

# Bailey Bridge Primer

---

*“Without the Bailey bridge, we should not have won the war. It was the best thing in that line we ever had.”*

## **Field Marshal Lord Bernard Law Montgomery**

The design concept for a modular bridge was first proposed by Donald Coleman Bailey in 1936. He was working as a civil engineer in the Experimental Bridging Establishment (EBE) at Christchurch, U.K. His design was for a through-type truss bridge with the roadway being carried between two main girders. The trusses in each girder would be formed by 10-foot panels pinned end to end. While his design was not initially accepted by the War Office, when the Second World War broke out and the war progressed, he was asked to review his original design. He did so and, by 1941, the design was far enough advanced to move into production.

The Bailey bridge has several distinctive features. It can be assembled by manpower alone; it is made entirely from prefabricated parts, the most notable of which are its light-steel panels linked by pinned joints; and, it can be moved from one site to another on cargo trucks. During the Second World War, bridges were moved, rebuilt, or replaced in hours, even under enemy fire.

The Bailey bridge was used widely by Allied armies in Italy and northwest Europe. Over 2500 Bailey bridges were built in the campaigns in Italy and over 2000 in Northwest Europe. The first Bailey bridge built under fire was at Leonforte in Sicily by the 3<sup>rd</sup> Field Company, Royal Canadian Engineers. Another Canadian achievement was constructing the longest Bailey bridge, the 1814 foot (558 metre) ‘Blackfriars Bridge’ over the Rhine in 1945 built by the II Corps Royal Canadian Engineers in March 1945.

Donald Bailey was knighted in 1946 for this contribution to the Allied victory in the Second World War. In 1985, the War Office paid then-Sir Donald £12,000 for his invention.

## **Design**

The original Bailey Bridge design had a roadway width of 10’6’ and a clear width between trusses of 12’11’ inches. By redesigning the transom and sway braces, three models of Bailey Bridge were built during and after the Second World War.

From the British Standard Bailey Bridge (SBB), the United States Army developed the Standard Widened Bailey Bridge (M2 in US nomenclature, SWBB in Canadian nomenclature). It has a roadway width of 10’9” and a clear width between trusses of 14’3”. The British later expanded on the US development and built the Extra Widened Bailey Bridge (EWBB) with strengthened transoms to handle larger tanks such as the

Centurion. The Canadian Army adopted this design and it was used in training through the 50s and into the 90s. It has a roadway width of 13'9" and a clear width between trusses of 15'8". Although the US Army named this variant the M3, they never took it into service.

