Chapter 7

Bridging

RIVER CROSSING

Operations

River crossing operations may be hasty, deliberate, or retrograde. Deliberate crossings are always conducted in three phases: assault, rafting (Table 7-1), and bridging.

Table 7-1. Planning factors for rafting operations

RIVER WIDTH M (FT)	MINUTES PER ROUND TRIP	MAXIMUM NUMBER OF RAFTS PER CENTERLINE
75 (246)	7	1
100 (328)	8	1
125 (410)	9	1
150 (492)	10	2
225 (738)	12	2
300 (984)	16	3-5
450 (1.476)	22	5-7

NOTES: 1. This table provides apprximate crossing times for LTR, Ribbon, M4T6. and Class 60 rafts in currents of 0.5MPS (0-1.5 FPS).

2. All round trip times include the time required to load and unload the rafts.
3. Increase crossing times by 50 percent at night.
4. Interpolate crossing times as necessary.

[redacted]

Equipment

Assault crossing

Table 7-2. Assault crossing equipment

EQUIPMENT	ALLOCATION	TRANSPORTATION	CAPABILITIES	ASSY/PROPULSION	REMARKS/LIMITATIONS
Pneumatic 15-man assault boat	J series TOE provides: • 18/Div Eng Bn • 27/Corps Float Bridge Co • 9/Sep Bde Eng Co	• 20 deflated boats per 2½-ton truck • Inflated boat is an 8-man carry • Deflated boat weighs 250 lb.	Carries: • 12 Inf and 3 Eng w/paddles or • 12 Inf and 2 Eng w/OBM or • 3,375 lb of equipment	• Inflation time is 5-10 minutes with pumps • Paddled speed is 1.5MPS (5 FPS) • Speed with OBM is 4.6MPS (15 FPS)	• Max current velocity: w/paddle - 1.5MPS (5 FPS) w/OBM - 3.5MPS (11 FPS) • 3 pumps, 11 paddles per boat • OBMs must be requested separately
Pneumatic 3-man reconnaissance boat	J series TOE provides: • 3/Cbt Eng Co • 10 Corps Float Bridge Co (L Series) • 18/Div Ribbon Co	• Carried by back-pack (1-man carry) • Boat and backpack weigh 37 lb	Carries: • 3 soldiers with equipment or • 600 lb of equipment	• Inflation time is 5 minutes with a pump • Paddle speed is 1.0MPS (3 FPS)	• Max current velocity 1.5MPS (5 FPS) • 1 pump, 3 paddles per boat • No provisions for OBMs
Armored personnel carrier (APC)	J series TOE provides: • 12/Eng Co of Div Eng Bn • 1/Inf Co (Mech) (BIFV) • 14/Inf Co (Mech) (M113)	• Self-propelled • Class 13 vehicle	Carries: • 12 soldiers with equipment	• Preparation time for swimming is 10 minutes • Track propulsion in the water • Swim speed is 1.6MPS (5.3 FPS) • Can ford up to 1.5M (5 ft)	• Max current velocity: 1.5MPS (5 FPS) • Drift (M) = $\frac{\text{Current (MPS)}}{1.6}$ x river width (M) • Drift (ft) = $\frac{\text{Current (FPS)}}{5.3}$ x river width (ft)

Table 7-2. Assault crossing equipment (continued)

EQUIPMENT	ALLOCATION	TRANSPORTATION	CAPABILITIES	ASSY/PROPULSION	REMARKS/LIMITATIONS
Bradley infantry fighting vehicle (BIFV)	J series TOE provides: • 13/Inf Co (Mech) (BIFV) • 12/Cav Troop of an ACR • 19/Cav Troop of an Div Cav Sqdn	• Self-propelled • Class 25 vehicle	Carries • 10 soldiers with equipment	• Preparation time for swimming is 18 minutes	• Max current velocity: 0.9MPS (3 FPS) • Drift (M) = $\frac{\text{Current (MPS)}}{2}$ x river width (M) • Drift (ft) = $\frac{\text{Current (FPS)}}{6.6}$ x river width (ft)
Armored vehicle launched bridge (AVLB)	Engr Bn of Heavy Div: • 16 launchers • 16 bridges Engr Co of Arm/Inf (M) Sep Bde: • 3 launchers • 3 bridges	Bridge carried on launcher (modified) M48A5 or M60A1 chassis) Bridge weighs 15T 20T crane transfers to launcher in 20-30 minutes	Class 60 vehicle One vehicle crossing at a time AVLB (19.2M-63 ft) spans: • 18.3M (60 ft) using prepared abutments or • 17M (57 ft) using unprepared abutments	Launched in 2-5 min by buttoned-up 2-man crew Retrieved from either end: one soldier exposed: guide and connect Allow 9.0M (3 ft) bearing for an unprepared abutment: 0.5M (1.5 ft) for a prepared abutment	M48A2 requires gas while M60 and M48A5 are diesel Scissors launch requires 10M (32.8 ft) overhead clearance Max launch slope • Uphill 2.7M (9 ft) • Downhill 2.7M (9 ft) • Sideslope 0.3M (1 ft) AVLB fords 1.2M (4 ft)

Bridging/Rafting

Boats. The current standard is the Bridge Erection Boat Shallow Draft (BEB-SD). Also still in use is the older 27-foot Bridge Erection Boat (BEB). Refer to TM 5-210 for additional information.

Table 7-3. Bridge erection boats

EQUIPMENT	ALLOCATION	TRANSPORTATION	CAPABILITIES	ASSY/PROPULSION	REMARKS/LIMITATIONS
Bridge erection boat - shallow draft (BEB-SD)	J series TOE provides: • 12/Div Ribbon Company • 14/Corps Ribbon Company • 10 Corps Float Bridge Company (M4T6)	Carried by: • One 5-ton bridge truck w/ cradle or • One medium lift helicopter Boat weighs 8,800 lb	Carries a 3-man crew and: • 12 soldiers with equipment or • 4,400 lb of equipment	• Launch time from the cradle is 5 minutes • Maximum speed is 25 knots	Draft • For normal operation—22 in • When fully loaded—26 in • For launch from the cradle—48 in
27-foot bridge erection boat (BEB)	Same as above Note: Units will normally have either the BEB-SD or the 27-ft BEB	Carried by: • One 5-ton bridge truck w/cradle or • One 2½-ton truck w/pole trailer or • One medium lift helicopter when procedures are certified	Carries a 3-man crew and: • 9 soldiers with equipment or • 3,000 lb of equipment	• Launch time from the cradle is 5 minutes • Launch time from the 2½-ton truck when using a crane or wrecker is 30 minutes • Maximum speed is 15 knots	Draft is 40 in

Improved Float Bridge (Ribbon). The Ribbon major components are the interior bay which weighs 12,000 pounds (5,443 kilograms) and the ramp bay which weighs 11,700 pounds (5,307 kilograms). Refer to TM 5-5420-209-12 for additional information.

Allocation.

Table 7-4. Allocation of Ribbon bridge (J series TOE)

	DIVISIONAL RIBBON COMPANY	CORPS RIBBON COMPANY
Number of bridge platoons	2	2
Number of interior bays	20	30
Number of ramp bays	8	12
Number of bridge erection boats	12	14
Longest bridge that can be constructed M (ft)	148 (485)	215 (705)

Methods of launch from the 5-ton bridge truck.

Table 7-5. Launch restrictions

	FREE LAUNCH	CONTROLLED LAUNCH	HIGH BANK LAUNCH
Minimum depth of water required CM (in)	Ramp bay 112 (44) Interior 92 (36) bay (Note 1)	76 (30) (Note 2)	76 (30) (Note 2)
Bank height restrictions M (ft)	0-1.5 (0-5)	0	1.5 - 8.5 (5 - 28)
Bank slope restrictions	0 - 30%	0 - 0%	Level ground unless the front of the truck is restrained

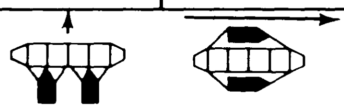
NOTE:

1. The launch is based upon a 10 percent slope with the transporter backed into the water The required water depth for a 30 percent slope with a 5 foot bank height is 183CM (72 in). Interpolate between these values when needed.
2. This is recommended water depth launch could technically be conducted in 43CM (17 in) of water.

Raft design.

Table 7-6. Ribbon raft design

CAPABILITIES	ASSEMBLY TIME	LOAD SPACE	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS								
Raft:	(Increase by 50% at night)	M (FT)		0.9 0-3	1.2 4	1.5 5	1.75 6	2 7	2.5 8	2.7 9	3 10
- 3 bay (2 ramps/1 interior)	8 min	6.7 (22)	L C	45 45	45 45	45 35	40 25	40 15	35 10	30 0	25 0
- 4 bay (2 ramps/2 interiors)	12 min	13 (44)	L C	70 60	70 60	70 60	60 *55	60 *40	60 *30	55 *15	45 0
- 5 bay (2 ramps/3 interiors)	15 min	20.1 (66)	L C	75 75	75 70	75 70	70 *70	70 *60	70 *50	60 *25	60 0
- 6 bay	20 min	26.8 (88)	L	W96/ T80	96/ 80	96/ 80	96/ 70	96/ 70	96/ 70	70/ 70	70 70
(2 ramps/4 interiors)			C	W96/ T75	96/ 70	96/ 70	*70/ 70	*70/ 70	*55/ 55	*30/ 30	0



CONVENTIONAL LONGITUDINAL

NOTES: 1. The asterisk (*) indicates that 3 bridge erection boats are required for conventional rafting of 4 5. or 6 bay rafts in currents greater than 1.5MPS/ 5 FPS.

2. When determining raft classification. L refers to longitudinal rafting and C refers to conventional rafting.
3. If the current velocity in the loading/unloading areas is greater than 1.5MPS/ 5 FPS, then conventional rafting must be used.
4. The roadway width of a Ribbon raftis is 4.1M (13 ft 5 in).
5. The draft of a fully loaded Ribbon raft is 61CM (24 in).
6. NEVER load vehicles on Ribbon ramp bays. Only interior bays may be loaded.

Bridge design. The number of Ribbon interior bays requlred are–

$$\frac{\text{gap (meters)} - 14}{6.7} = \text{number of interior bays}$$

OR

$$\frac{\text{gap(feet)} - 45}{22} = \text{number of interior bays}$$

■ Two ramp bays are required for all Ribbon bridges.

■ During daylight hours a Ribbon bridge can be constructed at the rate of 200 meters (600 feet) per hour (Add 50 percent at n!ght.) See Table 7-7 for bridge classification.

Table 7-7. Determination of bridge classification (wheel/track)

TYPE OF CROSSING	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS							
	0-.9 0-3	1.2 4	1.5 5	1.75 6	2 7	2.5 8	2.7 9	3 10
Normal (W/T)	96/ 75	96/ 75	96/ 70	96/ 70	82/ 70	65/ 60	45/ 45	30/ 30
Caution (W/T)	105/ 85	105/ 85	100/ 80	100/ 80	96/ 80	75/ 65	50/ 50	35/ 35
Risk (W/T)	110/ 100	110/ 95	105/ 90	105/ 90	100/ 90	82/ 75	65/ 65	40/ 40

■ Anchorage of Ribbon bridges is normally accomplished by tying BEBs to the downstream slde of rhe bridge. The number of boats required is shown in Table 7- 8.

Table 7-8. Determination of number of boats needed for the anchorage of a Ribbon bridge

CURRENT VELOCITY (MPS/FPS)	NUMBER OF BOATS : NUMBER OF BRIDGE BAYS
0 - 1.8/0 - 6	1 : 6
2 1 2 5 7 8	1 : 3
2.7/9	1 : 2
Over 2.7/Over 9	Bridge must be anchored using an overhead cable system.

M4T6 Floating Aluminum Bridge

Allocation

Each corps float brldge company (M4T6) has five sets of M4T6 and 10 BEBs. One set provides – 141 feet (43 meters) normal bridge.

OR

96 feet (29 meters) reinforced bridge,

OR

one 4 float normal raft,

OR

one 5 float normal raft,

OR

one 4-float reinforced raft and one 5-float reinforced raft,

OR

one 6 float reinforced raft.

Transportation

The M4T6 is normally transported using 5-ton bridge trucks. One bay of bridge disassembled, can be loaded on one 5-ton truck. Bays can also be preassembled and flown to the river, using medium lift helicopters.

Raft design

Table 7-9. M4T6 raft design and determination of raft classification (wheel track)

RAFT	LOAD SPACE M (FT)	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS				ASSEMBLY TIMES
		1.5 / 5	2 / 7	2.5 / 8	3.5 / 11	
4-float normal	15.7 (51.6)	50 / 55	45 / 50	40 / 45	30 / 35	Per 4-float raft: - 5 brg trucks - 2 BEB-SD - 1 plt, 2 1/4 hr (when preassembled, 1 1/4 hr)
5-float normal	20.3 (66.6)	55 / 60	50 / 55	45 / 50	35 / 40	
4-float reinforced	11.6 (38.3)	50 / 55	50 / 55	45 / 50	35 / 40	Per 5-float raft: - 6 brg trucks - 2 BEB-SD - 1 plt, 3 hr (when preassembled, 1 1/2 hr)
5-float reinforced	15.2 (50)	60 / 65	60 / 65	55 / 60	45 / 50	
6-float reinforced	16.2 (53.3)	65 / 70	65 / 70	65 / 70	45 / 50	Per 6-float raft - 7 brg trucks - 2 BEB-SD - 1 plt, 3 3/4 hr (when preassembled, 1 3/4 hr)

NOTES: 1. Refer to TM 5210 for methods of constructing M4T6 rafts.
2. Roadway width of an M4T6 raft is 4.2M (13 ft 10 in).
3. Draft of a fully loaded M4T6 raft is 66CM (29 in).
4. Construction times increase by 50 percent at night.

Bridge design

Floats (bays) required for normal bridges are—

$$\left(\frac{\text{gap (meters)}}{4.6} + 2 \right) \times 1.1 \quad \text{OR} \quad \left(\frac{\text{gap (feet)}}{15} + 2 \right) \times 1.1 \quad \text{(Round UP to next whole number.)}$$

Floats required for **reinforced bridges** are–

$$\left(\frac{\text{gap (meters)}}{3} \right) \times 1.1 \quad \text{OR} \quad \left(\frac{\text{gap (feet)}}{10} \right) \times 1.1 \quad \text{(Round UP to a number divisible by 3.)}$$

NOTE: For reinforced bridges, two-thirds of the total number of floats must be equipped with offset saddle adaptors.

Site and personnel requirements.

Table 7-10. Determination of site and personnel requirements

LENGTH (Normal Assy) M (FT)	UNITS NEEDED FOR ASSY	NUMBER OF ASSY SITES	TIME (HR)
45.5 (150)	1 Company	2	4
61 (200)	1 Company	2	5
76 (250)	1 Company	2	6
91.5 (300)	2 Companies	3	4
106.5 (350)	2 Companies	3	5
122 (400)	2 Companies	4	5½
152 (500)	2 Companies	5	6
183 (600)	3 Companies	6	4
213 (700)	3 Companies	6	5-7
244 (800)	3 Companies	6	6-8
305 (1,000)	3 Companies	6	7-10
366 (1,200)	3 Companies	6	8-12

NOTES:1. Refer to TM 5-210 for methods of constructing M4T6 bridges.
2. Increase construction times by 50 percent for reinforced bridges.
3. Increase all construction times by 50 percent at night.
4. Draft of an M4T6 bridge is 101.6CM (40 in).

Bridge classifications.

Table 7-11. Determination of bridge classification
(wheel/track) for M4T6 normal and M4T6 reinforced bridges

M4T6 NORMAL BRIDGE					M4T6 REINFORCED BRIDGE				
	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS					CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS			
TYPE CROSSING	1.5 / 5	2 / 7	2.5 / 8	3.5 / 11	TYPE CROSSING	1.5 / 5	2 / 7	2.5 / 8	3.5 / 11
Normal (W/T)	45/55	40/50	35/45	25/30	Normal (W/T)	75	70/75	65/70	27/30
Caution (W/T)	58/59	54/55	49/51	35/37	Caution (W/T)	80	79	73	43/45
Risk (W/T)	66/67	62/63	59/60	43/45	Risk (W/T)	90	90	87	59/60

Class 60 Steel Floating Bridge

One standard bridge set contains the components for the complete assembly of one floating brldge capable of spanning a 135-foot (41-meter) gap OR one 4-, 5-, or 6- bay raft.

Transportation

Class 60 bridges may be palletized and loaded on M172 semitrailers. Additionally, one 15-foot bay of bridge may be transported on one 5-ton bridge truck.

Raft design

Table 7-12. Class 60 raft design and determination of
raft classification (wheel/track)

RAFT	LOAD SPACE M (FT)	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS			
		1.5 / 5	2 / 7	2.5 / 8	3.5 / 11
4-float normal	15 (51)	40/45	40/45	35/40	25/30
5-float normal	20 (66)	50/55	50/55	45/50	40/45
5-float reinforced	15 (51)	55/60	50/55	50/55	45/50
6-float reinforced	16 (54)	65/75	65/75	65/70	50/50

NOTES: 1. Refer to TM 5-210 for methods of constructing Class 60 rafts.
2. One air compressor, one crane, and two bridge erection boats are needed for raft construction and propulsion.
3. Roadway width of a Class 60 raft is 4.1M (13 ft 6 in)
4. Draft of a fully loaded Class 60 raft is 73.6CM (29 in).

Bridge design

Floats (bays) required for **normal bridges** are—

$$\left(\frac{\text{gap (meters)}}{4.6}\right) \times 1.1 = \text{number of floats}$$

OR

$$\left(\frac{\text{gap (feet)}}{15}\right) \times 1.1 = \text{number of floats}$$

(Round UP to next higher number.)

Floats (bays) required **for normal bridges with reinforced end spans** are–

$$\left(\frac{\text{gap (meters)}}{4.6} + 2\right) \times 1.1 = \text{number of floats}$$

OR

$$\left(\frac{\text{gap (feet)}}{15} + 2\right) \times 1.1 = \text{number of floats}$$

(Round UP to next whole number

Site and personnel requirements.

Table 7-13. Class 60 bridge site and personnel requirements

BRIDGE LENGTH M (FT)	UNITS REQUIRED FOR ASSEMBLY	NUMBER OF ASSY SITES	TIME (HR)
0-75 (0-250)	1 company	2	3
76-160 (251-525)	2 companies	3-5	3-5
161-300 (526-1,000)	1 battalion plus 2 companies	6	5-8

NOTES: 1. Refer to TM 5-210 for methods of constructing Class 60 bridges.
2. One air compressor, one crane, and two bridge erection boats are required at each assembly site.
3. Roadway width of a Class 60 bridge is 4.1M (13 ft 6 in)
4. Draft of a Class 60 bridge is 101.6CM (40 in).
5. Construction time increases by 50 percent at night.

Bridge classifications.

Table 7-14. Bridge classification (wheel/track)

CLASS 60 NORMAL BRIDGE					CLASS 60 NORMAL BRIDGE W/REINFORCED END SPANS				
	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS					CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS			
TYPE CROSSING	1.5 / 5	2 / 7	2.5 / 8	3.5 / 11	TYPE CROSSING	1.5 / 5	2 / 7	2.5 / 8	3.5 / 11
Normal (W/T)	55	45/55	40/50	22/25	Normal (W/T)	55/65	45/55	40/50	22/25
Caution (W/T)	60	56/60	52/56	34/37	Caution (W/T)	62/67	56/61	52/56	34/37
Risk (W/T)	70	67/70	62/67	46/50	Risk (W/T)	72/77	67/72	62/67	46/50

NOTE: Classifications are based upon a 15 ft end span. Refer to TM 5-210 for bridges with longer end spans.

Light Tactical Raft (LTR)

One set of LTR can provide–

one 4-ponton, 3-bay raft,

OR

one 4-ponton, 4-bay raft,

OR

44 feet (13.4 meters) of bridge.

