Concrete Slab Bridges

As with most modern bridge forms, the slab bridge hearkens back to precursors from the remote past. In the case of the slab, the origins are found in prehistory, as in the ancient "clapper" bridges of Dartmoor and Dartmeet, England (Whitney 1983:52). The form was subsequently abandoned at an early period because separate stones rarely have the tensile strength needed for this type of construction (Whitney 1983:213). Nonreinforced concrete suffers from the same weakness, but the advent of reinforced concrete with its increased tensile capabilities allowed the reintroduction of the slab span around the turn of the twentieth century.

The reinforced concrete slab soon became one of the most popular and expedient types of small highway bridges (Figure 18). Bridge engineering treatises such as H. Grattan Tyrrell's 1909 *Concrete Bridges and Culverts for Both Railroads and Highways* (Tyrrell 1909) and J.A.L. Waddell's 1916 *Bridge Engineering* described the versatile usefulness of reinforced concrete slabs for single spans as well as multiple spans (Waddell 1916). In his 1916 text *Concrete Construction for Rural Communities*, Roy Seaton listed the slab span as one of the principal types of small bridges and recommended slab usage for spans up to 20 feet (Seaton 1916:207). Popular trade journals such as *Public Works* found that "spans up to 20 or 30 feet, or sometimes even longer, may be made with. . .concrete floor slabs" (*Public Works* 1916:353). By 1924, the standard text *Reinforced Concrete and Masonry Structures* noted that slab bridges could be built in multiple spans as concrete pile trestles, pier trestles, and trestles with framed bents (Hool and Kinne 1924).

At an early stage, slab spans became subject to a variation that was essentially a through girder design, in which the slab was reinforced by the use of parapets functioning as girders. Houghton's 1912 *Concrete Bridges, Culverts and Sewers* observed that "where the parapet and railings are reinforced by side girders, connected with ample reinforcement in the square pilasters, at each end of the bridge, a large portion of the loading is carried to the abutment by these girders; which serve a double purpose, as reinforcement and also as a parapet" (Houghton 1912:45-46). By 1924, Walter S. Todd, in George Hool and W.S. Kinne's text *Reinforced Concrete and Masonry Structures*, included a diagram for a 24-foot reinforced concrete slab bridge, but also observed that a through girder type bridge, in which "the loads from the roadway are carried to the girders through the floor slab; and the girders in turn carry the loads to the abutments," was satisfactory for spans "from about 30 to 60 ft." (Hool and Kinne 1924:399, 407).

This type of through girder structure with a solid slab continued to be illustrated in design texts well into the 1930s (Figure 19). The 1939 text *Reinforced-Concrete Bridges* noted that "the simplest design of floor construction for a through bridge consists of a slab spanning between the main girders."

Observing that "such arrangement is economical only for narrow bridges" because "the dead load would be excessive" in wider crossings, the text's authors included diagrams for a typical "slab spanning between girders" (Taylor et al. 1939:94).

A variation of the slab design that was developed in the 1930s was the continuous slab bridge, in which a single slab extends over several spans. By 1939, structures with spans of slab up to 70 feet had been designed. Although the design has some advantages, including simpler arrangement of reinforcement and better distribution of lateral and longitudinal loading, the greater cost of materials and larger dead loads reduced its advantages over the simply supported multiple-span slab bridge (Taylor et al. 1939:35).

In both its simple and continuous span forms, the reinforced concrete slab span has continued to be used for highway bridges.

