The Bailey bridge may be adapted to fit almost any gap. The field design procedure first determines the initial length of bridge required, and then the truss type needed to carry the required class of traffic is determined. However, the grillage type may cause a change to the initially determined bridge length. If so, the truss type will have to be rechecked, as well as the grillage type, for the new bridge length. To complete the field design, the number of rollers and jacks needed must also be determined.

**LENGTH, TRUSS TYPE, AND GRILLAGE TYPE**

**DETERMINING INITIAL BRIDGE LENGTH**
The initial bridge length is determined by adding the width of the gap, the safety setbacks, and the roller clearances.

**Gap**
The measurement of the gap depends on the condition of the abutments (Figure 4-1). These are usually classified as prepared, unprepared, or a combination of the two.

Prepared abutments are abutments which can hold the bridge load close to the face without failing. Examples of prepared abutments are mass concrete, headwall with piles, and headwall with footers and deadman. Technical Manual (TM) 5-312 gives more detailed information on prepared abutments.

An unprepared abutment is one which would probably fail if the bridge load were applied close to its edge. Examples of unprepared abutments are natural slopes, demolished abutments, or abutments with headwalls that are not strong enough to hold the load. The gap is measured from the toe of the slope of one unprepared abutment to the toe of the slope of the other.

If both prepared and unprepared abutments exist on one bridge site, the gap is measured from the face of the prepared abutment to the toe of the slope of the unprepared abutment.

**Caution:** Care must be taken when completing the design process or the bridge will fail. Abutment types and location of the toe of the slope for unprepared abutments should be done carefully. Incorrectly classifying abutment types or locating the toe of the slope is the most common and dangerous design mistake. When in doubt, always classify the abutment as unprepared. If an abutment is par-
Safety setback

Safety setback is the minimum distance that each rocking roller must be behind the bank of the gap. This distance depends on the condition of the abutments on each bank (Figure 4-2). If the bridge site has prepared abutments, the rocking rollers are set back a minimum of 3 feet 6 inches (1.1 meters) from the edge of the abutment.

When unprepared abutments exist, the safety setback must be calculated. If the rollers are placed too close to the edge of the gap, the soil may fail during launching. Therefore, place the rocking rollers at a location behind the toe of slope of the soil. For field design, the toe of slope is where the bank’s surface is 45 degrees (an average value) from the horizontal direction. This would mean that the rocking roller should be set back a distance equal to the height of the bank. However, an additional safety factor of 50 percent is added. Therefore, the safety setback is 1.5 times the bank height. The bank height is measured from the toe of the slope to the ground level at the abutment. The safety setback is measured back from the toe of the slope.

**EXAMPLE:**

*Given:*  
Unprepared abutment  
Bank height 8 feet (2.44 meters)

*Required:*  
Determine the safety setback (SS)

*Solution:*  
Safety setback = 1.5x bank height  
or 1.5 x 8 feet = 12 feet (3.66 meters)

Roller clearance

Roller clearance is the distance from the center of the rocking roller to the center of the bearing on which the bridge end posts will rest (Figure 4-3, page 38). The normal roller clearance, about 2 feet 6 inches (0.76 meters), is always used when determining the initial bridge length. The actual roller clearance will be determined by the type of grillage used.
An example of computing bridge length with both abutments prepared (Figure 4-4) is as follows:

**Given:**
Gap is 56 feet (17.07 meters)
(abutment to abutment)

**Required:**
Determine initial bridge length

**Solution:**
Initial bridge length ($b_L$) = gap + safety setbacks + roller clearances

\[
b_L = 56 \text{ feet} + (3.5 \text{ feet} + 3.5 \text{ feet}) + (2.5 \text{ feet} + 2.5 \text{ feet})
\]

Round up to the next 10-foot (3.05 meters) length to equal 70 feet (21.37 meters)

An example of computing bridge length with both abutments unprepared (Figure 4-4) is as follows:

**Given:**
Gap measurement (toe to toe)—57 feet (17.37 meters)

**Required:**
Determine initial bridge length

**Solution:**
Initial bridge length ($b_L$) = gap + safety setbacks + roller clearances

\[
b_L = 57 \text{ feet} + [1.5(9 \text{ feet}) + 1.5 (12 \text{ feet})] + (2.5 \text{ feet} + 2.5 \text{ feet})
\]

