Appendix B
Crossing Means

GENERAL

Crossing means is the equipment used to carry a force across a water obstacle. This equipment is specially designed to operate within certain limits, and commanders must understand these limits if the force is to cross safely.

A safety matter that affects operational use is the load capacity of rafts, bridges, and equipment. The quantities shown on the Equipment Characteristics Chart, page B-3, are the normal capacities or the design capabilities. In exceptional circumstances, certain safety factors or margins allow increased loadings. These capacities have been deliberately omitted here because they are not intended for use in operational planning. The standard or design capabilities are provided for normal crossings. The exceptional category is intended for special situations using the terms **caution** or **risk** crossings.

In addition to the command decision required to employ caution and risk crossing loads, commanders must consider the physical status of the equipment. Thus, crossing area or crossing force commanders obtain a professional judgement from the engineer. He weighs these factors with the tactical needs prior to directing increased loading, keeping in mind that the equipment may be lost for future use.

In a normal crossing, the vehicle class number is equal to or less than the bridge classification number, vehicles maintain 30-meter intervals on fixed or floating bridges, and speed is restricted to 15 mph. Sudden stopping or acceleration is forbidden.

In a caution crossing, vehicles with a classification exceeding the capacity of the bridge by 25 percent are allowed to cross under strict traffic control, The caution class number of standard freed or floating bridges may be obtained from FM 5-34, TC 5-210, or other appropriate TMs. Caution crossings require the vehicle to remain on the centerline and maintain a 50-meter distance from other vehicles. They also require vehicles not to exceed 13 kph (8 mph), not to stop, not to accelerate, and not to shift gears on the bridge.

A risk crossing may be made only on standard, prefabricated freed and floating bridges. Risk crossings are made only in the greatest emergencies. The vehicle moves on the centerline and is the only vehicle on the bridge. It does not exceed 5 kph (3 mph), does not stop, does not accelerate, and does not shift gears on the bridge. The vehicle class number must not exceed the published risk class for the bridge type being crossed. After the crossing, and before other traffic is permitted, the engineer officer reinspects the entire bridge for any damage.

This appendix supplements a general description of crossing means discussed in Chapter 4. It provides a pictorial review as well as equipment capability tables useful in selecting crossing means and planning crossing operations.

Available crossing means dictate both crossing operations and the force buildup rate on the far shore. Since the available crossing means often limits his options, the commander must understand the transportation of forces across the water before developing his tactics.

The military means to cross a river are –

- Fording vehicles.
- Boats.
- Aircraft.
- Amphibious vehicles.
- Rafts.
- Bridges.

FORDING VEHICLES

Combat vehicles can ford shallow rivers that have limited stream velocity and stable beds. Some vehicles have kits to increase fording depth. Fording is possible for stream velocity less than 1.5 meters per second. Riverbeds at fording sites must be firm and free of large rocks and other obstructions. Vehicle operator manuals contain specific depth capabilities and required adaptations.

Boats

Pneumatic assault boats are the primary crossing means for dismounted infantry and accompanying elements. For light infantry, assault boats may be the only means required if air resupply is available. They carry 12 assault troops and a two-man engineer crew in a silent or powered crossing.

Aircraft

Army aircraft are an alternative to assault boats for dismounted infantry. They give the force the capability to concurrently seize objectives from the exit bank out to the bridgehead line. Helicopters also lift other

crossing assets from rear areas to the river and carry essential combat support and critical resupply across the river.

Amphibious Vehicles

Some combat vehicles can swim. Bank entry and exit points must be clear of obstructions and have slopes consistent with vehicle capabilities. Current velocity sets limits. Crews of amphibious vehicles prepare and inspect each vehicle before entering the water. Engineer assistance, including recovery vehicles and standing cables, maximizes swimming opportunities.

Rafts

Heavy rafts are often the initial crossing means for tanks and other fighting vehicles. They are faster to assemble than bridges and can operate from multiple sites to reduce their vulnerability. The two types of heavy rafts currently available are ribbon and M4T6. The LTR supplements heavy rafts for vehicles under MLC 16.

Bridges

Rafts alone cannot handle the total volume of traffic in the needed time. Floating bridges are the primary means to rapidly cross the force and its supplies. The same units that provide heavy rafts also provide float bridges. They often assemble bridges from the rafts used earlier. Ribbon, M4T6, and Class 60 bridges are currently available.

The ribbon bridge is the primary assault bridge because it is quick to assemble. The M4T6 bridge replaces the ribbon bridge, which continues to move forward with the advancing force. Because it is manpower-intensive, the M4T6 is slower to assemble than the ribbon bridge. Preassembly of M4T6 floats in rear areas significantly reduces final assembly time on the river. The Class 60 bridge supplements M4T6 bridges. It is an old system still available in some depots; however, it is labor-intensive and requires an air compressor and a crane.

Fixed bridges rest on the river banks and intermediate supports instead of floating on the water. They span ravines as well as rivers. They have limited use for the initial assault, because they are slow to assemble and vulnerable to threat action. Where appropriate, they supplement or replace float bridges. Engineers also use fixed bridges to repair existing damaged bridges. The M2 Bailey bridge and medium girder bridge (MGB) are currently available. The AVLB can be used to cross short gaps.

