

PROCEDURE FOR ANALYSIS

The following procedure may be used to determine a specific displacement of any joint on a truss using the method of virtual work.

Virtual Forces n

- Place the unit load on the truss at the joint where the desired displacement is to be determined. The load should be in the same direction as the specified displacement, e.g., horizontal or vertical.
- With the unit load so placed, and all the real loads removed from the truss, use the method of joints or the method of sections and calculate the internal n force in each truss member. Assume that tensile forces are positive and compressive forces are negative.

Real Forces N

- Use the method of sections or the method of joints to determine the N force in each member. These forces are caused only by the real loads acting on the truss. Again, assume tensile forces are positive and compressive forces are negative.

Virtual-Work Equation

- Apply the equation of virtual work, to determine the desired displacement. It is important to retain the algebraic sign for each of the corresponding n and N forces when substituting these terms into the equation.
- If the resultant sum $\sum nNL/AE$ is positive, the displacement Δ is in the same direction as the unit load. If a negative value results, Δ is opposite to the unit load.
- When applying $1 \cdot \Delta = \sum n\Delta T L$, realize that if any of the members undergoes an increase in temperature, ΔT will be positive, whereas a decrease in temperature results in a negative value for ΔT .
- For $1 \cdot \Delta = \sum n \Delta L$, when a fabrication error increases the length of a member, ΔL is positive, whereas a decrease in length is negative.
- When applying any formula, attention should be paid to the units of each numerical quantity. In particular, the virtual unit load can be assigned any arbitrary unit (lb, kip, N, etc.), since the n forces will have these same units, and as a result the units for both the virtual unit load and the n forces will cancel from both sides of the equation.

Determine the displacement of joint C in Fig. 9-8a, and $E = 29$

Solution

Virtual Forces n
the force in each member is determined by the method of joints and negative results are shown by the force in each member.

Real Forces N
the method of joints and negative results are shown by the force in each member.

Member

AB
BC
CD
DE
FE
EB
BF
AF
CE

Thus

Converting the numerical values