BRIDGE AND ASSAULT CROSSING EQUIPMENT

RECONNAISSANCE BOATS

These were inflatable boats used by engineer officers for the reconnaissance and survey of obstacles. Often referred to as rubber dinghies they were in fact made of rubberized canvas.

Reconnaissance Boat Mk I

This was a two man boat. It was light and easy to handle on land but somewhat small for its role on water.

When inflated it had the following dimensions.

- Length - 6 foot 8½ inches
- Width - 2 foot 8½ inches
- Height - 1 foot 3 inches
- Weight – 40 lbs

The Reconnaissance Boat MkI came equipped with two paddles. For transport it could be packed into a bag 30 inches long and 15 inches in diameter. This could easily be lifted and carried by one man.

Each divisional Field Park Company RE carried 32 reconnaissance boats.

Each Bridging Company carried 16 reconnaissance boats.

Reconnaissance Boat Mk II

This was a three man boat. The extra man allowed for two men to row while the third surveyed and took notes or measurements. Weight was increased to 112 lb. A great advantage was that this boat could be powered by an outboard motor. In this case it could carry only two men.

KAPOK FOOT BRIDGE

The basic kapok bridge was designed as an infantry assault bridge but the equipment could be used in a variety of ways.

Infantry Assault Bridge

The components were simple, a number of kapok filled floats supported a wooden walkway.

- Floats were each 6 foot 6 inches long.
- Decking sections were each 6 foot 6 inches long and 1 foot 10½ inches wide.
- A bay of one float and one decking section weighed 1cwt.

Two men carried each float and one man carried each length of decking. A float was attached to each end of a length of decking using simple catches. The completed bay was then pushed out into the water. A second decking section was attached to the shore end of the first bay and then a float was attached. The bridge was progressively pushed out into the water until the far bank was reached. The maximum practical length was 150 foot, but this was only in still water. Any tide, current, flow or wind would make this length hazardous or impossible.

Thirty bays of kapok bridge could be carried in a 3 ton GS lorry. Although this was only half of the lorries weight capacity the bulk of the equipment made it impractical to carry more.

Attachment, Carrier Flotation, Kapok, Mk II

Kapok floats used with special fittings could be used to float a carrier across a water obstacle. The fittings could be used with any type of Carrier, except the T16, as long as it was a welded type and was correctly waterproofed. The Carrier, Armoured Observation Post, had to have the charging engine removed since it was mounted outside the body, and it required an extra float at the rear.

Eight brackets were clamped to the carrier, two at the front, two at the rear and two at each side. Nine kapok floats were used, three vertical at the front, two vertical at each side and two horizontal at the rear.

Flotation of a 6 pdr Anti Tank Gun

It was possible to float a 6 pdr AT gun, but this was hazardous in any but the stillest water. The trail legs were held open by a 4 foot 10 inches long piece of timber. Eight floats were required, three lashed under the trail, four lashed along the barrel with one lashed at right angles under the muzzle. The guns drag ropes can be used for lashings. The gun should be pulled across from the far bank. The crew can be carried but not ammunition.

Raft for 15 cwt Truck

It was possible to construct a raft to carry a 15 cwt truck but this was even more an emergency measure than was the flotation of a 6 pdr AT gun. Twenty seven floats were lashed together in three layers. Eight decking sections were lashed on top to form two trackways. Loading such a raft was difficult without ramps and the lack of rigidity caused problems.

ASSAULT BOAT MK IV

Assault Boats were folding boats with a plywood floor, wooden gunwales and canvas sides. Mk IV was double ended although there was a bow, which was strengthened and had a mooring line and ring, and a stern which had a rowlock for the steering oar. Being double ended did make it easier to use as a ferry when it was towed backwards on the return journey. No seats were provided, crew and passengers knelt on the floor (on one knee).

The assault boat was carried folded and strapped flat. It was readied for use by

- undoing the straps holding the gunwales to the floor
- fitting the removable bow and stern struts

- raising the canvas sides and holding them in position with six folding struts which were pinned into the underside of the gunwales.

When assembled it required six men to carry it to the water.

There was a crew of three. One man commanded and was the steersman, using an oar through a rowlock in the stern. Two others were oarsman who actually used paddles. Two further oarsmen were detailed from the passengers.

The following procedures were laid down
- The boat was launched and held with its stern against the bank.
- The boat NCO boards first and takes up his position in the stern.
- The two boat crew board next and take up their positions near the bow.
- Two of the passengers will be detailed to hold the boat to the bank and will board last.
- The section Bren gun will be carried in the centre of the boat

There were three ways of propelling the assault boat.
- it could be rowed with four men using paddles.
- it could be powered by a Seagull outboard motor. This was noisy and prevented any surprise.
- it could be ferried by using the 40 fathom of 1½ inch ferry cable provided. This method usually relied on the four men who would normally used the paddles hauling on the cable instead. This method could only be used on crossing of less than 100 feet and needed a cable taking across the obstacle first.

Assault boats were operated by infantry battalions although the boats were provided by the Royal Engineers and Royal Engineer personnel trained and supervised.

The Assault Boat MkIV had the following dimensions
- Length - 17 foot 6 inches
- Width - 6 foot
- Height - 2 foot 8 inches
- Weight - 415 lbs

The boat would carry fifteen fully equipped men in addition to the crew of three. This represented an infantry section plus a proportion of supporting personnel such as platoon headquarters, signallers, pioneers etc.

A Divisional Field Park Company Royal Engineers carried 48 assault boats.