Round up to the next 10 feet (3.05 meters) to equal 100 feet (30.48 meters)

An example of computing bridge length with one prepared and one unprepared abutment (Figure 4-4) is as follows:

**Given:**
Gap measurement (toe to toe)—53 feet (16.15 meters)

**Required:**
Determine initial bridge length

**Solution:**
Initial bridge length ($b_L$) = gap + safety setbacks + roller clearances

\[
b_L = 53 \text{ feet} + (3.5 \text{ feet} + 3.5 \text{ feet}) + (2.5 \text{ feet} + 2.5 \text{ feet})
\]

Round up to the next 10-foot (3.05 meters) length to equal 70 feet (21.37 meters)

Bank height—Near shore: 9 feet (2.74 meters)
Far shore: 12 feet (3.66 meters)

**Required:**
Determine initial bridge length

**Solution:**
Initial bridge length ($b_L$) = gap + safety setbacks + roller clearances

\[
b_L = 57 \text{ feet} + [1.5(9 \text{ feet}) + 1.5 (12 \text{ feet})] + (2.5 \text{ feet} + 2.5 \text{ feet}) = 93.5 \text{ feet} (28.5 \text{ meters})
\]

Round up to the next 10 feet (3.05 meters) to equal 100 feet (30.48 meters)

An example of computing bridge length with both abutments unprepared (Figure 4-4) is as follows:

**Given:**
Gap measurement (toe to toe)—57 feet (17.37 meters)

**Required:**
Determine initial bridge length

**Solution:**
Initial bridge length ($b_L$) = gap + safety setbacks + roller clearances

\[
b_L = 57 \text{ feet} + [1.5(9 \text{ feet}) + 1.5 (12 \text{ feet})] + (2.5 \text{ feet} + 2.5 \text{ feet}) = 93.5 \text{ feet} (28.5 \text{ meters})
\]

Round up to the next 10 feet (3.05 meters) to equal 100 feet (30.48 meters)
Solution:
\[ b_L = \text{gap} + \text{safety setbacks} + \text{roller clearances} \]
\[ b_L = 53 \text{ feet} + [3.5 \text{ feet} + 1.5(10 \text{ feet})] + (2.5 \text{ feet} + 2.5 \text{ feet}) \]
\[ b_L = 76.5 \text{ feet (23.32 meters)} \]

Round up to 80 feet (24.38 meters)

TRUSS TYPE
The required truss type for a given length of Bailey bridge to carry a specified class of traffic is found in Table A-7 in Appendix A. The actual class of the bridge maybe greater than required, but not less.

Note: The truss type required for a normal crossing is always used unless otherwise directed by the field commander.

EXAMPLE:
Given:
Bridge length — 80 feet (25.97 meters)
Required class — 60 wheel/60 track

Required:
Determine the truss type required

Solution:
From Table A-6 in Appendix A
Truss type: triple-single
Design class — 85 wheel/80 track

Description
Grillages are made of squared timbers laid under the base plate or roller template. These must be carefully leveled transversely; grillages on each side of the bridge must be level with each other so that all trusses will rest on bearing plates. If bearing plates are not level transversely, only one truss will carry the load at first, until deflection under load brings the other trusses to bear. The first truss to bear will then be overstressed before the last truss can be fully utilized. This can result in failure under less than the rated load of the bridge.

Timbers for use as standard grillages are supplied in panel bridge sets. The panel bridge set supplies 144 each 6-by-6-inch (15.2 by 15.2 centimeters) timbers 4½ feet (1.4 meters) long, and 48 each 3- by 6-inch (7.6 by 15.2 centimeters) timbers 4½ feet (1.4 meters) long for grillage. Standard grillages using these timbers and panel bridge parts are illustrated in Figures 4-5 through 4-8.

