B

Appendix B

A Gallery of Structural Analysis Results

Description

The Gallery of Structural Analysis Results provides internal member forces for 18 different truss configurations. All of these trusses are statically determinate, and all have a span length of ***6L***—six panels of equal length ***L***. In all cases, the loading is assumed to be a weight, ***W***, placed at the center of the span. The weight is placed on the top chord of the bridge, except in two cases where the rounded shape of the top chord provides no flat surface on which to place the load. In these cases (Trusses 5 and 11), the loading is applied to the bottom chord. Each truss is assumed to be one of two main trusses in a bridge; thus each truss carries exactly half of the load ***W***. All internal member forces are given in terms of ***W***, so the structural analysis results can be easily determined for any magnitude of load.

How to Use this Resource

Here are a few suggestions for using the Gallery of Structural Analysis Results to enhance your understanding of structures and engineering design:

- Select any bridge configuration from the Gallery, and calculate its internal member forces using the Method of Joints. Then use the analysis results provided in the Gallery to check your work. (Learning Activity #3)
- Compare the analysis results from various truss configurations in the Gallery to determine how the height and shape of a truss affect its internal member forces. (Learning Activity #4)
- Select a bridge from the Gallery, then design, build, and test a cardboard model of it. To determine the internal member forces—an essential part of the design process—use the Gallery in lieu of the Method of Joints. (Learning Activity #5)

How to Determine Internal Member Forces

To determine the internal member forces for a given truss:

1) Select a truss from the Gallery of Structural Analysis Results.
2) Decide on the total amount of weight that the bridge will carry. This is ***W***. Note that the total load applied to each truss is only half of the total weight *(**0.5W**)*. The bridge is assumed to consist of two main trusses; therefore, each truss carries half of the total load.
3) Next to each member on the diagram, you will see a decimal number. For each member, multiply the decimal number by the value of ***W*** you determined in Step 2. This product is the internal member force, expressed in the same units you used for ***W***. If the decimal value is positive, the member is in tension. If it is negative, the member is in compression.

For example, let's assume that Truss 1 (on the following page) has a total load ***W***=10 newtons. Then the bottom chord member on the left-hand side of the truss has an internal force of

$$\boldsymbol{F} = +\mathbf{0.333}\boldsymbol{W} = +\mathbf{0.333}(\mathbf{10}\ N) = +\mathbf{3.33}\ N = \underline{\underline{\mathbf{3.33}\ N\ (tension)}}$$

For ***W***=10 newtons, the two top-chord members at the center of the span have an internal force of

$$\boldsymbol{F} = -\mathbf{0.778}\boldsymbol{W} = -\mathbf{0.778}(\mathbf{10}\ N) = -\mathbf{7.78}\ N = \underline{\underline{\mathbf{7.78}\ N\ (compression)}}$$

Note that the internal member forces do not depend on the length ***L***. They are valid for a truss of *any* span—as long as the span length and height of the truss are in the proportions shown on the diagram.

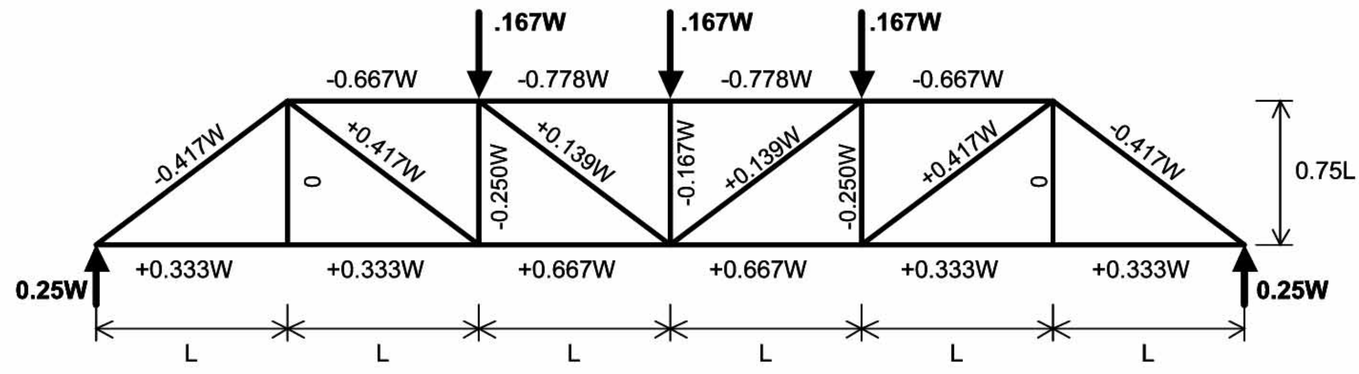
To determine ***L***, divide the total span length of the bridge by six. Once you know ***L***, you can use this number to determine the actual height of the truss.

