Analysis of Truss Structure 000	Method of Joints 00000	Method of Sections	Zero-Force Members	Summary 00

Analysis of Truss Structures

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4 Zero-Force Members

• Identification and Examples

Part 2

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Analysis of Truss Structure

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Modeling Assu	Imptions			



- Pins offer no resistance to moment (i.e., frictionless).
- Truss elements are straight.
- Truss elements can only carry axial forces: tension (T), compression (C).

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• Loads are only applied at the joints.

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Zero-Force Members

(Simplify Analysis by removing Zero-Force Members)

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Zero-Force Members					

Case 1. If no external load is applied to a joint connecting two bars, the force in both bars is zero.

Case 2. If no external load is applied to a joint connecting three bars, two of which are colinear, then the force in the bar that is not colinear is zero.



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Example 1.



At A and B [1] we have two connecting elements, but Case 1 does not apply because reaction forces V_A and V_B ≠ 0.0.

• But at [2] the pin is connected to three elements, two are colinear, and no external forces. Case II applies.

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Example 2.



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Step-by-Step Procedure:

$$\sum M_A = 0 \rightarrow PL + PL - V_C(2L) = 0 \rightarrow V_C = P.$$
(1)

$$\sum F_y = 0 \rightarrow V_A + V_C = P \rightarrow V_A = 0.$$
 (2)

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At pin B:

• A-B and B-C are colinear, no external force at B. Case 2 applies.

At pin E:

• Same argument as pin B. Case 2 applies.

At pin D:

• Element D-E is colinear with applied load. Force C-D = 0.



At pin A:

- $V_A = 0$. H_A is colinear with A-B and B-C.
- Element force A-F is zero.

Simplified Structure (with zero-elements removed):



Zero-Force Members: Midterm I, 2019



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Zero-Force Members: Midterm I, 2019



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Summary

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Summary				

Method of Joints vs Method of Sections

- Use method of joints when you need to know element forces throughout the structure. Two equations of equilibrium per joint.
- Method of sections provides a short cut for solution of forces in a few specified bars.

Simplifications

• You can reduce computational effort by taking advantage of symmetries (when they exist) and removing zero-force members.

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