Equipment Characteristics Chart

Equipment	Allocation	Transportation	Capabilities	Assembly/ Propulsion	Remarks/ Limitations
Pneumatic 15-man assault boat	L-series TOE provides: 18 per Div Ribbon Bridge Co. 27 per Corps Float Bridge Co. 9 per Sep Bde Engr Co. 27 per Corps Ribbon Bridge Co. 80 per Assault Boat Team. 21 per MGB Co. 21 per M2 Co.	20 deflated boats per 2 1/2-ton truck. Inflated boat is an 8-man carry. Deflated boat weighs 290 pounds.	Carries: 12 Infantrymen and 3 Engrs with paddles. or 12 Infantrymen and 2 Engrs with OBM. or 3,375 pounds of equipment.	Inflation time is 5 to 10 minutes with pumps. Paddled speed is 1.5 MPS (5 fps). Speed with OBM is 4.5 MPS (15 fps).	Maximum current velocity with paddle is 1.5 MPS (5 fps). 3 pumps, 11 paddles per boat. OBMs must be requested separately. 20-percent exit slope desired.
Pneumatic 3-man reconnaissance boat	L-series TOE provides: 3 per Combat Engr Co. 18 per Corps Float Bridge Co. 12 per Div Ribbon Bridge Co. 18 per Corps Ribbon Bridge Co.	Carried by backpack (1-man carry). Boat and backpack weigh 57 pounds.	Carries: 3 soldiers with equipment. or 675 pounds of equipment.	Inflation time is 5 minutes with a pump. Paddle speed is 1.0 MPS (3 fps).	Maximum current velocity is 1.5 MPS (5 fps). 1 pump 3 paddles per boat. No provisions for OBMs.
Armored personnel carrier (APC)	J-series TOE provides: 12 per Engr Co of Div Engr Bn. 1 per Inf Co (Mech) (BIFV). 14 per Inf Co (Mech) (M113). 9 per Armored Engr Co (ERI).	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 1.6 MPS (5.3 fps). Can ford up to 1.5 meters (5 feet).	Maximum current velocity is 1.5 MPS (5 fps). Drift (meters) = $\frac{\text{current}}{1.6} \times$ river width (meters)
Bridge erection boat - shallow draft (BEB-SD)	L-series provides: 12 per Div Ribbon Bridge Co. 15 per Corps Ribbon Bridge Co. 18 per Corps Float Bridge Co (M4T6).	Carried by: One 5-ton bridge truck with cradle. or One medium-lift helicopter. Boat weighs 8,800 pounds.	Carries a 3-man crew and: 12 soldiers with equipment. or 4,400 pounds of equipment.	Launch time from the cradle is 5 minutes.	Draft: 22 inches for normal operations. 26 inches when fully loaded. 48 inches for launch from the cradle.
27-foot bridge erection boat (BEB)	L-series provides: 12 per Div Ribbon Bridge Co. 15 per Corps Ribbon Bridge Co. 18 per Corps Float Bridge Co (M4T6). *Note: Units will normally have either the BEB-SD or the 27-foot BEB.*	Carried by: One 5-ton bridge truck with cradle. or One 2 1/2-ton truck with pole trailer. or One medium-lift helicopter when procedures are certified.	Carries a 3-man crew and: 9 soldiers with equipment. or 3,000 pounds of equipment.	Launch time from the cradle is 5 minutes. Launch time from the 2 1/2-ton truck when using a crane or wrecker is 5 minutes. Maximum speed is 15 knots.	Draft is 40 inches.
Bradley infantry fighting vehicle (BIFV)	J-series TOE provides: 13 per Inf Co (Mech) (BIFV). 12 per Cav Troop of an ACR. 19 per Cav Troop of a Div Cav Squadron.	Self-propelled. Class 24 vehicle.	Carries: 10 soldiers with equipment.	Preparation time for swimming is 18 minutes. Track propulsion in the water. Swim speed is 2 MPS (6 fps). Can ford up to 3.5 feet (1.07 meters).	Maximum current velocity is 0.9 MPS (3 fps). Drift (meters) = $\frac{\text{current (MPS)}}{2} \times$ river width (meters) Drift (feet) = $\frac{\text{current (fps)}}{6.6} \times$ river width (meters)

Raft Crossing Capabilities

River width (feet)	246	328	410	492	610	738	861	964	1148	1312	1476	1640	1968	2296	2824	2952	3280	3808	3936
River width (meters)	75	100	125	150	188	225	263	300	350	400	450	500	600	700	800	900	1000	1100	1200
Minutes per round trip	7	8	9	10	11	12	14	16	18	20	22	24	26	29	32	35	38	41	45
Round trips per hour	8	7	6	6	5	5	4	3	3	3	2	2	2	2	1	1	1	1	1
Number of rafts per centerline	1	1	1	2	2	2	3	3	4	5	5	5	6	6	6	6	6	6	6

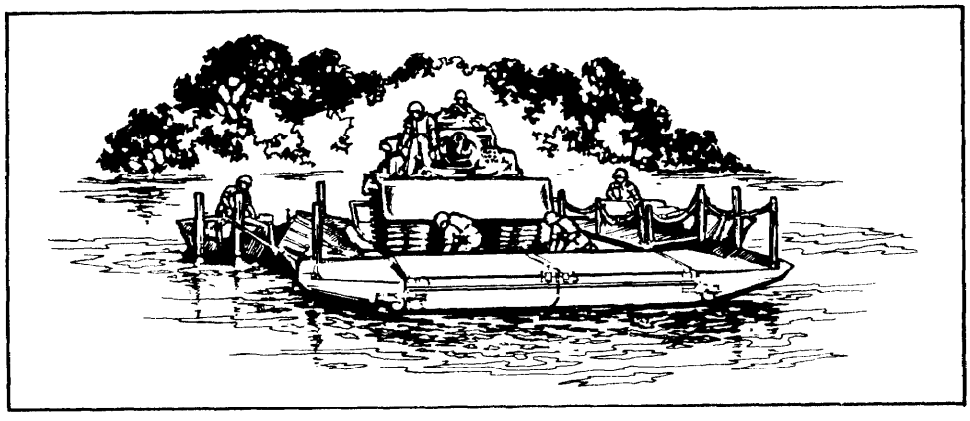
Notes:
1. This table is valid for ribbon, M4T6, Class 60, and LTR rafts in currents up to and including 1.5 MPS (5 FPS). This data assumes use of experienced crews under ideal conditions.
2. Round trip times include the times required to load and unload the raft.
3. Crossing times will take 50 percent longer at night.
4. If the river width falls between 2 columns, use the value found in the next higher column.

Boat/Raft Planning Factors

Equipment	Characteristic	River Width (1.5 MPS Velocity) Velocity		
		75 meters	150 meters	300 meters
Pneumatic assault boat with OBM	Minutes per round trip Trips per hour	3 20	4 15	5 12
Pneumatic assault boat without OBM	Minutes per round trip Trips per hour	4 15	6 10	10 6
Rafts (LTR, M4T6, and ribbon)	Minutes per round trip Trips per hour Rafts at each site	7 8 1	10 6 2	16 3 3

Notes:
1. Factors are average based on load/unload time and safety.
2. Planning times are for stream velocities up to 1.5 MPS for faster stream velocities, classification must be reduced to caution or risk crossings, and an engineer analysis must be made of actual site conditions before planning times may be assessed.