Transportation

One set of LTR is transported on two 2 ½-ton trucks and one pole trailer

Raft/bridge design

Table 7-15. Raft/bridge design and classification determinatlon

RAFT	ASSEMBLY TIME	LOAD SPACE M (FT)	CURRENT VELOCITY (MPS/FPS) AND LOAD CLASS					
			1.5 5	2 7	2.5 8	2.75 9	3 10	3.5 11
4-ponton/3-bay w/articulators	30 min	9.15 (30)	12	12	12	8	4	0
4-ponton/3-bay w/o articulators	25 min	9.15 (30)	16	16	12	8	4	0
4-ponton/4-bay w/articulators	36 min	12.5 (41)	10	10	10	6	2	0
5-ponton/5-bay w/ articulators	40 min	15.85 (52)	9	9	9	8	5	2
5-ponton/5-bay w/o articulators	35 min	15.85 (52)	16	14	11	8	5	2
6-ponton/4-bay w/articulators	45 min	12.5 (41)	13	13	13	13	12	5
6-ponton/5-bay w/o articulators	45 min	15.85 (52)	18	18	18	18	12	6
BRIDGE	150 ft/hr 45.7M/hr	NA	16	13	11	8	5	2

NOTES:
1. Refer to TM 5-210 for methods of construction.
2. Articulators allow the ramps to be adjusted up 1M (41 in) or down .48M (19 in).
3. Roadway width is normally 9 ft.
4. All classifications are based upon a Normal crossing.
5. Construction times increase by 50 percent at night.
6. The draft of a LTR raft with outboard motors is 61CM (24 in).
7. To determine the number of LTR sets required to bridge a given gap, use the formula:

$$\frac{\text{Gap (M)}}{14} = \text{number of sets OR} \quad \frac{\text{Gap (ft)}}{44} = \text{number of sets.}$$

Long-Term Anchorage Systems

All heavy floating bridges require the construction of long-term anchorage systems. All long-term anchorage systems include three baste components approach guys, upstream (primary) anchorage, and downstream (secondary) anchorage. Refer to TM 5-210 for additional information.

Approach guys

Approach guys are attached at one end to the first floating support of all floating bridges. The approach guy is secured at the other end using deadmen, pickets, or natural holdfasts. A minimum of ½ inch Improved Plough Steel (IPS) cable should be used. When installed, the approach guys should form a 45-degree angle with the bridge.

Upstream anchorage

See Table 7-16. The upstream anchorage system holds the bridge in position against the river's main current. Upstream anchorage systems should be designed based primarily upon current velocity and bottom conditions.

Table 7-16. Design of upstream (primary) anchorage systems

CURRENT VELOCITY (MPS/FPS)	BOTTOM CONDITIONS	
	SOFT	SOLID/ROCKY
0-0.9/0-3	Kedge anchors every float upstream or shore guys every 6th float upstream	Shore guys every 6th float upstream
1.0-1.5/3.1-5	Combination system (kedge anchors and shore guys)	Overhead cable system
1.6-3.5/5.1-11	Overhead cable system	Overhead cable system

Downstream anchorage

The downstream anchorage system protects floating bridges from reverse currents (tides) as well as from storms or severe winds which might change the direction of river flow.

Table 7-17. Design of downstream (secondary) anchorage systems

REVERSE CURRENT (MPS/FPS)	BOTTOM CONDITIONS	
	SOFT	SOLID/ROCKY
None expected	Kedge anchors every 3d float downstream or shore guys every 10th float downstream	Shore guys every 10th float downstream
0-0.9/0-3	Kedge anchors every float downstream or shore guys every 6th float downstream	Shore guys every 6th float downstream
1.0-1.5/3.1-5	Combintion system (kedge anchors and shore guys)	Overhead cable system
1.6-3.5/5.1-11	Overhead cable system	Overhead cable system

Installation

Table 7-18. Installation of long-term anchorage systems

SYSTEM	METHOD OF INSTALLATION
Kedge anchor system	1. Attach anchors to anchor lines. Anchor lines must be a minimum of 1" manila rope. 2. Set or lay anchors. The horizontal distance from the anchor to the float must be at least 10 times the depth of the river. 3. Attach anchor lines to floats.
Shore guy system	1. Attach shore guys to floats. 2. Shore guys must be a minimum of ½" Improved Plough Steel (IPS) cable and placed at an angle of 45° with the bridge. 3. Shore guys must be held above the water. Use floating supports if necessary. 4. Attach shore guys to deadman or holdfasts.
Combination system	1. Emplace a kedge anchor system as described above. Anchor lines must be attached to every float. 2. Once kedges are installed, emplace a shore guy system as described above. Shore guys must be attached to every sixth float.
Overhead cable system	1. Design the system. 2. Construct Class 60 towers and install deadman. 3. Install master cable. Check initial sag. 4. Using bridle lines, attach every float to the master cable.

Design

The following information must be calculated or determined when designing an overhead cable anchorage system:

1. Cable data

   Number of master cables. . . . .
   Size of master cable(s) (C_D) . . . .
   Length of the master cable(s) (C_L). . . . .
   Number of clips at each end of the cable. . . . .
   Spacing of cable clips . . . .
   Initial sag (S) . . . .

2. Tower data

   Actual tower height (H)
   near shore. . . . .
   far shore . . . .
   Tower-waterline distance (A)
   near shore . . . .
   far shore. . . . .
   Tower-bridge offset (O_1)
   near shore. . . . .
   far shore. . . . .

3. Deadman data

Depth of deadman (D_D)
- near shore . . . .
- far shore . . . .

Tower-deadman distance (C)
- near shore . . . .
- far shore . . . .

Tower-deadman offset (O_2)
- near shore . . . .
- far shore . . . .

Deadman face (D_f) . . . .

Deadman thickness (D_t) . . . .

Deadman length (D_L)
- near shore . . . .
- far shore . . . .

Bearing plate thickness (x] . . . .

Bearing plate length (y) . . . .

Bearing plate face (z) . . . .

Design sequence

Use Figure 7-1 to determine where to take the required measurements for an overhead cable anchorage system.

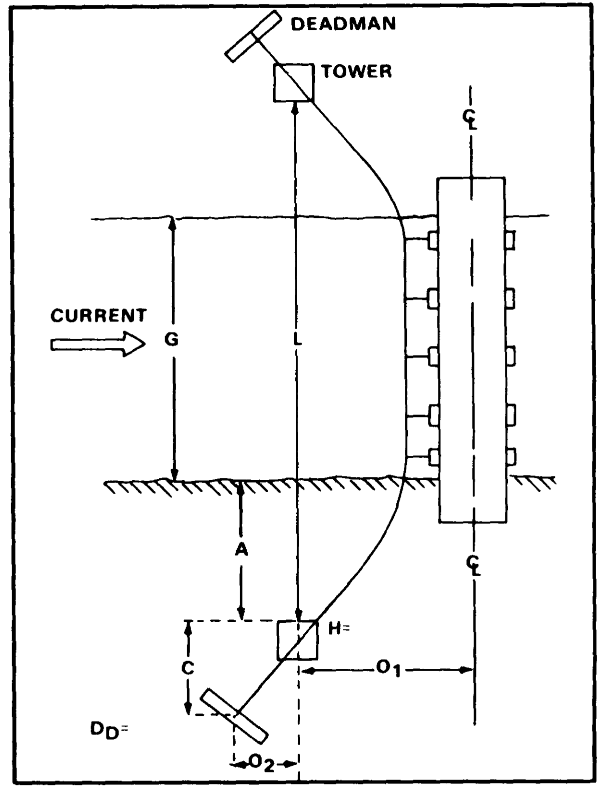


Figure 7-1. Dimensions for overhead cable design

Step 1. Determine the size and number of master cables required. See Table 7-19 for M4T6, Class 60, and Ribbon bridges. See Table 7-20 for light tactical bridges.

Number of cables = ...

C_D = ...

Table 7-19. Determination of cable size (C_D) and number of cables
for M4T6, Class 60, and Ribbon bridges

WET GAP WIDTH (G) FEET	TYPE BRIDGE ASSEMBLY	SIZE (IN) AND NUMBER OF CABLES FOR SPECIFIED RIVER VELOCITIES											
		5 FPS			7 FPS			9 FPS			11 FPS		
		SINGLE	DUAL	TRIPLE	SINGLE	DUAL	TRIPLE	SINGLE	DUAL	TRIPLE	SINGLE	DUAL	TRIPLE
200	Normal	1/2	3/8	3/8	5/8	1/2	1/2	3/4	5/8	1/2	7/8	3/4	5/8
	Reinforced	5/8	1/2	3/8	3/4	5/8	1/2	7/8	3/4	5/8	1 1/8	7/8	3/4
400	Normal	5/8	1/2	1/2	3/4	5/8	1/2	1	7/8	5/8	1 1/4	1	3/4
	Reinforced	3/4	5/8	1/2	1	3/4	5/8	1 1/4	1	3/4	1 1/2	1 1/4	7/8
600	Normal	3/4	5/8	1/2	1	3/4	5/8	1 1/4	1	3/4	1 1/2	1 1/4	7/8
	Reinforced	1	3/4	5/8	1 1/8	1	3/4	1 1/2	1 1/4	7/8	•	1 1/2	1 1/8
800	Normal	7/8	3/4	5/8	1 1/8	7/8	3/4	1 3/8	1 1/8	7/8	•	1 1/2	1 1/8
	Reinforced	1 1/8	7/8	3/4	1 3/8	1 1/8	7/8	•	1 3/8	1	•	•	1 1/4
1.000	Normal	1	7/8	3/4	1 1/4	1	7/8	1 1/2	1 3/8	1	•	•	1 1/4
	Reinforced	1 1/4	1	3/4	1 1/2	1 1/4	1	•	•	1 1/8	•	•	1 3/4
1.200	Normal	1 1/8	7/8	3/4	1 3/8	1 1/8	7/8	•	1 1/2	1 1/8	•	•	1 3/8
	Reinforced	1 3/8	1 1/8	7/8	•	1 3/8	1	•	•	1 1/4	•	•	•

NOTES: 1. All values are based upon IPS cable and a 2 percent initial sag.
2. Asterisks (*) indicate that is is unsafe to construct that system.

Step 2. Determine the distance between towers (L) in feet.

L = 1.1 (G) + 100'

Where G = the width of the wet gap in feet

L = ...

Table 7-20. Determination of cable size (C_D) for light tactical bridges

WET GAP WIDTH (G) FEET	CURRENT VELOCITY			
	5 FPS	7 FPS	9 FPS	11 FPS
200	3/8	3/8	1/2	1/2
300	3/8	1/2	5/8	3/4
400	1/2	1/2	5/8	3/4
500	1/2	5/8	5/8	3/4
600	5/8	5/8	3/4	7/8

NOTE: All values are based upon IPS cable and a 2 percent sag.

Step 3. Determine the length of the master cable (C_L) in feet.

C_L = L + 250' C_L = ...
Where L = the distance between towers in feet

NOTE. This is an approximation based upon the most extreme circumstances

Step 4. Determine the number of cable clips required to secure one end of the master cable.

Number of clips = (3 x C_D) + 1 Number of clips at each end = ...
Where C_D = the cable diameter in inches

Step 5. Determine the spacing of cable clips in inches

Clip spacing = 6 x C_D Clip spacing = ...
Where C_D = the cable diameter in inches

Step 6. Determine initial sag (S) in feet.

S = .02(L) S = ...
Where L = the distance between towers in feet

Step 7. Determine tower height (H) in feet.

a. H_R = 3' + S - BH
Where H_R = the REQUIRED tower height in feet
S = initial sag in feet
BH = bank height in feet

NOTE. This calculation must be done for both the near shore and the far shore since bank heights may be different.

b. Determine actual tower height (H). See Table 7-21 Compare the required tower height to the possible tower height. Select the smallest possible tower that is greater than or equal to the required height.

NOTE. If the near shore and the far shore towers are determined to have different heights, steps 9 through 16 must be calculated separately for both near and far shores.

H near shore = ...
H far shore = ...

Table 7-21. Possible tower heights (H)

NUMBER OF TOWER SECTIONS	TOWER HEIGHT (H)
Cap, base, and pivot unit	3' 8 1/4"
With 1 tower section	14' 6 1/4"
With 2 tower sections	25' 4 1/4"
With 3 tower sections	36' 2 1/4"
With 4 tower sections	47' 1/4"
With 5 tower sections	57' 10 1/4"
With 6 tower sections	68' 8 1/4"

Step 8. Determine the distance from each tower to the waterline (A) in feet.

$$A = \frac{L-G}{2}$$

A near shore

A far shore

Where L = the distance between towers in feel
G = the gap width in feet

Step 9. Determine the offset from each tower to the bridge centerline (0_1) in feet

0_1 near shore = ...

0_1 far shore = ...

a. If the bank height (BH) is less than or equal to 15', then O_1 = H + 50'.

b. If the bank height (BH) is greater than 15', then 0_1 = H + BH + 35'.

Where H = the actual tower height in feet

BH = the bank height in feet

Step 10. Identify deadman dimensions. Select a deadman from the available timbers and logs. Generally, the timber with the largest timber face/log diameter is selected. The largest face of the deadman is defined as D_f, and the thickness is D_t.

D_f = ...

D_t = ...

Step 11. Determine mean depth of deadman (D_D) in feet.

D_D near shore = ...

D_D far shore = ...

a. There must be a minimum of 1 foot of undisturbed soil between the bottom of the deadman and the ground water level (GWL). The deepest the deadman can be (D_{Dmax}) is calculated as:

$$D_{Dmax} = GWL - 1' - \frac{D_f}{2}$$

Where D_f = the deadman face in feet
GWL = depth of ground water level in feet

b. The minimum deadman depth is always 3 feet

c. The maximum deadman depth is always 7 feet

d. Compare D_{Dmax} to these minimum and maximum values to determine the actual mean depth of deadman (D_D).

Step 12. Determine length of deadman (D_L) in feet.

$$D_L = \left(\frac{CC}{HP \times D_f} \right) + 1$$

D_L near shore = ...

D_L far shore = ...

Where CC = the capacity of the anchorage cable in lb/1,000 from Table 7-22
HP = required holding power in lb/1,000 sq ft from Table 7-23
D_f = deadman face in feet (for log deadman use log diameter (d))

Table 7-22. Determination of capacity
of anchorage cable (CC) in lb/1,000

TYPE OF CABLE	SIZE (IN) OF CABLE (C_D)									
	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
IPS	1.26	21.6	33.2	47.4	64.4	84.0	106.0	130.0	157.0	185.0
PS	11.0	18.8	28.8	41.2	56.0	73.0	92.0	113.0	136.0	161.0
MPS	10.0	17.0	26.2	37.4	50.8	66.0	83.0	102.0	123.0	145.0

Table 7-23. Determination of required holding power (HP)
in lb/1,000 sq ft

DEPTH OF DEADMAN (D_D) FEET	TOWER TO DEADMAN SLOPE			
	1:1	1:2	1:3	1:4
3	.95	1.3	1.45	1.5
4	1.75	2.2	2.6	2.7
5	2.8	3.6	4.0	4.1
6	3.8	5.1	5.8	6.0
7	5.1	7.0	8.0	8.4

Step 13. Check minimum thickness of deadman (D_t) in feet

For timber: $\frac{D_L}{D_t}$ must be less than or equal to 9

For logs: $\frac{D_L}{d}$ must be less than or equal to 5

Step 14. Determine the tower to deadman distance (C) in feet.

$$C = \frac{H + D_D}{slope}$$

C near shore = ...
C far shore = ...

Where H = the actual tower height in feet
D_D = the mean depth of deadman in feet
slope = the tower to deadman slope

Step 15. Determine the tower to deadman offset (0_2) in feet.

$$0_2 = (C(O_2'))$$

0_2 near shore = ...
0_2 far shore = ...

Where C = the tower to deadman distance in feet
$0_2'$ = a factor determined from Table 7-24

Table 7-24. Determination of O_2'

TYPE OF ASSEMBLY	CURRENT VELOCITY				
	3 FPS	5 FPS	7 FPS	9 FPS	11 FPS
Normal	.09	.11	.14	.17	.19
Reinforced	.11	.14	.17	.19	.23

Step 16. Design a bearing plate for each deadman. Given deadman face (D_f) or log diameter (d) and the size of the master cable (CD), refer to Table 7-25 (page 7-20) to determine the length, thickness and face of the deadman bearing plate.

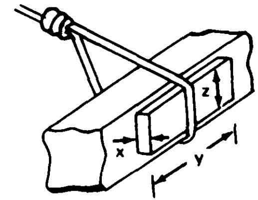
x = ...
y = ...
z = ...

Table 7-25. Determination of bearing plate dimensions
x, y, and z (inches)

DEADMAN FACE (D_f)		CABLE SIZE (C_D) (IN INCHES)								
		3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
8	x	7/16	7/8	1 1/4						
	y	4	8	11						
	z	6	6	6						
10	x	7/16	11/16	1	1 3/8					
	y	4	6	9	12					
	z	8	8	8	8					
12	x	7/16	9/16	13/16	1 1/8	1 7/16				
	y	4	5	7	10	13				
	z	10	10	10	10	10				
14	x	7/16	7/16	11/16	7/8	1 1/4	1 9/16	2		
	y	4	4	6	8	11	14	18		
	z	12	12	12	12	12	12	12		
16	x	7/16	7/16	9/16	13/16	1 1/8	1 3/8	1 11/16	2 1/8	
	y	4	4	5	7	10	12	15	19	
	z	14	14	14	14	14	14	14	14	
18	x	7/16	7/16	7/16	11/16	7/8	1 1/4	1 9/16	1 13/16	
	y	4	4	4	6	8	11	14	16	
	z	16	16	16	16	16	16	16	16	
20	x	7/16	7/16	7/16	11/16	7/8	1 1/8	1 3/8	1 11/16	
	y	4	4	4	6	8	10	12	15	
	z	18	18	18	18	18	18	18	18	
24	x	7/16	7/16	7/16	9/16	11/16	7/8	1 1/8	1 3/8	1 7/8
	y	4	4	4	5	6	8	10	12	17
	z	22	22	22	22	22	22	22	22	22

NOTE: The values in this table are based upon the use of IPS cable. For former bearing plates refer to TM 5-210.

Where x = bearing plate thickness
y = bearing plate length
z = bearing plate face



M4T6 FIXED SPAN

Refer to TM 5-210 for more detailed information.

Single Span Bridge

Single span bridge design is for 15 feet to 45 feet unsupported H-frames.

1. Classification of bridge (designated in the mission statement). 1. CL ____

2. Gap as measured during reconnaissance. 2. ____

3. Safety setback for near shore (NS) and far shore (FS) is a constant of 3' for both prepared and unprepared abutments. 3a. NS+3' 3b. FS+3'

4. Initial bridge length (add steps 2, 3a, and 3b). 4.= ____

5. Round UP to next highest standard H-frame configuration (Table 7-26) 5. ____________________

6. Determine deck/roadway (D/R) ratio required to carry load (Table 7-26) 6. ____________________

7. Final design of bridge

a. H-frame (from step 5) 7a. ____________________

b. D/R roadway ratio (from step 6) 7b. ____________________

c. Classification (Table 7-26) 7c. ____________________

Table 7-26. Deck balk fixed span data

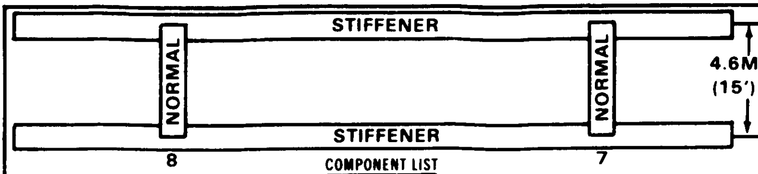
CAPACITY FOR SPECIFIED SPAN LENGTH IN METERS (FT) AND DECK/ROADWAY RATIO																			
LENGTH	4.6 (15)			7.1 (23.4)		8.1 (30)			11.7 (38.4)				13.7 (45)						
DECK WIDTH	22	22	26	22	22	22	22	24	22	22	24	26	20	22	22	24	24	26	26
ROADWAY WIDTH	18	18	22	18	16	18	16	18	18	16	18	18	16	18	16	18	16	18	16
TYPE CROSSING																			
Normal	100	100	100	100	100	85	90	90	45	50	56	65	24	24	30	30	40	40	45
	100	100	100	100	100	65	70	70	35	40	45	50	25	25	30	30	35	35	40
Caution	100	100	100	100	100	100	100	100	70	70	75	82	40	46	46	51	51	56	56
	100	100	100	100	100	80	80	85	51	51	55	50	35	40	40	43	43	46	46
Risk	100	100	100	100	100	100	100	100	78	78	85	90	47	54	54	60	60	66	66
	100	100	100	100	100	90	90	95	57	57	62	67	40	45	45	49	49	53	53

22_ Deck Width
18 Roadway Width } Number of balk

NOTES:

I. Figures 7-2 through 7-6 show H-frame layout and components for all lengths of M4T6 unsupported spans.

2. All bridges require four short and four long cover plates if roadway is 18 balk wide. For 16 balk roadway use four long and two short cover plates. For 22 balk roadway use four long and eight short cover plates. All bridges require four bearing plates.

