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THEORY OF STRUCTURES

CHAPTER 1 : STABILITY

PART 3

by

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Chapter 1 : Part 3 – Stability

- Aims
 - Defined the term of stability
 - Identified the stability of the structure
 - Calculated the determinacy criteria of structure and check the stability of structure.
- Expected Outcomes :
 - Able to identify the stability and determinacy of structures
- References
 - Mechanics of Materials, R.C. Hibbeler, 7th Edition, Prentice Hall
 - Structural Analysis, Hibbeler, 7th Edition, Prentice Hall
 - Structural Analysis, SI Edition by Aslam Kassimali, Cengage Learning
 - Structural Analysis, Coates, Coatie and Kong
 - Structural Analysis - A Classical and Matrix Approach, Jack C. McCormac and James K. Nelson, Jr., 4th Edition, John Wiley



STABILITY

- To ensure the equilibrium of a structure or its member, it is not only necessary to satisfy the equation of equilibrium, but the member must also be properly held or constrained by their support.
- Two situations may occur where the conditions for proper constraint have not been met. There are:

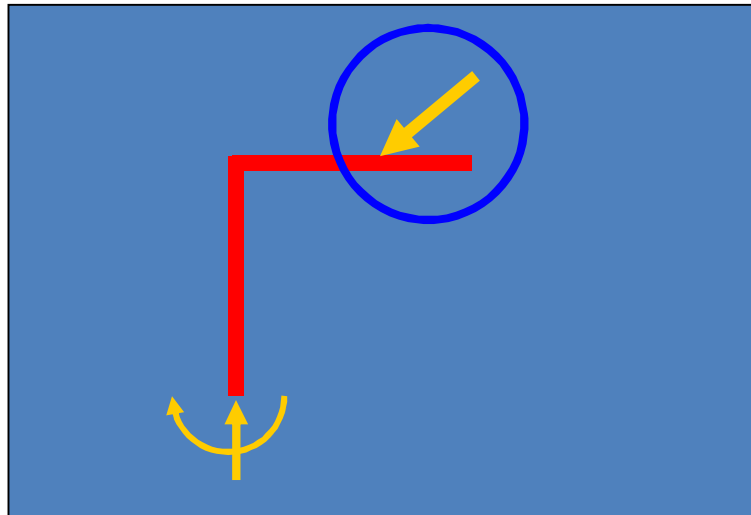


Partial Constraints



Improper Constraints

Partial Constraint

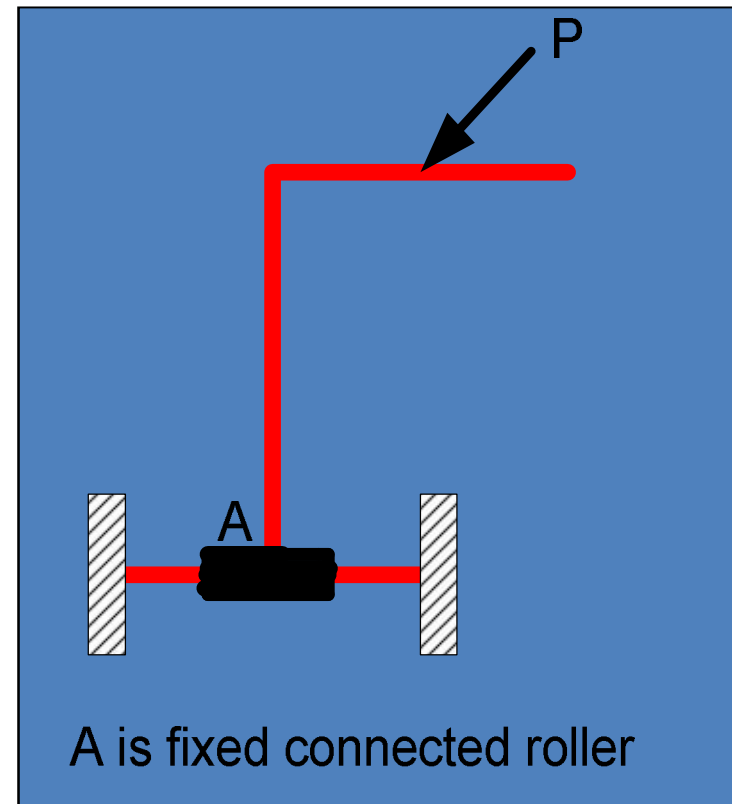


Note:

