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Ministry of Transportation

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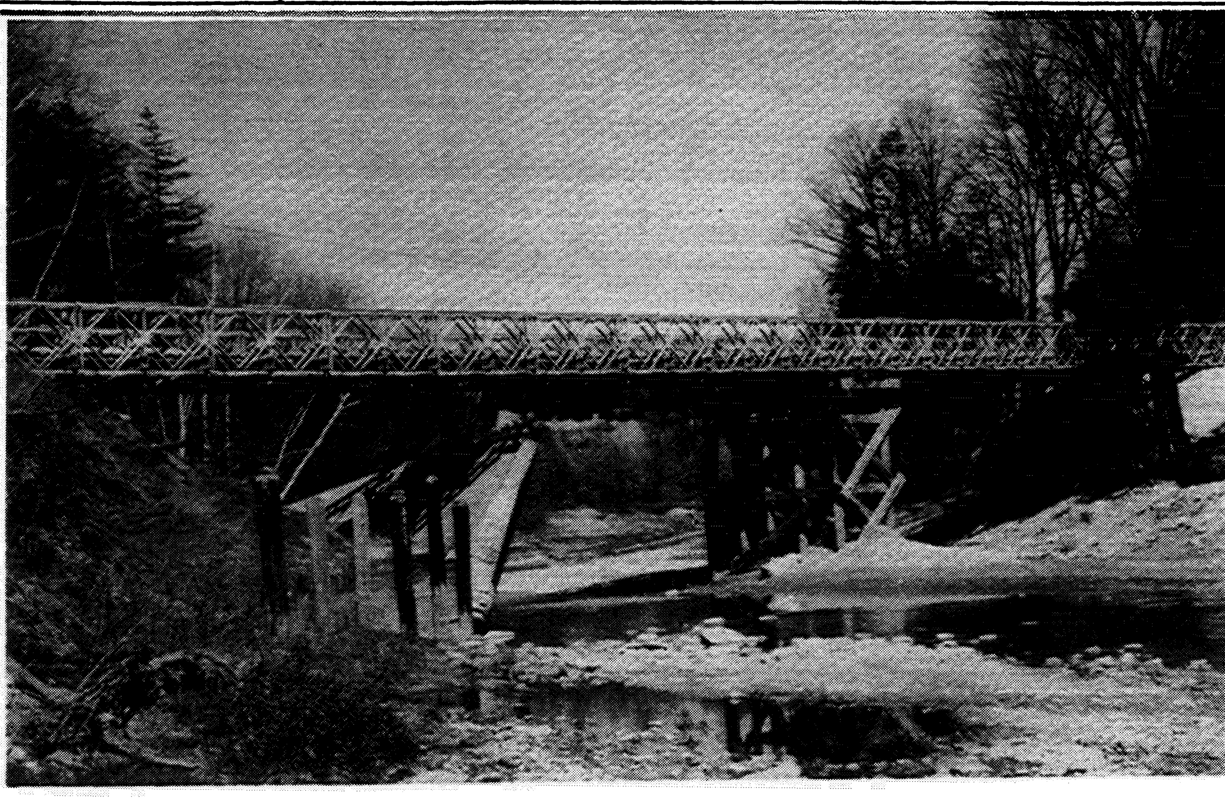
Manual SO 13



BAILEY BRIDGE

MANUAL

BAILEY BRIDGE MANUAL

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to the Manual

BAILEY BRIDGE

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Revision		Entered by	Date
No.	Date		

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1 Introduction

1. INTRODUCTION

Sir Donald Bailey invented the Bailey bridge and it was used extensively by the Allied Forces during World War II. Bailey bridges are well known for their flexibility and versatility. Bailey bridges can be used as pontoons as well as fixed bridges. The deck and truss systems can be strengthened to cope with a wide range of spans, difficult terrain and varying live loads. Bailey bridges are fabricated with reasonable tolerances for ease of erection. All parts can fit into a 5 ton truck and can be carried by a maximum of six men [1,2,3].

Since World War II many countries have used Bailey bridges for temporary and permanent civilian bridges. The Ministry of Transportation of Ontario used these bridges extensively during the 1950's and 1960's as temporary and semi-permanent structures. Since the development of a comphrensive highway network system in Ontario, the use of Bailey bridges has been reduced considerably. The Ministry has also reduced its Bailey stocks and the associated manpower. Currently, Bailey bridges are mainly used as bridge detours at bridge construction and rehabilitation projects and in remote locations where it is economical to have a semi-permanent Bailey bridge. Acrow Panel Bridging, 300 and 700 series, can be used as alternatives to Bailey bridges [4, 5].

This Manual deals with the Bailey bridges most commonly used by the Ministry of Transportation of Ontario at the present time. The manual discusses:

1) the types of Bailey bridges used, and their components,
2) the design of these bridges to meet the Ontario Highway Bridge Design Code, OHBDC [6],
3) the erection and dismantling techniques to be adopted,
4) the estimation of Bailey bridge components required for a bridge and
5) a brief introduction to possible future alternatives to Bailey bridges.

2. POLICIES AND PROCEDURES

The policies and procedures adopted currently by the Ministry to erect and dismantle Bailey bridges are given in Ministry Directive, Administration, B-147.

Supply policy for the issuance and recovery of Bailey Bridge Materials is covered under Ministry Directive, Administration, B-1.

The Ministry's Downsview complex has a Bailey Yard where Bailey components are stored. The stocking and maintenance of the Bailey Yard is managed by the Central Stores Section of the Ministry.

2 Policies & Procedures

3 Types and
Components

3. BAILEY BRIDGE TYPES AND COMPONENTS

3.1 Types of Bailey Bridges

The basic structure constituting a bay of a Bailey bridge is shown in Figure 3.1(a). This shows the basic panel member with which bridges of desired length, height and strength can be built. Typical Bailey bridge cross-sections are shown in Figure 3.1(b). The floor deck is built on transoms and floor stringers. Transoms used can be four per bay or two per bay. The transoms can be of standard width, standard wide width or extra wide width.

- Standard width transoms can accommodate 5 sets of stringers and provide a road width of 3.27 m (10 feet 9 inches).
- The standard wide width transom uses 6 sets of stringers and provides a road width of 3.86 m (12 feet 8 inches).
- The extra wide width transom uses 7 sets of stringers and the road width is 4.19 m (13 feet 9 inches).

The Ministry does not stock extra wide transoms but they can be acquired as a special purchase.

The decking commonly used on temporary Bailey bridges consists of timber chesses and a herring bone timber wearing deck. For semi-permanent bridges a transverse laminated timber deck is recommended.

The types of Bailey Bridges that are commonly used by the Ministry are shown in Figure 3.2.(a). Figure 3.2(b) shows a deck type Bailey bridge that has been used on occasion by the Ministry.

The Bailey consisting of single panels on each side is called a Single-Single (SS). The Bailey, consisting of two panels on each side is called a Double-Single (DS). The Bailey with three panels on each side is called a Triple-Single (TS) and the Bailey with four panels on each side is called a Quadruple-Single (QS). Two storey Bailey's are called Double-Double (DD), Triple-Double (TD) or Quadruple-Double (QD) for two, three or four panels respectively, on each side . Bailey bridges with top and bottom chords reinforced are called Double-Single Reinforced (DSR), Triple-Single Reinforced (TSR), Quadruple-Single Reinforced (QSR), Double-Double Reinforced (DDR), Triple-Double Reinforced (TDR) and Quadruple-Double Reinforced (QDR).

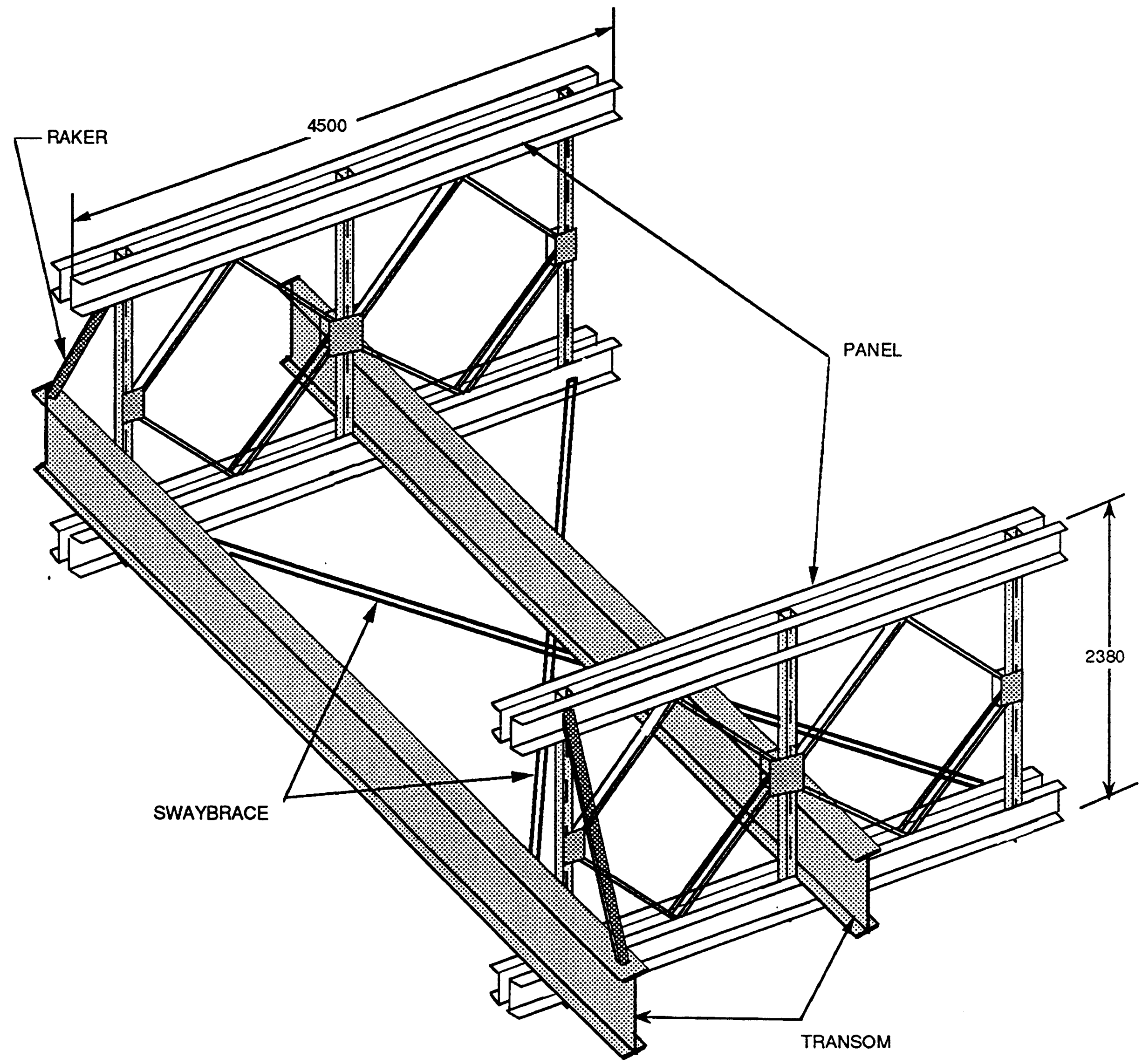
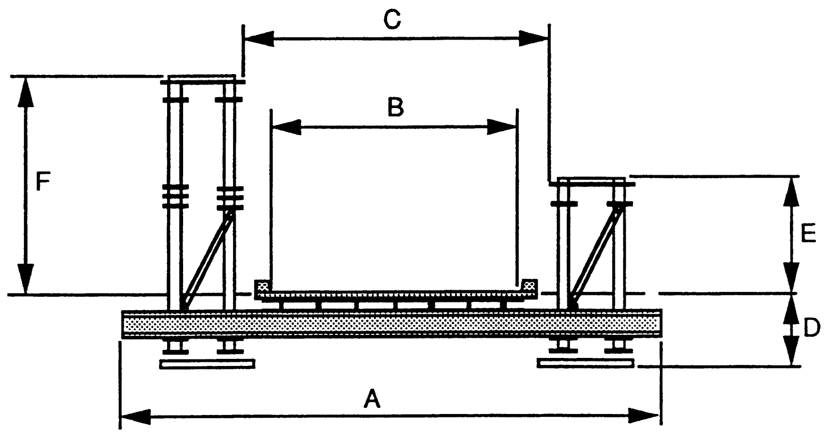
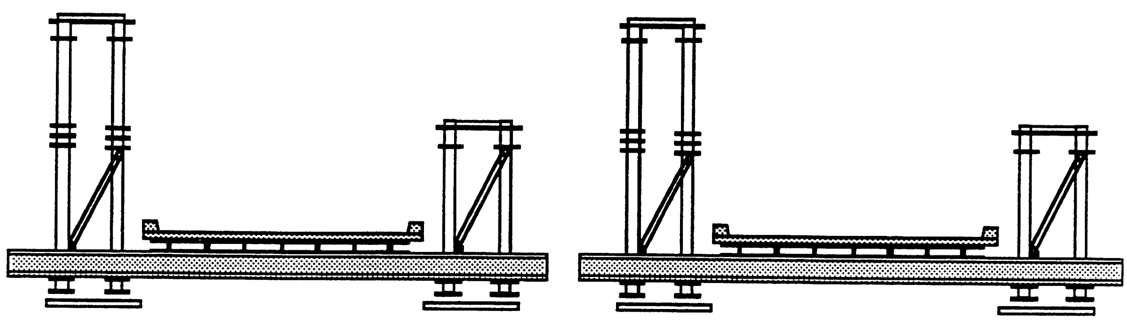


Figure 3.1(a) The Basic Structure Per Bay of a Bailey Bridge



Single Lane Bridge



Two Lane Bridge

TYPE	DIMENSIONS					
	A	B	C	D	E*	F*
Standard Bailey	5486 (18'-0")	3277 (10'-9")	3759 (12'-4")	711 (2'-4")	1073 (3'-6 1/4")	2622 (8'-7 1/4")
Standard Widened Bailey	6096 (20'-0")	3810 (12'-6")	4343 (14'-3")	762 (2'-6")	1022 (3'-4 1/4")	2571 (8'-5 1/4")
Extra Wide Bailey	6096 (20'-0")	4190 (13'-9")	4775 (15'-8")	762 (2'-6")	1022 (3'-4 1/4")	2571 (8'-5 1/4")

* If bridge is Chord Reinforced add 102 mm (4 inches) to this dimension.
( ) dimensions given in feet and inches.

Figure 3.1(b) Typical Bailey Bridge Cross-Sections

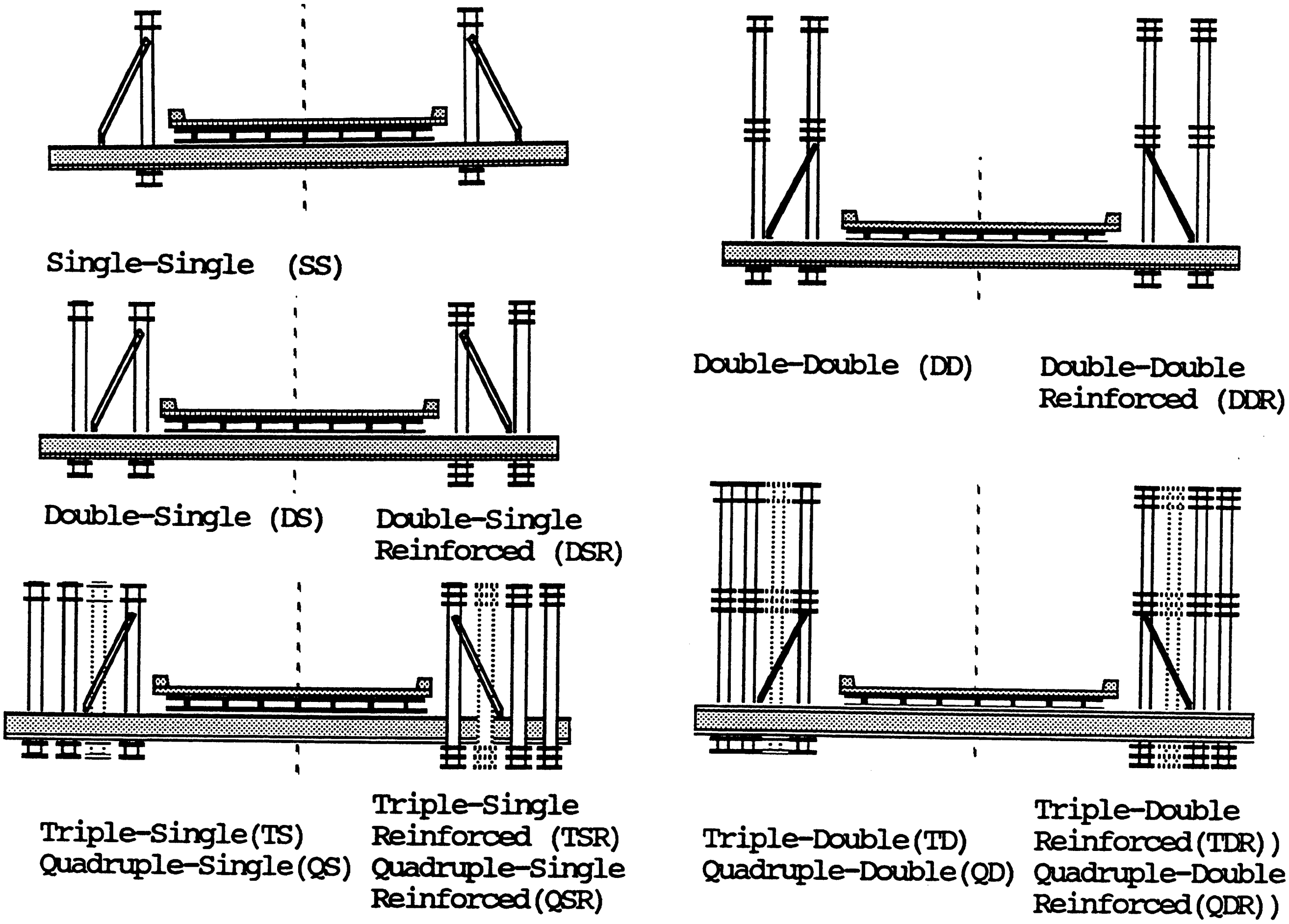


Figure 3.2(a) Bailey Bridge Types

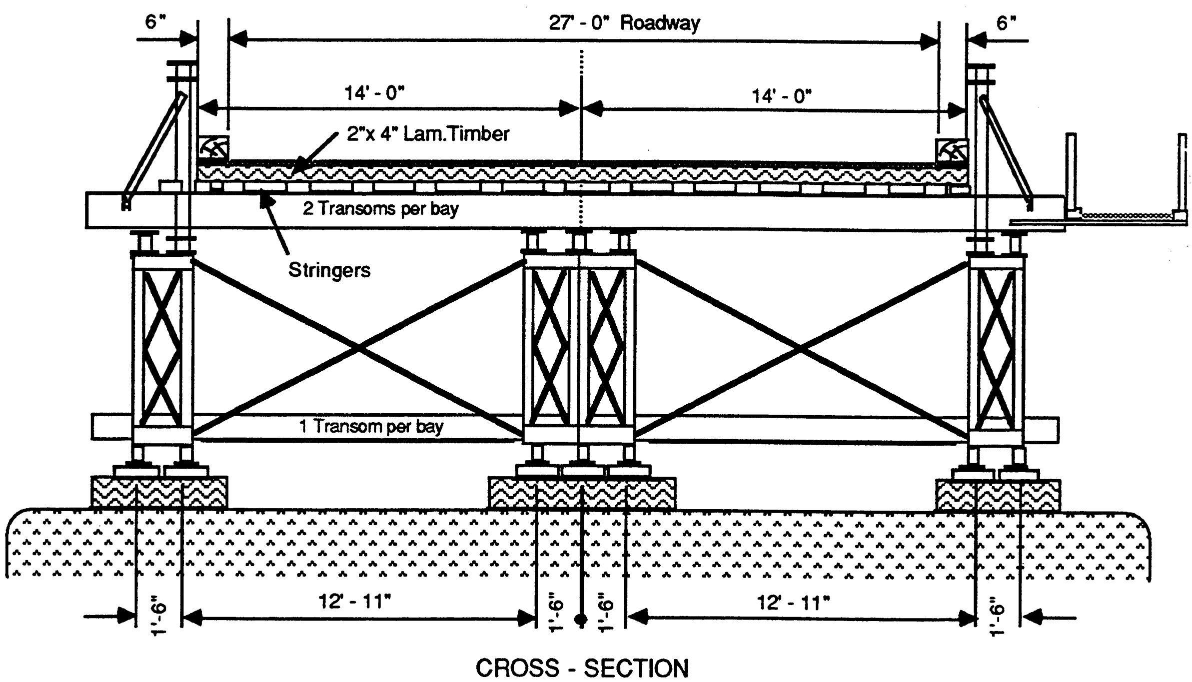


Figure 3.2(b) Deck Type Bailey Bridge

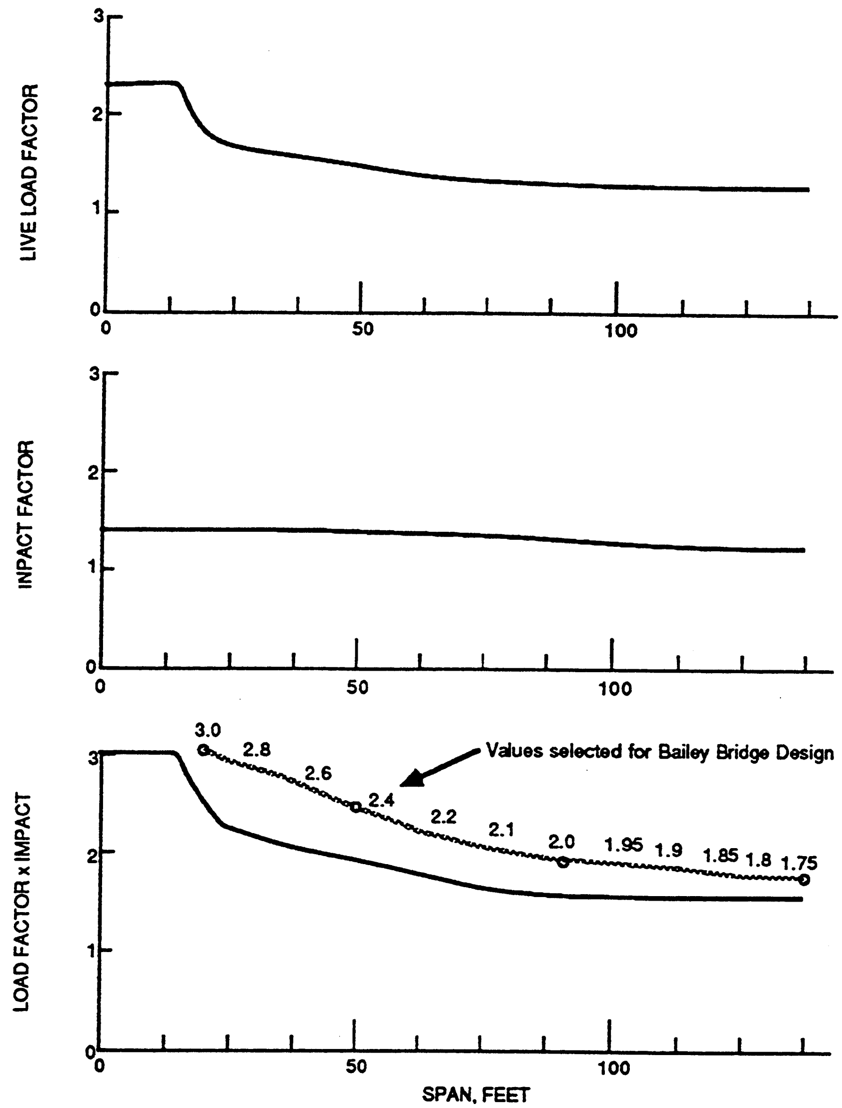
Bailey bridges can be of single span or continuous span construction. The approximate spans that can be bridged by the various Bailey types are given in Table 3.1. This is the table currently used by the Ministry to determine the Bailey cross sections required for specific spans. This table was prepared by the Ministry in 1972 and the design live load used for this table was Ontario Bridge formula loads [7]. This load is lower than the M.O.L. or OHBDC loads. The load factors and impact factors used for the design varied with span lengths. Resistance reduction factor (Φ) was not applied to the ultimate resistance values. However, a reduction in moment of resistance was applied to older panels to account for the fatigue deficiencies of those panels. A summary of loads and load factors used for this design is given in Figure 3.3. Section 4 of this manual provides the necessary information to design Bailey bridges to the current OHBDC requirements.

TABLE 3.1 Maximum Spans For Various Types of Bailey Bridges.

Span (ft.)	Type - Mabey-Johnson	Type - Old Renovated
30	S.S.	S.S.
40	S.S.	D.S.
50	D.S.	D.S.
60	D.S.	D.S.
70	D.S.	T.S.
80	T.S.-D.S.*	D.S.R.-D.D.-Q.S.-T.S*
90	T.S.	D.S.R.-D.D.-Q.S.
100	T.S.	T.S.R.
110	D.S.R.-D.D.-Q.S.	T.S.R.
120	D.D.-T.S.R.-Q.S.	D.D.R.
130	T.S.R.-T.D.	D.D.R.-Q.S.R.*
140	T.S.R.-T.D.	T.D.R.-D.D.R.*
150	T.S.R.-T.D.-Q.S.R.	T.D.R.
160	D.D.R.	T.D.R.
170	D.D.R.	Q.D.R.
180	D.D.R.	Q.D.R.
190	T.D.R.	
200	T.D.R.	
210	T.D.R.	
220	T.D.R.	
230	Q.D.R.	
240	Q.D.R.	
250	Q.D.R.	