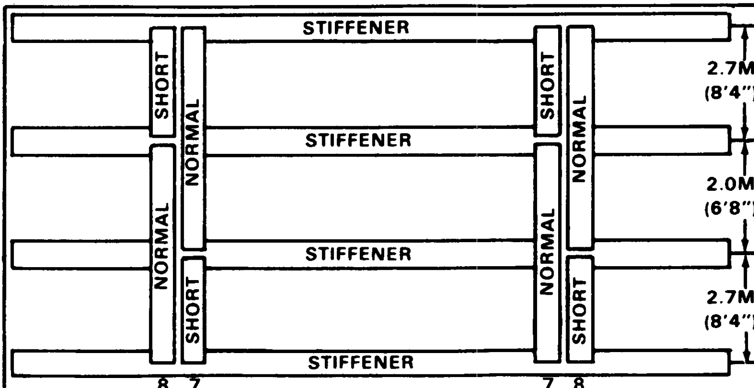


COMPONENT LIST

LENGTH	4.6M (15')		
DECK/ROADWAY	22/18	22/16	26/22
Component			
Balk, normal	22	22	26
Balk, short	—	—	—
Balk, tapered (note)	44	44	52
Stiffeners	2	2	2
Pins, stiffener	56	56	64
Adapter, curb	4	4	4

NOTE: Number of tapered balk may be reduced to quantity required to fill in ramps between curbs.

Figure 7-2. H-frame for 4.6M (15') fixed span

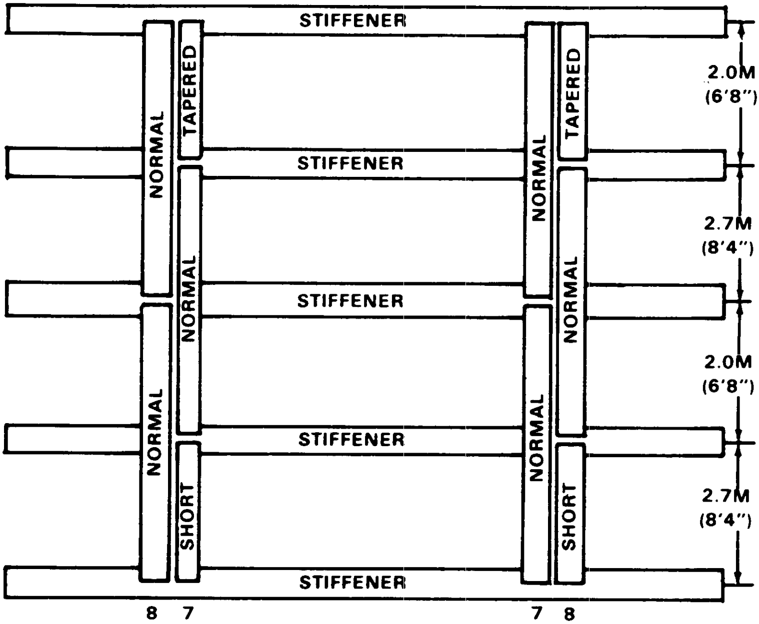


COMPONENT LIST

LENGTH	7.1M (23'4")		6.6M (21'8") [1]	
DECK/ROADWAY	22/18	22/16	22/18	22/16
Component				
Balk, normal	22	22	22	22
Balk, short	22	22	—	—
Balk, tapered [2]	44	44	66	66
Stiffeners	4	4	4	4
Pins, stiffener	104	104	104	104
Adapter, curb	8	8	8	8

NOTE: 1. Alternate to 7.1M (23'4"). Same class capability as 7.1M (23'4"). Use tapered balk in place of short balk.
2. Number of tapered balk may be reduced to quantity required to fill in ramps between curbs.

Figure 7-3. H-frame for 7.1M (23'4") fixed span

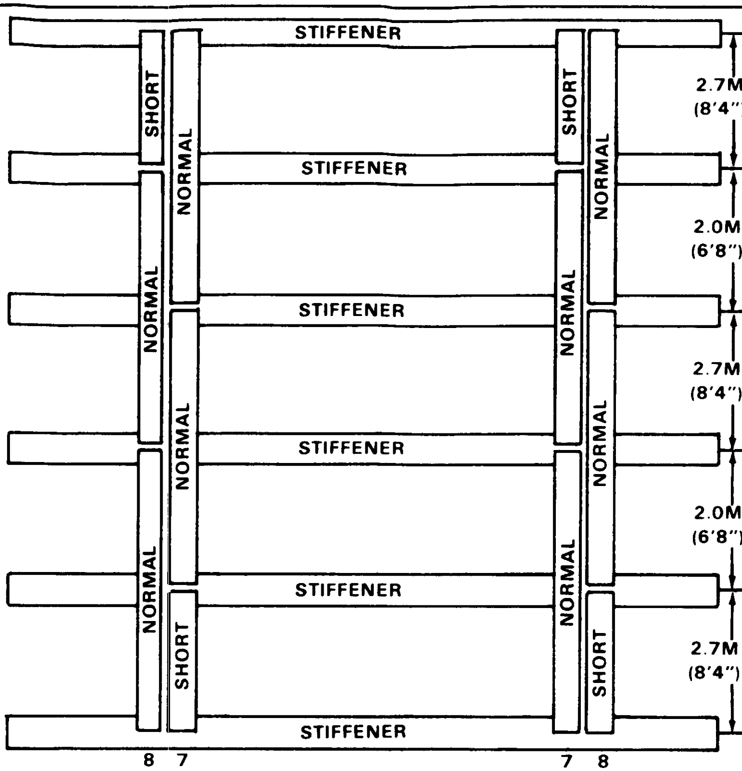


COMPONENT LIST

LENGTH	9.1M (30')		
DECK/ROADWAY	22/18	22/16	24/18
Component			
Balk, normal	33	33	35
Balk, short	22	22	22
Balk, tapered (note)	44	44	44
Stiffeners	5	5	5
Pins, stiffener	128	128	134
Adapter, curb	10	10	10

NOTE: Number of tapered balk may be reduced to quantity required to fill in ramps between curbs.

Figure 7-4. H-frame for 9.1M (30') fixed span

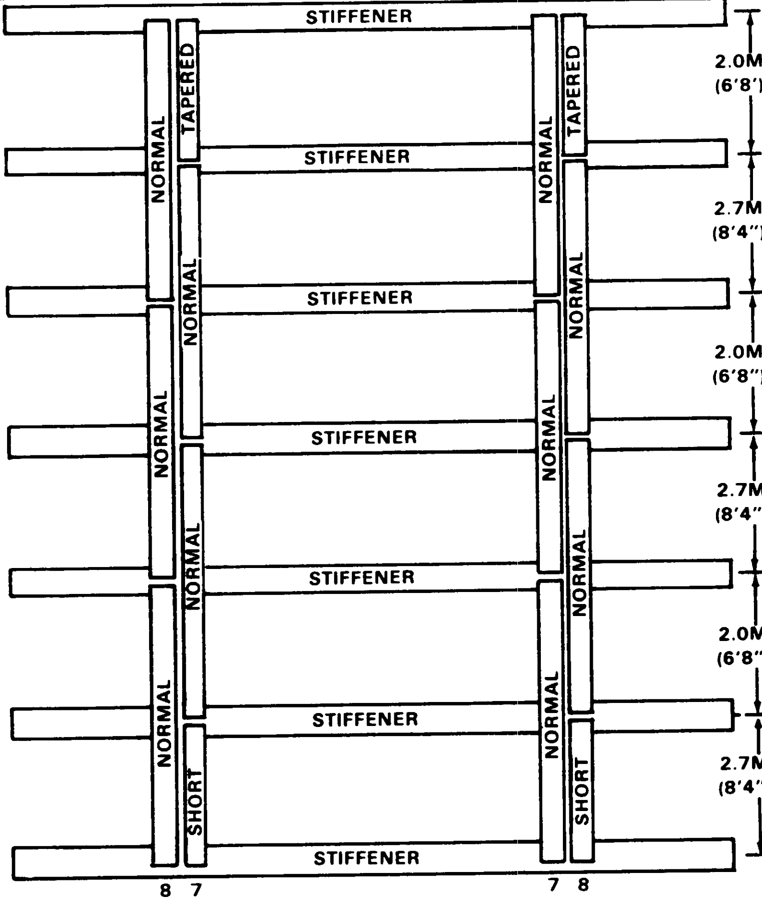


COMPONENT LIST

LENGTH DECK/ROADWAY	11.2M (36'8")[1] 22/18	22/16	24/18	26/18	11.7M (38'4") 22/18	22/16	24/18	26/18
Component								
Balk, normal	44	44	46	50	44	44	46	50
Balk, short	22	22	—	—	22	22	22	22
Balk tapered[2]	44	44	44	44	44	44	44	44
Stiffeners	6	6	6	6	6	6	6	6
Pins, stiffener	152	152	158	158	152	152	158	168
Adapter, curb	12	12	12	12	12	12	12	12

NOTES: 1. Alternate to 11.7M (38'4"). Same class capability as 11.7M (38'4"). Use tapered balk in place of short balk.
2. Number of tapered balk may be reduced to quantity required to fill in ramps between curbs.

Figure 7-5. H-frame for 11.7M (38'4") fixed span



COMPONENT LIST

LENGTH	13.7M (45')						
DECK/ROADWAY	20/16	22/18	22/16	24/18	24/16	26/18	26/16
Component							
Balk, normal	50	52	52	57	57	61	61
Balk, short	11	10	10	11	11	11	11
Balk, tapered (note)	51	51	51	55	55	55	55
Stiffeners	7	7	7	7	7	7	7
Pins, stiffener	162	172	172	182	182	192	192
Adapter, curb	14	14	14	14	14	14	14

NOTE: Number of tapered balk may be reduced to quantity required to fill in ramps between curbs.

Figure 7-6. H-frame for 13.7M (45') fixed span

Class 60 Trestle Arrangement

M4T6 FIXED SPAN BRIDGE DESIGN
FOR SUPPORT WITH CLASS 60 TRESTLE ARRANGEMENT
(FOR CLASS 60 AND BELOW) WITH EXAMPLE FILLED IN

1. Classification of the bridge that needs to be built (obtained from the mission statement).	1.	MLC 60/60		
2. Gap as measured during reconnaissance	2.	84'		
3. Safety setback for both the FS and NS is a constant of 3' for both prepared and unprepared abutments	3a.	FS: + 3'		
	3b.	NS: + 3'		
4. Initial bridge length (add steps 2 + 3a + 3b).	4.	= 90'		
5. Initially, enter the "2 trestle assemblies" column and subtract 15' from the total bridge length obtained in step 4. (This distance must be accounted for as it will be part of the bridge roadway.)	5.	**2 TRESTLE ASSEMBLIES**	**3 TRESTLE ASSEMBLIES**	**4 TRESTLE ASSEMBLIES**
	5a	-15'	-30'	-45'
	5b.	= 75'	= 60'	=
6. Divide the value obtained in step 5b by 2 to determine the lengths of the two end span H-frames.	6a.	÷ 2	÷ 2	÷ 2
NOTES: 1. If the value obtained in step 6b is greater than 45'0". You MUST return to step 5. Enter the next column, and repeat the design sequence. 2. You are not limited to adding only four trestle assemblies as may be implied by step 5. Only four are shown due to space limitations on this form. 3. When the value obtained in step 6b is less than or equal to 45'0", proceed to step 7.	6b.	= 37.5'	= 30'	=
7. Round UP the value obtained in step 6b to the next highest standard H-frame configuration from Table 7-26 (page 7-21).	7.	Ø 38'4"	Ø 30'	Ø
8. Determine the D/R ratio required and corresponding MLC for the standard configuration obtained in step 7 from Table 7-26. (Remember: The 22 pieces of decking is the maximum which may be used with a trestle.)	8a.	D/R =	D/R = 22/16	D/R =
NOTES: 1. This must meet or exceed the MLC requirements as stated in step 1 and is always based on a NORMAL CROSSING unless otherwise directed by the Tactical Commander. 2. If the MLC requirement cannot be met or exceeded, you MUST return to step 5, enter the next column, and repeat the design sequence. Add as many trestle assemblies as needed.	8b.	MLC =	MLC = 60/60	MLC =

9. Final bridge design:

a. H-frame end span configuration (from step 7). 9a. 30'

b. DR ratio (from step 8a). 9b. D/R = 22/16

c. MLC of bridge (from step 8b; however, this value can NEVER exceed MLC 60 because this is the capacity of the trestle). 9c. MLC = 60/60

d. Class 60 trestle assemblies required (from step 5). 9d. 3

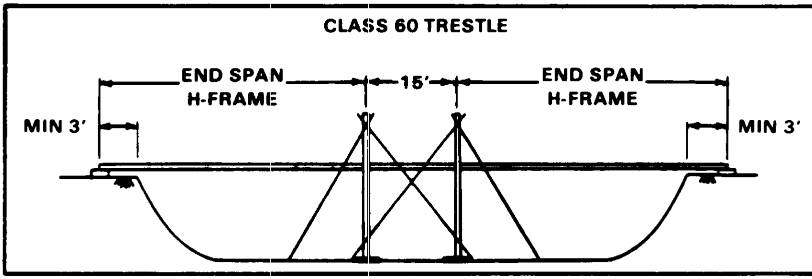


Figure 7-7. Two trestle assemblies

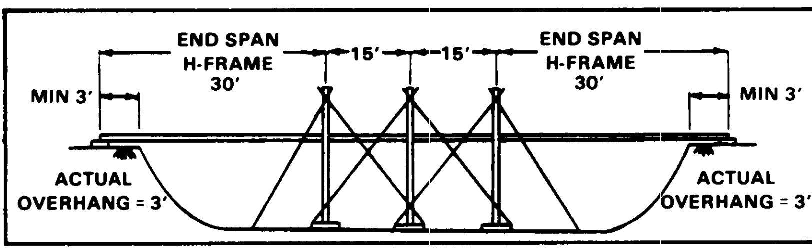


Figure 7-8. Three trestle assemblies

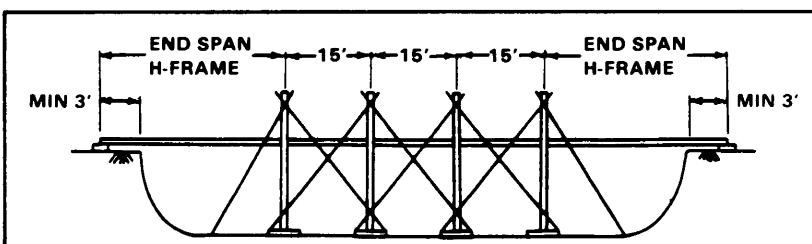


Figure 7-9. Four trestle assemblies

Class 100 Trestle Arrangement

M4T6 FIXED SPAN BRIDGE DESIGN
FOR SUPPORT WITH CLASS 100 TRESTLE ARRANGEMENT
(FOR CLASSES 61 TO 100) WITH EXAMPLE

1. Classification of the bridge that needs to be built (obtained from the mission statement).

   1. MLC 70/70

2. Gap as measured during reconnaissance.

   2. 66′

3. Safety setback for both the FS and NS is a constant of 3′ for both prepared and unprepared abutments.

   3a. FS: +3′

   3b. NS: +3′

4. Initial bridge length (add steps 2 + 3a + 3b).

   4. = 72′

5. Initially, enter the "1 trestle arrangement" column. You WILL NOT have to subtract any distance from step 4 because the end spans rest on the center of the trestle.
   NOTE: One trestle arrangement consists of two trestle assemblies; two trestle arrangements consist of four trestle assemblies.

6. Divide the value obtained in step 5b by 2 to determine the lengths of the two end span H-frames.
   NOTES: 1. If the value obtained in step 6b is greater than 30′0″, you MUST return to step 5, enter the next column, and repeat the design sequence.
   2. You are not limited to adding only three trestle arrangements as may be implied by step 5. Only three trestle arrangements are shown due to space limitations on this form.
   3. When the value obtained in step 6b is less than or equal to 30′0″, proceed to step 7.

7. Round UP the value obtained in step 6b to the next highest standard H-frame configuration from Table 7-26 (page 7-21).

8. Determine the D/R ratio required and corresponding MLC for the standard configuration obtained in step 7 from Table 7-26 (page 7-21). (Remember: The 22 pieces of decking is the maximum which may be used with a trestle.)
   NOTES: 1. This MUST meet or exceed the MLC requirements as stated in step 1 and is always based on a NORMAL CROSSING unless otherwise directed by the tactical commander.
   2. If the MLC requirement cannot be met or exceeded, you MUST return to step 5, enter the next column, and repeat the design sequence. Add as many trestle arrangements as needed.

Step	1 TRESTLE ARRANGEMENT	2 TRESTLE ARRANGEMENT	3 TRESTLE ARRANGEMENT
5a.	-0′0″	-23′4″	-46′8″
5b.	= 72′	= 48′8″	=
6a.	÷ 2	÷ 2	÷ 2
6b.	= 36′	= 24′4″	=
7.	ø	ø 30	ø
8a.	D/R =	D/R = 22/16	D/R =
8b.	MLC =	MLC = 90/70	MLC=

9. Final bridge design:

   a. H-frame end span configuration (from step 7). — 9a. 30′

   b. H-frame end span D/R ratio (from step 8a). — 9b. D/R = 22/16

   c. Number of trestle arrangement(s) required (from step 5). — 9c. 2

d. Bridge length(s) between trestle arrangement(s). 9d. One 23'4" span

NOTES. 1. For one trestle arrangement, enter NA.
2. For two trestle arrangements, enter one 23'4" span.
3. For three trestle arrangements, enter two 23'4" spans.
4. For four or more trestle arrangements, the number of 23'4" spans that are required will be equal to the number of trestle arrangements minus one.

e. The MLC of bridge length(s) between trestle arrangement(s). 9e. MLC 100/100

NOTES: 1. For one trestle arrangement, enter NA.
2. For two or more trestle arrangements, use Table 7-26 (page 7-21) to obtain the MLC. Use the same D/R as shown under step 9b.

f. The MLC of trestle(s) (constant of 100). 9f. MLC 100/100

g. The MLC of end spans (from step 8b). 9g. MLC 90/70

h. The MLC of entire bridge (compare the values of steps 9e, 9f, and 9g; choose the smallest). 9h. MLC 90/70

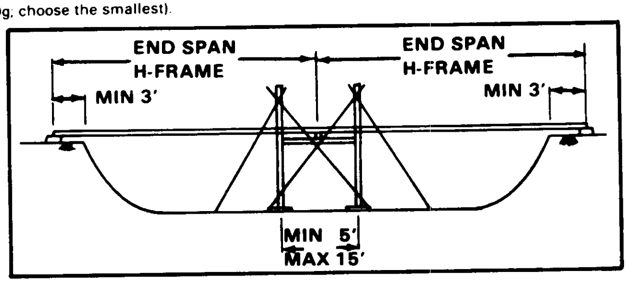


Figure 7-10. One trestle arrangement

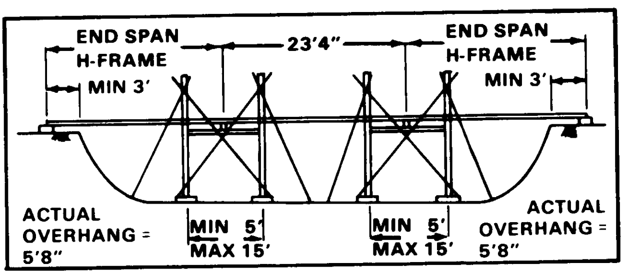


Figure 7-11. Two trestle arrangements

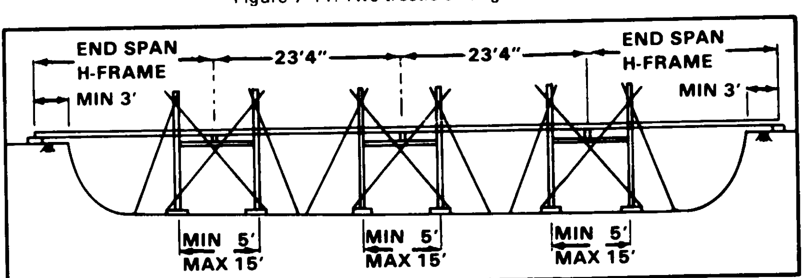


Figure 7-12. Three trestle arrangements

MEDIUM GIRDER BRIDGE (MGB)

For more detailed information pertaining to component descriptions, construction, palletizing, and maintenance procedures, refer to TM 5-5420-212-12 for the MGB, and to TM 5-5420-212-12-1 for the link reinforcement set (LRS).

