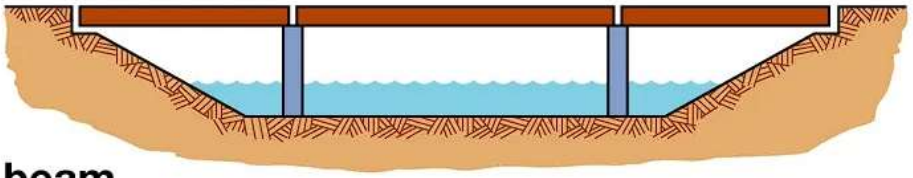
Bridges and Trestles

Bob Sorenson

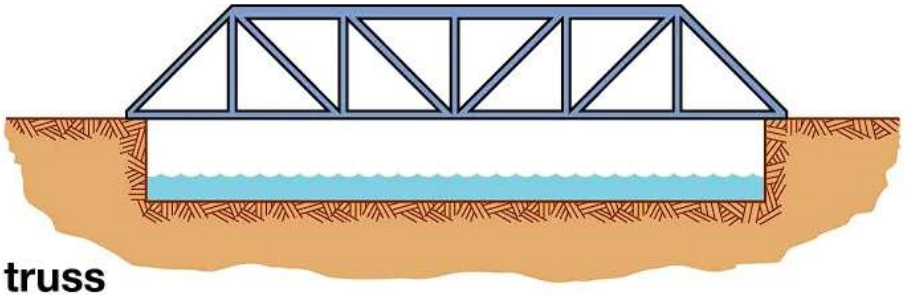
Objectives

- Types of Bridges
- Various examples
- Do some math
- Trestles

Bridge Types

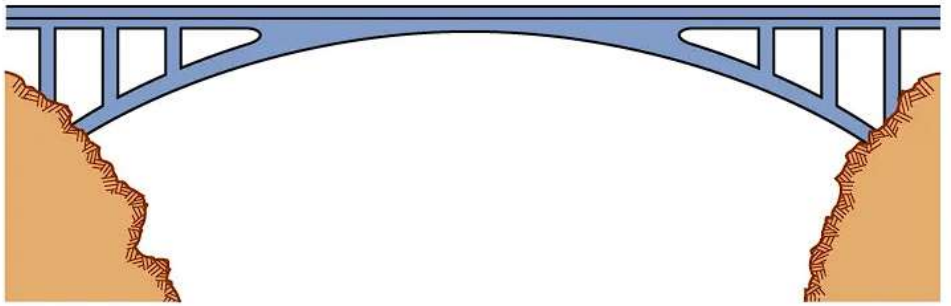


beam

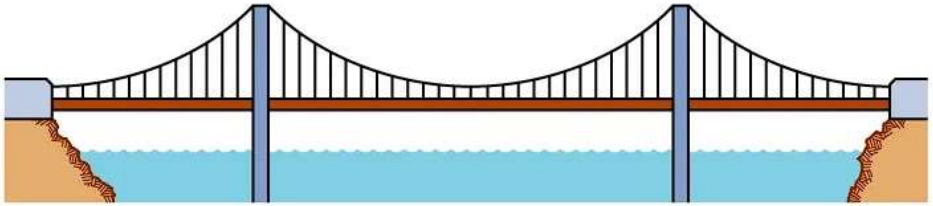


truss

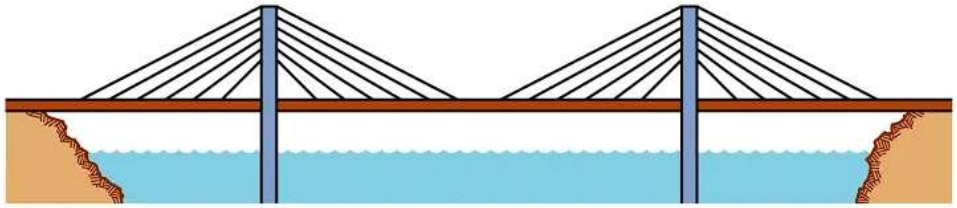
cantilever



arch



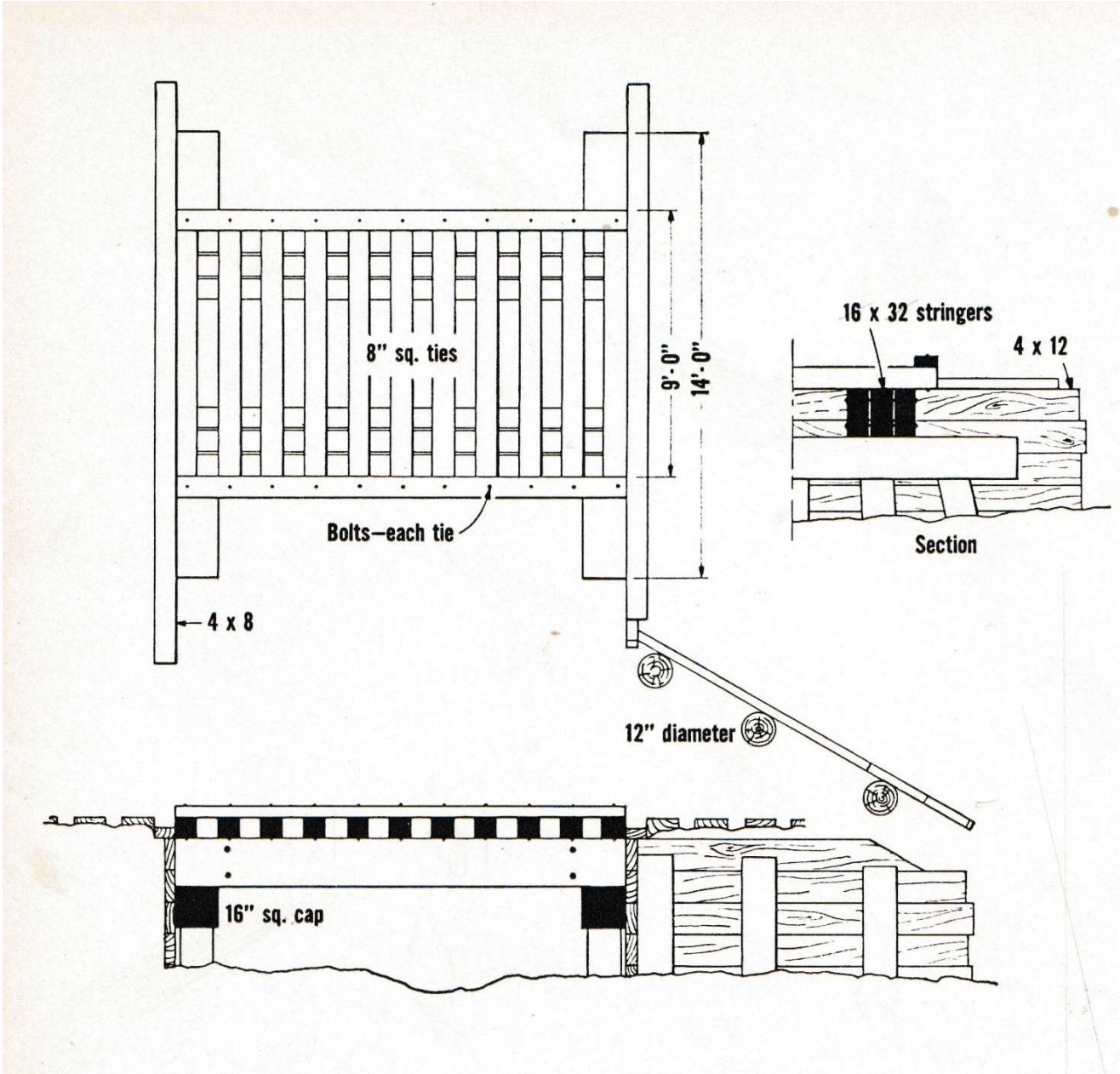
suspension



cable-stayed

Beam Bridge

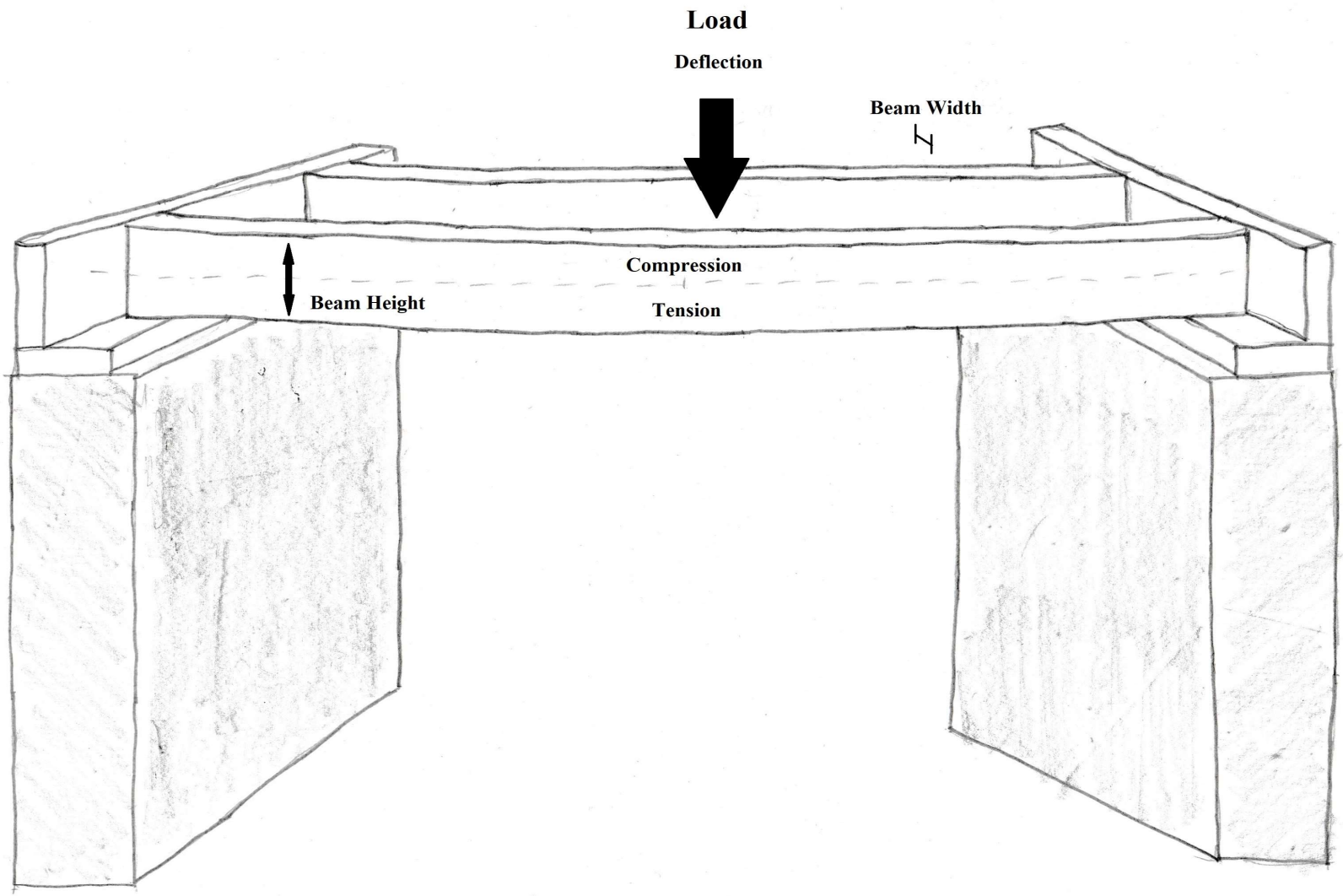
Beam Bridge


8" sq. ties
9'-0"
14'-0"
Bolts—each tie
4 x 8
16 x 32 stringers
4 x 12
Section
12" diameter
16" sq. cap

Beam Bridge