* - Summer only - these bridges can only be used in summer conditions. This is to avoid brittleness in extreme cold weather.

Notes:
1. Table 3.1 was prepared by the Ministry in 1972.
2. See Figure 3.3 for loads, load factors and impact factors.
3. For type definitions, see Section 3.2.



Load Factors and Impact Factors

Figure 3.3 Loads, Load Factors and Impact Factors Used for Table 3.1

3.2 Bailey Components

The basic structural component of a Bailey bridge superstructure is the panel member, transoms, stringer sets and the timber deck, as shown in Figure 3.4. There are, however, many other secondary parts required for the fabrication and erection of a Bailey bridge superstructure. This section summarizes all the components used by the Ministry, with Ministry identification numbers, for constructing Bailey bridges.

The Ministry has a stock of old Bailey panels that were acquired during the war. These panels are still used by the Ministry. These panels had fatigue deficiencies at the bottom chord slot provided for fixing sway braces. Most of the panels were renovated by welding reinforcements near the slots and galvanizing the panels. These are called renovated panels and should be designed for a reduced stress of 220 MPa (actual yield strength = 355 MPa) to account for the fatigue problems observed. The Ministry does not use un-renovated war time panels to erect new bridges. However, there are currently some bridges in service which have used un-renovated war time panels. The Ministry has also acquired Mabey-Johnson panels in the past and they do not have the fatigue problems and have a material yield strength of 350 MPa.

The other materials from the old Bailey bridge stock do not have fatigue problems and, hence, do not differ in strength from the new Mabey-Johnson components. The components of both types have the same weight.

Appendix A gives a list of Bailey components, the material yield strength, the self weight of the components and the allowable service load capacity values.

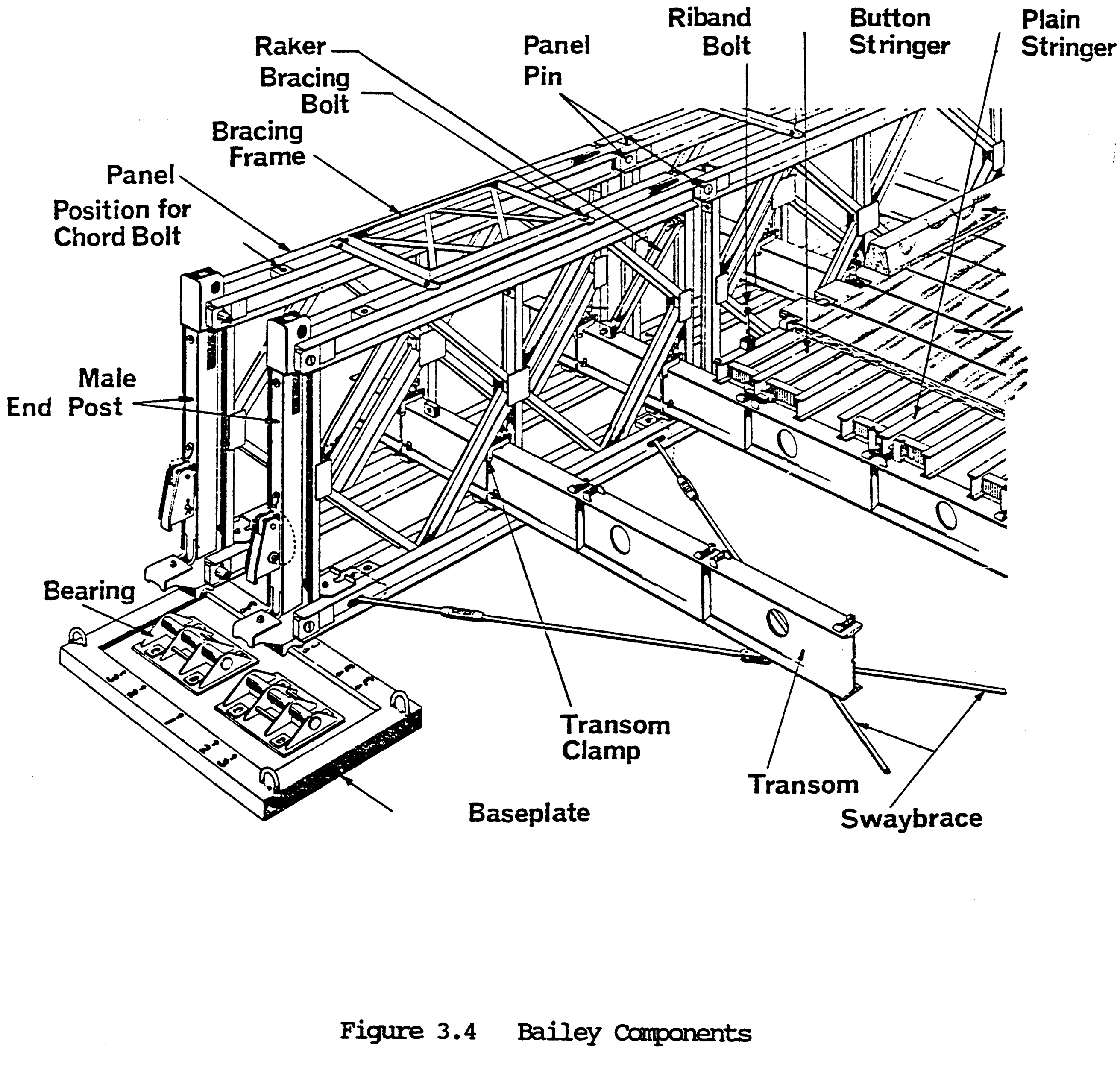
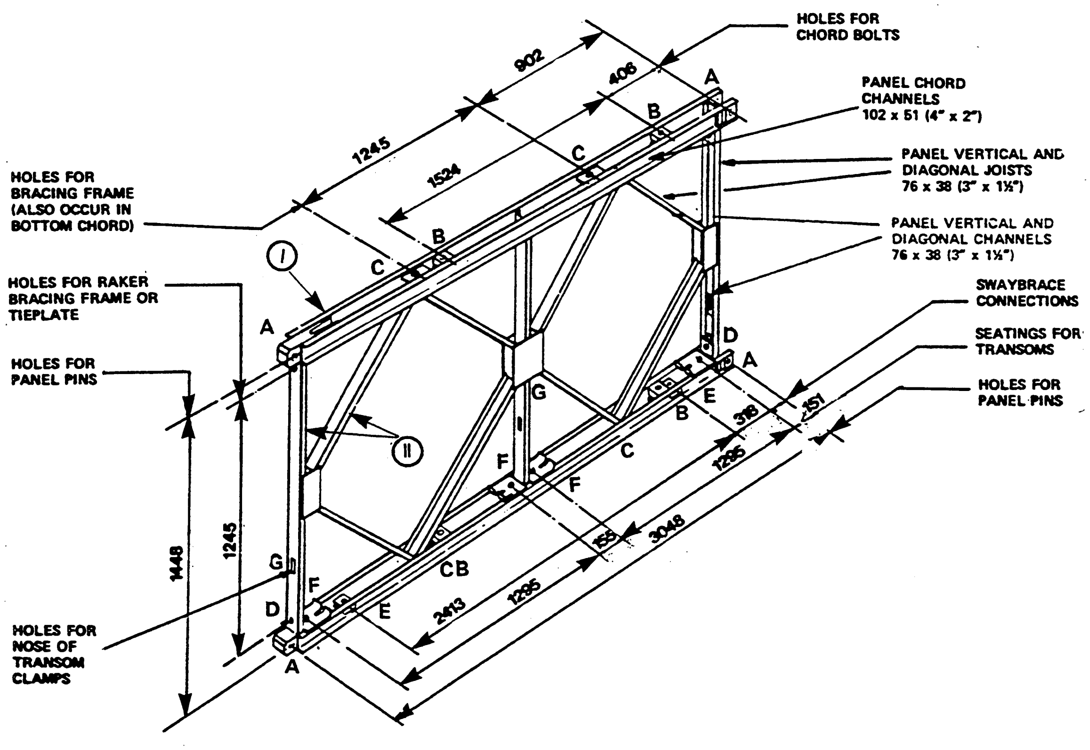


Figure 3.4 Bailey Components

3.2.1 Panel BB28A - Renovated Panel
BB28B - Mabey-Johnson Panel

The top and bottom chords of the panel terminate at one end with a male lug and at the other end with a female lug. The holes on the top and bottom chords take chord bolts to connect panels together and to connect chord reinforcements. Four transom seatings are provided at the bottom chord which also has two slots to pin sway braces. In both chords and end verticals, holes are provided for fixing bracing frames, rakers or tie plates. All verticals have holes above the transom seats to take transom clamps. The strength properties of the panels are given in Table 3.2.



A Holes for panel pins
B Holes for chord bolts
C Holes for bracing frames
D Holes for raker, bracing frame or tieplate
E Connections for swaybraces
F Seatings for transoms
G Holes for noses of transom clamps
I Panel chord channels
II Panel verticals and diagonals

Table 3.2 Strength Properties of Panels

	Renovated Panel	Mabey -Johnson Super Panels
Moment of resistance	850.0 kNm	1360.0 kNm
Shear capacity, single storey	267.5 kN	336.5 kN
Weight of panel	263.1 kg	263.1 kg

The capacity given is calculated using the steel yield strength values for renovated panels and Mabey-Johnson panels.

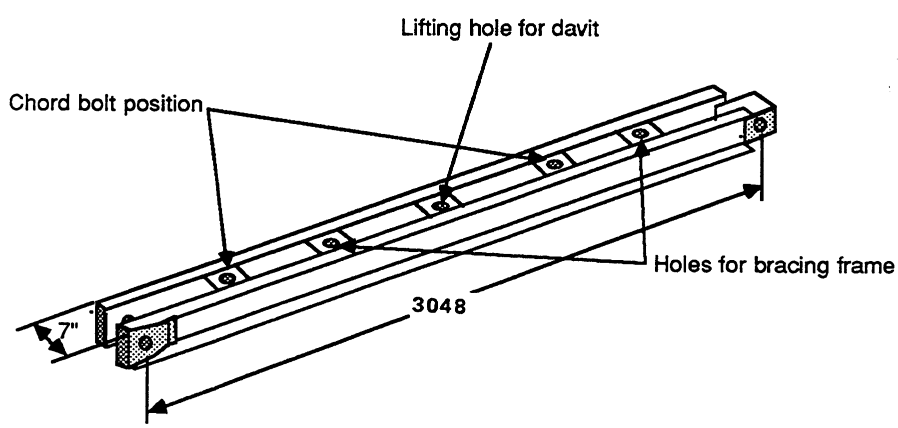
Yield strength for Mabey-Johnson panels is 350 MPa.

Yield strength for renovated panels used is 220 MPa (actual is 355 MPa).

Capacity reduction factor is not applied.

3.2.2 Chord Reinforcement BB12

The chord reinforcement is similar to the bottom chord of the Bailey panel. It has the sockets for the chord bolts set back so that when attached to the panel the heads of the chord bolts are housed inside the chord.

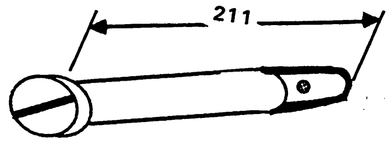


Weight = 92.5 Kg.

3.2.3 Panel Pin BB31

The panel pin is used to connect panels together by inserting through the male and female lugs of the panels. Panel pins must be inserted from the inside of the trusses. Fitting them from the outside reduces the roadway clearances. The Ministry does not stock safety pins. A suitable nail or a clip is used for the safety pins to hold the panel pin in place.

Panel Pin



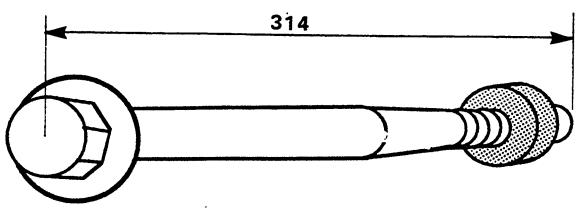
Weight = 2.7 Kg

Safety Pin

Weight = 0.06 Kg

3.2.4 Chord Bolt BB 14

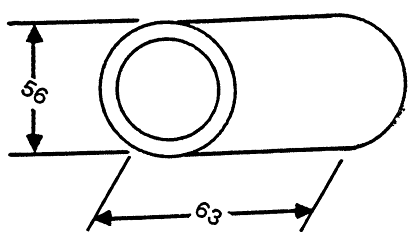
Chord bolts are used to connect a panel or chord reinforcement above or below a panel to form a multi-storey or chord reinforced bridge.



Weight = 3.63 Kg

3.2.5 Chord Bolt Collar BB 13

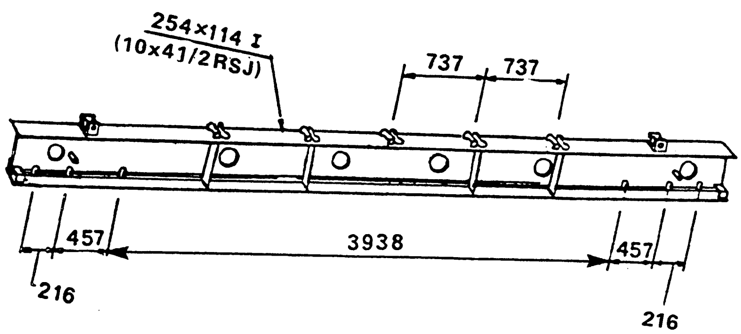
Chord bolts project further into the panel when used with chord reinforcements. A chord bolt collar is placed over the tail to enable the bolt to be tightened.



Weight = 0.68 Kg

3.2.6 Standard Transom BB 60

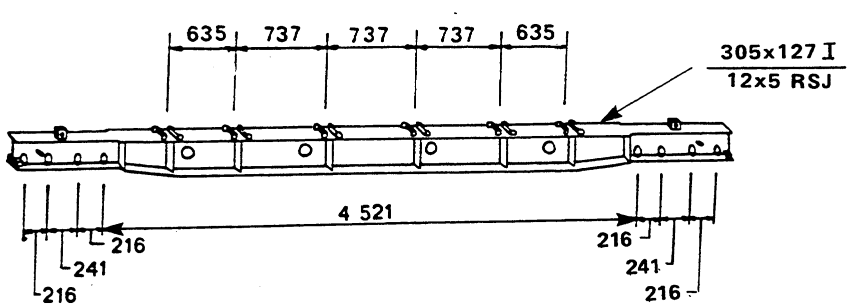
Transoms are transverse members running between the longitudinal trusses. The transom underside has recessed dowel holes, three at each end, which locate over the dowels on the panel seating. On its upper side there are five positioning lugs for stringer sets and two lugs at the outer ends for the lower end of the raker. Footwalk bearers slide over the web of the transom and are fixed by one lug on the web and the other on the bottom flange.



Weight = 204.1 Kg

3.2.7 Standard Wide Transom BB 61

This transom is similar to the standard transom except that it has six lugs for six stringer sets.



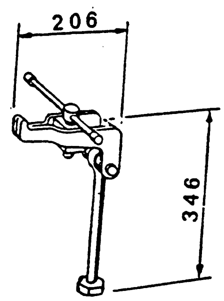
Weight = 295.0 Kg

3.2.8 Extra Wide Transom Special Purchase

This transom can accommodate seven stringers. The Ministry does not stock extra wide transoms.

3.2.9 Transom Clamp BB 15

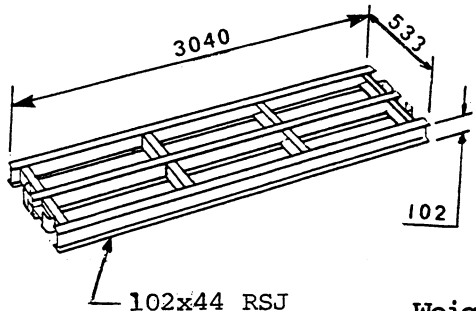
Transom clamps are used to hold the transoms in place. Mabey-Johnson panels use a bracket from the vertical of the panel and bolts to tighten down the transom.



Weight = 2.7 kg

3.2.10 Plain Stringer Set BB 55

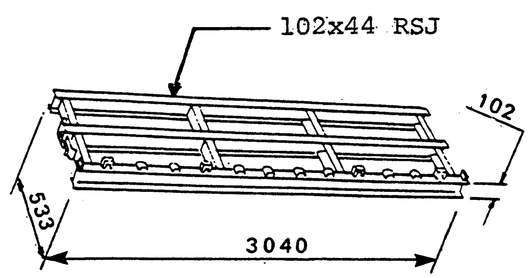
The stringer sets form the support for the roadway deck and span between the transoms. Each set consists of three girders connected by diaphragms with two stringer cleats at each end which are used to position the stringer set on the transom lugs.



Weight = 83.6 kg

3.2.11 Button Stringer Set BB 54

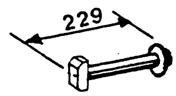
Button stringer sets are identical to plain stringer sets except that they have twelve buttons to take the timber chesses. When timber chesses are not used button stringer sets are used like plain stringer sets along the edges of the deck.



Weight = 86.18 kg

3.2.12 Riband Bolt BB 6

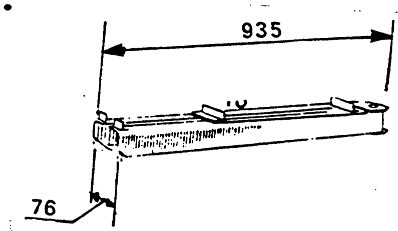
The riband bolt is used to fix the riband to the button stringer sets. The riband acts as a curb and holds down the decking. The Ministry does not store ribands but riband bolts may be obtained as a special order.



Weight = 0.63 kg

3.2.13 Footwalk Bearer BB 2

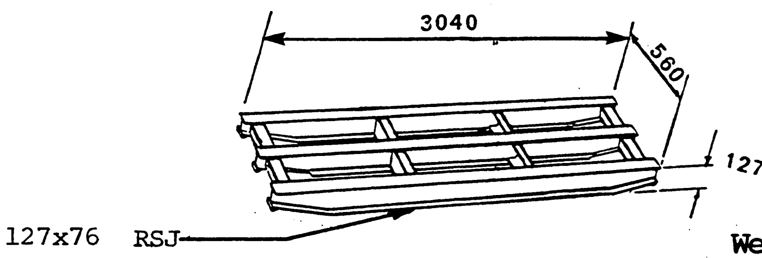
Footwalk bearers are cantilevered out of the transom, and provide support for the footwalk. The Ministry does not store the bearers but they may be obtained as a special order.



Weight = 9.1 kg

3.2.14 Plain Ramp BB 43

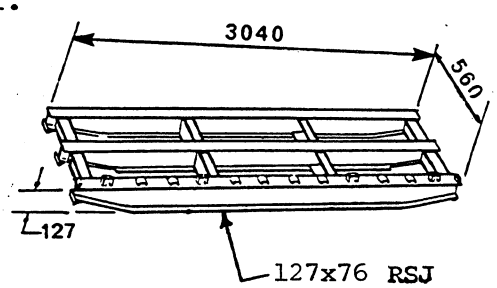
Plain ramps are used as ramps at each end of the Bailey bridge. A plain ramp consists of three girders connected by diaphragms. The ends of the girders are tapered and fitted with half round bearings. The end diaphragms are shaped to fit over the cleats on the transom.



Weight = 163.3 kg

3.2.15 Button Ramp BB 42

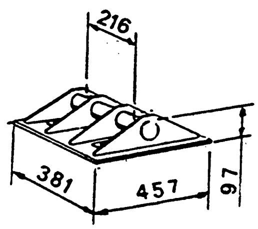
A button ramp is identical to a plain ramp except that it has twelve buttons on the end stringer.



Weight = 167.8 kg

3.2.16 Bearing BB 3

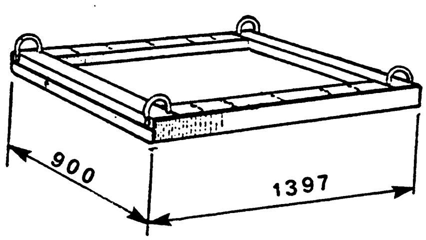
The bearing spreads the load to the base plate. The half round bearing end of the end post rests on the bearing round bar. For single truss bridges the end post is arranged to bear on the centre of the bearing. For double truss bridges, two bearings are used so that each rests on the centre of the bearing. For triple truss bridges, the inner one rests at the center of one bearing and the outer trusses bear on the two outer positions of the outer bearing.



Weight = 31.75 kg

3.2.17 Base Plate BB 33

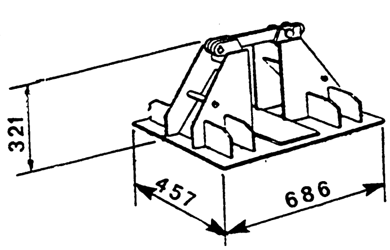
The base plate is designed to spread the load from the bearings evenly. One base plate is used for each corner of the bridge and can accommodate single, double or triple trusses. The base plate is marked with 1, 2 and 3 to indicate the correct position of the inner truss of single, double and triple truss bridges respectively.



Weight = 181.5 kg

3.2.18 Ramp Pedestal BB 30

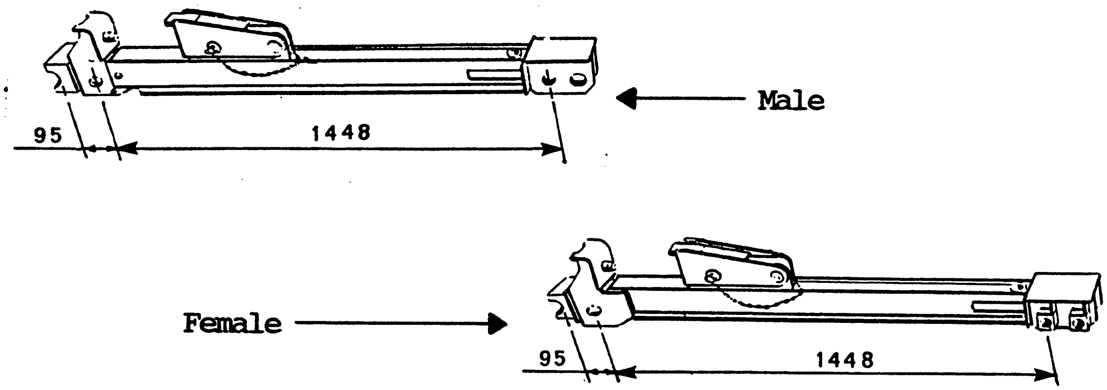
The intermediate transom in a two-bay ramp must be supported by four ramp pedestals.



Weight = 43.1 kg

3.2.19 Female End Post BB 35 and
Male End Post BB 36

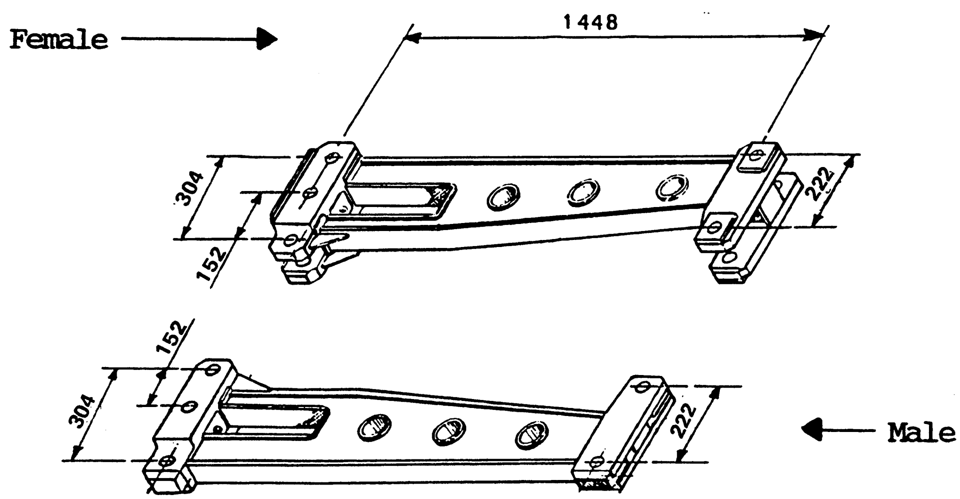
The end post is attached to each end of every main girder truss to transmit the end reaction of the bridge to the bearing. The female end post connects to the male lugs at the ends of the panels. The male end post is similar to a female end post but connects to the female lugs at the end of the panels.



Weight - Female = 66.2 kg
Male = 59.0 kg

3.2.20 Female Span Junction Post BS 24 and
Male Span Junction Post BS 25

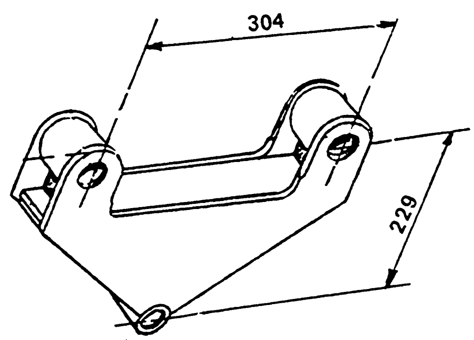
Span junction posts are of two types, female and male, for connecting to the male and female ends of the panels with panel pins. Each post also has two further connecting lugs with panel pin holes, female or male at the top, according to type, and a universal jaw at the base. These, together with the launching link allows junction posts to be pinned together during erection.