Figure 4-4 Profile of bridge site—prepared and unprepared abutments

On soft soils, some of the heavier bridges will require larger grillages than can be built from the timbers supplied in the set. For these bridges, grillages built from 8- by 8-inch (20.3 by 20.3 centimeters) timbers are shown in Figures 4-9 through 4-11.
**Figure 4-5** Type 1 grillage

**MATERIAL**
17 PCS 6\" x 6\" x 4'6\"

**Figure 4-6** Type 2 grillage

**MATERIAL**
27 PCS 6\" x 6\" x 4'6"
9 PCS 3\" x 6\" x 4'6\"

6\" x 6\" x 4'6\"
Figure 4-7 Type 3 grillage

MATERIAL
20 PCS 6" x 6" x 4'6"
2 PLAIN RAMPS

Figure 4-8 Type 4 grillage

MATERIAL
47 PCS 6" x 6" x 4'6"
4 PLAIN RAMPS
MATERIAL
12 PCS 8" x 8" x 12'0"
5 PCS 8" x 8" x 8'0"
3 PCS 8" x 8" x 6'0"

Figure 4-9 Type 5 grillage
MATERIAL
15 PCS 8" x 8" x 15'0"
3 PLAIN RAMPS

Figure 4-11 Type 7 grillage
Nonstandard grillages, made of other size timbers, can be used if each layer is at least as thick and wide as the corresponding standard grillage. Squared timbers should be used, since rough cut timbers often result in uneven, wobbly cribs.

### Selection of grillage

The selection of grillage is determined by the bridge length, the truss type, and the soil-bearing capacity. Table 4-1 gives the safe bearing pressure in tons per square foot (t/sf) on various soils. A careful evaluation of the soil character is essential to prevent grillage failures. Note that in sandy or gravelly soils, the bearing power of the soil is increased when the grillage is dug in so that it bears on the soil 1½ feet (.46 meter) or more below the surrounding surface.

---

**Note:** If soil-bearing capacity value from Table 4-1 is not listed on Table 4-4, the number must be rounded down to obtain the proper grillage type.

---

### Table 4-1 Safe bearing capacity for various soils

<table>
<thead>
<tr>
<th>SOIL DESCRIPTION</th>
<th>BEARING VALUES (tons per sq ft)</th>
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<tr>
<td>Hardpan overlying rock</td>
<td>12</td>
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<tr>
<td>Very compact sandy gravel</td>
<td>10</td>
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<tr>
<td>Loose gravel and sandy gravel, compact sand and gravelly sand; very compact sand, inorganic silt soils</td>
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<tr>
<td>Hard dry consolidated clay</td>
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<tr>
<td>Loose coarse-to-medium sand; medium-compact fine sand</td>
<td>4</td>
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<tr>
<td>Compact sand clay</td>
<td>3</td>
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<tr>
<td>Loose fine sand; medium-compact sand, inorganic silt soils</td>
<td>2</td>
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<tr>
<td>Firm or stiff clay</td>
<td>1.5</td>
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<tr>
<td>Loose saturated-sand clay soils; medium-soft clay</td>
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</tbody>
</table>

Grillage types for various soils and bridge types are also given in Table 4-4 (page 48).

### EXAMPLE:

**Given:**
- Bridge length—80 feet (25.97 meters)
- Truss type—triple-single
- Soil type—loose fine sand

**Required:**
- Determine the grillage type required

**Field solution:**
- From Table 4-1, soil-bearing capacity is 2 t/sf

From Table 4-4, grillage type required is type 4

**Detailed analysis:**
- From Table 4-3, corner reactions are 59 tons (54 metric tons)—base plate, 19.0 tons (17.2 metric tons)—rocking rollers

- From Table 4-3, type 4 grillage provides the necessary capacities. Type 4 provides 71 tons (64 metric tons)—base plate, 57 tons (52 metric tons)—rocking roller.

It is unlikely that the near and far banks would have different soil-bearing capacities but, if so, grillage is determined separately for each bank. The maximum allowable slope for a Bailey bridge is 1 to 30. If bank heights differ enough to cause a greater slope, the low end may be cribbed up to decrease the slope. The cribbing must have at least the same bearing area as the required grillage. If cribbing is impractical, the high end may be excavated to reduce the slope. Figures 4-5 through 4-11 show the dimensions and necessary materials for the grillage types.

**Note:** Types 5, 6, and 7 are made from materials not issued with the bridge set.

---

### Determining Final Bridge Length

The grillage type required may increase the roller clearance. This may affect the required bridge length. If so, the truss and grillage type must be rechecked for the new bridge length. The required roller clearances for
each type of grillage are shown in Figures 4-5 through 4-11. The roller clearance and total grillage height are given in Table 4-5 (page 49).