Ribbon Raft



Launch Restrictions			
	Free Launch	**Controlled Launch**	**High-Bank Launch**
Minimum depth of water required centimeters (inches)	Ramp bay 112 (44) Interior bay 92 (36) *	76(30)**	76(30)**
Bank height restrictions meters (feet)	0-1.5 (0-5)	0	1.5-8.5 (5-28)
Bank slope restrictions	0-30 percent	0-20 percent	Level ground unless the front of the truck is restrained

* 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 183 centimeters (72 inches). Interpolate between these values when needed.

** This is recommended water depth. Launch could technically be conducted in 43 centimeters (17 inches) water.

Allocation of Ribbon Bridge (L-Series TOE)		
	Division Ribbon Company*	**Corps Ribbon Company**
Number of bridge platoons	2	3
Number of interior bays	20	30
Number of ramp bays	8	12
Number of bridge erection boats	12	15
Longest bridge that can be constructed meters (feet)	148 (485)	215 (705)

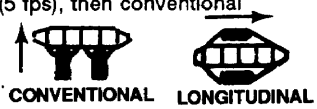
*The ribbon company will be eliminated from all active-component divisions by the end of FY 93 as a result of ERI.

Ribbon Raft (Cont.)

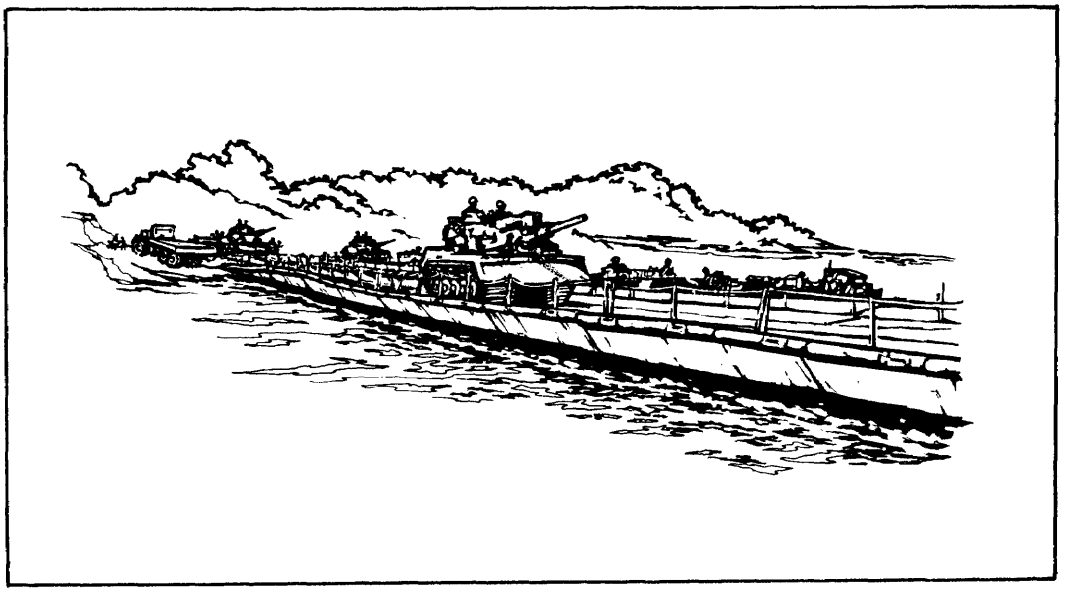
Ribbon Raft Design											
Capabilities	**Assembly Time (in minutes)**	**Load Space**	**Current Velocity (MPS/fps) and Load Class**								
Raft	(increases by 50 percent at night)	meters (feet)		0-.9 0-3	1.2 4	1.5 5	1.75 6	2 7	2.5 8	2.7 9	3 10
3 bay (2 ramps/ 1 interior	8	6.7 (22)	L C	45 45	45 45	45 35	40 25	40 15	35 10	30 0	25 0
4 bay (2 ramps/ 2 interiors)	12	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	20.1 (66)	L C	75 75	75 70	75 70	70 70*	70 60*	70 50*	60 25*	60 0
6 bay (2 ramps/ 4 interiors) wheeled/tracked	20	26.8 (88)	L C	96/ 80 96/ 70	96/ 80 96/ 75	96/ 80 96/ 70	96/ 70 70/ 70	96/ 70 70/ 70	96/ 70 55/ 55	70/ 70 30/ 30	70/ 70 0

*Three BEBs are required for conventional rafting of 4.5 or 6 bay rafts in currents greater than 1.5 MPS (5 fps).

Notes:
1. When determining raft classification, L refers to the longitudinal rafting and C refers to conventional rafting.
2. If the current velocity in the loading/unloading area is greater than 1.5 MPS (5 fps), then conventional rafting must be used.
3. The roadway width of a ribbon raft is 4.1 meters (13 feet 5 inches).
4. The draft of a fully loaded ribbon raft is 61 centimeters (24 inches).
5. Never load vehicles on ribbon ramp bays. Only interior bays may be loaded.
6. Each raft requires a minimum of two BEBs for propulsion.