Weight - Female = 92 kg
Male = 88 kg

3.2.21 Junction Link BS 12

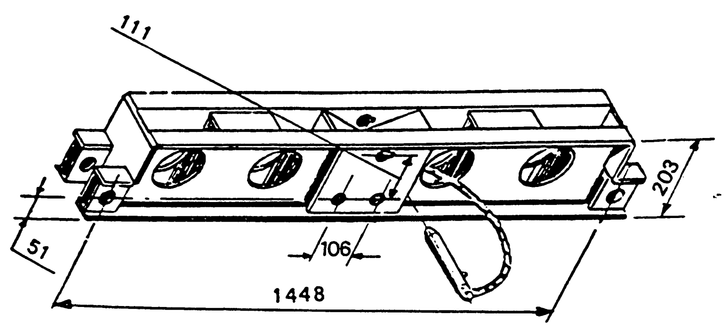
The junction link is a triangular fabrication having two projecting male lugs at the top with holes for panel pins and a hollow round bearing at the base.



Weight = 16 kg

3.2.22 Junction Link Bearing BS 2

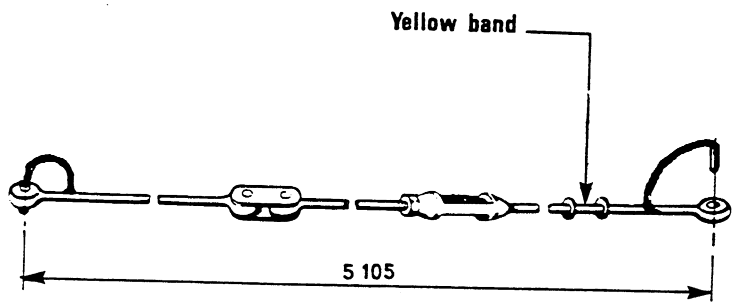
The junction link bearing supports the junction link, which is pinned into the 'V' seating.



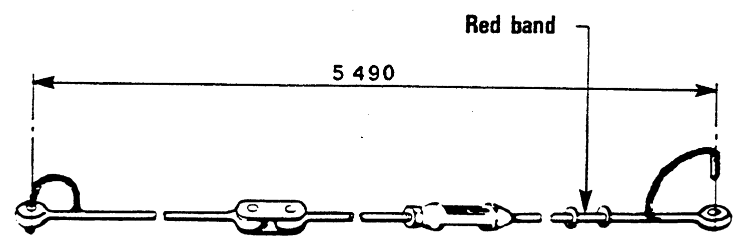
Weight = 84 kg

3.2.23 Standard Sway Brace BB 8 and
Standard Wide Sway Brace BB 9

The sway brace on the underside of the deck is connected diagonally to the ends of the two inner panels in a bay. It has two mild steel rods with an eye and a pin at the end of each. A turn buckle is used to connect and tighten the brace rods. The turn buckle contains the riding block gauge. When the ends of both screwed rods butt in this block, the sway brace is correctly adjusted.



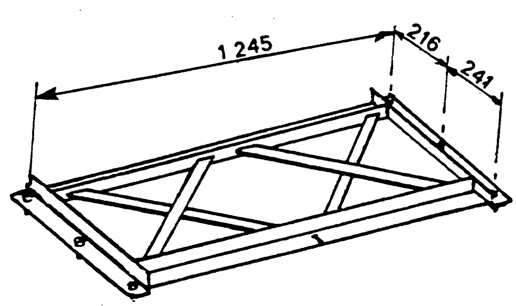
Weight - BB 8 = 29.5 kg



Weight - BB 9 = 32.5 kg

3.2.24 Bracing Frame BB 16

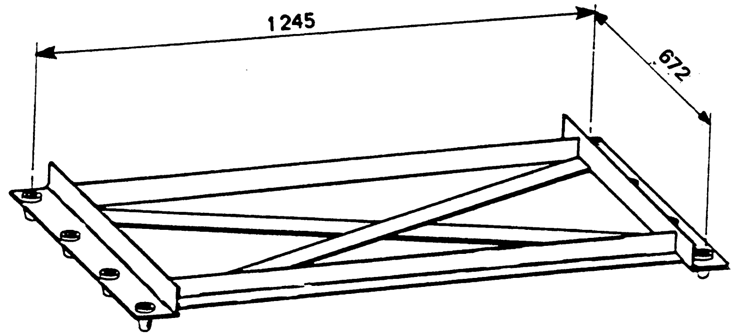
The bracing frame is a light mild steel frame with hollow conical dowels at each corner. In multiple truss single storey bridges, bracing frame is used horizontally across the top chords of the panels. In double storey bridges, it is used horizontally across the top chords and vertically across the end verticals.



Weight = 18.1 kg

3.2.25 Wide Bracing Frame BS 11

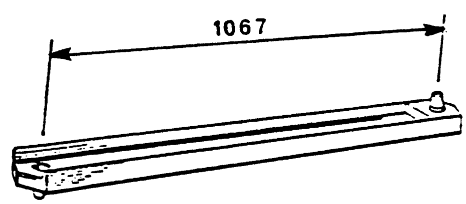
The wide bracing frame is a wider frame than bracing frame BB 16. It is used primarily for the quadruple truss bridges, horizontally across the top chords and vertically on the panel end verticals. It can also be used across the top chords in triple truss construction in standard or standard widened bridges. When this frame is used, tie plates can be omitted.



Weight = 34 kg

3.2.26 Raker BB 40

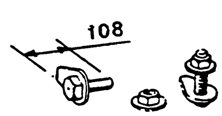
The raker is a steel beam connecting the end of the transom to the top of the inner truss. This provides lateral stability to the trusses. Conical dowels, when fitted, draw the trusses into correct alignment. One raker is used on each side of the bridge at every panel junction point. It may also be used at other transoms located within the bay. The rakers are fastened by bracing bolts.



Weight = 8.2 kg

3.2.27 Bracing Bolt BB 4

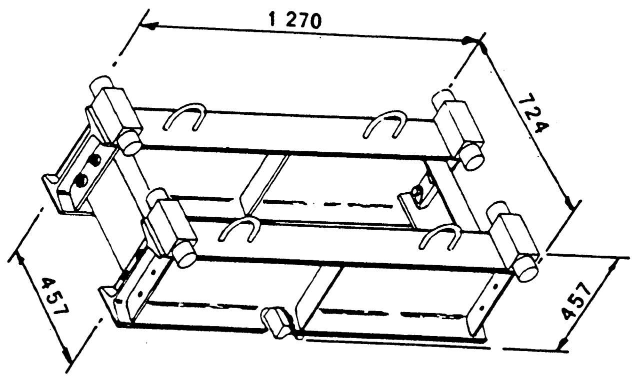
The bracing bolts are used to attach rakers to the transoms and panels. They are also used to attach the bracing frames to the panels.



Weight = 0.5 kg

3.2.28 Balance Beam Assembly BE 2

The longer and heavier bridges require double rocking rollers at the launching end position. The balance beams are provided for this purpose. They consist of two beams inter-connected by diaphragms. Each top flange end of the beam has a round bearing to carry a rocking roller. At the centre of the bottom frame, there is a half round bearing which seats on bearing BB 3.

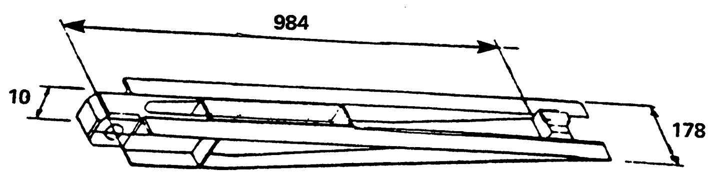


Weight = 285.0 kg

3.2.29 Female Chord Taper BE 3 and
Male Chord Taper BE 4

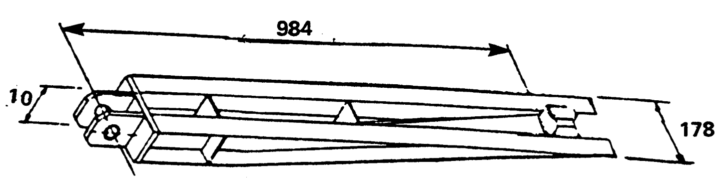
The chord tapers are used during erection to provide a smooth transition at the bottom chord reinforcement location.

BE 4



Weight = 34.0 kg

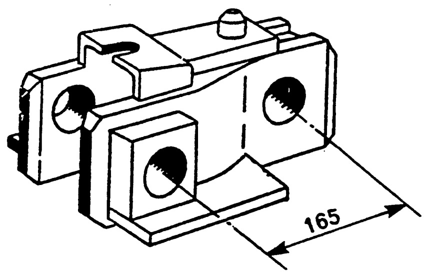
BE 3



Weight = 29.0 kg

3.2.30 Launching Link BE 14

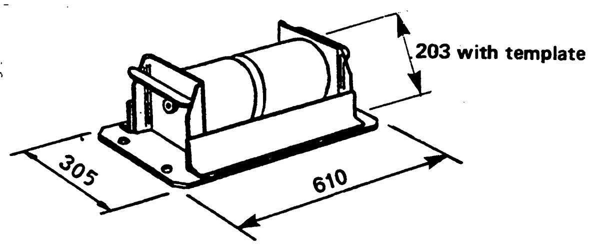
The launching link comprises of a male lug and female jaws which can be pinned between the bottom chords of two panels in the launching nose, thus raising the far end of one panel by 0.34 m.



Weight = 12.7 kg

3.2.31 Plain Roller BE 16

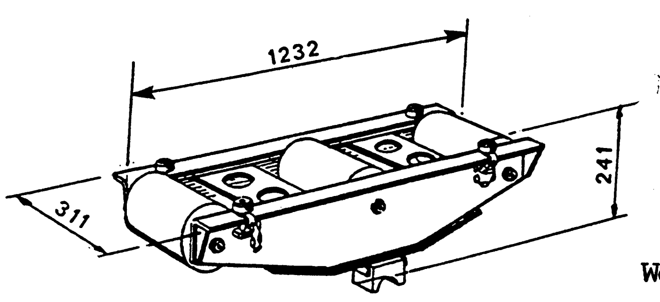
The plain roller consists of a welded housing containing a single roller, in two halves. It is immaterial on which half roller a single truss is carried, but the second and third trusses together fill the available width. The template used to hold the roller in position is not stocked by the Ministry.



Weight = 47.6 kg

3.2.32 Rocking Roller BE 17

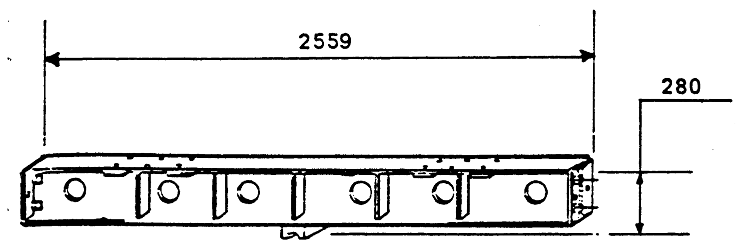
In launching long spans, severe local bending stresses occur in the bottom chord of the bridge at the point where it passes over the front roller. The rocking roller has been designed to spread the load over a length of 1.06 m. Three rollers are placed together in a balanced arm which fits over, and is free to rock, on the bridge bearing. Side rollers are provided on the arms to guide the trusses. For double and triple truss bridges the number of rocking rollers to be used on the near bank depends on the launching weight of the bridge.



Weight = 91.6 kg

3.2.33 Distributing Beam Special Purchase

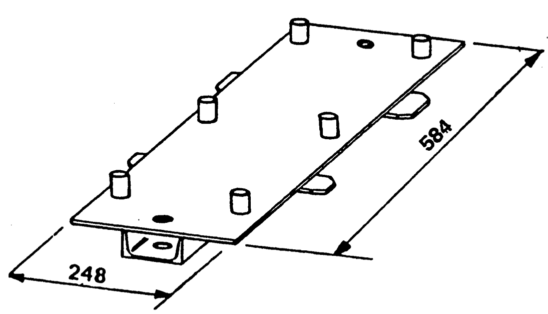
The distributing beam is formed from a rolled steel section. Under the centre of the bottom flange is welded a half-round bearing block and each end has a holed diaphragm to accept the end plates. Distributing beams are used at intermediate support locations to distribute the loads. A minimum of two distributing beams with end plates secured by bracing bolts must be used when supporting the trusses of bridges.



Weight = 111 kg

3.2.34 Distributing Beam End Plate Special Purchase

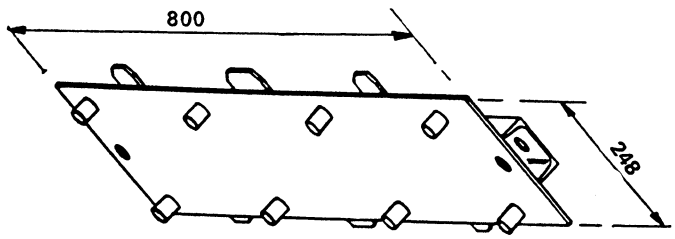
The distributing beam end plate is a stiffened plate with three sets of round dowels which locate in the end of the diaphragms of distributing beams and set them at the correct centres under the bridge trusses. Lugs on the end plates project upward between the bridge trusses to provide sideways location to the assembly. At each end is a hole by which the end plate is attached to the assembly with bracing bolts. Distributing beam end plates are not stocked by the Ministry but can be obtained as a special order.



Weight = 16 kg

3.2.35 Distributing Beam Long End Plate Special Purchase

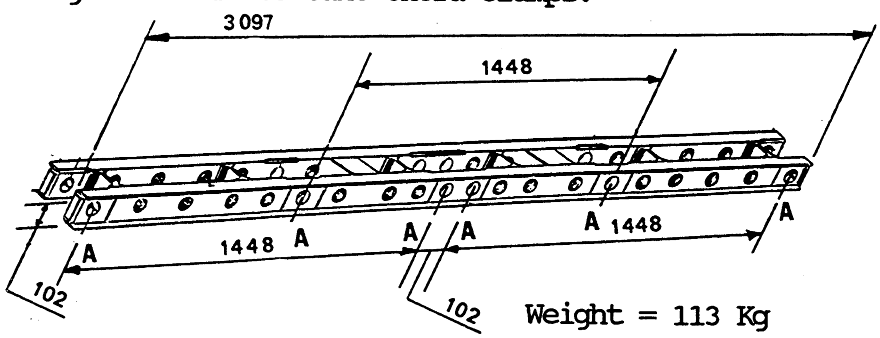
The distributing beam long end plate is used to enable sets of distributing beams to be used under bridge trusses of triple or quadruple construction. It can be distinguished from the distributing beam end plate by its length and by the four sets of round dowels provided. It is not stocked by the Ministry but can be obtained on a special order.



Weight = 23 Kg

3.2.36 Crib Capsill BS 7

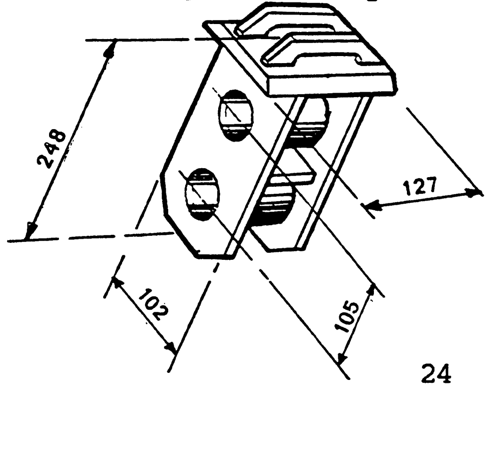
The crib capsill is similar to a panel chord but has a series of pinholes along it's length. Six of these holes, marked 'A', are arranged in pairs to pin across the male lugs of panels. The two most central holes are also used for pinning in a crib bearing. These six holes are reinforced to take heavy loads. The remaining holes are to take chord clamps.



Weight = 113 Kg

3.2.37 Chord Clamp BS 8

The chord clamp is a small fabrication with a shouldered plate head and contains two panel pin holes. The chord clamp is inserted through the bottom chord of a panel to retain a crib capsill using one panel pin. It is also used at each end of the junction link bearing to attach to a crib capsill. In the latter case two panel pins are required in each chord clamp.



Weight = 5.0 kg

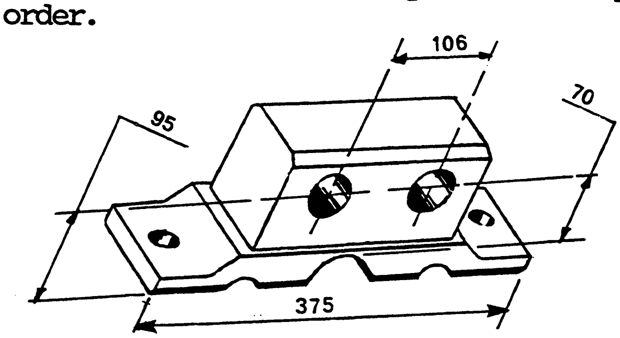
3.2.38 Crib Bearing BS 1

The crib bearing comprises a male lug containing two standard panel pin holes, welded to a base having on the underside a half round bearing. The base extends beyond the male lug at each end, where it is holed to enable it to be spiked or screwed to the timber. The half-round bearing on the underside enables the crib bearing to sit in a bridge bearing, and when so positioned, the height to the centre of the panel holes is 175 mm above the underside of the bearing.

It can perform several functions, and can be attached to the following:

(i) To the underside of a junction link bearing.
(ii) To the centre of a crib capsill.
(iii) To the female jaws of a panel or to two panel chords bolted together.

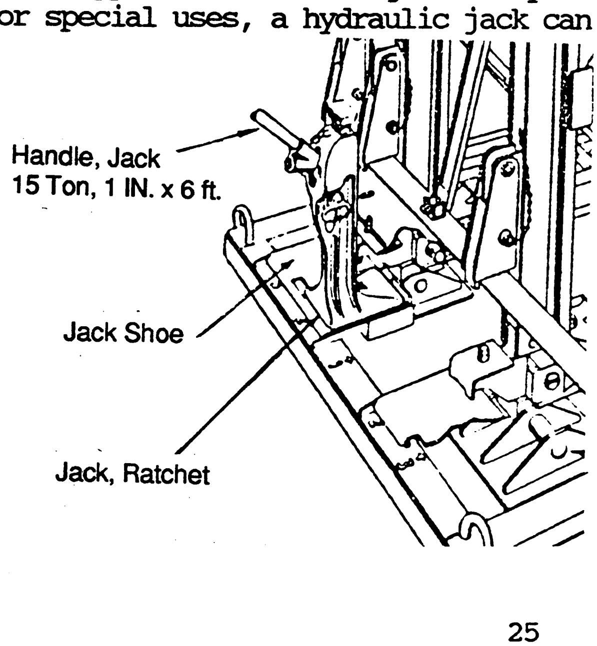
The crib bearing is not stocked by the Ministry but can be obtained as a special order.



Weight = 17 Kg

3.2.39 Ratchet Jack BE 11 and
Hydraulic Jack Special Purchase

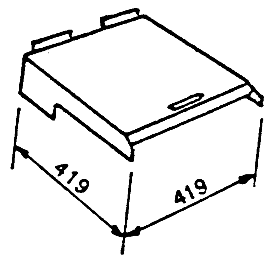
The jack supplied for erecting a Bailey is a ratchet type. For heavier bridges and for special uses, a hydraulic jack can be used.



Weight - Ratchet Jack = 59.0 Kg
Hydraulic Jack = 33.5 Kg

3.2.40 Jack Shoe BE 18

The jack shoe forms a fabricated box on which the jack stands. It fits into the box plate and allows limited movement to the bearing.



Weight = 16.3 kg

3.3 Piers and Abutments

Piers and abutments for temporary bridges are often constructed of timber, but for permanent or semi-permanent bridges, concrete piers and abutments are preferred. When designing these structures, the engineer must also consider the loads imposed during launching and dismantling. At the abutment ends, the launching and landing rollers are normally positioned 0.76 m in front of the bridge bearings. Landing rollers are also placed at pier locations and, hence, the abutments and piers should be wide enough to accommodate these bearings.

3.4 Examples of Bailey Bridges

Examples of various types of Bailey bridges and their components are shown in Figures 3.5 to 3.7.

Figure 3.5 : A 90' span, double-single chord reinforced standard Bailey with and without a sidewalk on compacted fill foundation.

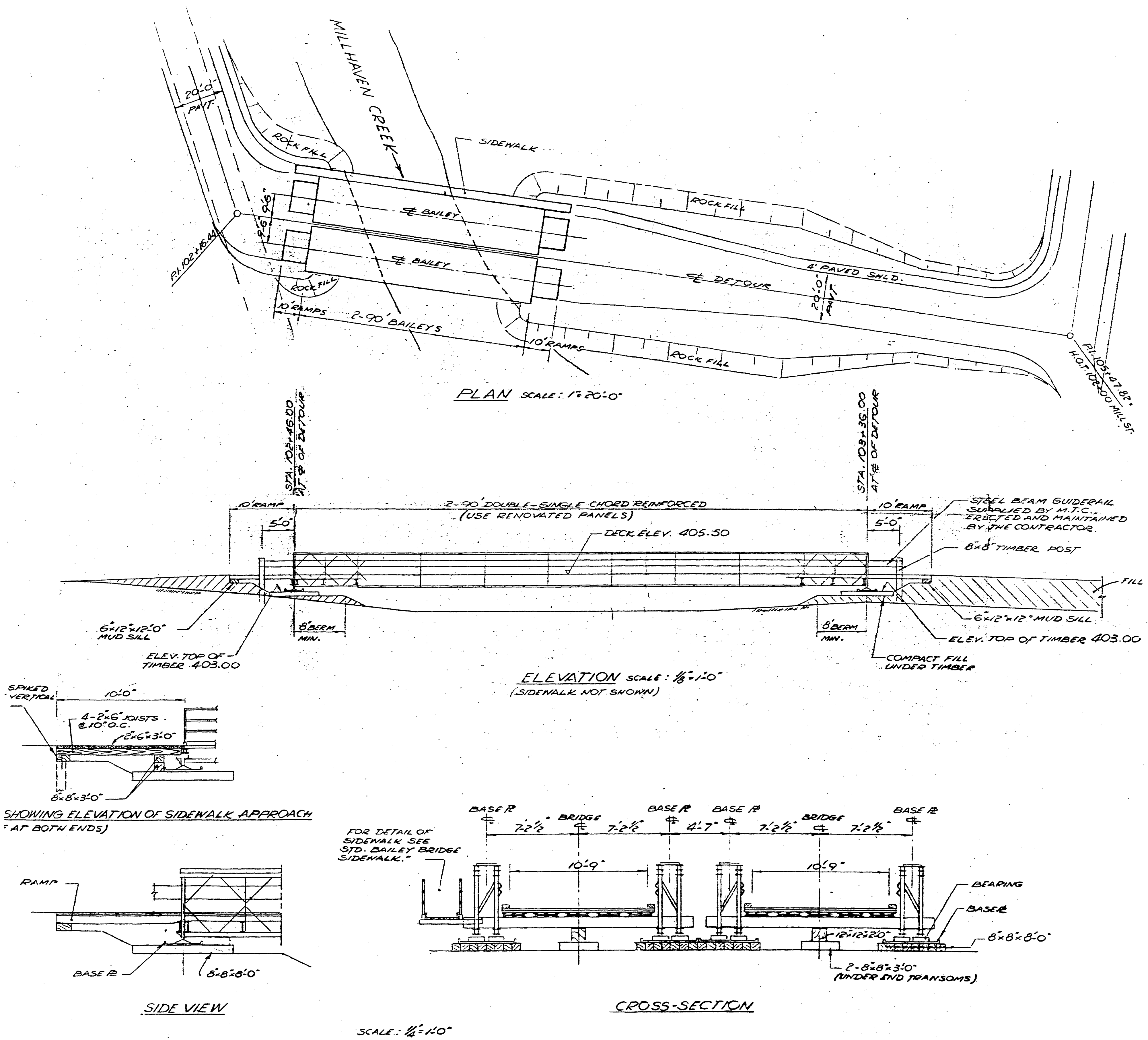
Figure 3.6 : A 110' span, double-single chord reinforced standard widened Bailey with pile foundation.

Figure 3.7 : A 140' span, triple-single chord reinforced Bailey with compacted fill foundation.

CONT No
WP No 35-73-01

MILLHAVEN CREEK BAILEY
HWY. 2 DIST. 8

SHEET



NOTES TO CONTRACTOR

1. Decking to be installed as shown on plan D.D. 1201.
2. Guide rail to be installed as shown on std. SD-9-74.
3. Fill as determined on the site.
4. **ERECTION AND LAUNCHING**

   (a) (i) The Contractor shall not assemble, launch or delaunch the Bailey until the layout and elevations of the launching and construction rollers have been approved by the Engineer. Double rollers shall be used at all locations.

   (ii) The tops of the rollers shall all be at the same elevation, unless specified otherwise on the drawings.

   (iii) The tops of the rollers shall be levelled across in pairs at right angles to the centre line of the structure.

   (b) (i) The launching nose shall consist of 60 feet of single-single skeleton construction and ___ feet of double-single skeleton construction.

   (ii) The launching links shall be inserted 20 feet from tip of nose.

   (c) (i) All pins, bolts and threaded parts must be free of dirt and be lubricated at the time of installation.

   (ii) Transom clamp tightening bars must be wired to the panel verticals. Sway braces shall be fully tightened to gauge blocks and all lock nuts secured.

   (iii) All panel pins on structure must be keyed.

   (d) When the combined weight of the bridge and nose exceeds 60.0 tons on a single storey bridge and 80.0 tons on a double storey bridge, the balance beam assembly must be used.

   (e) Wear deck shall be installed after launching.

5. **ADDITIONAL NOTES FOR CHORD REINFORCED BRIDGES**

   (a) Bracing frame bolts must be installed in the reinforcing chords prior to the chords being installed on the panels.

   (b) Tapered chords shall be used for launching and delaunching.

