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Crane operator [14]	-----	1	48	48	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●						
Drivers	-----	6	56	336	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	

[1] Data in this table are based on the following conditions:
Troops have had little experience in steel erection but are supervised by experienced NCO's.
Work is done in single 8-hour day shifts.
Weather conditions are favorable.
Crane gin-pole method of launching is used.
[2] Spare men are used for special tasks not shown in the table.
◐—First hour.
[3] Data based on construction of simple timber abutments. If other types are built the data may vary considerably. Site conditions may effect these data.
[4] 6 men at each abutment.
[5] 4 three-man bolting details.
[6] 4 men at each abutment and 4 men on guys.
[7] 6 men placing members and 3 men assisting.
◑—Second hour.
[8] 6 two man bolting details.
[9] 4 men nailing, 4 men carrying.
[10] 3 men each side, 2 men carrying.
[11] 4 men carrying, 2 men marking, 2 men drilling, 4 men bolting.
[12] 2 at each end.
[13] Senior NCO.
[14] Crane released after floor system has been placed.
●—Full time.

Table XIV. Loads on abutments [1]

	30-foot bridge (pounds)	60-foot bridge (pounds)	90-foot bridge (pounds)
Required abutment capacity	[2] 141,000	[3] 165,000	[4] 177,000
Maximum reaction on one bearing plate	[5] 56,800	[5] 68,750	[6] 100,000

[1] In multiple-span construction the total load on an intermediate pier is the sum of the abutment loads for the spans resting on the pier.
[2] Includes dead load of 16,000 pounds, live load of 100,000 pounds, and impact at 32 percent.
[3] Includes dead load of 40,000 pounds, live load of 100,000 pounds, and impact at 32 percent.
[4] Includes dead load of 52,000 pounds, live load of 100,000 pounds, and impact at 25 percent.
[5] Bridge has four bearing plates at each end.
[6] Bridge has two bearing plates at each end.

Table XV. Crane capacity data

QUICKWAY (COLEMAN) ⅜ CU. YD., 25-FT. BOOM

Radius (feet)	Safe load (pounds)		
	Side		End
	Without outrigger	With outrigger	
10	6,700	11,000	11,000
15	4,700	6,500	6,500
20	3,200	4,700	4,700
25	2,300	3,400	3,400

BUCKEYE MODEL 70, ¾ CU. YD., 35-FT. BOOM

Radius (feet)	Safe load (pounds)
10	13,600
15	8,600
20	5,850
25	4,350
30	3,550
35	3,000

OSGOOD MODEL 20, 35-FT. BOOM (WITH 1,100-LB. COUNTERWEIGHT)

Radius (feet)	Safe load (pounds)
10	13,840
12	11,500
15	6,750
20	4,570
25	3,490
30	2,700
35	2,340

BUCYRUS-ERIE MODEL 15-B ½ CU. YD. (COUNTERWEIGHT A)

Radius (feet)	Safe load (pounds)		
	30-ft. boom	35-ft. boom	40-ft. boom
10	11,700	11,625	
12	8,860	8,800	8,700
15	6,420	6,350	6,275
20	4,310	4,235	4,160
25	3,240	3,165	3,100
30	2,470	2,400	2,325
35			1,910

Table XVI. Winch data

Equipment	Winch capacity [1]		Cable		Gross [2] weight of vehicle (pounds)
	Bare drum (pounds)	Full drum (pounds)	Diamteer (inches)	Length (feet)	
Truck, command and reconnaissance, ¼-ton, 4 x 4	5,000		⅜	250	5,600
Truck, weapon carrier, ½-ton, 4 x 4	5,000		⅜	250	5,775
Truck, command, ¾-ton, 4 x 4	5,000		⅜	250	7,175
Truck, cargo and personnel carrier, 1½-ton, 6 x 6	5,000		⅜	250	10,500
Truck, cargo, 1½-ton, 4 x 4	10,000		½	250	11,500
Truck, dump, 1½-ton, 4 x 4	10,000		½	250	12,500
Truck, earth auger, 1½-ton, 4 x 4, M1	10,000		½	250	12,500
Truck, earth borer and pole setter, 1½-ton, 4 x 4, K-44	10,000		½	250	12,500
Truck, cargo, L. W. B., 2½-ton, 6 x 6, with wrecker set No. 7 and winch	10,000		½	250	16,200
Truck, cargo, S. W. B., 2½-ton, 6 x 6	10,000		½	250	15,350
Truck, dump, L. W. B., 2½-ton, 6 x 6	10,000		½	250	16,850
Truck, cargo, 2½-ton, 6 x 4	10,000		½	250	20,200
Truck, cargo, L. W. B., 2½-ton, 6 x 6	10,000		½	250	15,450
Truck, cargo, L. W. B., 4-ton, 6 x 6, w/w	15,000		⅝	250	26,500
D4 Towing winch	15,400	8,580	⅝	485	15,000
			¾	335	
D6 (Hyster)	25,000	14,000	¾	420	22,600
			⅞	300	
D7 (Hyster)	32,000	22,000	⅞	375	32,900
			1	280	

[1] Data based on information given in TM 9-2800.
[2] Carrying rated pay load.

TABLE XVII. Working stresses [1] for structural carbon steel (A. S. T. M.-A7) [2] used in design of bridges

Kind	Unit stress in pounds per square inch
Axial tension, structural steel, net section	22,500
Tension in extreme fibers of rolled shapes, girders, and built sections subject to bending	22,500
Axial compression, gross section	22,500
Compressions in extreme fibers of rolled shapes, girders, and built-up sections subject to bending (for value of $\frac{L}{b}$ not greater than 40)	$22{,}500-3.75\frac{L^2}{b^2}$
L=length in inches of unsupported flange between lateral connections. b=flange width in inches.	
Shear in power-driven rivets and pins	16,875
Shear in turned bolts	13,750
Bearing on turned bolts	25,000

[1] Increased 25 percent over A. A. S. H. O. 1941 specifications.
[2] Plates, sections, and bars:
Tensile strength ..... 60,000 to 72,000 p. s. i.
Yield point, minimum ..... 0.5 tensile strength, but in no case less than ..... 33,000 p. s. i.

Table XVIII. Working unit-stresses for treated timber used in design of bridge floors [1]

Grade and species	Fiber stress in bending or tension (pounds per square inch)	Maximum horizontal shear (pounds per square inch)	Compression perpendicular to grain (pounds per square inch)
1800 No. f dense select structural Douglas fir or prime structural yellow pine (long leaf or dense short leaf)	1,800	120	380

[1] A. A. S. H. O. 1941 specifications.

PART FOUR

GENERAL AND DETAILED DRAWINGS

Sheets 1 to 12 inclusive contain details of the design of the 30-, 60-, and 90-foot bridges. These are taken from the following Engineer Board drawings:

30-foot I-beam bridge—Plan No. D–2656–1 and No. D–2656–2, revised 8–27–43 and 11–2–43.

60-foot I-beam bridge—Plan No. D–2657–1 and No. D–2657–2, revised 8–26–43, 9–18–43, and 11–2–43.

90-foot truss bridge—Plan No. D–2658–1, No. D–2658–2, No. D–2658–3, and No. D–2658–4, revised 11–2–43 and 11–13–43.

Information contained in bills of materials and other details is the latest available and supersedes data contained in TB ENG 12, 15 March 1944.

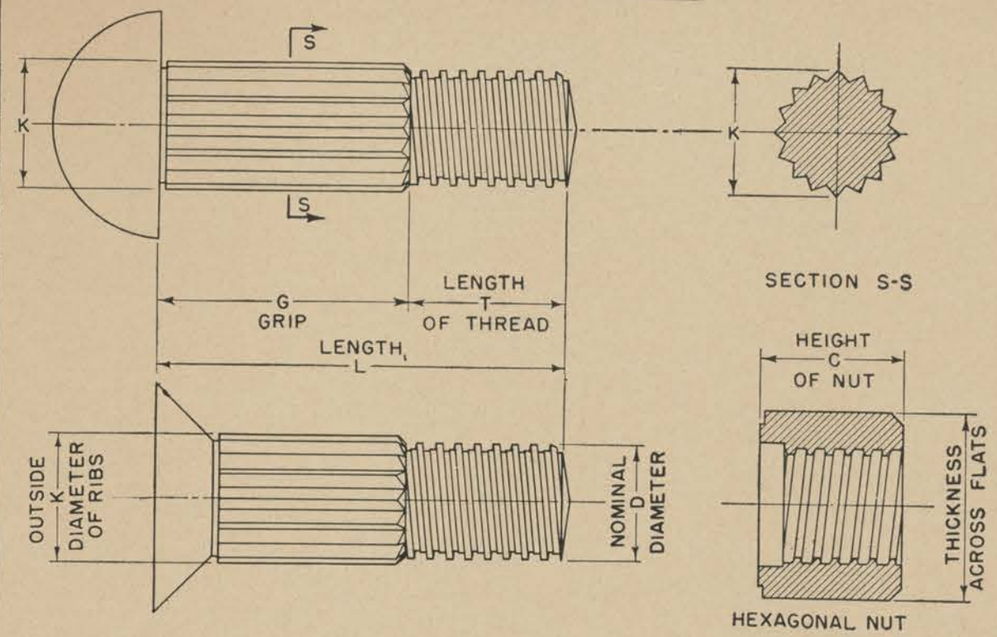
Sheets 13, 15, 16, and 17 contain information furnished by the Engineer Board on assembly and erection of all three bridges.

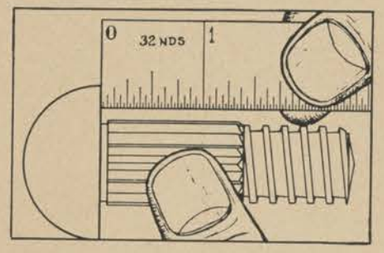
Sheets 14 and 18 contain information on assembly and erection obtained from tests made jointly by the Engineer School and the Engineer Board.

MARK	UNIT — BRIDGE, WITHOUT LUMBER SET STOCK NO. 2000-100	UNIT WEIGHT POUNDS	NO. REQ'D	TOTAL WEIGHT POUNDS
G1	Girder	2,554	4	10,216
D1	Diaphragm, intermediate	128	6	768
D2	Diaphragm, end	105	6	630
A1	Angle, protection	42	4	168
BP1	Plate, bearing	31	8	248
AB1	Bolt, anchor	4.3	18	78
C1	Clip, traction	8	8	64
	Clip, floor	0.71	130	92
	Bolt, erection, rough, 7/8" dia. x 2", threaded 1 1/2", sq. head, 1 sq. nut	0.96	50	48
	Bolt, structural, ribbed 7/8" dia. x 2 1/16", buttonhead, 1 hexagonal nut	0.95	160	152
	Bolt, structural, ribbed, 7/8" dia. x 2 1/4", countersunk head, 1 hexagonal nut	0.98	20	20
	Bolt assembly, curb	6.6	30	198
	Washers, cut, for 7/8" dia. bolts	0.13	75	10
	Nails, 50d, cement-coated	0.0625	3600	225
	TOTAL METAL IN BRIDGE SET			12,917
	LUMBER (MUST BE REQUISITIONED SEPARATELY) / LAMINATED FLOOR SYSTEM	FEET B.M. EACH GROSS QUANT.	NO. REQ'D	TOTAL M.B.M. GROSS QUANT.
	Lumber, rough, 2" x 6" x 14'-0"	14	210	2.940
	Lumber, rough, 2" x 12" x 15'-9"	32	12	0.384
	Lumber, rough, 2" x 12" x 12'-0"	24	4	0.096
	Lumber, rough, 2" x 12" x 9'-9"	20	8	0.160
	Lumber, rough, 6" x 6" x 16'-0"	48	4	0.192
	Lumber, rough, 4" x 6" x 4'-0"	8	12	0.096
	TOTAL LUMBER			3.868

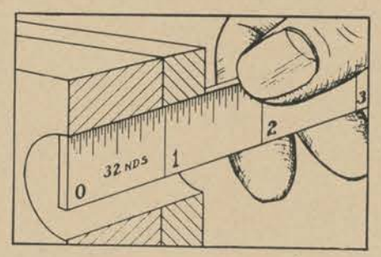
NOTE: One M.B.M. equals one thousand board feet.

