

## SECTION V: METAL TRUSS BRIDGES

### HISTORICAL DEVELOPMENT

Truss bridges built in either iron or steel constitute a large number of Maryland's known historic bridges. These bridges, designed and constructed in a wide variety of types during the nineteenth and twentieth centuries, are among the most familiar historic bridges in the state. The type is widely recognized, taking second place only to timber-covered bridges and stone arch spans in their attractiveness to feature writers for newspapers and magazines. Metal truss bridges possess a significant technological history directly reflecting the evolution of Maryland's transportation network.

Prominent American highway and bridge engineer Milo S. Ketchum in his 1908 work *The Design of Highway Bridges and the Calculation of Stresses in Bridge Trusses* offered the following, succinct definition of a truss bridge:

A truss is a framework composed of individual members so fastened together that loads applied at the joints produce only direct tension or compression. The triangle is the only geometrical figure in which the form is changed only by changing the lengths of the sides. In its simplest form every truss is a triangle or a combination of triangles. The members of the truss are either fastened together with pins, pin-connected, or with plates and rivets, riveted [Ketchum 1908:1].

Whereas a simply supported beam bridge spanning between abutments is subject to direct bending, with one structural member carrying both compressive and tensile stresses, the members of a truss individually carry only tensile or compressive stresses. The distribution of tensile (pulling a member apart) and compressive (pushing a member together) forces varies with the many types of trusses (Figures 8 through 11; Plate 5).

As presented in the Timber Bridges section of this report, construction of truss bridges in the United States originally began in the late eighteenth century utilizing timber as the basic building material. Renaissance architect Andrea Palladio's pioneering discussion of trusses was translated and circulated here as early as the 1740s, while in Europe during the late 1700s such innovative builders as the Grubenmanns erected covered wooden truss bridges in mountainous areas (Pennsylvania Historical and Museum Commission, and Pennsylvania Department of Transportation 1986:109-126).