Ribbon Bridge



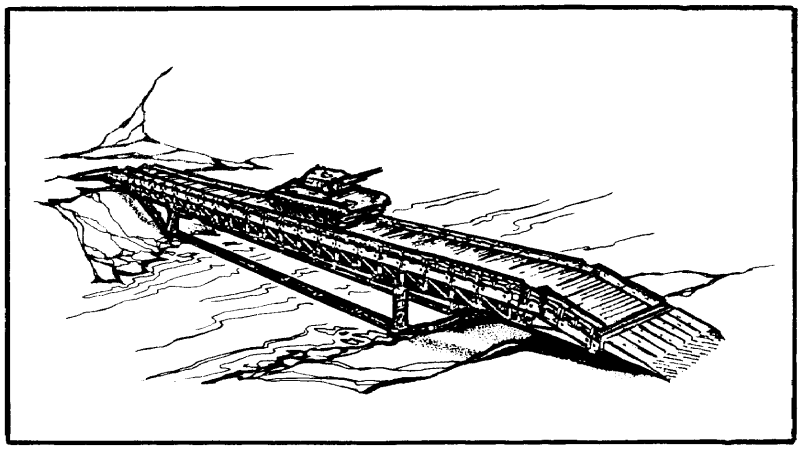
Number of Boats Needed for Anchorage of a Ribbon Bridge	
Current Velocity (MPS/fps)	**Number of Boats: Number of Bridge Bays**
0 to 1.8/0 to 6	1:6
2.1 to 2.5/7 to 8	1:3
2.7/9	1:2
Over 2.7/Over 9	Bridge must be anchored using an overhead cable system
Anchorage of ribbon bridges is normally accomplished by tying BEBs to the downstream side of the bridge. The number of boats required is shown in the table.	

Bridge Design
The number of interior bays = $\frac{Gap\ (meters) - 14}{6.7}$ *OR* $\frac{Gap\ (feet) - 45}{22}$
Notes: 1. Two ramp bays are required for all ribbon bridges. 2. During daylight hours, a ribbon bridge can be constructed at the rate of 200 meters (600 feet) per hour. Reduce by 50 percent at night. 3. Bridge can cross 200 vehicles per hour with 30 meters spacing at 16 kilometers per hour.

Determination of Bridge Classification									
Type of Crossing		**Current Velocity (MPS/fps) and Load Class**							
	meters feet	0-.9 0-.3	1.2 4	1.5 5	1.75 6	2 7	2.5 8	2.7 9	3 10
Normal (wheeled/tracked)		96/ 75	96/ 75	96/ 70	96/ 70	82/ 70	65/ 60	45/ 45	30/ 30
Caution (wheeled/tracked)		105/ 85	105/ 85	100/ 80	100/ 80	96/ 80	75/ 65	50/ 50	35/ 35
Risk (wheeled/tracked)		110/ 100	110/ 95	105/ 90	105/ 90	100/ 90	82/ 75	65/ 65	40/ 40

Medium Girder Bridge

Allocation and Transportation
1. Four bridge sets per corps MGB company. 2. Two reinforcement sets per corps MGB company. 3. Two erection sets per corps MGB company. 4. Each MGB set requires seven 5-ton dump trucks and seven 4-ton bolsters for transportation. 5. Each link reinforcement set requires one 5-ton dump truck and one 4-ton bolster trailer for transportation. 6. Each erection set requires one 5-ton dump truck and one 4-ton bolster trailer for transportation.



Work Parties for MGB	
Bridge Length	**Work Party**
4 and 5 bay SSB (26 to 32 feet or 7.9 to 9.8 meters)	1 NCO and 8 personnel
6 through 12 bay SSB (38 to 50 feet or 11.6 to 15.2 meters)	1 NCO and 16 personnel
All DSBs	1 NCO and 24 personnel
Anchorage party for DSBs (if required)	8 personnel
Link reinforcement party	8 personnel

SSB Length and Classification			
Bridge Length		Number of Bays	Military Load Classification
Feet	Meters		
26	7.9	4	60
32	9.8	5	60
38	11.6	6	40
44	13.4	7	30
50	15.2	8	30
56	17.1	9	24
62	18.9	10	20
68	20.7	11	16
74	22.6	12	16

Medium Girder Bridge (Cont.)

Building Times (Good Conditions)											
Bridge Type	**Single Story**			**Double Story without LRS**					**Double Story with LRS**		
Bridge Size	5 bay	8 bay	12 bay	4 bay	8 bay	12 bay	18 bay	22 bay	13 bay	18 bay	22 bay
Daylight (hours)	0.50	0.75	1.00	0.75	1.00	1.50	1.75	2.00	2.00	2.75	3.00
Night (hours)	0.75	1.00	1.25	1.25	1.50	2.00	2.75	3.00	3.00	4.00	4.50

Notes:
1. 25-meter by 20-meter assembly site required.
2. Only MGB company personnel required for assembly/disassembly.
3. Increase time 20 percent for untrained troops.
4. Increase time 30 percent for inclement weather.

DSB length and Classification				
Bridge Length		**2E + Number of Bays**	**MLC**	
Feet	Meters		without LRS	with LRS
37	11.3	1	60	
43	13.1	2	60	
49	14.9	3	60	
55	16.8	4	60	
61	18.6	5	60	
67	20.4	6	60	
73	22.3	7	60	
79	24.0	8	60	
85	26.9	9	60	
91	27.7	10	60	
97	29.6	11	60	
103	31.4	12	60	
109	33.2	13	50	60
115	35.1	14	50	60
121	36.9	15	40	60
127	38.8	16	40	60
133	40.5	17	30	60
139	42.5	18	30	60
145	44.2	19	24	60
151	46.0	20	24	60
157	47.9	21	20	60
163	49.7	22	16	60

Light Tactical Raft

Allocation and Transportation

1. Six sets per corps float bridge (H-series).
2. Six sets per LTR team (L-series).
3. One set has four pontoons and four deck bays.
4. One set is transported on two 2 1/2-ton trucks and on one pole trailer.
5. Each bay is 3.35 meters (11 feet) long and weighs 2,850 pounds.