A Bridging Company carried 24 assault boats

Attachment MkI, Carrier Flotation (Assault Boat)

This simple attachment enabled two assault boats to float a carrier across a water obstacle.

Two light steel beams were clamped to the sides of the Universal carrier. Struts connected the beams to the bottom of the bearers of the assault boat. The clamps were quick release so that the carrier could go into action very quickly once it had reached the far bank. Equally important

was the fact that the quick release clamps allowed the complete assembly of boats and struts to be lifted off and return for another carrier without delay.

The boats and struts needed to be fitted on dry land, preferably near the water but out of sight of the enemy. It was also important to find a launching site with banks which were not so steep as to cause the boat to swamp when entering the water. The same was true at the far bank. A landing site was required which gave an unhindered passage to the somewhat unwieldily boats and was not so steep as to swamp them. Canvas dodgers could be fitted to the bow and stern to help prevent swamping.

All Carriers had to be of the welded type and might need waterproofing.

Propulsion was normally by the Carriers own tracks.

FOLDING BOAT EQUIPMENT Mk III

Decked Rafts

The Folding Boat Equipment provided a rapid means of providing a bridge which would carry most of the vehicle in an infantry division. It was very versatile and the following were official modes:
The Decked Raft was the basic element of the FBE bridge and of most of the rafts. It consisted of two folding boats with four road-bearers fitted to the gunwales. Near the ends of each bearer was a metal plate with a socket in it. This fitted over pins on the boat gunwales. When all four bearers were in place deck panels were fitted between pairs of bearers, resting on a lip. For speed the centre deck panels could be omitted, the outer panels being sufficient to carry most vehicles.

Decked Raft Class 5

This was simple to build and operate but needed landing stages on both banks. It was a single floating bay of two boats and a standard 19 foot 6 inch length of roadway and so could later be incorporated into a bridge. The landing stage was usually a half floating bay of one boat and a standard roadway length resting on a shore transom at the shore end. More elaborate landing bays using trestles could be erected if necessary. The decked raft could be operated as a ferry with cables strung across the water obstacle. Power could be outboard motors, winches, or paddles.

A Class 5 raft could carry 6 pdr anti tank guns, carriers and 15cwt trucks. Vehicles could simply drive forward onto the raft and drive forward off at the other side. This was not true of all rafts.

Components required for the raft were
- 2 X boat
- 4 X road-bearer
- 15 X decking panels
- 4 X raft connector.

Decked Raft Class 9

This was as for Decked Raft Class 5 but used two bays. Being Class 9 it could carry a loaded 3ton lorry.

Shore Loading Decked Raft Class 5

This was single bay but with a half floating bay attached. The outer end of the half floating bay was fastened to a shore transom which rested on the bank when loading and unloading. If the banks were a suitable height the shore loading raft could be used without landing stages and could thus come into action more quickly. A further advantage was that the raft could be free ranging and be rapidly changed from one crossing point to another. A disadvantage was that the raft had to turn round in mid stream to allow the half floating bay to be brought against the far bank. This in turn meant that vehicles had to reverse onto the raft.

Components required for the raft were

- 3 X boat
- 8 X road-bearer
- 30 X decking panels
- 2 X raft connector.
- 1 X shore transom

Shore Loading Decked Raft Class 9

This consisted of two Class 5 Shore Loading Rafts with the two half bays on the outside. This could carry 3ton lorries. Having a half bay at each end meant that turning in mid stream and reversing onto the raft were not necessary.

Ferries

Any of the decked rafts could be used as a ferry. In that case a line must be taken across the river by the dinghy or a folding boat and fastened to holdfasts on each bank. A ferry set consisted of:

- 1 X cable drum with 100 fathoms of 1” cable
- 2 X 113 fathom coils of 2” manila hawser
- 2 X 2” double blocks
- 2 X 1” snatch blocks
- 4 X earth holdfast anchors

The raft can then be powered by whatever means is available. Oars and propulsion units are not suitable because of a lack of space but outboard motors and winches can be used. If necessary the raft can be powered by men hauling on the cable.

Bridge Class 9

Any number of Decked Rafts Class 5 could be connected to make a bridge, officially up to 240 foot long but longer bridges were built. Each end of the bridge needed a half floating bay and a trestle bay with ramps.

The FBE bridge was for assault use and should be built immediately after a successful assault crossing in order to move divisional vehicles across the obstacle. It is important that as much design and planning be done in advance as possible but designs and plans may have to be altered after a close inspection of the site, or as a result in changes in the tactical situation.

Since time is important vehicles should be off loaded as close to the construction point as possible. The following outline should be followed:

- A parking area should be chosen and signposted. It should be off the road but have easy access.
- Lorries should be called forward as required and park as close to the construction site as possible. Vehicles should be unloaded as their stores are required and stores should not be laid out on the ground.
- Work should be carried out on the decked rafts and the near bank landing stage simultaneously. It may be possible to work on the far bank landing stage but this will probably have to wait until the bridge is complete.
- Rafts can be added to the bridge as they are completed.

Folding Boat

The Folding Boat is constructed of plywood and canvas. The floor is covered with wooden slats and the bottom and sides have rubbing strakes for protection. A timber baulk runs down the centre of the floor and this provides a firm base for the spreaders. To open a boat requires twelve men. It is laid on the ground with five men on each side and two men in the boat. The sides are then pulled upwards and outwards until the men in the boat can fit the spreader tubes from the centre baulk to the gunwale clamps. Twelve men are then required to carry the boat to the water.

The folding boat can be used as an assault boat in which case it can carry eighteen men.