**EXAMPLE:**

**Given:**
- Initial bridge length—76.5 or 80 feet (23.9 or 24.4 meters)
- Required class—50 wheel/55 track
- Initial truss type—**double-single**
- Soil-bearing capacity—2 t/sf

**Required:**
- Determine the final bridge length, truss, and grillage type

**Solution:**
- Use the following steps:
  1. Grillage from Table 4-4—type 1 required
  2. Roller clearance from Table 4-5 or Figure 4-5—4 feet 6 inches (1.4 meters)
  3. Initial roller clearance was 2 feet 6 inches (.76 meter); therefore, 2 more feet (.6 meter) must be added to each end of bridge:

    New bridge length
    \[= 76.5 \text{ feet} + 2 \text{ feet} + 2 \text{ feet} = 82.5 \text{ or 90 feet (27.43 meters)}\]
4 Recheck truss type, Table A-6 in Appendix A—90 feet—triple-single required

5 Recheck grillage, Table 4-4—type 3 required

6 Recheck roller clearance, Table 4-5, Figure 4-7—3 feet 6 inches (1.07 meters)

This will not increase the bridge length

7 Final design—90 feet (27.43 meters) triple-single, type 3 grillage
Table 4-4 Types of grillage needed

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COMPOSITION
The launching nose (Figure 4-12, page 50) is a skeleton framework consisting of panels, transoms, rakers, sway braces, and, when necessary, launching-nose links. It does not have stringers or decking. One transom with transom clamps and rakers is used behind the leading upright of each panel. Sway bracing is used in all but the first bay at the front of the launching nose. Footwalks are not assembled on the nose.

USE OF LAUNCHING NOSE
The panel bridge is normally launched by cantilevering the launching nose over the gap. The weight of the bridge acts as the counterweight. When the launching nose reaches the far shore, it rests on the rocking rollers and supports the bridge as it is pushed across the gap. The composition of the nose depends on the length of the bridge and the type of assembly. The composition of the launching nose for the various combinations of span and bridge assembly is shown in Figure 4-12 and given in Chapter 6, Tables 6-1 through 6-3, Chapter 7, Tables 7-1, 7-2, and Chapter 8, Tables 8-1, 8-2. These tables must be followed exactly.

USE OF LAUNCHING-NOSE LINKS
The launching nose tends to sag as it is cantilevered over the gap. The approximate sag at the end of the nose just before it reaches the far bank is shown in the above mentioned tables. To overcome this sag, launching-nose links are used. Using one launching-nose link in each truss increases the length of the bottom chords of the nose by 7½ inches (19.0 centimeters); thus, the end of the launching nose is raised by 13½ inches (34.3 centimeters) for each bay ahead of the links. Because links must not be inserted with more than four bays of the launching nose ahead of them, the maximum amount of lift that can be obtained from one pair of links is about 54 inches (137 centimeters). If a greater amount of lift is required, an added pair of links can be used in one of the joints between the original pair and the end of the nose. Its position depends on how much lift is required. Figure 4-12 shows the vertical lifts that can be obtained using one or more pairs of links. The maximum lift obtainable using launching-nose links is 94½ inches (239.8 centimeters). When calculating the position of the links, add 6 inches (15.2 centimeters) to sag values shown for safety.

When the far-bank seat is higher than or level with the near-bank seat, launching-nose links must be used to compensate for sag, and the tops of all rollers must be in the same plane. If necessary, block and tackle should be used to prevent the bridge from sliding backwards.

Launching-nose links are necessary if the far-bank seat is low enough to require the use of block and tackle on the near bank to prevent the bridge from running away when the balance point passes the rocking rollers.

Use the following steps to determine the position of launching-nose links:

1. Determine sag from Tables 6-1 through 6-3, 7-1 and 7-2, or 8-1 and 8-2.
2. Safety sag of 6 inches (15.27 centimeters)
3 Lift required (LR):
LR = steps 1 + 2

4 Position of launching-nose link (Figure 4-12)

**EXAMPLE:**
Given a 160-foot (48.8 meters) *triple-single* bridge with grillage type 1 on both the near shore (NS) and far shore (FS). The far-bank seat is level with the near-bank seat.

**Problem:**
Are launching-nose links required? If links are required, at what distance are they placed from tip of launching nose?