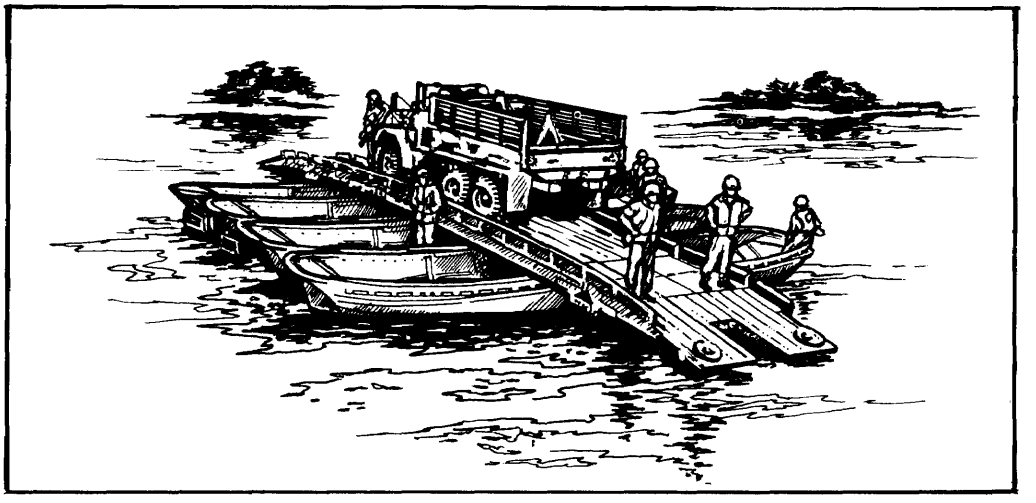
Notes:
1. Refer to TC 5-210 for methods of construction.
2. Articulators allow the ramps to be adjusted up 1 meter (41 inches) or down .48 meters (19 inches).
3. Roadway width is normally 9 feet.
4. All classifications are based on a normal crossing.
5. Construction times increase by 50 percent at night.
6. The draft of an LTR raft with outboard motors is 61 centimeters (24 inches).
7. To determine the number of LTR sets required to bridge a given gap, use the formula:

$$\frac{\text{Gap (meters)}}{14} = \text{Number of sets}$$

OR

$$\frac{\text{Gap (feet)}}{44} = \text{Number of sets}$$

8. 10 meters (33 feet) x 15 meters (50 feet) area needed for assembly.



Methods of Propulsion

Type	Draft	Restrictions
Outboard motors (25 or 40 HP)	24 inches	4 per LTR set
BEB, shallow draft 27-foot BEB	22 inches 40 inches	Availability of boats
Tow lines	Path across the river must be free of obstructions	Current must be slow (0 to 3 fps)
Ferry systems (trail or flying)	Path across river must be free of obstructions	Current must be fast

Light Tactical Raft (Cont.)

Raft/Bridge Design and Classification								
Raft	**Assembly Time**	**Load Space**	**Current Velocity (MPS/fps) and Load Class**					
		meters (feet)	1.5 5	2 7	2.5 8	2.75 9	3 10	3.5 11
4 pontoon/3 bay with articulators	30 minutes	9.15 (30)	12	12	12	8	4	0
4 pontoon/3 bay without articulators	25 minutes	9.15 (30)	16	16	12	8	4	0
4 pontoon/4 bay with articulators	36 minutes	12.5 (41)	10	10	10	6	2	0
5 pontoon/5 bay with articulators	40 minutes	15.85 (52)	9	9	9	8	5	2
5 pontoon/5 bay without articulators	35 minutes	15.85 (52)	16	14	11	8	5	2
6 pontoon/4 bay with articulators	45 minutes	12.5 (41)	13	13	13	13	12	5
6 pontoon/4 bay without articulators	45 minutes	15.85 (52)	18	18	18	18	12	6
Bridge	150 feet per hour 45.7 meters per hour	NA	16	13	11	8	5	2

Bridge Design

Floats (bays) required for normal bridges are-

$$\left(\frac{Gap\ (meters) + 2}{4.6}\right) \times 1.1$$

OR

$$\left(\frac{Gap\ (feet) + 2}{15}\right) \times 1.1$$

Round up to the nearest whole number.

Floats required for reinforced bridges are-

$$\frac{Gap\ (meters)}{3} \times 1.1$$

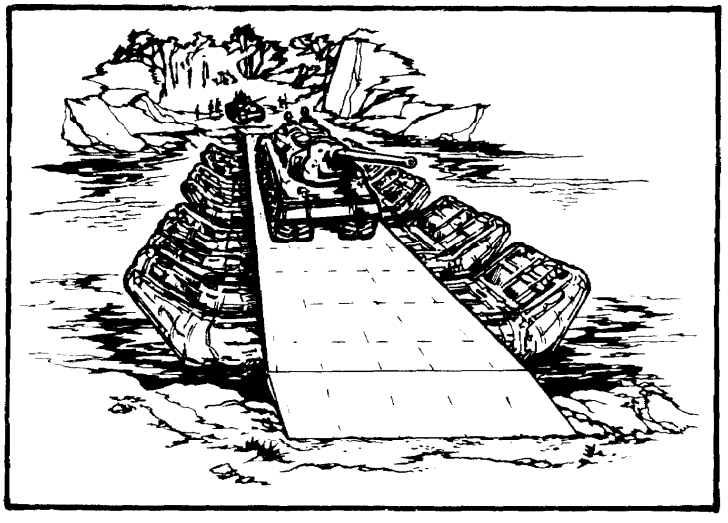
OR

$$\frac{Gap\ (feet)}{10} \times 1.1$$

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.

M4T6 Bridge



Determination of Site and Personnel Requirements			
Length for Normal Assembly meters (feet)	**Units Needed for Assembly**	**Number of Assembly Sites**	**Time (hours)**
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	5.5
152 (500)	2 companies	5	6
183 (600)	3 companies	6	4
213 (700)	3 companies	6	5 to 7
244 (800)	3 companies	6	6 to 8
305 (1,000)	3 companies	6	7 to 10
366 (1,200)	3 companies	6	8 to 12

Notes:
1. Refer to TC 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 101.6 centimeters (40 inches).

Allocation and Transportation

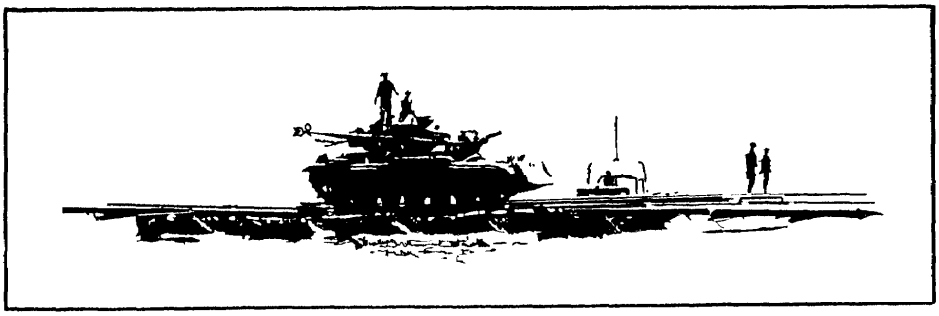
1. Each series corps float bridge company (M4T6) has six sets of M4T6 and 18 BEBs.

