499TH ENGINEER COMBAT BATTALION

RHINE RIVER

SWINGING BRIDGES

BETWEEN KARLSRUHE

AND MANNHEIM

FLOATING BRIDGE INFORMATION

RHEIN RIVER SWINGING BRIDGES

SECTION I - FOREWORD

In the late spring of 1952 the 1402 Engineer Combat Battalion located at Phillips Barracks, in Karlsruhe, Germany, was alerted to the task of assuming the responsibility for three (3) swinging bridges on the Rhein River. At the time, these bridges were the responsibility of the 109th Engineer Combat Battalion. The bridges were:

1. Bruhl — MV 638718
2. Germersheim — MV 553524
3. Leopoldshafen — MV 536407

Prior to assuming responsibility, the 1402 Engineer Combat Battalion trained on the bridges with the 109th Engineer Battalion for several weeks. Responsibility for the bridges was assumed on 15 June 1952.

The Bruhl bridge was constructed in 1951 by a German firm on a contract basis. After the bridge had been tried several times for effectiveness, the other two bridges were constructed on the same pattern by a German firm.

In April 1953, another bridge was constructed at Rheinhausen (MV 615598) by a German Firm. This bridge was of a Warren Truss type of construction, the other three being Bailey Bridges. It is a great deal heavier, requires more pontons, and has greater draft than the other bridges.

In April 1954, the newly constructed Warren Truss bridge at Rheinhausen was moved upstream to Germersheim, and the Germersheim bridge was moved downstream to Rheinhausen. Primarily, the switch was made because of differences in the river profile at the two sites. The Warren type bridge, with its greater draft, was easier to swing at Germersheim where the water near the banks was of a greater depth.

In 1955, pivot piles were installed at all of the sites except Germersheim. The piles were constructed and installed by a German firm, pursuant to instructions from Seventh Army. The piles at Germersheim were started but had to be withdrawn when it was realized that the placing of the pile in between the closely spaced pontons greatly limited the ability to manuever the bridge so as to cope with either high or low water. The Germersheim piles were finally installed in January 1956.

A gauge was painted on each of the piles after they had been installed. The graduations were in feet with the zero (0) being the elevation at which the concrete ramp makes a sharp angle of descent. These gauges were resurveyed in January 1956 and revealed that the pivot piles had not sunk in the least.

It has been determined after nearly four years of experience that there are a great many factors that directly affect the operation of the bridges. When the water level and other factors are favorable, very rapid closing times can be attained. The recorded record times as of February 1956 are:

Bruhl	10 minutes and 30 seconds
Rheinhausen	15 minutes and 5 seconds
Germersheim	7 minutes
Leopoldshafen	17 minutes

If the water level did not fluctuate, and if it were not for river ice, there would be no real problem in attaining these record closure speeds on every occasion.

However, this has not been the case. Within nine days in February 1956, the troops had to cope with ice that threatened to freeze the river solid, and with both low water and high water conditions.

The bridge commanders have learned that certain precautions must be taken as the water level fluctuates, and that certain methods must be utilized in swinging the bridges at the varying water levels.

Therefore, It has been decided to record all of this experience to facilitate the work of future replacement personnel or units that may be confronted with similiar problems.

SECTION II - GENERAL CHARACTERISTICS OF THE AREA & OF THE RHEIN RIVER

1. General Description:

a. Current: The normal velocity of the current between Maxau and Mannheim is approximately 2.5 meters per second. This is high compared to other sections of the river. At Worms, the velocity is 1.0 meters per second; at Gernsheim, 1.14 meters per second; and at Kaub, 1.9 meters per second

b. Width:

Site	Wet Gap (feet)	Bank Gap (feet)
Karlsruhe	800	900
Leopoldshafen	600	650
Germersheim	700	750
Rheinsheim	600	720
Rheinhausen	660	765
Speyer	660	750
Bruhl	660	720
Rhinau	600	750
Mannheim	750	840

c. Banks: The banks at all large cities and a good portion of the banks between cities are bricked. The channel of the river varies at different times of the year, making some dredging necessary.

d. Terrain: The Rhein River valley from Karlsruhe to Mannheim is about 20 miles wide. The valley between the two cities is very flat and most of it is under cultivation. The uncultivated part is either too wet or covered by woods.

e. Roads: The main roads running north and south on the east bank are Route 36 and the Autobahn. Route 36 between Karlsruhe and Mannheim is A20F. Autobahn between Karlsruhe and Mannheim is A28F. The main road running north and south on west bank is Route 9. Route 9 between Karlsruhe and Mannheim is A20F.

2. Weather Conditions

a. Temperature and Precipitation

LEGEND:

Max - Daily mean temp degrees F.

Min - Daily mean temp degrees F.