**Solution:**
Launching-nose links are required. Therefore the following steps are used:

1 **Determine** sag for 160-foot *triple-single* (Table 6-3)
   77 inches (195.58 centimeters)

2 Safety factor of
   6 inches (15.24 centimeters)

<table>
<thead>
<tr>
<th>LAUNCHING LINK INTERVAL FROM TIP OF NOSE</th>
<th>DISTANCE OF LINKS FROM LEADING EDGE OF LAUNCHING NOSE</th>
<th>RESULTING VERTICAL LIFT IN TIP OF LAUNCHING NOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>40'</td>
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<td>13½&quot;</td>
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<td>20'</td>
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<tr>
<td>10'</td>
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<td>54&quot;</td>
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<td>67½&quot;</td>
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<tr>
<td>20' &amp; 40'</td>
<td></td>
<td>81&quot;</td>
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<tr>
<td>30' &amp; 40'</td>
<td></td>
<td>94½&quot;</td>
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</tbody>
</table>

*Figure 4-12 Upturned skeleton launching nose*
3 Lift required (LR):

\[ LR = (\text{steps } 1 + 2) \]
\[ LR = 77 \text{ inches} + 6 \text{ inches} \]
\[ LR = 83 \text{ inches} (210.82 \text{ centimeters}) \]

4 Position of launching-nose link (Figure 4-12):

Two pairs of launching-nose links placed at 30 feet (9.144 meters) and 40 feet (12.192 meters) from the tip of the nose

**ROCKING ROLLERS**

Use rocking rollers on both banks during launching. Normally, use two rocking rollers on the near bank for single-single and double-single truss bridges of 100 feet (30.5 meters) and shorter. Use four for all other assemblies. Two rocking rollers are normally required on the far bank; however, use four if the skeleton launching nose is double-truss in any part. Table 4-6 shows the required number of rocking rollers on near and far banks for various bridge lengths and assemblies.

**PLAIN ROLLERS**

Place rows of plain rollers behind the rocking rollers at intervals of 25 feet (7.6 centimeters) to support the bridge during construction. The number of rollers in each row depends on the type of bridge. Single-single and double-single bridges need two plain rollers per row. All other types of construction need four plain rollers per row (Chapter 3). The number of rows required depends on the construction backspace needed. Place plain rollers only every 25 feet (7.6 meters). More rollers are not required to support an overhang under 25 feet (7.6 meters). In addition, two construction rollers are used to aid in inserting the launching-nose links. These are plain rollers placed 12½ feet (3.8 meters) behind the rocking rollers and 2 to 4 inches (5.0 to 10.1 centimeters) below the plane of the other rollers. They may be removed once the construction extends back to the first row of plain rollers. The number of plain rollers needed for various bridges is shown in Table 4-7 (page 52).

**JACKS**

The number of jacks required to jack down a bridge depends on the span length and the type of the bridge. The number of jacks needed to jack down the end of the bridge is shown in Table 4-8 (page 52). Details on jacking procedures are given in Chapters 6, 7, and 8.

**Note:** Jacks must be positioned so that they carry no more than 7½ tons (6.8 metric tons) on the toe or 15 tons (13.6 metric tons) on the top.

---

**Table A-1** in Appendix A gives the number and position of launching-nose links required for normal bridges. This table assumes that both near- and far-shore rocking rollers are at the same elevation.
RAMP REQUIREMENTS

Ramps are used at each end of the bridge. The slope of the ramp must not exceed 10 to 1 for loads up to and including 50 tons, and 20 to 1 for loads over 50 tons.

SUPPORT FOR END OF RAMP

The end of the ramp will carry about one quarter of the weight of the heaviest tracked vehicle to pass over it when the ramp is supported at midspan. If there is no midspan support, the end of the ramp will carry about 40 percent of the weight of the tracked vehicle. One or two stacks of chess, side by side, are laid in two layers under the tapered end of the ramp to provide the necessary bearing area on the soil. If greater area is needed for heavy loads on very soft soil, footings are used under the chess. On soil capable of supporting 2 tons per square foot, two chess under the tapered end of the ramp are enough for bridges up to class 67. For higher capacity bridges, four chess are used (Figure 4-13). One chess on edge at the end of the ramp serves as an end dam, so the approach can be made level with the ramp floor. An alternate method for supporting the ramps on the ground is to use a transom as a sill under the ramp.