RIVET BOLT DETAILS



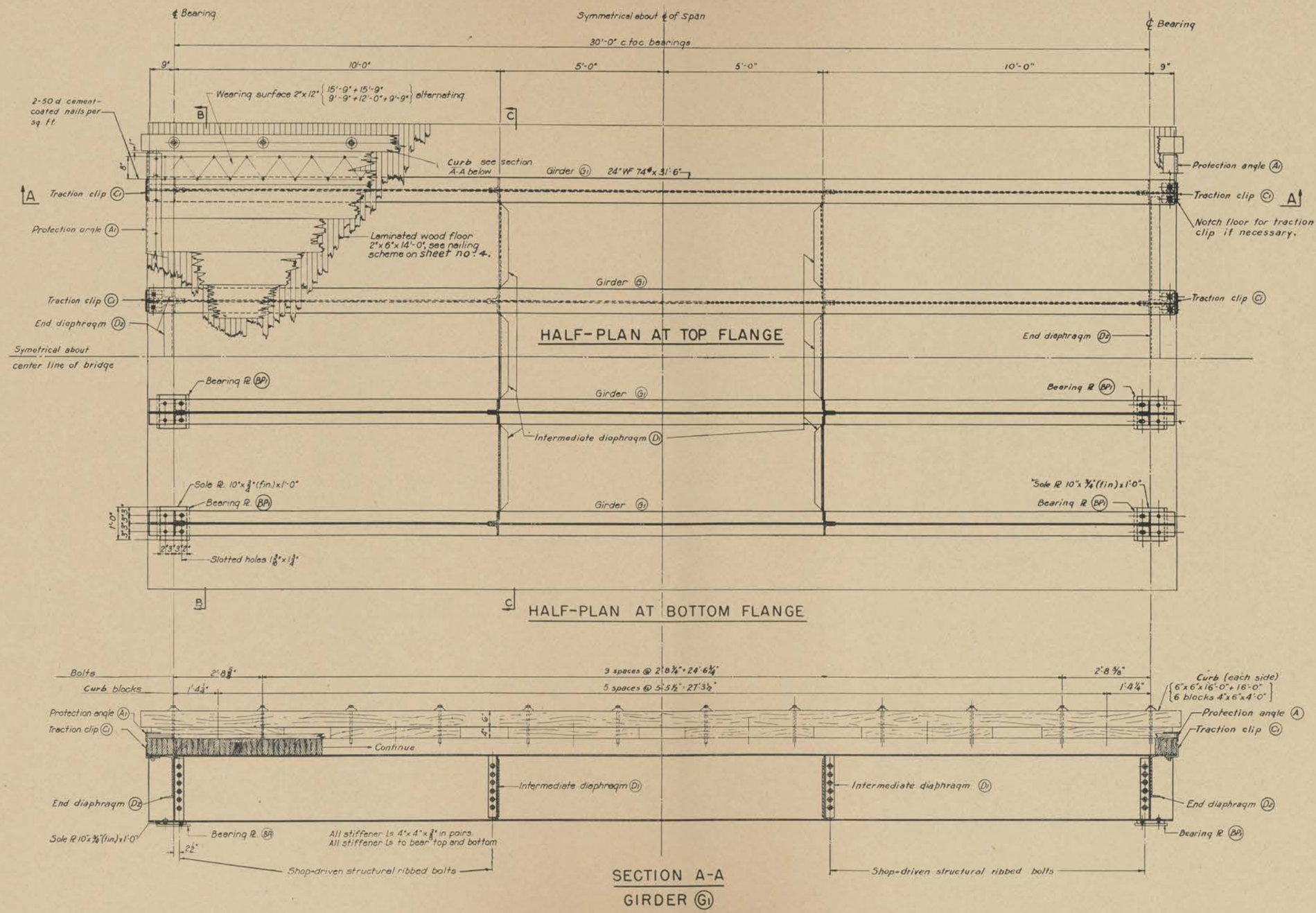


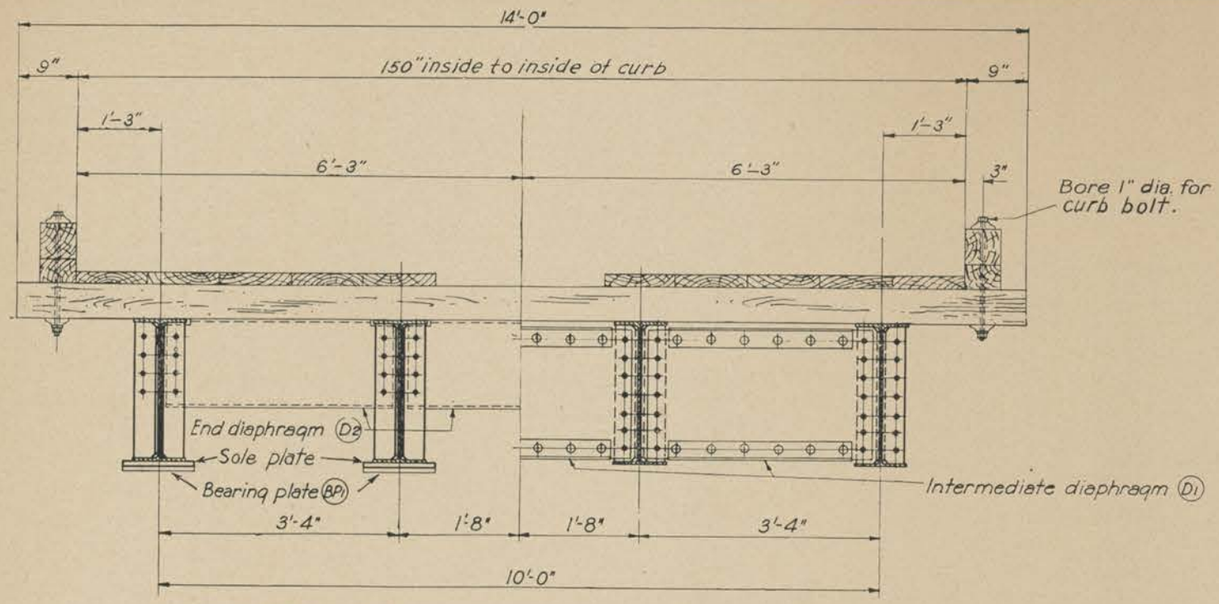
CHECKING GRIP LENGTHS



CHECKING WORKING THICKNESS

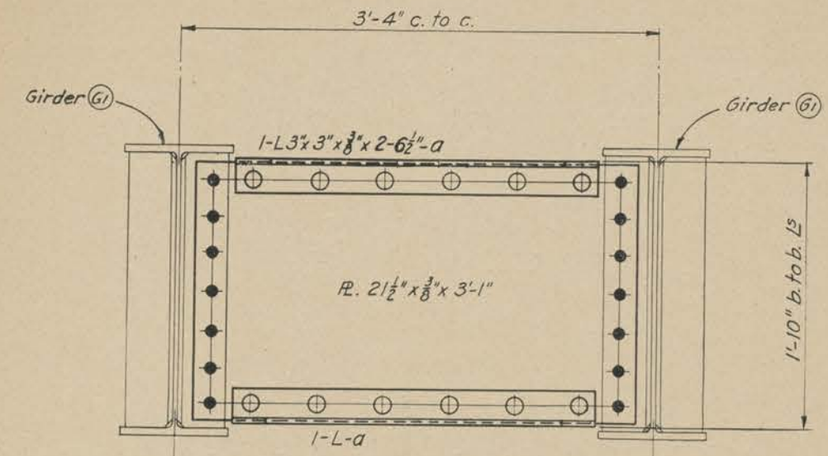
STRUCTURAL RIBBED BOLTS		
CONNECTION	GRIP (INCHES)	LENGTH
DIAPHRAGM, END, TO GIRDER WEB	27/32"	2 1/16"
DIAPHRAGM, INTERMEDIATE, TO GIRDER WEB	27/32"	2 1/16"
CLIP, TRACTION, TO GIRDER, TOP FLANGE	1 1/32"	2 1/4"
ALL BOLTS 7/8" DIAMETER		


℄ Bearing
Symmetrical about ℄ of Span
℄ Bearing
30'-0" c.to.c. bearings
9"
10'-0"
5'-0"
5'-0"
10'-0"
9"
2-50 d cement-coated nails per sq ft
Wearing surface 2"x12" (15'-9"+15'-9" 9'-9"+12'-0"+9'-9") alternating
B
C
Curb see section A-A below
Girder (G1) 24"WF 74#x31'-6"
Protection angle (A1)
A
Traction clip (C1)
A
Protection angle (A1)
Laminated wood floor 2"x6"x14'-0", see nailing scheme on sheet no: 4.
Notch floor for traction clip if necessary.
Girder (G1)
Traction clip (C1)
Traction clip (C1)
End diaphragm (D2)
End diaphragm (D2)
HALF-PLAN AT TOP FLANGE
Symetrical about center line of bridge
Bearing R (BP1)
Bearing R (BP1)
Girder (G1)
Intermediate diaphragm (D1)
Sole R. 10"x⅜"(fin.)x1'-0"
Bearing R. (BP1)
Girder (G1)
"Sole R 10"x ¾"(fin)x1'-0"
Bearing R (BP1)
Slotted holes 1⅛"x1¼"
B
C
HALF-PLAN AT BOTTOM FLANGE
Bolts
Curb blocks
2'-8⅜"
1'-4½"
9 spaces @ 2'-8¾"=24'-6¾"
5 spaces @ 5'-5½"=27'-3½"
2'-8⅜"
1'-4¼"
Curb (each side) 6"x6"x16'-0"+16'-0" 6 blocks 4"x6"x4'-0"
Protection angle (A1)
Traction clip (C1)
Continue
Protection angle (A)
Traction clip (C1)
End diaphragm (D2)
Intermediate diaphragm (D1)
Intermediate diaphragm (D1)
End diaphragm (D2)
Sole R 10"x ¾"(fin)x1'-0"
Bearing R. (BP)
All stiffener Ls 4"x4"x⅜" in pairs. All stiffener Ls to bear top and bottom
Bearing R (BP)
22"
Shop-driven structural ribbed bolts
Shop-driven structural ribbed bolts
SECTION A-A
GIRDER (G1)

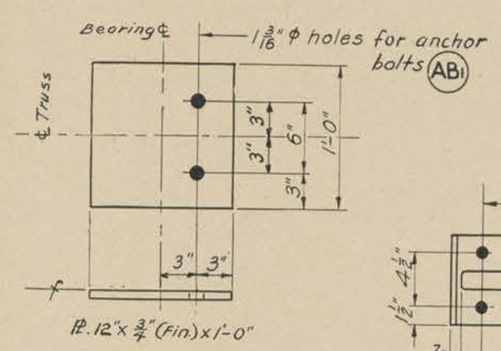


HALF-SECTION B-B

HALF-SECTION C-C

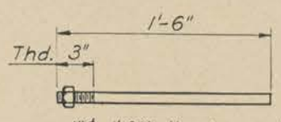


INTERMEDIATE DIAPHRAGM (D1)

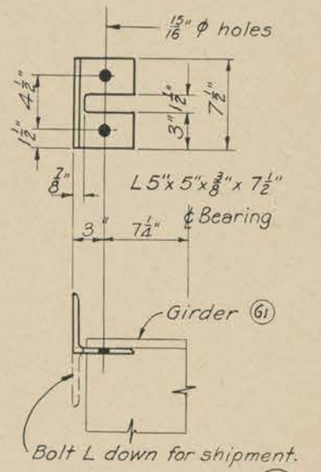


BEARING PLATE (BP1)

Bolt to sole plate for shipment.



ANCHOR BOLT (AB1)



TRACTION CLIP (C1)

RIVET AND BOLT SYMBOLS



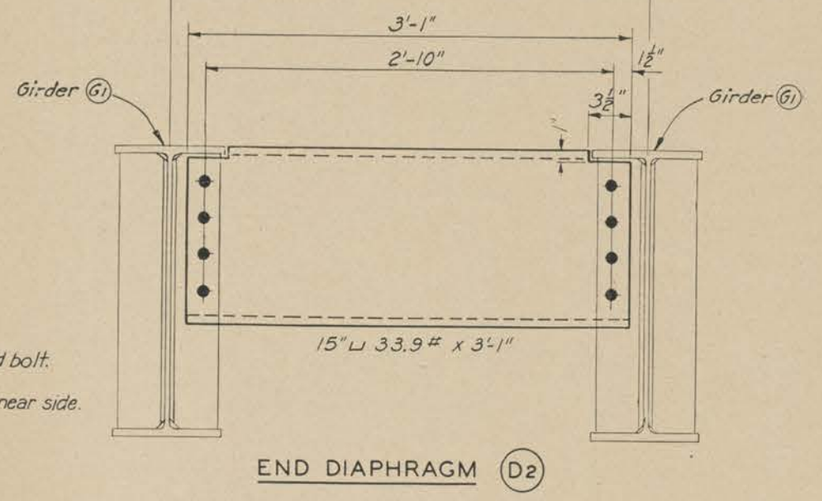
Shop rivet - 2 full heads.

Shop rivet - countersunk and chipped far side.

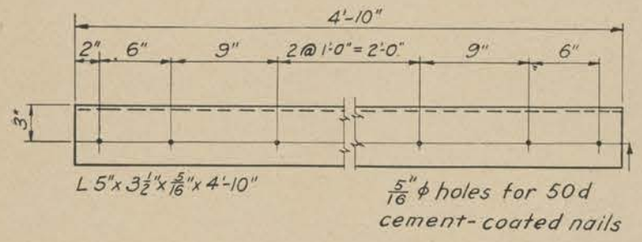
Shop structural ribbed buttonhead bolt

Open hole for structural ribbed buttonhead field bolt.

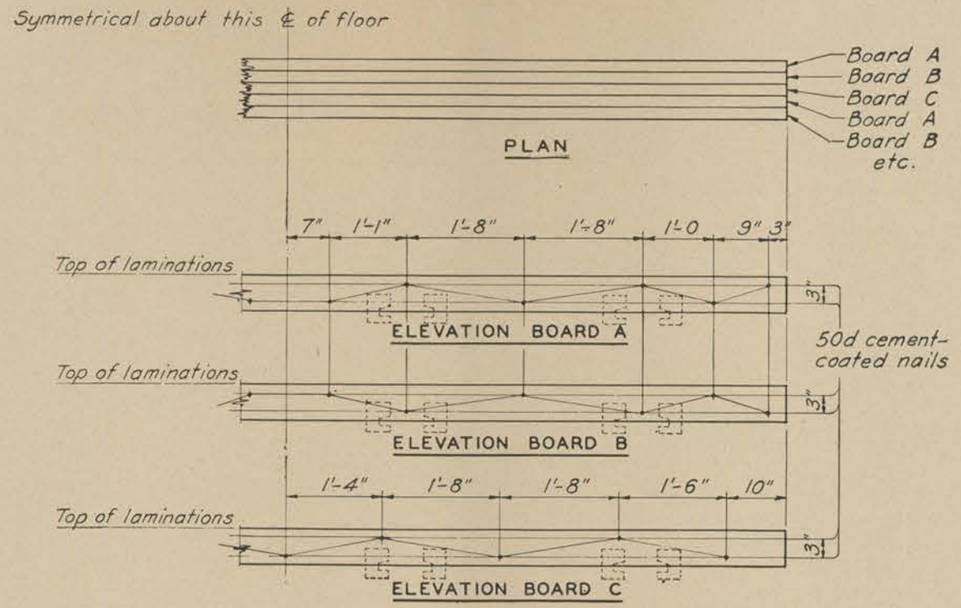
Open hole for structural ribbed c'sk. head field bolt, near side.