Monthly - Monthly mean precipitation

Daily - Average days/month with precipitation

Month	Max	Min	Monthly	Daily
Jan	38	29	2.0	11
Feb	42	30	1.7	11
Mar	50	35	2.3	11
Apr	58	41	2.0	13
May	67	48	2.4	11
June	73	54	3.1	11
July	75	57	3.2	15
Aug.	74	56	3.0	14
Sept	67	51	2.6	12
Oct	56	43	2.5	13
Nov	46	36	2.1	13
Dec	40	31	2.3	15

b. Fog - Number of days: (Karlsruhe)

0700 Hrs	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Clear	5	6	10	7	9	10	10	10	8	4	4	4	87
Prtly Cldy	2	2	3	3	3	4	4	3	4	3	2	2	35
Cloudy	24	20	18	20	19	16	17	18	18	24	24	25	243
1300 Hrs													
Clear	5	6	9	4	7	8	7	8	7	5	3	5	74
Prtly Cldy	2	3	5	5	6	6	8	7	6	4	4	2	56
Cloudy	24	19	17	21	18	16	18	16	17	22	23	24	235
1800 Hrs													
Clear	7	7	9	5	8	10	8	10	8	7	6	6	91
Prtly Cldy	2	2	5	5	5	5	6	5	6	5	3	2	51
Cloudy	22	19	17	20	18	15	17	16	16	19	21	23	223

c. Frequency of Gales - Mean number of days per month with winds of more than 20 MPH: (Karlsruhe)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	1	1	*	*	*	*	1	1	*	*

* - Less than 0.5 days per month (probability of occurence of less than once every two years.)

d. Sunrise and sunset data: (Karlsruhe)

Date	Jan SR	Jan SS	Feb SR	Feb SS	Mar SR	Mar SS	Apr SR	Apr SS	May SR	May SS	Jun SR	Jun SS
1	0721	1539	0658	1622	0610	1709	0505	1756	0407	1842	0327	1921
6	0720	1544	0652	1631	0600	1716	0455	1804	0358	1848	0324	1926
11	0718	1550	0644	1639	0550	1724	0445	1811	0350	1856	0322	1930
16	0715	1557	0635	1647	0540	1731	0434	1819	0343	1903	0321	1932
21	0711	1605	0626	1656	0529	1739	0424	1826	0337	1908	0321	1934
26	0706	1612	0616	1704	0519	1747	0416	1834	0331	1915	0323	1935
31	0659	1620			0508	1754			0327	1920		

Date	Jul SR	Jul SS	Aug SR	Aug SS	Sep SR	Sep SS	Oct SR	Oct SS	Nov SR	Nov SS	Dec SR	Dec SS
1	0325	1934	0358	1907	0442	1813	0524	1707	0613	1608	0658	1532
6	0329	1933	0404	1859	0449	1800	0532	1656	0621	1559	0704	1529
11	0333	1930	0411	1851	0456	1749	0539	1645	0628	1551	0710	1528
16	0338	1925	0419	1842	0503	1739	0547	1636	0636	1545	0714	1529
21	0344	1920	0426	1832	0510	1728	0555	1626	0645	1540	0718	1531
26	0350	1914	0433	1822	0517	1717	0603	1617	0651	1535	0720	1534
31	0357	1908	0440	1813			0611	1609			0721	1538

The sunrise and sunset times for Karlsruhe may be considered accurate to within plus 12 minutes for those parts of the areas which are furthest from Karlsruhe. For most of the area this data is accurate to within plus 5 minutes.

3. High and low water readings over past recorded years at Maxau guage (Karlsruhe):

	ALW	AHW	10 Year LW	10 Year MW	10 Year HW		HHW	LLW
Guage Cms	325	683	*7 Nov 1949 283	446	830	*9 July 1817	882	Mar 1858 213
Width (meters)	240	Banks over-flown	236	250	Banks over-flown		Banks over-flown	232
Channel Depth (meters)	3.40	6.93	2.98	4.61	8.45		8.97	2.28
Maximum Velocity M/Sec	1.65	2.68	1.48	2.06	2.94		3.01	1.18

* - Denotes date of last occurance
X - Approximate
ALW - Annual Low Water - the lowest water reading that is most probable in any given year.
Ten Year LW - Ten Year Low Water - lowest low water reading that is most probable to occur in any ten year period.
Ten Year MW - Ten Year Mean Water - mean water reading most probable to occur in any ten year period.
Ten Year HW - Ten Year High Water - highest water reading that is probable to occur in any ten year period.
HHW - Highest High Water - highest high water reading recorded.
LLW - Lowest Low Water - lowest low water reading recorded.

4. Ice Conditions:

Upstream of Mannheim

Date		River Frozen
1899-1900	-	No Data
1900-1901	-	No Data
1901-1902	-	16 Feb to 20 Feb
1902-1903	-	9 Dec to 13 Dec
1903-1904	-	No Data
1904-1905	-	1 Jan to 5 Jan
1905-1906	-	3 Jan to 5 Jan 16 Jan to 17 Jan
1906-1907	-	No Data
1907-1908	-	23 Jan to 28 Jan
1908-1909	-	5 Jan to 6 Jan 13 Jan to 16 Jan
1909-1910	-	1 Jan to 3 Jan 28 Jan to 29 Jan
1910-1917	-	No Data
1917-1918	-	29 Jan to 31 Jan
1918-1929	-	No Data
1929-1930	-	2 Feb to 13 Feb 23 Feb to 28 Feb
1930-1933	-	No Data
1933-1934	-	23 Jan to 30 Jan 15 Dec to 20 Dec
1934-1946	-	No Data
1946-1947	-	20 Dec to 23 Dec 7 Jan to 9 Jan 24 Jan to 4 Feb