The folding boat had the following dimensions:

- Length - 22 foot
- Width - 6 foot 8 inches
- Height - 2 foot 9 inches
- Weight - 940 lb

Each boat has the following:

- 5 X oars
- 1 X boathook
- 1 X bailer
- 1 X anchor
- 1 X buoy with line
- 2 X dodger to fit over the ends of the boat to keep water out

Road-Bearers

Road bearers were steel girders each with four square plates with sockets to correspond with pins on the boat gunwales. Bearer had ledges at the bottom to support deck panels, and had eighteen holes, one foot apart, to reduce weight.

- Length - 19 foot 6 inches
- Height - 10½ inches
- Weight - 380 lb

Deck Panels

Deck panels were made up from four planks of Douglas Fir fasten together. Five panels were fitted between each pair of bearers. They were located by small welded distance pieces on the bearer and by dowels on the panels fitting into slots in the bearers.

- Length - 3 foot 10½ inches
- Width - 2 foot 7½ inches
- Thickness - 1¾ inches
- Weight - 78 lb

Bay Connectors

Rafts were connected to each other using raft connectors which were clamps fitting over pins near the end of each bearer. This allowed for vertical movement as vehicles passed over the bridge.

Trestles

The trestle supported the roadway at the shore ends of the bridge and allowed for some adjustment for height. A transom was supported on two legs and a saddle fitted to the transom to accommodate the road bearers. An NCO and 6 men can erect a trestle in ten minutes.

Where a water obstacle is too shallow, has sand banks or obstacles, or even where there is no water, a bridge can be constructed entirely from trestle equipment. This is expensive in equipment since the trestles from several bridges will be needed.

Trestle Transom

This was a steel box girder with slots at each end to accommodate the supporting legs.

- Length - 13 foot 5 inches
- Width - 6 inches
- Height - 10 inches
- Weight - 210 lb

Transom Saddle

A steel beam with location points for road bearers. This was clamped to the top of the transom.

- Length - 11 foot 3 inches
- Width - 4½ inches
- Height - 1½ inches
- Weight - 50 lb

Trestle Legs

These were steel box sections with holes drilled every four inches to accommodate pins to support the transom at the required height. Should this height need to be adjusted jacks could be fitted to the legs and transom and the transom thus raised or lowered.

- Length - 10 foot 10 inches or 7 foot.
- Width - 5 inches
- Height - 3 inches
- Weight - 150 lb

Shoes

These were circular metal supports for the legs. They fastened to the base of the legs by pins so as to allow some articulation to accommodate uneven surfaces.

- Diameter - 1 foot 4 inches
- Weight - 22 lbs

Struts

Steel telescopic struts were used to brace the legs. These were fastened to the top of each leg and then fixed to the bank with spikes.

- Length - Variable from 22 foot 6 inches to 13 foot.
- Weight - 22 lb.

Ramps

Ramps were provided to allow easy access to the shore ends of the landing bay. They were deck panels permanently fitted to a tapering base with trunnions to fit onto a shore transom.

- Length - 3 foot 4 inches
- Width - 3 foot
- Thickness - 4½ inches tapering to 2 inches

Shore Transom

A steel shore transom was used on each shore to locate the road bearers and the ramps. Much as a transom saddle but more substantial.

- Length - 10 foot 6 inches
- Width - 6 inches
- Height - 4 inches

Folding Dinghy

The folding dinghy was part of the Folding Boat Equipment and was intended for use in bridging operations. It was constructed from plywood panels hinged together with canvas. It could carry three men and could be carried by two. Erection was a matter of seconds. The sides were pulled upwards and outwards and then held in place with two wooden thwarts which also served as seats. Two oars were supplied.

Dimensions when open:

- Length - 10 foot 3 inches
- Width - 4 foot 3 inches
- Height - 1 foot 8 inches
- Weight - 100 lbs

Tracked Raft

The Tracked Raft used two folding boats but otherwise was a different equipment. It could not be used as part of a bridge or in any but the basic form. Two folding boats were fitted with tracked raft transoms which fitted on the outer gunwale pins. Two steel lattice trackways are clamped onto the transoms, facing fore and aft rather than across the boats. Four trackways are hinged to the ends of the centre trackways to form ramps and then the ramps are braced into the desired position. Note that ramps must be resting on the banks before vehicles can cross them.

A tracked raft requires:

- 2 X boat plus accoutrements
- 2 X transom
- 6 X trackway (two centre trackway and four ramps, all identical except for clamps)
- 2 X set of ramp bracing members (long tie bar, A frame and short tie bar)
- 2 X set of trackway bracing members (2 X tie bar and 2 X A frame)
- 8 X 2” breast-lines
- 4 X wheel chocks to secure the load

The minimum detachment for assembly is an NCO and 11 men. Construction time is 10 minutes using the following procedure:

- ten men assemble and launch the two boats and two men moor them to the bank with breast-lines and pickets.
- The boats are positioned at right angles to the shore and raft numbers, 1 to 4, get into them.
- numbers 5 to 8 pass the transoms to the raft numbers who place them into position, offshore end first.
- Numbers 1 to 6 carry and fit the upstream trackway and numbers 1 to 3 remain on board.
- Numbers 4 to 9 carry and fit the downstream trackway.
- Numbers 1 to 3 and 7 to 8 fit guides and articulation members
- Numbers 1 to 6 carry and fit the upstream ramp and numbers 1 to 3 remain on board to adjust the ramp and fit bracing
- Numbers 4 to 9 carry and fit the downstream ramp.
- The boat is turned round so that the remaining ramps can be fitted.