Again, as an example, let's use Truss 1 and assume that its total span length is 60 centimeters. Then

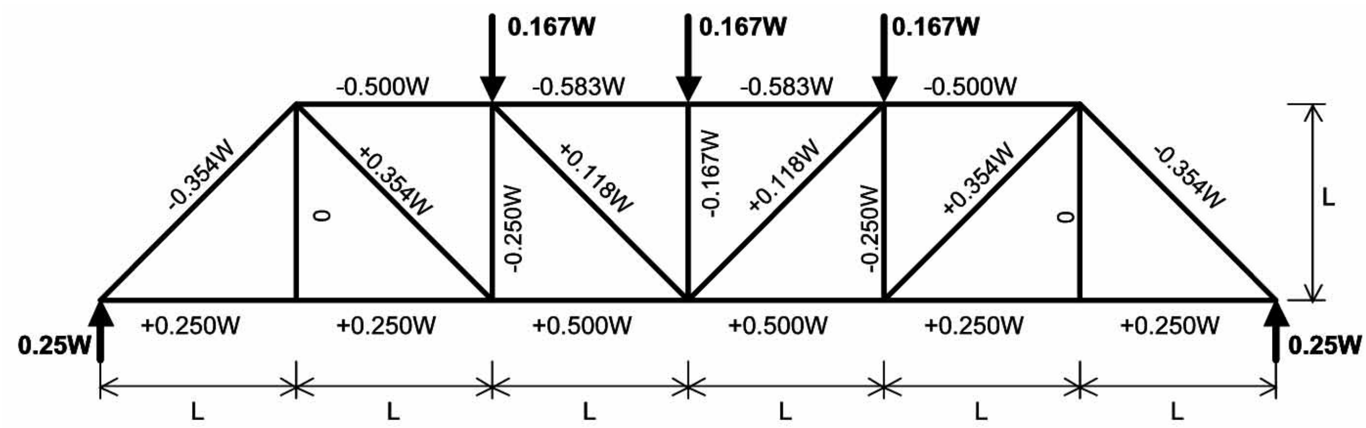
$$\boldsymbol{L} = \frac{Total\ Span}{\mathbf{6}} = \frac{\mathbf{60}\ cm}{\mathbf{6}} = \underline{\underline{\mathbf{10}\ cm}}$$

On the picture, the height of Truss 1 is shown as ***0.75L***. Therefore the actual height is

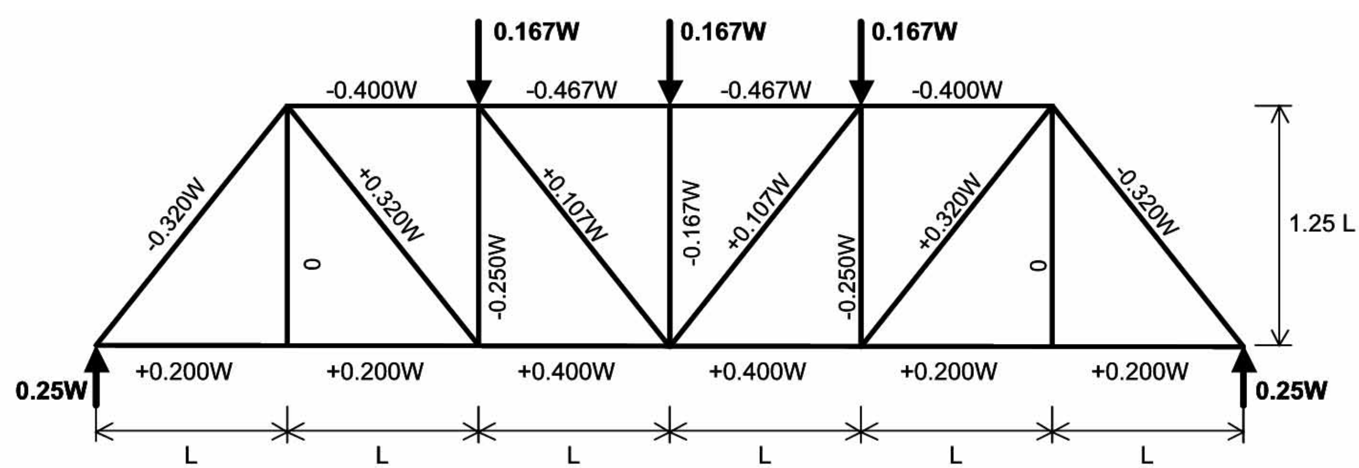
$$Height = \mathbf{0.75}\boldsymbol{L} = \mathbf{0.75}(\mathbf{10}\ cm) = \underline{\underline{\mathbf{7.5}\ cm}}$$