MIDSPAN RAMP SUPPORTS

For loads of 45 tons (40.8 metric tons) or over, each ramp section must be supported at its midpoint by cribbing and wedges. This support will carry one half of the class of the vehicle passing over, and the base of the cribbing should be large enough to spread the load over the soil without exceeding the allowable bearing pressure of the soil. On soil capable of supporting 2 tons per square foot, two chess side by side under the cribbing provide enough bearing area for all bridges. An alternative method for loads of 45 tons or more is to make the ramp level with at least 3½ feet (1.07 meters) of the ramp supported on the abutment (Figure 4-14).
Because the slope of the ramp should not exceed 1 to 10, it may be necessary to use two or more ramp bays. The junction of the ramp bays rests on a transom supported by four ramp pedestals spaced as shown in Figure 4-15. These pedestals (Figure 4-16, page 54) take two thirds of the class of the vehicles passing over and must be set on enough grillage to spread the load over the soil. Three 6-by 6-inch (15.2 by 15.2 centimeters) timbers 4 feet 6 inches (1.4 meters) long under each pair of pedestals provide enough area for 40-ton loads on soil that will carry 2 tons per square foot. For heavier loads, three chess are placed side by side under the 6- by 6-inch (15.2 centimeters by 15.2 centimeters) timbers.
SUPPORTS FOR END TRANSON
For loads of 40 tons (36.3 metric tons) or more, use cribbing and wedges under the midpoint of the end transom. This support will carry 40 percent of the weight of the heaviest tracked vehicle to pass over, and the area of the base of the cribbing should be large enough to spread the load over the ground without exceeding the allowable bearing pressure on the soil. Seven 6- by 6-inch (15.2 centimeters by 15.2 centimeters) timbers 4-feet 6-inches (1.4 meters) long laid side by side provide enough area for all the bridge loads on soil that will carry 2 tons per square foot.

EXAMPLE FIELD DESIGN PROBLEM
MISSION GIVEN: Design a Bailey to span the gap shown in Figure 4-17. Bridge must have Military Load Class (MLC) 60 wheeled/60 tracked. All data required is given in Figure 4-17.

I. INITIAL BRIDGE DESIGN
(Steps 1 through 6)
1. Gap measured during reconnaissance (p 36)
   a. 112
2. Safety setback (p 37)
   a. Prepared abutment = constant of 3.5'.
   b. Unprepared abutment = 1.5x bank height.
   2. NS  1.5 x 18' = 27'
3. Initial roller clearance. Always use a constant of 2.5'.
   3. NS  2.5'
4. Initial bridge length.
   a. Add steps 1+2+3.
      4a. 147.5'
   b. If value in step 4a is NOT a multiple of 10, round UP to the next highest 10.
      4b. 150.0'
5. Initial truss/story type. (Table A-7, p 303)
   5. DT
6. Initial bridge class. (Table A-7, p 303)
   a. Class must meet or exceed the MLC given in the mission.
   b. The truss/story type selected is always based on a NORMAL CROSSING unless otherwise directed by the TACTICAL COMMANDER.
5. 60/60
II. ADJUSTED/FINAL BRIDGE DESIGN
7. Selection of grillage.
   a. Safe soil bearing. (Table 4-1, p 45)
      7a. NS  2 tons/ft²
          FS  6 tons/ft²
   b. Safe soil pressure. (Table 4-4, p 48). If the soil bearing capacity values from step 7a are NOT listed in Table 4-4, round DOWN to the closest value listed. Use these values for step 7c.
      7b. NS  2 tons/ft²
          FS  3.5 tons/ft²
c. Grillage required.

7c. NS Type(s) 4, 6, & 7
FS Type(s) 2

8. Determine adjusted bridge length.

a. Distance required for new roller clearance.
(For Table 4-5, p 49)

8a. NS 4.5'
FS 4.5'

b. Add steps 1+2+8a.

8b. 151.5'

c. If value in step 8b is NOT a multiple of 10, round UP to the next highest 10.

8c. $\phi = 160.0'$

NOTE: Compare the value in step 8c to the value in step 4b. If different, you must redesign the bridge as outlined in steps 9 through 12, using length from step 8c to find truss type in step 9. If not, use this as your final bridge length and go to step 13.