The tracked raft can be powered by:

- Oars. Five oars are provided for each boat, usually two are for steering.
- Propulsion unit. An engine is carried in the bows of the boat and the propulsion unit fitted to the stern. Usually only one set is used per raft.
- Seagull outboard motor. This is clamped to the stern of one of the boats.

Transport

The Tracked Raft was carried by

- 3ton 4 X 4 GS lorry which carried the superstructure
- FBE MkII trailer which carried two boats and the two transoms

The bridge loads were:

- 3 ton 6 X 4 FBE lorry carrying a complete landing stage unit
- 3 ton 6 X 4 FBE lorry carrying a complete floating bay unit
- 3 ton 4 X 4 GS lorry carrying 8 rolls of trackway for the approaches
- 15 cwt GS truck carrying ferry gear, auxiliary equipment and a dinghy

STORM BOAT

The storm boat was intended for the assault crossing of wide and fast flowing rivers. It had an oak frame and plywood sides and bottom. Seat/tracks extended down both sides and served both as seats and tracks for guns or light vehicles. There was a false floor to allow any water that was shipped to flow into the bilges. It could carry eighteen fully armed men in addition to a crew of two, although twelve fully armed men was the normal load under operational conditions. The maximum speed was 20 knots when empty or 6 knots when fully laden. It was particularly useful since it could carry a jeep or a 6 pdr anti tank gun and ammunition. To assist in loading and landing it could be equipped with steel ramps. The inside ramps rested on the seat/tracks and were fixed into position. The outer tracks could be swivelled so that they rested inside the boat, or they could be extended forward and fixed into one of three positions. These allowed loading and landing at up to banks 3 foot high. A centre ramp could be fitted between the ramps to act as steps for personnel.

The storm boat was powered by a 50hp outboard motor. This was mounted on the stern on a swivel mount. This allowed the motor to be turned 90 degrees for steering. The mount also tilts for and aft so that the motor will tilt if it strikes the river bottom or an obstacle, and the motor can be tilted right over and brought into the boat.

This equipment was operated by Royal Engineers as it required some skill. When loading it was important that the boat be sufficiently far from the bank to ensure that it did not settle into the river bottom as the guns or jeeps were loaded. The boat had also to be held steady and square with the bank. This was done by driving spiked through holes in the ends of the ramp and by breast-lines fastened to the stern of the boat. In very fast flowing rivers it may be necessary to find an inlet or other water sheltered from the current.

- Length - 20 foot
- Width - 6 foot 6 inches
- Maximum draught - 2 foot 3inches

- Weight - 1,500 lbs

Equipment included an outboard motor, ramps, canvas dodger, breast-lines and wheel chocks.

Three boats could be carried nested in a 3 ton 4 X 4 GS lorry. A special 18 inch high wooden frame was needed to lift the boats above the lorries wheel arches and so that the widest (top) part of the boat cleared the body sides. The lorry tilt and frame could not be fitted. The length of the boat meant that the lorry tailboard had to be lowered or removed. The ramps and motors were carried in the top boat and covered with tarpaulins.

CLOSE SUPPORT RAFT

A Close Support Raft MkII was introduced and this gave a higher free board. Either the MkI or MkII could be made into a Class 12 Close Support Raft by using a Bailey centre pontoon.

The Close Support Raft was developed in 1943 to carry vehicle across water obstacles in the early stages of an assault river crossing. It was expected that there would be considerable demand for these in NW Europe. The design used the experience of a variety of earlier rafts which used a variety of components from other bridging systems. It was designed specifically as a raft and was not intended for use as a bridge. Its features included

- light road way bearers which were easy to manhandle.
- rapid construction using few personnel
- ease of operation with a small crew
- shore loading in that it had ramps and did not require landing stages or prepared landing sites
- free ranging in that it could be powered by propulsion units and was not limited to one crossing point.

Construction

The Close Support Raft MkI used MkV or MkV* pontoons with a specially designed saddle. The pontoons were mounted on wooden sledges with steel runners so that when unloaded from the pontoon lorries they could be towed across country by any armoured tracked or half tracked vehicle. Four road bearers were each assembled from two sections and fitted to the pontoons. Ramps were fitted at each end and propulsion units fitted.

The Close Support Raft was Class 9. This meant that it could normally take four wheeled vehicles up to 9 tons but could carry six wheeled vehicles and tracked vehicles of greater weight. This included all the tactical vehicles of an infantry battalion plus armoured cars and Quad tractors with 17 pdr anti tank guns. Although two pontoon piers were normally used it was possible to add a third pontoon pier. This did not increase the capacity but did give a greater freeboard and allowed an extra propulsion unit to be fitted. Three part pontoon piers using Bailey centre pontoons were authorized and this did increase the capacity to Class 12.

The ramps were connected by cables so that when one ramp was lowered the other was raised. It was possible for the vehicle being carried to operate the ramps by driving slowly on to them but it was generally wiser to send a man. One mans weight was sufficient to operate the system.