Abbreviations

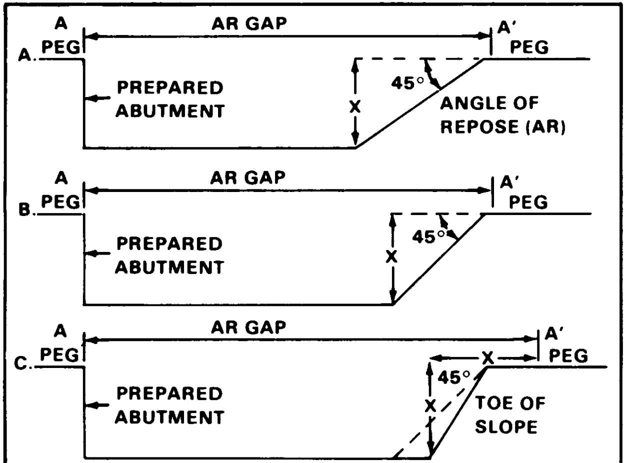
A	indicates edge of gap, far bank
A'	indicates edge of gap, near bank
AA	anchor assembly
AA(L)	long link of anchor assembly
AA(S)	short link of anchor assembly
AF	antiflutter tackle
AR	Angle of repose which is marked on site with A (far bank) and A' (near bank) pegs.
AR Gap	The distance from the edge of firm ground (A') on the near bank to the edge of firm ground (A) on the far bank.
BES	bridge erection set
Boom Marker	Carrying bar (painted orange) which marks the position of the next booming/launching point.
BP	building pedestal (SS only), baseplate (SS and DS)
BSB	bank seat beam
C	Distance of water below line joining FRB and F at distance W from FRB (negative). Fine for up to 2E+12. For 13 to 22 bays, a CRB is required.
CG Marker	Carrying bar (painted blue) which marks the center of gravity of the bridge during construction.
CRB	Capsill roller beam MUST be used for 2E+13 through 2E+22 bays DS bridges with or without LRS.
D	Deflection of bridge during launch in relation to line joining FRB and F pegs.
DS	double story bridge construction
DU	deck unit
E	end of bridge
F	Final position of the far end of the bridge as marked with the F peg.
F'	Final position of the near end of the bridge as marked with the F' peg.
FRB	front roller beam
G	distance between 0 peg and baseline
H	far bank height at F peg, relative to the baseline
Ht	height
L	length of bridge
LLN	light launching nose
LNCG	launching nose cross girder
LNH	launching nose heavy
LR	Landing roller. Used by itself for 4 through 8 bays SS. Used in LRP for all other bridge lengths.
LRD	Long ramp and deck pallet. The last pallet to be used on a bridge site should be loaded on the push vehicle to maintain a proper counterweight.
LRP	Landing roller pedestal (MK I for 2E+1 through 2E+12 bays DS-MK 2 for 2E+13 through 2E+22 bays DS with or without LRS).
LRS	link reinforcing set
LT	light tackle
LZ	landing zone
MLC	military load class
N	nose tip height above baseline
***N1**	launching nose heavy one story high
****N2**	launching nose heavy two stories high

O	Distance "R" from RB (single story), FRB (double story), and CRB (double story with or without LRS) as marked with the O peg.
PT	post tensioning assembly
R	Maximum distance to the rear of bridge during construction (excluding push bar and vehicle).
RB	roller beam
RRB	rear roller beam
SS	single story bridge construction
T	Height of home bank end of bridge in relation to baseline.
V	For delaunching purposes, the distance from the FRB or CRB to the LRP for DS bridges requiring a launching nose.
W	Distance of end taper panel from FRB for maximum deflection.
WL	waterline
1LL	one long link
1SL	one short link
***6N1,7N1, and 8N1**	Types of single story nose construction. The first number shows the number of heavy nose sections used. The N1 means single nose.
****6N1 + 3N2**	Type of double story nose construction. The 6N1 is explained above. The 3N2 means three heavy nose sections used in second story. The N2 means nose double story.
2 + 3 + or 8 through 10	Describes the number of bays to be added. The 2+3+ means add second and third bays and the 8 through 10 means add bays 8 through 10.
Boom to	Movement of bridge until the panel point given is over the RB (for SS) or RRB (for DS).
Launch to	Movement of bridge until the panel point given is over the RB, FRB, or CRB.
3D, 8D, 20D, 27D+6C, and 37D + 6C	Counterweight codes giving the number of deck units and curbs required.
(4p0), (2p4), and (8p3)	Examples of the way that the center of gravity is shown.

Design

Measure

Measure the angle of repose (AR) gap. See Figure 7-13 Select a bridge centerline Measure a distance from the firm ground on the home bank to the firm ground on the far bank.



NOTES: 1. If actual slope of bank does not exceed 45° from the horizontal, place A, A' peg as shown in A or B.

2. If actual slope of bank does exceed 45° from the horizontal, place A, A' peg a distance equal to the height of the bank which is measured from the toe of slope. This is illustrated in C by the distance X.

3. Gaps above are shown with one prepared and one unprepared abutment. Actual sites may be any combination of examples shown.

Figure 7-13. Measuring AR gap

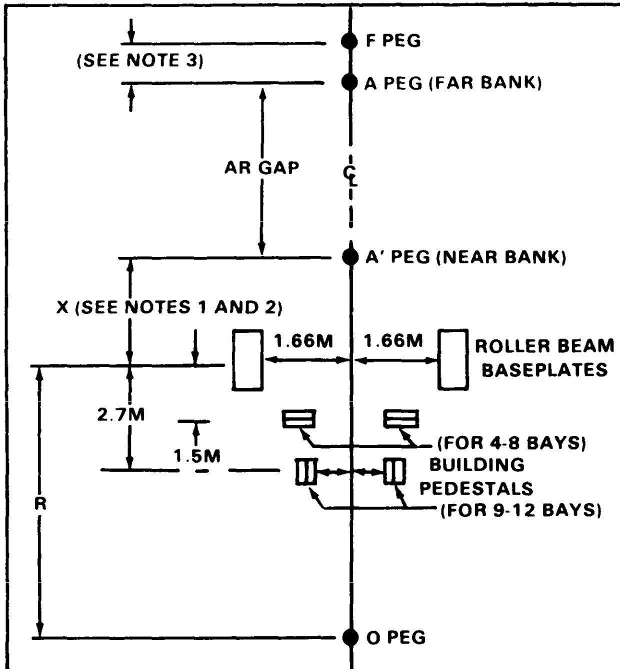
Select

Select a bridge from Table 7-27 to meet the AR gap and MLC required. Using the bridge selected, go to the appropriater page: single story, page 7-33; double story 1 - 12 bays, page 7-37; double story 13-22 bays without LRS, page 7-41; double story 13 - 22 bays with LRS, page 7-45.

Table 7-27. Bridge selection table

SS BRIDGES 4 - 12 BAYS TABLE A		DS 1 - 12 BAYS TABLE B		DS 13 - 22 BAYS TABLE C			
AR gap M	MLC	AR gap M	MLC	AR GAP M wo/LRS	MLC	AR GAP M w/LRS	MLC
3.7 - 6.1	60	6.7 - 9.0	60	28.6 - 30.9	50	28.6 - 31.4	60
5.6 - 8.0	60	8.5 - 10.8	60	30.5 - 32.8	50	30.5 - 33.3	60
7.4 - 9.8	40	10.3 - 12.6	60	32.3 - 34.6	40	32.3 - 34.7	60
9.2 - 11.6	30	12.2 - 14.5	60	34.1 - 36.4	40	34.1 - 36.9	60
11.0 - 13.4	30	14.0 - 16.3	60	35.9 - 38.2	30	35.9 - 38.7	60
12.9 - 15.3	24	15.8 - 18.1	60	37.8 - 40.1	30	37.8 - 40.6	60
14.7 - 17.1	20	17.7 - 20.0	60	39.6 - 41.9	24	39.6 - 42.4	60
16.5 - 18.9	16	19.5 - 21.8	60	41.4 - 43.7	24	41.4 - 44.2	60
18.4 - 20.8	16	21.3 - 23.6	60	43.3 - 45.6	20	43.3 - 45.6	60
		23.1 - 25.4	60	45.1 - 47.4	16	45.1 - 46.5	60
		25.0 - 27.3	60				
		26.8 - 29.1	60				

Single story MGB design - 4 to 12 bays long



NOTES: 1. Push launch:
x (L + 0.23M) (AR gap + 0.9M)
2. Jack launch:
x (L - 0.23M) - (AR gap + 0.9M)
3. Maximum bearing (each end) 2.1M.
Minimum bearing (each end) 0.9M.
4. Push launches are to be performed only in an actual wartime bridge operation. Push launches are no longer performed for training or demonstration.

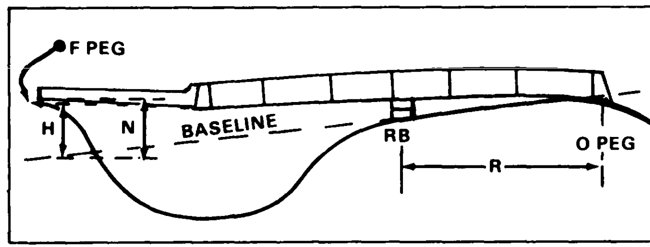


Figure 7-14. Single story MGB site layout (4 through 12 bays)

MGB DESIGN PROFORMA SS 4 TO 12 BAYS

(All Measurements are in Meters)

Grid ________ Recon Officer ________ Map Ref ________

Unit ________ MLC ________

1. Measure AR gap A to A' ________

NOTE Use Table 1 or 2 to obtain the answers to the following

2. Select bridge ________

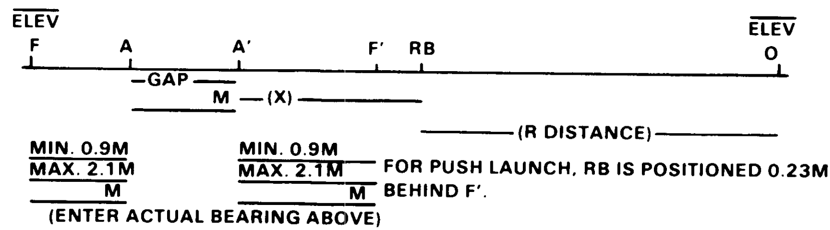
3. Bridge length ________

4. R distance ________

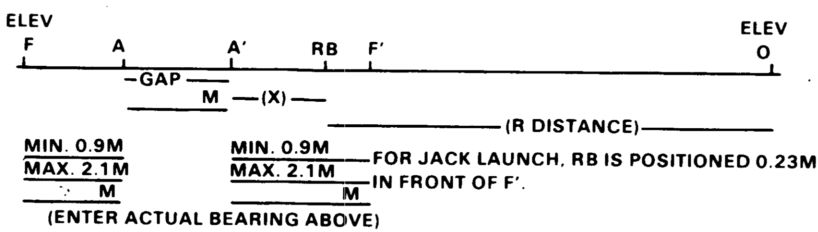
5. Nose construction ________

6. Key construction points, dimensions, and elevations.
   Calculate the distance from the RB to A' peg (X), where:

   a. Push launch. X = (L + 0.23M) - (AR gap + 0.9M)



   b. Jack launch. X = (L - 0.23M) - (AR gap + 0.9M)



   c. Check bearing. Bearing FB + AR gap + bearing HB = L

7 Slope check. Ensure that the difference in elevation between the F' and the F pegs does not exceed 1/10th of the total bridge length. If it does, you are either going to have to crib up, undertake a major construction project, or find another centerline

TABLE 1

BRIDGES 4-8 BAYS SS									
SITE DIMENSIONS						LAUNCH DESIGN			
AR Gap (a)	L (b)	Bays (c)	MLC (d)	Nose (e)	R Dist (f)	RB BP Only (g)	RB BP+DU Only (h)	N BP Only (i)	N BP+DU Only (j)
3.7-6.1	7.9	4	60	LLN ONLY	5.8	0.43	0.60	1.30	1.75
5.6-8.0	9.8	5	60		6.7			1.14	1.68
7.4-9.8	11.6	6	40		7.6			1.07	1.60
9.2-11.6	13.4	7	30		9.5			0.76	0.91
11.0-13.4	15.2	8	30		11.3			0.38	0.84

TABLE 2

BRIDGES 9-12 BAYS SS											
SITE DIMENSIONS						Dimension N above line through ground at RB and O when rear BSB is on ground. The RB is on BP or BP and DU, and LNCG is on 4, 2, or 1.					
						LNCG SETTINGS					
						4		2		1	
AR Gap (a)	L (b)	Bays (c)	MLC (d)	Nose (e)	R Dist (f)	BP Only (g)	BP+ DU (h)	BP Only (i)	BP+ DU (j)	BP Only (k)	BP+ DU (l)
12.9-15.3	17.1	9	24	5N1	10.4	-0.76	-0.08	0.61	1.14	1.83	2.36
14.7-17.1	18.9	10	20		12.2	-0.99	-0.61	0.38	0.76	1.60	1.98
16.5-18.9	20.7	11	16	6N1	12.2	-1.37	-1.07	0.15	0.48	1.83	2.44
18.4-20.8	22.6	12	16		14.0	-2.13	-1.60	-0.46	0.08	1.07	1.60

NOTES: 1. An extra 75mm of clearance can be obtained by lifting on the nose to take out the pin sag. Where levels are estimated this should not be taken into account during the design but left to compensate for any inaccuracies in calculating the value of H (for bridges 4 to 8 bays).

2. An extra 0.6M of clearance can be obtained by lifting on the nose to take out pin sag (for bridges 9 to 12 bays).

3. Any additional packing under the RB will increase the vertical interval N by three times the thickness of the packing; such as, if the packing is 75mm thick, N will be increased by 225mm.

4. The table incorporates an allowance to ensure that the nose clears the LR when it is positioned 230mm in front of point F.

8 Calculate H $H = HtF + \frac{[HtO \times (L \pm 0.23)]}{R\ distance}$ +0.23 if push launch; -0.23 if jack launch

9. Launch design:

4 to 8 Bays (Table 1)
Choose a packing where N > H (From columns i or j)
Packing ________ (From columns g or h)

9 to 12 Bays (Table 2)
Choose an LNCG setting where N > H (From columns g, h, i, j, k, or l)
LNCG Setting ____ Packing ____

10. Loads required. From Table 3, determine the truck and trailer loads required for the bridge.

TABLE 3

MGB PALLETS SS									
Pallet	Number of Bays								
Type	4	5	6	7	8	9	10	11	12
Erection	1	1	1	1	1	1	1	1	1
Bridge	2	2	3	3	4	4	5	5	5
Total	3	3	4	4	5	5	6	6	6

NOTE: More vehicles are required to transport personnel. Erection pallets may only be partial depending on bridge being constructed.

11. Construction times and manpower requirements. From Table 4, extract the following information:

a. Construction time ______________

b. Manpower requirements ______________

TABLE 4

WORKING PARTIES AND BUILDING TIMES ON GOOD SITES (FIRM DRY GROUND)			
	Single Story		
(a)	5 Bays 9.8M MLC 60 (b)	8 Bays 15.2M MLC 30 (c)	12 Bays 22.6M MLC 16 (d)
Working Party	1 + 8	1 + 16	1 + 16
Time by Day (hours)	½	¾	1
Time by Night (hours)	¾	1	1 ¼

12. Final design.

a. Bays ______________

b. LNCG setting ______________

c. Packing required ______________

d. Bearing: HB ________ FB ________

e. Truck and trailer loads ______________

f. Manpower required ______________

g. Time to construct ______________

Double story MGB (2E+1 through 2E+12)

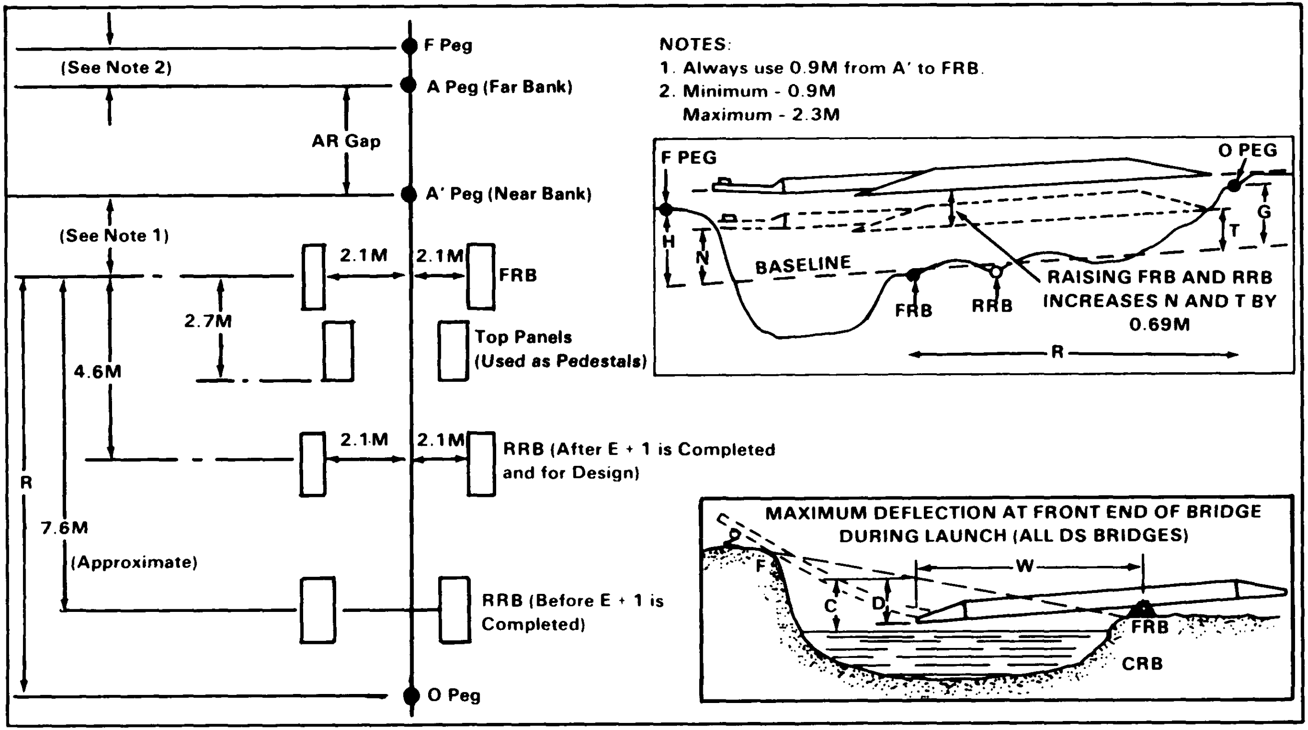


Figure 7-15. Double story MGB site layout (2E+1 through 2E+12 bays)

MGB DESIGN PROFORMA DS 2E+1 THROUGH 2E+12 BAYS

Grid ______ Recon Officer ______ Map Ref ______

Unit ______ MLC ______

1. Measure AR gap A to A' ______

NOTE: Use Table 1 to obtain the answers to the following:

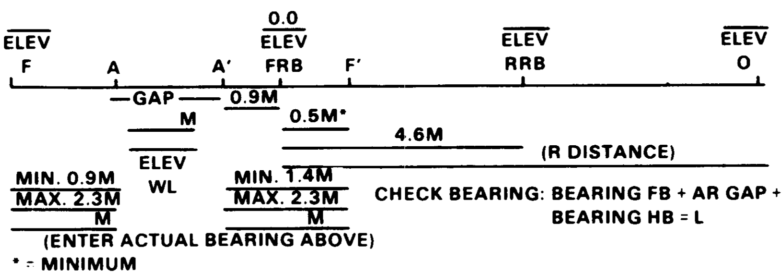
2. Select bridge 2E + bays

3. Bridge length ______

4. R distance ______

5. Nose construction ______

6. Key construction points, dimensions, and elevations:



7. Slope check. Ensure that the difference in elevation between the F' and F peg does not exceed 1/10th of the total bridge length. If it does, you are either going to have to crib up, undertake a major construction project, or find another centerline.