6. **MAINTENANCE**

   The Contractor shall be responsible for the maintenance of the structure and approaches, including the following:

   (a) Check that all bracing bolts, chord bolts, transom clamps are and remain fully tightened.

   (b) Keep baseplates and bearings free of debris. Inspect baseplates and cribs periodically and correct any uneven settlement to the satisfaction of the Engineer. Packing under end transom and ramps must be kept tight.

   (c) Notify the Engineer immediately of any damages.

QUANTITIES

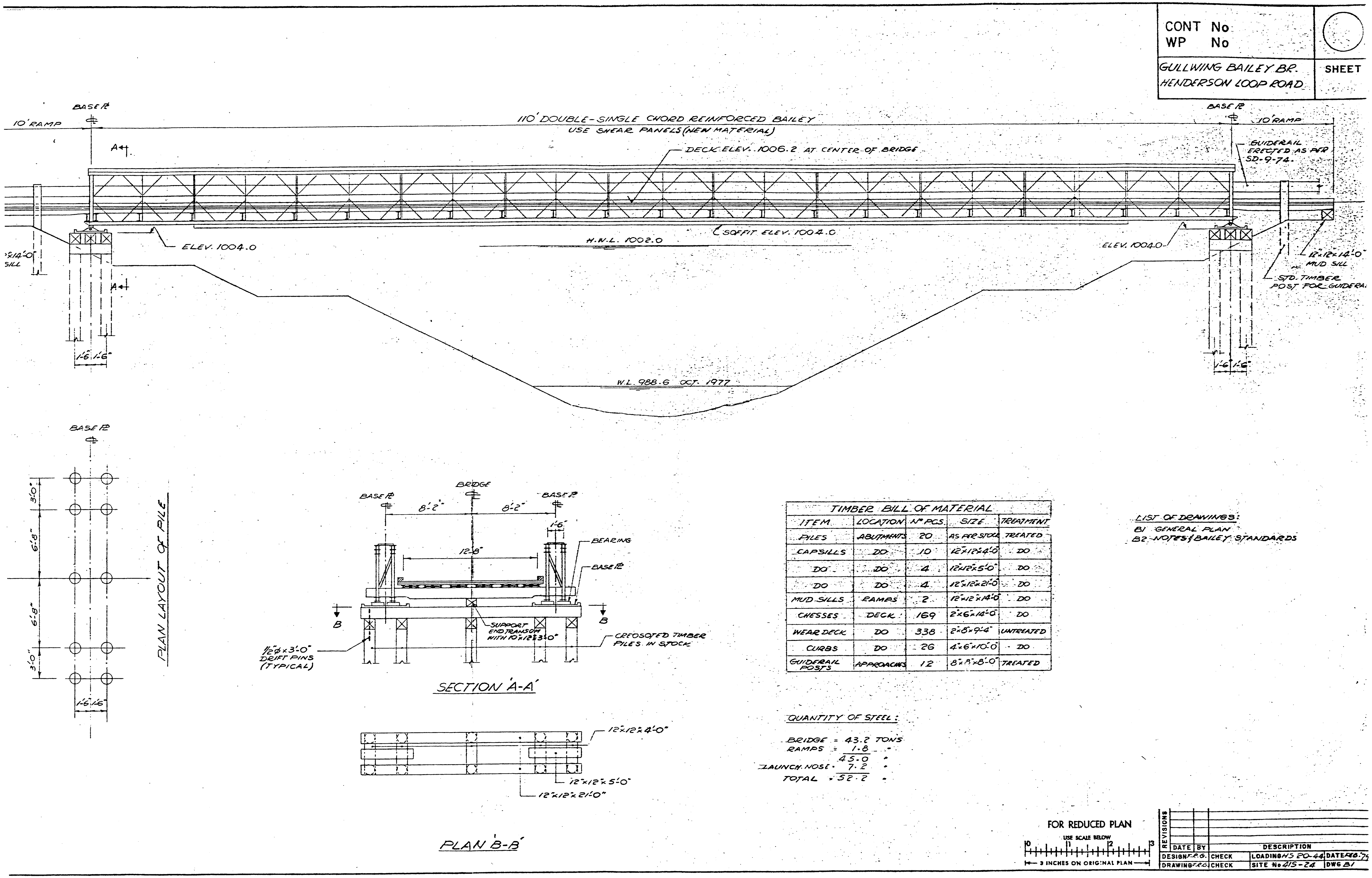
STEEL: bridges 61.0 Tons
ramps 3.6
Sidewalk 1.6
launch. nose 5.7
TOTAL = 71.9

TIMBER: deck 9.0 Mfbm
Sidewalk 1.0
grillages 1.7
TOTAL = 11.7

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS		
DATE	BY	DESCRIPTION
DESIGN F.R.G.	CHECK	LOADING HS 20-40	DATE Dec.
DRAWING F.R.G.	CHECK	SITE No 17-79	DWG PRELIM

FIGURE 3.5



TIMBER BILL OF MATERIAL

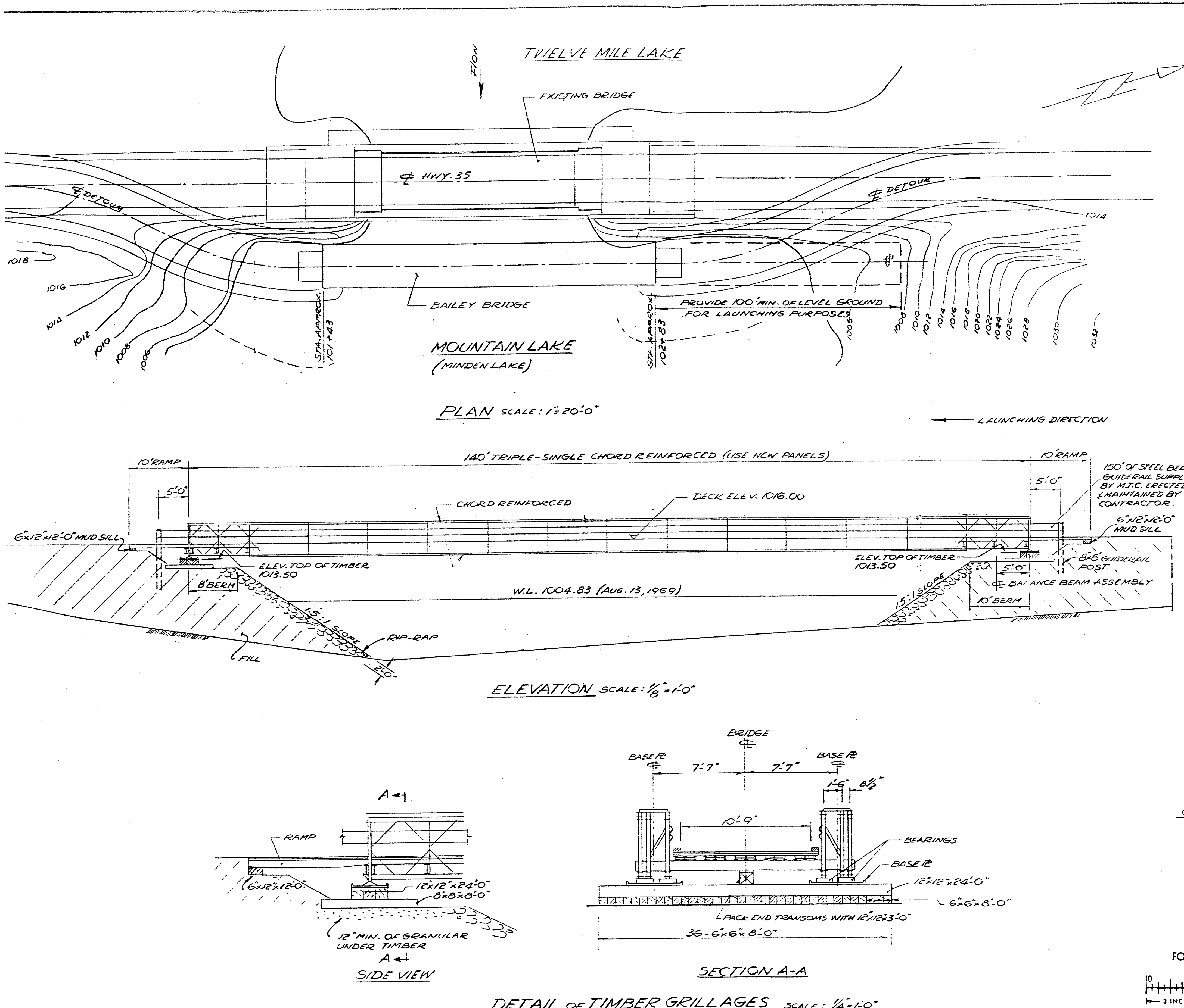
ITEM	LOCATION	N° PCS.	SIZE	TREATMENT
PILES	ABUTMENTS	20	AS PER STOCK	TREATED
CAPSILLS	DO	10	12"x12"x4'-0"	DO
DO	DO	4	12"x12"x5'-0"	DO
DO	DO	4	12"x12"x21'-0"	DO
MUD SILLS	RAMPS	2	12"x12"x14'-0"	DO
CHESSES	DECK	169	2"x6"x14'-0"	DO
WEAR DECK	DO	338	2"x8"x9'-4"	UNTREATED
CURBS	DO	26	4"x6"x10'-0"	DO
GUIDERAIL POSTS	APPROACHES	12	8"x8"x8'-0"	TREATED

FIGURE 3.6

CONT No
WP No 119-68-01

MOUNTAIN LAKE BAILEY BR.
HWY. 35, DIST. 11

SHEET



NOTES TO CONTRACTOR

1. Decking to be installed as shown on plan D.D. 1201.
2. Guide rail to be installed as shown on std. SD-9-74.
3. Fill as determined on the site.
4. ERECTION AND LAUNCHING
   (a) (i) The Contractor shall not assemble, launch or delaunch the Bailey until the layout and elevations of the launching and construction rollers have been approved by the Engineer. Double rollers shall be used at all locations.

   (ii) The tops of the rollers shall all be at the same elevation, unless specified otherwise on the drawings.

   (iii) The tops of the rollers shall be levelled across in pairs at right angles to the centre line of the structure.

   (b) (i) The launching nose shall consist of 60 feet of single-single skeleton construction and 20 feet of double-single skeleton construction.

   (ii) The launching links shall be inserted 40 feet from tip of nose.

   (c) (i) All pins, bolts and threaded parts must be free of dirt and be lubricated at the time of installation.

   (ii) Transom clamp tightening bars must be wired to the panel verticals. Sway braces shall be fully tightened to gauge blocks and all lock nuts secured.

   (iii) All panel pins on structure must be keyed.

   (d) When the combined weight of the bridge and nose exceeds 60.0 tons on a single storey bridge and 80.0 tons on a double storey bridge, the balance beam assembly must be used.

   (e) Wear deck shall be installed after launching.
5. ADDITIONAL NOTES FOR CHORD REINFORCED BRIDGES
   (a) Bracing frame bolts must be installed in the reinforcing chords prior to the chords being installed on the panels.

   (b) Tapered chords shall be used for launching and delaunching.
6. MAINTENANCE

   The Contractor shall be responsible for the maintenance of the structure and approaches, including the following:

   (a) Check that all bracing bolts, chord bolts, transom clamps are and remain fully tightened.

   (b) Keep baseplates and bearings free of debris. Inspect baseplates and cribs periodically and correct any uneven settlement to the satisfaction of the Engineer. Packing under end transom and ramps must be kept tight.

   (c) Notify the Engineer immediately of any damages.

QUANTITIES:

STEEL = 74.7 TONS

TIMBER = 10.5 MFBM.

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION	
DESIGN F.R.G.	CHECK		LOADING HS 20-40	DATE Aug. 78
DRAWING F.R.G.	CHECK		SITE No 40-32	DWG PRELIM.

FIGURE 3.7

4. DESIGN OF BAILEY BRIDGES

4.1 Design Approach

Bailey bridges are simple to design. Bailey bridges commonly used by the Ministry and municipalities in Ontario are simple span structures, or continuous span structures. The design examples given in Section 4 conform to th OHBDC loadings and load factors. The live load factor used is 1.4 for long term use and 1.25 for use up to five years. Dynamic load allowances used are 1.25 of OHBDC truck loading. This may be adjusted to suit the speed of the traffic using the bridge.

4.2 Strength of Steel Used

Panels, transoms, raker, ramps, distributing beams, crib capsill, and chord reinforcements are fabricated with high tensile steel which has an ultimate tensile strength of 539 - 638 MPa and a yield strength of 355 MPa.

Most of the other components, including stringers and light bracing frames, are made from mild steel with minimum yield strength of 235.0 MPa.

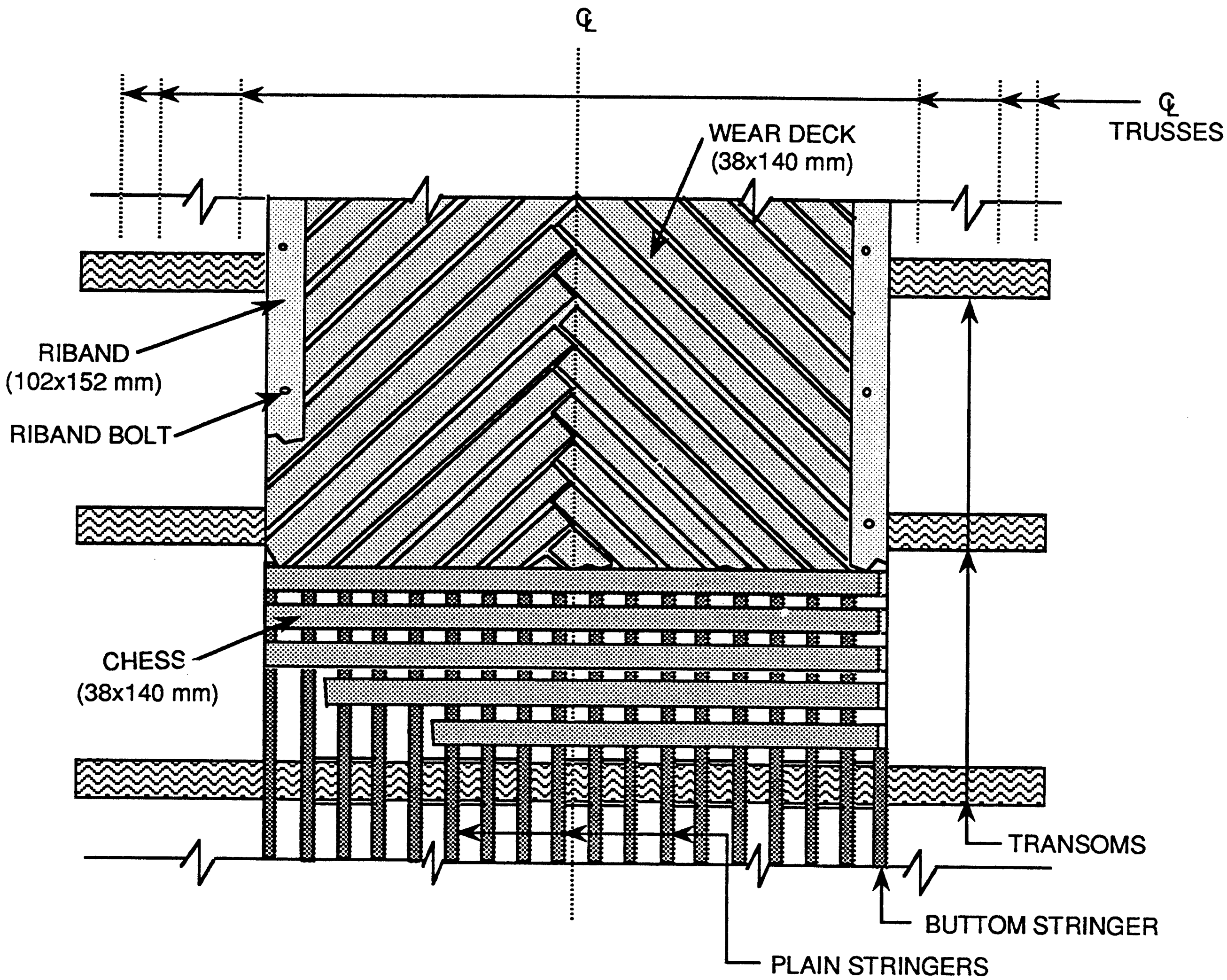
Bailey panel pins are made of very high strength steel with a yield strength of 770.0 MPa.

The Ministry has renovated wartime Bailey panels and Mabey-Johnson panels in stock. The wartime panels had fatigue problems at the slotted holes in the bottom chord, which were provided for attaching sway bracings. These panels were renovated by strengthening around the slotted holes and by galvanizing the panels. Although they were strengthened, the DeHaviland Study [8] recommended the use of a reduced yield strength of 238 MPa for the panel chords. The Mabey-Johnson panels now are designed to have adequate fatigue strength. Therefore, for these panels a material yield strength of 355 MPa can be used for the design. Other components are not affected by fatigue and therefore both renovated Bailey bridge components and Mabey-Johnson components have similar strengths.

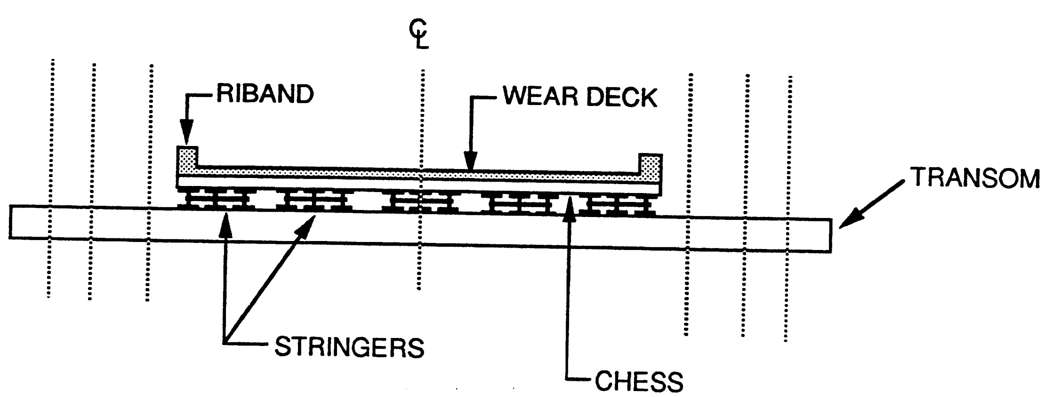
4.3 Design of Floor System

The floor system consists of timber decking, Bailey stringers and transoms. The timber decking commonly used by the Ministry is shown in Figure 4.1. The decking spans are very small and usually do not require a special design. The chesses and stringers are adequate for carrying OHBDC loads. However, the chesses are only 38 mm thick and can wear or be damaged easily, therefore a transverse or longitudinal laminated timber deck is recommended for bridges.

The transoms are adequate to carry OHBDC loads for a reduced load factor of 1.25 and a dynamic load factor of 1.25 . This reduction is considered acceptable for the temporary installations.



TYPICAL PLAN OF DECK



CROSS-SECTION

Figure 4.1 Deck Details

4.4 Design of Trusses

The design of Bailey bridge trusses is simple. Since, it is a prefabricated bridging system, an elaborate design check is not usually carried out. The truss configuration is obtained by checking the applied bending moments and shear forces against the allowable bending moments and shear forces. Lateral stability of the top chords and fatigue are not normally investigated as it is assumed implicitly that the Bailey truss system selected will satisfy these conditions.

Dead loads of various types of Bailey bridges are given in Tables 4.1(a) and 4.1(b). Table 4.1(a) gives the dead loads of the Bailey panels but does not include the timber deck. Table 4.1(b) gives the dead load of the Bailey panels including the timber decking shown in Figure 4.1. The sidewalk loads have to be added separately in both cases.

The ultimate unfactored moment and the shear capacities, calculated according to OHBDC, of various Bailey trusses are given in Table 4.2. The performance factor of $\phi = 0.9$ has to be applied to these values to obtain the ultimate resistance capacity values.

The designer may not be able to differentiate between the old Bailey panels and the new Maybey panels. The Ministry usually marks the panels to identify the type supplied.

Table 4.1.(a) Dead Loads of Half the Cross Section of Bailey Bridge per 10 foot Bay

DEAD LOAD OF STEEL BAILEY COMPONENTS PER 10 FOOT BAY, kN				
Bailey Type	STANDARD		STANDARD WIDE	
	2 Transoms/bay	4Transoms/bay	2 Transoms/bay	4 Transoms/bay
TYPICAL PANEL				
SS	7.4	9.5	10.0	13.0
SSR	9.5	11.7	12.2	15.2
DS	10.4	12.6	13.0	16.0
DSR	14.7	16.8	17.4	20.3
TS	13.2	15.4	15.8	18.8
TSR	19.7	21.8	22.4	25.4
DD	16.2	18.4	18.9	21.8
DDR	20.3	22.6	23.2	26.2
TD	21.9	24.1	24.6	27.5
TDR	28.4	30.5	31.1	34.0
NOSE				
SS	4.2		4.7	
DS	7.2		7.7	
DD	13.0		13.5	
END PANEL				
SS	6.4		7.1	
DS,DD	8.5		9.2	
TS,TD	10.1		10.3	
RAMP				
3.05m LONG	4.1		4.9	
6.10m LONG	10.1		12.1	
NOTE: These loads do not include timber decking or sidewalk loads.				

Table 4.1(b) Dead Loads of Half the Cross Section of Bailey Bridge

Bridge Type	Dead Loads of Bailey Bridges, kN/m.				
	Standard		Standard Wide		Chord Reinforcing
	2 Transoms/Bay	4 Transoms/Bay	2 Transoms/Bay	4 transoms/Bay	
SS	3.65	4.40	4.55	5.50	0.715
DS	4.60	5.40	5.50	6.45	1.400
TS	5.55	6.30	6.45	7.40	2.115
DD	6.55	7.25	7.40	8.40	1.400
TD	8.40	9.15	9.30	10.25	2.115

Note: These loads include the weight of timber decking shown in Figure 4.1.

Table 4.2 Ultimate Unfactored Moment and Shear Capacities, OHBDC, of One Set of Bailey Trusses

TYPE	Relative Strength Factor		Ultimate Moment Capacity, kN M		Ultimate Shear Capacity, kN		Moment of Inertia
	Moment	Shear	Old Material Fy = 238 Mpa	New Material Fy = 355 Mpa	Old Material Fy = 238 MPa	New Material Fy = 355 MPa	$mm^4 X10^8$
SS	1	1	850	1360	268	335	56.6
SSR	2.03	1	1726	2761	268	335	130.3
DS	2	2	1700	2720	535	669	113.2
DSR	4.05	2	3442	5508	535	669	260.5
TS	3	3	2550	4080	803	1004	169.8
TSR	6.07	3	5160	8255	803	1004	390.8
DD	4.27	3.3	3630	5807	883	1104	485.7
DDR	8.62	3.3	7327	11723	883	1104	1038.4
TD	6.44	4.38	5474	8759	1171	1465	728.5
TDR	12.9	4.38	10965	17544	1171	1465	1557.6
DT	8.1	3.3	6885	11016	883	1104	1375.7
DTR	14.6	3.3	12410	19856	883	1104	2592.8
TT	12.12	4.38	10302	16483	1170	1465	2063.5
TTR	21.8	4.38	18530	29852	1170	1465	3889.2

NOTES:

The relative strength factor is defined as the number of times a Bailey truss type is stronger than the single Bailey truss.

The ultimate moment capacity of old wartime material is reduced by 33% because of low temperature embrittlement.

4.5 Estimation of Deflection

The deflection of a Bailey bridge is a sum of two components, the sag and the elastic deflection. They can be estimated by the empirical formulae given below;

Sag

Sag develops due to the play between the panel pins and the male and female panel lugs.

For a bridge with an odd number of bays; $\triangle_s = \frac{d(n^2-1)}{8}$ mm

For a bridge with an even number of bays; $\triangle_s = \frac{dn^2}{8}$ mm

where,
n = number of bays,
d = 3.55 mm for single storey girder
= 1.71 mm for double storey girder
= 1.13 mm for triple storey girder.
$\triangle_s$ = sag in the bridge

Approximate Sag expected at the launching nose as it reaches the launching rollers is given in Table 4.3. Effects of launching link on launching nose are given in Table 4.4.

Elastic Deflection

Elastic deflections can be calculated by using elastic method and by considering the truss as an elastic beam.

For uniformly distributed loads, $\triangle_s = \frac{5\ WL^3}{384\ EI}$

For point loads, $\triangle_s = \frac{WL^3}{48EI}$

where,
W = the total load,
EI = Elastic stiffness of the panels

SPAN OF BRIDGE		SINGLE STOREY BRIDGE		DOUBLE STOREY BRIDGE		TRIPLE STOREY BRIDGE	
feet	metres	inches	metres	inches	metres	inches	metres
30	9.14	2.5	0.06	—	—	—	—
40	12.19	4	0.1	—	—	—	—
50	15.24	6	0.15	—	—	—	—
60	18.29	8.5	0.21	6.5	0.16	—	—
70	21.37	12	0.31	8.5	0.21	—	—
80	24.38	16	0.41	11	0.28	—	—
90	27.43	20	0.51	14	0.36	—	—
100	30.48	25	0.64	17	0.43	—	—
110	33.53	30	0.76	21	0.53	16	0.41
120	36.58	36	0.92	25	0.64	20	0.51
130	39.62	43	1.1	30	0.76	24	0.61
140	42.67	52	1.3	36	0.92	28	0.71
150	45.72	61	1.55	43	1.1	33	0.84
160	48.77	74	1.88	50	1.27	39	0.99
170	51.82	—	—	57	1.45	47	1.2
180	54.86	—	—	64	1.63	56	1.42
190	57.91	—	—	72	1.83	65	1.65
200	60.96	—	—	81	2.06	74	1.88

Table 4.3 Sag Expected at Tip of Launching Nose as it Reaches the Landing Rollers.