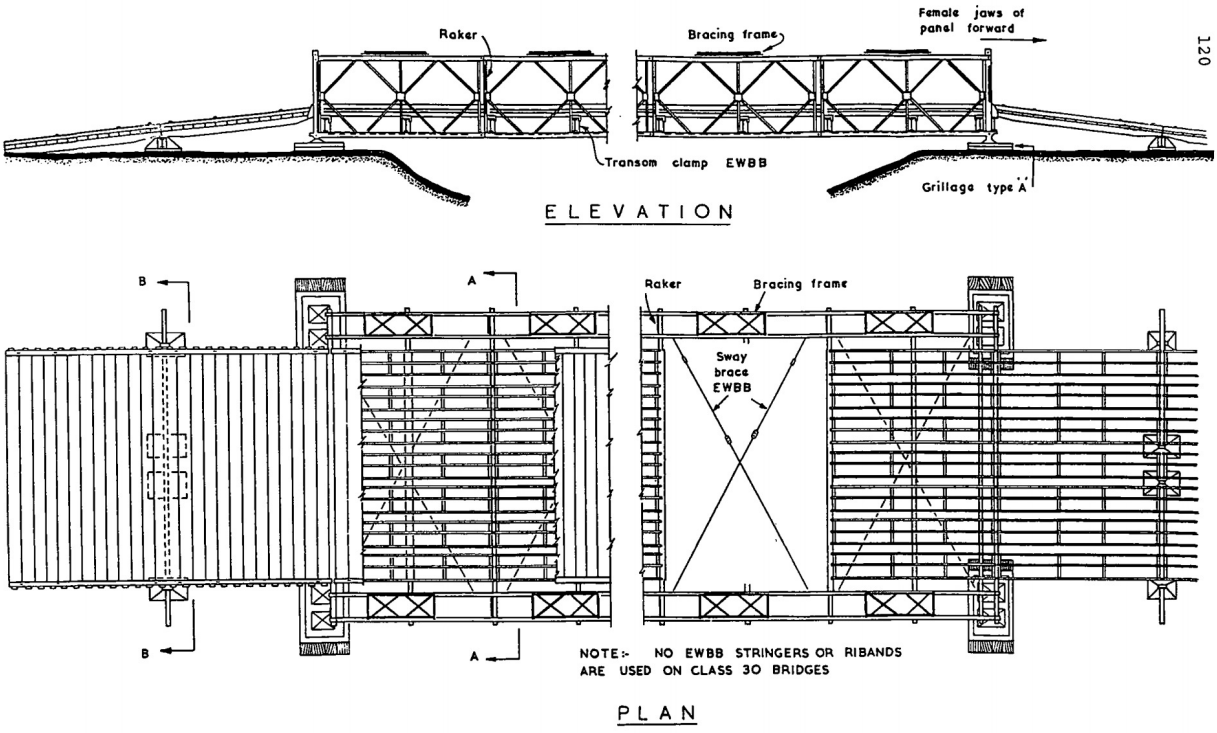
A Close Support Raft MkII was introduced and this gave a higher free board.

BAILEY BRIDGE

The Bailey Bridge became almost a universal bridge equipment, capable of being used in a wide variety of roles and replacing all other equipment except the FBE in forward areas, and supplementing other equipment in rear areas. It could be built in an infinite variety of lengths and load classes. It could be built by almost any engineer unit and could be built without machinery. It could be carried in standard 3 ton GS lorries. It could also be used for pontoon bridges and rafts. It was adopted by the US Army and others, and remained in service for many years. In only slightly modified form it is still in use today.

The basic unit of the Bailey Bridge was a 10 foot length using he following components

- A panel which was a steel frame 10 foot long by 5 foot 1 inch high. These were fastened together with standard panel pins 8 1/4 inch long and 1 7/8 diameter
- A steel I Girder transom which was 18 foot long, 10 inches high and 4 ½ inches wide. These were clamped to the panels using transom clamps. Transoms had five sets of lugs on the top surface to locate the roadway stringers. There were four holes drilled through the transom to allow the transom to be carried using lifting bars.
- Five stringers, each consisting of three connected girders, were laid across the transoms. The stringer was 10 foot long, 1 foot 9 inches wide and 4 inches deep. The two outside stringers were button stringers which had buttons along the outside edge to locate the roadway chesses.
- Chesses were of wood and were 12 foot long, 8 ¾ inches wide and 2 inches deep. These were laid across the stringers and located by the buttons on the button stringers.
- Ribands, 6 inches by 6 inches, 10 foot long and chamfered on both sides, held the chesses in place.
- Rakers were fastened to the top run of the panel and a lug near the end of the transom. These kept the panel vertical



- Tubular Sway Bracing was fitted under the roadway. A brace ran from one end of the lower run of a panel to the diagonally opposite end.

The bridge could be strengthened in a number of ways.

- Extra transoms could be added. There were normally two per bay but four could be used.
- An extra truss of panels could be fitted outside the first. The panels were fastened together with bracing frames 4 foot 3 inches long and 1 foot 9 inches wide.
- A third truss could be added outside the first two. This did not have bracing frames.
- Extra stories of panels could be added over the lower ones.

Each end of the bridge was supported by end posts which fitted onto a base plate 4 foot 7 inches by 3 foot. This had bearings to accommodate single, double or triple trusses.

Foot walks could be fitted either side of the bridge. Bearers 3 foot long were fitted to each end of the transom. Foot walks were 10 foot long by 3 foot wide and made up of 6 inch wide strips of wood 3 inches apart and fasten by four battens. Handrails could also be fitted.

Ramps were used at either end of the bridge. These were 10 foot long but two could be fitted together and rested on a transom.