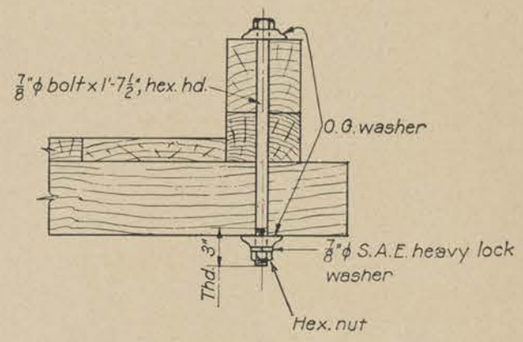
END DIAPHRAGM (D2)



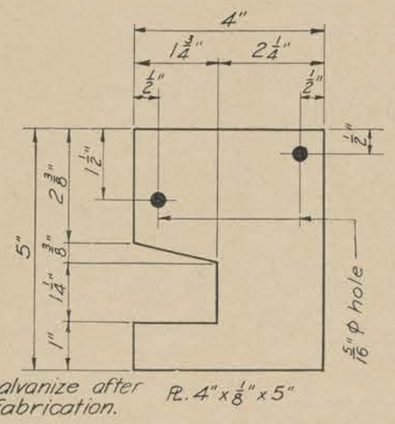
PROTECTION ANGLE (A1)



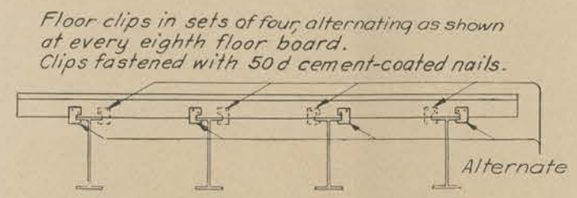
LAMINATED FLOOR SYSTEM



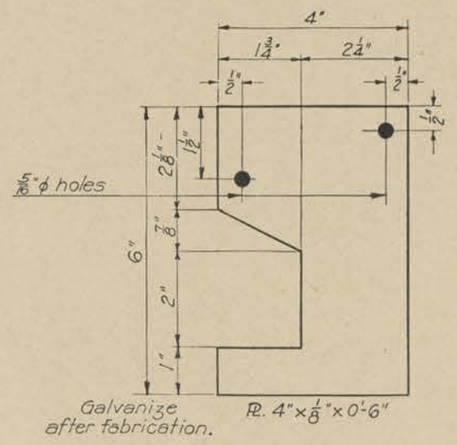
CURB BOLT DETAILS



FLOOR CLIP FOR 30-FOOT BRIDGE

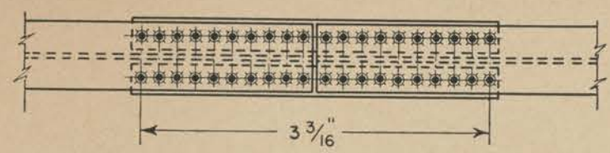


NAILING SCHEME FOR FLOOR CLIPS

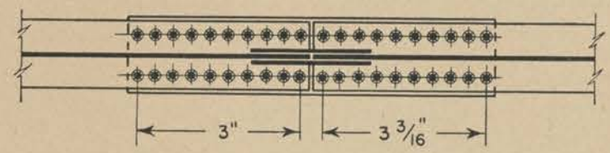


FLOOR CLIP FOR 60-FOOT BRIDGE

MARK	UNIT	BRIDGE, WITHOUT LUMBER SET STOCK NO. 2000-110	UNIT WEIGHT POUNDS	NO. REQ'D	TOTAL WEIGHT POUNDS
G2R	Girder section, outer, end, (incl. splice)		3,075	2	6,150
G2L	Girder section, outer, end, (incl. splice)		3,075	2	6,150
G3	Girder section, outer, center		3,491	2	6,982
G4	Girder section, inner, end, (incl. splice)		3,065	4	12,260
G5	Girder section, inner, center		3,495	2	6,990
D3	Diaphragm, intermediate		154	15	2,310
D4	Diaphragm, end		132	6	792
A1	Angle, protection		42	4	168
BP1	Plate bearing		31	8	248
AB1	Bolt, anchor		4.3	18	78
C2	Clip, traction		9	8	72
T1	Bracing, lateral, diagonal		21.6	12	259
T2	Bracing, lateral, diagonal		18.9	12	227
	TOTAL STRUCTURAL STEEL				42,686
	Clip, floor		0.85	230	196
	Bolt, erection, rough, 7/8" dia. x 3", threaded 2 1/2", sq. head, 1 sq. nut		1.12	425	476
	Bolt, structural, ribbed, 7/8" dia. x 2 1/16", buttonhead, hexagonal nut		0.95	330	314
	Bolt, structural, ribbed, 7/8" dia. x 3 3/16", countersunk head, 1 hexagonal nut		1.13	540	610
	Bolt, structural, ribbed, 7/8" dia. x 2 5/8", buttonhead, 1 hexagonal nut		1.04	400	416
	Bolt, structural, ribbed, 7/8" dia. x 3", countersunk head, 1 hexagonal nut		1.10	190	209
	Bolt, structural, ribbed, 7/8" dia. x 2 7/16", countersunk head, 1 hexagonal nut		1.01	20	20
	Bolt, assembly, curb		6.6	54	356
	Washers, cut, for 7/8" dia. bolts		0.13	720	94
	Nails, 50d, cement-coated		.0625	6,400	400
	Turnbuckle, 1" dia.		2.27	2	5
	Nuts, 1" dia.		0.423	14	6
	TOTAL METAL IN BRIDGE SET				45,788
	LUMBER (MUST BE REQUISITIONED SEPARATELY)	FT. B.M. EACH GROSS QUANT.	NO. REQ'D		TOTAL M.B.M. GROSS QUANT.
	LAMINATED FLOOR SYSTEM				
	Lumber, rough, 2" x 6" x 14'-0"	14	410		5.740
	Lumber, rough, 2" x 12" x 14'-0"	28	40		1.120
	Lumber, rough, 2" x 12" x 5'-6"	12	10		0.120
	Lumber, rough, 6" x 6" x 18'-0"	54	6		0.324
	Lumber, rough, 6" x 6" x 8'-0"	24	2		0.048
	Lumber, rough, 4" x 6" x 4'-0"	8	24		0.192
	TOTAL LUMBER				7.544

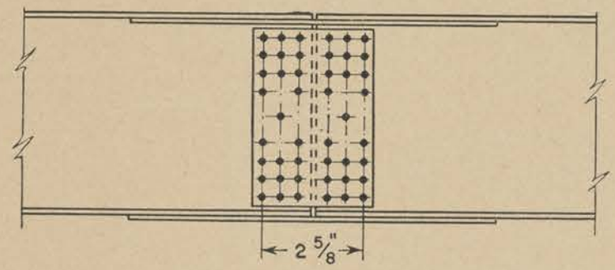


PLAN AT TOP FLANGE



PLAN AT BOTTOM FLANGE

NOTE: USE 3 3/16" BOLTS ON SIDES OF SPLICE WHERE FILL PLATES ARE REQUIRED. WHEN NO FILL PLATES ARE REQUIRED, USE 3 3/16" BOLTS ON ONE SIDE OF SPLICE AND PLACE WASHERS UNDER NUTS.

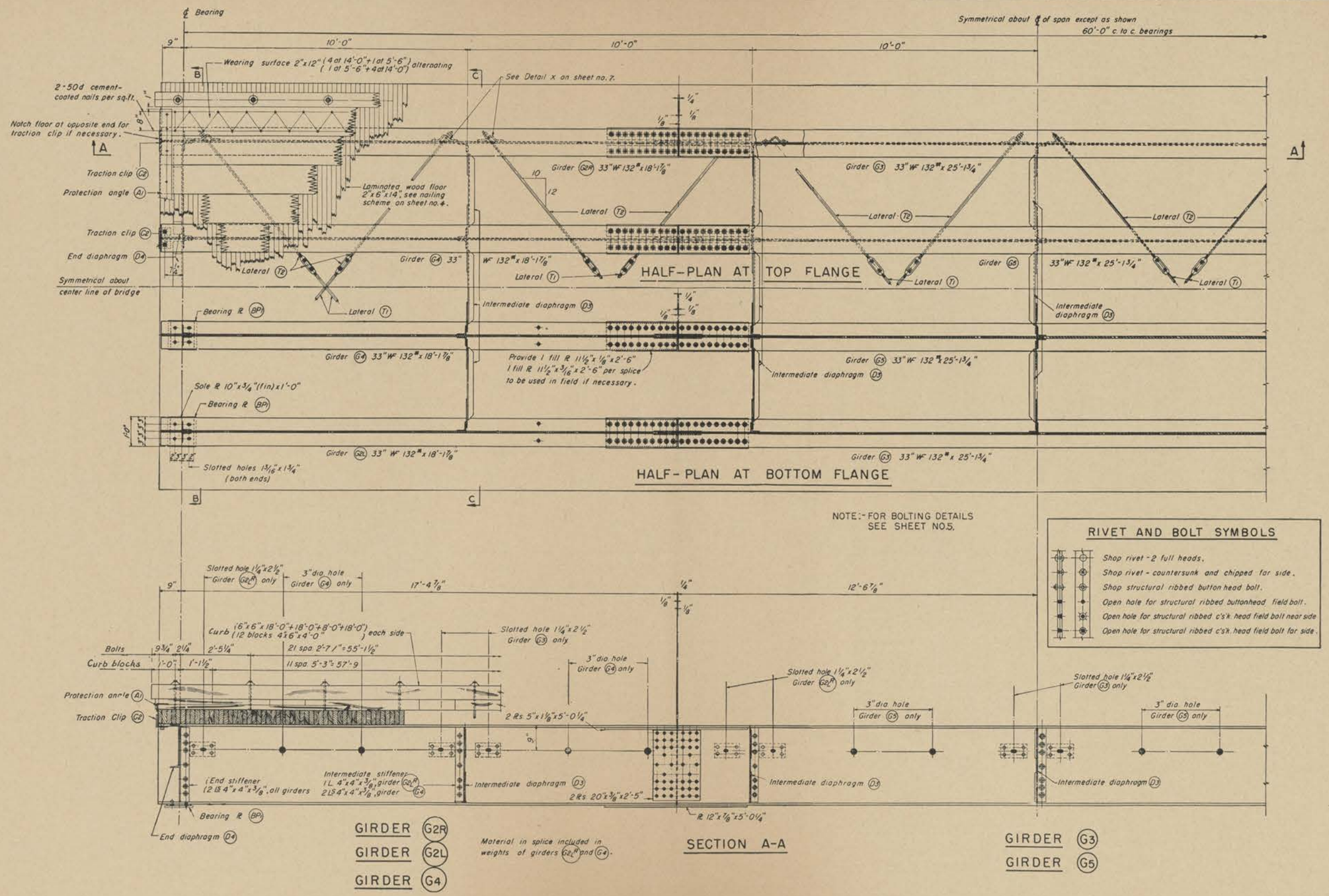


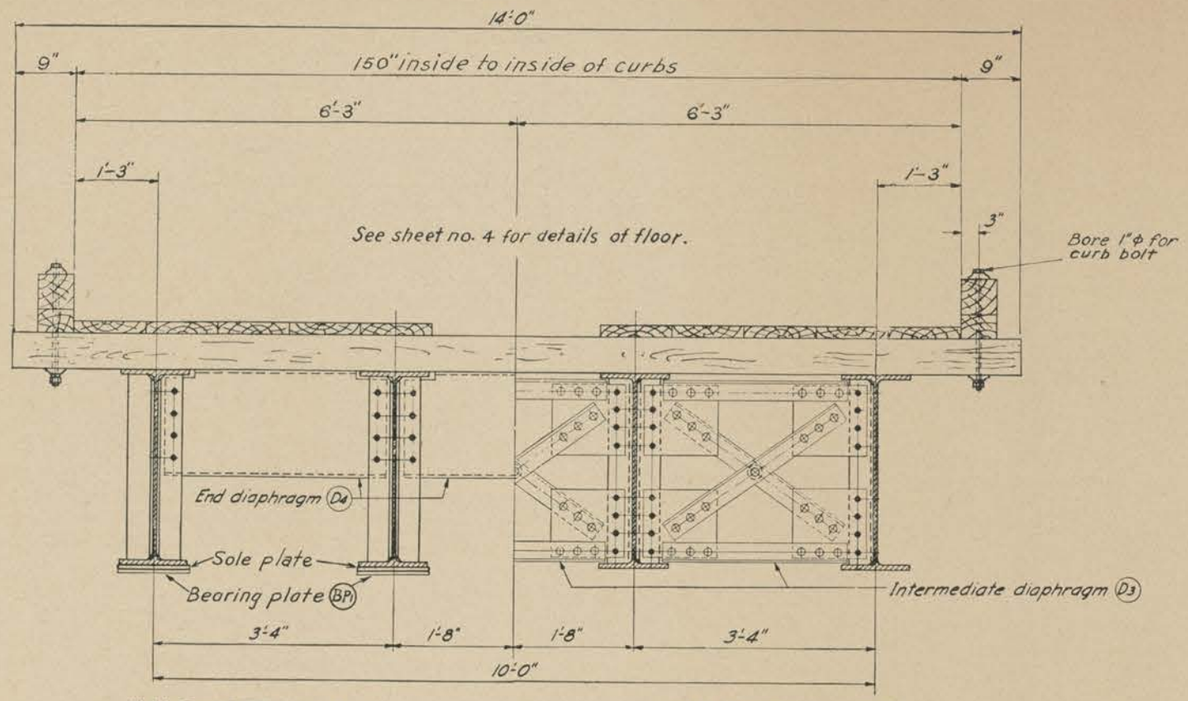
ELEVATION

BOLT DETAILS OF GIRDER SPLICE

STRUCTURAL RIBBED BOLTS		
CONNECTION	GRIP (INCHES)	LENGTH
SPLICE, GIRDER, TOP FLANGE	1 31/32"	3 3/16"
SPLICE, GIRDER, BOTTOM FLANGE	1 25/32"	3"
	1 31/32"	3 3/16"
SPLICE, GIRDER, WEB	1 3/32"	2 5/8"
DIAPHRAGM, END, TO GIRDER WEB	27/32"	2 1/16"
DIAPHRAGM, INTERMEDIATE, TO GIRDER WEB	27/32"	2 1/16"
CLIP, TRACTION, TO GIRDER, TOP FLANGE	1 7/32"	2 7/16"
ALL BOLTS 7/8" DIAMETER		

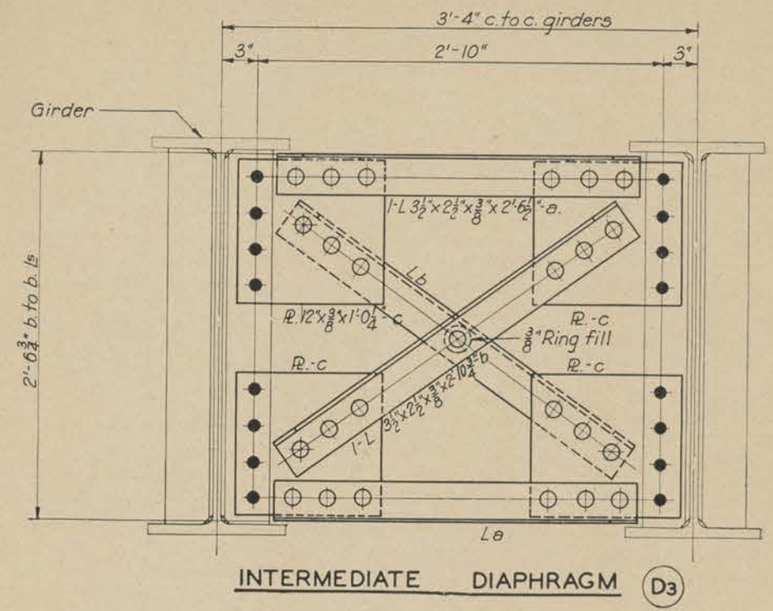
NOTE: One M.B.M. equals one thousand board feet.