8. Calculate H, G, and C:

$$H = HtF + \frac{HtRRB \times (L - 0.5)}{4.6}$$

$$G = HtO - \frac{HtRRB \times R\ dist}{4.6}$$

$$C = HtWL - \frac{HtF \times W\ dist}{(L - 0.5)}$$

9. Rule 1. (If both bank heights > 0.6M, go to Rule 2.)

Choose a LNCG setting that ensures depth of C > depth of D.

LNCG settings permitted ______ ______ ______

10. Rule 2. Use a LNCG setting to give N > H and T > G.

Choose a LNCG setting so that N > H.

LNCG setting chosen ______

NOTE: Setting chosen cannot be lower than that chosen in Rule 1.

If $N \ngtr H$ and/or $T \ngtr G$, go to Rule 3.

11. Rule 3. Raise the FRB and RRB by 0.69M.

$N_{Rule\ 3} = N_{Rule\ 2} + 0.69M$ N = ___________

Check $T > G$ — Yes/No (Column p) T = ___________

If yes, design is all right.

If $N_{Rule3} \ngtr H$, go to Rule 4A.

If $T_{Rule3} \ngtr G$, go to Rule 4B.

TABLE 1

DS MGB DESIGN 2E + 1 THROUGH 2E + 12 BAYS (all measurements are in meters)

Site Dimensions						RULE 1 D for Given LNCG Setting with FRB in Lowest Position				Launch Design: RULE 2 Nose lift N, Using Various LNCG Settings and FRB in Lowest Position				Other Methods of Adjusting N and T: RULE 3 Raise FRB and RRB by 0.69M		RULE 4A Lowering to Increase N	4B Lowering FRB to Increase T
AR Gap (a)	Brg Lgth (b)	2E + # of Bays (c)	MLC (d)	Nose Const Note 1 (e)	R Dist (f)	W Dist (g)	Hole #6 Note 2 (h)	Hole #4 Note 2 (i)	Hole #2 Note 2 (j)	Tail Lift T (k)	Hole #6 Note 2 (l)	Hole #4 Note 2 (m)	Hole #2 Note 2 (n)	N (o)	T (p)	N (q)	T (r)
6.7-9.0	11.3	1	All DS MGBs are MLC 60	2N1	10.0	—	—	—	—	0.55	1.02	1.48	2.04	$N_{Rule\ 3} = N_{Rule\ 2} + 0.69M$	1.24	1.75 (1.24-G)	0.2 ($N_{Rule\ 3}$ - H)
8.5-10.8	13.1	2		3N1	11.9	—	—	—	—		0.89	1.53	2.30				
10.3-12.6	14.9	3			12.2	—	—	—	—		0.86	1.50	2.28				
12.2-14.5	16.8	4			13.1	—	—	—	—		0.81	1.45	2.23				
14.0-16.3	18.6	5		4N1	14.9	—	—	—	—	0.52	0.70	1.52	2.51		1.21	1.75 (1.21-G)	
15.8-18.1	20.4	6			14.9	—	—	—	—		0.65	1.48	2.47				
17.7-20.0	22.3	7			15.8	13.1	0.70	0.31	-0.09		0.53	1.36	2.36				
19.5-21.8	24.1	8		5N1	16.8	15.0	0.67	0.25	-0.20	0.46	0.49	1.48	2.69		1.15	1.75 (1.15-G)	
21.3-23.6	25.9	9			17.7	16.5	0.64	0.21	-0.30		0.33	1.35	2.55				
23.1-25.4	27.7	10			19.5	17.6	0.60	0.12	-0.40		0.25	1.28	2.49				
25.0-27.3	29.6	11		6N1	20.4	18.5	0.50	0.04	-0.43	0.40	0.16	1.23	2.63		1.09	1.75 (1.09-G)	
26.8-29.1	31.4	12			21.6	19.2	0.46	-0.06	-0.58		-0.20	1.02	2.47				

NOTES: 1. Each nose includes a light nose complete.

2. Nose cross girder setting — 6, 4, and 2 is the position of the cross girder resting on the 6th, 4th, and 2d hole from the bottom of the LNCG post.

12. Rule 4A. Lower RRB.

$N = N_{Rule\ 3}$ + answer to Column q

Check N > H

13. Rule 4B. Lower FRB.

$T = T_{Rule\ 3}$ + answer to Column r

Check T > G

14. Loads required.

From Table 2, determine the truck and trailer loads required for the bridge.

TABLE 2

MGB PALLETS DS												
Pallet	Bays											
Type	1	2	3	4	5	6	7	8	9	10	11	12
Erection	1	1	1	1	1	1	1	1	1	1	1	1
Bridge	5	5	5	6	6	6	7	7	7	8	8	8
Total	6	6	6	7	7	7	8	8	8	9	9	9

NOTE: More vehicles are required to transport personnel.

15. Construction time and manpower requirements.

From Table 3, extract the following information:

a. Construction time ______________

b. Manpower requirements ______________

TABLE 3

WORKING PARTIES AND BUILDING TIMES ON GOOD SITES			
	Double Story Single Span		
(a)	4 Bays 16.8M MLC 60 (b)	8 Bays 24.1M MLC 60 (c)	12 Bays 31.4M MLC 60 (d)
Working Party	1 + 24	1 + 24	1 + 24
Time by Day (hours)	¾	1	1 ½
Time by Night (hours)	1 ¼	1 ½	2

NOTES: 1. All timings exclusive of work on approaches and so forth.
2. Add 20 percent for unskilled personnel.
3. Add 30 percent for adverse site conditions.

16. Final design.

a. 2E + ______ Bays

b. LNCG setting ______________

c. FRB setting ______________

d. RRB setting ______________

e. Bearing: HB ________ FB ________

f. Truck and trailer loads ______________

g. Manpower required ______________

h. Time to construct ______________

Double story (2E+13 through 2E+22) without LRS

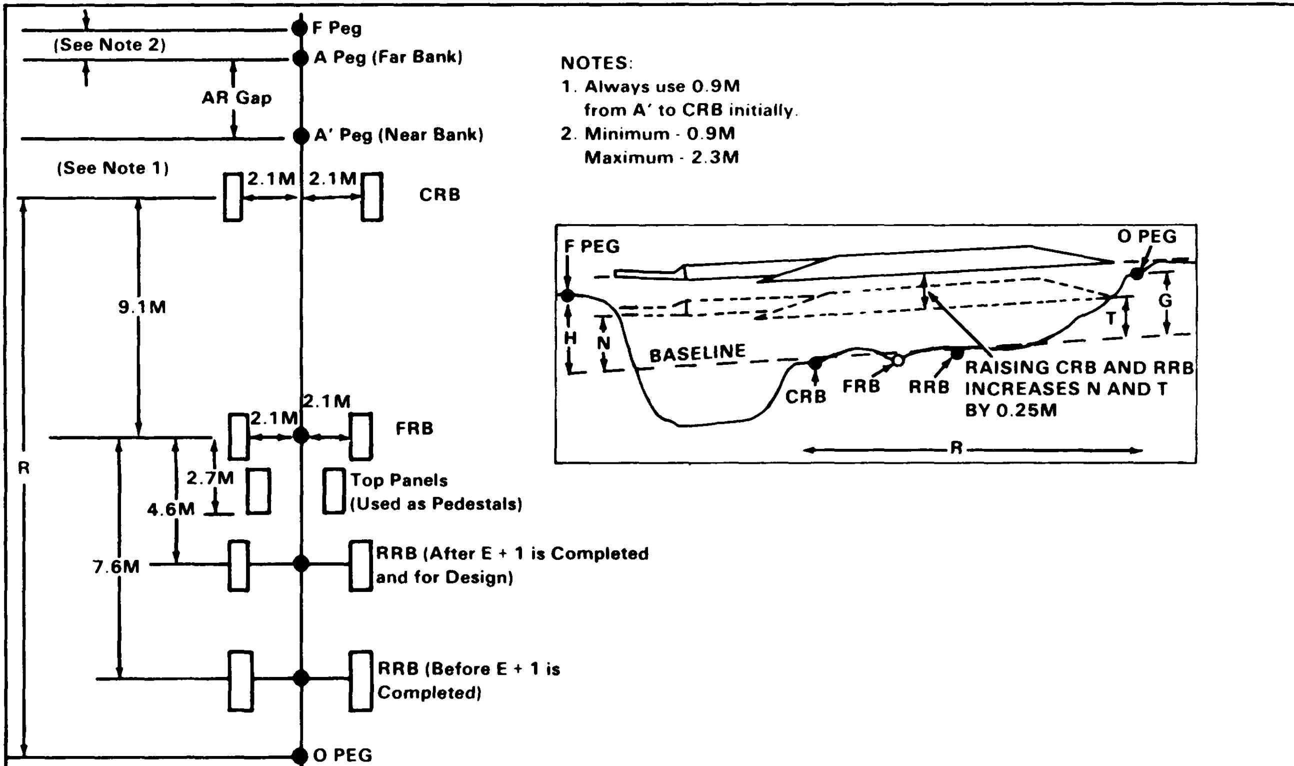


Figure 7-16. Double story MGB site layout (2E+13 through 2E+22 bays) without LRS

MGB DESIGN PROFORMA DS 2E+ 13THROUGH 2E+22 BAYS
(Without LRS)
Where Water Level or Any Obstructions
are at Least 2.7M Below Bank Heights

Grid ______________ Recon Officer ______________________________ Map Ref ______________

Unit ____ MLC ______________

1. Measure AR gap A to A' ______________

NOTE: Use Table 1 to obtain the answers to the following:

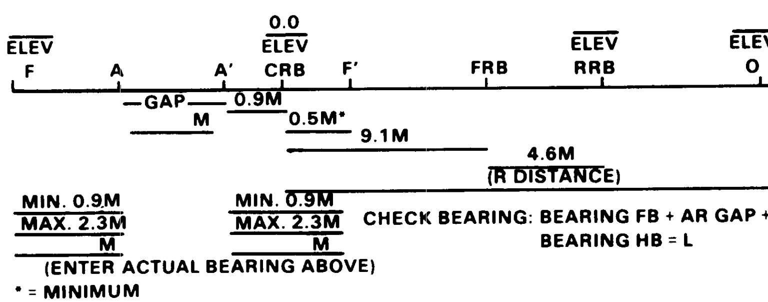
2. Select bridge ___2E + ______ Bays___

3. Bridge length ______________

4. R distance ______________

5. Nose construction ______________

6. Key construction points, dimensions, and elevations:



7. Slope check. Ensure that the difference in elevation between the F' and F peg does not exceed 1/10th of the total bridge length. If it does, you are either going to have to crib up, undertake a major construction project, or find another centerline.

8. Calculate H and G:

$$H = HtF + \frac{HtRRB \times (L - 0.5)}{13.7}$$

$$G = HtO - \frac{HtRRB \times R\ dist}{13.7}$$

9. Rule 1. Use a LNCG setting to give $N > H$ and $T > G$.

Choose a LNCG setting so that $N > H$. LNCG setting chosen __________

Then check if $T > G$.

If $N \not> H$ and/or $T \not> G$, then go to Rule 2.

10. Rule 2. Raise the CRB and RRB by 0.253M.

Check N > H — Yes/ No (Column k) Check T > G – Yes/No (Column l)

If yes, design is all right.

If N > H, go to Rule 3A.

If T > G, go to Rule 3B.

TABLE 1

DS MGB 2E + 13 THROUGH 2E + 22 BAYS WITHOUT LRS WHERE WATER OR ANY OBSTRUCTIONS ARE AT LEAST 2.7M BELOW BANK HEIGHTS

Site Dimensions						Launch Design							
						RULE 1 Nose Lift N with Nose Cross Girder at:				Other Methods of Adjusting N and T			
										RULE 2 Raise RRB and CRB by 0.25M		RULE 3 Lowering RRB to Increase N	RULE 3B Lowering CRB to Increase T
AR Gap (a)	Brg Lgth (b)	2E + # of Bays (c)	MLC (d)	Nose Const Note 1 (e)	R Dist (f)	Tail Lift T (g)	Hole #6 Note 2 (h)	Hole #4 Note 2 (i)	Hole #2 Note 2 (j)	N (k)	T (l)	N (m)	T (n)
28.6-30.9	33.2	13	50	6N1	27.4	0.40	-0.07	1.49	2.68	2.93	0.65	1.9 (0.82-G)	0.2 (2.93-H)
30.5-32.8	35.1	14			28.7	0.37	-0.38	1.00	2.65	2.90	0.62	1.9 (0.79-G)	0.2 (2.90-H)
32.3-34.6	36.9	15	40	7N1	28.7	0.34	-0.49	0.90	2.55	2.80	0.59	1.9 (0.76-G)	0.2 (2.80-H)
34.1-36.4	38.7	16			29.6	0.30	-0.61	0.79	2.43	2.68	0.55	1.9 (0.72-G)	0.2 (2.68-H)
35.9-38.2	40.5	17	30	8N1	29.3	0.27	-0.15	0.75	2.69	2.94	0.52	1.9 (0.69-G)	0.2 (2.94-H)
37.8-41.9	42.4	18			29.3	0.24	-1.33	0.54	2.54	2.79	0.49	1.9 (0.66-G)	0.2 (2.79-H)
39.6-40.1	44.2	19	24	6N1+3N2	34.8	0.21	-2.04	-0.19	1.72	1.97	0.46	1.9 (0.63-G)	0.2 (1.97-H)
41.4-43.7	46.0	20			38.4	0.21	-1.93	-0.31	1.61	1.86	0.46	1.9 (0.63-G)	0.2 (1.86-H)
43.3-44.6	47.9	21	20		38.4	0.18	-2.65	-0.52	1.17	1.42	0.43	1.9 (0.60-G)	0.2 (1.42-H)
45.1-47.4	49.7	22	16		40.1	0.15	-2.58	-0.68	1.04	1.29	0.40	1.9 (0.57-G)	0.2 (1.29-H)

NOTES: 1. Each nose includes a light nose complete

2. Nose cross girder setting – 6, 4, and 2 is the position of the cross girder resting on the 6th, 4th, and 2d hole from the bottom of the LNCG post.

11. Rule 3A. Lower RRB.

$N = N_{Rule\ 2}$ + answer to Column m

Check $N > H$

12. Rule 3B. Lower CRB.

$T = T_{Rule\ 2}$ + answer to Column n

Check $T > G$

13. Loads required.

From Table 2, determine the truck and trailer loads required for the bridge.

TABLE 2

MGB PALLETS DS wo/LRS										
Pallet Type	Bays									
	13	14	15	16	17	18	19	20	21	22
Erection	1	1	1	1	1	1	1	1	1	1
Bridge	9	9	9	10	10	10	11	11	11	12
Total	10	10	10	11	11	11	12	12	12	13

NOTE: More vehicles are required to transport personnel.

14. Construction time and manpower requirements.

From Table 3, extract the following information:

a. Construction time ____________

b. Manpower requirements ____________

TABLE 3

WORKING PARTIES AND BUILDING TIMES ON GOOD SITES			
	Double Story Single Span 13-22 Bays wo/LRS		
(a)	13 Bay 33.2M MLC 50 (b)	18 Bay 42.4M MLC 30 (c)	22 Bay 49.7M MLC 60 (d)
Working Party	1 + 24	1 + 24	1 + 24
Time by Day (hours)	1 ½	1 ¾	2
Time by Night (hours)	2	2 ¾	3

NOTES: 1. All timings exclusive of work on approaches and so forth.
2. Add 20 percent for unskilled personnel.
3. Add 30 percent for adverse site conditions.

15. Final design.

a. 2E + ______ Bays

b. LNCG setting ____________

c. CRB setting ____________

d. RRB setting ____________

e. Bearing

HB ____________

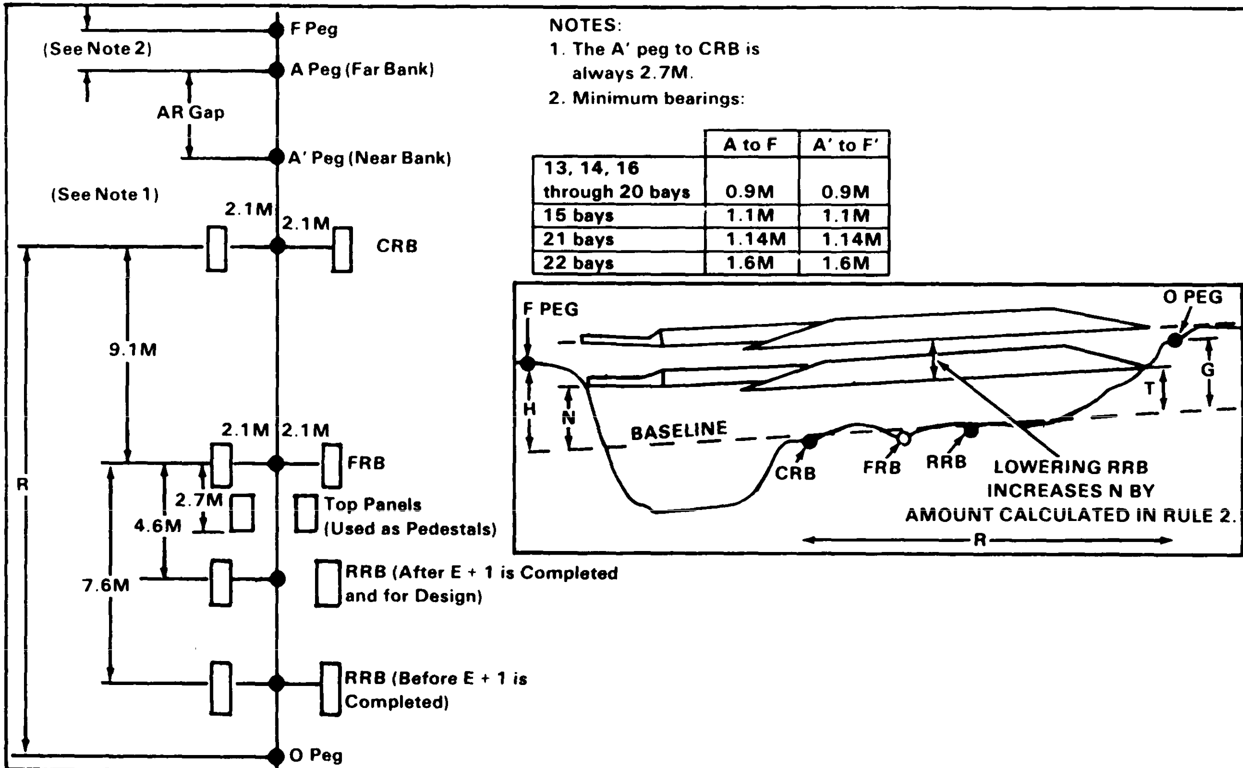
FB ____________

f. Truck and trailer loads ____________

g. Manpower required ____________

h. Time to construct ____________

Double story (2E+13 through 2E+22) with LRS



	A to F	A' to F'
13, 14, 16 through 20 bays	0.9M	0.9M
15 bays	1.1M	1.1M
21 bays	1.14M	1.14M
22 bays	1.6M	1.6M

Figure 7-17. Double story MGB site layout (2E+13 through 2E+22 bays) with LRS

MGB DESIGN PROFORMA DS 2E + 13 THROUGH 2E + 22 BAYS
(With LRS)
Where Water Level or Any Obstructions are at Least 3.7M Below Bank Heights

Grid ______ Recon Officer ______ Map Ref ______

Unit ______ MLC ______

1. Measure AR gap A to A' ______

NOTE: Use Table 1 to obtain the answers to the following:

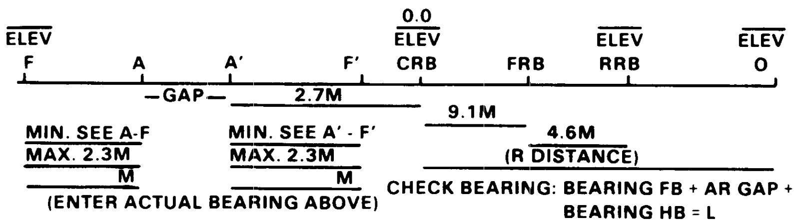
2. Select bridge 2E + ___ Bays

3. Bridge length ______

4. R distance ______

5. Nose construction ______

6. Key construction points, dimensions, and elevations:



Minimums

	A to F	A' to F'
13, 14, 16 through 20 bays	0.9M	0.9M
15 bays	1.1M	1.1M
21 bays	1.14M	1.14M
22 bays	1.6M	1.6M

7. Slope check. Ensure that the difference in elevation between the F' and F peg does not exceed 1/20th of the total bridge length. If it does, you are either going to have to crib up, undertake a major construction project, or find another centerline.

