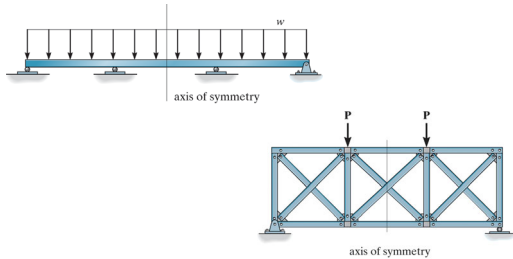


Chapter 9

Analysis of statically indeterminate **symmetric** structures by the force method



1

Analysis of statically indeterminate structures by the **force method**

Statically indeterminate **symmetric** structures

➤ A structural analysis of any highly indeterminate structure, or even a statically determinate structure, can be simplified if you can recognize symmetric structures and that support either symmetric or antisymmetric loadings.

➤ In a general sense, a structure can be classified as being **symmetric** provided half of it develops the same internal loadings and deflections as its mirror image reflected about its central axis.

2

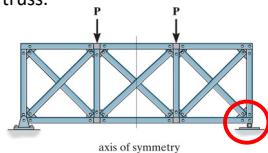
Analysis of statically indeterminate structures by the **force method**

Statically indeterminate **symmetric** structures

➤ Normally, **symmetry** requires the material composition, geometry, supports, and loading to be the same on each side of the structure.

➤ However, this does not always have to be the case.

➤ For example, for horizontal stability, a pin is required to support this truss.



3

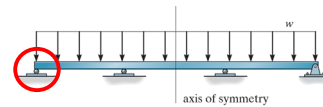
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➤ For example, for horizontal stability, a pin is required to support this beam.



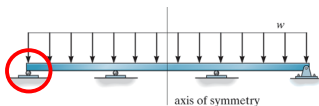
4

Analysis of statically indeterminate structures by the **force method**

Statically indeterminate **symmetric** structures

➤ In these cases, the horizontal reaction at the pin is zero, and so both structures will deflect and produce the same internal loading as their reflected counterpart.

➤ Thus, they can both be classified as **symmetric**.

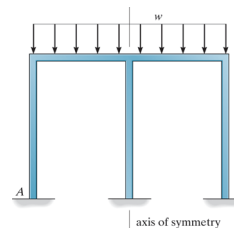


5

Analysis of statically indeterminate structures by the **force method**

Statically indeterminate **symmetric** structures

➤ This would **not** be the case for the following frame



➤ If a pin replaced the fixed support at A, then the deflected shape and internal loadings would not be the same on its left and right sides.

6

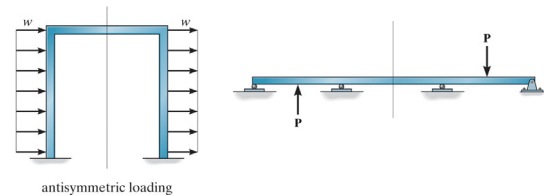
Analysis of statically indeterminate structures by the **force method****Statically indeterminate symmetric structures**

- Sometimes a symmetric structure supports an antisymmetric loading, that is, the loading on its reflected side has the opposite direction.
- Provided the structure is symmetric and its loading is either symmetric or antisymmetric, then a structural analysis will only have to be performed on half the members of the structure since the same (symmetric) or opposite (antisymmetric) results will be produced on the other half.

7

Analysis of statically indeterminate structures by the **force method****Statically indeterminate symmetric structures**

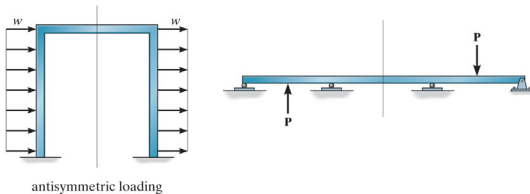
- Sometimes a symmetric structure supports an antisymmetric loading, that is, the loading on its reflected side has the opposite direction.



8

Analysis of statically indeterminate structures by the **force method****Statically indeterminate symmetric structures**

- If a structure is symmetric and its loading is either symmetric or antisymmetric, then a structural analysis will only have to be performed on half the members of the structure since the same (symmetric) or opposite (antisymmetric) results will be produced on the other half.



9

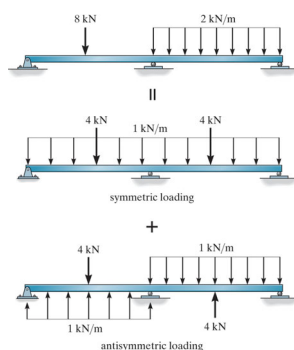
Analysis of statically indeterminate structures by the **force method****Statically indeterminate symmetric structures**

- In cases where a structure is symmetric and its applied loading is unsymmetrical, then it is possible to transform this loading into symmetric and antisymmetric components.
- To do this, *the loading is first divided in half, then it is reflected to the other side of the structure, so that both symmetric and antisymmetric components are produced.*

10

Analysis of statically indeterminate structures by the **force method****Statically indeterminate symmetric structures**

- For example, the loading is divided by two and reflected about the beam's axis of symmetry.



11

Analysis of statically indeterminate structures by the **force method**

Let's work on some problems

12

Analysis of statically indeterminate structures by the **force method**

Any questions?