℄ Bearing
Symmetrical about ℄ of span except as shown
60'-0" c. to c. bearings
9"
10'-0"
10'-0"
10'-0"
Wearing surface 2"x12" (4 at 14'-0" + 1 at 5'-6") alternating (1 at 5'-6" + 4 at 14'-0")
See Detail x on sheet no. 7.
2-50d cement-coated nails per sq.ft.
Notch floor at opposite end for traction clip if necessary.
Traction clip G2
Protection angle A1
Traction clip G2
End diaphragm D4
Symmetrical about center line of bridge
Laminated wood floor 2"x6"x14", see nailing scheme on sheet no. 4.
Girder G4 33" WF 132#x18'-1 7/8"
Lateral T2
Lateral T1
Bearing R BP
Girder G2L 33" WF 132#x18'-1 7/8"
Sole R 10"x3/4"(fin)x1'-0"
Bearing R BP
Slotted holes 1 3/16"x1 3/4" (both ends)
Girder G2R 33" WF 132#x18'-1 7/8"
Lateral T2
Intermediate diaphragm D3
Provide 1 fill R 11 1/2"x1/8"x2'-6" 1 fill R 11 1/2"x3/16"x2'-6" per splice to be used in field if necessary.
HALF-PLAN AT TOP FLANGE
HALF-PLAN AT BOTTOM FLANGE
Girder G3 33" WF 132#x25'-1 3/4"
Lateral T2
Lateral T1
Intermediate diaphragm D3
Girder G5 33" WF 132#x25'-1 3/4"
Lateral T2
Lateral T1
Intermediate diaphragm D3
A
B
C
NOTE:- FOR BOLTING DETAILS SEE SHEET NO.5.
RIVET AND BOLT SYMBOLS
Shop rivet - 2 full heads.
Shop rivet - countersunk and chipped flat side.
Shop structural ribbed button head bolt.
Open hole for structural ribbed buttonhead field bolt.
Open hole for structural ribbed c'sk. head field bolt near side
Open hole for structural ribbed c'sk. head field bolt far side.
Slotted hole 1 1/4"x2 1/2" Girder G2R only
3" dia. hole Girder G4 only
17'-4 7/8"
12'-6 7/8"
Curb (12 blocks 4'6"x4'-0") 16"x6"x18'-0"+18'-0"+8'-0"+18'-0" each side
Bolts
Curb blocks
9 3/4" 2 1/4"
1'-0" 1'-1 1/2"
2'-5 1/4"
21 spa. 2'-7 1/"=55'-1 1/2"
11 spa. 5'-3"=57'-9
Protection angle A1
Traction Clip G2
Slotted hole 1 1/4"x2 1/2" Girder G3 only
3" dia. hole Girder G4 only
2 Rs. 5"x1 1/8"x5'-0 1/4"
Slotted hole 1 1/4"x2 1/2" Girder G2R only
3" dia. hole Girder G5 only
Slotted hole 1 1/4"x2 1/2" Girder G3 only
3" dia. hole Girder G5 only
9"
(End stiffener (2 Ls 4"x4"x3/8", all girders
Intermediate stiffener 1 L 4"x4"x3/8" girder G2R 2 Ls 4"x4"x3/8", girder G4
Intermediate diaphragm D3
2 Rs. 20"x3/8"x2'-5"
R 12"x7/8"x5'-0 1/4"
Intermediate diaphragm D3
Intermediate diaphragm D3
Bearing R BP
End diaphragm D4
SECTION A-A
GIRDER G2R
GIRDER G2L
GIRDER G4
Material in splice included in weights of girders G2R and G4.
GIRDER G3
GIRDER G5

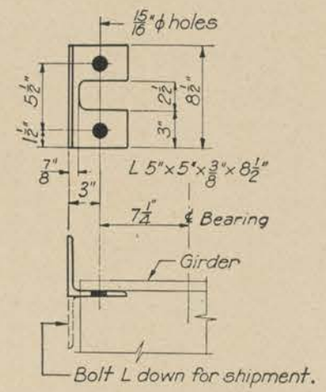


HALF-SECTION B-B

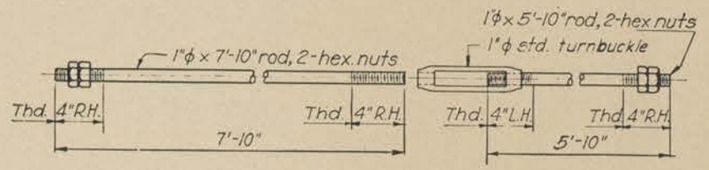
HALF-SECTION C-C



INTERMEDIATE DIAPHRAGM (D3)

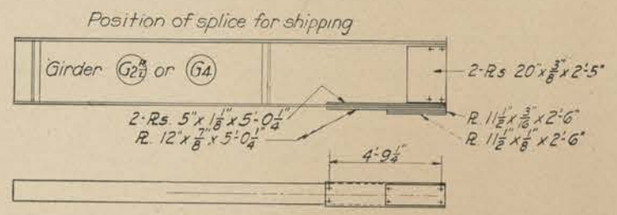


TRACTION CLIP (C2)

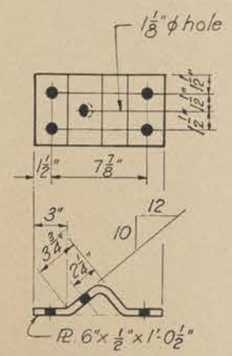


LATERAL (T1)

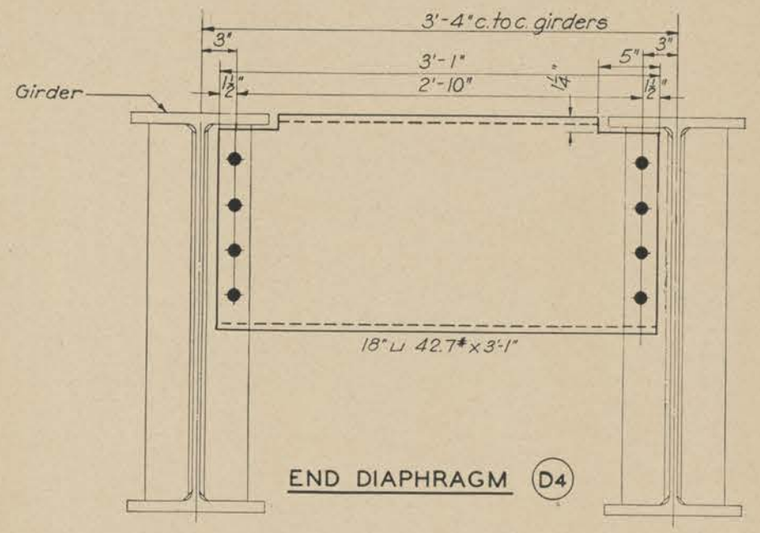
LATERAL (T2)



SHIPPING SCHEME FOR GIRDER SPLICE



DETAIL X



END DIAPHRAGM (D4)

NOTE: BEARING PLATE (BP1) AND ANCHOR BOLT (AB1)
same as for 30-foot bridge; see sheet no. 4.

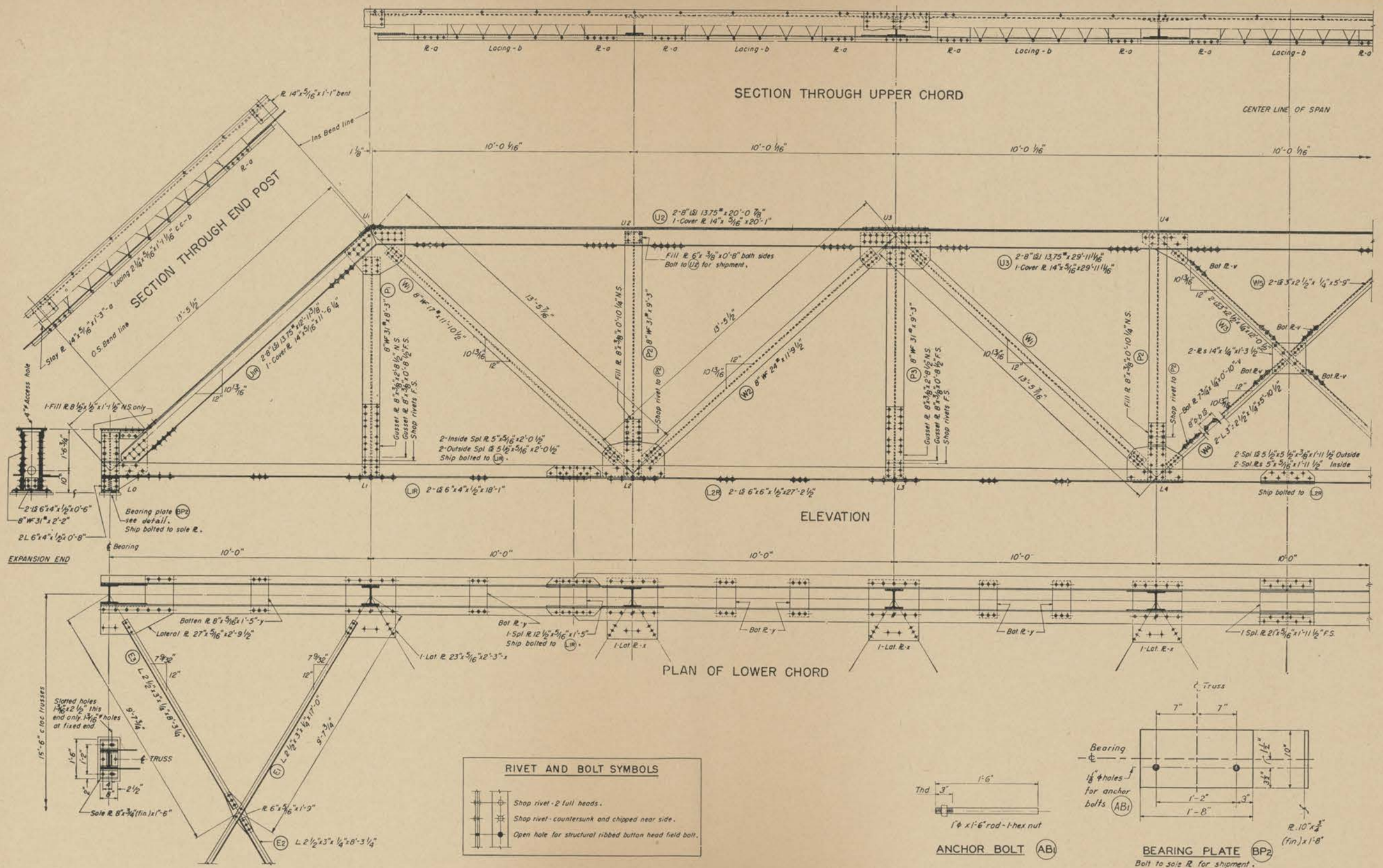
90-FOOT TRUSS BRIDGE BILL OF MATERIAL

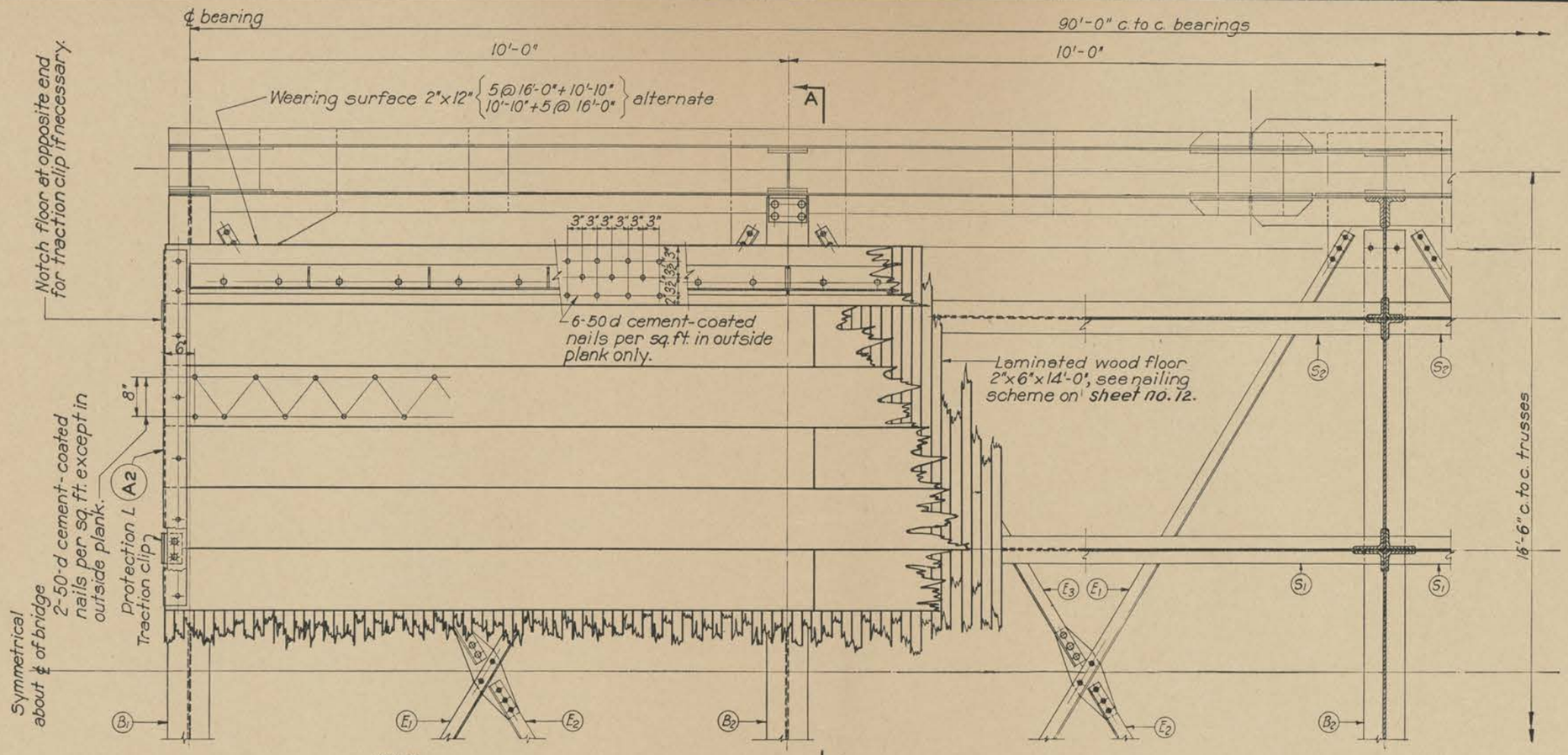
SHEET NO. 8

MARK	UNIT — BRIDGE, WITHOUT LUMBER SET STOCK NO. 2000-120	UNIT WEIGHT POUNDS	NO. REQ'D	TOTAL WEIGHT POUNDS
U1R	Post, end, sloped	740	2	1,480
U1L	Post, end, sloped	740	2	1,480
U2	Chord section, upper, end	1,227	4	4,908
U3	Chord section, upper, center	1,655	2	3,310
L1R	Chord section, lower, end	1,129	1	1,129
L1L	Chord section, lower, end	1,129	1	1,129
L2R	Chord section, lower, center	1,589	2	3,178
L2L	Chord section, lower, center	1,466	2	2,932
L3R	Chord section, lower, end	1,129	1	1,129
L3L	Chord section, lower, end	1,129	1	1,129
P1	Vertical, web	293	4	1,172
P2	Vertical, web	297	8	2,376
P3	Vertical, web	324	4	1,296
W1	Diagonal, web	202	8	1,616
W2	Diagonal, web	283	4	1,132
W3	Diagonal, web	172	2	344
W4	Diagonal, web	69	2	138
W5	Diagonal, web	67	2	134
B1	Beam, floor, end	1,093	2	2,186
B2	Beam, floor, intermediate	1,146	8	9,168
E1	Bracing, lateral, diagonal	77	9	693
E2	Bracing, lateral, diagonal	37	9	333
E3	Bracing, lateral, diagonal	46	9	414
A2	Angle, protection	52	4	208
A3	Guardrail	241	18	4,338
BP2	Plate, bearing	43	4	172
AB1	Bolt, anchor	43	10	43