8. Calculate H and G:

$$H = HtF + \frac{HtRRB \times (L - 0.5)}{13.7}$$

$$G = HtO - \frac{HtRRB \times R\ dist}{13.7}$$

9. Rule 1. Use a LNCG setting to give N > H and T > G.

Choose a LNCG setting so that N > H.   LNCG setting chosen ____________

If N ≯ H, then go to Rule 2.

If T ≯ G, choose another site or prepare to dig out under HB end of bridge prior to launch.

10. Rule 2. Lower RRB

$N = N_{Rule\ 1}$ + answer to Column k

Check N > H

TABLE 1

DS MGB 2E + 13 THROUGH 2E + 22 BAYS WITH LRS WHERE WATER OR ANY OBSTRUCTIONS ARE AT LEAST 3.7M BELOW BANK HEIGHTS

Site Dimensions						Launch Design				
						RULE 1 Nose Lift N with Nose Cross Girder at:				RULE 2 Lowering RRB to Increase N
AR Gap (a)	Brg Lgth (b)	2E + # of Bays (c)	MLC (d)	Nose Const Note 1 (e)	R Dist (f)	Tail Lift T (g)	Hole #6 Note 2 (h)	Hole #4 Note 2 (i)	Hole #2 Note 2 (j)	N (k)
28.6-31.4	33.2	13	All MLC 60	7N1	27.4	-0.40	0.48	1.87	3.52	1.9 (0.82-G)
30.5-33.3	35.1	14			28.7	-0.37	0.31	1.72	3.35	1.9 (0.79-G)
32.3-34.7	36.9	15			28.7	-0.34	0.25	1.64	3.29	1.9 (0.76-G)
34.1-36.9	38.7	16		8N1	29.6	-0.30	-0.82	1.27	3.25	1.9 (0.72-G)
35.9-38.7	40.6	17			29.3	-0.27	-0.77	1.12	3.10	1.9 (0.69-G)
37.8-40.6	42.4	18		6N1+3N2	29.3	-0.21	-1.06	0.80	2.71	1.9 (0.66-G)
39.8-42.4	44.2	19			34.8	-0.21	-1.46	0.40	2.32	1.9 (0.63-G)
41.4-44.2	46.0	20			38.4	-0.21	-1.75	0.11	2.03	1.9 (0.63-G)
43.3-45.6	47.9	21			38.4	-0.18	-2.08	0.05	1.75	1.9 (0.60-G)
45.1-46.5	49.7	22			40.1	-0.15	-2.44	-0.31	1.40	1.9 (0.57-G)

NOTES: 1. Each nose includes a light nose complete.
2. Nose cross girder setting — 6, 4, and 2 is the position of the cross girder resting on the 6th, 4th, and 2d hole from the bottom of the LNCG post.

11. Loads required.

From Table 2, determine the truck and trailer loads required for the bridge.

TABLE 2

MGB PALLETS DS w/LRS										
Pallet	Bays									
Type	13	14	15	16	17	18	19	20	21	22
Erection	1	1	1	1	1	1	1	1	1	1
Bridge	9	9	9	10	10	10	11	11	11	12
Link	2	2	2	2	2	2	2	2	2	2
Total	12	12	12	13	13	13	14	14	14	15

NOTE: More vehicles are required to transport personnel.

12. Construction time and manpower requirements.

From Table 3, extract the following information:

a. Construction time ______________

b. Manpower requirements ______________

TABLE 3

WORKING PARTIES AND BUILDING TIMES ON GOOD SITES			
	Double Story Single Span 13-22 Bays w/LRS		
(a)	13 Bays 33.2M MLC 60 (b)	18 Bays 42.4M MLC 60 (c)	22 Bays 49.7M MLC 60 (d)
Working Party	2 + 32	2 + 32	2 + 32
Time by Day (hours)	2	2 3/4	3
Time by Night (hours)	3	4	4 1/2

NOTES: 1. All times exclusive of work on approaches and so forth.
2. Add 20 percent for unskilled personnel.
3. Add 30 percent for adverse site conditions.

13. Final design.

a. 2E + ______ Bays

b. LNCG setting ______________

c. CRB setting ______________

d. RB setting ______________

e. Bearing

HB ______________

FB ______________

f. Truck and trailer loads ______________

g. Manpower required ______________

h. Time to construct ______________

Truss

The Bailey bridge trusses are formed from 10-foot panels and may be constructed in any configuration shown in Table 7-28.

Table 7-28. Truss/story configuration

TYPE		NOMENCLATURE	ABBREVIATION
TRUSS	STORY		
Single	Single	Single-Single	SS
Double	Single	Double-Single	DS
Triple	Single	Triple-Single	TS
Double	Double	Double-Double	DD
Triple	Double	Triple-Double	TD
Double	Triple	Double-Triple	DT
Triple	Triple	Triple-Triple	TT

Site Reconnaissance

A site reconnaissance must be conducted. The construction area must provide enough space for equipment layout (Figure 7-18) and for the bridge site layout (Figure 7-19).

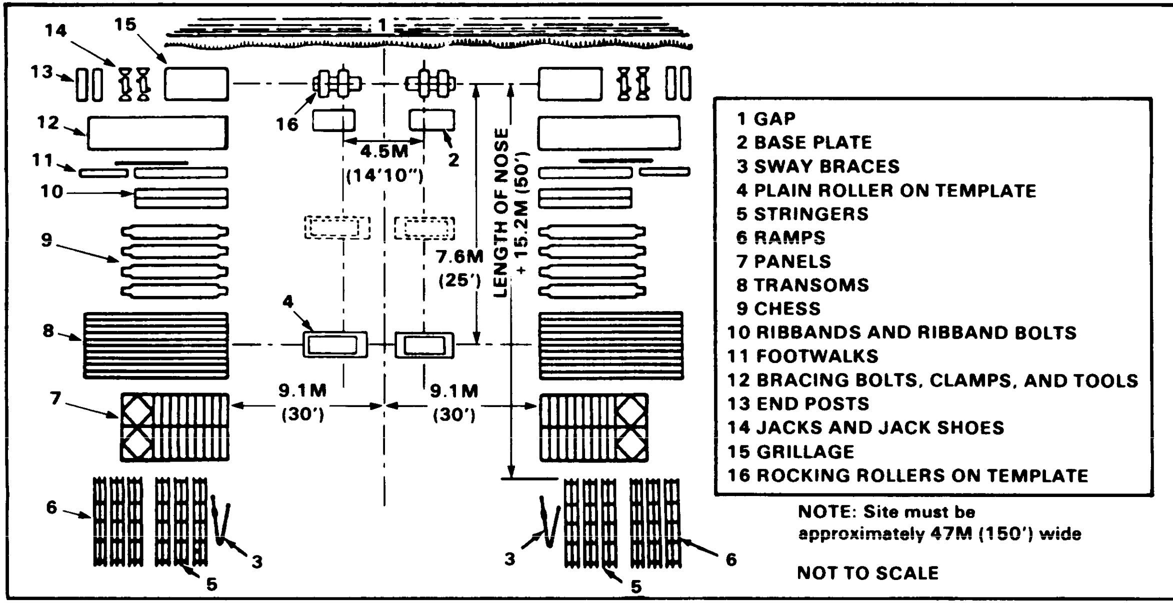


Figure 7-18. Layout of bridging equipment at site

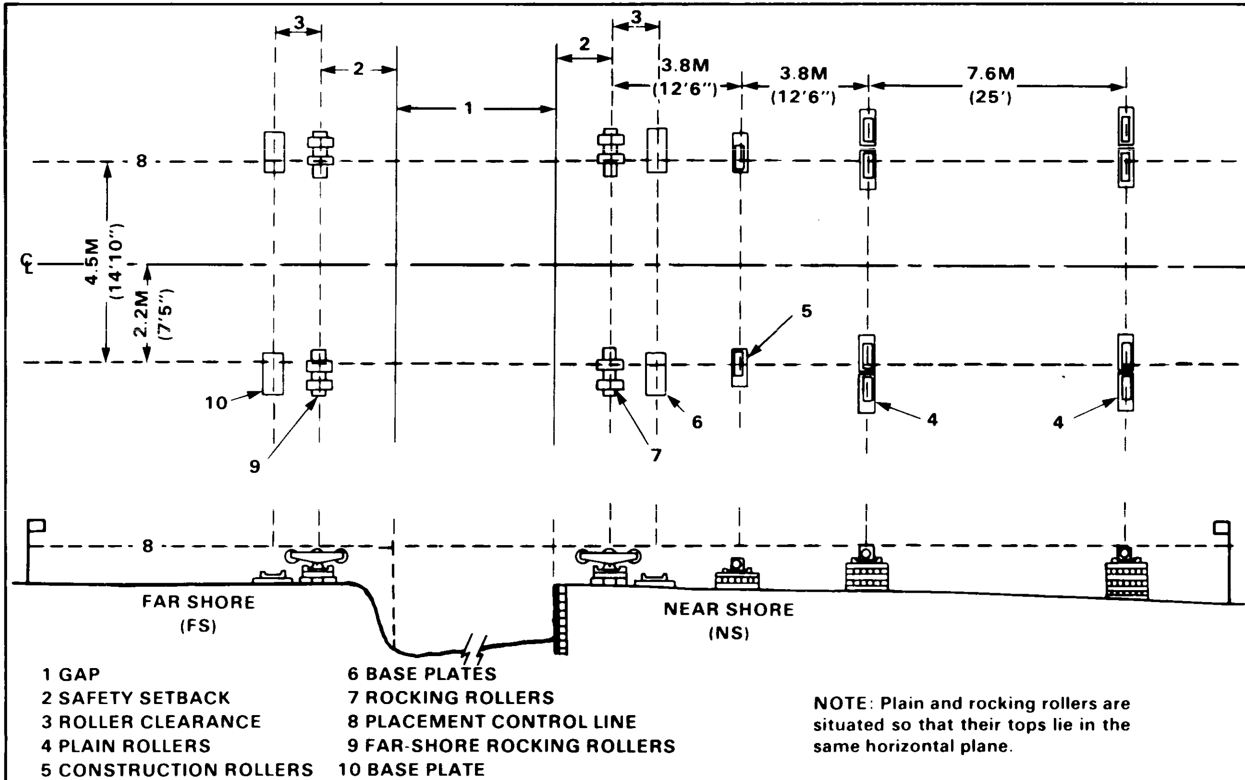


Figure 7-19. Plan and profile views of a typical roller layout for a triple- truss or multistory bridge

Bridge Design (with example)

See Figure 7-20 and Tables 7-29 through 7-45 (pages 7-54 through 7-68).

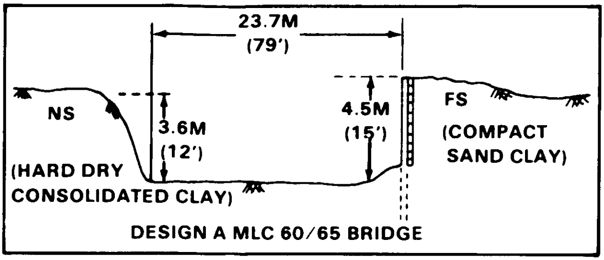


Figure 7-20. Site profile example

I. INITIAL BRIDGE DESIGN
(Steps 1 through 6)

1. Gap as measured during reconnaissance — 1. 79'

2. Safety setback
   a. Prepared abutment = a constant of 3.5'
   b. Unprepared abutment = 1.5 x bank height

2. NS 1.5 x 12 = 18
   FS 3.5'

3. Initial roller clearance
Always a constant of 2.5'

3. NS 2.5'
   FS 2.5'

4. Initial bridge length:
   a. Add Steps 1 + 2 + 3 — 4a. = 105.5'
   b. If the value determined in Steps 4a is not a multiple of 10', round UP to the next highest 10' — 4b. 110'

5. Initial truss/story type (Table 7-29) — 5. DD

6. Initial bridge class (Table 7-29) — 6. 65/70
   a. Class must meet or exceed the requirements designated in the mission statement.
   b. The truss/story type selected is always based upon a NORMAL CROSSING unless otherwise directed by the Tactical Commander.

Table 7-29 Classes of Bailev bridge M2 (by type of construction and type of crossing)

TYPE OF CONSTRUCTION	RATING	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
		SPAN (FT)																		
SS	N	30	24		20	20	16	12	8											
		30		24																
	C	42	36	33	30	24	20	16	12											
		37	34	31	29															
	R	47	40	36	33	30	24	19	14											
		42	38	35	32	30														
DS	N			75	75	60	50	40	30	20	16	12	8							
				70	65	60	55	45	30											
	C			83	77	68	60	50	37	30	23	18	14							
				76	73	69	60	50	39	32										
	R			88	85	78	66	55	42	34	27	21	17							
				84	79	75	64	55	44	36	30									
TS	N						85	65	50	35	30	20	16	12	8	4				
							80	65	55	40	35									
	C						95	74	57	47	38	31	24	18	15	10				
							90	75	60	49	41	33								
	R						100*	82	64	52	43	35	29	22	17	13				
							90*	82	66	54	45	38	31							
DD	N								80	65	45	35	30	24	16	12	8			
									80	70	55	45	35							
	C								86	72	57	47	39	32	25	19	15			
									90	76	61	50	42	35						
	R								96	80	64	53	44	36	30	24	18			
									90	83	68	56	48	40	33					
TD	N									90	75	55	45	35	30	20	16	12		
										90*	80	60	55	45	35					
	C									100*	83	65	57	47	37	31	24	18		
										90*	90*	72	62	51	41	34				
	R									100*	91	74	64	54	45	37	29	22		
										90*	90*	80	70	58	48	40	32			
DT	N											70	70	60	55	45	35	30	20	16
												80	70	60	55	50	45	35		
	C											80	80	77	69	57	48	39	32	25
												90*	90*	85	78	64	58	43	36	
	R											90	88	85	80	64	55	46	38	31
												90*	90*	90*	89	74	60	51	43	35
TT	N														80	70	55	45	35	24
															75	70	60	55	40	
	C														100	80	66	59	48	38
															90*	90*	75	66	52	43
	R														100*	90	77	68	55	46
															90*	90*	87	77	62	51

Note:
N=Normal
C=Caution
R=Risk
1 Upper figure represents wheeled-load class
2 Lower figure represents tracked-load class
* Limited by roadway width

7. Selection of grillage.

a. Safe soil bearing (Table 7-30)

7a. NS 5 tons/ft^2

FS 3 tons/ft^2

Table 7-30. Safe bearing capacity for various soils

SOIL DESCRIPTION	BEARING VALUES (tons per sq ft)
Hardpan overlying rock	12
Very compact sandy gravel	10
Loose gravel and sandy gravel, compact sand and gravelly sand; very compact sand, inorganic silt soils	6
Hard dry consolidated clay	5
Loose coarse-to-medium sand; medium-compact fine sand	4
Compact sand clay	3
Loose fine sand; medium-compact sand, inorganic silt soils	2
Firm or stiff clay	1.5
Loose saturated-sand clay soils; medium-soft clay	1

b. Safe soil pressure (Table 7-31)

If the soil bearing capacity values determined in step 7a are not listed in Table 7-31, round DOWN to the closest listed. Use these values for step 7c.

7b. NS 3.5 tons/ft^2

FS 2.5 tons/ft^2

c. Grillage required.

7c. NS Type 1

FS Type 1

Table 7-31. Types of grillage needed

TYPE OF CONSTRUCTION	SAFE SOIL PRESSURE (tons per sq ft)	SPAN (FT) 30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
SS	0.5	6.7	5.6.7	5.6.7	4	4	4	4	4											
	1.0	4	3	3	1	1	1	1	1											
	2.0	1	None	None	None	None	1	1	1											
	2.5	None	None	None	None	None	None	None	None											
	3.5	None	None	None	None	None	None	None	None											
DS	0.5			6	6	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7							
	1.0			6.7	5.6.7	4	4	4	4	4	4	4	4							
	2.0			4	3	1	1	1	1	1	1	1	1							
	2.5			1	1	1	1	1	1	1	1	1	1							
	3.5			1	None	None	None	None	None	1	1	1	1							
TS	0.5						6	6	6.7	6.7	6.7	6.7	6	6.7	6.7					
	1.0						6.7	5.6.7	4	4	4	4	4	4	4					
	2.0						4	3	1	1	1	1	2	1	1					
	2.5						3	1	1	1	1	1	1	1	1					
	3.5						1	1	1	1	1	1	1	1	1					
DD	0.5								6	6	6	6	6	6	6	6	6			
	1.0								6.7	5.6.7	5.6.7	4	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7			
	2.0								4	4	3	2	2	4.6.7	2	4.6.7	2			
	2.5								3	1	1	1	1	2	1	2	1			
	3.5								1	1	1	1	1	1	1	1	1			
TD	0.5									6	6	6	6	6	6	6	6	6		
	1.0									6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7		
	2.0									4.6.7	4.6.7	4.6	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7		
	2.5									4.6.7	3	2	2	2	2	2	2	2		
	3.5									1	1	1	2	2	2	2	2	2		
DT	0.5											6		6	6	6	6	6	6	6
	1.0											6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
	2.0											6.7	4.6.7	4.6.7	6.7	6.7	6.7	4.6.7	4.6.7	4.6.7
	2.5											6.7	4.6.7	4.6.7	6.7	6.7	6.7	4.6.7	4.6.7	4.6.7
	3.5											2	2	2	2	2	2	2	2	2
TT	0.5															6	6	6	6	6
	1.0															6.7	6.7	6.7	6.7	6.7
	2.0															6.7	6.7	6.7	6.7	4.6.7
	2.5															6.7	6.7	6.7	6.7	4.6.7
	3.5															6.7	6.7	2	2	2

8. Determine adjusted bridge length:

a. Distance required for new roller clearance (Table 7-32).

8a. NS 4.5'

FS 4.5'

b. Add steps 1 + 2 + 8a.

8b. = 109.5'

c. If the value determined in step 8b is not a multiple of 10', round UP to the next highest 10'.

8c. 110'

NOTE: Compare the value determined in step 8c to the value previously calculated in step 4b. If different, you must redesign the bridge as outlined in steps 9 through 12. If not, use this as your final bridge length and go directly to step 13.

Same as initial, go to step 13.

Table 7-32. Roller clearance and grillage height

GRILLAGE TYPE	OVERALL HEIGHT (IN)	BASE-PLATE HEIGHT (IN)	ROLLER CLEARANCE (FT)
1	6	6	4.5
2	15	6	4.5
3	11	11	3.5
4	17	11	4.5
5	16	16	3.5
6	26	20	3.5
7	13	13	3.5

FINAL BRIDGE

Try 1 **Try 2**

9. Final truss/story type (Table 7-29, page 7-53).

9. ______ | ______

10. Final bridge class (Table 7-29, page 7-53).

a. Class must meet or exceed the requirements designated in the mission statement.

b. The truss/story type selected is always based upon a NORMAL CROSSING unless otherwise directed by the Tactical Commander.