2. 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

3. 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.

M4T6 Raft

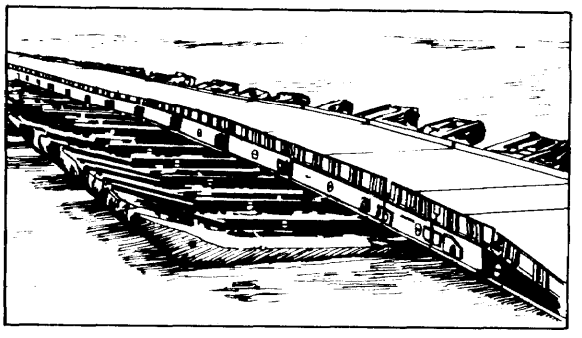


M4T6 Raft Design and Classification						
Current Velocity (MPS/fps) and Load Class						
Raft	**Load Space** meters (feet)	1.5 5	2 7	2.5 8	3.5 11	**Assembly Times**
4-float normal	15.7/51.6 (wheeled/tracked)	50 55	45 50	40 45	30 35	Per 4-float raft: -5 bridge trucks -2 BED-SD -1 platoon, 2 1/4 hours (when preassembled, 1 1/2 hours)
4-float reinforced	11.6/38.3 (wheeled/tracked)	50 55	50 55	45 50	35 40	
5-float normal	20.3/66.6 (wheeled/tracked)	55 60	50 55	45 50	35 40	Per 5-float raft: -6 bridge trucks -2 BED-Sd -1 platoon, 3 hours (when preassembled, 1 1/2 hours)
5-float reinforced	15.2/50 (wheeled/tracked)	60 65	60 65	55 60	45 50	
6-float reinforced	16.2/53.3 (wheeled/tracked)	65 70	65 70	65 70	45 50	Per 6-float raft -7 bridge trucks -2 BED-SD -1 platoon, 3 3/4 hours (when preassembled, 1 3/4 hours)
Notes: 1. Refer to TC 5-210 for methods of constructing M4T6 rafts. 2. Roadway width of an M4T6 raft is 4.2 meters (13 feet 10 inches). 3. Draft of a fully loaded M4T6 raft is 66 centimeters (29 inches). 4. Construction times increase by 50 percent at night.						

Bridge Classifications									
M4T6 Bridge, Normal					**M4T6 Bridge, Reinforced**				
Crossing Type	**Current Velocity (MPS/fps) and Load Class**				**Crossing Type**	**Current Velocity (MPS/fps) and Load Class**			
	1.5/ 5	2/ 7	2.5/ 8	3.5/ 11		1.5/ 2	2/ 7	2.5/ 8	3.5/ 11
Normal (wheeled/tracked)	45/ 55	40/ 50	35/ 45	25/ 30	Normal (wheeled/tracked)	75	70/ 75	65/ 70	27 30
Caution (wheeled/tracked)	58/ 59	54/ 55	49/ 51	35/ 37	Caution (wheeled/tracked)	80	79	73/	43 45
Risk (wheeled/tracked)	66/ 67	62/ 63	59/ 60	43/ 45	Risk (wheeled/tracked)	90	90	87	59 60

Class 60 Floating Equipment

Allocation and Transportation
1. Five sets in a Class 60 float bridge company. 2. One set has 41 meters (136 feet) of bridge. 3. One disassembled bay per 5-ton bridge truck. 4. Two BEBs per set. 5. 40-meter by 40-meter (120-foot by 120-foot) assembly area. 6. Varied assembly time, according to experience. 7. Roadway width of 4.1 meters (13 feet 6 inches). 8. Air compressor, crane, and BEBs for each raft/bridge construction site.



Raft Design					
Raft Type	**Load Space** meters (feet)	**Classification Based on Current Velocity**			
		1.5 MPS 3 fps	2 MPS 7 fps	2.5 MPS 8 fps	3.5 MPS 11 fps
4-float normal (wheeled/tracked)	15 (51)	40/45	40/45	35/40	25/30
5-float normal (wheeled/tracked)	20 (66)	50/55	50/55	45/50	30/35
5-float reinforced (wheeled/tracked)	15 (51)	55/60	50/55	50/55	35/40
6-float reinforced (wheeled/tracked)	16 (54)	65/75	65/75	60/70	50/55
Notes: 1. One set makes only one raft. 2. The draft of a fully loaded raft is approximately 29 inches (.75 meters).					

Bridge Bay Requirements	
Class 60 Bridge with Normal End Span	**Class 60 Bridge with Reinforced Span**
Number of bays = $\frac{Gap(meters)}{4.6} \times 1.1$ *OR* $\frac{Gap(feet)}{15} \times 1.1$ *Round final answer up to the next whole bay/float.*	Number of bays = $\frac{Gap\ (meters) + 2}{4.6} \times 1.1$ *OR* $\frac{Gap\ (feet) + 2}{15} \times 1.1$ *Round final answer up to the next whole bay.*

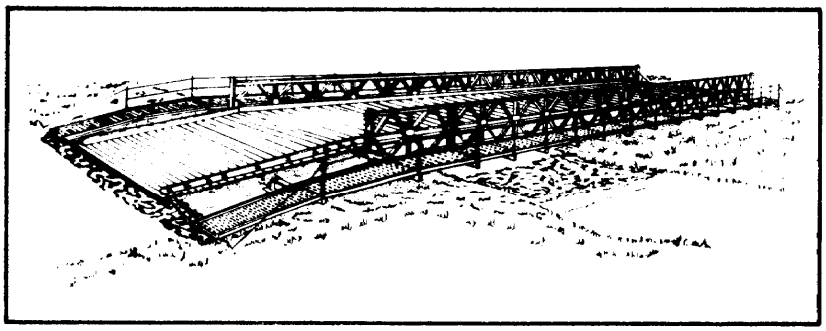
Class 60 Floating Equipment (Cont.)