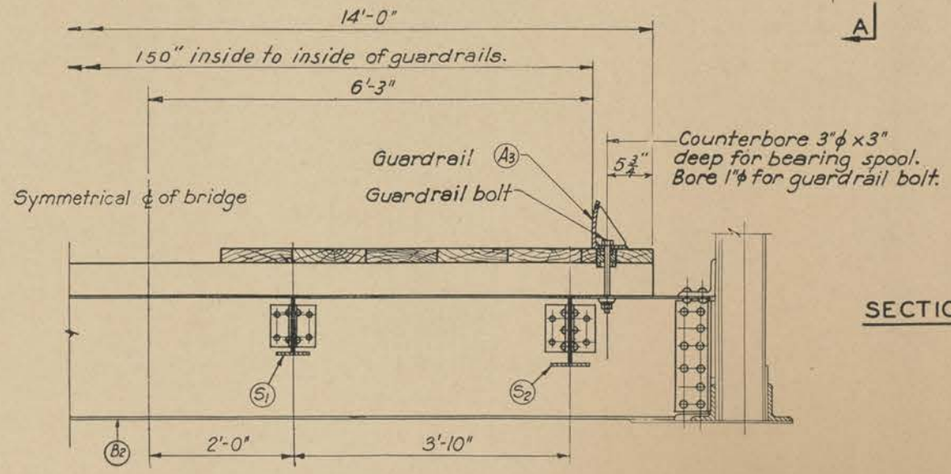
MARK	UNIT	UNIT WEIGHT POUNDS	NO. REQ'D	TOTAL WEIGHT POUNDS
S1	Stringer	242	18	4,356
S2	Stringer	278	18	5,004
	TOTAL STRUCTURAL STEEL			56,927
	Clip, floor	0.71	330	234
	Bolt, erection, rough, 3/4" dia. x 2 1/2", threaded 2 1/4", sq. head, 1 sq. nut	0.74	650	481
	Bolt, structural, ribbed, 3/4" dia. x 1 1/2", buttonhead, 1 hexagonal nut	0.588	40	24
	Bolt, structural, ribbed, 3/4" dia. x 1 11/16", buttonhead, 1 hexagonal nut	0.611	780	477
	Bolt, structural, ribbed, 3/4" dia. x 1 7/8", buttonhead, 1 hexagonal nut	0.634	310	197
	Bolt, structural, ribbed, 3/4" dia. x 2 1/16", buttonhead, 1 hexagonal nut	0.657	70	46
	Bolt, structural, ribbed, 3/4" dia. x 2 1/4", buttonhead, 1 hexagonal nut	0.680	370	252
	Bolt, structural, ribbed, 3/4" dia. x 2 7/16, buttonhead, 1 hexagonal nut	0.703	350	246
	Bolt, structural, ribbed, 3/4" dia. x 2 5/8", buttonhead, 1 hexagonal nut	0.726	80	58
	Bolt, structural, ribbed, 3/4" dia. x 2 13/16", buttonhead, 1 hexagonal nut	0.749	280	210
	Bolt, assembly, guardrail	5.1	186	949
	Spool, bearing	3.7	186	688
	Washers, cut for 3/4" dia. bolts	0.111	975	108
	Nails, 50d, cement-coated	0.0625	11,200	700
	Washer, bevel, upper-chord	0.27	170	46
	Washer, bevel, floor-beam	0.21	50	11
	TOTAL METAL IN BRIDGE SET			61,654
	LUMBER- (MUST BE REQUISITIONED SEPARATELY) / LAMINATED FLOOR SYSTEM	FT. B.M. EACH GROSS QUANT.	NO. REQ'D	TOTAL M.B.M. GROSS QUANT.
	Lumber, rough, 2" x 6" x 14'-0"	14	600	8.400
	Lumber, rough, 2" x 12" x 16'-0"	32	60	1.920
	Lumber, rough, 2" x 12" x 10'-10"	24	12	0.288
	TOTAL LUMBER			10.608

NOTE: One M.B.M. equals one thousand board feet.


SECTION THROUGH UPPER CHORD
CENTER LINE OF SPAN
R-a
Lacing-b
10'-0 1/16"
SECTION THROUGH END POST
R 14"x5/16"x1'-1" bent
Ins Bend line
O.S. Bend line
Stay R 1/4"x5/16"x1'-3"-a
Laang 2 1/4"x5/16"x1'-1 1/16" c.c.-b
13'-5 1/2"
4" Access hole
1-Fill R 8 1/2"x1/2"x1'-1 1/2" NS only
1'-6 3/8"
10"
L0
2-L 6"x4"x1/2"x0'-6"
8"WF 31#x2'-2"
2 L 6"x4"x1/2"x0'-8"
Bearing plate (BP2) see detail. Ship bolted to sole R.
℄ Bearing
EXPANSION END
U1
U2
U3
U4
(U2) 2-8" I.S. 13.75#x20'-0 7/8"
1-Cover R 14"x 5/16"x20'-1"
Fill R 6"x 3/16"x0'-8" both sides Bolt to (U2) for shipment.
(U3) 2-8" I.S. 13.75#x29'-11 11/16"
1-Cover R 14"x5/16"x29'-11 11/16"
(U1a) 2-8" I.S. 13.75#x12'-11 3/16"
1-Cover R 14"x5/16"x11'-6 1/4"
12"
10 13/16"
13'-5 7/16"
13'-5 1/2"
(P1) 8"WF 31#x8'-3"
(W1)
(P2) 8"WF 31#x9'-3"
(W2) 8"WF 24#x11'-9 1/2"
(P3) 8"WF 31#x9'-3"
Gusset R 8"x3/8"x2'-8 1/2" N.S.
Gusset R 8"x3/8"x0'-8 1/2" F.S.
Shop rivets F.S.
Fill R 8"x3/8"x0'-10 1/4" N.S.
Shop rivet to (P2)
2-Inside Spl R 5"x3/16"x2'-0 1/2"
2-Outside Spl L 5 1/2"x5/16"x2'-0 1/2"
Ship bolted to (L1R).
L1
L2
L3
L4
(L1R) 2-L 6"x4"x1/2"x18'-1"
(L2R) 2-L 6"x6"x1/2"x27'-2 1/2"
Bot R-v
(W3a) 2-L 3"x2 1/2"x 1/4"x5'-9"
(W3) 2-L 3"x2 1/2"x 1/4"x12'-0 1/2"
2-R s 14"x 1/4"x1'-3 1/2"
Bot R-v
Bot R-v
Bot R-v
Bot R 7 3/4"x 1/4"x0'-10"-v
8"b.b.s.
2-L 3"x2 1/2"x 1/4"x5'-10 1/2"
2-Spl L 5 1/2"x5 1/2"x 3/8"x1'-11 1/2" Outside
2-Spl R s 5"x 5/16"x1'-11 1/2" Inside
Ship bolted to (L2R)
ELEVATION
10'-0"
Batten R 8"x 5/16"x1'-5"-y
Lateral R 27"x 5/16"x2'-9 1/2"
Bot R-y
1-Spl R 12 1/2"x 5/16"x1'-5" Ship bolted to (L1R).
1-Lat R 23"x 5/16"x2'-3"-x
1-Lat R-x
1-Spl R 21"x 5/16"x1'-11 1/2" F.S.
PLAN OF LOWER CHORD
15'-6" c to c trusses
Slotted holes 1 3/16"x2 1/2" this end only. 1 3/16" holes at fixed end
1'-6"
1'-2"
2 1/2"
℄ TRUSS
Sole R 8"x 3/4" (fin.)x1'-6"
(E3) L 2 1/2"x3"x 1/4"x8'-3 1/4"
(E1) L 2 1/2"x3"x 1/4"x11'-0"
9'-7 3/4"
7 9/32"
R 6"x 5/16"x1'-3"
(E2) L 2 1/2"x3"x 1/4"x8'-3 1/4"
RIVET AND BOLT SYMBOLS
Shop rivet - 2 full heads.
Shop rivet - countersunk and chipped near side.
Open hole for structural ribbed button head field bolt.
1'-6"
Thd 3"
1"ϕ x1'-6" rod - 1 hex nut
ANCHOR BOLT (AB1)
℄ Truss
7"
7"
Bearing ℄
1 1/8" ϕ 4 holes for anchor bolts (AB1)
1'-2"
3"
1'-8"
3 1/2"
1 1/2"
10"
R 10"x 3/4" (fin.)x1'-8"
BEARING PLATE (BP2)
Bolt to sole R for shipment.



PART PLAN OF FLOOR

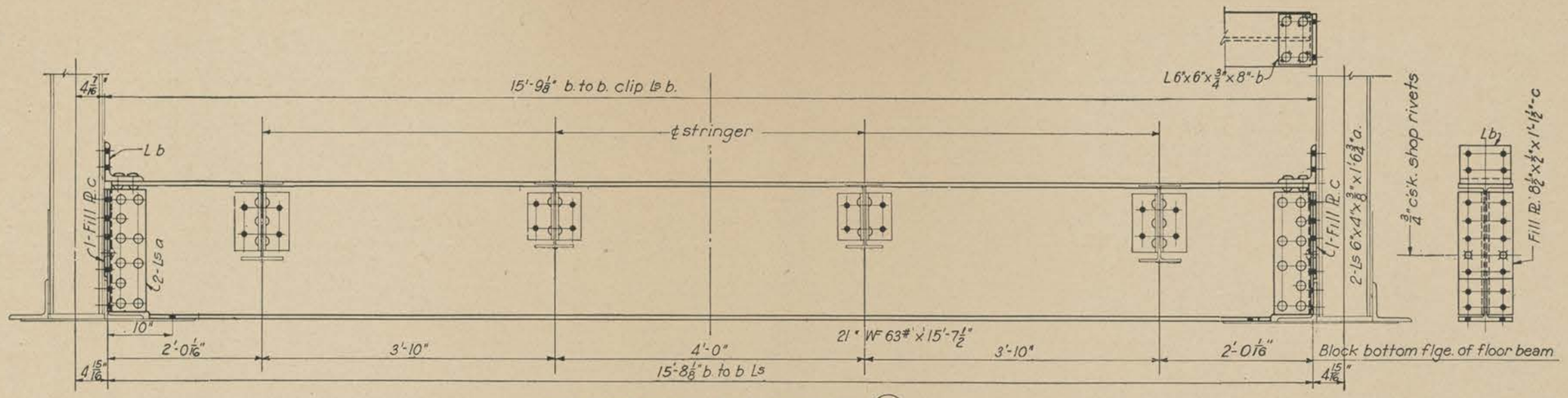


SECTION A-A

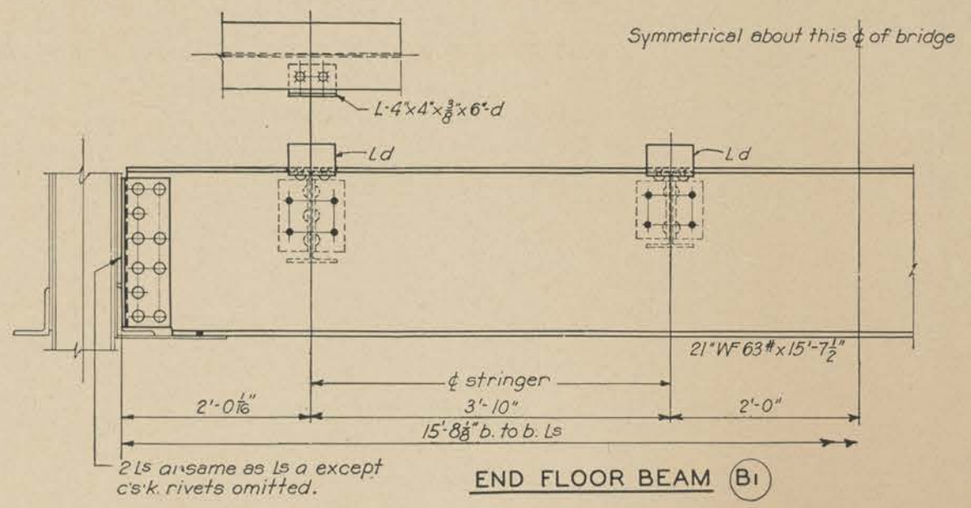
RIVET AND BOLT SYMBOLS



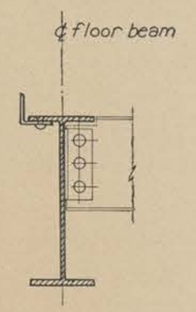
- Shop rivet - 2 full heads.
- Shop rivet - countersunk and chipped near side.
- Shop rivet - countersunk and chipped far side.
- Shop structural ribbed buttonhead bolt.
- Open hole for structural ribbed buttonhead field bolt.
- Open hole for structural ribbed c'sk head field bolt, near side.
- Open hole for structural ribbed c'sk head field bolt, far side.



INTERMEDIATE FLOOR BEAM (B2)

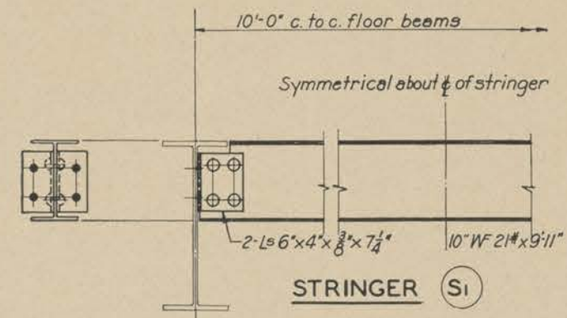


END FLOOR BEAM (B1)

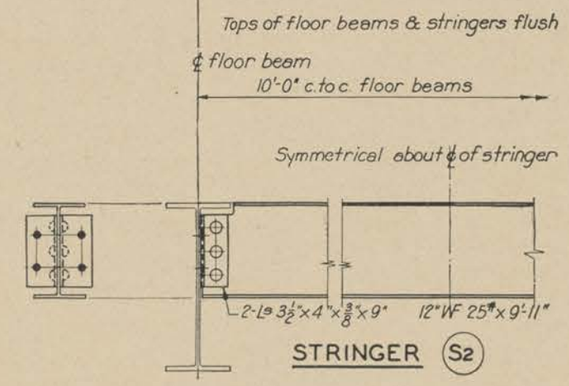


Note:

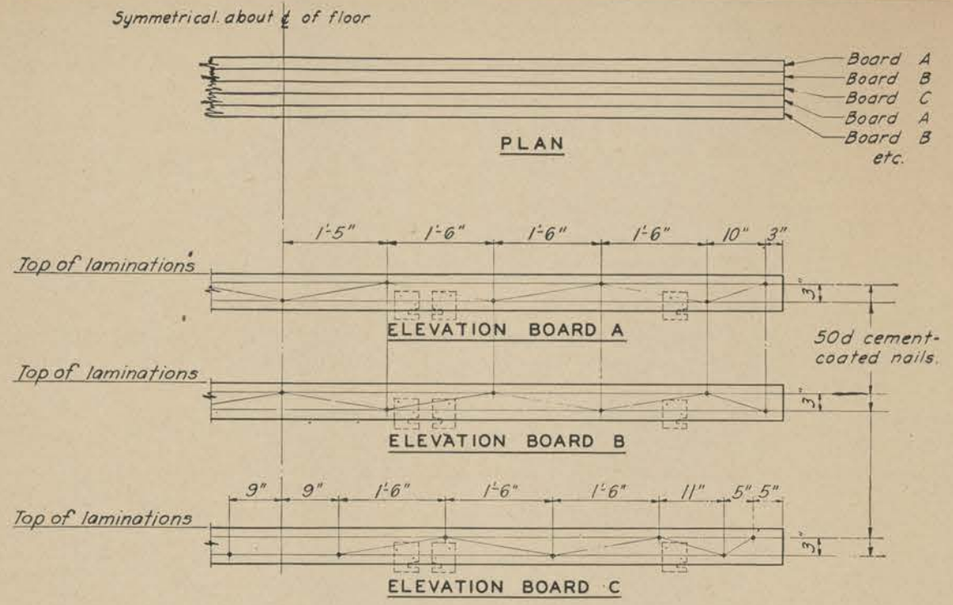
All shop rivets in floor beams and stringers 7/8"℄ except as noted.
All open holes 13/16"℄.
All edge distances 1 1/2" except as shown.