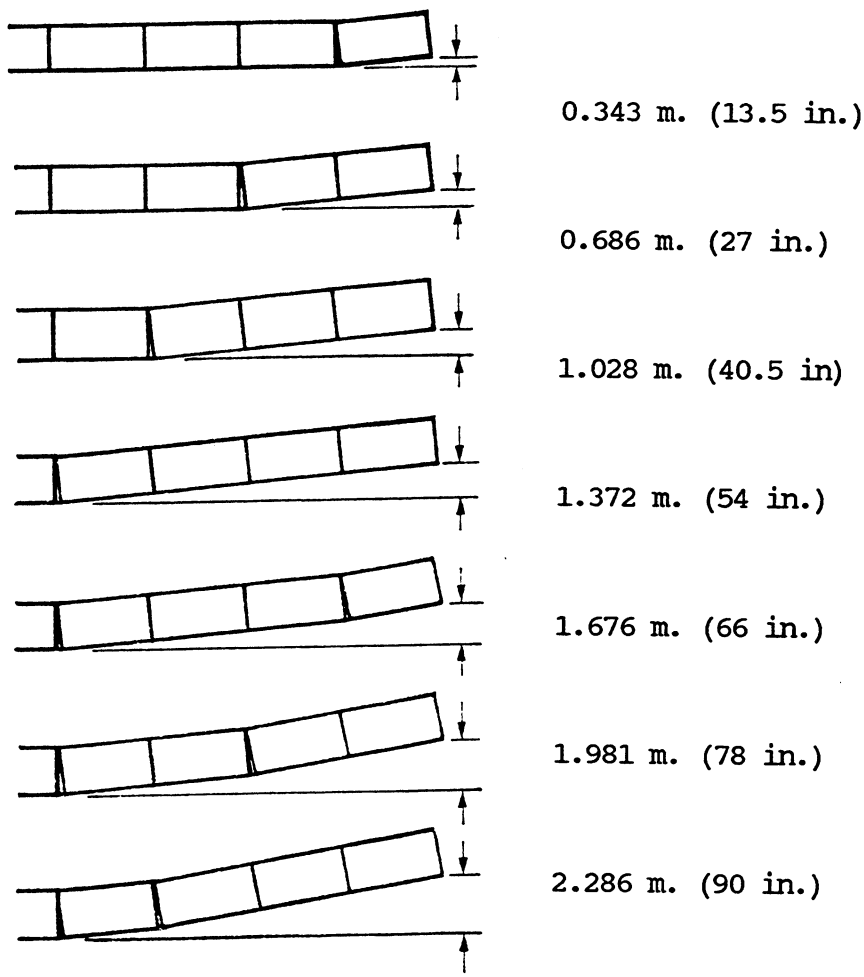


Figure 4.2 Effect of Launching Link on Launching Nose

4.6 Computer Program to Design Bailey Bridges

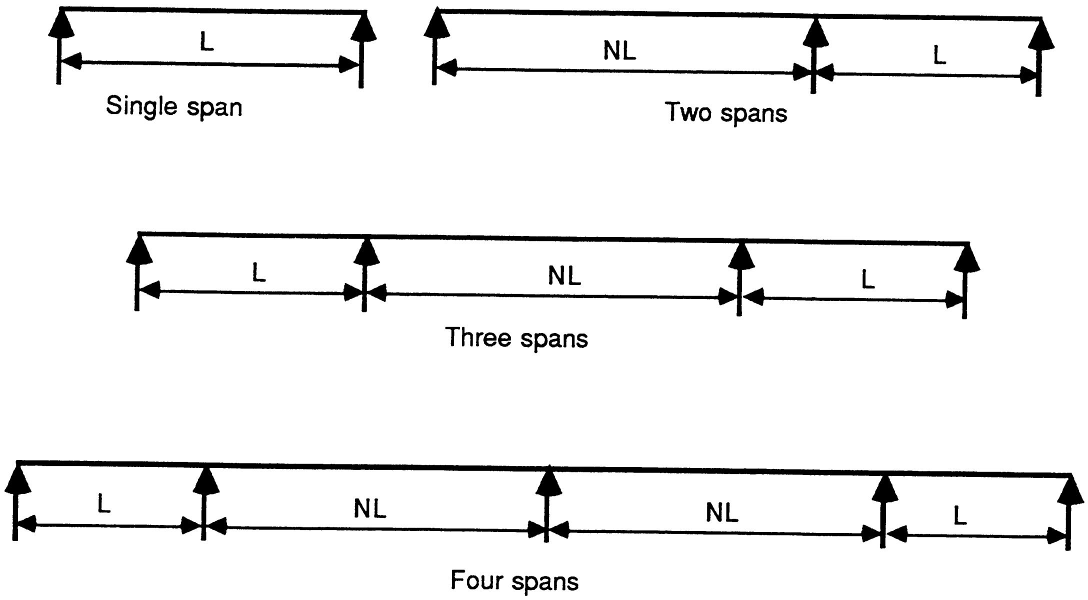
The Bailey bridge design program, BALYDN, may be used to design simply supported or continuous Bailey bridges according to the OHBDC. The program uses influence coefficients given in Reference [9] to calculate the critical moments, shear forces and support reactions for spans shown in Figure 4.3. The required influence coefficients data are stored in data sets. N value indicates the span ratio and N varies from 1.0 to 1.7 in steps of 0.1. For N values such as 1.12 or 1.27 etc., the program uses N values closest to the actual ratio, ie., 1.10 and 1.30 respectively.

The BALYDN program is interactive. Load the program BALDYN and it then requests the following inputs;

- the total bridge length;
- the individual span lengths;
- unfactored dead load in UDL (KN/m) on one set of trusses, Figure 4.4;
- the maximum number of truck or lane load carried by one set of trusses, Figure 4.4.;
- dead load factor;
- live load factor;
- dynamic load factor;
- the type of Bailey panel required, renovated panels or Maybey-Johnson panels.

The output can be viewed on the screen or be printed.

A copy of the BALYDN program is given on a floppy disk in the manual. Sample outputs are given in Appendix A.

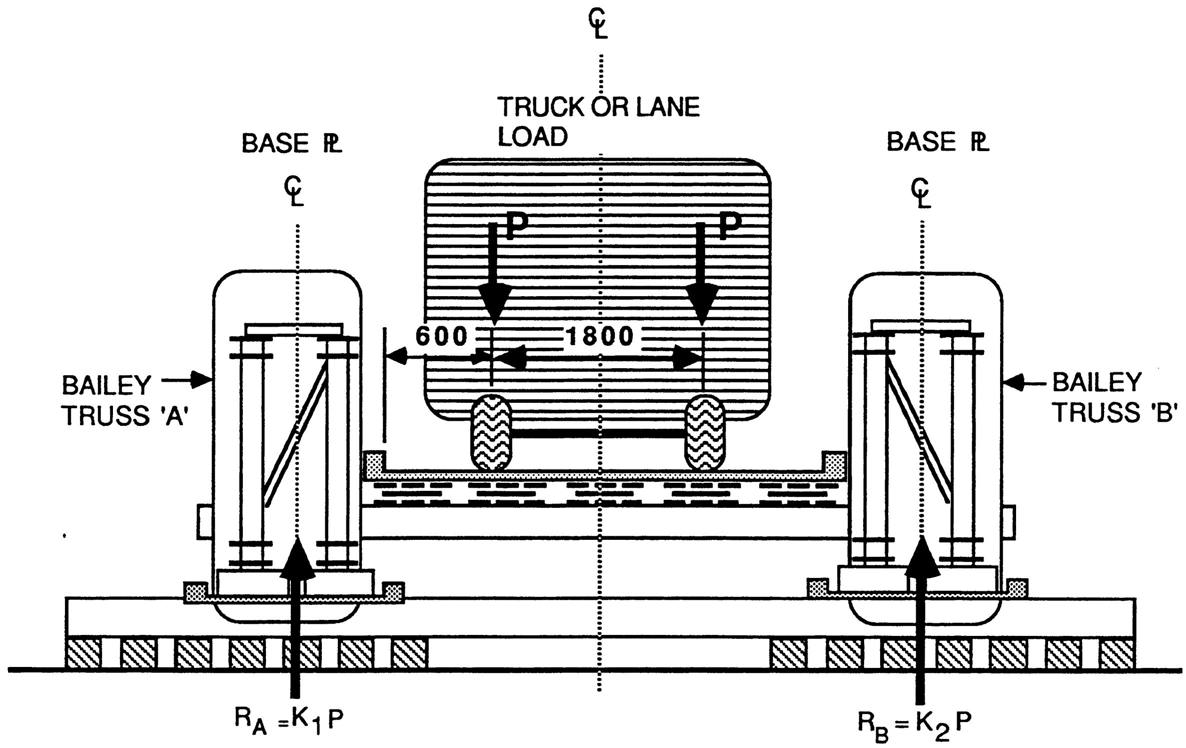


Span ratios available in the Data Set

N	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7

Where N = Long Span ÷ Short Span

Figure 4.3 Spans For Which Influence Coefficients are Stored in the Data Set



R_A = Reaction on one set of Bailey trusses.
R_B = Reaction on other set of Bailey trusses.
K_1 = Fraction of OHBDC truck or live load on one set of Bailey trusses.
K_2 = Fraction of OHBDC truck or live load on other set of Bailey trusses.
P = Half truck or lane load.

<u>Dead Load</u> = Unfactored dead load carried by one set of trusses in KN/m.

<u>Number of OHBDC Load</u> = The maximum fraction, K_1P, of unfactored OHBDC truck or lane load carried by one set of trusses.

Figure 4.4 Dead and Live Loads Required for BALDYN

5 Erection and Dismantling

5. ERECTION AND DISMANTLING OF BAILEY BRIDGES

5.1 General

The assembly and erection of a Bailey bridge involves the assembling of the various Bailey components in a suitable order and launching of the truss system with considerations to safety and proper placement of the bridge at the bearing locations. During the dismantling of a Bailey bridge the same procedures are repeated in reverse order. It requires considerable experience to carry out these tasks satisfactorily and safely, hence, the erection and dismantling has to be carried out by experienced personnel, or under the guidance of a professional engineer.

Normally, Bailey bridges are assembled behind one abutment and launched over to the supports on the opposite abutment. A launching nose is assembled first to help launch the structure. Bailey bridges can be assembled in full length and launched in one operation or constructed partially and launched in more than one launching operation. Usually, the trusses and the transoms of the Bailey bridges are assembled and launched first and the deck construction is carried out after positioning the bridge on the support bearings. However, Bailey bridges can also be launched fully decked except for the first bay. In all these operations, the main consideration is that the structure does not overturn or induce unduly high stresses on the Bailey bridge components.

5.1.1 Selection of Construction Areas

The construction area should be firm ground that can support the weight of the men and machines used for the erection of the Bailey bridge. The construction area on the launching end should be approximately level and preferably have sufficient room to accommodate the full length of the bridge. A minor longitudinal slope in the construction area may not be avoided and the associated difficulty can be overcome by raising or lowering the roller levels to keep the structure level.

When more than one launching operation is used the construction area may be less than the full length of the bridge, however, the length available should be sufficient to satisfy the minimum length requirement for overturning and to accommodate a crane or pushing vehicle used for launching. The time required to launch a Bailey can be reduced if sufficient clear space is available past the other abutment for the launching nose to pass fully beyond the bearings. Otherwise, the launching has to be effected in a series of small launches.

The construction area width should preferably be at least 5 metres wider than the width of the Bailey structure.

5.1.2 Stacking of Components

Stacking of the various Bailey components should be planned properly in the construction area since the actual construction position of the individual bays moves progressively back from the launching rollers as bays are added. The stacking should be based on the reach of the crane and the least amount of movement required to erect the panels.

5.1.3 Final Grades

The final grade of the bridge may be sloped and may be different from the slope of the launching plane. However, it is recommended that the final grade of the bridge should not exceed 1 in 7 and there should be no crossfall on the bridge during construction or in its final position.

5.2 Erection

5.2.1 Crane and Crew Sizes

The erection of Bailey bridges can be handled without a crane, however, the use of a crane will speed up the construction. A mobile crane with a telescopic jib which is able to handle 15 KN (1-1/2 tons) at a radius of 9.15 m (30 ft.) is adequate for this purpose. When a crane is not used for the erection, a working party of six to eight men is recommended. However, depending on the type and size of construction more manpower may be employed.

5.2.2 Roller Layout

5.2.2.1 General

The rollers are used to build on and launch the Bailey bridges. The rollers are used in three ways; launching rollers on the home bank, landing rollers on the far bank, and construction rollers spaced out behind the launching rollers at suitable intervals. Rocking rollers are used for the launching and landing positions. In all other positions plain rollers are used.

The accurate levelling of the rollers is essential for ease and safety during construction and launching. It is recommended that the differences in level between longitudinal rollers should be less than 10 mm. Transversely the rollers should be level.

5.2.2.2 Allowable Loads on Panel Chords and Rollers

The maximun allowable point load that can be applied at any location on the panel chord is 6.1 tonnes. The maximum load that can be applied to a plain roller is also 6.1 tonnes. The maximum reaction on a rocking roller is 15.2 tonnes for a single storey bridge and 18.3 tonnes for double and triple storey bridges.

5.2.2.3 Launching Rollers

When the combined weight of the bridge and nosing is less than 61 tonnes , four launching rollers (rocking rollers) are used. The rollers are spaced at 457 mm (1-1/2 ft.) apart on each side of the trusses. When the combined weight exceeds 61 tonnes, eight launching rollers are used with a balance beam assembly. The balance beam assembly is placed 1.525 m (5 feet) minimum in front of the bridge bearings. When the balance beam assembly is required, the abutments must be designed to accommodate the balance beam assembly.

For triple truss bridges, the outer trusses are not supported on rocking rollers. The outermost set of guide rollers must be removed since they will damage the third truss.

5.2.2.3 Construction Rollers

The first set of construction rollers is placed 7.75 m behind the launching rollers and consists of a single plain roller on each side of the bridge under the inner trusses. Additional sets of rollers are placed at 7.75 m intervals to suit the length of the bridge. For bridges with spans greater than 40 metres, plain rollers are used at each location behind the first set of plain rollers.

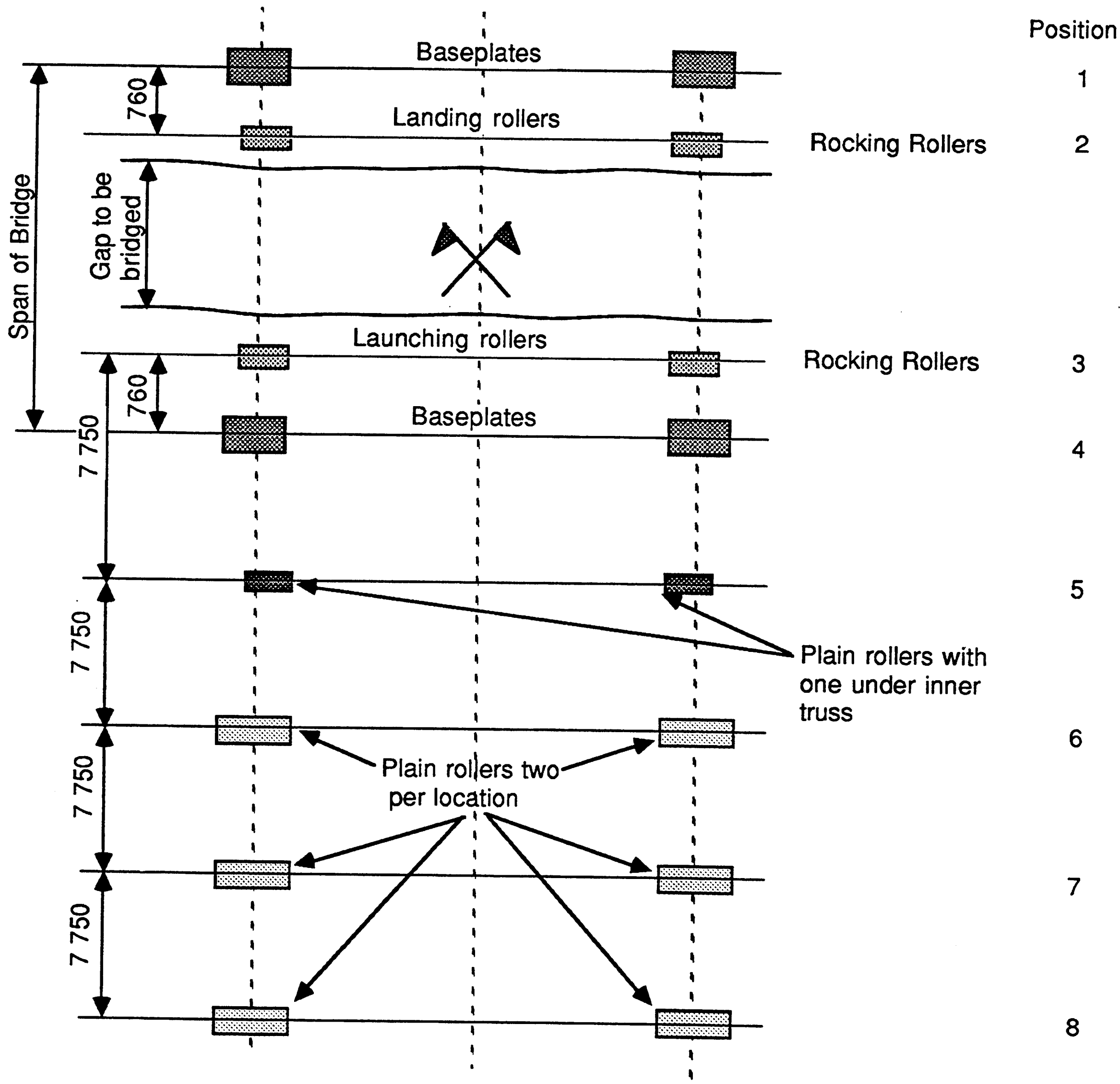
5.2.2.4 Landing Rollers

Landing rollers are usually one set of rocking rollers. When the reaction of the bridge and the nose on the landing roller exceeds its capacity, additional rocking rollers have to be used.

5.2.2.5 Layout of Rollers

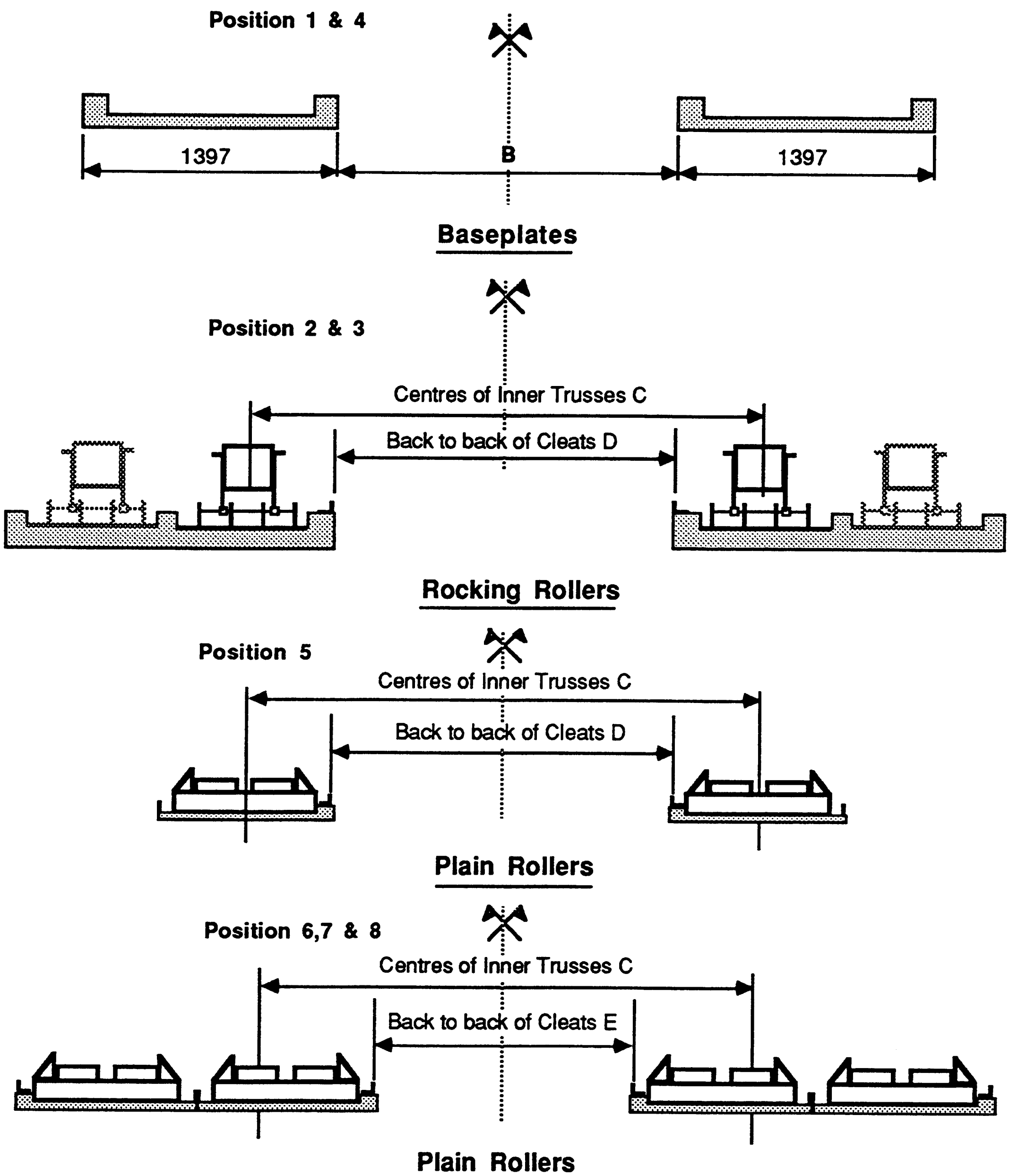
The setting of rollers should begin by setting out pegs along the centreline of the bridge and on both launching and receiving ends of the bridge. On the launching end, the centreline pegs should extend back at least two-thirds of the bridge length. Also, two additional lines parallel to, and one on either side of the centreline, should be marked with pegs to indicate the transverse edges of the bridge. The position of these lines depends on the width of the bridge being constructed. Figure 5.1 (a) gives a plan view of the way the rollers are located for launching a typical Bailey bridge.

The transverse locations of the rollers for various types of Bailey bridges are shown in Figures 5.1 (a) and (b).



SITE LAYOUT

Figure 5.1 (a) Typical Plan of Roller Layout



Dimensions.

B: No. of Trusses in Main Girder					C	D	E
Single	Double	Triple	Quadruple				
2540	2997	3290	3213	Standard	3 937	2 933	2 730
3124	3581	3874	3798	Standard Widened	4 521	3 518	3 315a
3556	4013	4013		Extra Wide	4 953	3 950	3 747b

NOTE: a Except Quadruple truss, Ref. [2]

b Except Triple truss, Ref. [2]

Figure 5.1 (b) Setting Out Dimensions

5.2.3 Bearing Locations

The transverse bearing location used for standard and standard widened bridges are given in Figures 5.2(a) and 5.2(b) respectively.