5. Local Conditions:

a. River Traffic - The Rhine is 1100 Kms long, flowing from Switzerland to the North Sea. The river is navigable as far south as Basel, 850 Kms from its mouth, although large passenger ships seldom ply upstream of Mannheim. Over the past century, much work has been done to improve shipping on the river by deepening the channel, and by blasting of the rapids in the channel. Parts of harbors and landing places along the Rhine vary greatly in size, depending upon the rail network and industries of the area. The twelve largest ports of the Rhine system are listed below in terms of tonnage handled in 1950:

CITY	TONNAGE
Duisburg	10 million
Strassbourg	4.4 million
Mannheim	3.6 million
Schwelaern	3.2 million
Ludwigshafen	3.0 million
Wessaling	3.0 million
Walsum	2.2 million
Homberg	1.9 million
Koln	1.8 million
Karlsruhe	1.5 million
Dusseldorf	1.3 million
Mulheim	1.0 million

Due to the limited funds available to the West German government, no large scale plans are presently contemplated for the building of new dikes along the Rhine. Normally flood protection costs are borne by the localities along the Rhine with some aid from the Federal Government. Maintenance of existing flood protection works is under the jurisdiction of local German water officers. Much construction has been done on the Rhine in the past to straighten its former meandering course; however, no such work is planned further to improve it. Dredging is carried out under the jurisdiction of local water agencies.

b. Floating bridges between Karlsruhe and Mannheim

NAME	[illegible] POINT	TYPE	LENGTH	OVERHEAD CLEARANCE	NO. OF TRAFFIC LANES	CLASS	REMARKS
Leopoldshafen	370.3	Floating Ponton Bridge	800	Unlimited	1	Ramp 65 Ton Brg 100T	Floating Bailey Excellent Condition
Germersheim	383	Floating Ponton Bridge	800	Unlimited	1	Ramp 65T Bridge 100T	German Bridge Excellent Condition
Rheinhausen	393	Floating Ponton Bridge	800	Unlimited	1	Ramp 65T Bridge 100T	Floating Bailey Excellent Condition
Bruhl	[illegible]08.5	Floating Ponton Bridge	800	Unlimited	1	Ramp 65T Bridge 100T	Floating Bailey Excellent Condition

SECTION III - NORMAL WATER CONDITIONS

1. General:

Normal water at each of the Battalion site is as indicated below. The readings given are in feet and are taken from the pivot piles at each of the bridges. Normal water conditions are those water levels that occur most frequently and, in general, require very few adjustments.

As the water level changes, between these limits, the angle of the ramp changes on all the bridges. In some cases, it may be necessary to sand bag or crib the approach to reduce the angle of the ramp in order to increase the volume of traffic that can be carried.

The banks, except at Bruhl, are far enough away from the pivot ponton to allow easy swinging at the lowest reading indicated below. For lower water conditions, additional precautions are explained in SECTION IV.

Limiting readings for "normal water" are:

	Lower	Higher
Leopoldshafen	-6	-2
Germersheim	-8	-3
Rheinhausen	-9	-5
Bruhl	-13	-8

2. Effect of normal water on bridges.

a. Leopoldshafen:

Between the limiting readings of -6 feet to -2 feet, no adjustment of the length of the bridge is necessary. The length remains 800 feet, and the slot numbers remain the same for swinging (pivot pile between # 8 and # 10 on each side). Any final adjustment necessary can be made by taking the long section or the stub into the stream. This adjustment may be made on the stub when the water reading is above -4 by turning the one mule (power unit) on this stub in the direction of travel desired and releasing or tightening the winch cable. If the water is below -4 feet, very limited adjustment is possible on the stub if it is necessary to move toward the shore due to the extremely shallow water on the east side.

Because of the shallow water on the east side, the stub must be swung into the stream at a reading of -4 feet (taken at the west pile). Normal closing time is 20 minutes.

b. Germersheim

Between the limits of -3 feet and -8 feet the bridge length remains 847 feet 10 inches. The bridge is secured with the pivot pile between slot numbers 1 and 3 and swung in slot numbers 23 and 25. No changes in slot numbers are caused by variations in water level between these limits. The pile here is relatively far from shore and the water is deep so neither side is swung into the stream at "normal water" and neither side is removed from the pivot pile between these limits.

When the bridge is swung, adjustments must be made because of the closing guides being designed to fit like a door into the frame and the long side swings fastest (see diagram). Because of this the bridge must be swung to 90° with a gap left between the sections, and pulled together, after removal of all pile pins, with the diesel powered closing winches. Normal closing time is 15 minutes.

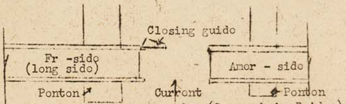

Diagram of closing guides (Germersheim Bridge)

c. Rheinhausen:

Limiting pile readings at this site for normal water are -5 to -9 feet. Between these readings the length of the bridge remains unchanged at 800 feet, and no adjustments of the bridge on the pile are necessary. For swinging during normal water the pile is placed between slot numbers 11 and 9 on each side. This leaves a 30 inch gap which is taken up by the closing winches. Normal closure during normal water is 15 minutes.

d. Bruhl:

Normal water at Bruhl is considered to be from -8 to -11 feet on the pile. Between these limits the bridge length remains 800 feet. At -10 feet 6 inches the eastern bridges section must be taken off the pile and at -11 feet the bridge must be taken off the west side pile.