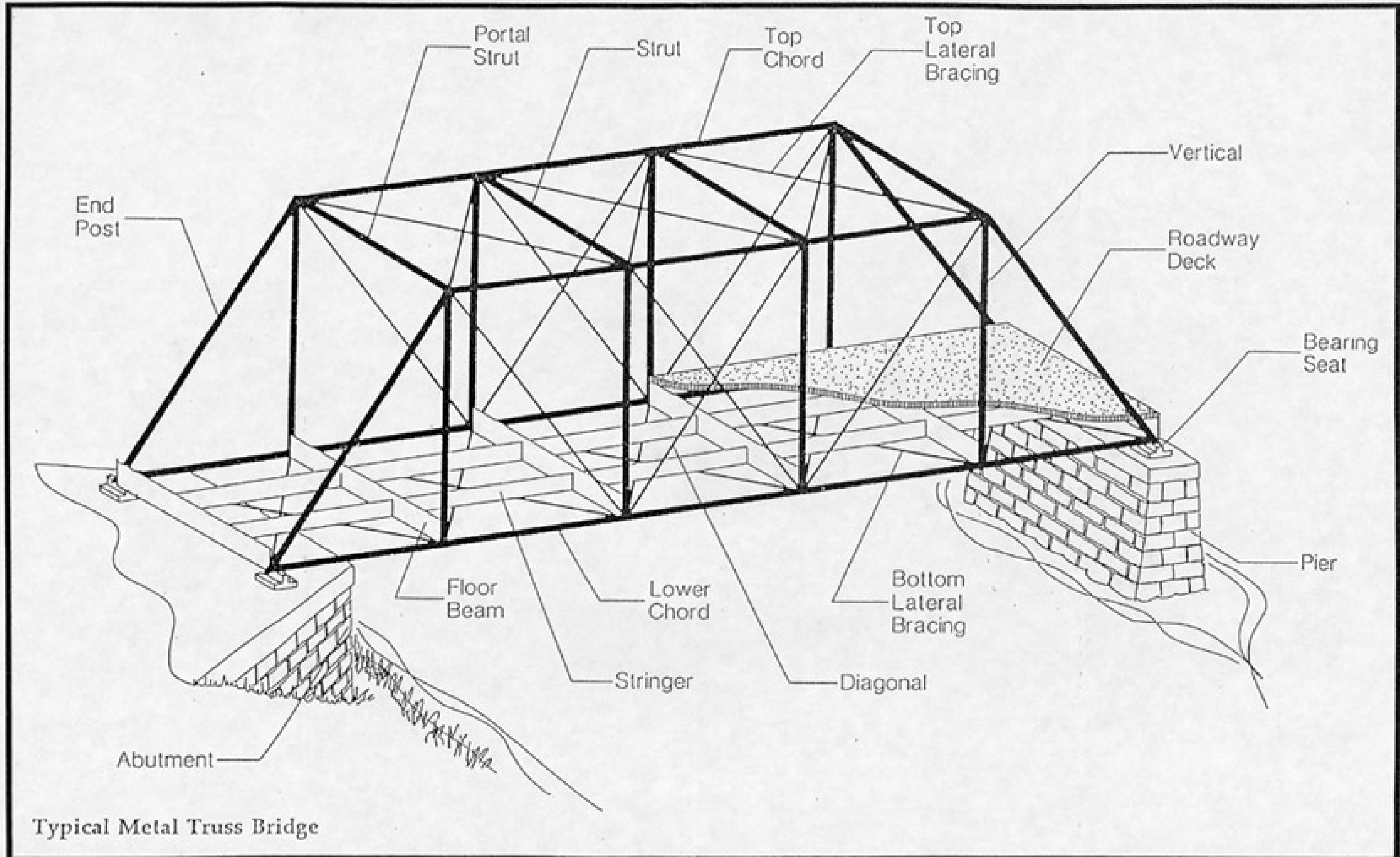


FIGURE 8: Typical Metal Truss Bridge

SOURCE: Pennsylvania Historical and Museum Commission and Pennsylvania Department of Transportation 1986



### HOWE

1840 - 20TH CENTURY

(WOOD, VERTICALS OF METAL)

DIAGONALS IN COMPRESSION, VERTICALS IN TENSION.

LENGTH: 30-150 FEET  
9-45 METERS



### PRATT

1844 - 20TH CENTURY

DIAGONALS IN TENSION, VERTICALS IN COMPRESSION, (EXCEPT FOR HIP VERTICALS ADJACENT TO INCLINED END POSTS).

LENGTH: 25-150 FEET  
8-45 METERS

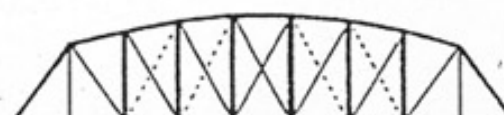


### PRATT HALF-HIP

LATE 19TH-EARLY 20TH CENTURY

A PRATT WITH INCLINED END POSTS THAT DO NOT HORIZONTALLY EXTEND THE LENGTH OF A FULL PANEL.

LENGTH: 30-150 FEET  
9-45 METERS

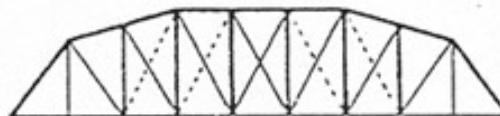


### PARKER

MID-LATE 19TH-20 CENTURY

A PRATT WITH A POLYGONAL TOP CHORD

LENGTH: 40-200 FEET  
12-60 METERS

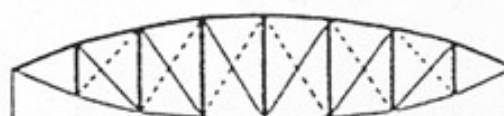


### CAMELBACK

LATE 19TH-20TH CENTURY

A PARKER WITH A POLYGONAL TOP CHORD OF EXACTLY FIVE SLOPES.

LENGTH: 100-300 FEET  
30-90 METERS



### LENTICULAR (PARABOLIC)

1870 - EARLY 20TH CENTURY

A PRATT WITH BOTH TOP AND BOTTOM CHORDS PARABOLICALLY CURVED OVER THEIR ENTIRE LENGTH.

LENGTH: 150-400 FEET  
45-120 METERS



### BALTIMORE (PETIT)

1871 - EARLY 20TH CENTURY

A. A PRATT WITH SUB-STRUTS  
B. A PRATT WITH SUB-TIES

LENGTH: 250-400 FEET  
75-100 METERS



### PENNSYLVANIA (PETIT)

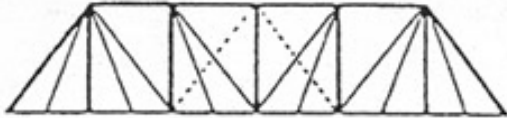
1875 - EARLY 20TH CENTURY

A. A PARKER WITH SUB-STRUTS.  
B. A PARKER WITH SUB-TIES.

LENGTH: 250-400 FEET  
75-100 METERS

FIGURE 9: Metal Truss Types

SOURCE: Allen and Jackson 1975

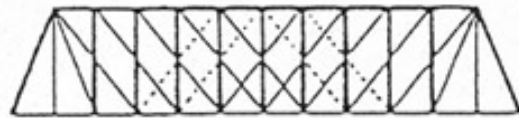


### KELLOGG

LATE 19TH CENTURY

A VARIATION ON THE PRATT WITH ADDITIONAL DIAGONALS RUNNING FROM UPPER CHORD PANEL POINTS TO THE CENTER OF THE LOWER CHORDS.