10. ______ | ______

11. Final grillage selection:

a. Safe soil bearing (Table 7-30, page 7-54).

11a. NS ______ | ______

FS ______ | ______

b. Safe soil pressure (Table 7-31, page 7-55). If the soil bearing capacity values determined in step 11a are not listed in Table 7-31, round DOWN to the closest listed. Use these values for step 11c.

11b. NS ______ | ______

FS ______ | ______

c. Grillage required.

11c. NS **Type** ______ | **Type** ______

FS **Type** ______ | **Type** ______

12. Determine final bridge length:

a. Distance required for new roller clearance (Table 7-32).

12a. NS ____ | ____

FS ____ | ____

b. Add steps 1 + 2 + 12a.

12b. ____ = ____ | ____ = ____

c. If the value determined in step 12b is not a multiple of 10', round UP to the next highest 10'.

12c. ____ ∅ ____ | ____ ∅ ____

NOTES: 1. For Try 1: Compare the value in step 12c to the value in step 8c. If the same, go to step 13. If different, compare this value (step 12c) to the value in step 4b:

a. If these are the same, the designer is placed in a judgmental situation. Repeating the design sequence under the Try 2 column, using the bridge length from step 12c of Try 1 column, will place you in an endless circle unless the final bridge length can be reduced. In these cases, you will have to either overdesign a longer final bridge as shown in the Try 1 column or choose a higher number grillage than originally selected in step 7c. The latter procedure could reduce the roller clearance on one or both banks so that the required bridge length/final truss/story may be at the minimum to do the job. You may choose a higher number grillage than allowed within step 11c, however, you must be careful not to exceed the BP and RRT capacities listed in FM 5-277, Tables 4-2 and 4-3. Make your decision and go to step 13.

b. If these are different, you must redesign the bridge by entering the Try 2 column with the bridge length from step 12c of Try 1 columnto determine the truss/story type in step 9.

2. For Try 2 and Higher: Compare the value in step 12c to the value in step 12c of the previous Try ___ column. If the same, go to step 13. If different, use the same methodology and repeat the design sequence until the value obtained in a particular step 12c matches the value in step 12c of the previous design. Then go to step 13.

13. Slope check.

a. The maximum allowable bank height difference is 1 to 30. Therefore, maximum allowable bank height difference = final bridge length ÷ 30

13a. 110 ÷ 30 = 3.7' > 3'

b. If

(1) The step 13a value ≥ actual bank height difference, the slope is all right.

13b. (GO) / NO GO (circle)

Remarks:

(2) The step 13a value < actual bank height difference:

(a) Choose another site, or

(b) Crib up/excavate the FS or NS until the bridge slope is within acceptable limits.

14. Final bridge requirements:

Length 110'

Truss/story type DD

Class 65/70

Grillage:

NS Type 1

FS Type 1

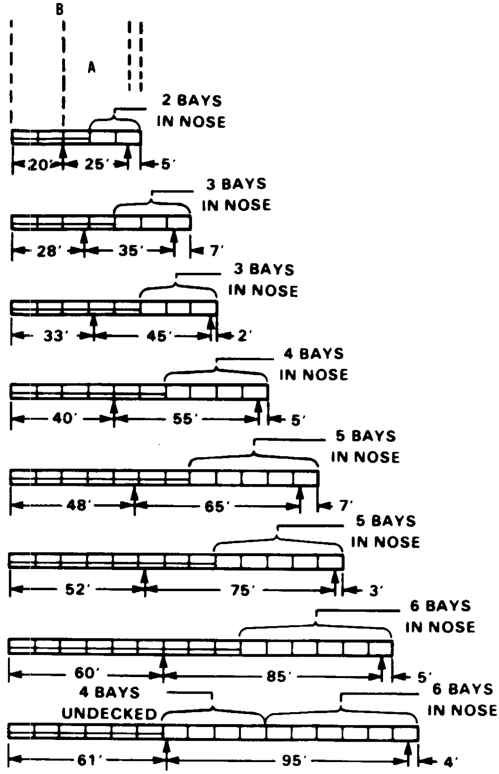
15. Launching nose composition (use Tables 7-33 through 7-39, pages 7-58 through 7-64 dependent upon truss/story type).

15. 7 bays single truss

NOTE: Design sequence continues on page 7-64.

Table 7-33. Launching-nose composition for SS bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
30	11.0	3
40	14.5	4
50	17.5	5
60	21.0	8
70	25.0	12
80	27.5	15
90	31.5	25
100	28.5	33



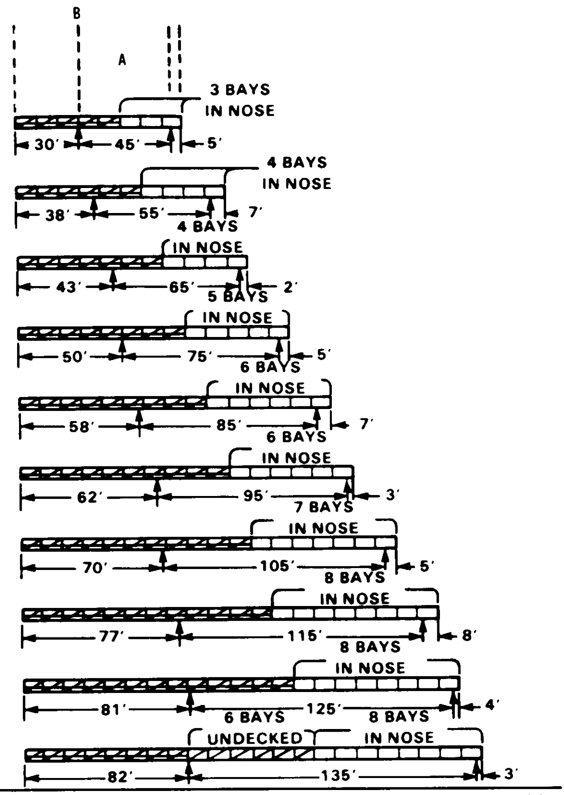
SINGLE TRUSS WITH DECKING

SINGLE TRUSS

NOTES: A. Distance between near and far bank rocking rollers.
B. Balance point of bridge, ready for launching.

Table 7-34. Launching-nose composition for DS bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
50	24.0	4
60	25.0	7
70	28.5	9
80	33.0	14
90	37.0	20
100	40.5	23
110	45.0	33
120	49.5	45
130	53.0	52
140	47.5	63

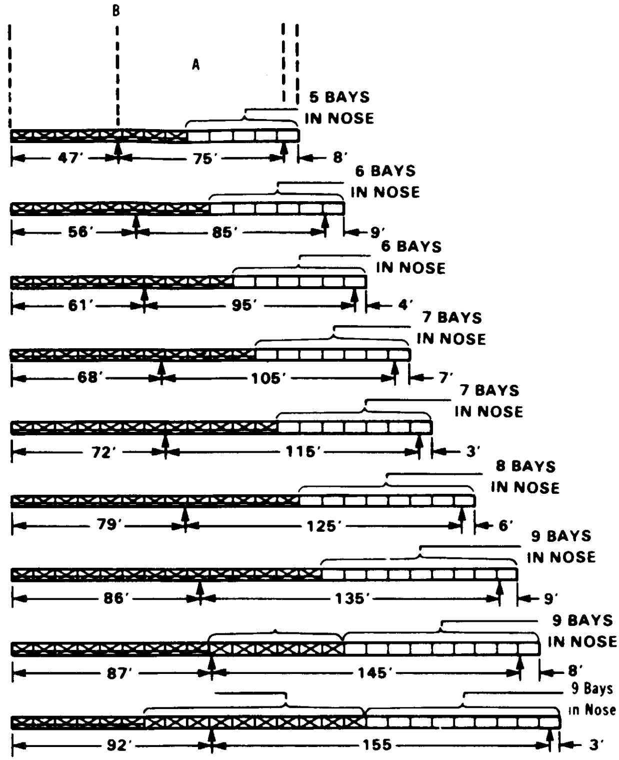


▨ DOUBLE TRUSS WITH DECKING ▨ DOUBLE TRUSS ▭ SINGLE TRUSS

NOTES: A. Distance between near and far bank rocking rollers.
B. Balance point of bridge, ready for launching.

Table 7-35. Launching-nose composition for TS bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
80	43.4	13
90	42.5	19
100	46.5	22
110	51.5	30
120	55.5	34
130	60.5	47
140	65.5	62
150	60.5	70
160	59.0	77

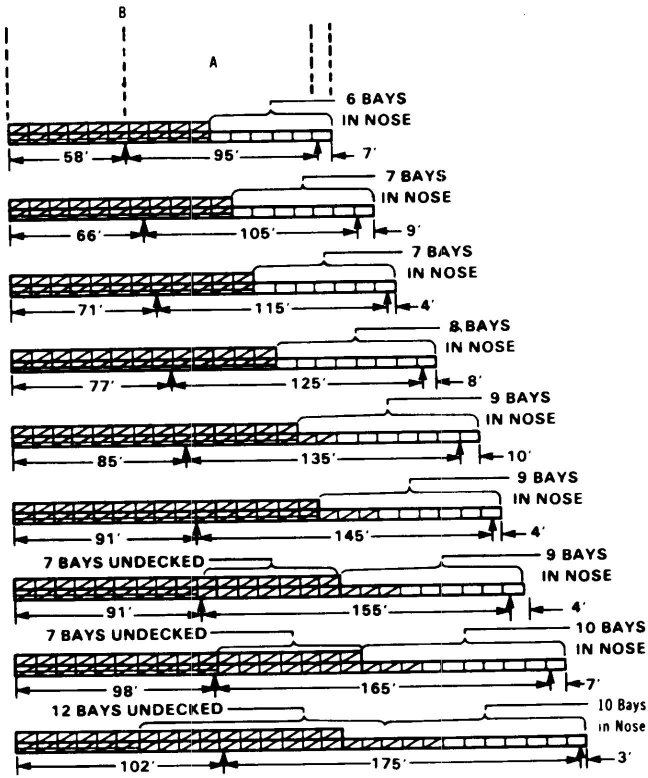


TRIPLE TRUSS WITH DECKING   TRIPLE TRUSS   SINGLE TRUSS

NOTES: A. Distance between near and far bank rocking rollers.
B. Balance point of bridge, ready for launching.

Table 7-36. Launching-nose composition for DD bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
100	60.5	17
110	59.0	22
120	63.5	24
130	69.0	31
140	76.0	38
150	81.5	41
160	75.5	45
170	81.0	57
180	76.0	68



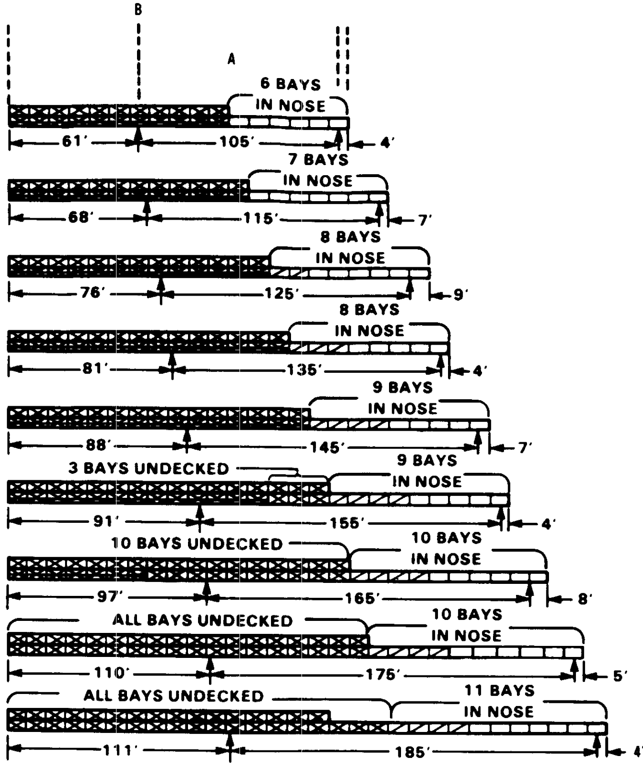
DOUBLE TRUSS WITH DECKING DOUBLE TRUSS SINGLE TRUSS

NOTES: A. Distance between near and far bank rocking rollers.

B. Balance point of bridge, ready for launching.

Table 7-37. Launching-nose composition for TD bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
110	79.4	17
120	87.1	22
130	86.0	29
140	93.0	31
150	100.0	39
160	101.5	42
170	98.0	53
180	93.5	60
190	91.5	78



TRIPLE TRUSS WITH DECKING   TRIPLE TRUSS   DOUBLE TRUSS   SINGLE TRUSS

NOTES: A. Distance between near and far bank rocking rollers.
B. Balance point of bridge, ready for launching.

Table 7-38. Launching-nose composition for DT bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
130	104.2	25
140	101.0	27
150	109.0	34
160	117.0	42
170	119.0	45
180	118.5	47
190	111.0	60
200	110.5	72
210	112.0	80

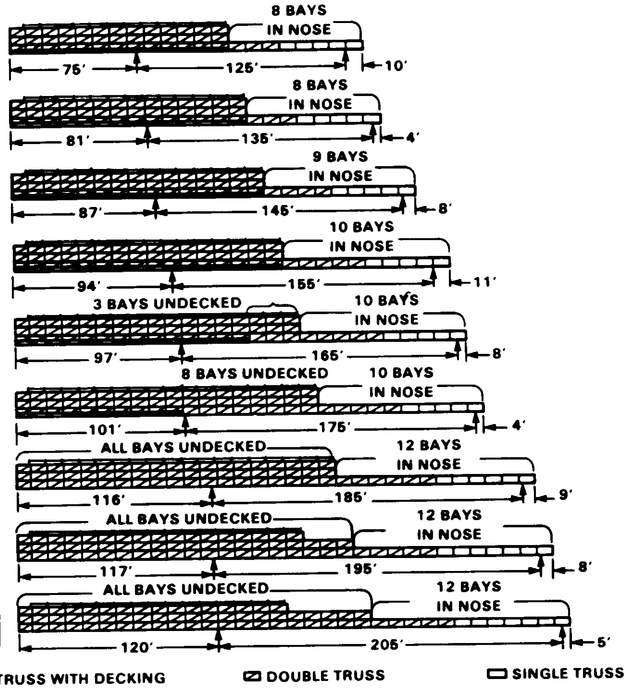
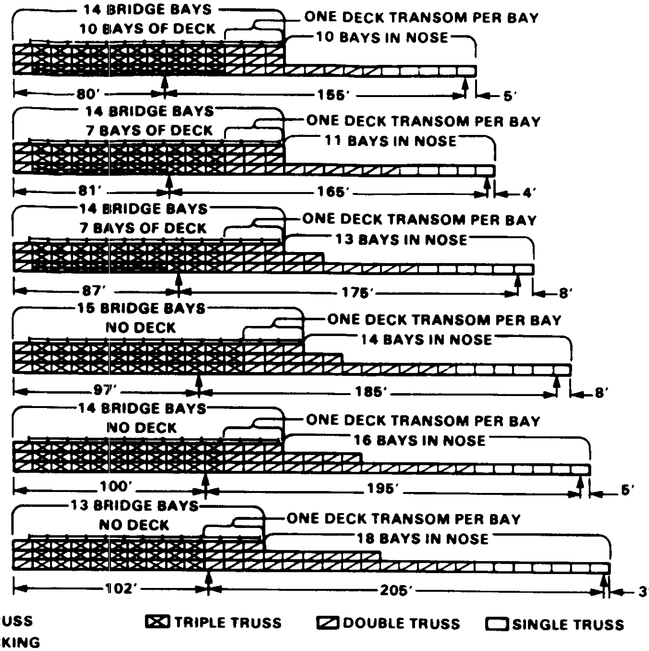


Table 7-39. Launching-nose composition for TT bridges

SPAN (FEET)	LAUNCHING WT (TONS)	SAG (INCHES)
160	126.5	40
170	112.5	45
180	119.0	50
190	116.0	62
200	115.0	72
210	113.5	80



16. Placement of launching nose links:

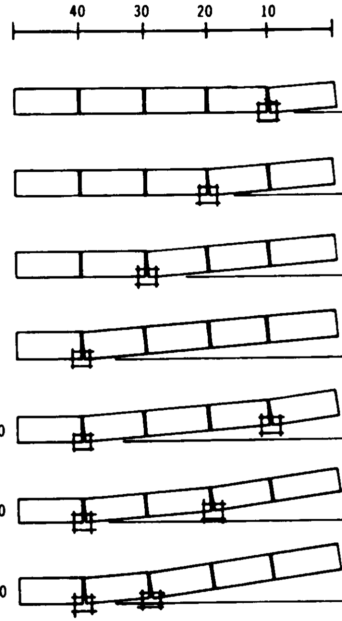
a. Sag (use the same table as step 15). 16a. 22"

b. Safety sag (constant of 6"). 16b. + 6"

c. Lift required (add steps 16a + 16b). 16c. = 28"

d. Position of launching nose link (Table 7-40). 16d. 30' from tip of nose

Table 7-40. Upturned skeleton launching nose



LAUNCHING LINK INTERVAL FROM TIP OF NOSE (FT)	RESULTING VERTICAL LIFT IN TIP OF LAUNCHING NOSE (IN)
10	13.5
20	27
30	40.5
40	54
10 and 40	67.5
20 and 40	81
30 and 40	94.5

17. Rocking rollers needed (Table 7-41). 17. NS 4

FS 2

Table 7-41. Number of rocking rollers needed for bridge

TYPE OF CONSTRUCTION	SPAN (FT)	NEAR BANK	FAR BANK
SS	30-100	2	2
DS	50-80	2	2
	90-100	2	2
	110-140	4	2
TS	80-160	4	2
DD	100-130	4	2
	140-180	4	4
TD	110-120	4	2
	130-190	4	4
DT	130-210	4	4
TT	160-210	4	4

18. Plain rollers needed:

a. The SS and DS bridges only have two rollers per row. All others have four rollers per row. Use Table 7-42 to determine the number of rows and then multiply.

18a. 12

Table 7-42. Rows of plain rollers needed for bridge

SPAN (FT)	TYPE OF CONSTRUCTION SS	DS	TS	DD	TD	DT	TT
30-50	1	1					
60-80	2	2	2				
90	3	2	2				
100	3	3	2	2			
110-120		3	3	3	3		
130		3	3	3	3	3	
140		3	4	4	3	3	
150			4	4	4	4	
160			4	4	4	4	3
170				4	4	4	3
180				4	5	4	4
190					5	5	4
200-210						5	4

b. Add two more plain rollers to allow for your construction roller needs.

18b. +2

c. Add steps 18a + 18b.

18c. = 14

19. Jacks required (Table 7-43).

19. 4

NOTE: Only one end of the bridge will be jacked down at any one time.

Table 7-43. Number of jacks

TYPE OF CONSTRUCTION	SPAN (FT)	JACKS NEEDED AT EACH END OF BRIDGE
SS	30-100	2
DS	50-140	4
TS	80-140	4
	150-160	6
DD	100-120	4
	130-180	6
TD	110-140	6
	150-190	8
DT	130	6
	140-180	8
	190-210	10
TT	160-170	10
	180-210	12

20. Ramp requirements.

a. Slope requirements (check one).

(1) Final bridge class ≤ 50 = 1 to 10. ( )

(2) Final bridge class > 50 = 1 to 20. (x)

b. Support for end ramp (check one).

(1) Final bridge class ≤ 67 = 2 chess. ( )

(2) Final bridge class > 67 = 4 chess. (x)

c. Midspan ramp supports (check one).

(1) Final bridge class ≤ 44 = not needed. ( )

(2) Final bridge class > 44 = needed. (x)

d. Pedestal supports (check one).

(1) Not needed. ( )

(2) Needed. (x)

NOTE: See FM 5-277 for criteria and drawings. Ramp lengths must be estimated from the site sketch.

e. Support for end transom (check one).