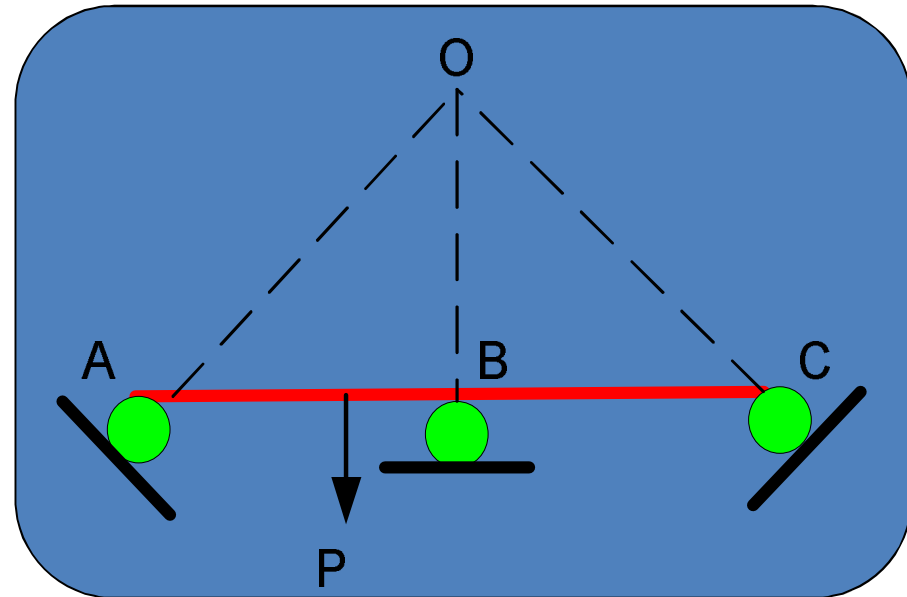
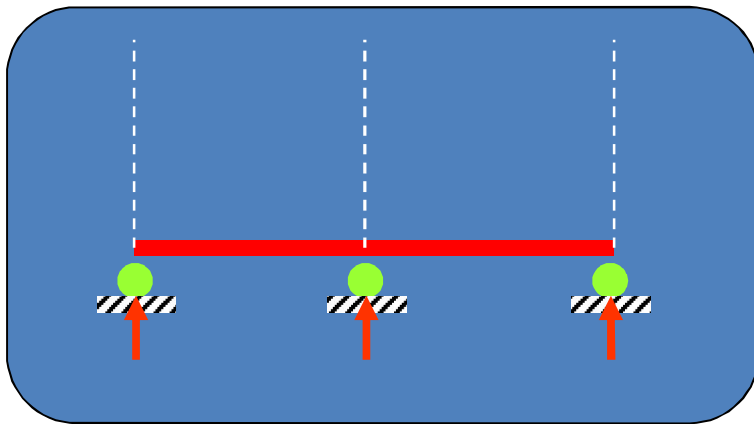
Not fulfill equation of equilibrium