Between the above levels, when on the piles, the bridge is placed so that the pile is between numbers 7 and 9 slots on the west and numbers 5 and 7 on the east. Adjustments necessary are made with a dozer on each end of the bridge when off the pile and with closing winches when on the pile. Normal time for closing is 15 minutes if on the pile. 50 minutes if off the pile.

SECTION IV - LOW WATER CONDITIONS

1. Low water conditions prevail when the pile readings are as follows:
   a. Leopoldshafen -6 and lower
   b. Germersheim -8 and lower
   c. Rheinhausen -9 and lower
   d. Bruhl -13 and lower

2. Low water may occur anytime of the year on the Rhine River, however, during the period from September through May (less January) low water is most likely to occur.

3. Effect of low water on the bridge sites.

a. Leopoldshafen:

(1) East side:

(a) The stub end is swung out into the stream during normal water of -4. As water goes lower it is allowed to ground in place.

(b) When the stub is swung, the pile pins are placed in slots number 8 and 10.

(2) West side:

(a) It is removed from the pivot pile when the water reaches a level of -7.

(b) Move bridge stub clear of pile, pull upstream and use stand off poles to keep bridge from grounding.

(c) Normal swing with use of pivot cable. Use D-7 to push bridge stub off when grounded.

(d) The only effect the jetties have during low water is to slow the current when ice is present on the river and make it difficult to keep ice clear of the stub. The existence of the jetties makes it necessary to swing the stub daily during low water to preclude grounding on the jetties.

(3) Normal swing time is from 30 minutes to 1 hour or more.

b. Germersheim:

(1) East side:

(a) During low water, use slots 23 to 25 when 83 feet of usable water is available. If not available, adjust pile rack slot to usable water figure.

(2) West Side:

(a) The bridge stub can always be left on the pile until just before the swing if less than 63' of usable water is available.

(b) If removed from pile, secure the same as Leopoldshafen.

(c) If stub is off pile, swing the same as Leopoldshafen.

(d) Due to complicated connections, it has never been practical to remove any portion of the bridge on either side to swing during periods of low water.

(e) Normal swing time is from 30 minutes to 1 hour.

c. Rheinhausen:

(1) East side:

(a) The stub end is swung out into the stream when a pile reading of -10 occurs. If water continues to go lower it is allowed to ground in place.

(b) When the stub is swung, two additional 3/4" safety cables are placed upstream and one safety cable downstream.

(c) When the stub end is swung the pile pins are place in slots number 1 and 3 or 2 and 4.

(d) When a water level of -11' is reached, 10' of the bridge stub is removed.

(2) West side:

(a) It is removed from the pivot pile when the water reaches a level of -11.5'.

(b) If removed from pile secure the same as Leopoldshafen.

(c) If stub is off pile, swing the same as at Leopoldshafen.

(d) When the water level reaches -12.8', remove 10' of the bridge.

(e) Normal swing time is from 30 minutes to 1 hour or more.

d. Bruhl:

(1) East side:

(a) The stub end is removed from the pivot pile during normal water and is swung in the same manner as the Leopoldshafen west stub when it is off the pile.

(b) From -15' and below, difficulty is encountered with the landing bays dragging on he concrete ramps. The bridge must be kept away from the banks with stand off piles or dozers.

(2) West side:

(a) The stub is removed from the pivot pile during normal water.

(b) When removed from pile secure the same as at Leopoldshafen.

(c) When stub is off pile, swing the same as at Leopoldshafen

(d) When water reaches a level of -15', remove 30' of the bridge.

(e) Normal swing time is from 30 minutes to 1 hour or more.

(f) From -15' and below, difficulty is encountered with the landing bays dragging on the concrete ramps. The bridge must be kept away from the banks with stand off piles or dozers.

SECTION V - HIGH WATER CONDITION.

1. High water condition is defined as follows:

a. Leopoldshafen - pile reading of minus two feet to plus one foot.

b. Germersheim - pile reading of minus four feet to zero.

c. Rheinhausen - pile readings of minus four feet to zero

d. Brull - pile reading of minus eight feet to zero.

2. Effect of high water conditions on operation of bridges.

a. Leopoldshafen

(1) Length of bridge including floating bay and landing bays is 800 feet. Bridge can be operated from the pivot piles. Piles should be between pin holes seven and nine for both sections for any high water condition as defined in 1a above.

(2) The high water condition offers no great obstacles to the swinging operation. Total time for a swing should be approximately twenty minutes.

(3) High water requires the use of cribbing and twenty foot ramp sections for smooth approach to and exit from the bridge. The landing bays can not be safely lowered below the horizontal, therefore, the base plates must be cribbed up high enough for the bearing plates on the landing bays to rest in a horizontal position. Therefore a twenty foot ramp section is used, so the approach angle will be desirable. (See drawing)

b. Germersheim:

(1) Length of bridge, which including floating section and ramp sections, is 847 feet. Bridge can be operated from the pivot piles, piles should be between pin holes twenty-three and twenty-five for both sections for any high water condition as defined above.

(2) The high water condition is ideal for swinging. Total time for a swing is approximately ten minutes.

c. Rheinhausen.