Beam Bridge

Beam Bridge


Load
Deflection
Beam Width
Compression
Tension
Beam Height

Beam Bridge

$$\text{Deflection} = \frac{\text{Load (lbs)} * \text{Length}^3\text{ (in)}}{48 * 10^6 * \left(\frac{w * h^3}{12}\right)}$$

$$\text{Deflection} < \frac{\text{Length}}{360}$$

Given a 12” long beam with a load of 50 lbs.

Maximum allowable deflection is 0.033”

Example 1: Beam 0.25” wide, 1.00” tall. Deflection = 0.086” X

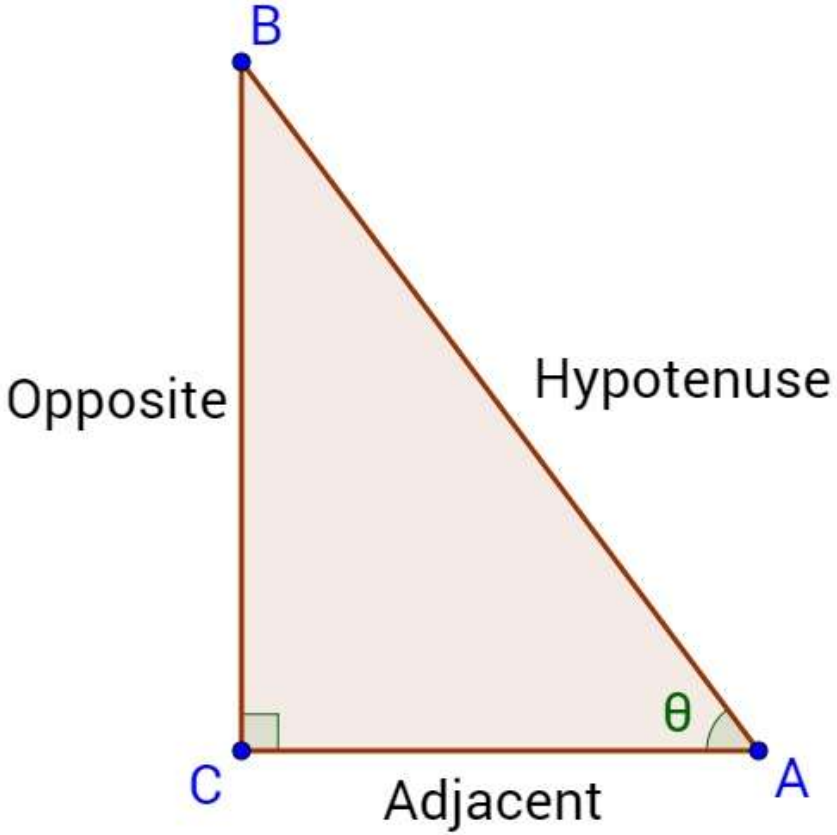
Example 2: Beam 0.25” wide, 1.50” tall. Deflection = 0.026” 

Truss Bridge

What is a truss?

Truss Bridge

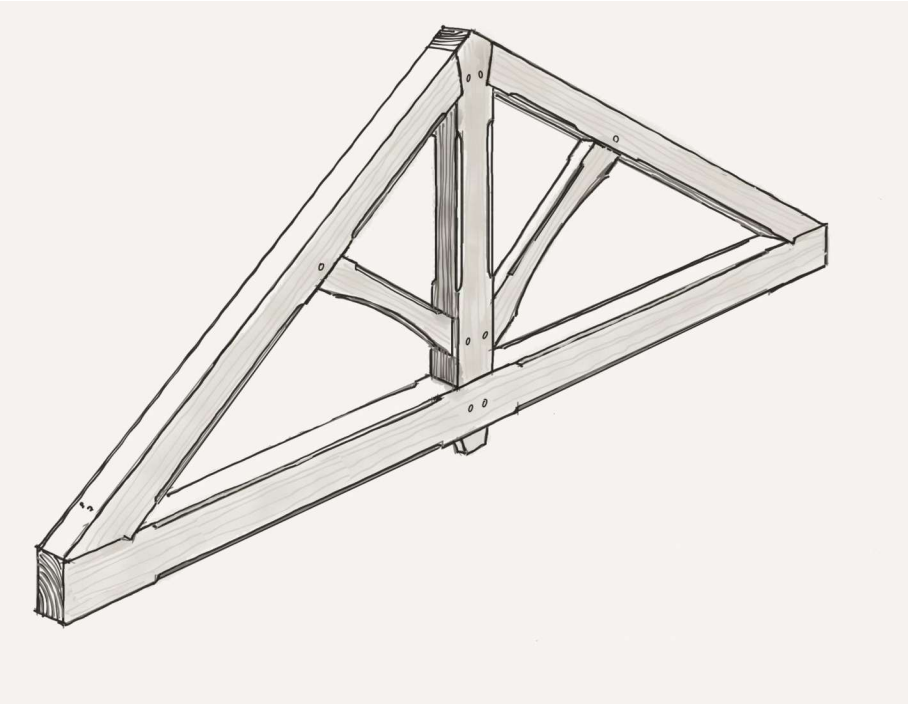
What is a truss?