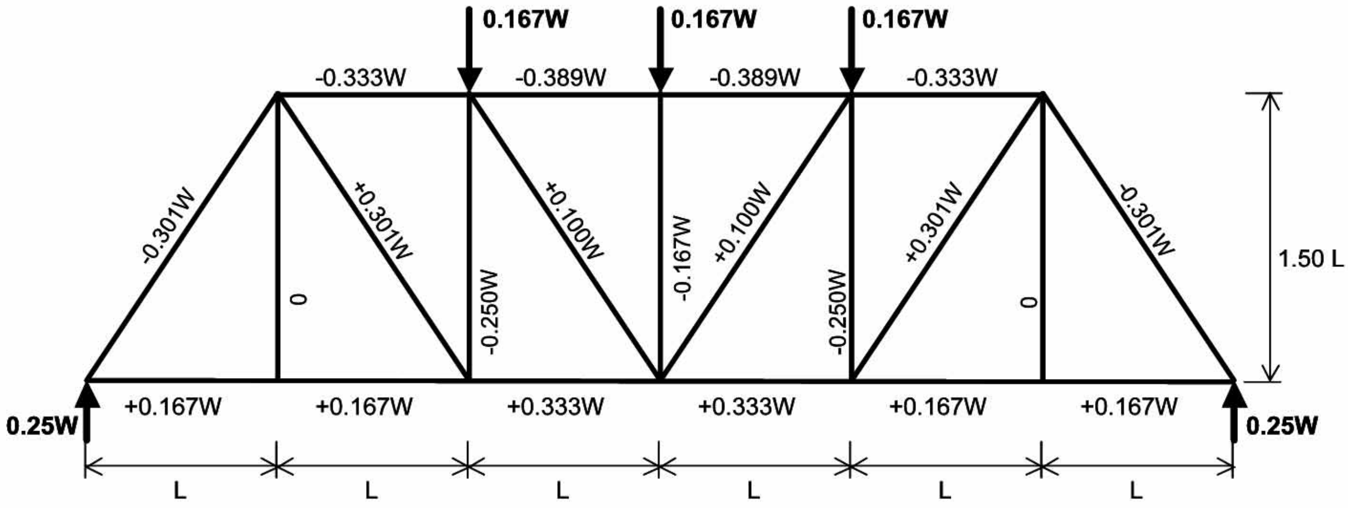
1. Pratt Through Truss (Span=6L, Height=0.75L).



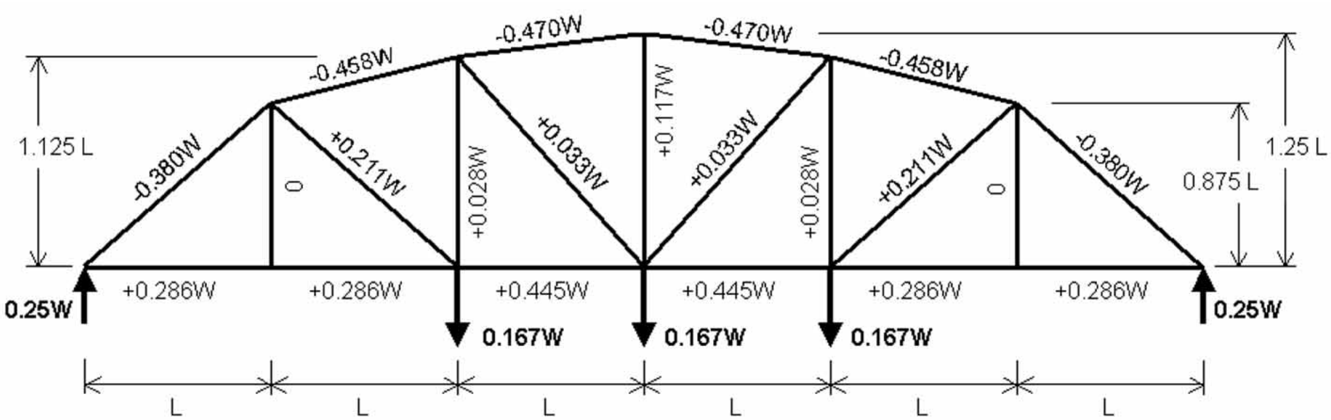
2. Pratt Through Truss (Span=6L, Height=L).



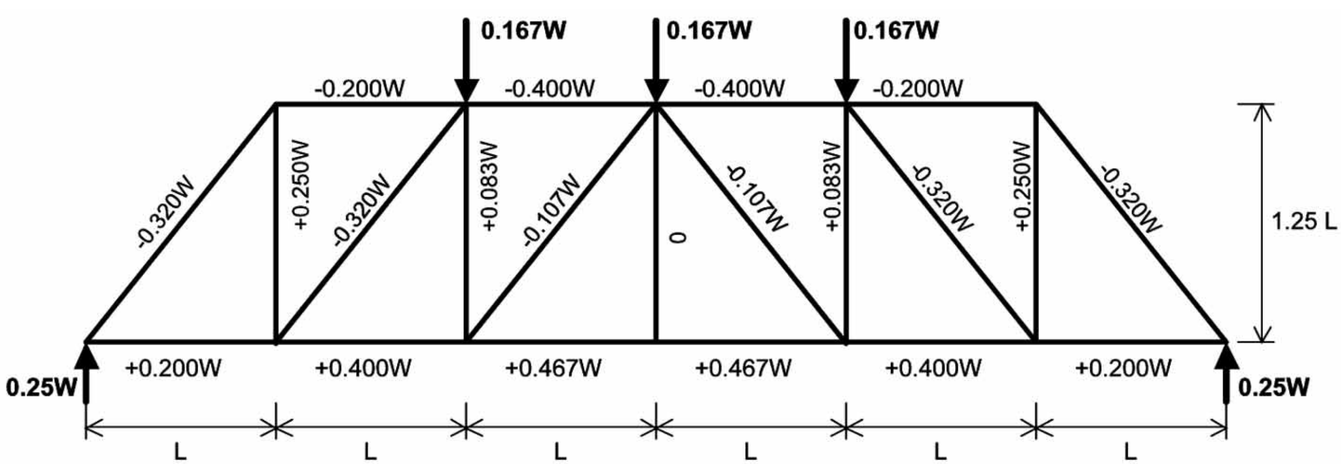
3. Pratt Through Truss (Span=6L, Height=1.25L).