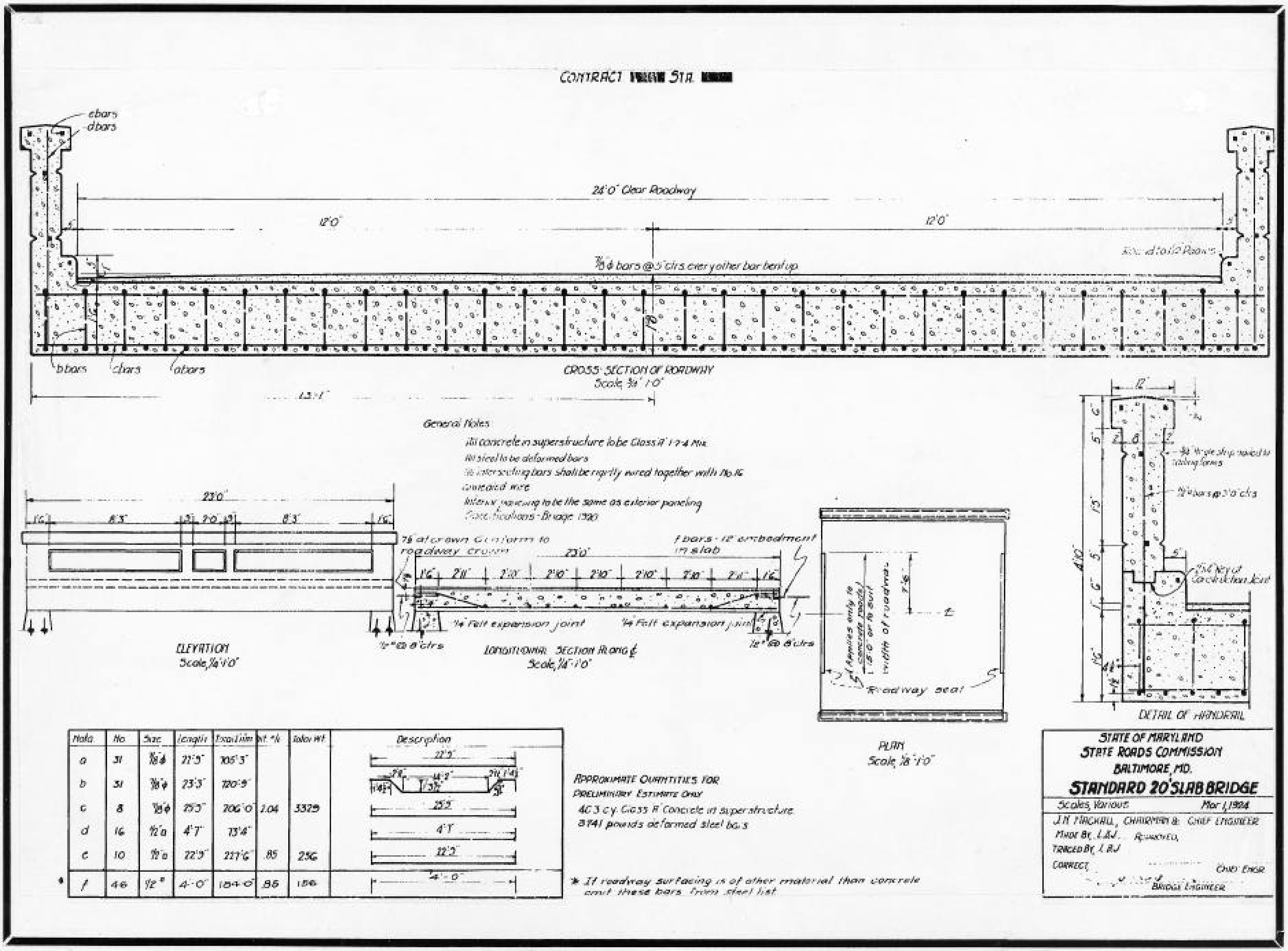
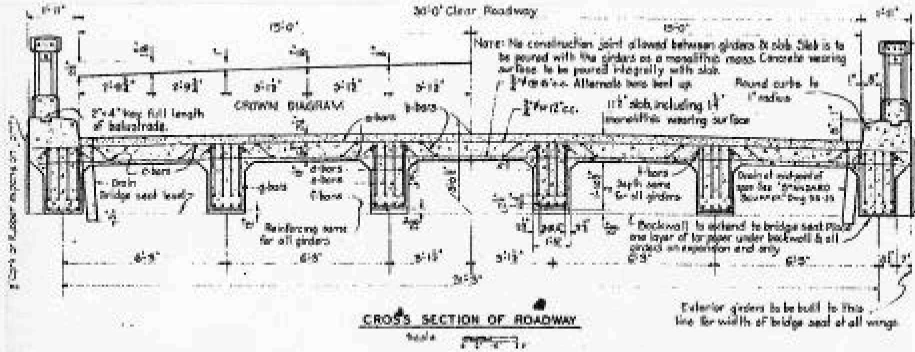
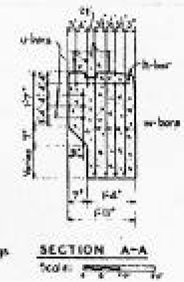
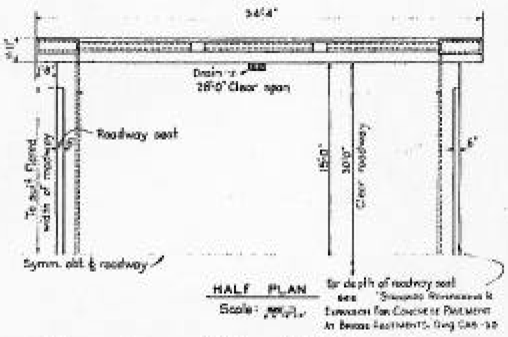