- A structure made up of triangles
- Rigidity
- Forces act in compression or tension
- Openness to minimize weight

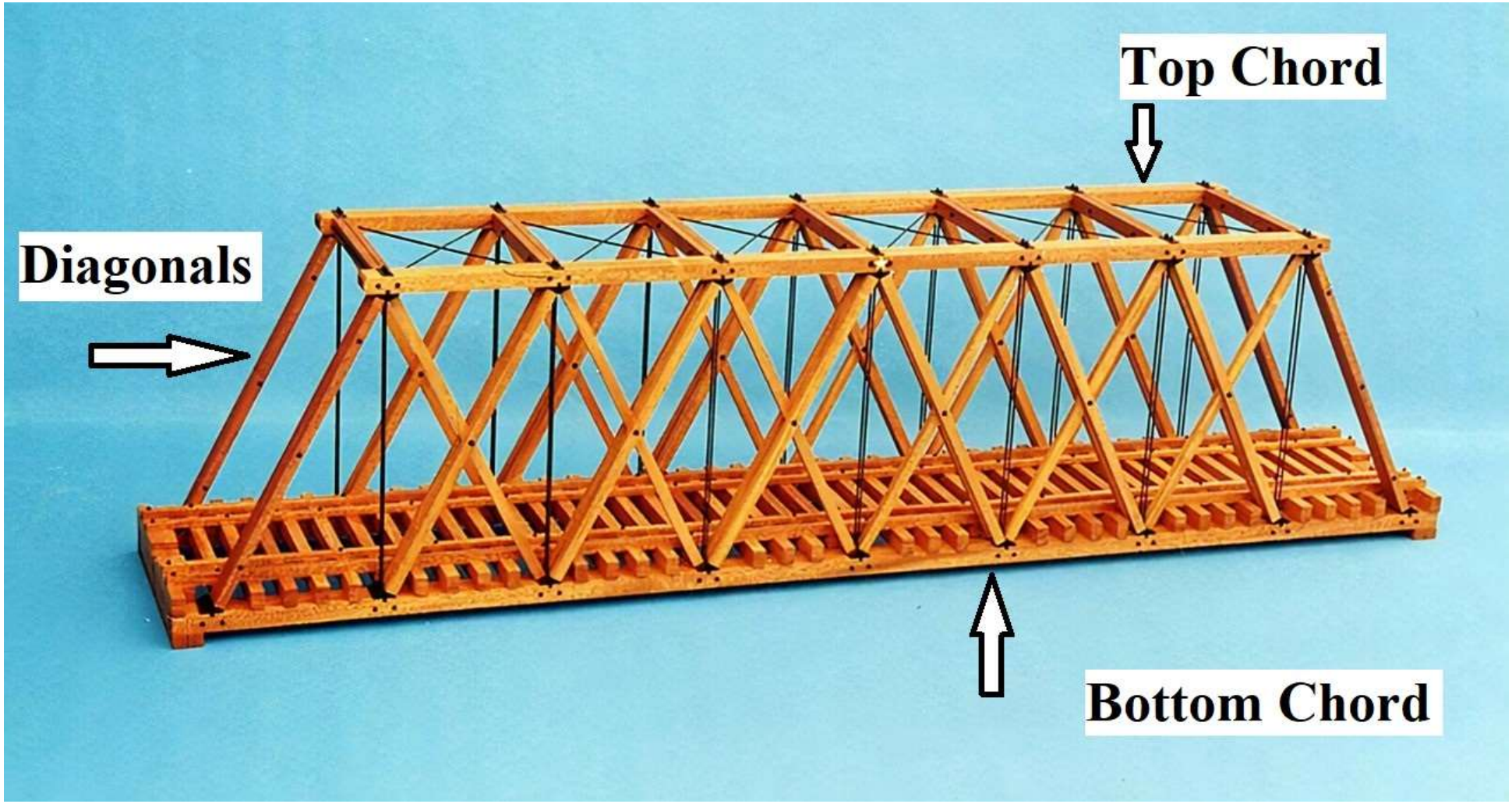
Truss Bridge

King Post Trust



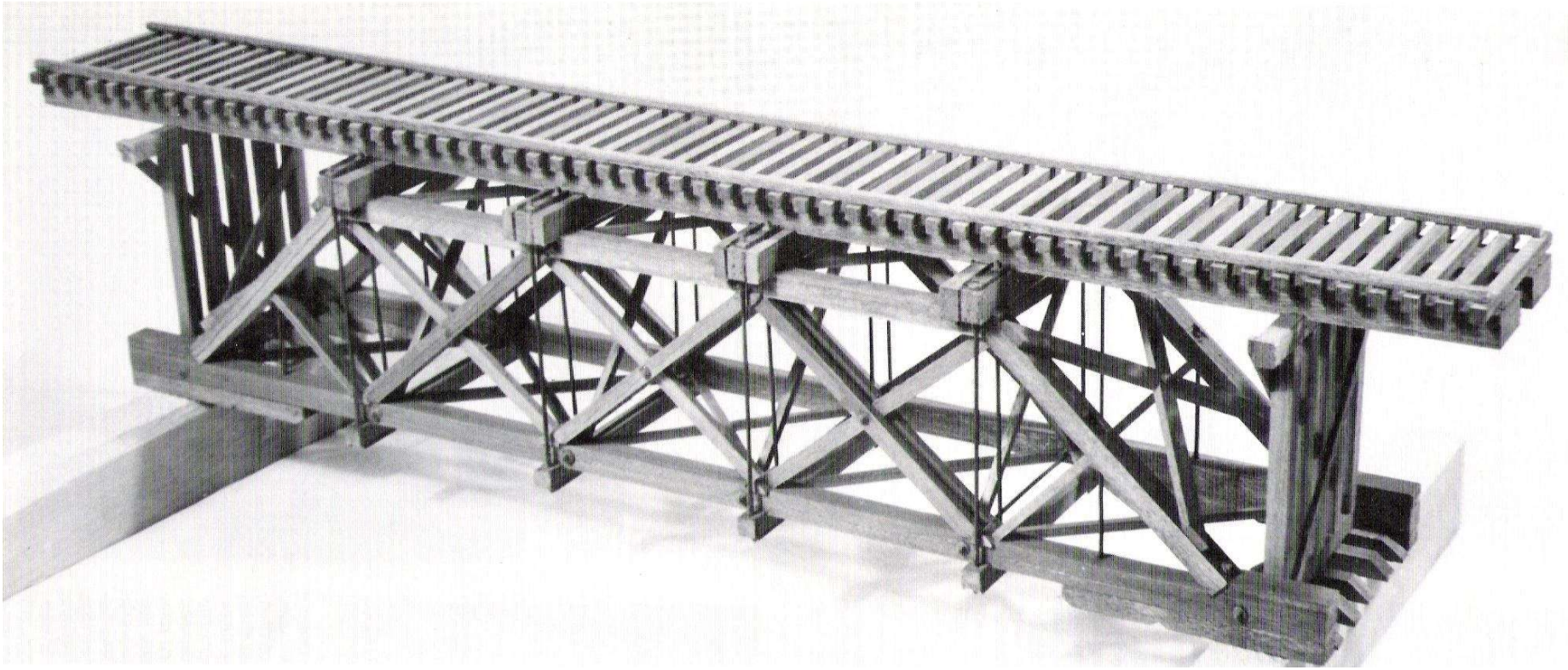
Truss Bridge

Howe Truss



Truss Bridge

Howe Truss

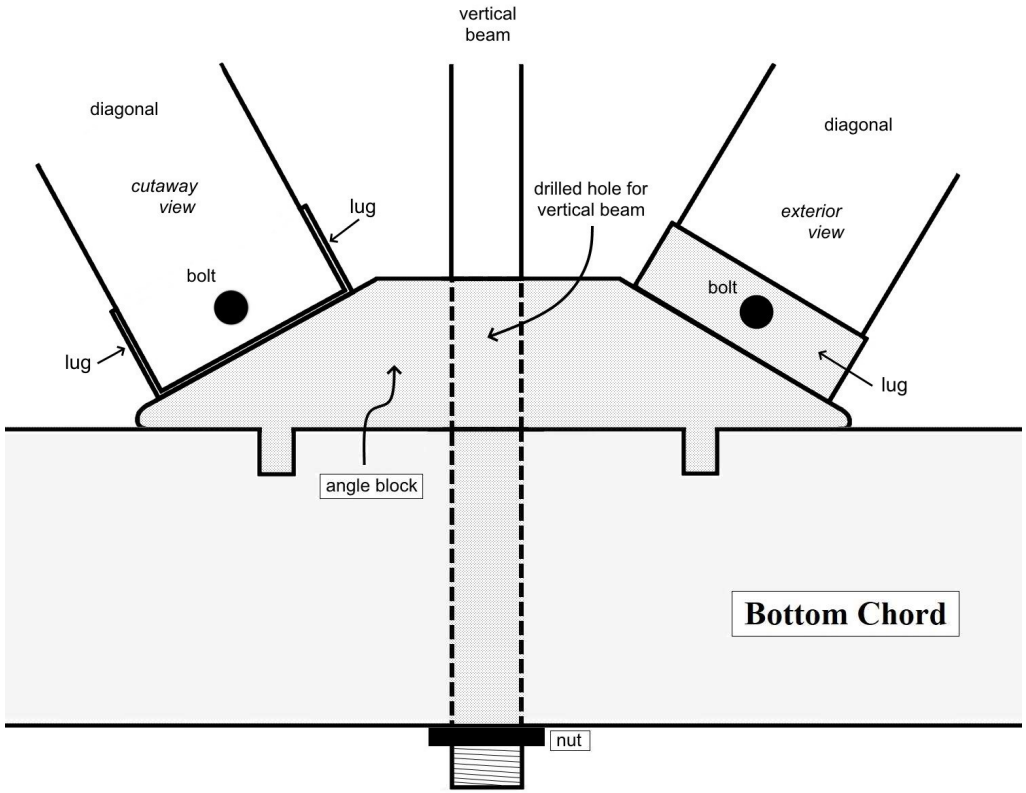


Truss Bridge

Howe Truss

Truss Bridge

Howe Truss



Truss Bridge

Howe Truss

Truss Bridge

Howe Truss

Truss Bridge

Pratt Truss

Truss Bridge

Pratt Truss

Truss Bridge

Pratt Truss

Truss Bridge

Warren Truss

Truss Bridge

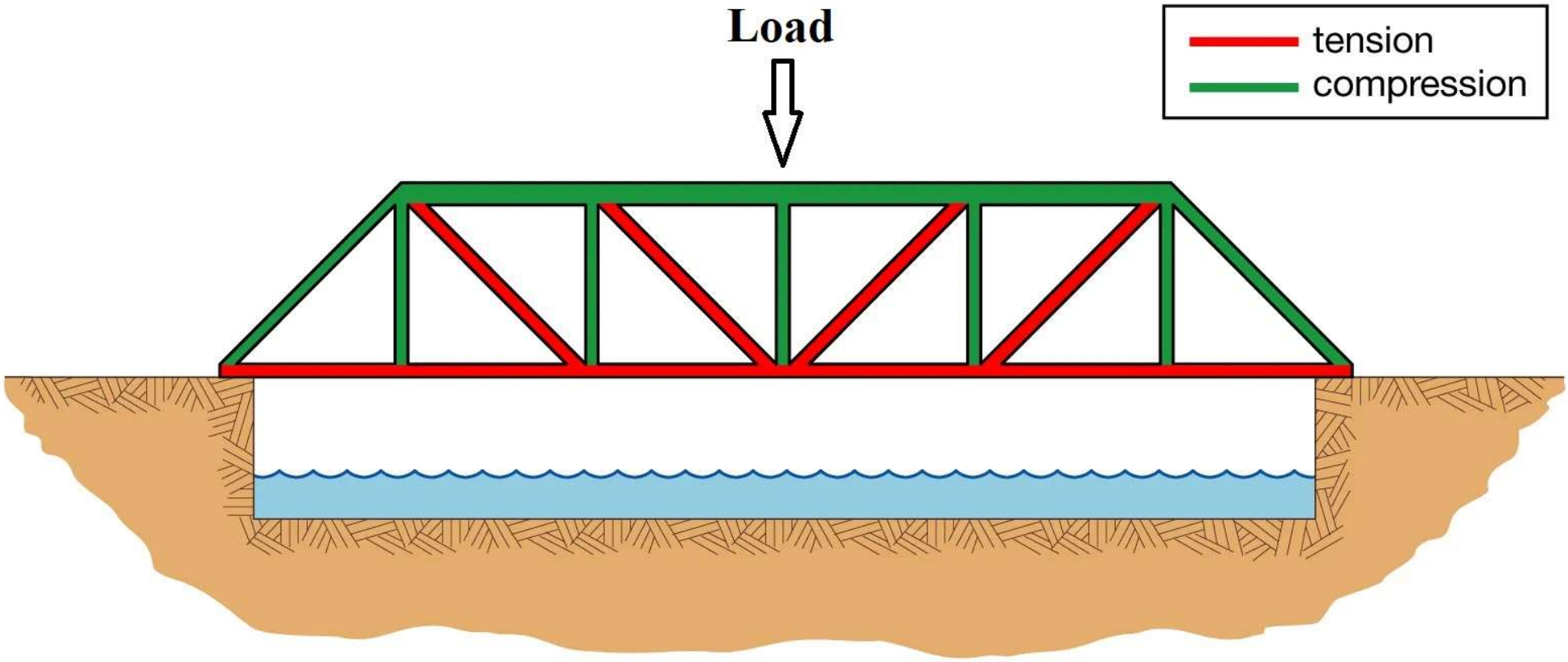
Warren Truss

Truss Bridge

Warren Truss

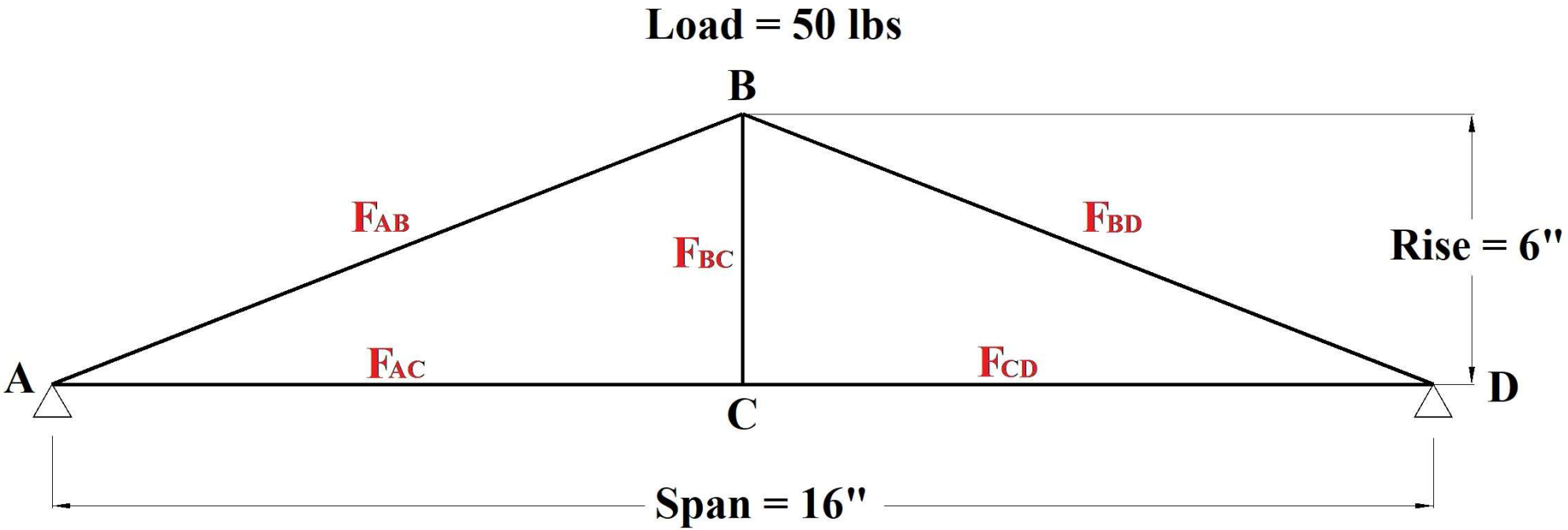
Truss Bridge