Bridge Classification				
Class 60 Bridge with Normal End Span				
Crossing Type	1.5 MPS 5 fps	2 MPS 7 fps	2.5 MPS 8 fps	3.5 MPS 11 fps
Normal (wheeled/tracked)	55/55	45/55	40/50	22/25
Caution (wheeled/tracked)	60/60	56/60	52/56	34/37
Risk (wheeled/tracked)	67/60	67/70	62/67	46/50
Class 60 Bridge with Reinforced End Span				
Normal (wheeled/tracked)	55/65	45/55	40/50	22/25
Caution (wheeled/tracked)	62/67	56/61	52/56	34/37
Risk (wheeled/tracked)	72/77	67/72	62/67	46/50

Notes:
1. Bridge classifications assume the use of 15-foot end sections. For longer end sections, refer to TC 5-210.
2. For risk and caution crossing information, refer to TC 5-210.
3. Assembly times increase by 50 percent at night.

Bridge Assembly Requirements			
	0 to 250 feet (0 to 75 meters)	250 to 525 feet (76 to 160 meters)	526 to 1,000 feet (161 to 300 meters)
Assembly time	3 hours	3 to 5 hours	5 to 8 hours
Number of bridge sets	2	5	8
Manpower (combat engineer company)	1	2	5
Number of sites	2	3 to 5	6

M2 Bailey Bridge



Allocation/Transportation
1. One set per corps panel bridge company. 2. One set requires twenty-nine 5-ton dump trucks for transportation.

Estimated Time for Assembly									
Span (feet)	Type of Construction								
	SS	DS	TS	DD	TD	DT	TT	DT	TT
	Time (hours)								
	Construction by manpower only							One crane	
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 1/4		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

Notes:
1. 20-meter by 30-meter assembly site required.
2. Assembly crew required in addition to bridge company personnel.
3. See FM 5-34 or TM 5-277 for more information.

M2 Bailey Bridge (Cont.)

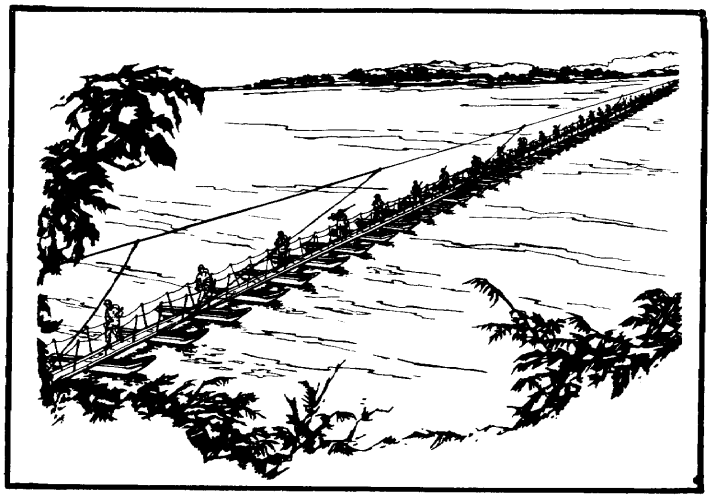
CLASSES OF BAILEY BRIDGE M2

(BY TYPE OF CONSTRUCTION AND TYPE OF CROSSING)

TYPE OF CONSTRUCTION	RATING	SPAN (FT)																			
		30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
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

Notes: N = Normal C = Caution R = Risk
1. Upper figure represents wheeled-load class, limited by roadway width.
2. Lower figure represents tracked load class.

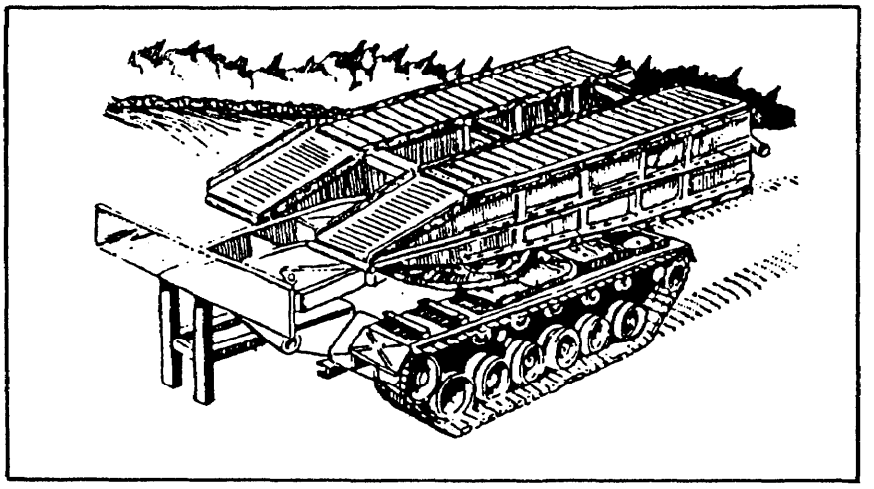
Aluminum Foot Bridge



Allocation/Transportation
One set provides- 472.5 feet of normal footbridge or 100 feet of expedient light-vehicle bridge or 14 expedient three-pontoon rafts

Assembly Time	
Daylight	15 minutes plus 1 minute per each 15 feet of bridge
Night with illumination or moonlight	20 minutes plus 1 1/4 minute per each 15 feet of bridge
Blackout	30 minutes plus 2 minutes per each 15 feet of bridge
The time includes installation of anchor cables and deadmen. These figures are based on trained and experienced troops assembling from stockpiled parts. Allow additional time for assembly from trucks for any anticipated anchorage difficulties, enemy interference, or other delaying factors.	