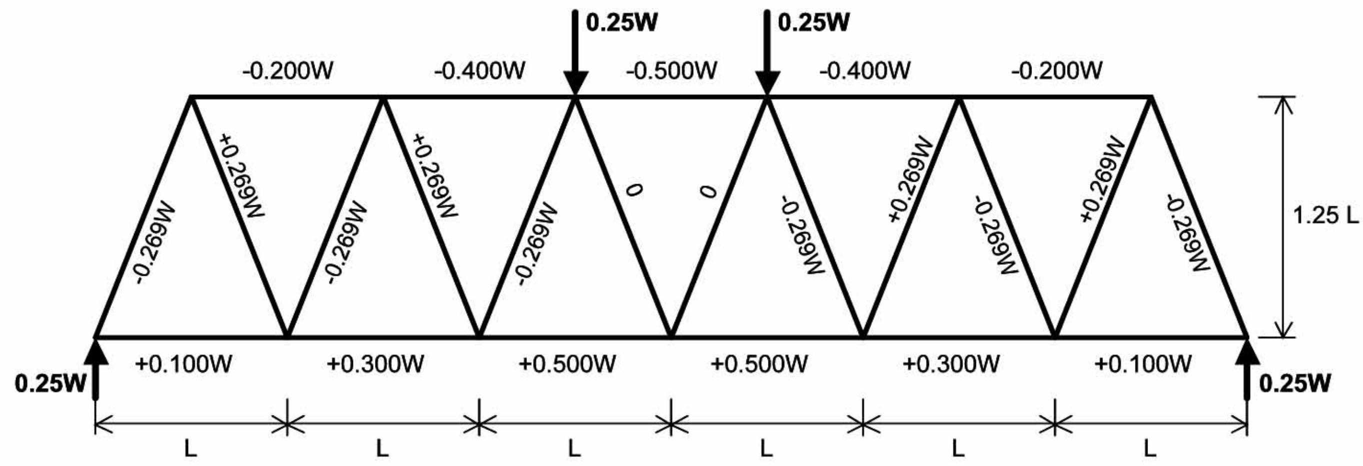
4. Pratt Through Truss (Span=6L, Height=1.50L).



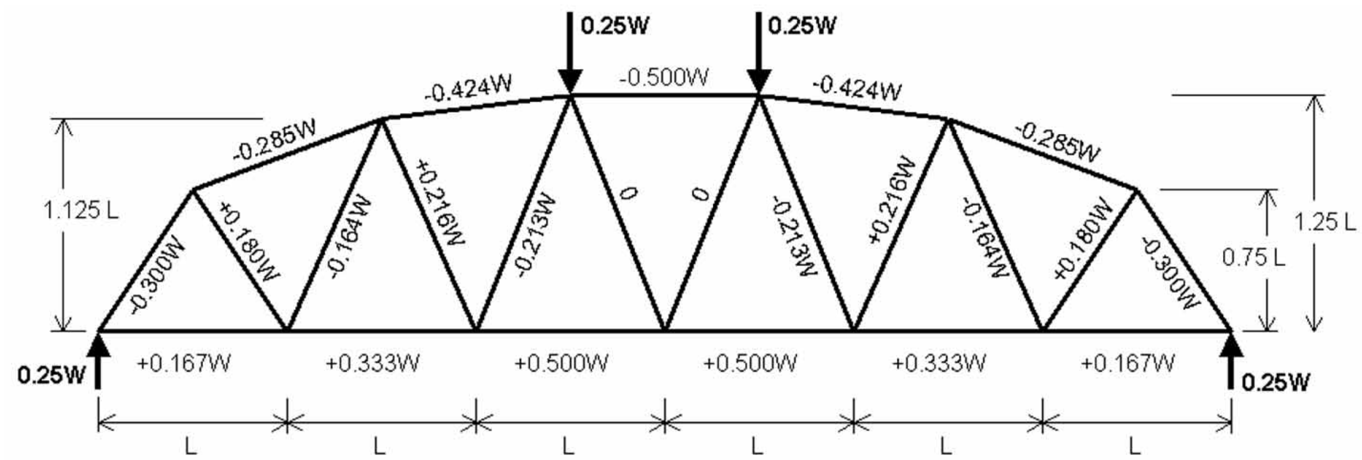
5. Parker Through Truss (Span=6L, Height=1.25L).