(1) Length of bridge including floating bay and landing bays, is 800 feet. Bridge can be operated from the pivot piles. The piles should be between pin holes nine and eleven for both sections for any high water condition as defined above.

(2) The high water condition offers no great obstacles to the swinging operation. Total time for swing should be approximately twenty minutes.

(3) For water levels of minus two foot to zero, cribbing under the base plates and twenty foot ramps should be used. (See draft for Leopoldshafen)

d. Bruhl.

(1) Length of bridge including floating bay and landing bays, is 800 feet. Bridge can be operated from the pivot piles. West pile should be between pin holes nine and eleven, and east pile between pin holes seven and nine for any high water condition as defined in 1d above.

(2) Except for very high water, the high water condition is ideal for the swinging operation. Total time for a swing should be approximately fifteen minutes.

2(a)3 Drawing shows need for cribbing under base plates and a 20 foot ramp at Leopoldshafen during high water conditions.

(3) For the water levels of minus two feet to zero, one of two things should be accomplished to create smooth approaches and exits to the bridge. First, cribbing under the base plates and twenty foot ramps can be used as stated for Leopoldshafen in Section V, paragraph 2a (3). Second, a twenty foot section could be added to the center of the bridge to allow the base plates to set down at the top of the concrete ramps (zero water level mark). If the second method is used, the pile settings must be moved to allow for the added twenty feet when the bridge joins the center.

SECTION VI - Flood Conditions

1. Flood conditions at each site are defined as follows:

a. Leopoldshafen - pile reading in excess of plus one foot.

b. Germersheim - pile reading in excess of zero.

c. Rhinehausen - pile reading in excess of zero.

d. Bruhl - pile reading in excess of zero.

e. Maxau - guage reading in excess of 590 cm will flood Leopoldshafen.

2. Floods are most likely to occur during the months of January and July. Although flooding has occured at least once during each of the other months according to existing records. During the winter months, unseasonably warm weather after a cold spell will cause the river to rise rapidly. Rises as rapid as 6' overnight have been recorded at some sites.

3. When the river is at high water and there is danger of a flood, the following procedure is recommended:

a. Bridge site NCO keeps parent unit notified on river conditions at all times.

b. All equipment that can not be evacuated is cabled down. (Latrine at Rhinehausen is cabled to a tree)

c. A priority of evacuation is established at each site and is followed. If there is much equipment at any given site, this priority should be arranged so that evacuation occurs as water levels begin to reach equipment.

d. The bridge itself should be utilized to the maximum for storage of equipment during flood stage.

4. Administrative Procedures.

a. Site should be manned by enough men to insure two shifts on a 24 hour cycle if necessary.

b. Initially, houses and shacks built at all of the sites were designed and built high enough so that the water would overflow the back dike before it entered the houses. During the flood of January 1955, this proved true at all sites except Brühl, where the house proved to be approximately 2' lower than the rear dike and, consequently, could not be used to quarter troops. The mess house at this site was built high enough to be used. During the January 1955 flood, a squad tent was pitched in the outskirts of Bruhl and a crew worked from it. The Gasthaus Farmhaus was used to billet the men that worked on the French shore. At all other sites, the houses and mess shacks were operational during the entire period.

c. Extra DUKW's should be assembled at each site for safety work and also for aiding the local German population.

d. A 27' or 19' power boat is very effective for rapid crossing at the river when it is at flood stage. (Current is about 10 - 11 feet per sec)

5. Holding Bridge in River

a. As all sites now have pivot piles, the danger of a bridge half floating over the banks and becoming grounded if the river drops rapidly over night is almost negligible.

b. A bumper piling at the upstream end of the bridge, such as is on the east bank at Rheinhausen, has proven very satisfactory. These piles should be driven at every site.

c. Great difficulty was encountered at Germersheim in the January 1955 flood as this site was the only bridge without a pivot pile. Following is a summarized account of the solution for holding that bridge in the channel.

(1) Crew slept on the bridge at night and took readings periodically during the night.

(2) When the river started to drop, two 27 foot power boats (one at each end of the bridge) pushed it back into the channel. 12 foot poles were used to catch the bank and hold the bridge in the channel.

(3) Anchors were tested but this method proved completely useless.

6. Closing Ramps at Flood Stage

As bridges are on pivot piles, there would be no difficulty in closing the bridges and pinning them. After bridges are closed, the following methods could be used for getting traffic to the bridge.

a. Fording in the water, depth permitting.

b. Building Class 60 or M-4 bridge out to the swung bridge. At some sites, this would mean cutting a large amount of trees to clear right of way for bridges. This would have to be done before river flooded and would require a considerable amount of work.

7. After-Flood Procedures:

a. Check all deadmen and cable clamps.

b. Survey site for damage. All damage should be reported to the responsible R&U branch as soon as possible.

c. Inventory all bridge property and equipment for loss or damage.

8. Summary: A summary of these points for flood operations on the river is as follows:

a. Secure bridge

b. Secure equipment at the site.

c. Keep the bridge in the channel.