Armored Vehicle Launched Bridge (AVLB)



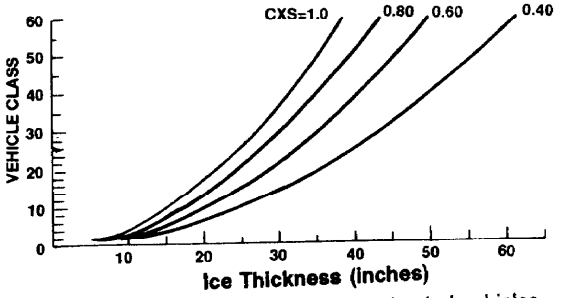
Allocation	Transportation	Emplacement	Capacity Class	Limitations/Remarks
Engineer battalion of armor/infantry/infantry (M) division: 4 launchers 6 bridges Engineer company of armor/infantry (M) separate brigade: 3 launchers 3 bridges	Bridge carried on launcher (modified) M48A5 or M60A1 chassis. Spare bridge folded on low-bed trailer (25-ton) with 10-ton tractor. Bridge weighs 15 tons.	Launched in 2 to 5 minutes by buttoned-up 2-man crew. Retrieved from either end. One man exposed to guide and connect. Vehicle turning in soft earth within 5 meters of bridge ends limits retrieval.	Class 60 vehicle 19.2 meters (63 feet)* AVLB spans, 18.3 meters (60 feet) using prepared abutments 17.4 meters (57 feet) using natural earth	M48A and M60A1 are diesel. Scissors launch requires 10 meters or 32 feet overhead clearance. Maximum launch slope: 28 percent uphill 19 percent downhill 11 percent side slope
*For crossings that exceed MLC 60, see current safety of use message.				

Ice Bridging

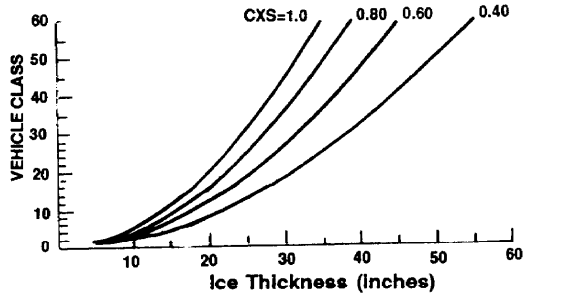
Bridge Width Determination		
Vehicle class		**Recommended Bridge Width (Effective Flood Area) and Vehicle Spacing (feet)**
Wheeled	Tracked	
1	1	90
2	2	120
3	4	150
4	5	180
5	6	195
6	7	205
7	9	220
8	10	230
9	11	240
10	12	250
11	14	260
12	15	270
13	17	280
14	18	290
16	20	300
18	22	310
20	25	320
22	27	330
24	30	340
26	32	350
28	35	360
30	37	380
35	45	400
40	50	430
45 and over	55 and over	460

Recommended bridge widths for ice supported by water (extracted from SIPRE Report 36)

Strength Factor	
S = 1	Ice is solid, and temperatures have remained at or below freezing for the previous week.
S = .9	Ice is solid, and temperatures have been above freezing during the day but drop below freezing during the night.
S = .7	Ice is not solid, and water or air pockets are found in between layers of ice.
S = .6	An air pocket is under the ice, so the ice is not floating on the water underneath.



Required ice thickness for wheeled vehicles.



Required ice thickness for tracked vehicles.

Color Factor
C = 1 Ice is clear (transparent) C = .9 Ice is semiclear C = .8 Ice is white C = .7 Ice is discolored (stained brown or yellow)

Ice Depth Requirements			
Personnel	**Ice Thickness Requirements (inches)**		
	Strong C = 1, S = 1	Medium C = 0.8, S = 0.8	Weak C = 0.7, S = 0.6
On skis	1.5	2	3
In file with 2-meter interval	3	4	5
On snowmobile	3	4	5

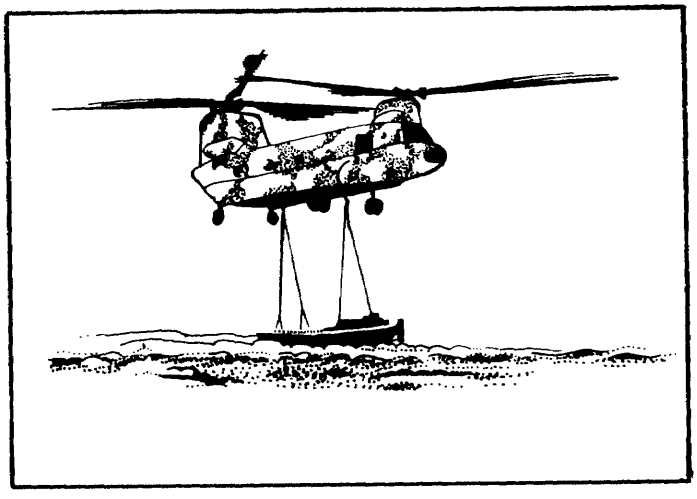
Determining the Class of Ice

Class (wheeled) = $\frac{T^2 \times C \times S}{25}$

Class (tracked) = $\frac{T^2 \times C \times S}{20}$

T = Ice thickness in inches
C = Color factor (see color factor chart)
S = Strength factor (see strength factor chart)

Helicopters



Typical External Loads		
Equipment	**Weight (pounds)**	**Remarks**
M4T6 fixed spans 23 feet 4 inches, Class 100 30 feet 0 inches, Class 65 38 feet 4 inches, Class 35 45 feet 0 inches, Class 25	 12,900 15,600 18,800 20,900	Components assembled in 8-foot 4-inch and 15-foot 0-inch increments. May be transported in packages to reduce load. Load class may be increased by varying deck size
LTR Pontoon load Deck load	 6,000 10,500	Separate loads delivered to assembly site for final assembly. Combination load placed on water surface.
Pneumatic assault boat	290	Transported in bundle or inflated mode.
27-foot BEB	6,800/8,800	Also lifted in bow and stern configuration.
M4T6 float bridge components Float without deck Float with deck Two floats with partial deck	 6,700 11,700 16,900	Additional loading contained in TM 5-450-11. Loads placed on water or shore for further assembly.
Ribbon bridge bays Interior bay End bay	 11,700 12.000	Placed directly on water surface.