Weights of components:

- Panel 570 lbs
- Transom 445 lbs
- Transom Clamp 7 lbs
- Rakers 18 lbs
- Sway Bracing 65 lbs
- End Posts 130 lbs
- Base Plate 400 lbs
- Bearings 70 lbs
- Foot walks 98 lbs
- Foot walk Bearer 20 lbs
- Handrail 7 lbs
- Stringers 133 lbs
- Button Stringers 190 lbs
- Chesses 50 lbs
- Ribands 95 lbs

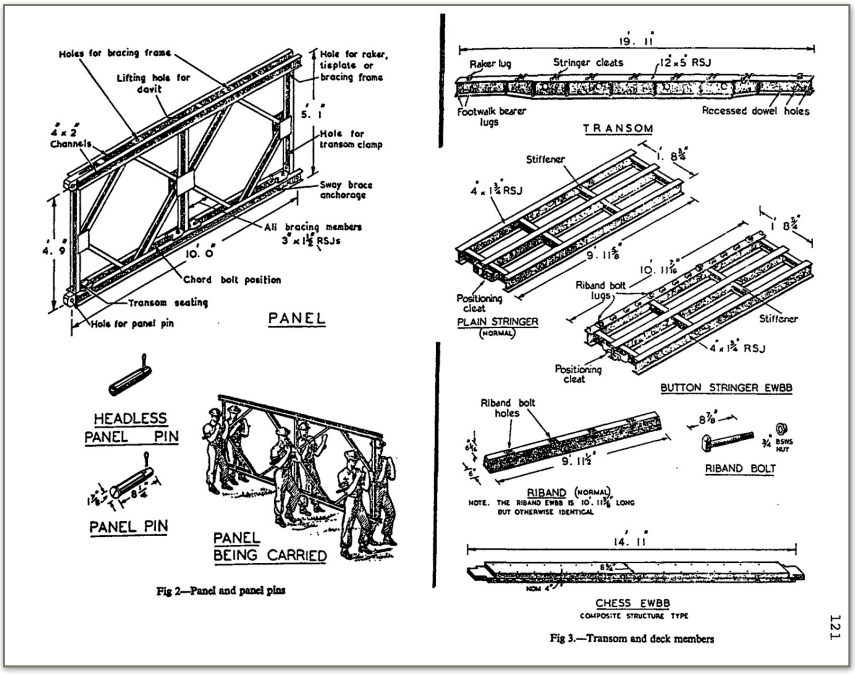


Fig 2—Panel and panel pins

Fig 3.—Transom and deck members

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IMPROVISED RIVER CROSSING EQUIPMENT

It was a principle that every effort should be made to force a crossing if a river obstacle was reached. To delay only allows the enemy to organize a defence and necessitate a set piece assault. Only a small force on the far bank can yield great gains. The following were official uses of readily available military material. Obviously many other improvised floats and rafts could be utilized.

Groundsheets

Groundsheet float

Two men could use their two waterproof groundsheets to make a float to carry their equipment while they swam across a water obstacle. The uniforms and equipment are packed into the groundsheet and the two rifles are laid lengthways on either side of the equipment to provide ballast and rigidity. When tightly fastened this should remain afloat long enough to cross a river. The men should swim and push the float ahead of them. If one man cannot swim he can use the float for support while the other man swims and tows the float on a line. It should be possible to carry a Bren gun or 2” mortar instead of rifles.

Groundsheet raft

Twenty four ground sheets filled with straw or bracken can be used to make a raft. Twelve such ground sheets should be tied together to make a float and two floats tied alongside each other to make the raft. A deck of bridge chesses or similar timber can be used to make a flat deck with an area of 6 foot by 11 foot. This will carry 1800lb.

Tarpaulin

Tarpaulin sheet float

A standard 20 foot square tarpaulin sheet can be filled with straw or similar material to make a float 4 foot 6 inches by 4 foot 6 inches by 1 foot 6 inches. This can be made in 15 minutes and will carry three men.

Tarpaulin sheet raft

Four tarpaulin sheet floats are lashed together with poles or spars, leaving a 3 foot gap between floats. A deck of planks can be laid over the spars to make a raft 15 foot long and 12 foot wide. This will carry 24cwt.

Lorry tilt

The frame and tilt from a 3ton GS lorry is inverted and the frame stiffened with thin timber. Bearers of 4inch by 2 inch timber are laid on the frame and trackways of 6 inch by 2 inch timber laid on them. This will take 15 minutes to build and will carry a 6pdr gun, its crew and eight boxes of ammunition.

Field Artillery

A standard 25 pdr field gun or a 6 pdr anti tank gun can be stripped and the components carried in rafts or boats which would not carry the entire piece. A 25 pdr can be stripped in 20 minutes and reassembled in 30 minutes. A 6 pdr can be stripped in 15 minutes and reassembled in 20 minutes. The following components will weigh less than 1000 lb each:

- Barrel with breach
- Recoil mechanism and cradle
- Trail

- Axle and wheels
- Shields, platform etc.

TRACKED BRIDGES

Tracked bridges consisted of two steel channels which could be spaced to accommodate the wheels or tracks of vehicles. Originally intended for tanks they were used more widely when they became obsolete in that role.

Tracked Bridge 12 foot, No 3, Class 9
These were steel channels with lattice sides and pierced steel decking. There were various patterns weighing between 450 lbs and 500 lbs. They could carry trucks, carriers and lorries up to 3ton 4 X 4.

Tracked Bridge 20 foot.
Originally intended for tracked vehicle up to Class 24 these were carried and laid by specially fitted 3 ton 6 X 4 lorries. By 1944 it was obsolete in the intended role but could be used for wheeled vehicles when it was Class 12 for four wheeled vehicles and Class 18 for six wheeled vehicles.

Valentine Bridge-layer

The Valentine Bridge-layer was a Valentine MkII with the turret and ammunition stowage removed and hydraulic equipment installed in the hull. The bridge was Bridge, Tank, 30ft, No1, which was actually 34 foot long and could carry a 30ton load. The bridge was a scissors type which folded in the centre for transport.