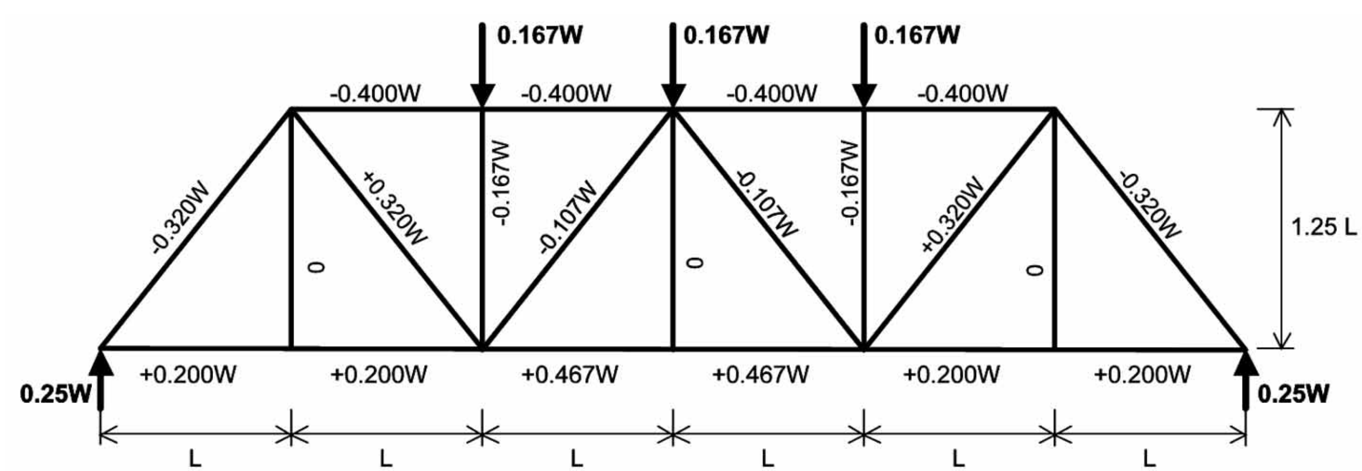
6. Howe Through Truss (Span=6L, Height=1.25L).



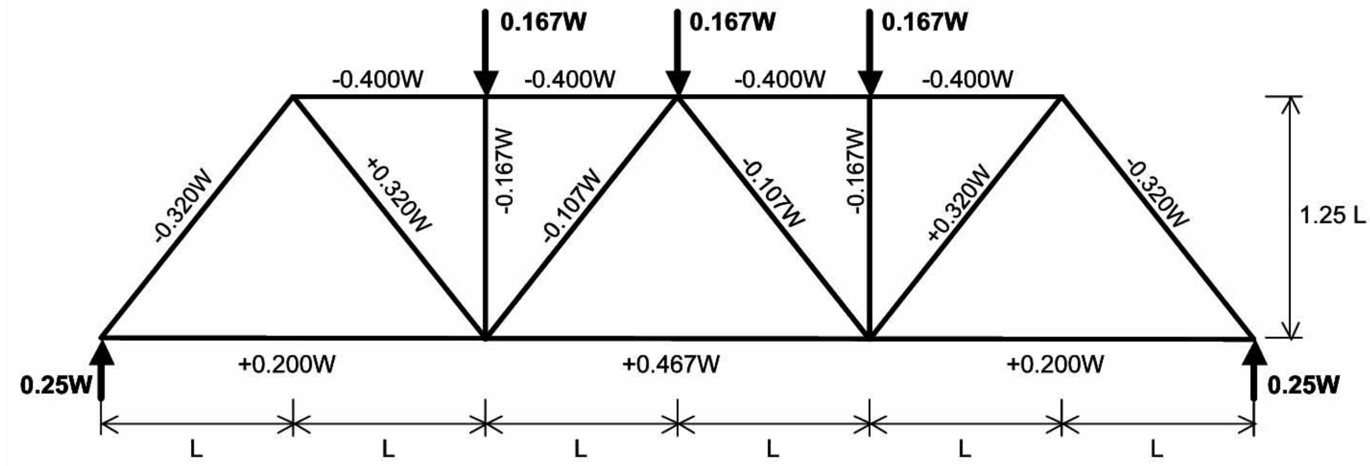
7. Warren Through Truss (Span=6L, Height=1.25L).



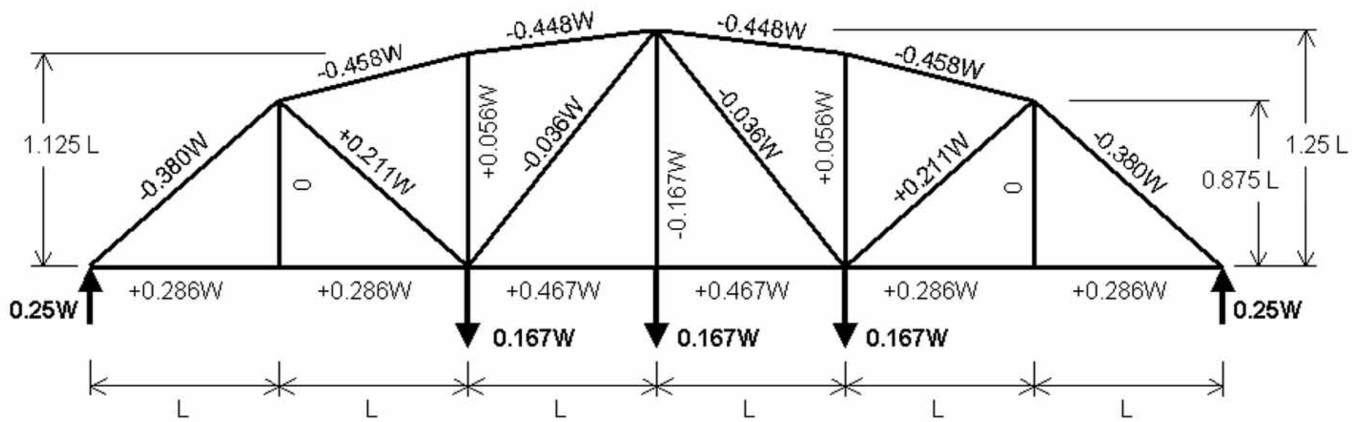
8. Warren Through Truss (Span=6L, Height=1.25L).