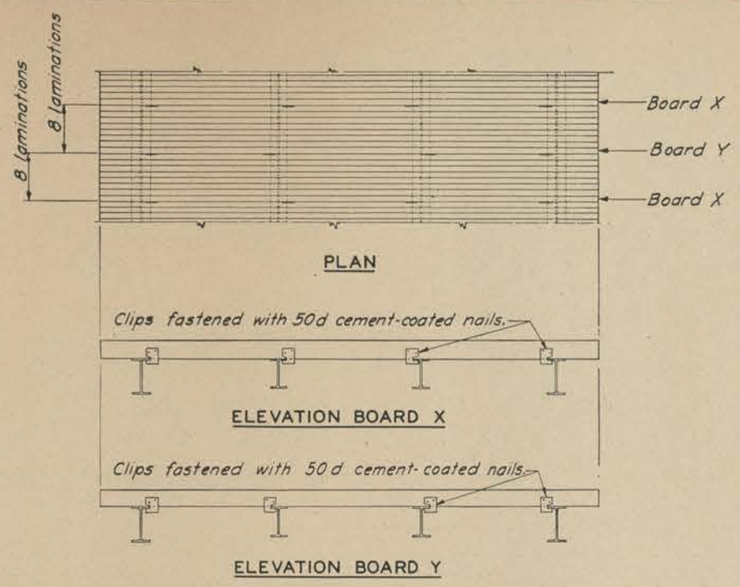
STRINGER (S1)



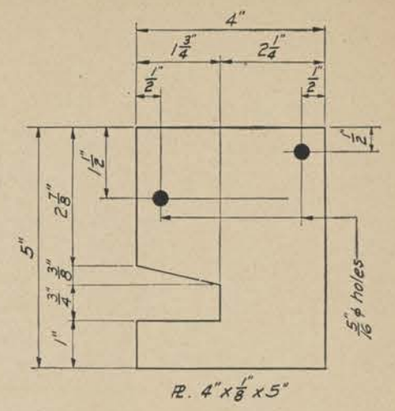
STRINGER (S2)



NAILING SCHEME FOR LAMINATED FLOOR

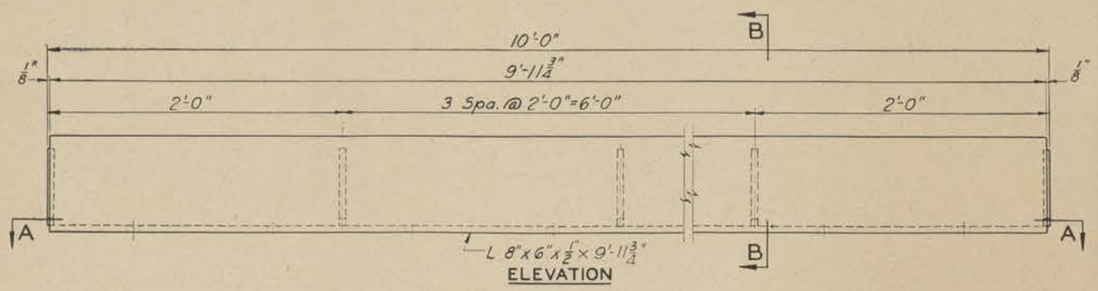


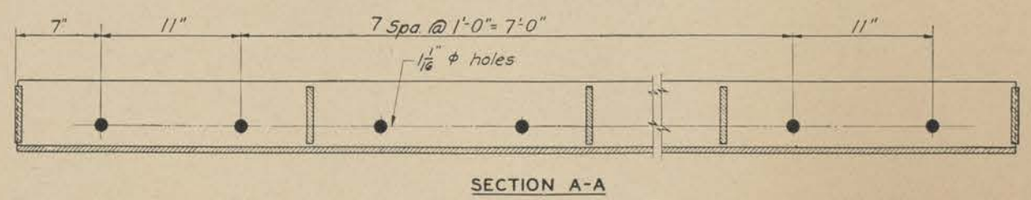
NAILING SCHEME FOR FLOOR CLIPS



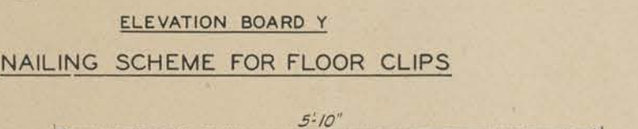
FLOOR CLIP

Galvanize after fabrication.

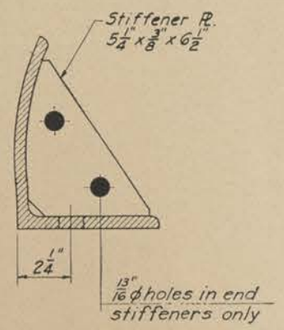


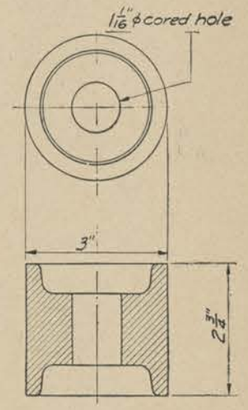


GUARDRAIL (A3)



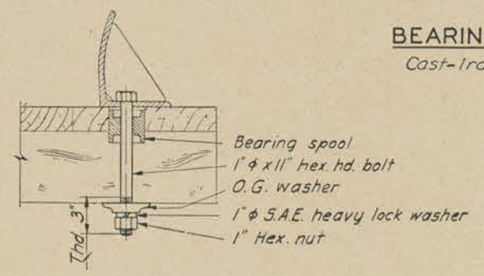
PROTECTION ANGLE (A2)



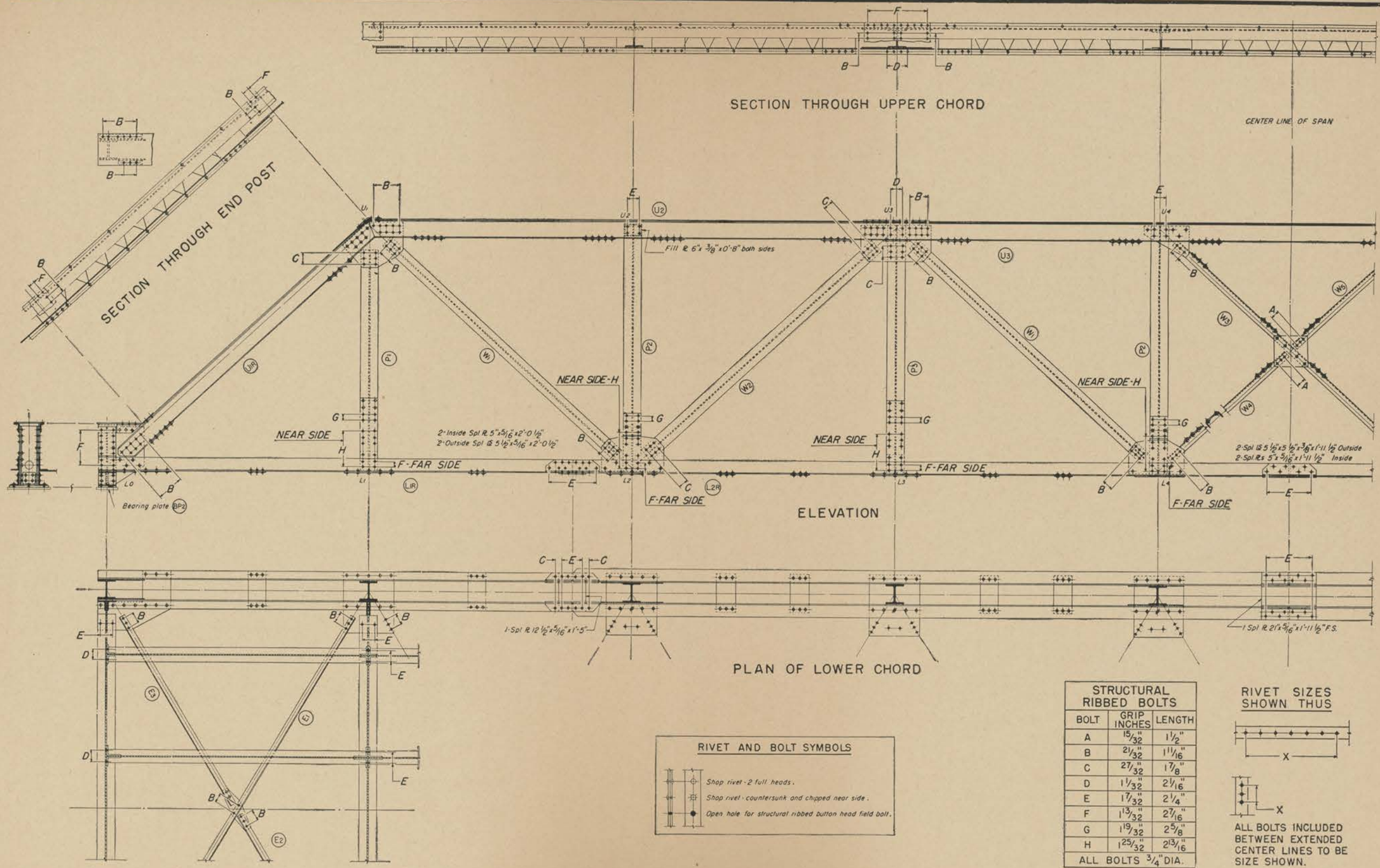


BEARING SPOOL

Cast-Iron, class 20



GUARDRAIL BOLT



RIVET AND BOLT SYMBOLS

Shop rivet - 2 full heads.
Shop rivet - countersunk and chipped near side.
Open hole for structural ribbed button head field bolt.

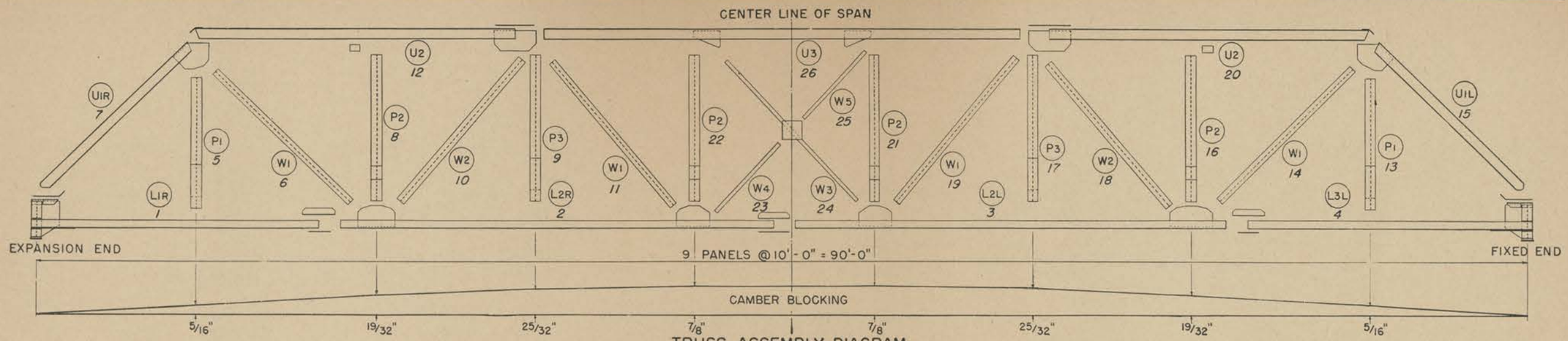
STRUCTURAL RIBBED BOLTS		
BOLT	GRIP INCHES	LENGTH
A	15/32"	1 1/2"
B	21/32"	1 11/16"
C	27/32"	1 7/8"
D	1 1/32"	2 1/16"
E	1 7/32"	2 1/4"
F	1 13/32"	2 7/16"
G	1 19/32"	2 5/8"
H	1 25/32"	2 13/16"
ALL BOLTS 3/4" DIA.		