(1) Final bridge class ≤ 39 = not needed. ( )

(2) Final bridge class > 39 = needed. (x)

21. Personnel required (Table 7-44). 21. 5/66

NOTE: The differences between manpower and crane construction.

Table 7-44. Organization of assembly party

DETAIL	TYPE OF CONSTRUCTION																	
	SS		DS		TS		DD		TD		DT		TT		DT		TT	
	CONSTRUCTION BY MANPOWER ONLY														USING ONE CRANE*			
	NCO	EM	NCO	EM	NCO	EM	NCO	EM	NCO	EM	NCO	EM	NCO	EM	NCO	EM	NCO	EM
Crane															0	3	0	3
Truck driver																1		1
Crane operator																1		1
Hook man																1		1
Panel	1	14	1	14	2	28	2	32	3	50	3	50	3	68	3	30	3	30
Carrying		12		12		24		28		44		44		60		24		24
Pin		2		2		4		4		6		6		8		6		6
Transom	1	9	1	10	1	10	1	10	1	10	2	28	2	28	2	20	2	20
Carrying		8		8		8		8		8		24		24		16		16
Clamp		1		2		2		2		2		4		4		4		4
Bracing	1	4	1	6	1	8	1	12	1	20	1	32	1	40	1	32	1	38
Sway brace		2		2		2		2		2		6		6		6		6
Raker		2		2		2		2		2		2		2		2		2
Bracing frame				2		2		4		4		8		8		10		8
Chord bolt								4		8		10		14		10		14
Tie plate						2				4				4				4
Overhead support												6		6		4		4
Decking	1	12	1	12	1	12	1	12	1	12	1	12	1	12	1	12	1	12
Stringer		8		8		8		8		8		8		8		8		8
Chess and ribband		4		4		4		4		4		4		4		4		4
Total	4	39	4	42	5	58	5	66	6	92	7	122	7	148	7	97	7	103

* Normally, a crane is not used for single- or double-story assembly.

22. Assembly time (Table 7-45). 22. 5 hr

NOTE: This time allows for ideal bridge construction conditions and does not allow for site preparation or roller layout.

Table 7-45. Estimated time for assembly

SPAN (FT)	TYPE OF CONSTRUCTION — CONSTRUCTION BY MANPOWER ONLY							USING ONE CRANE	
	SS	DS	TS	DD	TD	DT	TT	DT	TT
	TIME (HR)								
40	1 1/2								
60	1 3/4	2							
80	2	2 1/2	3						
100	2 1/4	3	3 1/2	4 1/4					
120		3 1/2	4	5	6 3/4				
140		3 3/4	4 1/2	5 3/4	7 1/2	11 3/4		10 1/2	
160			5	6 1/4	8 1/2	13 1/4	19	11 3/4	16 1/4
180				7	9 1/2	14 3/4	21 1/4	13 1/4	18 1/4
200						16 1/4	24	14 1/2	20 1/2

HASTY NONSTANDARD FIXED BRIDGES

This paragraph describes the procedures for designing a hasty, one-lane fixed bridge. MLC 30 or MLC 70.

NOTE: This is only a temporary design. Refer to TM 5-312 for design of a semipermanent timber trestle bridge.

Nomenclature

Superstructure
The load carrying component of the superstructure is the stringer system, which may be rectangular timber, round timber, or steel beams.

Substructure
Intermediate supports are required if the available material is not long enough or of sufficient capacity to cross the required gap. Abutments are always required a each end of the bridge.

Superstructure Design - Timber Stringers

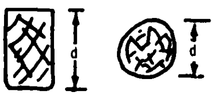
Step 1. Determine the gap length and MLC (either MLC 30 or MLC 70).

Step 2. Determine the size of available structural timber. For round timbers, use the average diameter.

Step 3. Use Table 7-46, enter at the top with the stringer size (round DOWN if available size is not listed), then read down to appropriate gap size and desired MLC to find the number of stringers per span required. If no number is listed, use two or more shorter spans.

Table 7-46. Number of timber stringers required

SPAN LENGTH M (FT)	MLC	RECTANGULAR - bxd: *20x46 (8x18)	*20x61 (8x24)	25x30 (10x12)	25x46 (10x18)	*25x61 (10x24)	30x30 (12x12)	30x46 (12x18)	30x61 (12x24)	36x36 (14x14)	36x46 (14x18)	36x61 (14x24)	41x46 (16x18)	41x61 (16x24)	46x46 (18x18)	46x61 (18x24)	ROUND - d: 30 (12)	36 (14)	41 (16)	46 (18)	51 (20)	56 (22)	61 (24)
3 (10)	30	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4
	70		4			4		4	4	4	4	4	4	4	4	4		7	4	4	4	4	4
4.5 (15)	30	4	4	6	4	4	5	4	4	4	4	4	4	4	4	4		6	4	4	4	4	4
	70		6			4		5	4	8	5	4	4	4	4	4			9	6	4	4	4
6 (20)	30	6	4		5	4		4	4		4	4	4	4	4	4			7	5	4	4	4
	70					6		10	5		8	4	7	4	6	4				11	8	6	4
7.5 (25)	30	8	4			4			4			4		4		4						4	4
	70					11			8			6		5		4						8	6



*Lateral bracing required

(Chart assumes structural quality timbers in good condition.)

Step 4. Use Table 7-47 to determine the required deck thickness based on MLC and number of stringers.

Table 7-47. Required deck thickness - CM (in)

NUMBER OF STRINGERS / MLC	4	5	6	7	8	9	10	12	14	16
30	13.9 (5.5)	11.3 (4.5)	10.1 (4)	8.8 (3.5)	7.6 (3)	7.6 (3)	7.6 (3)	7.6 (3)	7.6 (3)	7.6 (3)
70	20.2 (8)	17.6 (7)	15.1 (6)	12.6 (5)	10.1 (4)	7.6 (3)	7.6 (3)	7.6 (3)	7.6 (3)	7.6 (3)

Step 5. Lateral braces are required for those stringers listed with an asterick in Table 7-46 (page 7-69) or if d is greater than 2b. If lateral braces are needed, they should have a depth of half the stringer depth and a minimum width of 3 inches. Locate the braces at the ends and the midpoint of the span and in the top half of the stringer (Figure 7-21).

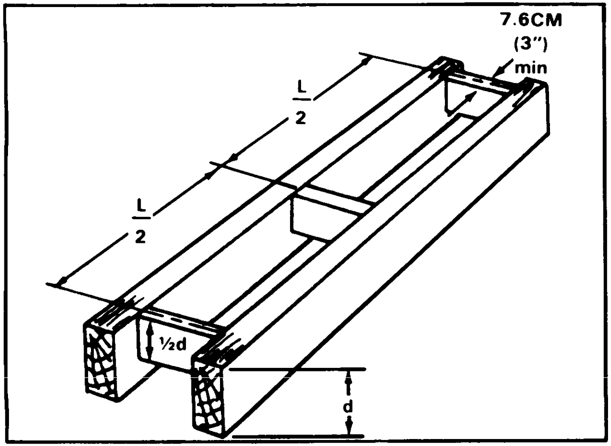


Figure 7-21. Lateral bracing for timber stringers

Step 6. Curbs, handrails and a wearing surface can be omitted for hasty bridges Figure 7-22 illustrates a cross-section of a hasty MLC 30 to MLC 70 one-lane timber stringer bridge.

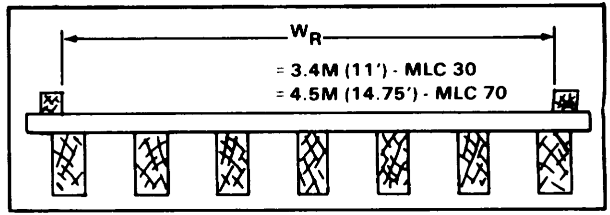


Figure 7-22. One-lane hasty timber stringer fixed bridge

Superstructure Design - Steel Stringers

Step 1. Determine the gap length and MLC (either MLC 30 or MLC 70)

Step 2. Measure the depth (d) and the base (b) of the available steel sections to the nearest quarter inch or centimeter.

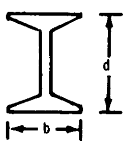
Step 3. Use Table 7-48, enter at the top with the stringer size (round DOWN if the exact dimensions are not listed), then read down to the appropriate gap size and desired MLC to find the number of stringers per span required. If no number is listed. use two or more shorter spans.

Step 4. Use Table 7-47 (page 7-69) to determine the required deck thickness based on MLC and number of stringers.

Table 7-48. Number of steel stringers required (number of lateral braces)

Key: Number of Stringers MLC 30 = 5; Number of Braces = (4); Number of Stringers MLC 70 = 15

SPAN LENGTH M (FT)	MLC	30.5x12.5 (12x5)	30.5x20 (12x8)	35.5x15 (14x6)	35.5x30 (14x11.75)	40.5x17.5 (16x7)	40.5x30 (16x11.75)	45.5x17.5 (18x7)	45.5x30 (18x11.75)	53x20 (21x8)	61x20 (24x8)	61x30 (24x11.75)	68.5x25 (27x10)	76x26.5 (30x10.5)	83.5x29 (33x11.5)	83.5x40 (33x15.75)	91.5x30.5 (36x12)	91.5x42 (36x16.5)
7.5 (25)	30 70	10 (5)	8 (3)	8 (6)	4 (3) 6	5 (5) 15	4 (3) 5	4 (5) 10	4 (3) 4	4 (5) 7	4 (4) 5	4 (3) 4	4 (4) 4	4 (4) 4	4 (4) 4	4 (3) 4	4 (4) 4	4 (3) 4
9 (30)	30 70			10 (6)	4 (3) 8	6 (6)	4 (3) 7	4 (5) 14	4 (3) 4	4 (5) 10	4 (5) 6	4 (4) 4	4 (5) 4	4 (5) 4	4 (4) 4	4 (3) 4	4 (4) 4	4 (3) 4
10.5 (35)	30 70				4 (3) 11	8 (7)	4 (3) 9	6 (6)	4 (3) 4	4 (6) 12	4 (6) 8	4 (4) 5	4 (5) 5	4 (5) 4	4 (5) 4	4 (3) 4	4 (5) 4	4 (3) 4
12 (40)	30 70				4 (3) 13	10 (8)	4 (3) 11	7 (7)	4 (3) 5	5 (6) 14	4 (6) 10	4 (4) 6	4 (6) 6	4 (6) 5	4 (5) 4	4 (4) 4	4 (5) 4	4 (4) 4
13.5 (45)	30 70				5 (3) 15	11 (8)	4 (3) 13	8 (7)	4 (3) 6	5 (7)	4 (7) 11	4 (5) 7	4 (6) 8	4 (6) 6	4 (6) 4	4 (4) 4	4 (6) 4	4 (4) 4
15.1 (50)	30 70				6 (3)		5 (4) 15	9 (8)	4 (4) 7	6 (8)	4 (7) 13	4 (5) 8	4 (7) 9	4 (7) 7	4 (6) 4	4 (4) 4	4 (6) 4	4 (4) 4



(Chart assumes structural quality steel Fy 33 KSI.)

Step 5. Lateral braces are always required for steel stringers. Use Table 7-48 (page 7-71 (to determine the number of braces between each stringer. Figure 7-23 shows how to install hasty lateral braces. If steel is used for bracing, it is not necessary to weld it as long as the bridge is of a temporary nature. Attach steel as shown in Figure 7-24 for timber.

Step 6. Curbs, handrails, and a wearing surface can be omitted for hasty bridges Figure 7-23 illustrates a cross-section of a hasty MLC 30 or MLC 70 one-lane steel strtnger bridge.

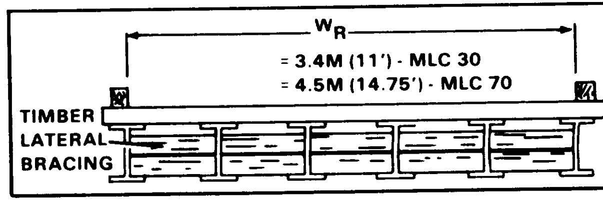


Figure 7-23. One-lane hasty steel stringer fixed bridge

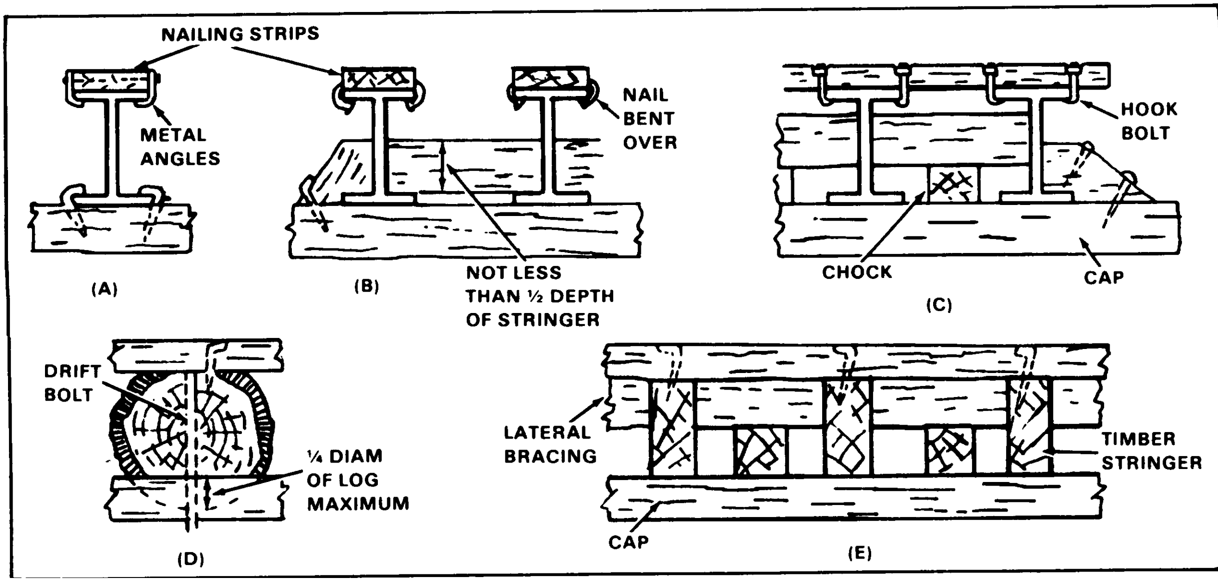


Figure 7-24. Alternate methods of securing stringers and nailing strips

Substructure Design - Abutments

Abutments act as the interface between the bridge and the ground and must be able to adequately spread the bridge loads into the soil without danger of soil failure, abutment overturning, or abutment sliding. The easiest design for hasty temporary construction is a timber sil abutment (Figure 7-25). Piles or concrete abutments should be used for permanent design Refer to TM 5-312 for design procedures.

Substructure Design - Intermediate Supports

For hasty temporary construction, a crib pier can be constructed from available materials. Crib piers will be rarely used in heights over 15 feet (4.6 meters). When small sized timber is the only available material, cribs can be successfully built to heights of 20 feet (6 meters) or more. Hasty piers can also be constructed of rubble, rocks, vehicles. Bailey bridge parts, or any other available support material. The TM 5-312 outlines the design procedure for timer trestle, timber pile and steel framed intermediate supports.

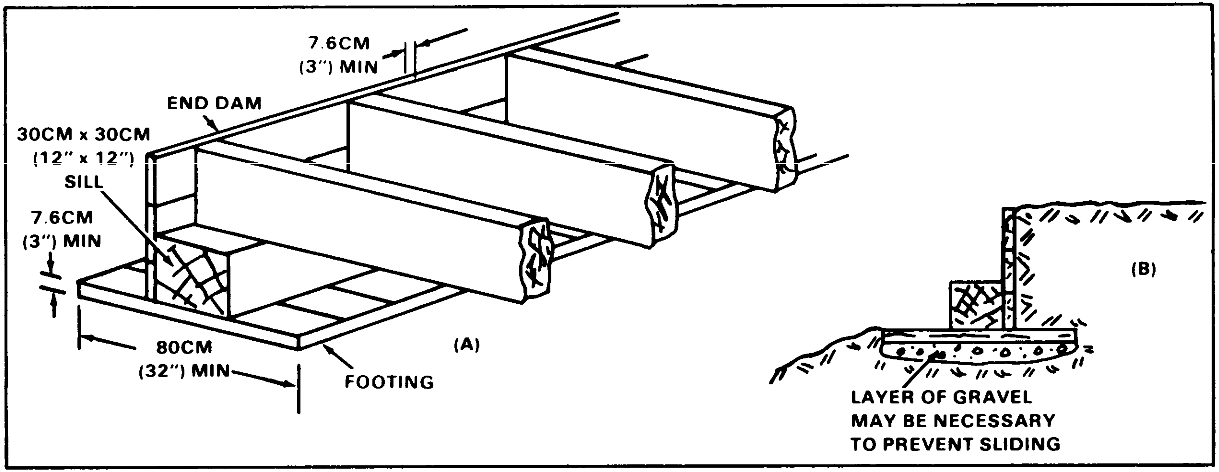


Figure 7-25. Timber sill abutment

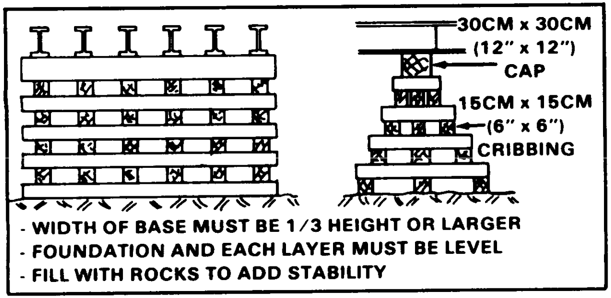


Figure 7-26. Timber crib piers

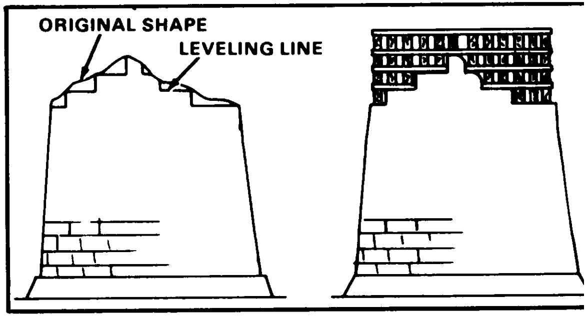


Figure 7-27. Leveling the top of a damaged pier

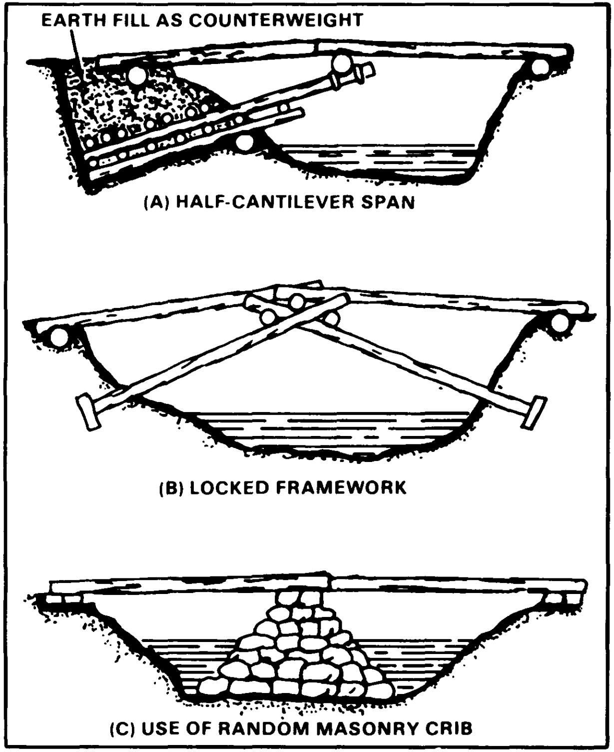


Figure 7-28. Timber spar bridges

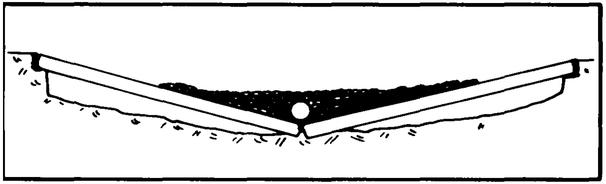


Figure 7-29. Use of sandbags to repair damaged bridge