Compression and Tension



Truss Bridge

Forces of Compression and Tension



$F_{AB} = F_{BD} = -41.67$ lbs (compression)

$F_{AC} = F_{CD} = +33.34$ lbs (tension)

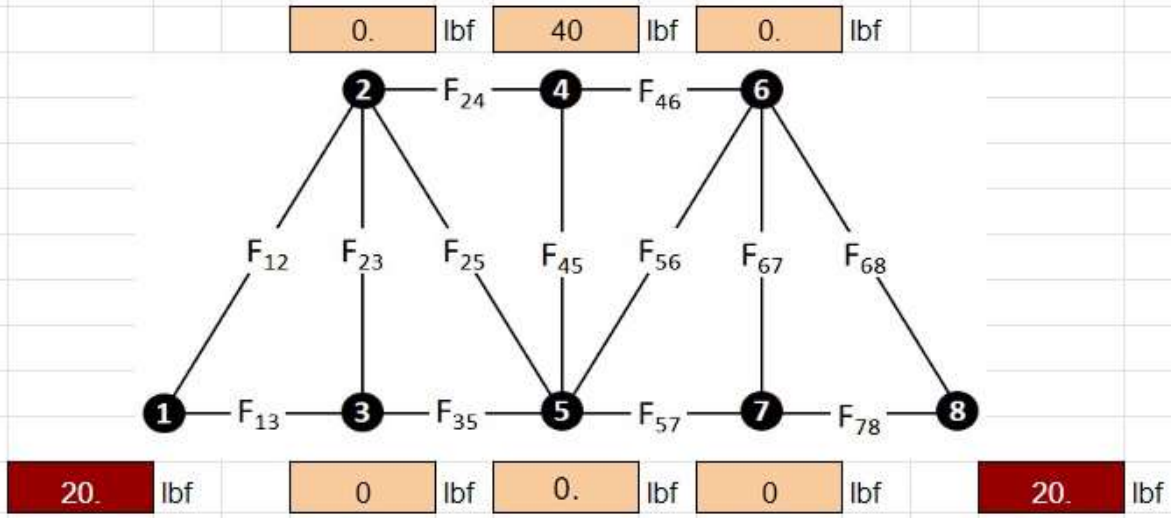
$F_{BC} = +50.00$ lbs (tension)

Truss Bridge

Forces of Compression and Tension

Warren Truss. 3 Isosceles-Equilateral Triangles - 3 Verticals

Tension-Compression on Elements. Vertical Downward Loads on Nodes



Triangles' base lenght:	6.	in
Angles of Diagonals:	60	degrees

Tensions - Compressions on Truss Elements

	F45 =-40		
	F23 =0	**F67 =0**	
	F24 =-23.094	**F46 =-23.094**	
F12 =-23.094	**F25 =23.094**	**F56 =23.094**	**F68 =-23.094**
F13 =11.547	**F35 =11.547**	**F57 =11.547**	**F78 =11.547**