RIVET SIZES SHOWN THUS

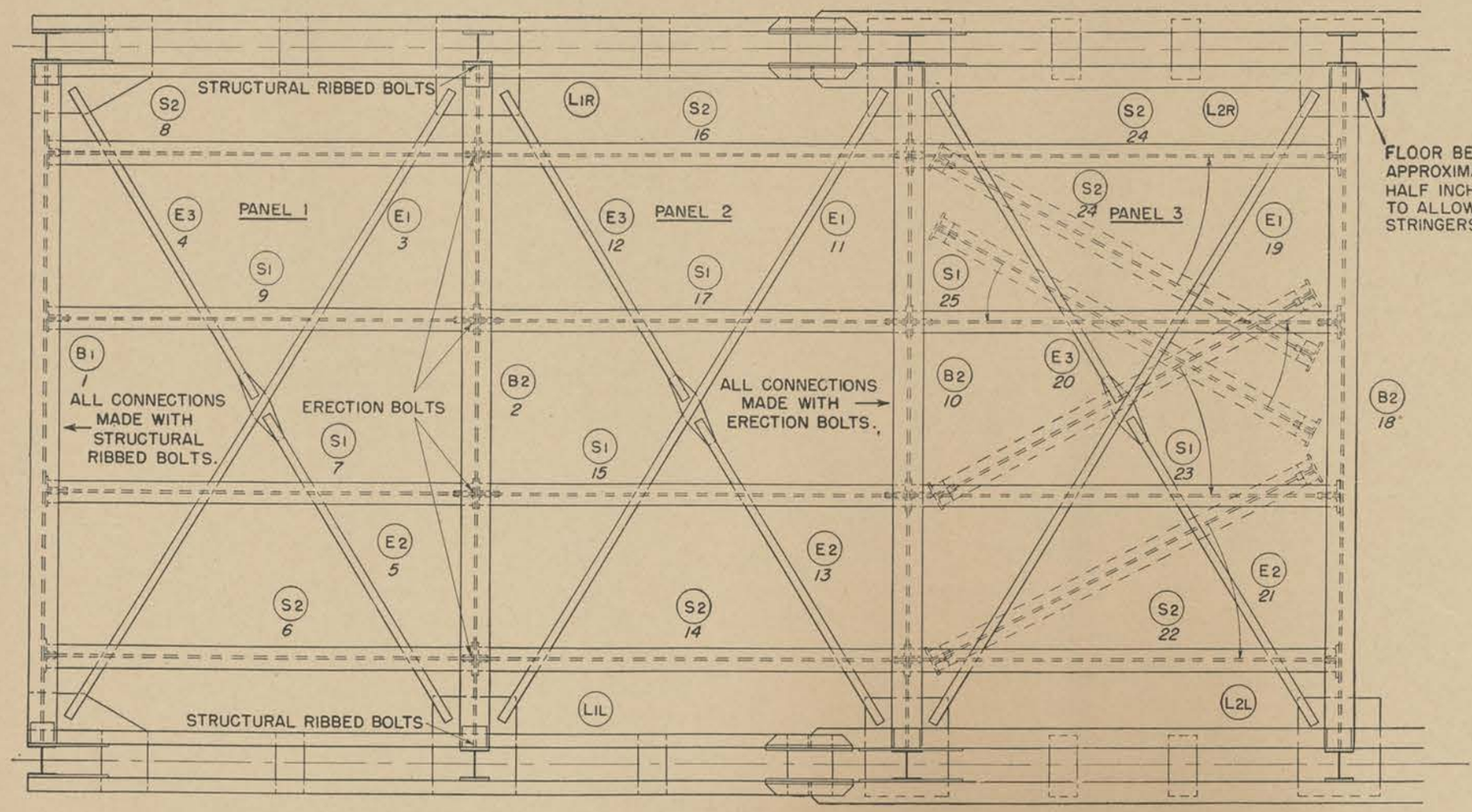
X

X

ALL BOLTS INCLUDED BETWEEN EXTENDED CENTER LINES TO BE SIZE SHOWN.



TRUSS ASSEMBLY DIAGRAM



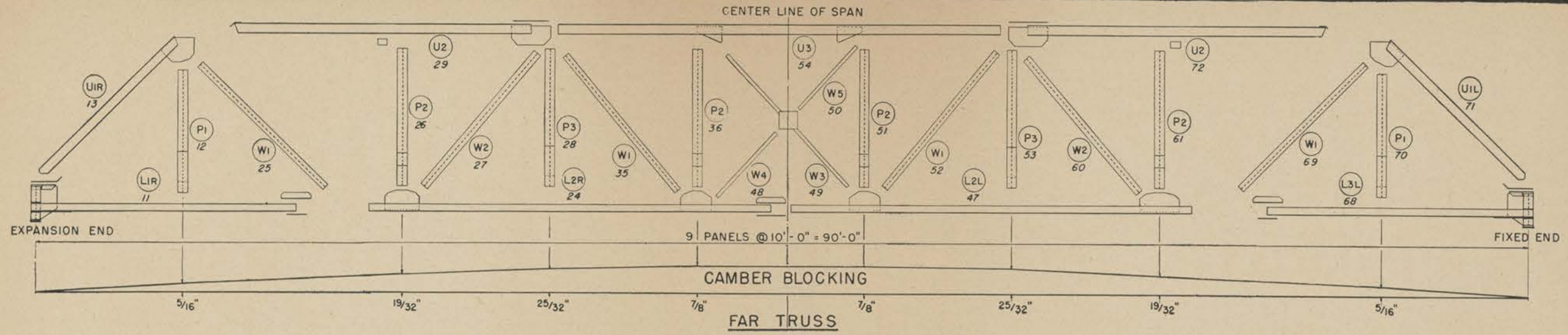
FLOOR ERECTION DIAGRAM

(ENLARGED)

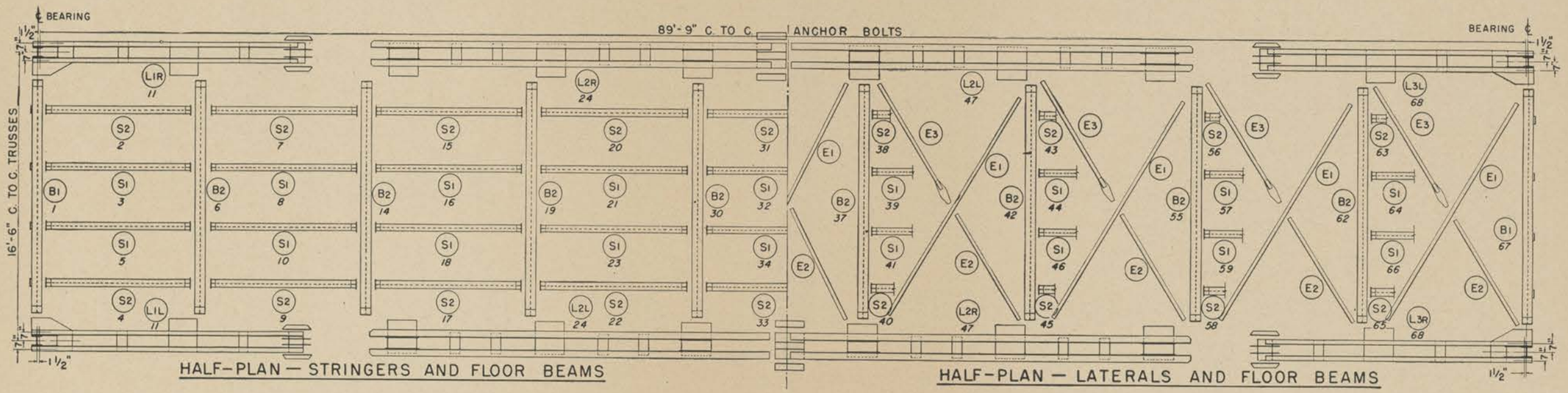
NOTE: NUMBERS UNDER THE CIRCLES INDICATE CONSECUTIVE ORDER FOR PLACING MEMBERS WHEN TRUSSES ARE ASSEMBLED AND LAUNCHED SEPARATELY AND FLOOR IS ERECTED IN PLACE. ORDER OF ERECTION IN FLOOR PANELS SHOWN CONTINUES FOR ENTIRE SPAN.

NOTE: THE METHOD FOR PLACING STRINGERS SHOWN IN PANEL 3 APPLIES TO ALL PANELS.

NOTE: AFTER STRINGERS IN PANEL 3 HAVE BEEN PLACED AND CONNECTED WITH ERECTION BOLTS, ALL CONNECTIONS IN PANEL 1 ARE MADE WITH STRUCTURAL RIBBED BOLTS. THIS PROCEDURE IS TO BE FOLLOWED IN ALL SUBSEQUENT PANELS.

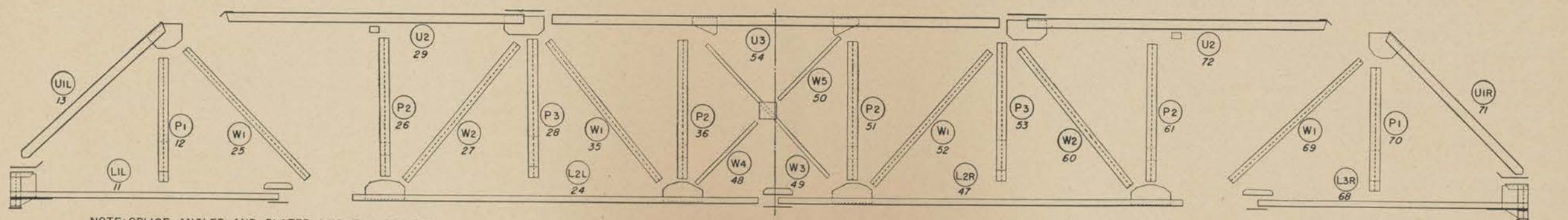


FAR TRUSS



HALF-PLAN — STRINGERS AND FLOOR BEAMS

HALF-PLAN — LATERALS AND FLOOR BEAMS

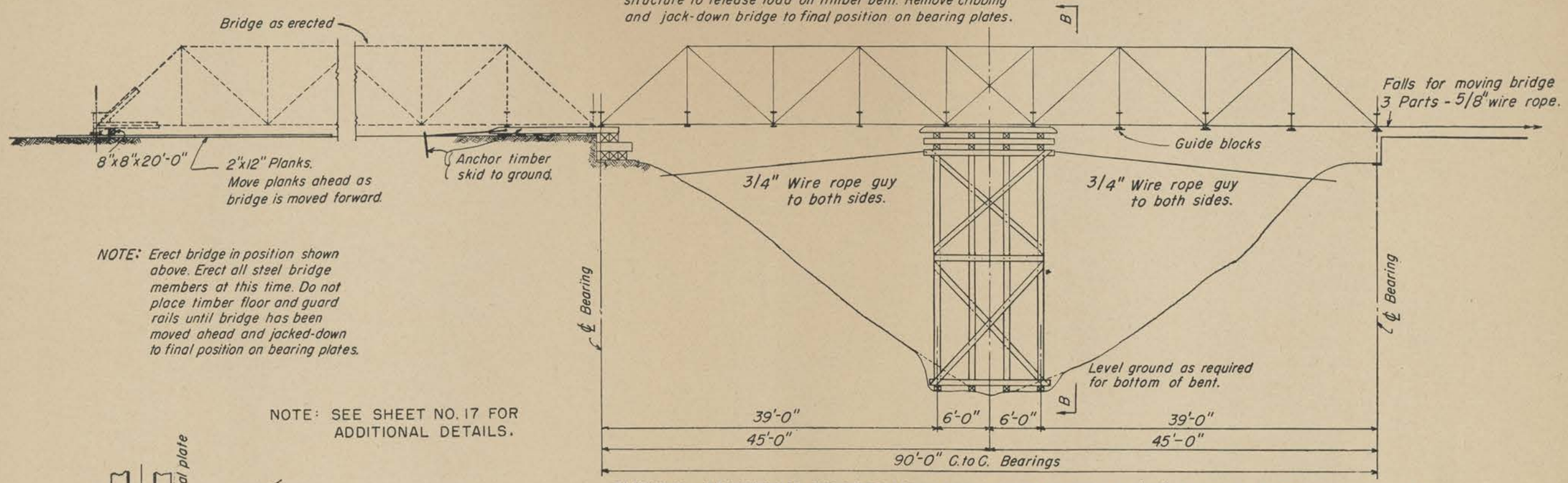


NEAR TRUSS

NOTE: SPLICE ANGLES AND PLATES, AND FILL PLATES ARE BOLTED TO MEMBERS FOR SHIPMENT.

NOTE: THE NUMBERS SHOWN UNDER THE CIRCLES INDICATE THE CONSECUTIVE ORDER FOR PLACING MEMBERS WHEN THE ENTIRE BRIDGE IS ASSEMBLED PRIOR TO LAUNCHING.

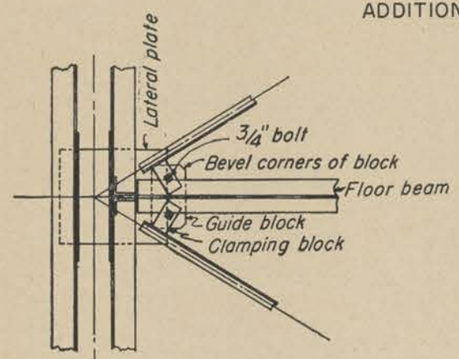
NOTE: When bridge has been moved to a position with the ends directly above their respective bearing plates, jack up structure to release load on timber bent. Remove cribbing and jack-down bridge to final position on bearing plates.



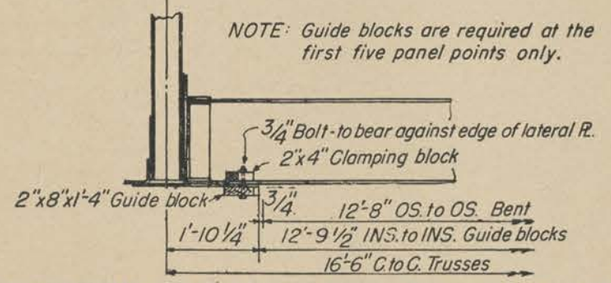
TYPICAL ERECTION PROCEDURE FOR ASSEMBLED 90'-0" TRUSS SPAN

NOTE: Erect bridge in position shown above. Erect all steel bridge members at this time. Do not place timber floor and guard rails until bridge has been moved ahead and jacked-down to final position on bearing plates.

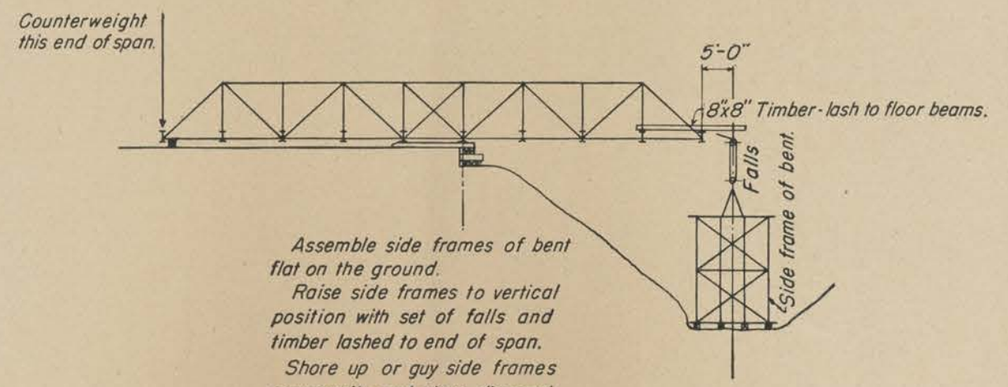
NOTE: SEE SHEET NO. 17 FOR ADDITIONAL DETAILS.



NOTE: Guide blocks are required at the first five panel points only.



CONNECTION OF GUIDE BLOCKS TO BOTTOM LATERAL PLATES

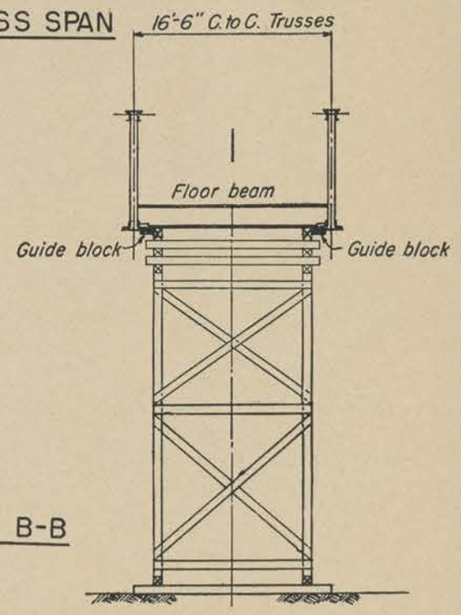


Assemble side frames of bent flat on the ground.