$\Sigma F_x = 0$ will not be satisfied

Member will be unstable



Improper constraints



When support reaction concurrent at joint
reaction force are all parallel

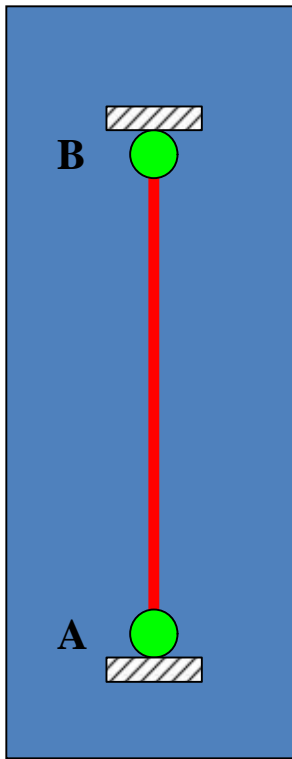


Figure A

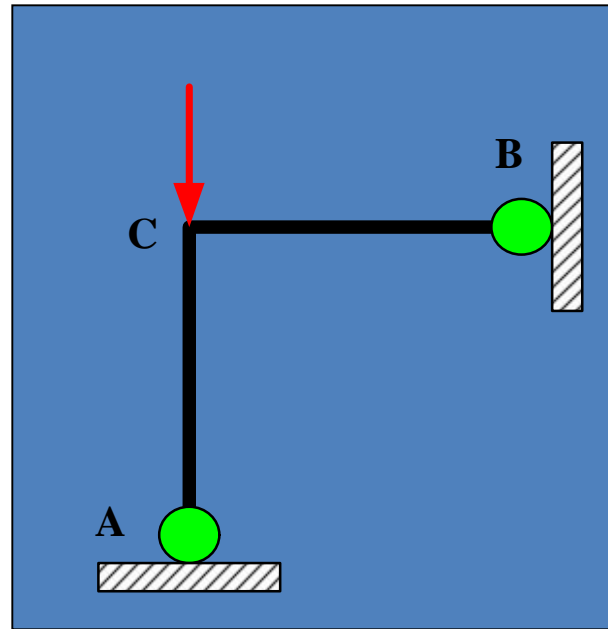


Figure B

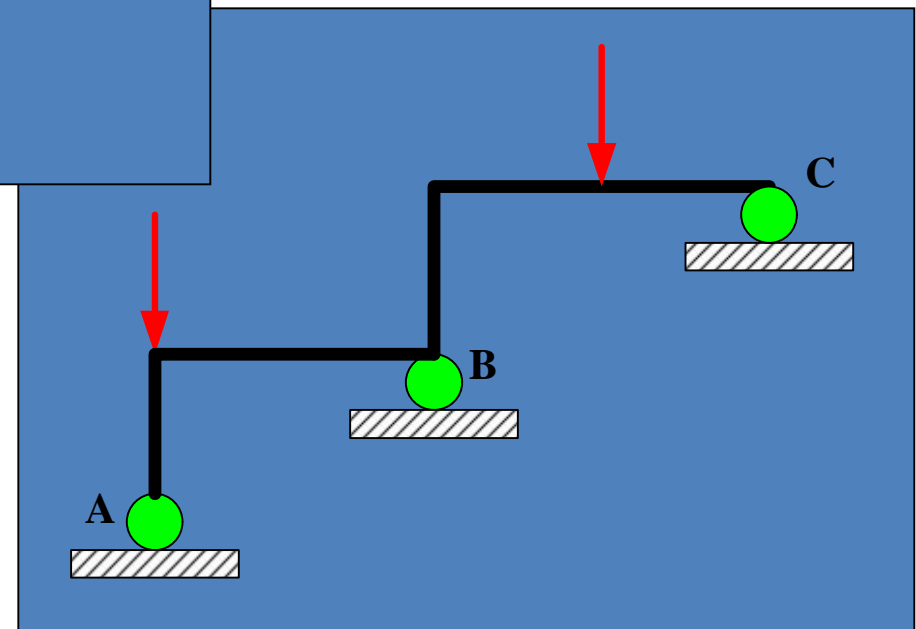
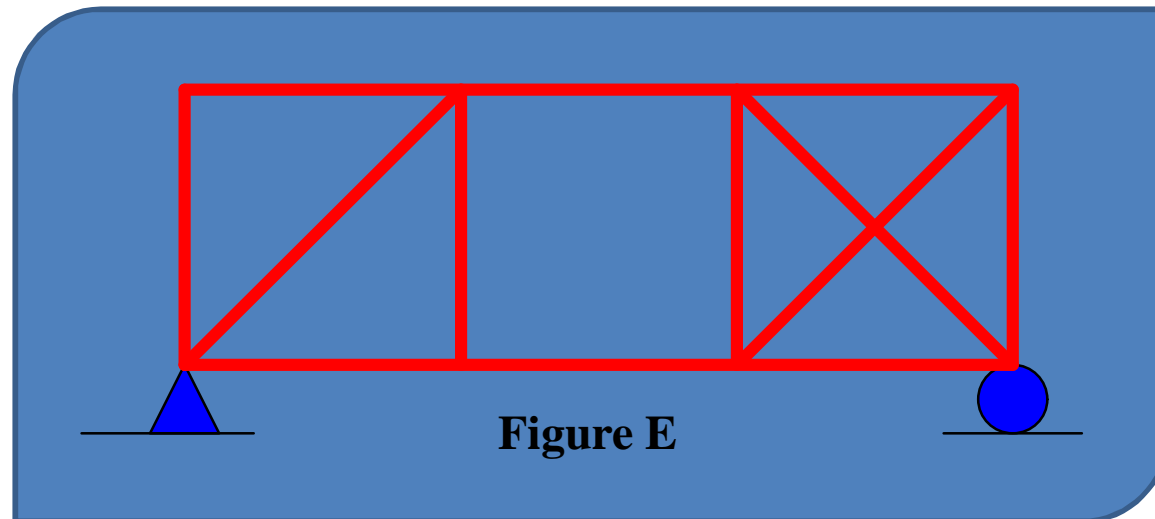
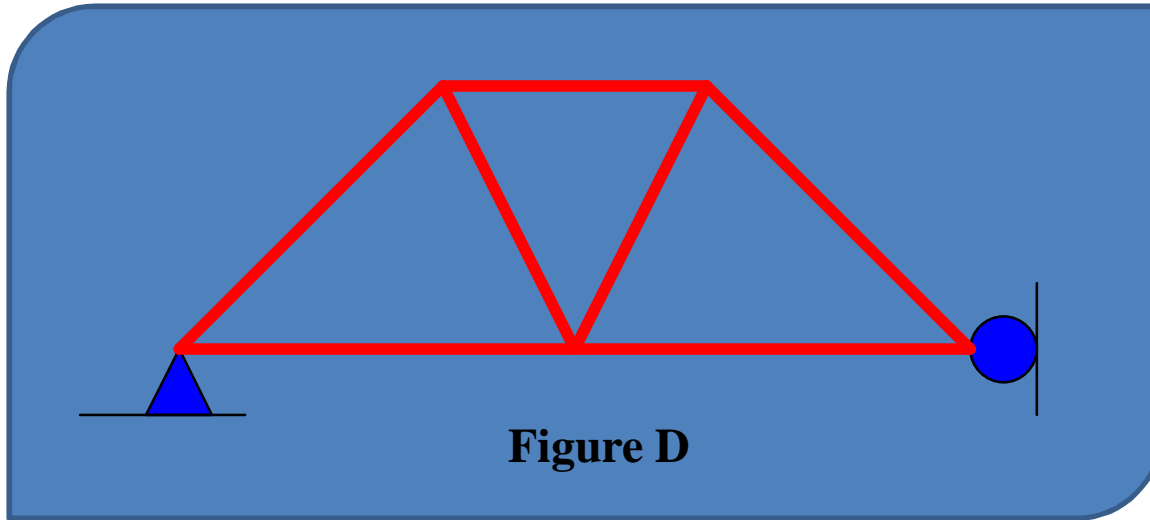
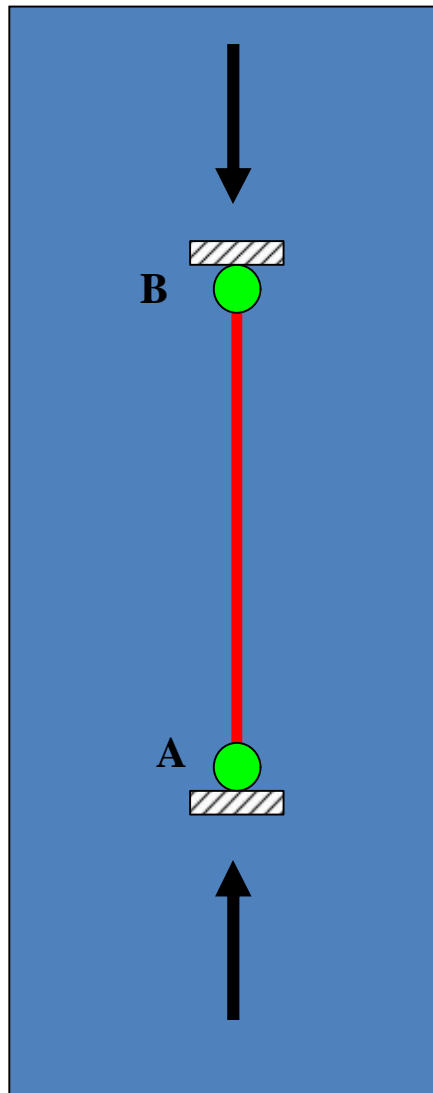