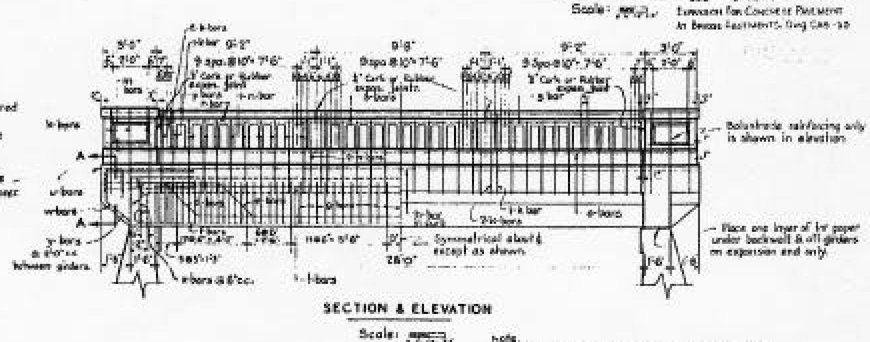
FIGURE 18: **Typical Flat Slab Concrete Bridge**

SOURCE: Maryland State Roads Commission 1924









Mark	No.	Size	Length	Total Length	Wt. #/Ft.	Total Weight	Detail
a	60	¾"	33'-3"	1995'-0"	1.52	3032	Straight
b	30	¾"	35'-9"	1072'-6"	1.52	1630	[illegible]
c	20	½"	29'-8"	593'-4"	.86	510	Straight
d	12	1¼"	33'-11"	407'-0"	5.37	2188	[illegible]
e	12	1¼"	33'-11"	407'-0"	5.37	2186	[illegible]
f	24	1¼"	33'-4"	800'-0"	5.37	4296	[illegible]
g	426	⅝"	7'-3"	3088'-6"	.68	2100	[illegible]
h	2	½"	34'-0"	68'-0"	.86	58	Straight
k	42	½"	4'-7"	192'-6"	.86	166	Straight
m	32	½"	2'-10"	90'-8"	.86	78	Straight
n	66	½"	4'-2"	275'-0"	.86	237	Straight
o	4	½"	27'-6"	110'-0"	.86	95	Straight
p	8	½"	8'-8"	69'-4"	.86	60	Straight
r	2	½"	8'-4"	16'-8"	.85	14	Straight
s	8	½"	9'-4"	74'-8"	.86	64	Straight
t	12	⅜"	28'-4"	340'-0"	.38	129	Straight
u	20	¾"	5'-10"	116'-8"	1.52	177	[illegible]
w	16	¾"	8'-9"	140'-0"	1.52	213	[illegible]
x	8	½"	32'-3"	258'-0"	.86	222	Straight
y	30	½"	2'-6"	75'-0"	.86	65	Straight
						17,518#	

Note: Top surface of slab to be finished & cured as described in latest S.R.C. Specifications for finishing and curing "One Course Plain Cement Concrete Pavement."

Provide standard eye bolt for wire rope guard fence where directed by the Engineer. See "STANDARD EYE BOLT DETAILS," Drawing SC3-33

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
LOADING: H20, with double (L.L.+impact)
UNIT STRESSES: Fc = 1200#/" — Fs = 24,000#/"
CONCRETE: All concrete in superstructure to be "Class A"
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior & exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed
EXPANSION JOINTS: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" or "Class A Concrete Balustrade"
DRAINS: Cost of furnishing & placing drains to be included in the contract unit price for "Class A Concrete."

APPROXIMATE QUANTITIES IN SUPERSTRUCTURE. (for preliminary estimate only)
64.20 Cu. yd. "Class A Concrete," excluding balustrades.
5.53 Cu. yd. "Class A Concrete" in balustrades.
17,518 Lb. Deformed Steel Bars.

Note: For section and additional balustrade details see "STANDARD BALUSTRADE DETAILS" Drawing SB-33

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 28'-0" CONCRETE GIRDER BRIDGE
SUPERSTRUCTURE DETAILS

SCALE: AS NOTED — MARCH, 1933

REVISIONS: Revised April 1934

MADE BY: J.O.N.
TRACED BY: J.O.N.
CHECKED BY: A.L.G.
CORRECT: 5/8/33 — BRIDGE ENGINEER
APPROVED: 5/19, 1933 — CHIEF ENGINEER

CG-28-33

FIGURE 19: Typical Concrete Girder Bridge

SOURCE: Maryland State Roads Commission 1933