**FINAL BRIDGE**  
**TRY 1**  
**TRY 2**

9. Final truss/story type. (Table A-7, p 303)

9. TT 1 DT

10. Final bridge class. (Table A-7, p 303)

a. Class must meet/exceed the MLC given in the mission.

b. The Truss/Story Type selected is always based on a NORMAL CROSSING unless otherwise directed by the TACTICAL COMMANDER.

10. 80/75 | 60/60

11. Final grillage selection.

a. Safe soil bearing. (Table 4-4, p 45)

11a. NS 2 tons/ft² | 1.2 tons/ft²
FS 6 tons/ft² | 1.6 tons/ft²

b. Safe soil pressure. (Table 4-4, p 48). If the soil bearing capacity values from step 11a are NOT listed in Table 4-4, round DOWN to the closest listed. Use these values for step 11c.

11b. NS 2 tons/ft² | 1.2 tons/ft²
FS 3.5 tons/ft² | 1.35 tons/ft²

c. Grillage required.

11c. NS Type(s) 6 & 7 | 4, 6, & 7
FS Type(s) 6 & 7 | 4, 6, & 7

12. Determine final bridge length.

a. Distance required for new roller clearance.
(For Table 4-5, p 49)

12a. NS 3.5' | 3.5'
FS 3.5' | 3.5'

b. Add steps 1+2+12a.

12b. 149.5' | 149.5'

c. If value in step 12b is NOT a multiple of 10, round UP to the next highest 10.

12c. $\phi = 150.0'$ | $\phi = 150.0'$

NOTE: (1) FOR TRY 1: Compare the value in step 12c to the value in step 8c.

a. If the same, go to step 13.

b. If different, compare this value (step 12c) to the value in step 4b:

1. If these are the same, the designer is placed in a judgmental situation. Repeating the design sequence under the "TRY 2" column using the bridge length from step 12c of "TRY 1" column will place you in an endless circle unless the final bridge length can be reduced. In these cases, one will have to use common sense and either overdesign a longer final bridge as shown in the "TRY 1" column or choose a higher number grillage than that originally selected in step 7c. The latter procedure could reduce the roller clearance on one or both banks so that the required bridge length/final truss-story may be at the minimum to do the job. You may choose a higher number grillage than allowed within step 11c; however, you must be careful not to exceed the BP and RRT capacities listed in Table 4-2 and Table 4-3, p 46 and Table 4-3, p 47, FM 5-277. Make your decision and go to step 13. In this example problem, the designer chose to select Type 3 grillage for the FS. Since this was not an option within step 11c, he had to look at Table 4-2 and Table 4-3 under a 150' DT bridge with a safe soil pressure of 3.5 tons/ft² to see if the BP and RRT capacities were exceeded:

<table>
<thead>
<tr>
<th>Table 4-2</th>
<th>Table 4-3</th>
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<tr>
<td>BP Reaction</td>
<td>BP Allowable</td>
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<td>= 55 tons</td>
<td>= 61 tons</td>
</tr>
<tr>
<td>RR Reaction</td>
<td>RRT Allowable</td>
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<tr>
<td>= 54.8 tons</td>
<td>= 60 tons</td>
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Had the designer not accomplished this, he would have been forced to build the 160' TT bridge shown under the "TRY 1" column and wasted a lot of assets.

2. If these are different, you must redesign the bridge by entering the "TRY 2" column with the bridge length from step 12c "TRY 1" to determine the truss/story type in step 9.

NOTE: (2) FOR TRY 2 and HIGHER: Compare this value in step 12c to the value in step 12c of the previous "TRY" column. If the same, go to step 13. If different, use the same methodology and repeat the design sequence until the value obtained in a particular step 12c matches the value in step 12c of the previous design. Go to step 13.
13. Slope check. (p 43)
   a. The maximum allowable bank height difference is 1 in 30. Therefore, maximum allowable bank height difference = final bridge length + 30.
   \[ \text{max. bank height difference} = \frac{\text{final bridge length}}{30} \]
   b. If:
      (1) The step 13a value ≥ actual bank height difference the slope is all right.
      (2) The step 13a value < bank height difference
         a. Choose another site, OR
         b. Crib up/excavate the FS or NS until the bridge slope is within limits.
   13b. (GO)/NO GO(circle one)

REMARKS:
14. Final bridge requirements:
   Length 150'
   Truss/Story Type DT
   Class 60/60
   Grillage: NS Type 6
   FS Type 3