Arch Bridge

Arch Bridge

Arch Bridge

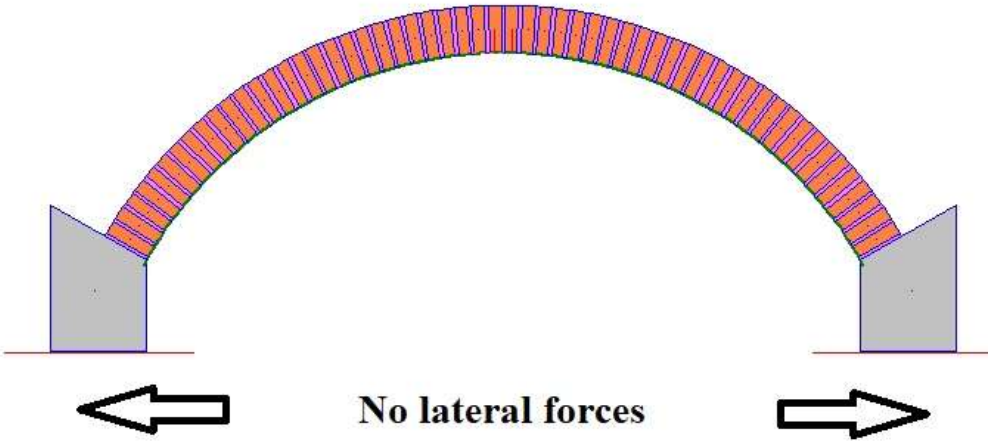
Arch Bridge

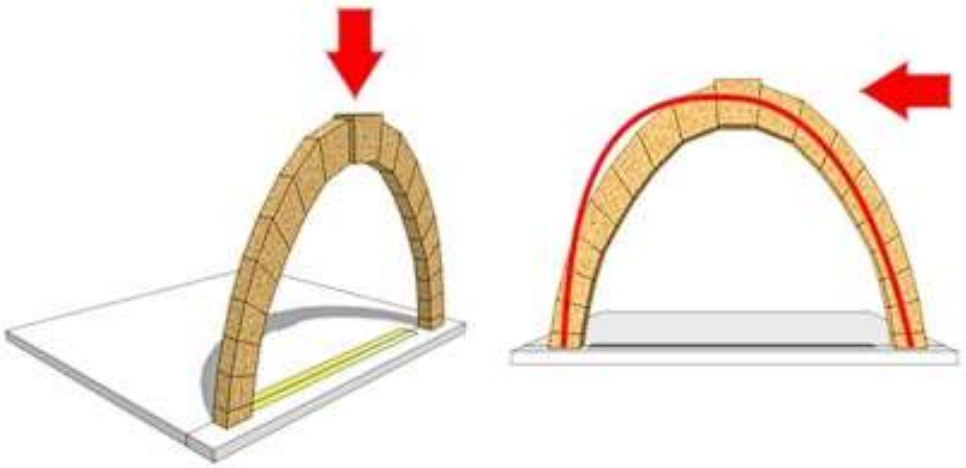
Catenary Arch

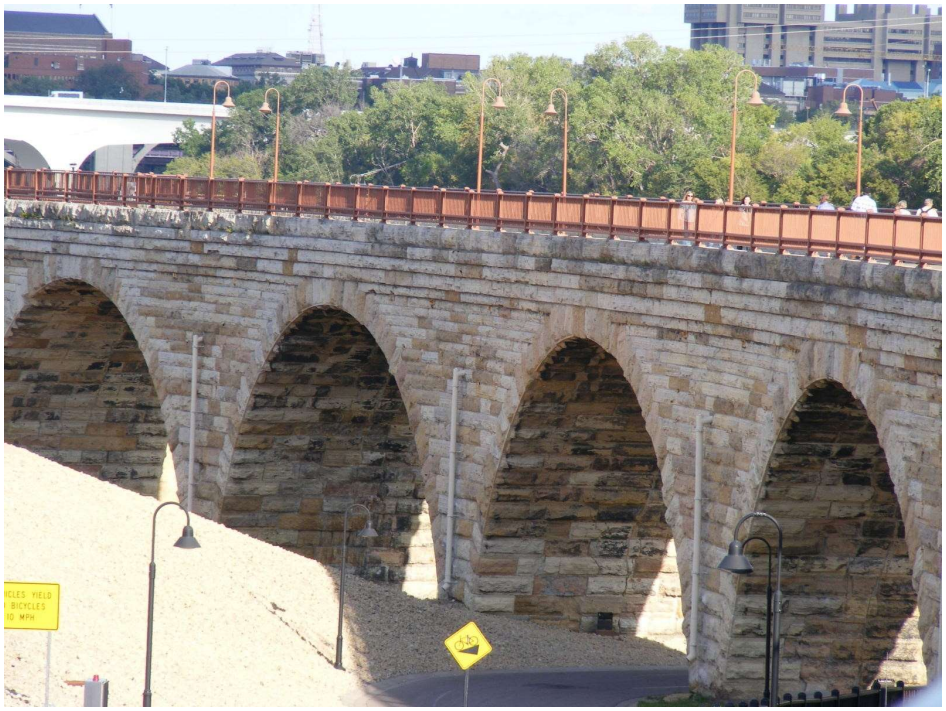
$$y = a \cosh (x/a)$$

Arch Bridge

Catenary Arch Forces

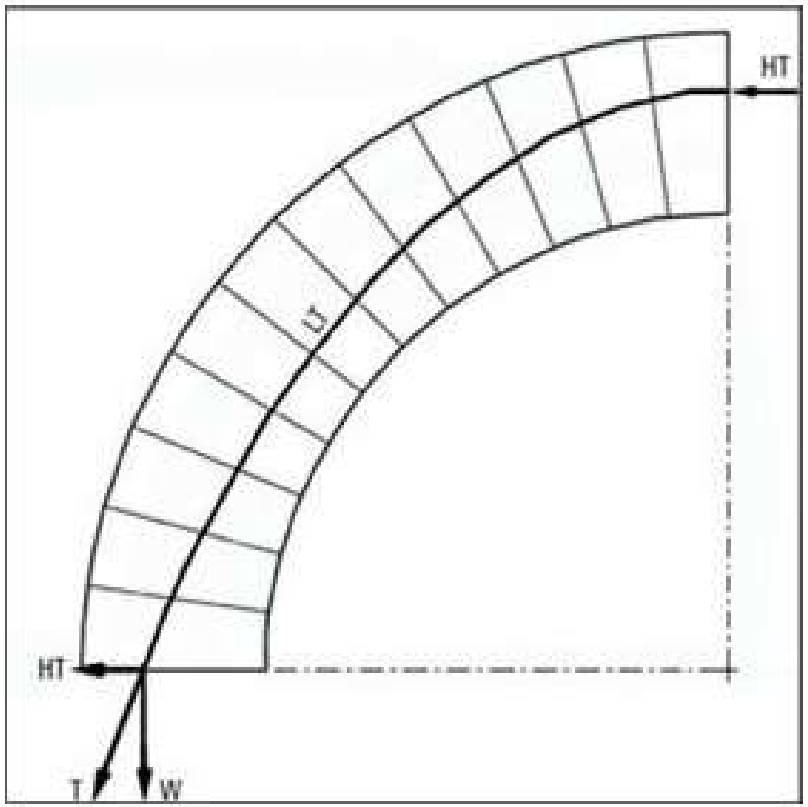