SECTION VII

COLD WEATHER OPERATION

1. General

Cold weather affects the operation of the bridge equipment but the effect of the river ice on the operational status of the bridges is the more important consideration. Icing on the Rhein River is confined to floe ice (floating ice blocks of varying dimensions) that will flow freely with the current but will occasionally solidify into ice jams for the full width of the river. Because of the relatively rapid velocity of the Rhein, sheet ice (solid freezing of the ice on the surface) will not usually occur except on the dead arms of the river and along the river edge. During warm winters, little or no ice will appear. In the Middle Rhein area, temperatures of -12°C (10°F), or colder, that last for two or more days, will cause floe ice to freeze together and jam. This freezing condition is most likely to occur during the months of January and February. As ice forms, it plugs up many of the tributaries of the Rhein. Therefore, the Rhein's water level starts dropping, usually at a rapid pace. It is for this reason that cold weather operations have several characteristics similar with ordinary low-water operations. The effect of cold weather on bridge equipment, the ice characteristics at each bridge site, and the ice removal methods used at each site are considered separately below.

2. Bridge Equipment

a. Power Winches, 15 ton

(1) Operate efficiently until the temperature is approximately 32°F. Then the usual 30 weight oil has to be changed to a lighter 10 weight oil.

(2) Unnecessary strain should not be put on the swing cables since they become more brittle.

(3) If a partial swing (10° to 60°) is attempted in order to flush downstream the ice between the bridge pontons, there is much extra pull on the swing cables because of all the ice which backs up before the flushing action starts. The winch cable is then forced to release itself faster than feasible. Because of this the hand brake may have to be used occasionally.

b. Marine Engines (Mules)

(1) With careful maintenance, these units may be started with a minimum of trouble during cold weather. See "Hints on Cold Weather Operation of Engineer Equipment" published by the Office of the Engineer, 7th Army Headquarters.

(2) The freezing of the engines is caused by the intake pipes of the cooling systems being too short, thus drawing slush near the water surface into the water pumps, and freezing the pumps. Longer pipes are no solution since heavy pieces of floating ice will break them off.

(3) A modified radiator system works well; the only requirement being that the water in the radiator barrels be changed often enough to keep the temperature of the water low.

(4) If the propellers are to be let down into the water, they must be running continuously to prevent freezing.

c. DUKW's

(1) Icy water causes the DUKW propellers to freeze when taken out of the water, unless they are left turning for several minutes after the DUKW comes from the water.

(2) They can operate successfully in the river on safety or ferry missions, when the ice flow is no more than 30%, and when the pieces of ice are no more than 3 inches thick.

(3) Icy DUKW approaches have to be sanded.

3. Individual Bridge Sites

a. Leopoldshafen

(1) East bridge-half

(a) When the river be ns to freeze, the eastern side should be swung, even though the water may not as yet have dropped to -4 feet, the low reading at which this bridge half is normally swung. This should be done because the bridge-half may freeze in and become grounded in a sudden drop of the water level, which is characteristic when ice starts forming. As long as the bridge-half does not extend too far across the stream, there is actually no need to set this bridge-half in any certain pivot slot, because the other half can be adjusted. The slot numbers can vary from slot 8 to slot 12. The important thing is that this bridge-half be placed exactly on the bridge centerline and at 90° when it is swung. Once it freezes in, it is difficult to move. Use extra cables to keep the bridge in the correct position while ice forms around it. Keep the cables clear of the water surface. The cables will back up floating ice for a considerable distance.

(b) Effects of ice freezing upstream. This causes no really detrimental effects. The bridge-half freezes in place, both upstream and downstream. There is no extra strain on the cables until the ice starts melting. Then all of the weight of the half melted ice starts pushing against the bridge as it begins to move with the stream current.

(c) The best method discovered for ice removal at this site was the use of an air-driven spade. A channel about three feet wide should be started, and the ice then should be chipped off piece by piece and sent downstream. There is no current to carry away ice blown up by explosives.

(d) Ice flow behavior because of the current is fairly even all the way across since there are no major bends in the river at this point. However, there are some man-made jetties from the shoreline that produce certain underwater currents.

(2) West bridge-half

(a) This side is best cleared of ice by explosives.

(b) The ice between the pontons should be removed from between at least 30% of the pontons, especially on the downstream side. It is best to get rid of all ice between the pontons, because if the bridge has to be swung to 90° much ice backs upstream putting tremendous weight and pressure on the bridge and swing cables. The ice must have some channels to flush through. The critical end is the downstream end of this bridge-half. As it swings toward 90°, the majority of the ice floe is collected between the shore and the downstream end of the bridge-half. Therefore, the ice between those last few pontons and between the pivot piling and the shore should be cleared out.

(c) The dropping water level should be watched, even during the night, so that the bridge does not become grounded while the ice holds it in one place.

b. Germersheim

(1) East bridge-half

(a) Since this bridge-half is too long to swing 90° without blocking the channel, it must stay parallel to the shore line as the water drops. This is no hindrance since the pivot piles are so far from shore.

(b) The pivot pile is sufficiently far from shore that neither bridge-half would have to be removed from the pivot pile to prevent grounding. Only during extremely low water, which has not occured in 1955 or 1956, would they have to be removed from the pivot piles.

(c) The best method of ice removal at this site was the use of explosives. Many of the resulting ice chunks had to be poled out toward midstream, where there is some current.