Churchill Bridge-layer

The Churchill Bridge-layer was a Churchill MkII or MkIV with the turret and ammunition stowage removed. Hydraulic equipment was installed in the hull to work the bridge launching gear. The bridge itself was Bridge, Tank, 30ft, No2 which could carry loads up to 60 tons.

Churchill ARK MkI

The original Churchill ARK was developed for climbing sea walls and other obstacles on D Day. A Churchill MkII or MkIV had the turret removed and the ring plated over. Timber trackways were fitted above the hull and ramps fitted at both ends, supported by kingposts.

Churchill ARK MkII

The MkI Churchill Arks were rebuilt to make them more generally useful. The left hand tracks and ramps were widened from 2 foot to 4 foot to allow narrower track vehicles to cross as well as tanks. A square cupola was added.

RAILWAY BRIDGES

Military railway bridges did not differ greatly from civilian bridges except that they needed to be built rapidly and there was seldom a great deal of time for planning. They usually replaced a damaged existing bridge and the extent of the damage could not be assessed until the area was secured. Thus the military railway bridge had to be:

- **Flexible**. The components had to be capable of being adapted to the needs of the moment and the site.
- **Standardized**. Personnel needed to be able to construct a bridge without additional training.
- **Rapid to construct**. Railway bridges naturally took longer to construct than did the military road bridge but they were needed in a short time to maintain supplies for the armies and for the civilian population.
- **Easy to transport**. Railway bridge components could often be transported by rail but this was not guaranteed. Components had to be light enough to be carried on military lorries, and preferably components should be light enough to be manhandled.

For the campaign in NW Europe railway bridging was of the following types.

- **Rolled Steel Joist (RSJ) and Sectional Joist Equipment**. These shared several components and the Sectional Joist Equipment was a more easily transported version of the RSJ equipment. These could be used for spans up to 39 foot.
- **Sectional Welded Plate Girder**. This was a heavier equipment capable of constructing spans up to 56 foot. It was not much used since the other equipments were capable of performing the same task, often in combination.
- **Unit Construction Railway Bridge**. This could construct spans up to 110 foot. The great majority of railway bridges in NW Europe were built with this equipment, often with RSJ and Sectional Joist Equipment forming approach spans.
- **Sectional Truss Railway Bridge**. A heavier equipment capable of building 150 foot spans. This was just coming in to service at the end of the campaign.
- **Light Standard Unit Trestle**. This was a flexible system of building supports for bridge spans. The Light equipment was the most widely used.
- **Heavy Standard Unit Trestle**. Capable of forming higher or heavier trestles with fewer components and less effort than the Light equipment. Not much used.

The US Army was happy to standardize on the same bridging material as the British Army and much of the equipment was manufactured in the USA.

UNIT CONSTRUCTION RAILWAY BRIDGE

UCRB was a railway bridge design intended to provide spans from 50 foot to 85 foot. This was later increased to 110 foot.

The largest component of the UCRB was the trough shaped chord member. This was formed from three plates welded together in either fifteen foot or twenty foot lengths. Any span from 30 foot to 85 foot, or later 110 foot, could be constructed by combining the appropriate members. The chord members were fastened together on site using plates bolted through predrilled holes at the end of each member. Vertical members were bolted into the trough of the chord member using predrilled holes. Verticals were at 5 foot intervals. Diagonal bracing was then added to form an N shaped pattern. A trough shaped chord member was then added to the top of the uprights and the truss was then complete. Depth of the truss was 6 foot 10 inches. Width of the truss was 18 inches.

Usually four trusses were used to support a railway track. Trusses were fastened together in pairs using spacers top and bottom. This gave a three foot spacing. Cross bracing was added at the uprights.

The heaviest component of the bridge was the 20 foot trough shaped chord which weighed 1 ton.

The later, and heavier, chord members were painted brown while the earlier members were painted grey.

COMPONENTS

The chord member.
These were the trough shaped components which formed the to and bottom of the truss. They could be 15 foot or 20 foot long and were 18 inches wide. All were predrilled to accept the bolts to hold uprights and sloping members as well as cross bracing and splicing plates.

Splicing plates.
Splices were used to fasten chord members together to form longer trusses. The side splicing plates were oblong but with the corners clipped. They were fastened to the chord members using bolts through the predrilled holes. The flange splicing plates used on the top and bottom surfaces were divided so that there was a three inch gap along the centre to allow free passage to the launching rollers.

Verticals and diagonals.
All verticals and diagonals were identical and were 6 foot 6 inches long lengths of 10 inch by 8 inch RSJ. These were bolted to the chords using the predrilled holes.

Bearings.
Bearings were components on which the completed truss rested. A rocker slab was welded onto a bearing plate which was seated on a bed plate. These could be placed at 11¾ inches, 15 inches or 2 foot 6 inches from the ends of the truss.

All the above were universal and used in any type of UCRB. The spacers and cross members varied with the type of bridge.

Spacers

Cross members.
Cross members used in a through UCRB were I shaped girders. They were 2 foot 3 inches by 9 inches and were 11 foot 6 inches long. They were positioned at each vertical. Girders were fastened lengthwise on top of the cross members, wooden sleepers were laid across the girders and the rails laid on the sleepers in the usual manner.

LAUNCHING NOSE

A launching nose was used when a completed span was being hauled into position. The nose would reach the rollers on the far side of the gap before the centre of gravity was reached and the span fell into the gap.

The launching nose was of a similar, but lighter construction than the bridge itself. It was of the same overall dimensions so that it could be temporarily fastened to the end of the span. Trusses were T shaped girders with strengthening gussets. The uprights, angles and bracing were all standard UCRB components.