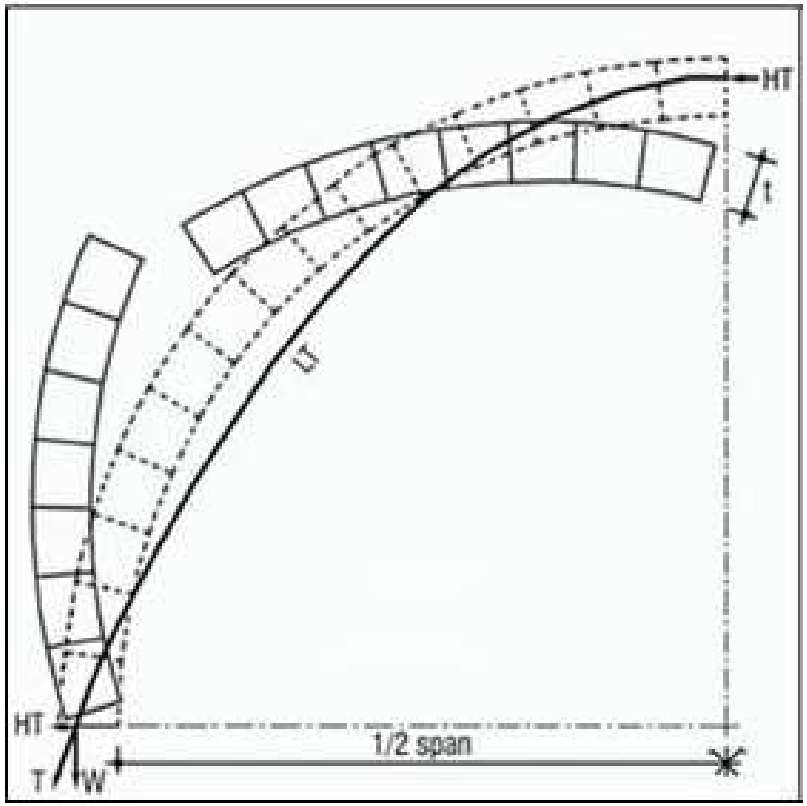




Arch Bridge

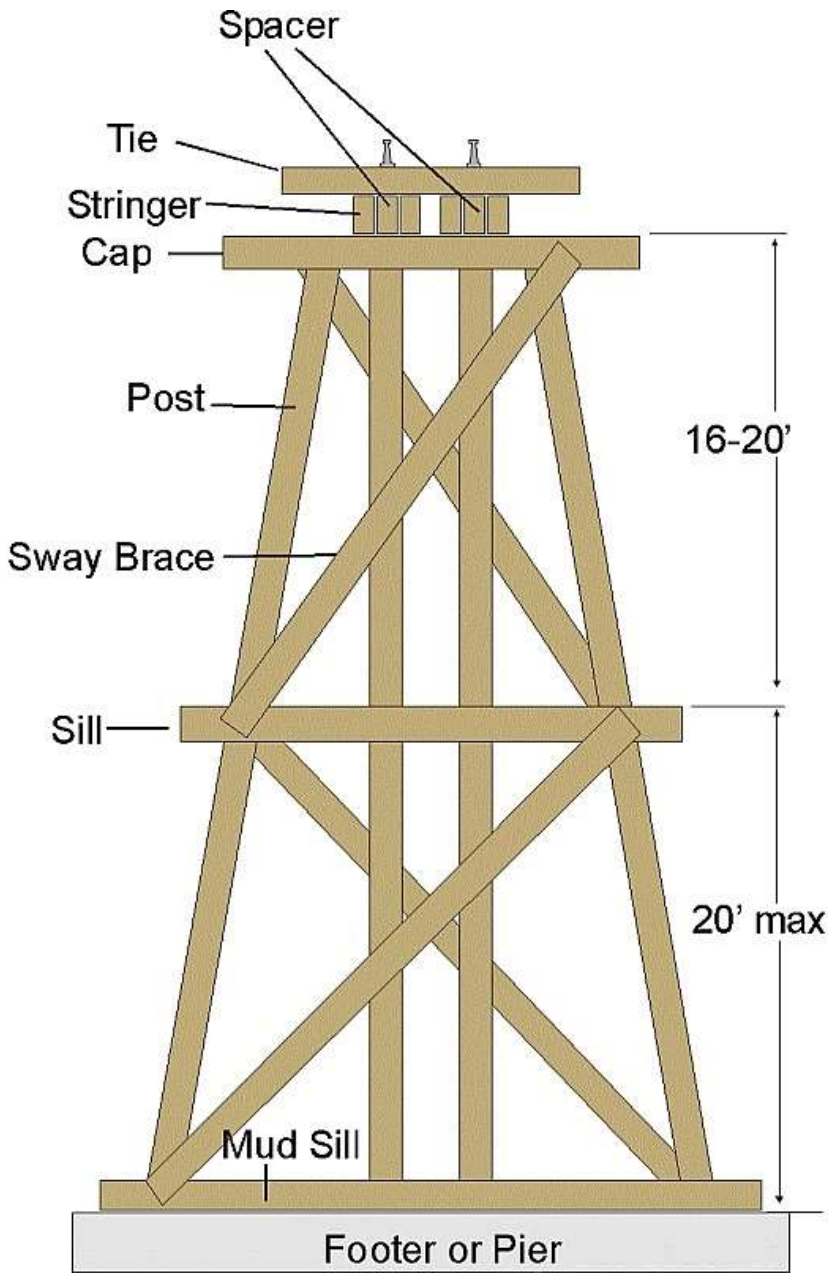
Catenary Arch, Line of Thrust



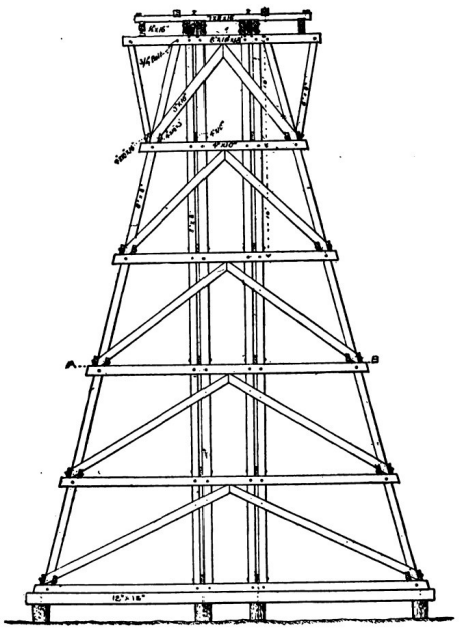


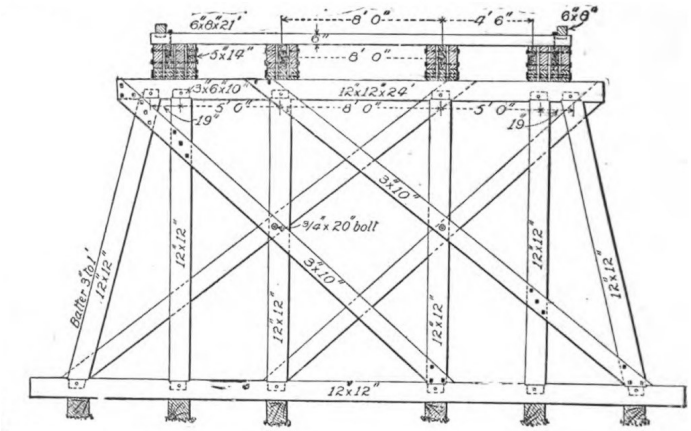
Trestle Bents

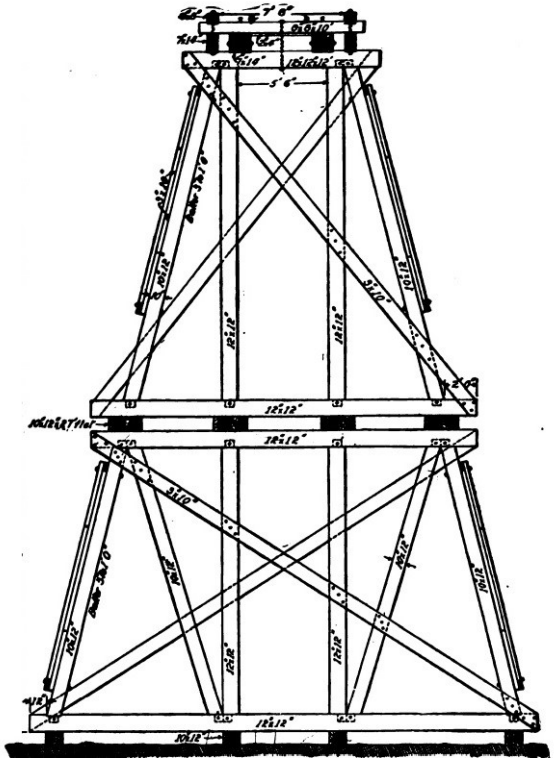
Trestle Bents