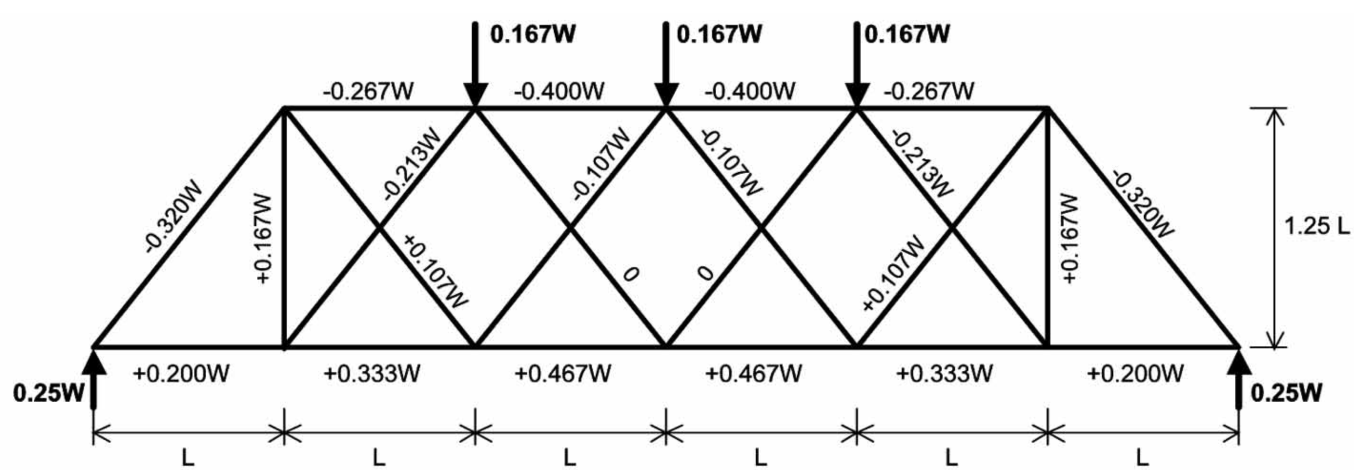
9. Warren Through Truss with Verticals (Span=6L, Height=1.25L).



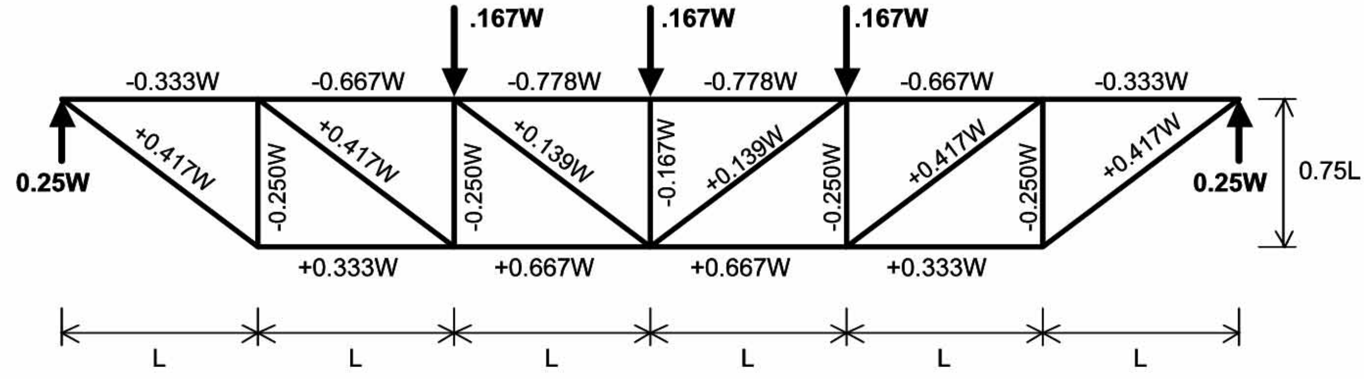
10. Warren Through Truss with Verticals (Span=6L, Height=1.25L).