A Launching nose was 52 foot 6 inches long and came in three sections.
- The nose section which was 19 foot 3 inches long
- The centre section which was 14 foot 3inches long
- The rear section which was 18 foot long

LAUNCHING

The completed bridge span was launched by using hauling and preventer tackles. The hauling tackle was attached to the far bank and used a winch to haul the span across the gap. The preventer tackle was attached to the near bank and acted as both a brake and a means of keeping the nose up.

Rollers were laid out on the both sides of the gap and the completed span placed on them. The bottom trusses rested on the rollers and where chords were joined with plates there was a gap to allow the rollers an unobstructed path.

The span was winched out until the launching nose front section just cleared the far side rollers when it was removed. Winching resumed until the mid section just cleared the far side rollers when it too was removed. When the span was in the correct position the rear section was removed and the span was jacked down into position. Usually jacking was assisted by a gantry erected on the bridge trestles. This was removed when the bridge was complete.

TRESTLES

LIGHT STANDARD TRESTLE

The Light Standard Trestle was the most widely used. It was constructed using a number of standard columns of various lengths. These were bolted together to obtain the required height. They were then connected horizontally with struts and braced with diagonal bracing.

Columns.
These came in 12 foot (L1), 8 foot (L2), four foot (L3), and 3 foot (L4)lengths. They were constructed from 10 inch by 3 inch rolled steel channels, two such channels being fastened together with 9 inch square plates at 2 foot intervals. Each column had the relevant letter painted on it, L1, L2, L3, L4.

Each column had a plate at the top and bottom so that they could be bolted together. The plates were 16 inch square and had predrilled holes.

Struts.
The horizontal struts were 4 foot 1¾ inches long with 9 inch square plates at each end. They were placed at 4 foot centres, again using predrilled holes.

Bracing.
The diagonal bracing was of 2 inch by 2 inch angle iron.

Grillage joists.
The joists were used as a footing for the trestle and as a capping to which the bridge trusses could be connected. They consisted of either 10 foot or 15 foot lengths of 12 inch by 6 inch RSJ. They were predrilled to allow columns to be fastened on the flange surface and to accept connecting pieces. The joists themselves could rest on a grillage of timbers or sleepers.

Connecting pieces.
These were used to join grillage joists in pairs. The connecting piece was 9½ inches long.

Camels foot.
A camels foot was a circular foot which could articulate so as to rest firmly on the ground. It was 3 foot in diameter and had a leg which could be adjusted for length between 3foot 11¼ inches and 5 foot 11¾ inches. This was connected to the bottom of columns and replaced a grillage. It was particularly useful on uneven ground, on existing but damaged piers of bridges or when trestles were to be set on a river bed.

HEAVY STANDARD TRESTLE
The Heavy Standard Trestle was much less used than was the Light Standard Trestle. It was a scaled up version using heavier components.

Columns.
There were three columns of 14 foot 8 inch (H1), 9 foot 4 inch (H2) and 4 foot (H3). Each was constructed from two 12 inch by 3½ inch RSJ joined by 10 inch by 12 inch plates placed 2 foot 8

inches apart. They were capped by 20 inch square plates. H1, H2 or H3 was painted on the columns.

Struts.
These were 5 foot long with 10 square plates at each end.

Grillage.
The grillage joists were either 12 foot or 18 foot lengths of 12 inch by 6 inch RSJ with 13 ½ inch distance pieces.

Camels feet could not be used with the heavy trestle.

SECTIONAL JOIST EQUIPMENT

Sectional Joist Equipment was introduced in order to simplify supply by providing just three lengths of joist which could be used for any span up to 39 foot.

All the joists were of 24 inch by 7½ inch RSJ and there were three lengths, 9 foot, 12 foot and 15 foot. They were predrilled and could be cut by one foot at either end or both ends so that by combining joists of different lengths and by cutting any length could be obtained in one foot increments.

Joists were spliced together using splicing plates bolted through predrilled holes.

SECTIONAL WELDED PLATE GIRDER BRIDGE

Sectional Welded Plate Girders were heavier that Sectional Joists and could be used to form longer spans. A plate girder was constructed by welding plates to form an I shape rather than manufactured by rolling.

The plate girders were 2 foot 11 inches deep and 14 foot long. As supplied the unit was a pair of 14 foot girders welded together in parallel by diaphragms. They were supplied as end units and centre units. The end units incorporated stiffened end posts at one end. A centre unit and two end units were spliced together using splicing plates through pre drilled holes to make a single unit 42 foot long. If required the girders could be cut to give a bridge with a span of 34 foot or 37 foot.

A bridge span required two trusses. These were normally placed separately either by launching on rollers with a light launching nose, or by using a derrick attached to trestle piers. When both trusses were in position they were connected by steel channel spacers. It was possible to construct a deck bridge or a half through bridge, the decked type being most common.

EVERALL SECTIONAL TRUSS BRIDGE

The Everall Sectional Truss Bridge was developed late in the war and was intended for long spans, up to 400 foot. It was of most use in the immediate post war period when the European

railway systems were being rebuilt. The long spans were particularly useful for crossing the navigable rivers of Holland and Germany. Naturally the size, weight and complexity of the bridges meant that they were slow to build, but much quicker than a custom designed bridge for which the components would have to be produced to order.

There were in fact three type of Everall Sectional Truss:

- Type 15 had girders 15 foot deep and could be used for spans up to 180 foot.
- Type 30 had girders 30 foot deep and could be used for spans up to 330 foot.
- Type 45 had girders 45 foot deep and could be used for spans up to 400 foot.