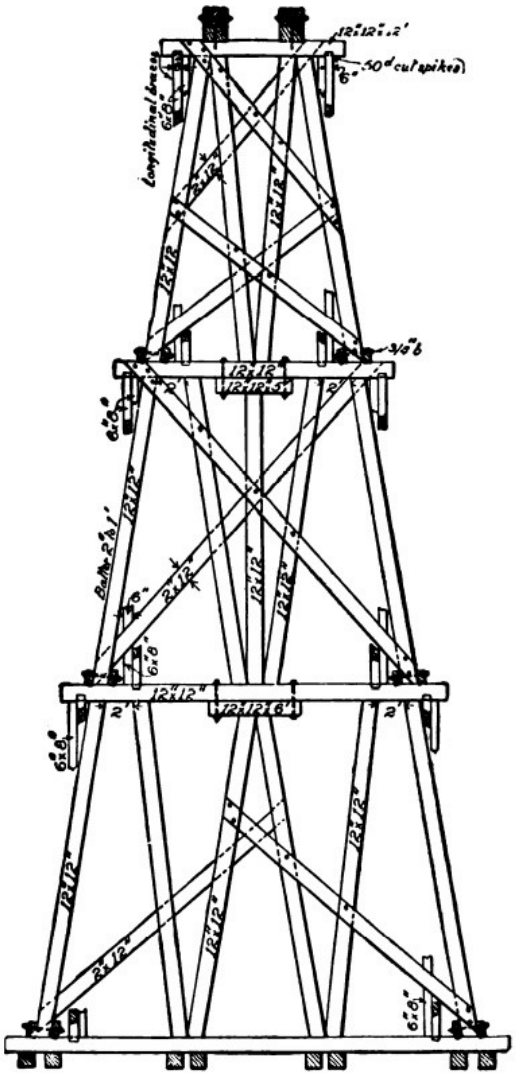


Trestle Bents



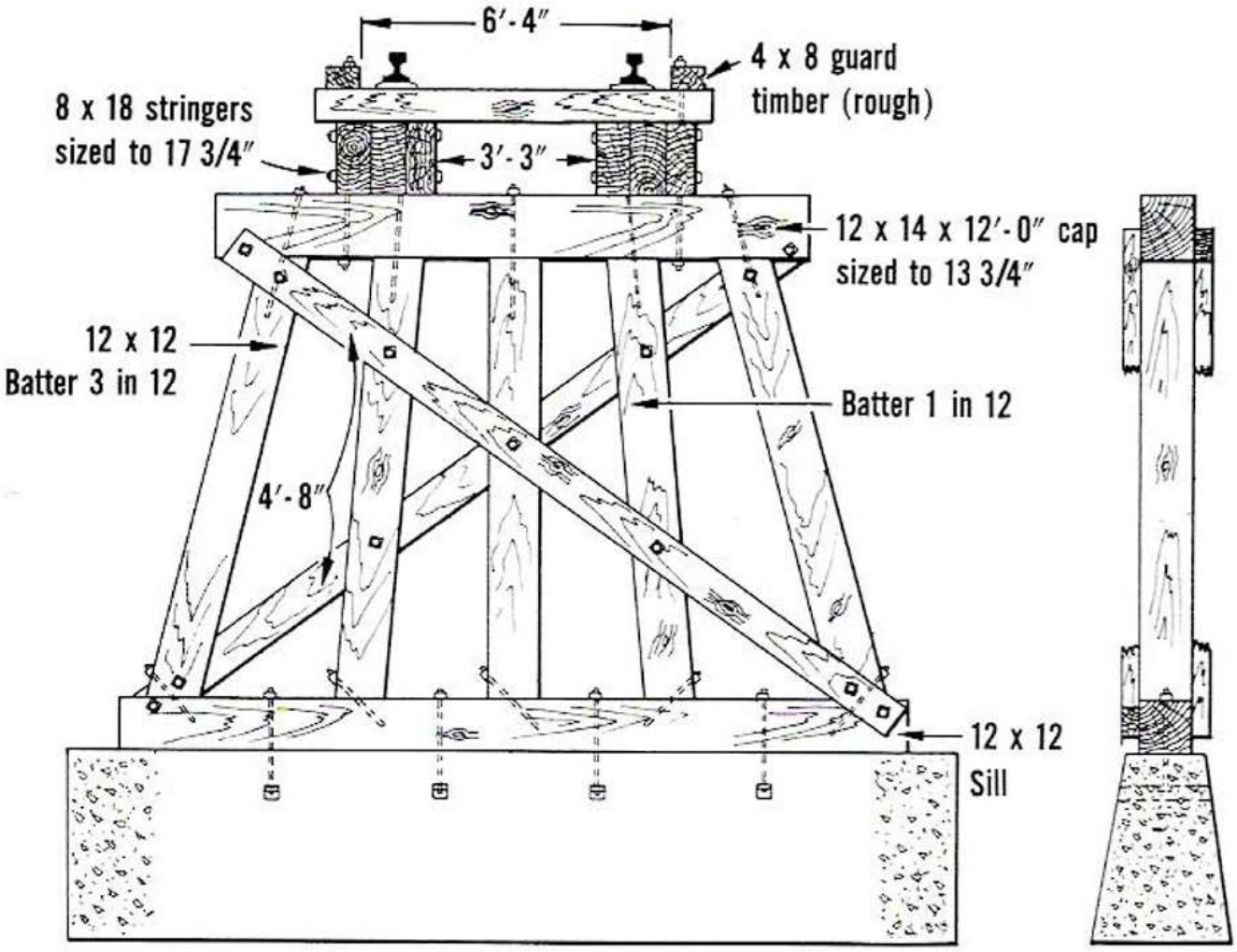






Trestle Bents

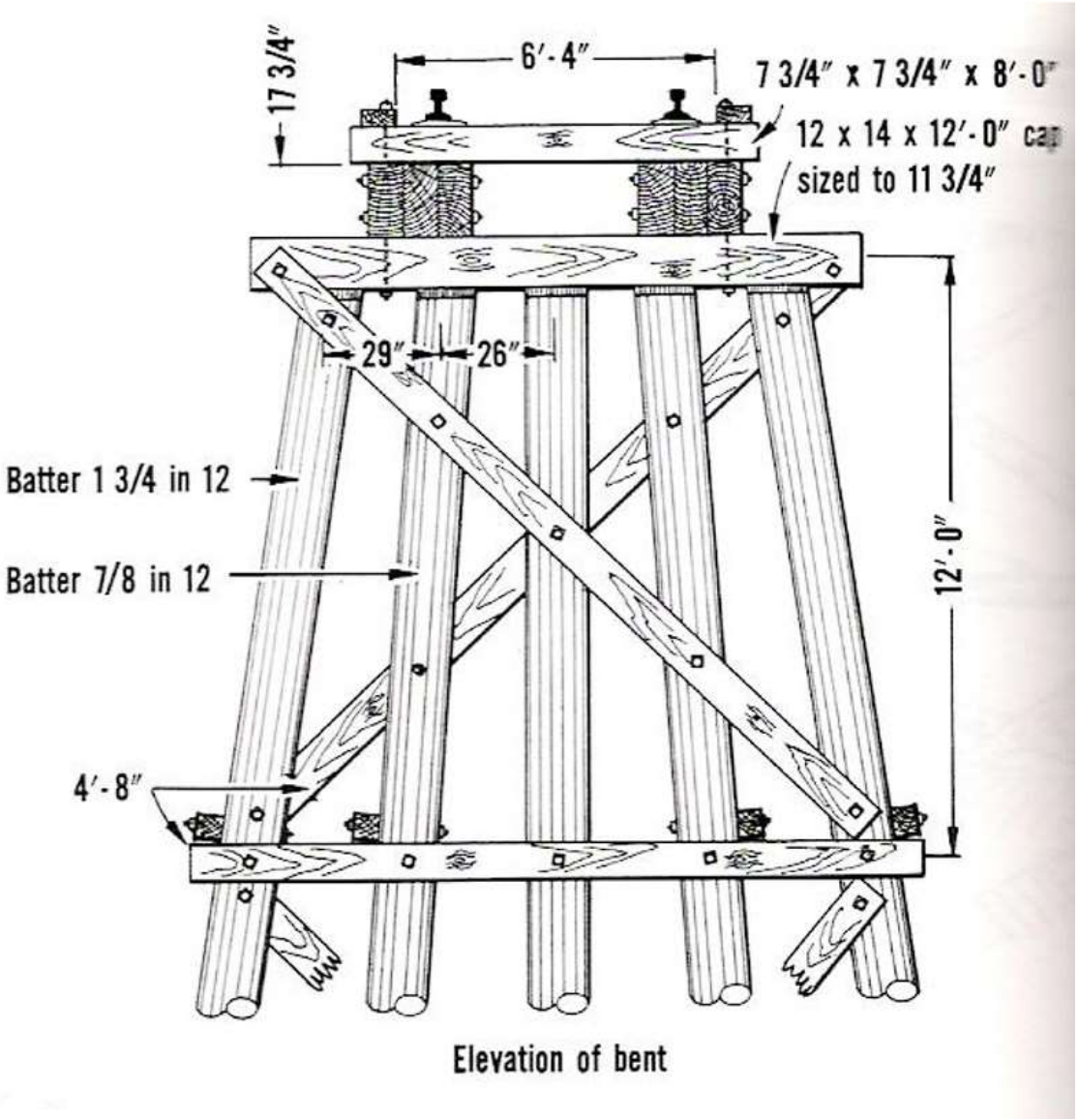
Southern Pacific Practice



Frame bent on concrete footing

Trestle Bents

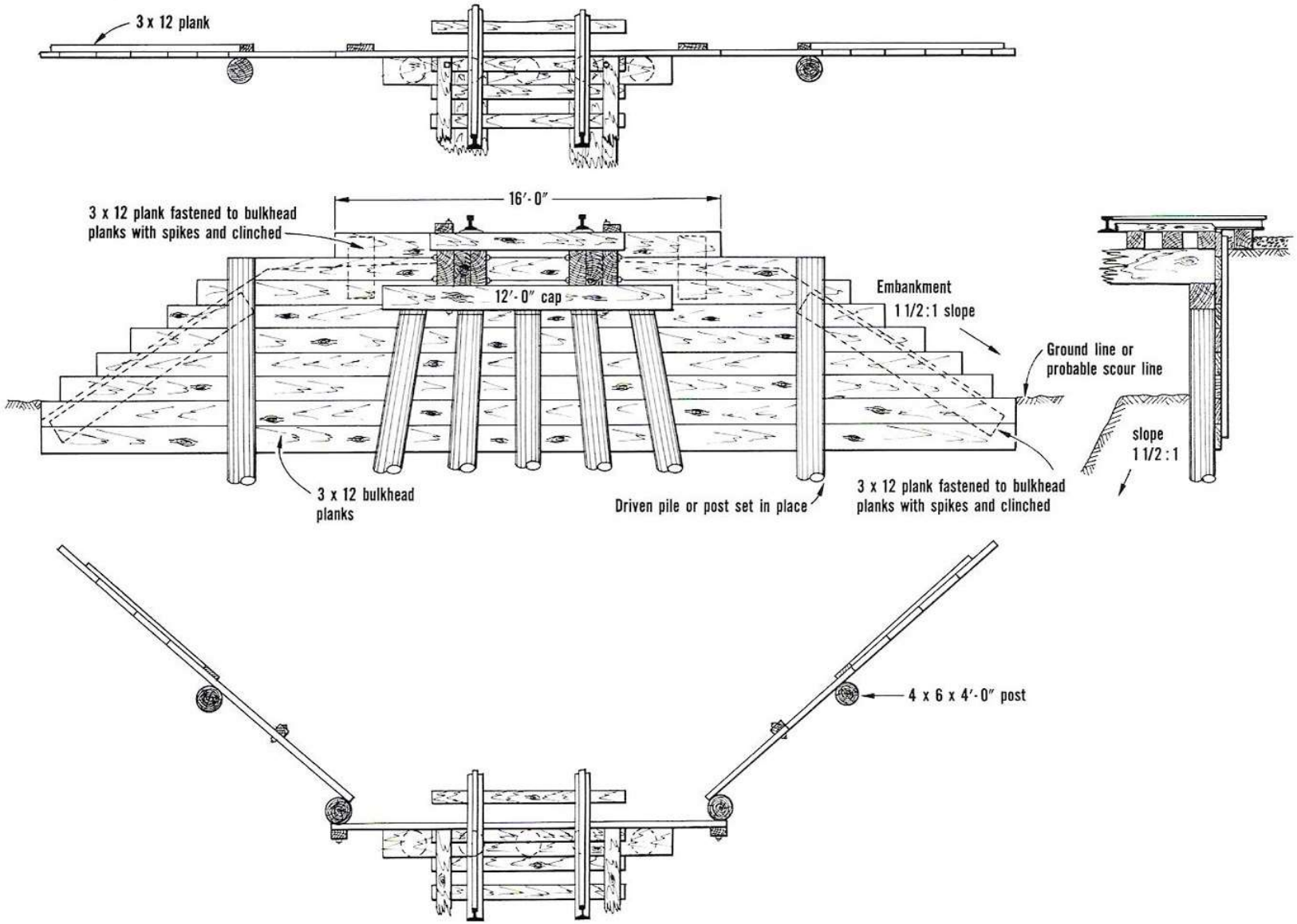