Standard Bailey

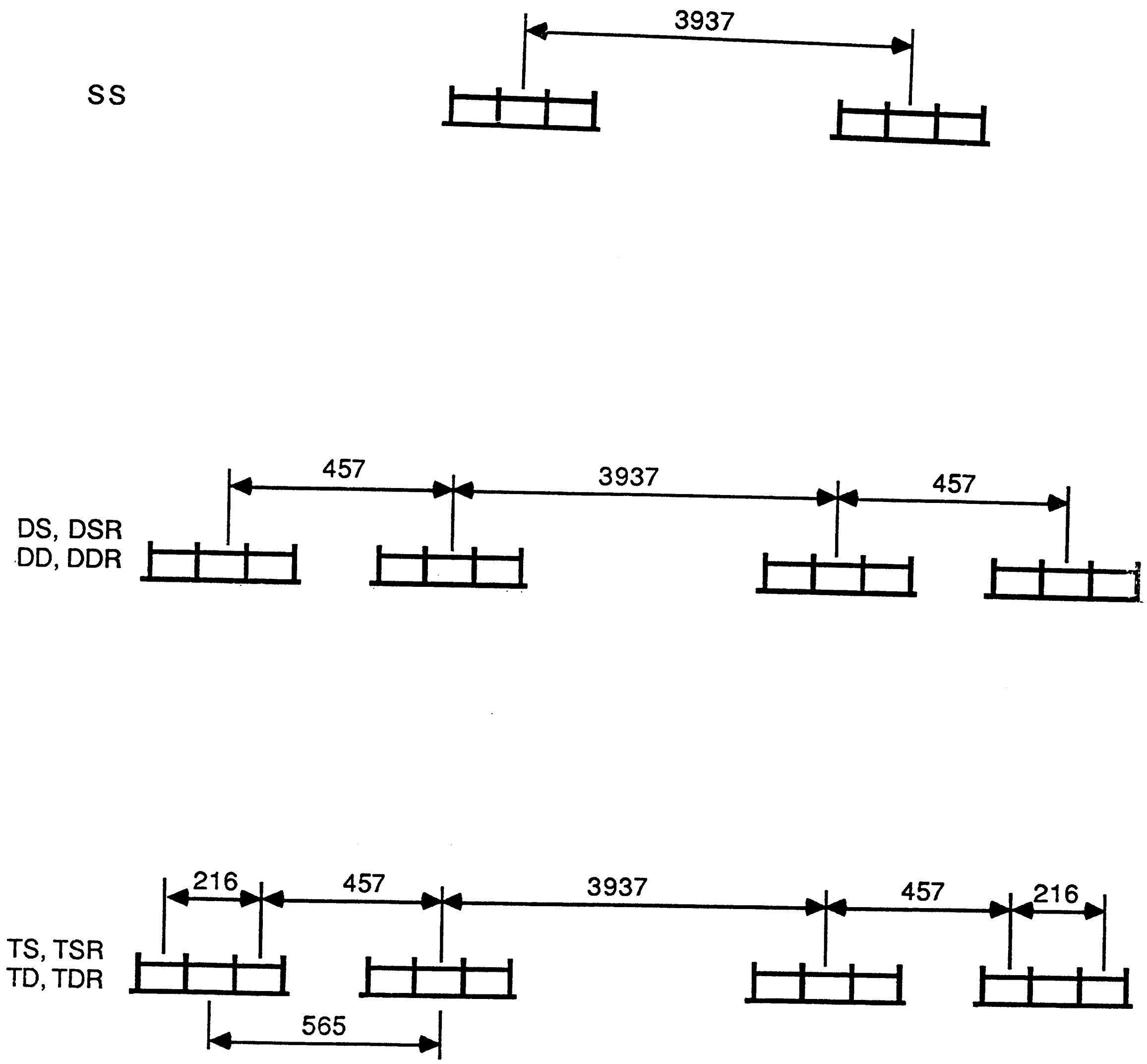


Figure 5.2(a) Setting Out Dimensions - Transverse Centres of Bridge Bearings

Standard Widened

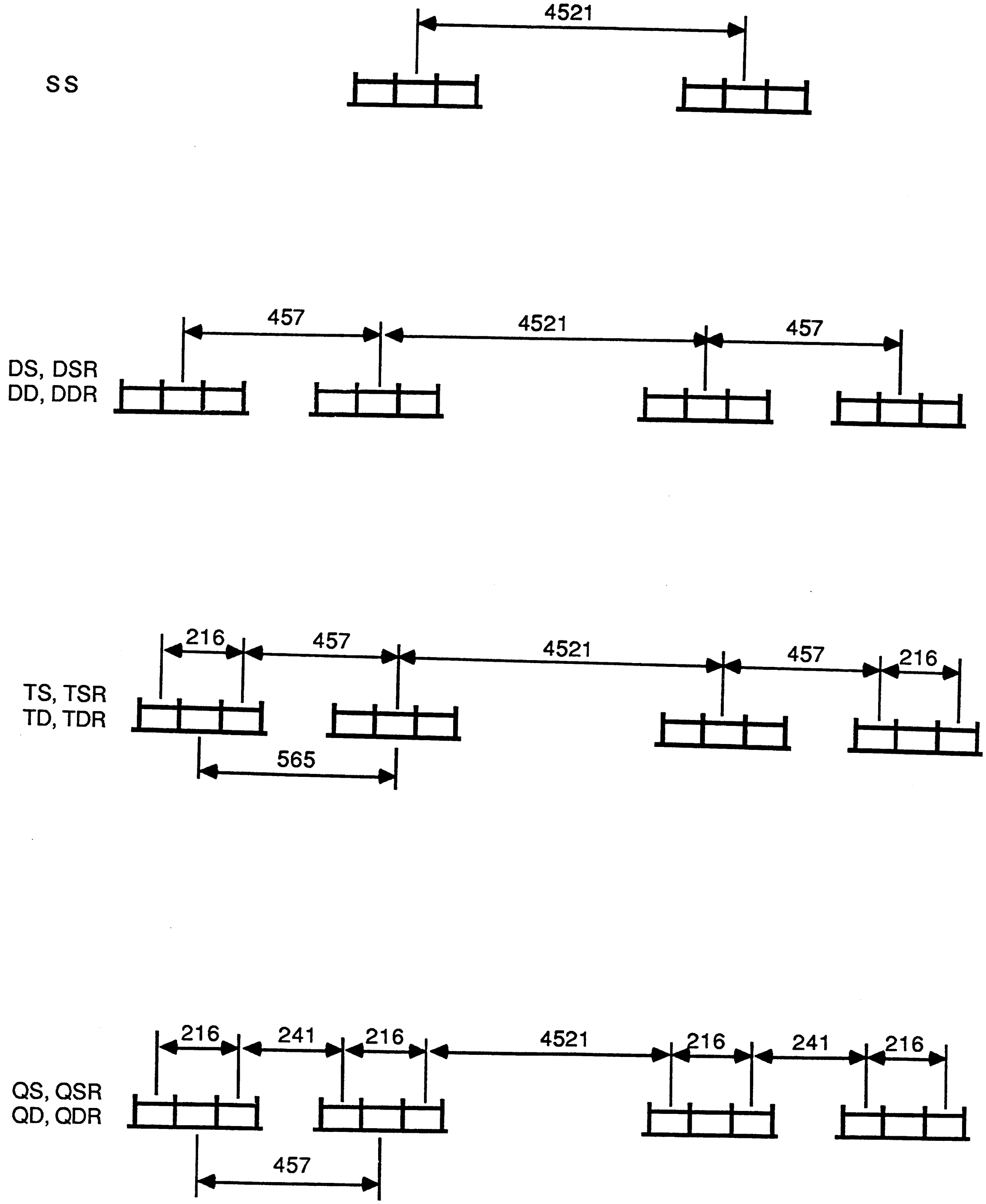


Figure 5.2(b) Setting Out Dimensions - Transverse Centres of Bridge Bearings

5.2.4 Assembling Launching Nose

The launching nose required for the launching of a Bailey bridge is first assembled and the bridge sections are then assembled behind the launching nose. The length of the launching nose required is generally determined by the type and span of the Bailey bridge under construction. The type of launching nose required is determined by the length of the launching nose used. Usually a Single-Single type can be used for a launching nose up to 6 bays long, a Double-Single for the next 4 bays and a Double-Double for the next 4 bays. The above gives an approximate guideline to the type of launching noses that can be used, the engineer should select a suitable launching nose type by checking the member resistances against the forces induced during the launching operation.

The following explains the method of assembling a Single-Single launching nose. For other types, such as the Double-Single or the Double-Double, the method described later for the assembly of similar bridges can be used.

1. Compute the number of panels and links in the nose.

2. Place one set of panels on the launching rollers with the centreline of the panels over the inside edges of the rollers. The female jaws towards the launching direction.

3. Add a transom behind the verticals at the front end of the panels.

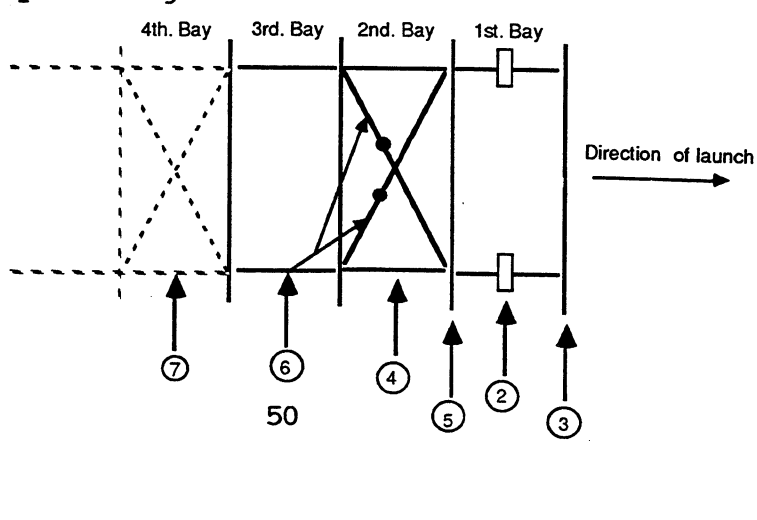
4. Connect, by pins, a second pair of panels to the rear of the first set of panels. Support the ends temporarily on blocks and connect rakers to the front vertical and transom of the first set of panels.

5. Add a transom through the second set of panels behind the front vertical.

6. Connect a third set of panels at the rear of the second set. Install sway bracing in the second bay with the long arm towards the front.

7. Continue the cycle until the nose is completed. Connect rakers on 1st, 3rd, 5th and on every transom thereafter. Connect sway bracing on 2nd, 4th and on every bay thereafter as these bays are completed. Tighten transom clamps, bracing bolts and sway bracings of each bay on completion of the assembly of the next bay.

8. After the first plain roller behind the launching roller is reached, remove temporary blocking.



5.2.5 Assembling A Single-Single Bailey Bridge

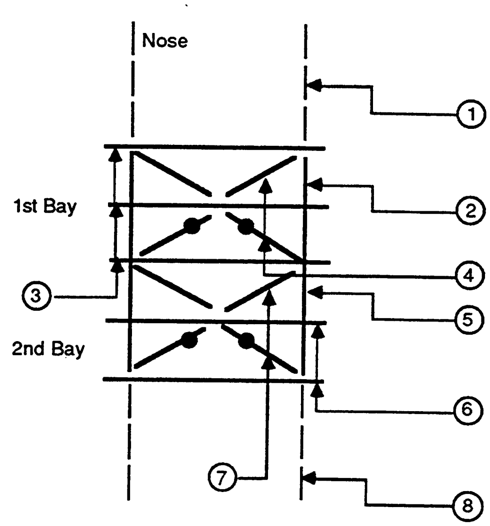
A Single-Single Bailey bridge is not used by the Ministry, since it constitutes a single load path structure. However, a Single-Single type forms the basic unit in constructing other types of Bailey bridges and therefore the assembly operation for a Single-Single Bailey bridge is given below.

First Bay

1. Assemble the launching nose.
2. Connect, by pins, a set of panels to the rear of the launching nose.
3. Add three transoms, one behind the front vertical, one in front of the centre vertical and one in front of the rear vertical. Connect rakers to the front and rear transoms.
4. Install sway bracing with the long arm towards the front.

Second Bay

5. Connect, by pins, a set of panels behind the first bay.
6. Add two transoms, one in front of the centre vertical and one in front of the rear vertical.
7. Connect rakers to the rear transom. Install sway bracing with the long arm towards the front.
8. Continue the cycle until the required bridge length is assembled. Tighten transom clamps, bracing bolts and sway bracings of each bay on completion of the assembly of the next bay.



5.2.6 Assembling A Double-Single Bailey Bridge

First Bay

1. Assemble the launching Nose.

2. Connect, by pins, a set of inner panels to the rear of the launching nose.

3. Add one transom in front of the centre vertical and one transom behind the front vertical.

4. Add a set of outer panels to the transoms. Install sway bracing with the long arm towards the front.

5. Add a transom in front of the rear vertical. Connect rakers to the rear transom. Connect bracing frames to the top chords.

Second Bay

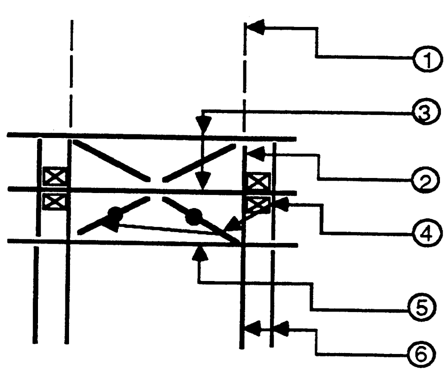
6. Connect, by pins, the outer panels of the second bay. Connect, by pins, the inner panels of the second bay.

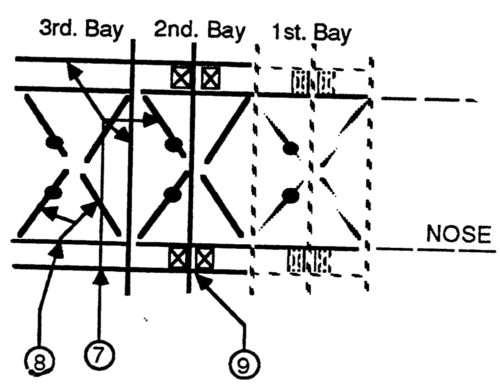
7. Install sway braces with the long arm towards the front. Add a transom in front of the rear verticals. Connect, by pins, the outer panels of the third bay.

8. Connect rakers to the rear transom of the second bay. Connect the inner panels of the third bay. Install sway bracings to the third bay with the long arm towards the front.

9. Connect bracing frames to the top chords of the second bay. Add a transom in front of the centre vertical of the second bay. Install three plain stringers and two button stringers on the second bay.

10. Continue the cycle until the required bridge length is assembled. Tighten transom clamps, bracing bolts and sway bracings of each bay on completion of the assembly of the next bay.





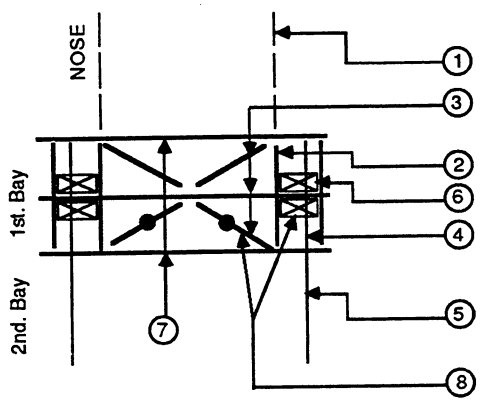
5.2.7 Assembling A Triple-Single Bailey Bridge

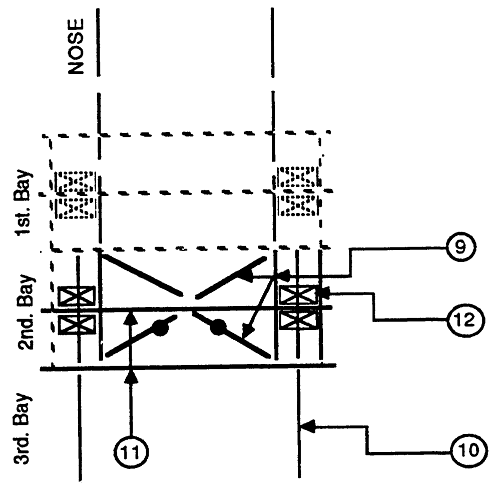
First Bay

1. Assemble the launching nose.
2. Connect, by pins, a set of panels to the rear of the launching nose.
3. Add transom in front of the centre vertical. Install sway bracing with the long arm towards the front.
4. Add a set of panels of the second truss to the transoms .
5. Connect, by pins, a set of panels for the second bay, to the rear of the second truss of the first bay.
6. Add a set of panels of the third truss of the first bay to the transoms.
7. Add a transom behind the front vertical of the first bay panels. Add a transom in front of the rear verticals of the first bay panels. Connect rakers to this transom. Add a transom behind the rear verticals.
8. Connect bracing frames to the top chords of the first bay.

Second Bay

9. Connect, by pins, the set of panels for the inner truss of the second bay. Install sway bracing with the long arm towards the front.
10. Connect, by pins, the set of panels for the second truss of the third bay. Connect, by pins, the set of panels for the third truss of the second bay.
11. Add a transom in front of the centre vertical of the second bay panels. Add a transom in front of the rear verticals of the second bay and connect bracing frames to the top chords of the second bay. Note that the bracing frame for a triple-single is wider than the bracing frame for the double single.
12. Install three plain stringers and two button stringers on the second bay.
13. Continue the cycle until the required bridge length is assembled. Tighten transom clamps, bracing bolts and sway bracings of each bay on completion of the assembly of the next bay.





5.2.8 Assembling A Double-Double Bailey Bridge

1. Assemble the launching nose.

2. Assemble three bays of a Double-Single Bailey as described in Section 5.2.6.

3. Add top trusses of the first bay and install chord bolts to hold trusses in position. Connect bracing frames to the top chords of the first bay.

4. Connect, by pins, the top trusses of the second bay and install the chord bolts. The bottom truss assembly is to be kept two bays ahead of the top truss assembly.

5. Continue the cycle until the required bridge length is assembled. Tighten the chord bolts of each bay on completion of the assembly of the next bay.

On restricted sites where the bridge is fed forward in more than one operation, the sequence of construction is the same as above, except for the following;

1) the top trusses can only be added in locations where the bottom trusses are sufficiently level;

2) the assembly of the second storey trusses should begin sufficiently back, to keep the structure balanced and to avoid the assembly from overturning over the front rollers.

As the bridge is fed forward, the truss assembly hogs over the front roller, and the trusses will not be level in this area. However, at the contraflexure point the trusses will be level and the second storey trusses can be added at this location. The contraflexure point usually occurs about 8.23 m (27 ft.) behind the first roller or can be calculated by simple moment calculations. The second storey trusses can be added further back and held in position and pinned at the bottom chord. The chord bolts can then be added when it passes the level location at the contraflexure point.

5.2.9 Assembling A Triple-Double Bailey Bridge

1. Assemble the launching nose.

2. Assemble four bays of a triple-single Bailey bridge as described in Section 5.2.7.

3. Add top inner and second trusses of the first bay and install chord bolts to hold the trusses in position. Connect, by pins, the top second truss of the second bay. Add the top third truss of the first bay and install chord bolts to hold the truss in position. Install bracing frames on the top chords of the first bay.

4. Continue the cycle until the required bridge length is assembled. Tighten the chord bolts of each bay on completion of the assembly of the next bay. Always keep the second truss ahead of the third truss so that the pins can be inserted correctly.

5.2.10 Chord Reinforced Bridges

All types of Bailey bridges can be reinforced by installing reinforced chords on the top chord and under the bottom chord of the trusses. The chord reinforcing has to be used for the full length of the bridge, except for the last bay at each end of the bridge, which doesn't need chord reinforcing. On the end bays taper chords are fitted to aid the launching and are removed after erection. The male and female ends of the chord reinforcing should be kept at the same end as the male and female ends of the panels. The chord reinforcement is added to each panel as that panel is put together.

At the bottom chords, the chord reinforcements are placed in position and pinned with chord bolts, so that the heads of the chord bolts are inside the channels. This provides an unobstructed bottom surface to roll the bridge out. A special chord bolt collar is fitted under the nut, otherwise, the bolt will be too long.

At the top chords, the chord reinforcing is fitted with the chord bolt pointing downwards and clear of the bracing frames. Bracing bolts cannot, however, be fitted after chord reinforcing has been bolted to the top chord. Therefore, bracing bolts must be fitted in the bracing frame sockets of each chord reinforcing, pointing upwards and nuts attached loosely with fish tail washer of each bolt in place.

After the chord reinforcing is in place, bolted down with chord bolts and panel pins inserted, the bracing frame is installed. Prior to installing the bracing frame, the bracing bolt nut is removed, this usually causes the bolt to drop by about 25 mm. However, bracing bolts have sufficient length for the bracing dowels to engage the bracing frames. The required projecting length of the bolt can be achieved by inserting small wooden blocks underneath the bolt heads.

For double storey bridges, chord reinforcing are placed under the bottom chord of the first storey truss and the top chord of the second storey. At these locations, taper chords are fitted during launching and removed after erection.

5.2.11 Launching and Jacking Down

The launching of the bridge forward can be carried out in one operation or by more than one operation. The launching operation can be carried out by using a crane to push forward the structure. The pushing forward should be carried out carefully so that the bridge is kept in alignment and can be made to sit on the predetermined bearing locations.

On completion of the launching, the bridge ends will align above the centre of the base plate. The rear end of the bridge can then be jacked down. The launching nose is then dismantled and the front end is jacked down.

The number of jacks required should be determined by dividing the bridge weight by the allowable jack loads. The jacks are usually used under the inner and second trusses. Before the jacks are positioned, centre the bearings under the end posts. Care must be taken to achieve the correct alignment. Usually the jack shoe placed over the bearings has little room for adjustment and it cannot be moved when the bridge weight is acting on it. Three men are required to operate a jack and to insert packing underneath the bottom chord as the bridge is jacked up. At no time should the space between the packing and the bottom chord be more than 50 mm. The packing reduces the risk of damage if there is any failure of the jacks. Once jacked up, the rocking rollers can be withdrawn and the bridge lowered.

If the bridge is on a slope, tackles should be used to keep the bridge from sliding, due to its own weight, during the jacking down operation.

5.2.12 Ramps

Ramps are usually placed at the ends of the Bailey bridge. They are commonly one or two bays long, 3.05 m (10 ft.) or 6.1 m (20 ft.). The maximum permissible slope on the ramp is 1 in 7. The ends of the ramp must be supported adequately. A 150 mm X 300 mm X 3.70 m long timber may be used to support a standard ramp and a 150 mm X 300 mm X 4.3 m long timber may be used to support a standard wide ramp.

When ramps are used, the end transom of the bridge is supported at the middle with timber blocking and steel plate wedges. A ramp pedestal is used to place the intermediate transoms, between two bays of ramps, in position. A transom requires four pedestals, all four to fit within the ramp cross-section, or two can be placed outside and the other two kept within the ramp cross-section.

5.2.13 Footwalks

Footwalks for Baileys are normally fitted outside the trusses and are, therefore, completely separate from the main roadway of the bridge. They may be fitted to either, or both, sides of the bridge and should be erected before launching as it is difficult to place bearers and timber footwalk panels after the bridge is in place.

They are supported on cantilevered footwalk bearers, which are fitted within special lugs welded to the ends of the transoms.

Two footwalk bearers are used per bay, ie. where the bridge construction uses two transoms per bay they are fitted to the ends of every transom and where the construction uses four transoms, then the footwalk bearers are fitted on every other transom. Foot walk beams are not available from Central Stores.

The footwalk is normally made up of boarded timber panels 3.05 m long and thus one such panel is required in every bay of the bridge. The width of the footwalk is 0.915 m.

5.3 Strengthening Existing Bailey Bridges

Existing Bailey bridges can be strengthened by adding chord reinforcement or by adding a second storey to the bridge. If the bridge is reasonably level the chord reinforcement can be added as described in Section 5.2.10 with minor modifications. The sequence involved in adding a second storey truss to an existing double-single storey bridge is described in this section.

When the bridge length is 36.6 m or less, a chord jack is not required to add the second storey trusses.

1. Assume that the existing bridge is a double-single Bailey bridge.

2. Add a set of panels of the inner and outer trusses for the first bay at the centre of the bridge. Install chord bolts to hold trusses in position.

3. Connect, by upper pins, a set of panels on each end of the first set of panels. Install chord bolts. Tighten chord bolts to reduce sag. Drive the lower panel pins with a sledge hammer.

4. Continue the cycle until the required length of strengthening is achieved. Connect bracing frames to the top chords of each panel and verticals on the ends of alternate panels.

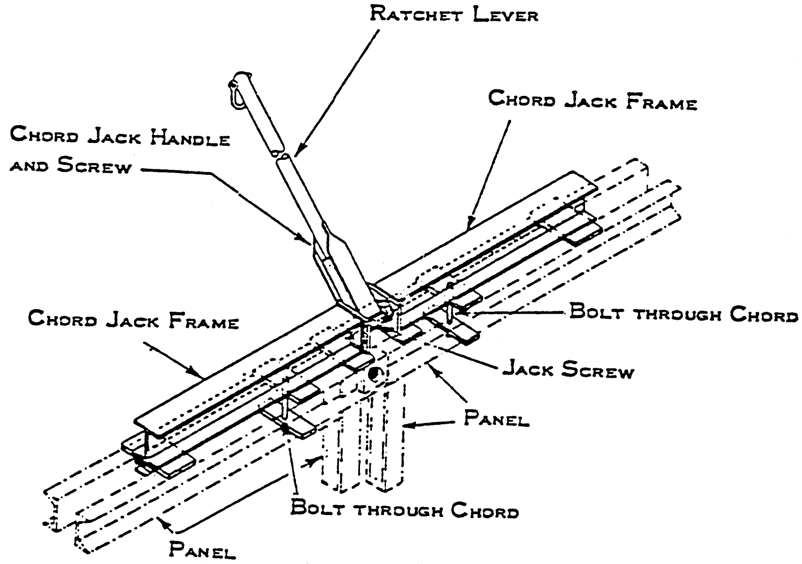
When the bridge length is more than 36.6 m, the sag can be high and has to be reduced before the second storey panels can be attached. The sag of the bridge is reduced by chord jacks, Fig. 5.3. The method of adding the second story trusses is as follows:

1. Assume that the existing bridge is a double-single Bailey bridge.

2. Add a set of panels of the inner and outer trusses for the first bay at the centre of the bridge. Install chord bolts to hold trusses in position.

3. Connect, by lower pins, a set of panels on each end of the first set of panels. Install chord bolts and tighten. Connect bracing frames on the top chords and on the panel verticals facing the ends of the bridge.

4. Continue the cycle until the required length of strengthening is achieved. Tighten all the bracing frames and chord bolts. Then attach the chord jacks over the panel joint to be pinned. Jack the panel chords until the pins can be inserted. Re-tighten the bracing frames and the chord bolts adjacent to the pinned joint before moving on to pin the next joint.



NOTE: CHORD JACK IS SHOWN IN JACKING POSITION ON TOP CHORD.

Figure 5.3 Chord Jack

5.4 Dismantling Bailey Bridge

The Bailey bridge is dismantled in the reverse order employed to assemble the structure.

The dismantling sequence is as follows:-

1. Remove the ramps, jack up the bridge, and place rocking rollers under each end of the bridge. Place and level plain rollers at suitable intervals.

2. Remove the end posts and attach the launching nose.

3. Pull the bridge back on to the plain rollers.

4. Dismantle the bridge and launching nose.

5.5 Maintenance

Bailey bridges require very little maintenance. These bridges, however, have to be inspected by an experienced inspector or a Professional Engineer. The following items should be checked on a frequent basis;

1. Check for corrosion of truss members, transoms and stringer sets; especially bridges exposed to salt.

2. Check that all bracing bolts, chord bolts, transom clamps, and sway braces are fully tightened. Transom clamps should be wired to the panel vertical, otherwise, vibrations from the traffic may loosen them off.