(2) West bridge-half

(a) The movement of floe ice on the eastern side is straight, but on the western side there is an old bridge abutment near the channel that creates peculiar currents. In general, the current is not strong enough on either shoreline between the bridge halves and the banks to effect the flow of ice significantly.

c. Rheinhausen

(1) East bridge-half

(a) The east half is swung when the water drops to a -10 feet. If, however, an ice floe threatens to freeze it to the bank before the water level is a +10 feet, the bridge half should be swung 90°. It should be fixed on the 85° line with at least three extra safety cables; two 3/4 inch cables upstream, and one 3/4 inch cable downstream. The ice pressure will force the bridge to the full 90°.

(b) There are no adverse effects of the ice building up upstream, because it usually flushes through the pontons. When the ice does eventually jam and freeze upstream, the ice on the downstream side counteracts it. As the water level drops, more pontons of this bridge half are sitting on the bottom of the river to add to its stability in staying on the centerline.

(c) The best method of ice removal at this site is the use of demolitions.

(2) West bridge-half

(a) This bridge-half comes off the pivot pile at -11.5 foot. However, if floe ice threatens, it should be removed from the piling before the water gets that low, and be moved upstream far enough so that it could be swung 90° if necessary.

(b) Because of the characteristics of the flow of ice on the bend of the river, it is best to keep the bridge out far enough so that an 8 to 10 foot channel can be maintained between the bridge and the bank. As with the other bridge sites, ice must be kept free between about 30% of the pontons.

(c) To keep this bridge-half from grounding, the ramp end should be cabled to the pivot piling, and the upstream end hold off from the shore by means of a holdoff pole.

(d) The big factor to consider at this site is the bend in the river which throws most of the ice toward and behind the west bridge-half.

d. Bruhl

(1) East bridge-half

(a) Since the east bridge-half would extend across the river channel if swung to 90°, it must be kept in the same position as the west bridge-half. Therefore, the same things that have been said about the west halves of the other two Bailey bridges at Leopoldshafen and Rheinhausen apply here.

(b) The best method of preventing the ice from building up upstream is to maintain a channel between the bridge and the banks.

(c) The floe ice is fairly even all the way across the river.

(2) West bridge-half

(a) As with the east bridge-half, it is important to either move off the pivot pile before the ice freezes the bridge there or to keep that area free enough of the ice so that the bridge-half could be removed from the pivot pile whenever the water dropped to the necessary level.

(b) It is advisable to keep ice free between about 30% of the pontons, so that if the bridge were swung to 90°, there would be room enough for the ice floe to flush through instead of jamming up.

(c) A vigilance must be maintained 24 hours a day during critical periods to make sure the water does not suddenly drop unnoticed under the ice leaving the bridge grounded.

(d) The most successful ice removal method was the use of explosives.

4. Ice Removal Methods

a. Demolitions

(1) Demolitions were by far the best ice removal method used at any of the bridge sites. The charges vary from ½ pound to 2 pounds. The charges should be placed under the ice and tamped well to get the maximum effect of the explosive. Tamping charges with sandbags above the ice can be used, but the greatest effectiveness is not obtained. This method will cause the ice to be broken into large chunks.

(2) One half pound charges of TNT placed 5 to 10 feet apart were found best for blasting areas near the bridge, between the pontons, or under the roadway of the bridge. It is good for cracking the ice in a desired direction without blasting the surrounding ice to small pieces. Tetratol, M-1 demolition blocks, split in half to equal a 1¼ pound charge can be placed 10 to 30 feet apart, depending on the thickness of the ice.

(3) Because of its explosive power, tetratol is suggested for clearing larger areas of ice that are not directly next to the bridge. All charges can be fired electrically or non-electrically. Detonating cord ring and line mains were found to be the best non-electric means of firing as many charges could be fired at the same time. The charges could also be placed underwater.

(4) The most difficult work is moving the blown up ice, especially that between the pontons, out into the current where it will move downstream.

(a) At Leopoldshafen the currents created by the mule props were used on the west side to move broken ice.

(b) At Germersheim an anchor pulled by a dozer was used to move ice.

(c) The bridge at Rheinhausen was swung 45° to allow the current to flush away the ice.

(d) At Bruhl a DUKW was placed on the riverward side of the bridge and the wake from the prop was used to push the ice.

b. Saws

This is a usable method but very slow. One-man saws were used, but due to the thinness of the cut, the men could cut only small pieces of ice at a time and the ice chunks had to be pushed out immediately or the cuts would freeze solid again in a few minutes.

c. Pneumatic Tools

Pneumatic tools, such as clay spades or pavement breakers, are also a very slow means of ice breaking. It is somewhat better than the use of the saw in that a wider cut could be made, giving the men more time to push the ice away before it refroze. The use of pneumatic tools was found to be very dangerous when the men had to work near the outer edge of the ice.

d. Drop Hammer

The drop hammer from a 25 ton crane was used with limited effectiveness. When the hammer was dropped, it went through the ice and the cables became entangled in the ice. The ice was broken into little pieces making it very hard to push into the current. This method was used at Leopoldshafen.

e. Anchor Pulled By Dozer

An anchor or weight was attached to an end of a cable and the other end was attached to a bulldozer. The weighted end was dropped through the ice and the cable was then pulled, cutting the ice. Because of the narrowness of the cut the chunks had to be immediately pushed out to the current, before they refroze. This method is very cumbersome and is good only for ice less than 12 inches thick.

f. Steam Jetting

(1) Steam jetting was found to be a very slow, almost useless way of removing the ice. Pressure between 90-100 PSI was used and every time the steam melted the ice, the pressure would blow the melted ice to an already cleared spot where it would refreeze. This was true for both the ice found on the decks of the bridge and that on the water.