15. Launching nose composition. (Tables 6-1 through 6-3, p 64/65, Tables 7-17-2, p 95, or Tables 8-1/8-2, p 104, dependent upon truss type)

   a. Sag. (See tables as in step 15)
      16a. \[ \text{Sag} = \frac{\text{final bridge length}}{150} \]
   b. Safety sag. (Constant of 6")
      16b. \[ \text{Safety sag} = \frac{\text{final bridge length}}{160} + 6" \]
   c. Lift required. (Add steps 16a + 16b)
      16c. \[ \text{Lift} = \text{Sag} + \text{Safety sag} \]
   d. Position of launching nose links (Figure 4-12, pg 50)
      16d. 30' from tip of nose

17. Rocking rollers needed. (Table 4-6, pg 51)
   17. NS \[ \frac{\text{PS}}{4} \]
   17. FS \[ \frac{\text{FS}}{4} \]

18. Plain rollers needed.
   a. SS and DS bridges ONLY have two rollers per row. All others have four rollers per row. Use Table 4-7 to determine the number of rows then multiply.
      18a. 4x4 = 16 rollers
   b. Add two more plain rollers to allow for your construction rollers.
      18b. \[ \text{Construction rollers} = \text{PS} + 2 \]
   c. Add steps 18a to 18b.
      18c. \[ \text{Total rollers} = \text{PS} + 2 \]

19. Jacks required. (Table 4-8)
   19. \[ \text{Jacks} = 8 \]

NOTE: Only one end of the bridge will be jacked down at any onetime.

20. Ramp requirements.
   a. Slope requirements (check one)
      (1) Final bridge class ≤ 50 = 1 to 10 ( ).
      (2) Final bridge class > 50 = 1 to 20 (x)
   b. Support for end ramp (check one)
      (1) Final bridge class ≤ 67 = 2 Chess (x).
      (2) Final bridge class > 67 = 4 Chess ( )
   c. Midspan ramp supports (check one)
      (1) Final bridge class ≤ 44 = Not needed ( ).
      (2) Final bridge class > 44 = Needed (x)
   d. Pedestal supports (check one)
      (1) Not needed ( )
      (2) Needed (x)

NOTE: See Page 53 for criteria and drawings. Ramp length must be estimated from the site sketch.

e. Support for end transoms (check one)
   (1) Final bridge class ≤ Class 39 = Not needed ( ).
   (2) Final bridge class > Class 39 = Needed (x)

21. Personnel required. (Table 3-2, p 33)
   21. \[ \frac{7/22}{w/o Crane} \]
   \[ \frac{7/97}{w/Crane} \]

NOTE: Check the difference between manpower only and crane construction.

22. Assembly time. (Table 3-3, p 34)
   22. 13 1/4 hrs w/o Crane / 11 3/4 hrs w/Crane
Bailey bridge classifications may be determined by entering Table A-6 in Appendix A with the span length and truss type. This will give the classification of the bridge for normal, caution, and risk crossings. Table 4-9 gives restrictions for the types of crossing.

Notes: The caution class number is found by test and is normally 25 percent greater than the normal class. Risk loads will probably cause permanent deformation of bridge parts and may result in failure if repeated. Therefore, the engineer officer must thoroughly check the condition of the bridge before and after such a crossing. The grillage, cribbing, and number of transoms per bay must also be checked and the bridge class reduced or upgraded to obtain the required classification. The condition of the bridge and its supports must also be considered in its classification. If the bridge is deformed or damaged, the grillage has rotted, or the abutment has failed, the bridge classification must be drastically lowered.

EXAMPLE:
Given:
Bridge length—80 feet
(24.4 meters)
Truss type—double-single
Grillage—none
Soil-bearing capacity—10 t/sf

Cribbing—none
Condition—excellent

Required:
Determine the normal track classification of the bridge without upgrading

Solution:
Take the following steps:

1. Class—55 track
   (from Table A-6 in Appendix A)
2. Grillage—install type 1 as a minimum (Table 4-4)

3. Cribbing
   Midspan ramp supports
   None—limits class to 44 tons
   (39.9 metric tons)

4. Condition—excellent, no reduction

5. Final classification—39 track. The overall classification is determined by the lowest classification of steps 1 and 3.