3. Check that the base plates and bases are free from dirt and debris, and check that there is no uneven settlement. Check that packing under the transoms and ramps is tight.

4. Check for splitting and warping of chesses and deck planks. Check for uneven bearing of deck planks on the stringers.

6 Estimating Quantities

6. ESTIMATING BAILEY BRIDGE COMPONENTS

6.1 Quantities for Launching Nose

The launching nose type, length, and quantities required for various types of Bailey bridges are given in Table 6.1. The designer may use these as guidelines to estimate the quantities required for the assembly of the launching nose.

6.2 Quantities for Bailey Bridges

The parts required to assemble the bays of various types of Bailey bridges are given in Tables 6.2(a) and 6.2(b). The designer may use these as guidelines to estimate the quantities required for the assembly of various types of Bailey bridges.

6.3 Accessories

Erection of Bailey bridges involves the use of accessory components tailor made for Bailey bridges. Accessories required for various types of Bailey bridges are given in Table 6.3.

Table 6.1 Quantities for Launching Nose

Type of Construction		Length of Bridge in Feet											
Single - Single		30	40 50										
Double - Single		30 40	50	60 70	80	90 100	110 120						
Triple - Single				70	80 90	100	110 120	130 140	150				
Double - Double					80	90 100	110 120	130 140		140 150	160 170	180	
Triple - Double								130 140		150 160	170	180 190	200
Part		Quantity											
BB 4	Bracing Bolt	4	8	8	12	16	28	40	52	52	72	92	112
BB 8	Sway Brace	2	2	4	6	8	10	12	14	14	16	18	20
BB 14	Chord Bolt	-	-	-	-	-	-	-	-	-	8	16	24
BB 15	Transom Clamp	4	6	8	10	12	16	20	24	24	28	32	36
BB 16	Bracing Frame	-	-	-	-	-	2	4	6	6	10	14	18
BB 28	Panel	4	6	8	10	12	16	20	24	24	32	40	48
BB 31	Panel Pin	6	10	14	18	22	24	32	40	40	56	72	88
BB 40	Raker	2	4	4	6	8	10	12	14	14	16	18	20
BB 60	Transom	2	3	4	5	6	7	8	9	9	10	11	12
E 14	Launch Link MK2	2	2	2	2	2	2	2	4	2	4	4	4
		Number of Bays of Each Type											
Construction of Launching Nose:	S.S.	2	3	4	5	6	6	6	6	6	6	6	6
	D.S.	-	-	-	-	-	1	2	3	3	3	3	3
	T.S.	-	-	-	-	-	-	-	-	-	-	-	-
Number of Bays of Each Type	D.D.	-	-	-	-	-	-	-	-	-	1	2	3

Table 6.2(a) Quantities for Bailey Bridges

	End Bay at End of Bridge					Intermediate Bay					End Bay at Tail of Bridge				
	SS	DS	TS	DD	TD	SS	DS	TS	DD	TD	SS	DS	TS	DD	TD
BB 2, Bearer, Footwalk	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2
BB 3, Bearing, Low	2	4	4	4	4	-	-	-	-	-	2	4	4	4	4
BB 4, Bolt, Bracing	8	16	20	32	44	4	12	16	20	28	4	12	16	20	28
BB 6, Bolt, "T" Riband	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
BB 8, Brace, Sway	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
BB 14, Chord, Bolt	-	-	-	8	12	-	-	-	8	12	-	-	-	8	12
BB 15, Clamp, Transom	6	12	18	12	18	4	8	12	8	12	4	8	12	8	12
BB 16, Frame, Bracing	-	2	2	6	6	-	2	2	4	4	-	2	2	4	4
BB 28, Panel	2	4	6	8	12	2	4	6	8	12	2	4	6	8	12
BB 31, Pin, Panel	4	8	12	12	18	4	8	12	16	24	8	16	24	28	42
BB 33, Plate, Base	2	2	2	2	2	-	-	-	-	-	2	2	2	2	2
BB 35, Post End, Female	-	-	-	-	-	-	-	-	-	-	2	4	6	4	6
BB 36, Post End, Male	2	4	6	4	6	-	-	-	-	-	-	-	-	-	-
BB 40, Raker	4	4	4	4	4	2	2	2	2	2	2	2	2	2	2
BB 54, Stringer, Button	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
BB 55, Stringer, Plain	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BB 60, Transom	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2
For Bridges Requiring Four Transoms per Bay															
BB 15, Clamp, Transom	-	-	-	-	-	-	4	6	4	6	-	4	6	4	6
BB 60, Transom	-	1	1	1	1	-	2	2	2	2	-	2	2	2	2

Note: These Tables are based on the following construction:-

(i) Female jaws foremost:
(ii) Transoms in front of verticals:
(iii) End bay at head of bridge has a transom.

Table 6.2(b) Quantities for Bailey Bridges

Additional Equipment to be Added if Bridge Needs to be Reinforced												
	End Bay at Head of Bridge				Second Last Bay at Head of Bridge				Intermediate Bay			
	DS	TS	DD	TD	DS	TS	DD	TD	DS	TS	DD	TD
BB 21, Chord, Reinforcing	4	6	4	6	8	12	8	12	8	12	8	12
BB 13, Chord Bolt, Collar	8	12	8	12	16	24	16	24	16	24	16	24
BB 14, Chord	8	12	8	12	16	24	16	24	16	24	16	24
BB 31, Pin, Panel	4	6	-	-	4	6	4	6	8	12	8	12

	Second Last Bay at Tail of Bridge				End Bay at Tail of Bridge			
	DS	TS	DD	TD	DS	TS	DD	TD
BB 21, Chord, Reinforcing	8	12	8	12	4	6	4	6
BB 13, Chord Bolt, Collar	16	24	16	24	8	12	8	12
BB 14, Chord	16	24	16	24	8	12	8	12
BB 31, Pin, Panel	4	6	4	6	4	6	-	-

Table 6.3 Accessories

			1	2	3	4	5	6	7
Type of construction and length of bridge in feet.		S.S.	30 40						
		D.S.	40 50	60 to 100					
		D.S. C.R.			80 110				
		T.S.		70 80		90 100			
		T.S. C.R.					100 110 120	130 140 150	
		D.D.					90 120		
		D.D. C.R.					120 130	160 170	
		T.D.					130 140	150	
		T.D. C.R.						140 to 180	180 to 220
BE 3	Taper Chord "F"		"One" per Truss + "One" Panel						
BE 4	Taper Chord "M"		Pin per Tape Chord						
BE 8	Jack Handle		2	4	4	4	4	6	6
BE 9	Chord Jack Frame MK2		-	-	-	-	-	-	2
BE 10	Jack Chord Handle and Screw MK2		-	-	-	-	-	-	1
BE 11	Toe Jack, 14 Ton		2	4	4	4	4	6	6
BE 16	Roller, Plain		2	6	6	10	10	10	12
BE 17	Roller, Rocking		4	6	6	6	6	6	6
BE 18	Jack Shoe		2	4	4	4	4	4	4
BE 21	Ratchet Span, 1-7/8		-	-	2	-	2	2	4
BE 22	Wrench, O/End 1-1/8		2	2	2	2	4	4	6
BE 23	Wrench, O/End 1-7/8		2	2	2	2	2	2	2
BE 24	Cranked Span 1-1/8		2	2	4	4	4	4	4

P.S. When the combined weight of the bridge and nose exceeds 61.1 tonnes on a single storey bridge and 81.4 tonnes on a double storey bridge, the Balance Beam assembly shall be used.

Each Balance Beam assembly requires four rocking rollers

7 Alternatives

7. ALTERNATIVES TO BAILEY BRIDGES

There will always be a need for temporary bridges. The situations for which a temporary bridge is required include;

- detours, when a permanent bridge or roadway is being built or repaired;
- disasters, when a bridge is destroyed by flood or accident; and,
- off road sites, when access by utility or temporary road is required.

The Bailey bridge developed by the British in World War II is the most well known relocatable bridge. The Ministry has been using the Bailey bridges since the early 1950's mainly for temporary bridging needs and in some cases as permanent structures. A cost comparison between Bailey bridges and other bridges which would perform similar functions was not a consideration until now, since the general opinion was that there was not a suitable alternative system available. It is important to note that the smaller size members and manageable member weights which were considered essential for easy transportion and erection in the early days can be relaxed somewhat to suit the current transportability and erection capability at the various sites. Components up to 30 m long can be transported easily on provincial highways. The labour costs involved in assembling a variety of Bailey parts and erecting a Bailey bridge which consists of 3.05 m panels is more expensive than using larger length members. Although actual costs have to be evaluated to study the merits of alternative systems, an attempt is made to present various systems available or conceptualized in the recent years.

William Zuk [10] has described in his report a number of alternatives and concepts for relocatable bridges. A brief description of the systems is given in the following sections.

7.1 Medium Girder Bridge

This type of bridge was developed by the British Military to replace Bailey bridges. It is also in use by the United States Army. The basic component of this bridge is an aluminum alloy box unit in 6' lengths. For short spans box beams are used, for medium spans box beams and truss units are used and for long spans cables and struts are added to the box beams and truss units. The bridge details are shown in Figure 7.1.

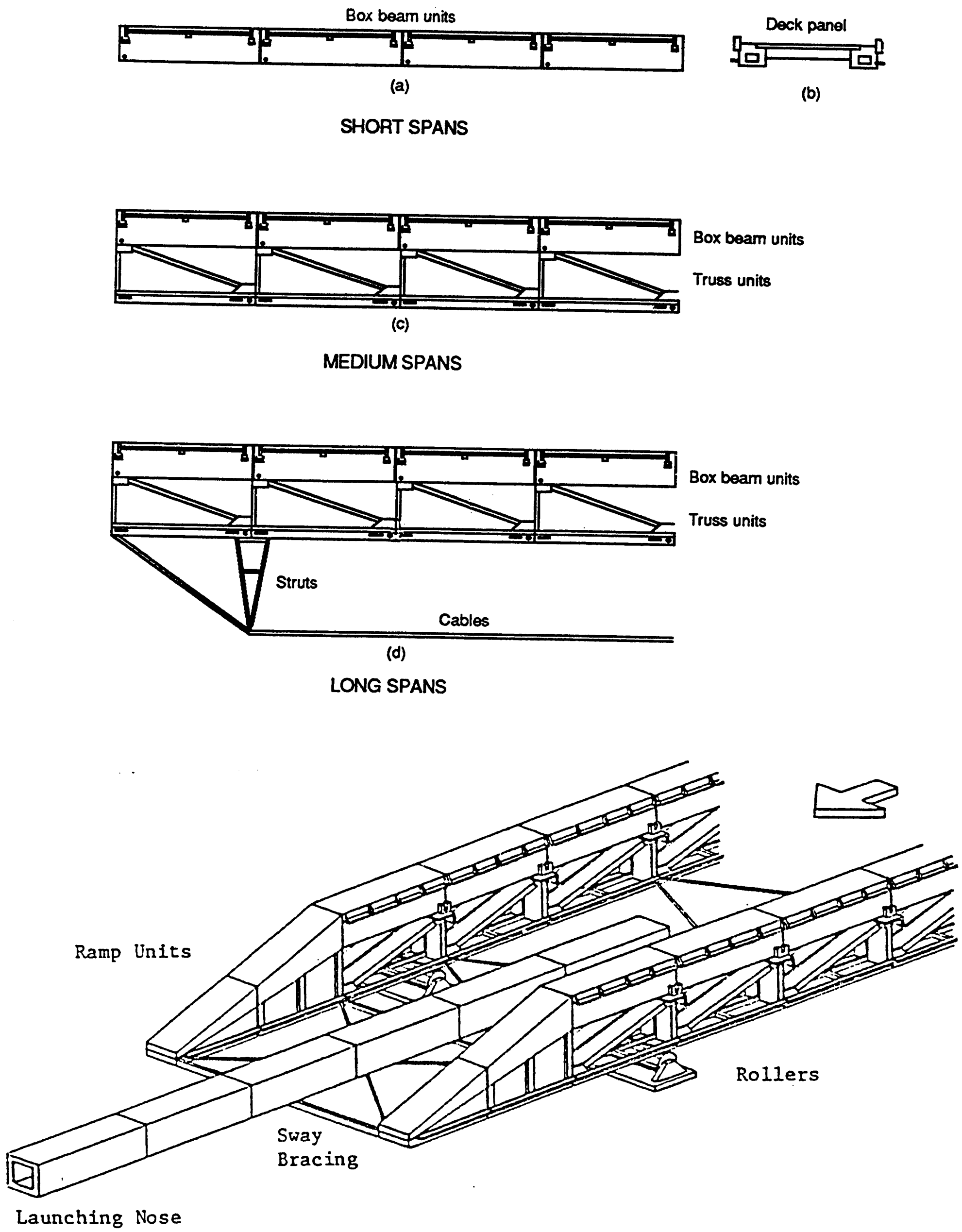


Figure 7.1 Medium Girder Bridge

7.2 Rheinhausen Fast Assembly Bridge

Produced in West Germany, the Rheinhausen bridge system is a prefabricated steel structure that can be dismantled and reused. The basic system consists of unitized girders, floor beams and steel deck components, 8 or 12 metres in length and approximately 3 m wide and 1 m deep. The bridge is shown in Figure 7.2.

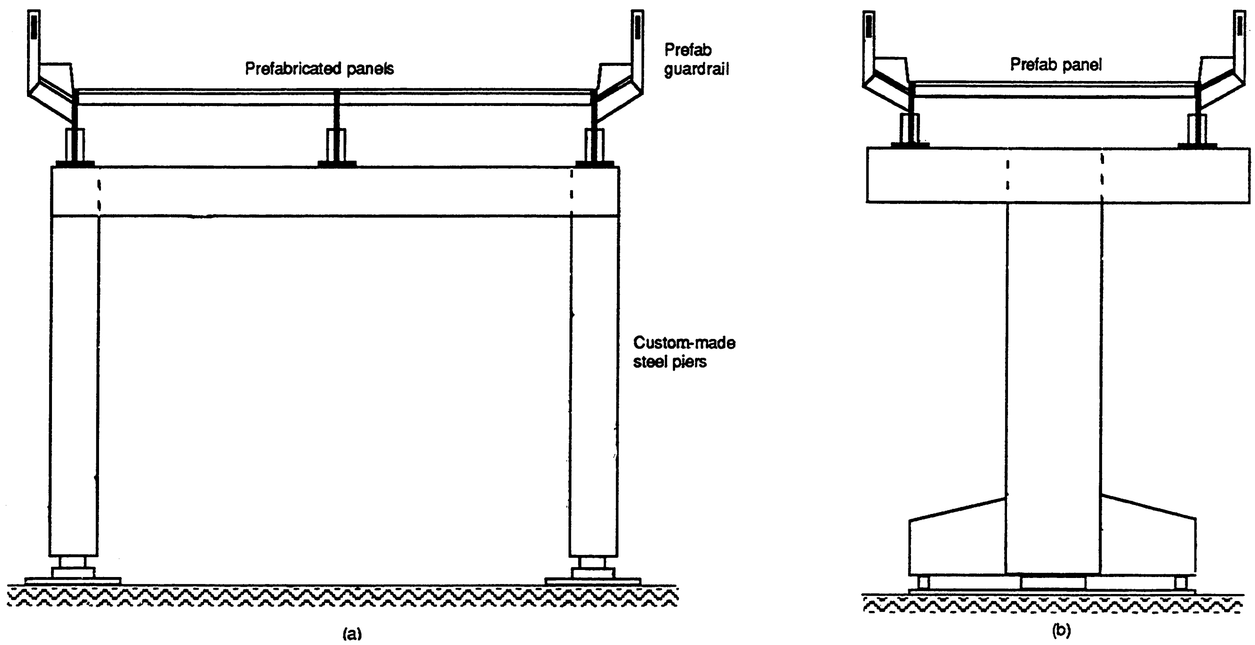


Figure 7.2 Rheinhaussen Fast Assembly Bridge

7.3 Nobels-Kline Bridge

This system was conceived in Belgium. It consists of tee-shaped girders in which an orthtropic deck section, 1.83 m (6 ft.) wide, is welded to a stiffened web. A narrow lower flange is attached to the bottom of the web. The depth of the section is 1.06 m (3.5 ft.). The girders can span 24.4 m (80 ft.). The bridge is shown in Figure 7.3

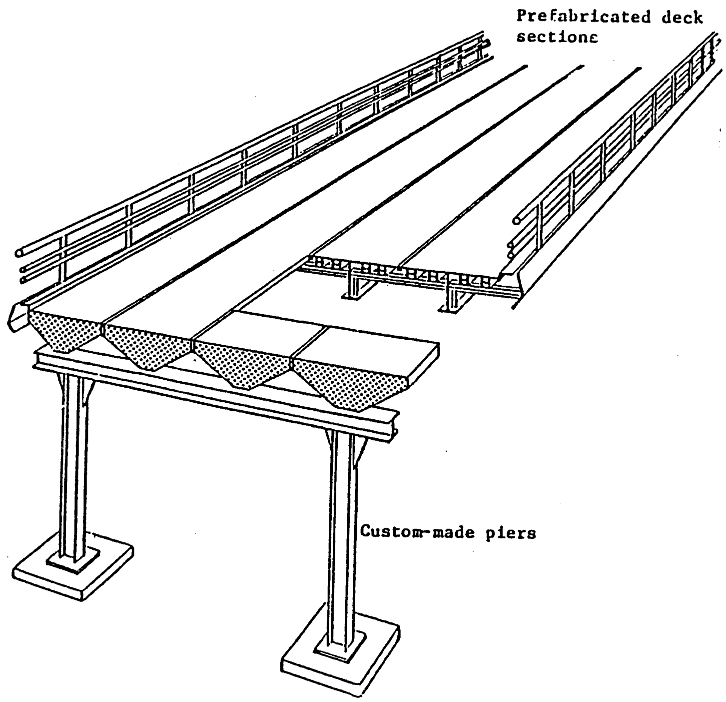


Figure 7.3 Nobel-Klines Bridge

7.4 Nobels-Kline Emergency Bridge

This is a one lane emergency structure. Basically this bridge is a Warren truss of weathering steel made of standard components capable of spanning 12 m to 68 m in 4 m increments. The basic truss depth is 3.5 m. The bridge is shown in Fig. 7.4.

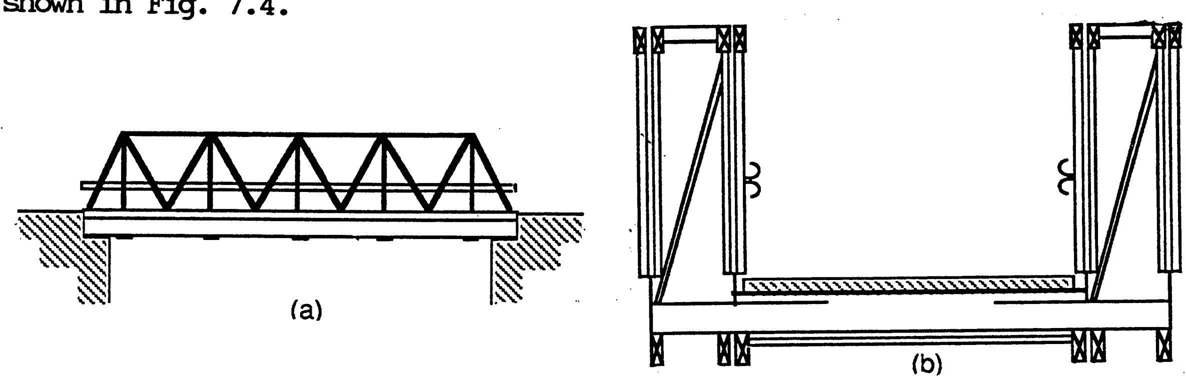


Figure 7.4 Nobel-Klines Emergency Bridge

7.5 Demountable Concrete Bridge

The system developed by Dyckenhoff and Widmann of West Germany is of concrete construction. The main super structure is made of hollow box beams of three types. Type 1 is 20 m long, is made of dense concrete and weighs 20 tonnes; type 2 is 30 m long, is made of dense concrete and weighs 30 tonnes; type 3 is 35 m long and made of light weight concrete and weighs 35 tonnes. The bridge can be assembled in 5 m steps. The bridge details are shown in Figure 7.5.

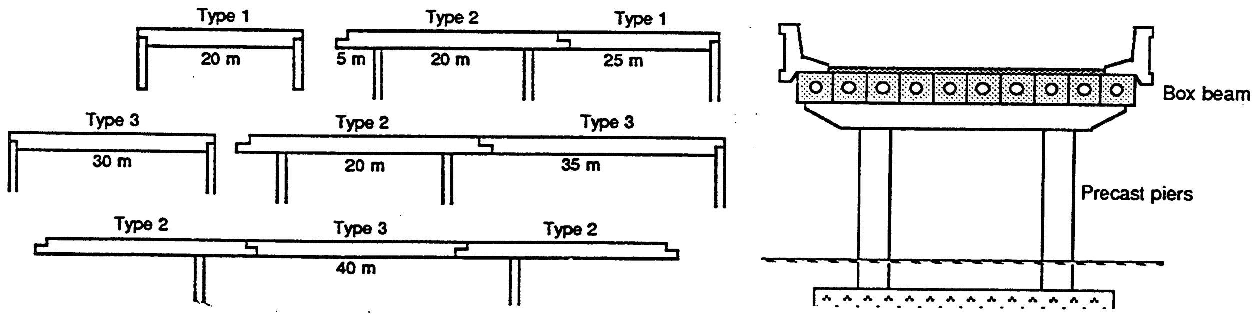


Figure 7.5 Demountable Concrete Bridge

7.6 Ribbon Float Bridge

Patterned after a successful design in the U.S.S.R., the ribbon bridge is an American version developed by the U.S. Army for use as a pontoon bridge. The basic float unit weighs 5 tonnes (11,000 lbs.) and is transported in a folded configuration 6.86 m (22.5 ft.) long, 3.26 m (10.7 ft.) wide and 2.34 m (7.7 ft.) high. When unfolded each unit is 6.71 m (22.0 ft.) long, 8.08 m (26.5 ft.) wide and 2.34 m (3.5 ft). deep. Effective roadway width is 4.11 m (13.5 ft.). The bridge is shown in Figure 7.6.

Ribbon Float Bridge
(a) Unloading unit
(b) Opening unit
(c) Opened unit
(d) Completed bridge

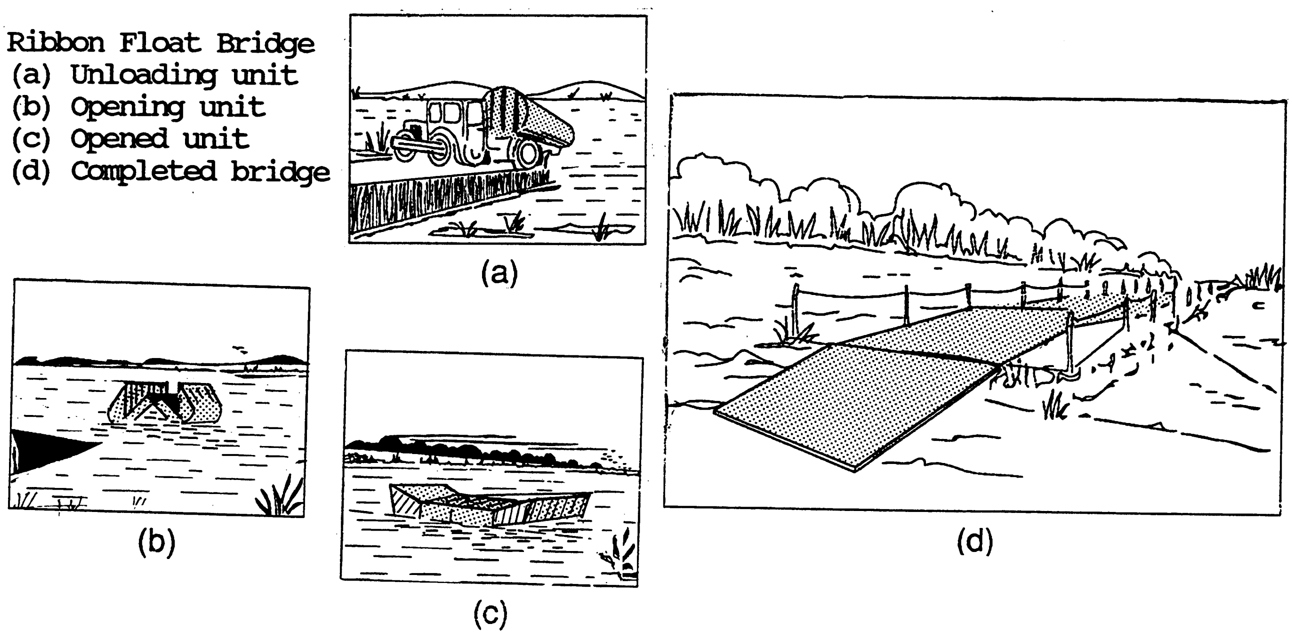
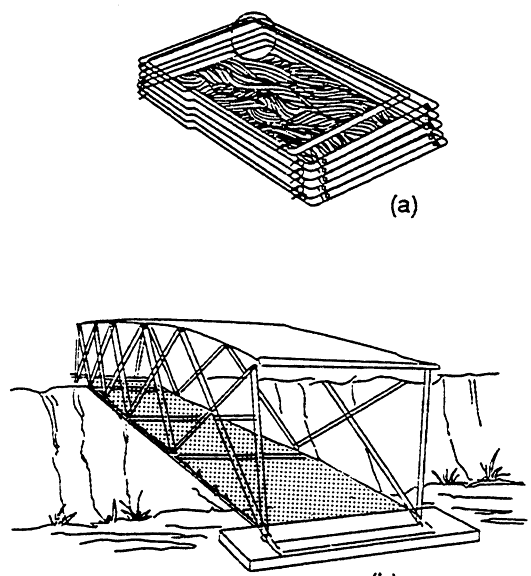


Figure 7.6 Ribbon Float Bridge

7.7 Martin Marietta Expandable Bridge

Made of folding scissors or pantograph beams of aluminum, it can be folded to a small fraction of its length for easy transport. A 9.15 m (30 ft) long bridge is shown in Fig. 7.7, it weighs only 50 kg (110 lbs.). A similar concept is envisioned for a longer and stronger vehicular bridge. No production bridges are available at this time.