LENGTH: 75-150 FEET  
23-30 METERS



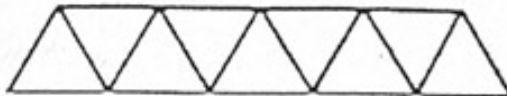
### DOUBLE INTERSECTION PRATT

1847-20TH CENTURY

(WHIPPLE, WHIPPLE-MURPHY, LAMVILLE)

AN INCLINED END POST PRATT WITH DIAGONALS THAT EXTEND ACROSS TWO PANELS.

LENGTH: 70-300 FEET  
21-90 METERS



### WARREN

1840-20TH CENTURY

TRIANGULAR IN OUTLINE THE DIAGONALS CARRY BOTH COMPRESSIVE AND TENSILE FORCES. A TRUE WARREN TRUSS HAS EQUILATERAL TRIANGLES.

LENGTH: 50-400 FEET  
15-120 METERS



### WARREN

WITH VERTICALS

MID 19TH-20TH CENTURY

DIAGONALS CARRY BOTH COMPRESSIVE AND TENSILE FORCES. VERTICALS SERVE AS BRACING FOR TRIANGULAR WED SYSTEM.

LENGTH: 50-400 FEET  
15-120 METERS

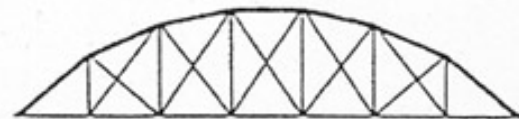


### DOUBLE INTERSECTION WARREN (LATTICE)

MID 19TH-20TH CENTURY

STRUCTURE IS INDETERMINANT. MEMBERS ACT IN BOTH COMPRESSION AND TENSION. TWO TRIANGULAR WED SYSTEMS ARE SUPERIMPOSED UPON EACH OTHER WITH OR WITHOUT VERTICALS.

LENGTH: 75-400 FEET  
23-120 METERS

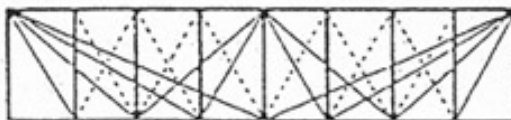


### BOWSTRING ARCH-TRUSS

1840- LATE 19TH CENTURY

A TIED ARCH WITH THE DIAGONALS SERVING AS BRACING AND THE VERTICALS SUPPORTING THE DECK.

LENGTH: 70-175 FEET  
21-50 METERS



### FINK

1851- MID-LATE 19TH CENTURY

(RARE)

VERTICALS IN COMPRESSION, DIAGONALS IN TENSION. LONGEST DIAGONALS RUN FROM END POSTS TO CENTER PANEL POINTS.

LENGTH: 75-100 FEET  
23-45 METERS



### BOLLMAN

1852- MID-LATE 19TH CENTURY

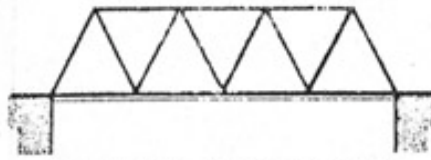
(RARE)

VERTICALS IN COMPRESSION, DIAGONALS IN TENSION. DIAGONALS RUN FROM END POSTS TO EVERY PANEL POINT.

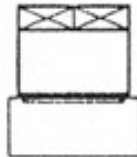
LENGTH: 75-100 FEET  
23-30 METERS

FIGURE 10: Metal Truss Types

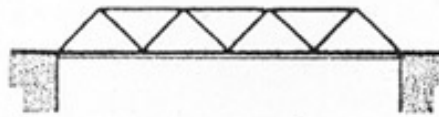
SOURCE: Allen and Jackson 1975



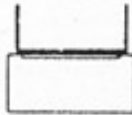
LONGITUDINAL SECTION/ELEVATION



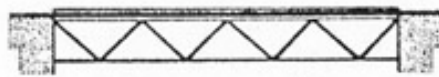
TRANSVERSE SECTION  
THROUGH TRUSS



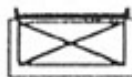
LONGITUDINAL SECTION/ELEVATION



TRANSVERSE SECTION  
PONY TRUSS



LONGITUDINAL SECTION/ELEVATION



TRANSVERSE SECTION  
DECK TRUSS

FIGURE 11: Types of Metal Truss Bridges

SOURCE: Allen and Jackson 1975