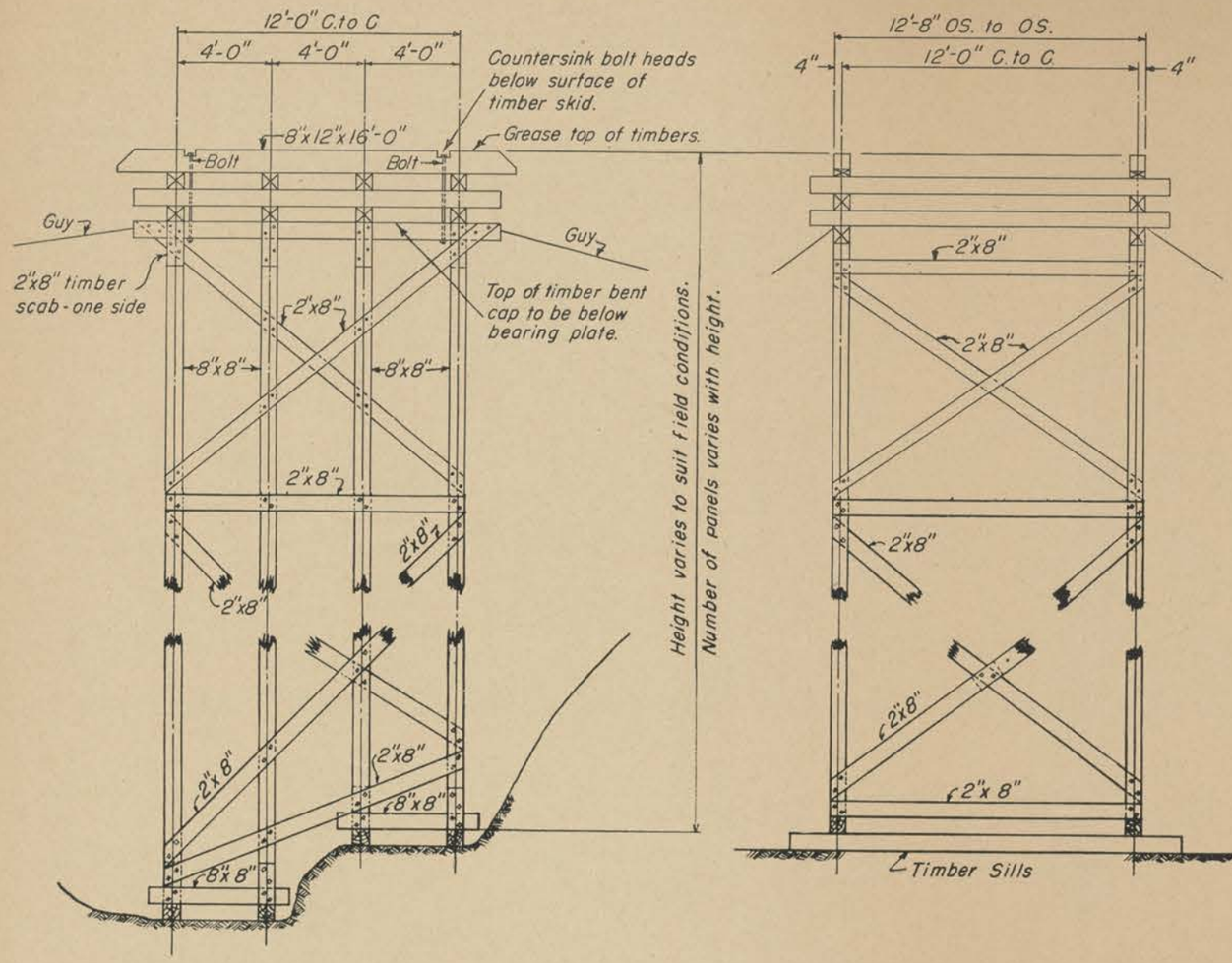
Raise side frames to vertical position with set of falls and timber lashed to end of span.

Shore up or guy side frames temporarily and place diagonal and horizontal timber bracing between frames.

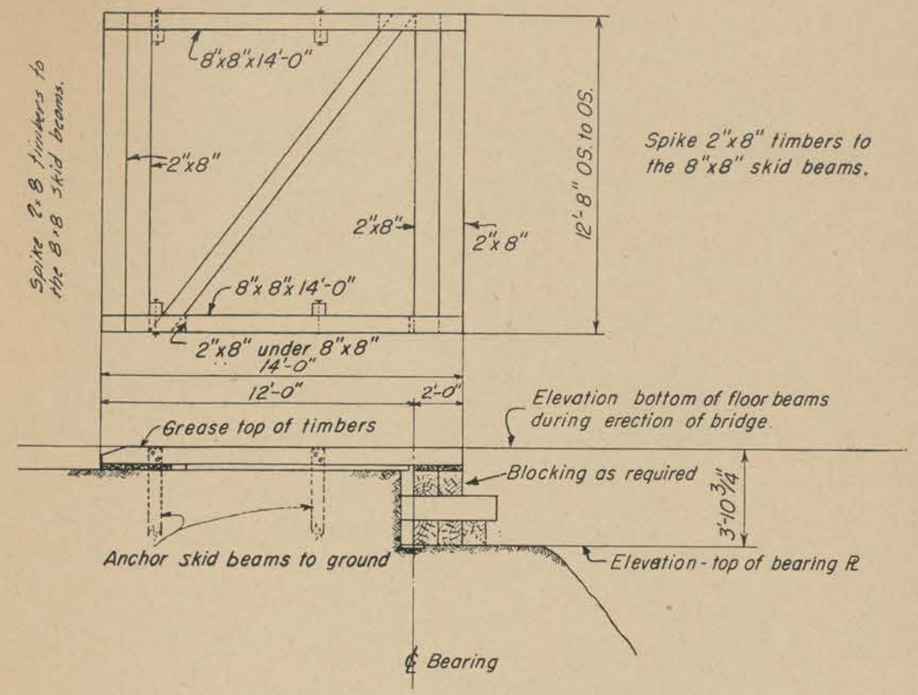
SCHEME FOR ERECTING TIMBER BENT



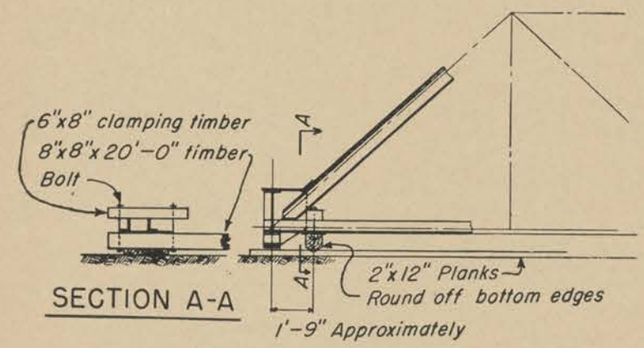
VIEW B-B



TYPICAL DETAIL OF TIMBER BENT



TIMBER SKID AT ABUTMENT



SECTION A-A

BLOCKING AT END OF TRUSS

SPECIAL NOTE

The center support can be built without cribbing. In that case it will be removed by sawing trestle supporting members and pulling the trestle down.

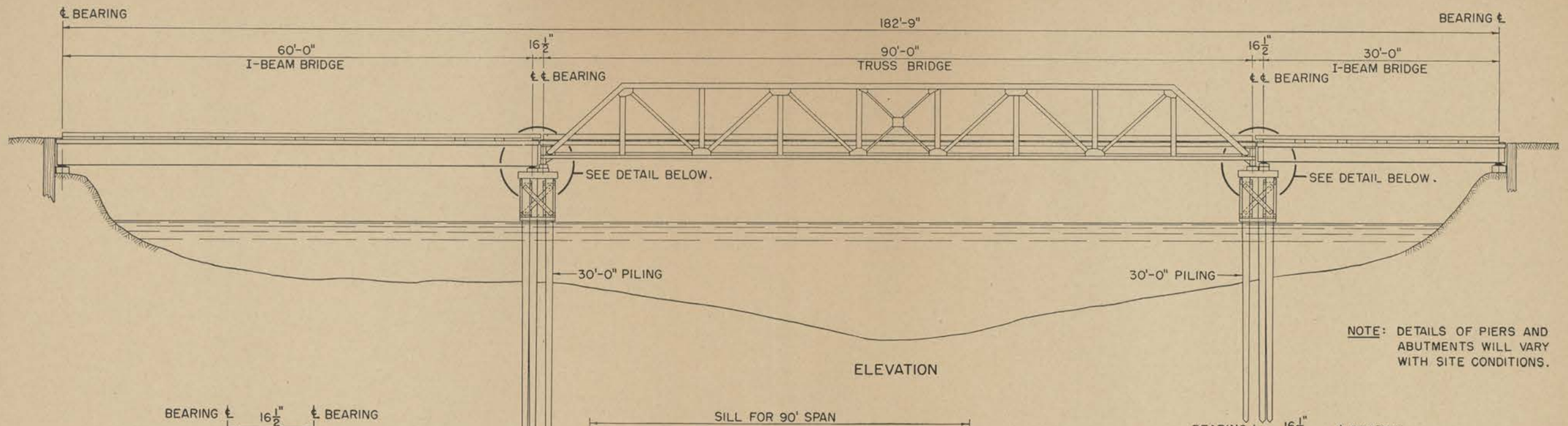
NOTES FOR TIMBER BENT

Height of bent and number of panels will vary to suit field conditions.

Slope of diagonal bracing to be approx. 12 :12. Vary slightly as required.

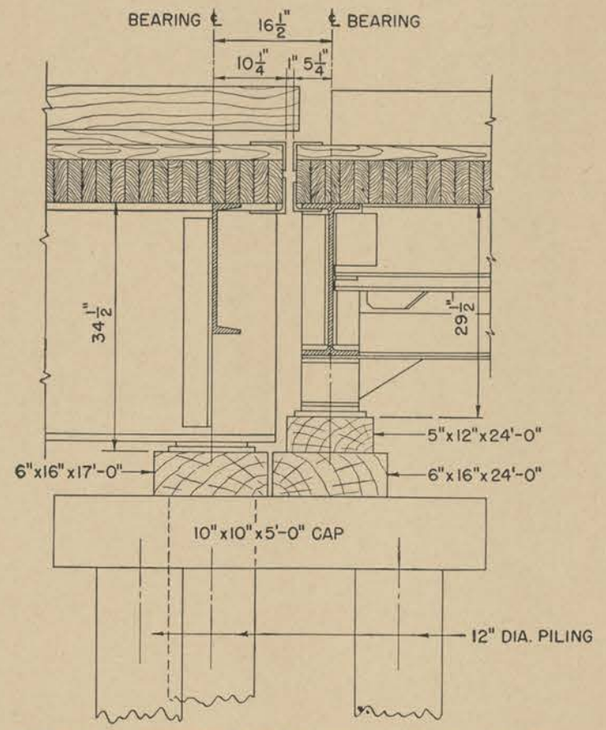
Unbraced length of 8"x 8" bent legs is not to exceed 14'-0".

Frame bottom of bent so a minimum amount of excavation will be required to level timber sills.

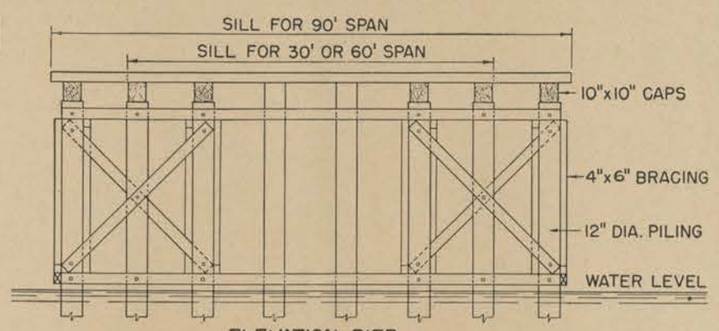


ELEVATION

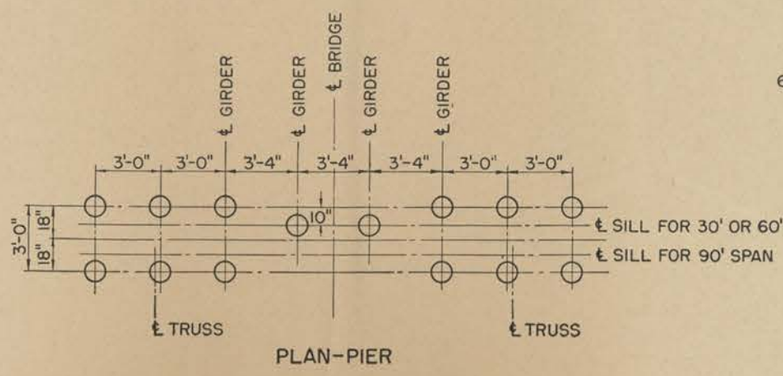
NOTE: DETAILS OF PIERS AND ABUTMENTS WILL VARY WITH SITE CONDITIONS.



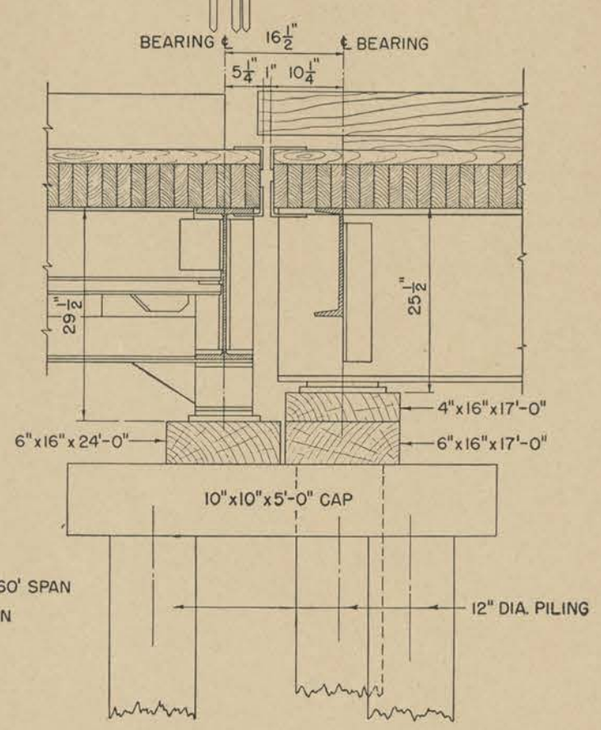
DETAIL AT JUNCTION OF 60-AND 90-FOOT SPANS



ELEVATION-PIER



PLAN-PIER



DETAIL AT JUNCTION OF 90-AND 30-FOOT SPANS

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