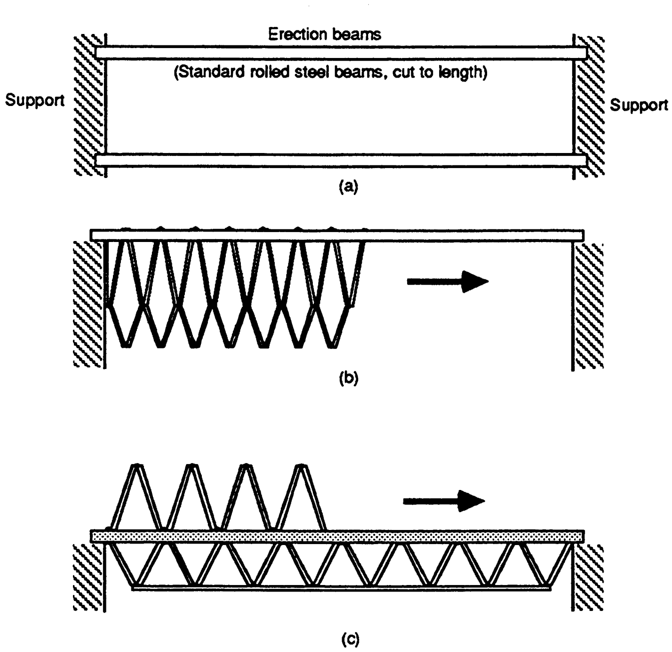
(a)

(b)

Figure 7.7 Martin Marietta Expandable Bridge

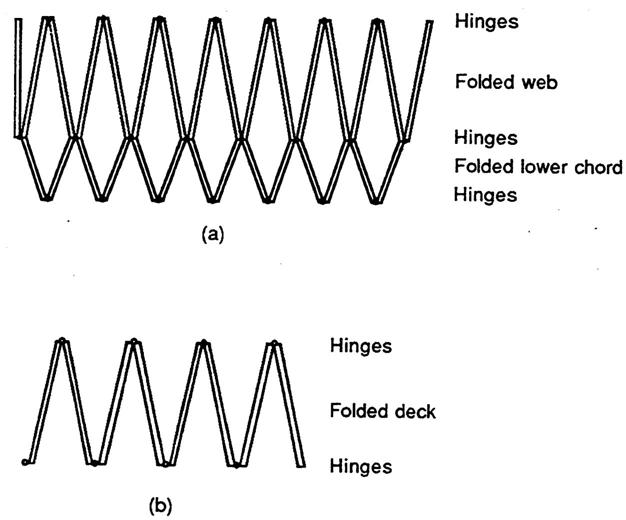
7.8 Folding Bridge

The concept of this bridge was developed by William Zuk. At this time there is no working model available. The construction and erection of the bridge and the bridge details are shown in Figure 7.8.



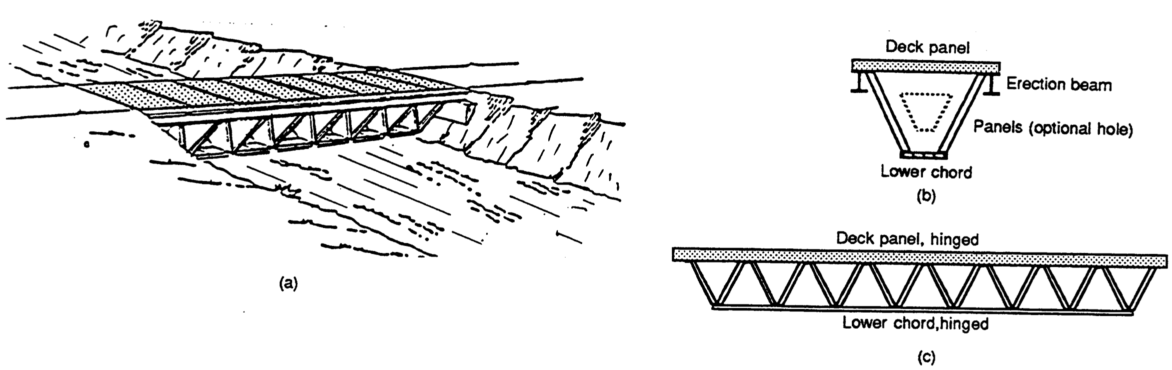
Erection sequence

(a) Plan view of erection beam placement
(b) Elevation view of web and lower chord being polled into place across erection beams
(c) Elevation view of deck being pulled into place across erection beams



Folded bridge components

(a) Web and lower chord
(b) Deck



Basic bridge
(a) Erected bridge
(b) Cross section of bridge (reiling not shown)
(c) Elevation of the bridge

Figure 7.8 Folding Bridge

7.9 M60 Armoured Vehicle Launch Bridge

This is a highly sophisticated single lane, short span bridge which has been developed by the U.S. Army. It can span up to 19.2 m (63 ft.). This self launching bridge is made of aluminum and is transported on the back of a special launch vehicle and can be deployed hydraulically. The bridge is shown in Figure 7.9.

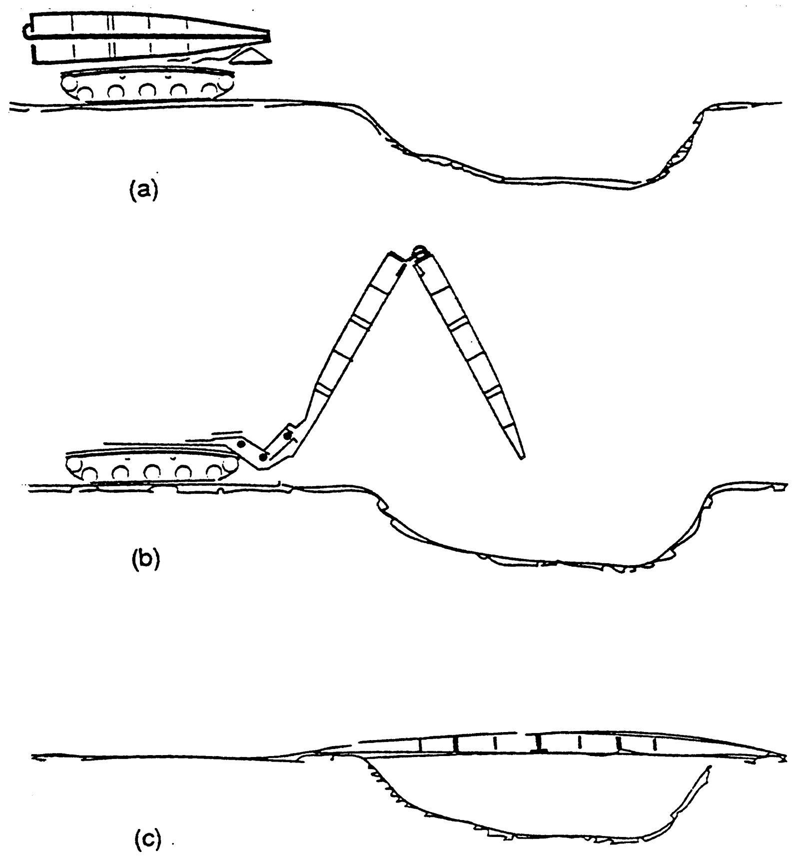
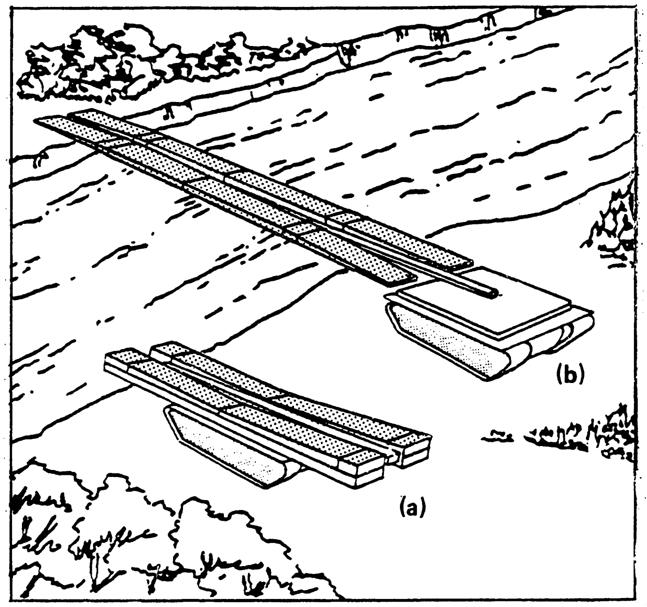


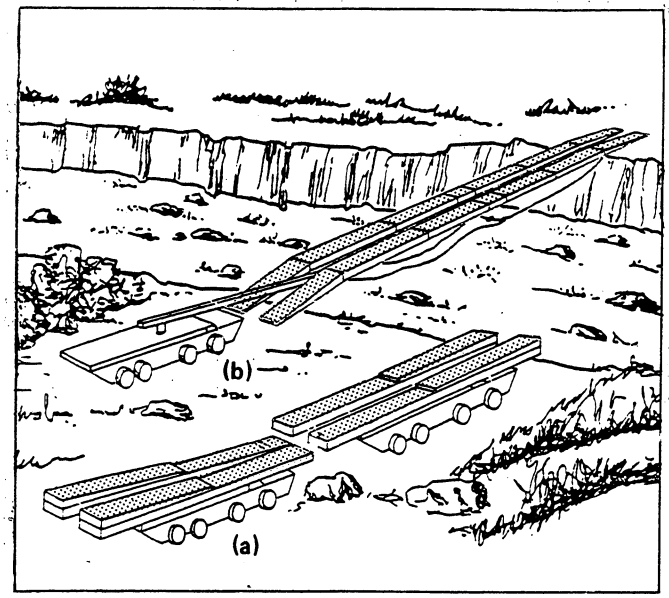
Figure 7.9 M60 Armoured Vehicle Launch Bridge

7.10 Tactical Support Bridge

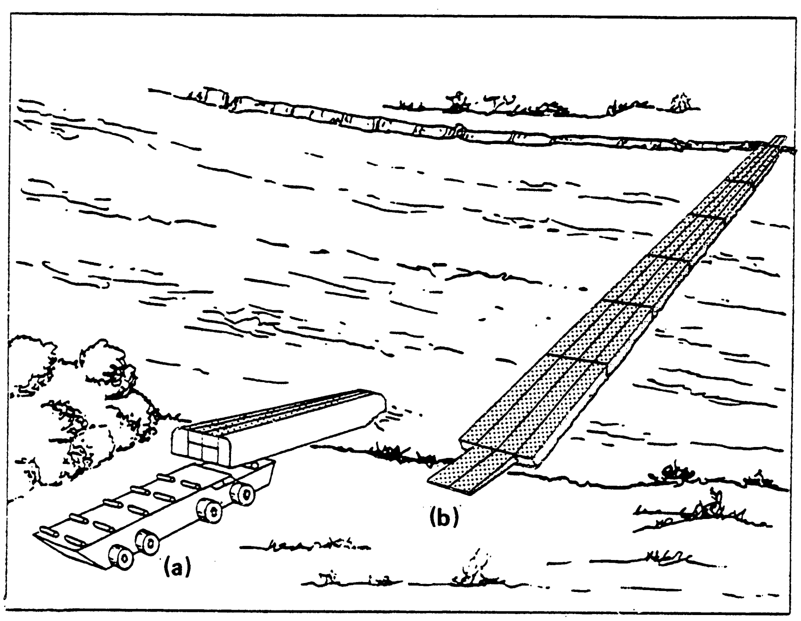
This bridge was developed by the U.S. Army. It is a versatile, rapidly deployable bridge supporting spans of either 30 or 50 metres and supporting a 60 tonne vehicle load. It is made out of two aluminum box girders separated by a gap. The bridge can be folded for transportion. The bridge can also be made into a pontoon bridge. The bridge is shown in Figure 7.10.



30 Metre Bridge
(a) Folded for transport.
(b) Deployed by launching boom.



50 Metre Bridge
(a) Folded for transport.
(b) Deployed by launching boom.



Pontoon Bridge
(a) Launching with flotation covers.
(b) Assembled bridge.

Figure 7.10 Tactical Support Bridge

7.11 Pneumatic Bridge

This bridge was developed in England for military applications. It consists of a series of pneumatic tubes, or beams, joined together to form a one-lane bridge. Air pressure in the cells is sufficient to support a light vehicle on a span of about 6.56 m (20 ft.). The bridge is shown in Figure 7.11.

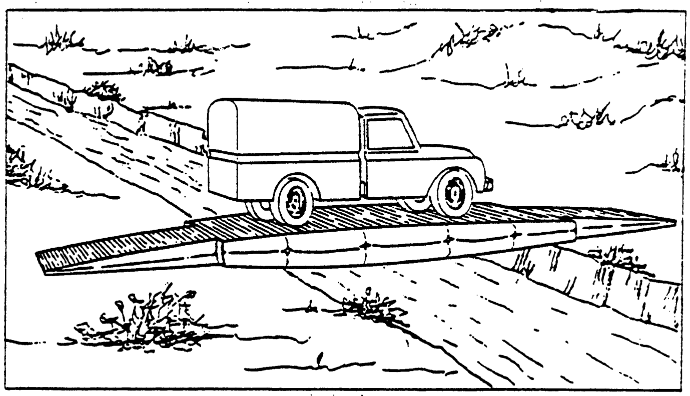


Figure 7.11 Pneumatic Bridge

7.12 Proposed Alternative to Bailey Bridge

A concept is proposed here as an alternative to Bailey bridges. The proposed bridge will serve spans of 5 metres to 50 metres in steps of 5 metres for single spans, and of unlimited length for continuous spans. The girder spacings can be varied from 1 metre to 2 metres to suit the span lengths.

The basic girders consist of 5, 10, 20 and 30 metre lengths. The steel girders have suitable shear connectors welded at 1 metre centres. The deck is made up of 10 metre long X 1 metre wide X 175 millimetre deep concrete precast panels with holes to allow for shear connectors. The deck has longitudinal holes to allow prestressing tendons at 1 metre centres. The deck also has holes at the sides to bolt down barrier walls to it.

Alternatively, the deck can be a prestressed, transversely laminated timber deck of 100 to 150 mm depth. The deck sections can be prefabricated and of suitable lengths of 3 to 5 metres. For transversely laminated decks, the steel girders are fabricated without shear connectors.

The girders are launched from one end of the structure. A launching girder is used if required. The splice detail is designed to facilitate any launching. Once the girder is in place the deck members can be placed into place from one end of the bridge to the other. Then the prestressing tendons are threaded through and a nominal prestress is applied. The deck opening at the shear connectors is filled with mortar.

The barrier walls are put in place and bolted down. The deck can then be paved if desired. The various details involved in this bridge are shown in Figure 7.12.

In the case of a transverse laminated deck, the prefabricated sections can be placed in position and secured to the steel girders.

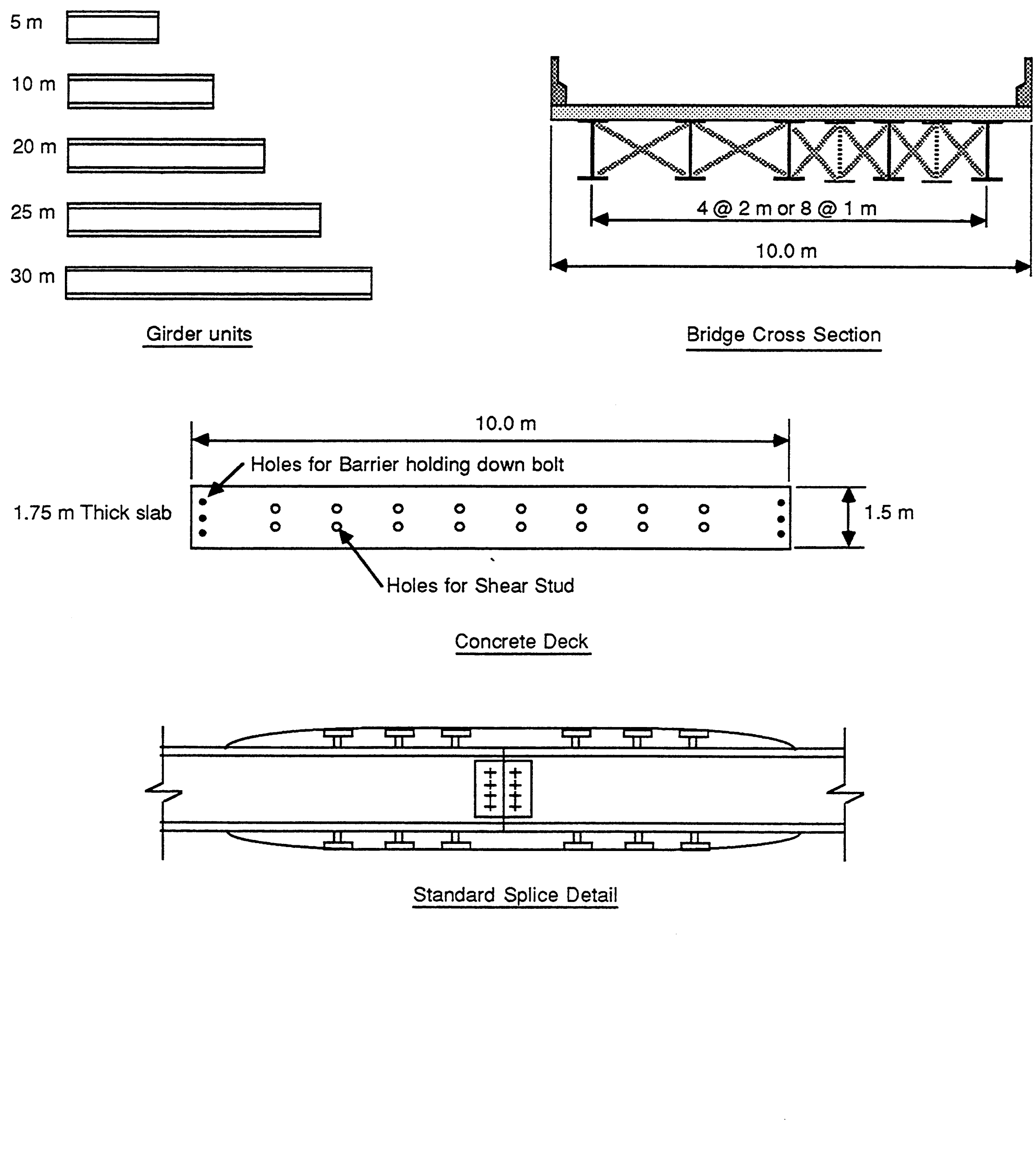


Figure 7.12 Proposed Alternative to Bailey Bridges

8 References

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9 Appendix "A"

APPENDIX 'A'.

TABLE A.1. Bailey Components

Bailey Component	Yield Strength, MPa	Weight, kg	Allowable Service Load Capacity
Panel	355	263.1	759 KNM
Chord Reinforcment	355	92.5	Ten/Comp 548.4 KN
Panel Pin	770	2.7	Double Shear 548.4 KN
Chord Bolt	235	3.63	Single shear 149.1 KN Direct Tension 79.5 KN
Chord Bolt Collar	---	0.68	-------
Standard Transom	355	204.1	Moment - 79.5 KNm Shear - 179.5 KN
Standard Wide Transom	355	195.0	Moment -118.7 KNm Shear - 213.8 KN
Transom Clamp	235	2.7	Vertical Load - 19.6 KN
Plain Stringer	235	83.9	Moment - 9.14 KNm
Button Stringer	235	86.2	Moment - 9.15 KNm
Riband Bolt	---	0.68	Ten. = 24.5 KN
Footwalk Bearer	235	9.1	----------
Plain Ramp	355	163.3	15.2 KNm
Button Ramp	355	163.8	15.2 KNm
Bearing	235	31.75	Max. Centre Load =398.2 KN Max. Load =598.0 KN
Base Plate	---	181.5	Max. Load =896.6 KN
Ramp Pedestal	---	45.4	--------------
Male/Female End Post	235	M - 56.5 F - 63.5	Allowable Load - Single St.-149.1 KN Double St.-249.2 KN
Junction Link	235	16.0	Max. Load = 225 KN

TABLE A.1. Bailey Components (cont.)

Bailey Component	Yield Strength, MPa	Weight, kg	Allowable Service Load Capacity
Junction Link Bearing	235	84.0	--------
Standard Sway Bracing	235	29.5	Tension - 70.0 KN
Standard Wide	235	32.2	Tension - 70.0 KN
Bracing Frame	235	18.1	Lateral Shear - 5.0 KN
Wide Bracing Frame	235	34.0	Lateral Shear - 5.0 KN
Raker	355	8.2	Ten./Com. - 22.5 KN
Bracing Bolt	---	0.5	Single Storey/Ten. - 24.5 KN
Balance Beam Assembly	235	285.0	-------
Male/Female Chord Taper	235	M- 34.0 F- 29.0	-------
Plain Roller	235	47.6	Allowable Load- 59.8 KN
Rocking Roller	235	91.6	Allowable Load - Single St. - 149.1 KN Double St. - 179.5 KN
Distribution Beam	355	110.0	Vertical Load Under Panel Pin- 490 KN Single Storey - 294 KN Double Storey - 392 KN
Distribution Beam End Plate	235	16.0	------
Distribution Beam Long End Plate	235	23.0	------
Crib Capsill	355	113.0	------
Chord Clamp	---	5.0	-------
Crib Bearing	---	17.0	-------
Ratchet Jack	---	59.0	Allowable Load-149.1 KN
Jack Shoe	---	16.3	-------

Examples

Example 1

Bridge Length: 20.00 m

Span Lengths: span 1 = 20.00 m

Dead Load : 10.00 KN/m

OHBD load per set of trusses: .60

Dynamic load allowance: 1.20

Live load factor: 1.25

Bailey material used: Old

Critical Moment, KN-m		Critical Shear, KN		Bailey Bridge Type Selected
Location	Magnitude	Location	Magnitude	
0.4	2230.56 T			TS
0.5	2284.80 T			TS
0.7	1974.96 T			TS
		AB	514.20 T	TS ,TSR

Bailey Bridge Type (of uniform cross section) Required : TS

Supports	Reactions, KN
A	514.20 T

Example 2

Bridge Length: 40.00 m

Span Lengths: span 1 = 20.00 m
span 2 = 20.00 m

Dead Load : 10.00 KN/m

OHBD load per set of trusses: .60

Dynamic load allowance: 1.20

Live load factor: 1.25

Bailey material used: Old

Critical Moment, KN-m		Critical Shear, KN		Bailey Bridge Type Selected
Location	Magnitude	Location	Magnitude	
0.3	1579.85 T			TS
0.4	1688.64 T			TS
0.7	1013.88 T			DS
1.0	1681.06 L			TS
1.3	1013.88 T			DS
1.6	1687.90 T			TS
1.7	1580.33 T			TS
		AB		DS ,DSR
		BA		TS ,TSR
		BC		TS ,TSR
		CB		DS ,DSR

Bailey Bridge Type (of uniform cross section) Required : TS

Supports	Reactions, KN
A	455.63 T
B	894.25 L
C	455.63 T

Example 3

Bridge Length: 60.00 m

Span Lengths: span 1 = 20.00 m
span 2 = 20.00 m
span 3 = 20.00 m

Dead Load : 10.00 KN/m

OHBD load per set of trusses: .60

Dynamic load allowance: 1.20

Live load factor: 1.25

Bailey material used: Old

Critical Moment, KN-m		Critical Shear, KN		Bailey Bridge Type Selected
Location	Magnitude	Location	Magnitude	
0.3	1595.08 T			TS
0.4	1715.16 T			TS
0.7	1059.51 T			DS
1.0	1553.32 L			SSR
1.2	718.77 T			SS
1.5	1201.78 T			DS
		AB	459.64 T	DS ,DSR
		BA	578.13 T	TS ,TSR
		BC	525.92 T	TS ,TSR

Bailey Bridge Type (of uniform cross section) Required : TS

Supports	Reactions, KN
A	459.64 T
B	844.98 L

Example 4

Bridge Length: 80.00 m

Span Lengths: span 1 = 20.00 m
span 2 = 20.00 m
span 3 = 20.00 m
span 4 = 20.00 m

Dead Load : 10.00 KN/m

OHBD load per set of trusses: .60

Dynamic load allowance: 1.20

Live load factor: 1.25

Bailey material used: Old

Critical Moment, KN-m		Critical Shear, KN		Bailey Bridge Type Selected
Location	Magnitude	Location	Magnitude	
0.2	1284.22 T			DS
0.4	1700.34 T			DS
0.7	1032.96 T			DS
1.0	1601.15 L			DS
1.2	718.77 T			DS
1.5	1237.19 T			DS
1.7	938.11 T			DS
2.0	1297.32 L			DS
		AB	457.81 T	
		BA	579.94 T	
		BC	532.71 T	
		CB	519.27 T	

Bailey Bridge Type (of uniform cross section) Required : TS

Supports	Reactions, KN
A	475.81 T
B	858.73 L
C	785.07 L