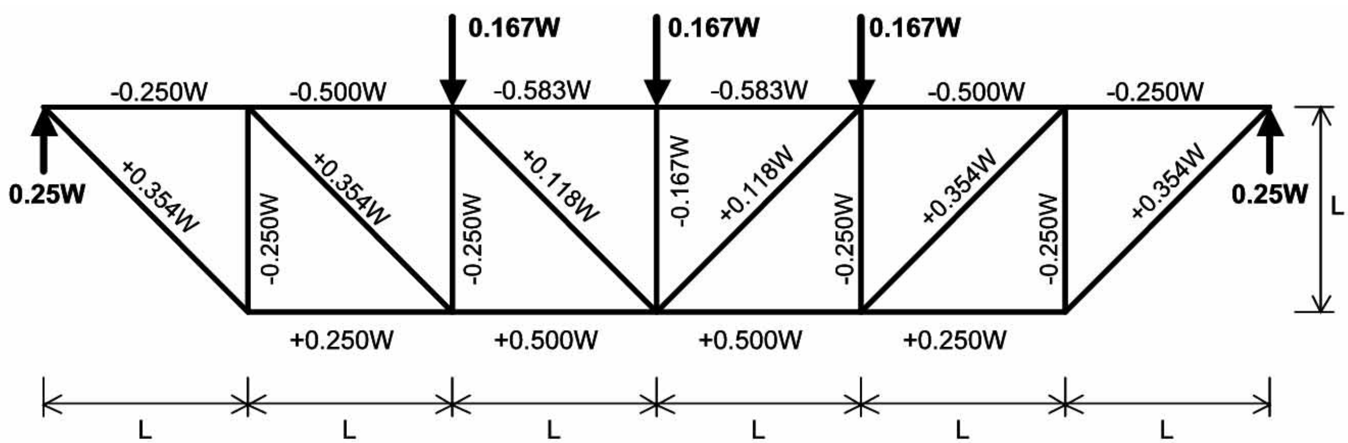
11. Warren Through Truss with Verticals (Span=6L, Height=1.25L).



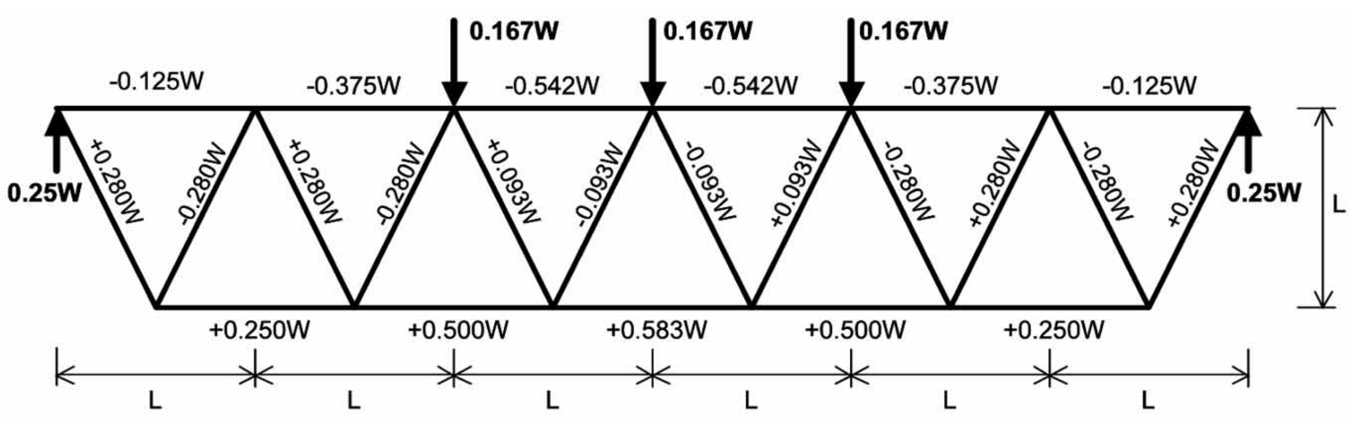
12. Double-Intersection Warren Through Truss (Span=6L, Height=1.25L). On this truss, the points where pairs of diagonals cross over each other are *not* joints. The members are not physically connected to each other at these points.



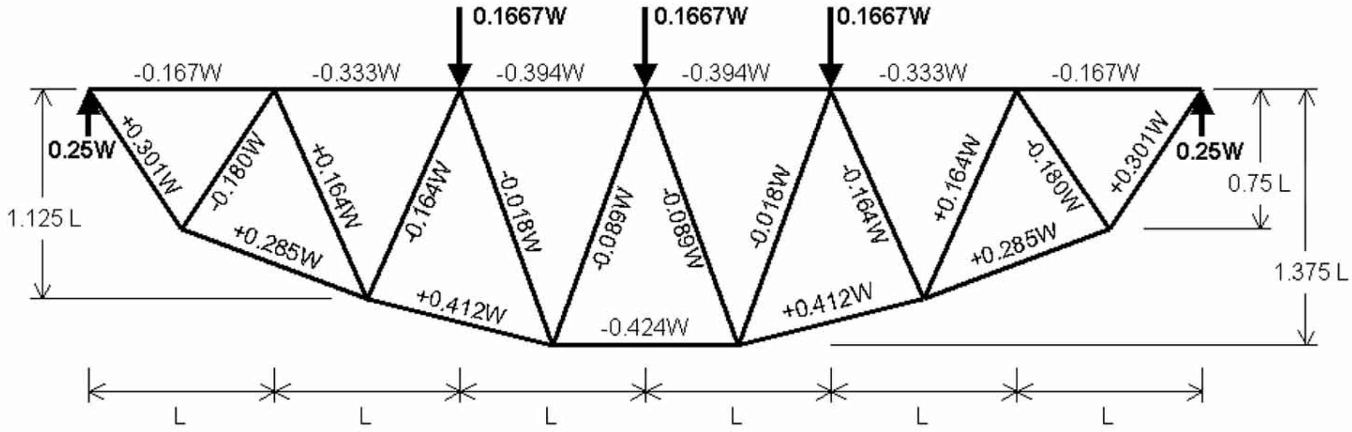
13. Pratt Deck Truss (Span=6L, Height=0.75L).