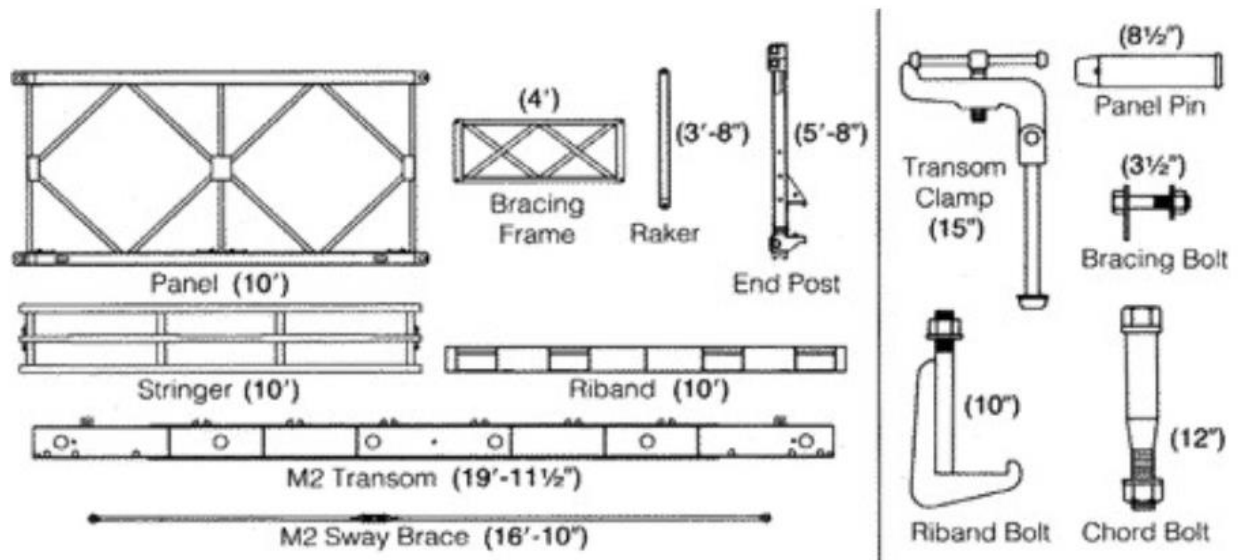


**This Bailey bridge at the Pegasus Bridge Museum near Caen in Normandy commemorates its contribution to the war effort. The launching nose was left in place to demonstrate how the bridge was constructed using only manpower and pushed from the friendly to the enemy bank of a gap.**

## Components

The Bailey bridge is essentially made from transverse floor beams, called transoms, clamped to the bottom chords of the trusses to support stringers and decking. Sway braces between the girders provide horizontal bracing; rakers between the trusses and transoms keep the trusses upright; and bracing frames and tie plates between the trusses provide lateral bracing within each girder. Footwalks can be carried on the transoms outside of the main trusses on each side of the bridge. The SBB uses two or three transoms per bay to support the roadway. The SWBB (M2) and EWBB (M3) carry more weight by using a fourth transoms id required.

There are 29 different bridge parts and 30 parts used in the erection of the bridge, including tools. All parts are man-portable. The transoms and panels are six-man loads. The EWBB transom is an eight-man load. Stringers are a two-man load. Most other parts can be handled by one man.



### Basic Components for the Standard Widened Bailey Bridge

**Component Materials.** Panels, end posts, transoms, and ramps are low-alloy, high-tensile steel. All other parts are carbon structural steel. All joints in the parts are welded. The decking (called chesses), and (called ribbands) are made of hardwood.

**Panels.** Panels are made from welded steel. Each is 10'5" long with lugs at each end on the top and bottom chords. The interlocking male and female lugs allow panels to be joined together by inserting panel pins. The bottom chord has three or four transom seats, depending on the bridge type. The girders on each side of the centerline of the bridge can be assembled from a single truss or two or three trusses side by side attached to the transom seats. For greater strength, a second story of panels can be added to the trusses. The upper stories are bolted to the top chord of the lower story. For greatest strength, a third story is added.

**Transoms.** Transoms are clamped to the panels using transom clamps. Transoms have lugs on the top surface to locate the roadway stringers. Holes drilled through the transom to allow the transom to be carried using lifting bars.

**Sway Braces.** Sway braces provide lateral stability to the bridge. A sway brace is fitted under the roadway at each end of each inner panel and run diagonally from across from the inner panel on one side to the inner panel on the opposite side of the bridge.

**Decking.** Steel stringers form the bottom layer of the roadway. They are 10 feet long and fit between lugs welded to the tops of the transoms. Slightly different stringers are laid on the outside edge with buttons on which to locate the wooden ribbands or curbs. Wooden