(2) An acetylene cutting torch was also tried on the ice and for the same reasons stated above the result was not satisfactory.

g. Combustible Material

Five gallons of gasoline were poured on the ice and ignited. The result was a very slight melting of the ice on top which refroze as soon as the fire subsided. This method was found unsafe for use near the bridge because of the danger of setting the bridge on fire.

h. Hand axes

(1) The use of axes is a slow method, but it is faster than using saws.

(2) Axes are good for chopping holes for placement of demolitions.

i. Poles

As stated above, the biggest problem with most of these ice removal methods is getting the broken-up ice out to the current to be carried downstream. Poles or long 2 x 4's can be used for this purpose. With the poles, the chunks of ice can be pushed and guided until the current will take them with its own power.

j. Bridge

(1) Much ice can be loosened and crushed by moving the bridge back and forth a few feet. The bridge can be pulled toward the shore with the swing winches and then pulled back toward the center of the river by the mules.

(2) An additional or alternate method is a dozer pulling the bridge-half toward the shore with a cable

(3) The bridge can be swung 45° to allow the current to flush through all of the ice which has been broken up by any of the methods mentioned,

5. Summary

Although the best thing to do in an ice operation is still a matter for speculation, there are some definite conclusions based on experience.

(1) Mule modifications should be put on as soon as the water starts freezing.

(2) DUKW's can be used as long as the floe ice is not over 30% and not more than 3 inches thick.

(3) Demolitions is the best form of ice removal. Sufficient demolitions should be stored at the bridge sites, or should be readily available. Permission to blast on the Rhein river should be given at as early a time as possible.

(4) The oil in the power winches and mules should be changed to winter weight oil as soon as the temperature demands it.

(5) Instead of attempting to fight the ice, it would be better to let the bridges freeze in place and blast them out if they have to be swung providing the water is rising. When the water level is receding the bridges must be swung 5° several times a day to prevent the water from dropping out under the ice and grounding the bridge. This is the primary danger.

1. Suggestions for Daily and Weekly Maintenance of Floating Bridge Sites:

a. Close supervision by the NCO in charge of each site should be employed to gain the utmost service from the 8595 Labor Service Personnel assigned to each site as mechanics. This should be accomplished through daily contact with the LS NCO in charge. Additional service and inspection can be obtained from the 964th Engr Co (FM) at Tompkins Barracks, Switzengen.

b. Daily maintenance should start with step by step inspection by the NCOIC, however the following is merely a guide, experience at each site will govern the best method for procedure:

(1) Starting at the banks, check all cables for fraying, sharp bends and proper lubrication to insure free movement.

(2) Clearance between the river bank and pontons for proper depth of water to insure that the ponton will be kept afloat.

(3) Check safety lanterns for excess carbon on the glass, properly trimmed wicks and fuel for night operations and foggy weather.

(4) Check tower cables and blocks for wear, insuring that the ramp can be freely raised and lowered.

(5) Check alignment of pontons to insure stability of spacers at base of panels.

(6) Replace any tread showing excessive wear and weathering. Remove any protruding nails.

(7) Check for spot painting and general tightening of panel braces.

(8) Weekly check of sway bracing for general tightening.

(9) Insure that all tools are removed from bridge during non-working hours.

(10) General check of area for police and proper storage of gasoline and lubricants.

2. Navy propulsion units.

a. There are a total of 20 Navy "Mules" on the swinging bridges; 6 at Leopoldshafen, 4 at Germersheim, 6 at Rheinhausen, and 4 at Bruhl. These are General Motors products, diesel fueled, developing 115 hp. The engines require constant maintenance to get peak performance.

b. The diesel fuel available in the theater is of poor quality and it is not uncommon to find a great deal of water in the fuel, thus making it a danger spot in freezing weather.

c. The unit's cooling system is composed of two pumps, a fresh water intake stays within the unit and requires anti-freeze during the cold season, and a salt water intake that although free circulating, causes the pipes to clog and the rubber gaskets are frequently damaged during freezing weather. To reduce this wear and clogging, shields of canvas on wood and metal frames were erected around the units and in some cases, a 55 gallon drum, cut in half lengthwise was employed as a shield, however the latter caused overheating.

d. These units are serviced primarily by the mechanics of the 8595 Maintenance Platoon for 1st and 2nd echelon maintenance. 3rd echelon maintenance is provided by the 964th Field Maintenance Company which is also the support unit for replacement parts. Requisitions ar made on a form 811, and can usually be delivered on receipt of the 811.

e. In the event that one of the units is beyond repair for lack of parts, etc., it will be necessary to exchange the unit at the 7th Army Bridge Park. A recommended method of removal is to request a landing craft from the Rhine River Patrol (USN), load a crane at the patrol base to be ferried upstream.

f. At the floating bridge sites there are three types of powered winches, all German diesel fueled. The weak point on these winches is the friction type clutches that must be replaced annually.