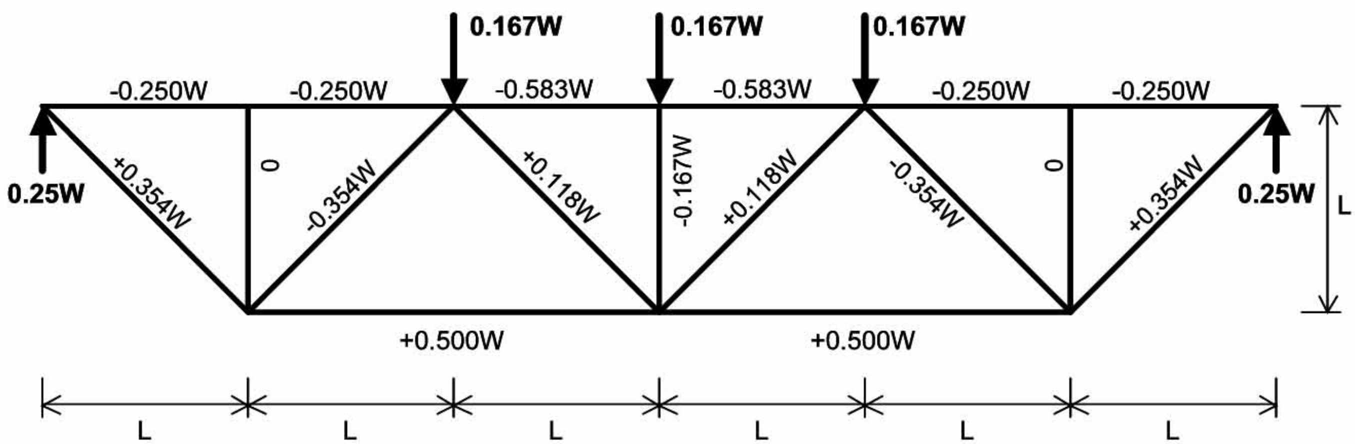
14. Pratt Deck Truss (Span=6L, Height=L).



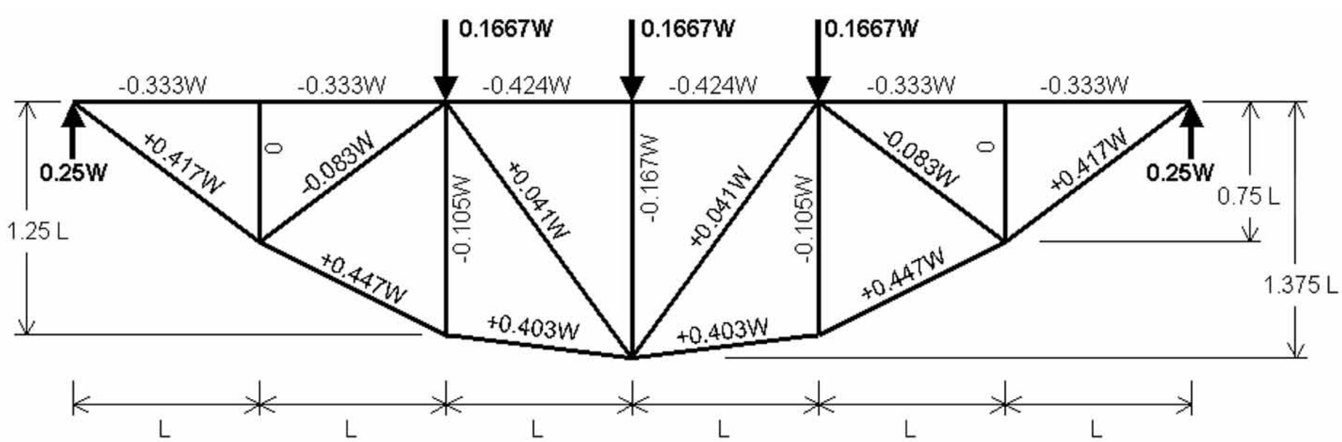
15. Warren Deck Truss (Span=6L, Height=L).



16. Warren Deck Truss (Span=6L, Height=1.375L).



17. Warren Deck Truss with Verticals (Span=6L, Height=L).



18. Warren Deck Truss with Verticals (Span=6L, Height=1.375L).