Southern Pacific Practice



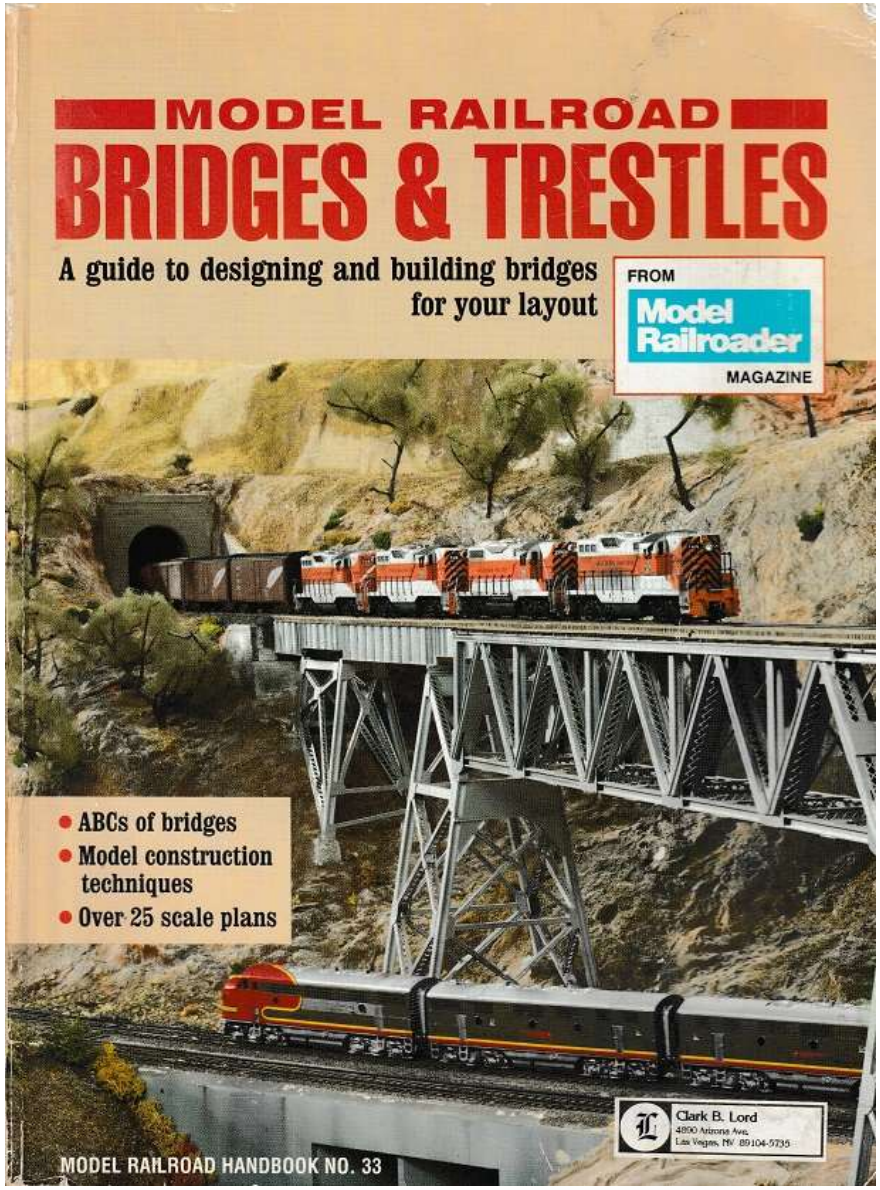
Elevation of bent

Trestle Bents

Southern Pacific Practice



References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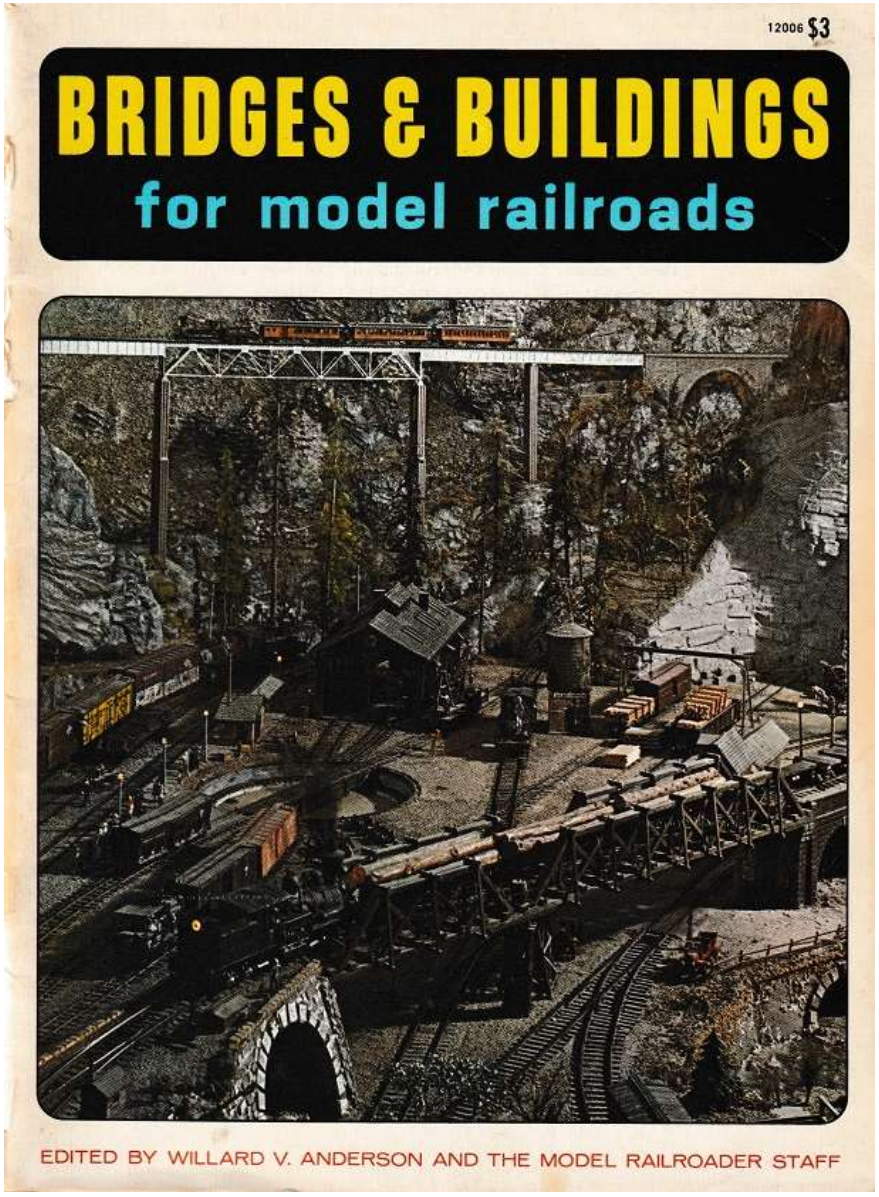
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