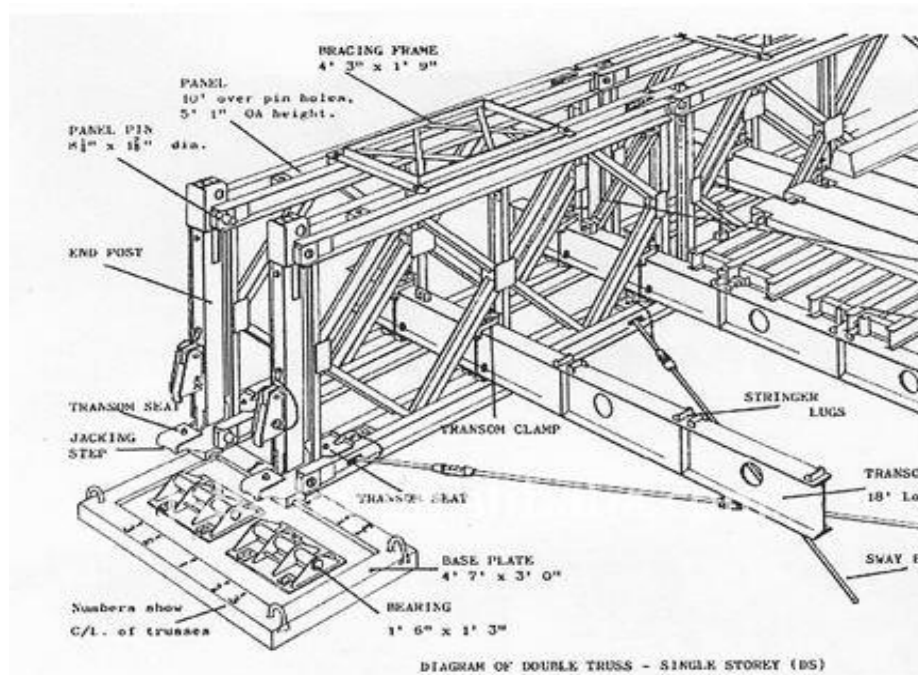
chesses are laid on top of the stringers, and if the bridge is to be left in place for any length of time, an additional wooden wearing surface can be nailed in place.

**Bearings.** End posts pinned to the end of each truss sit on cylindrical bearings which rest on a steel base plate. On soft soil, timber grillage can be used under the base plates to distribute the load.

## Construction

The Bailey bridge was designed to be constructed and launched by hand. In simple terms, the bridge is assembled on the home bank and pushed out bit-by-bit, panel-by-panel over the gap to land on the far bank. Rollers are laid out on the ground and panels and transoms are lifted and assembled on the rollers to form bays.

A single bay is one panel long and can contain up to six panels, three on each side, and two, three or four transoms depending on the weight the bridge is designed to carry. Bays are added and pushed forward, always balanced on the rollers. With three panels across and two high, the Bailey Bridge could support Sherman tanks over a 200-foot span. Panels are held to the transoms with transom clamps. When there is more than one panel in the truss, bracing frames are bolted to the top of the panels to hold them together. Bays are added and pushed forward, always balanced on the rollers.



**Diagram of a double truss, single-storey Bailey bridge (DS)**

When a crew starts to build a bridge, the first bays are used to form a launching nose. The launching nose is the lightest section of the bridge, consisting of the minimum of panels and transoms, but no roadbed components. Because of the play between the panel pins

that hold the ends of each panel to the next, the nose sags into the gap. To compensate, the nose is angled upwards by placing a link on the bottom chord of the last nose panel and the bridge. The bridge is pushed forward onto another set of rollers set up on the far bank and when the nose passes over those rollers, it is removed and both ends are jacked down onto bearing plates. The rollers are removed in the process and the decking and other elements are put in place.



**A double truss, double-storey (DD) Bailey bridge over a drainage canal in Nijlen near Antwerp. Belgium**

## Military Load Class Chart

The Military Load Classification is used to classify the safe amount of load a bridge can carry. This chart shows how the versatile design of the Bailey bridge can meet any number of traffic requirements over a range of bridge spans.

Load Class	Span in Feet						
	SS	DS	TS	DD	TD	DT	TT
9	90	150	170	180	200		
12	80	140	160	170	190		
18	60	110	140	160	180	200	
24	60	110	140	150	170	200	
30	50	100	120	140	160	190	200
40	30	80	110	130	150	180	180
50		50	90	110	130	160	180
60		50	80	100	120	130	160
70		40	70	90	110	120	150

## Conclusion

It is no hyperbole to describe the Bailey bridge as an engineering marvel, and there is no doubt the Bailey bridge was a major contributor to the Allied victory in 1945. So versatile was its design, that three-quarters of a century later, its legacy and use are present to this day. Slight improvements in the construction of its components have resulted in the manufacture and use of variants used in both civil and military applications.



**TS Bailey bridge built by 3<sup>rd</sup> Canadian Division Engineers in October 1944 across the Leopold Canal near Maldegem, Belgium is still in use today.**