Figure C

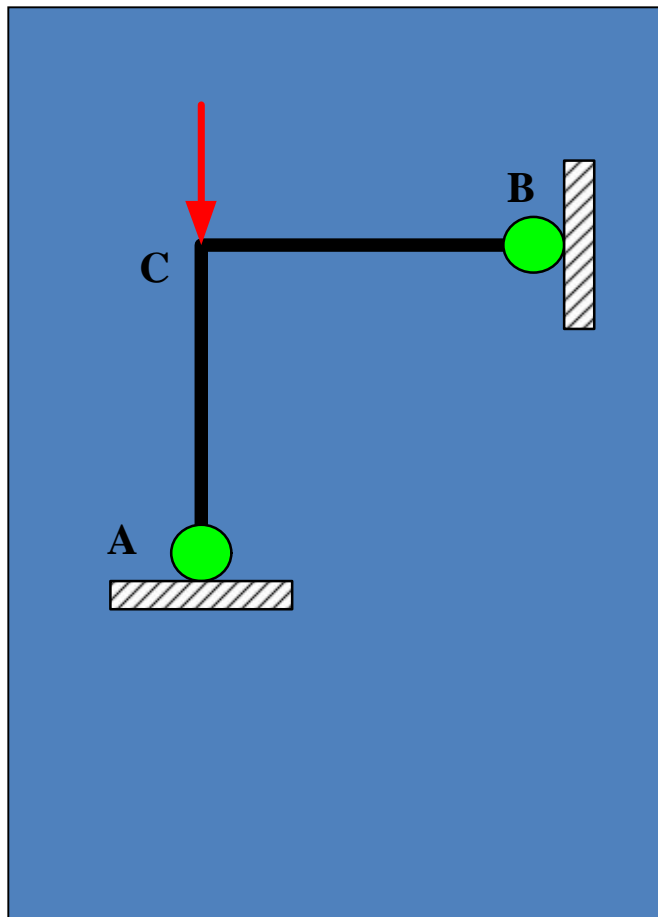
CONDITION OF DETERMINANCY FOR BEAMS





The structure is not stable because the reaction at support A and B are parallel.

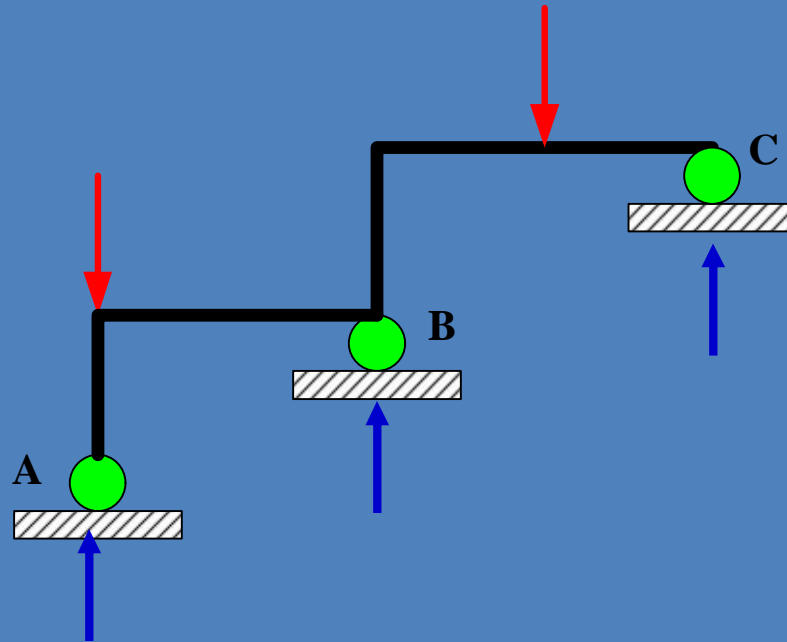
Figure A



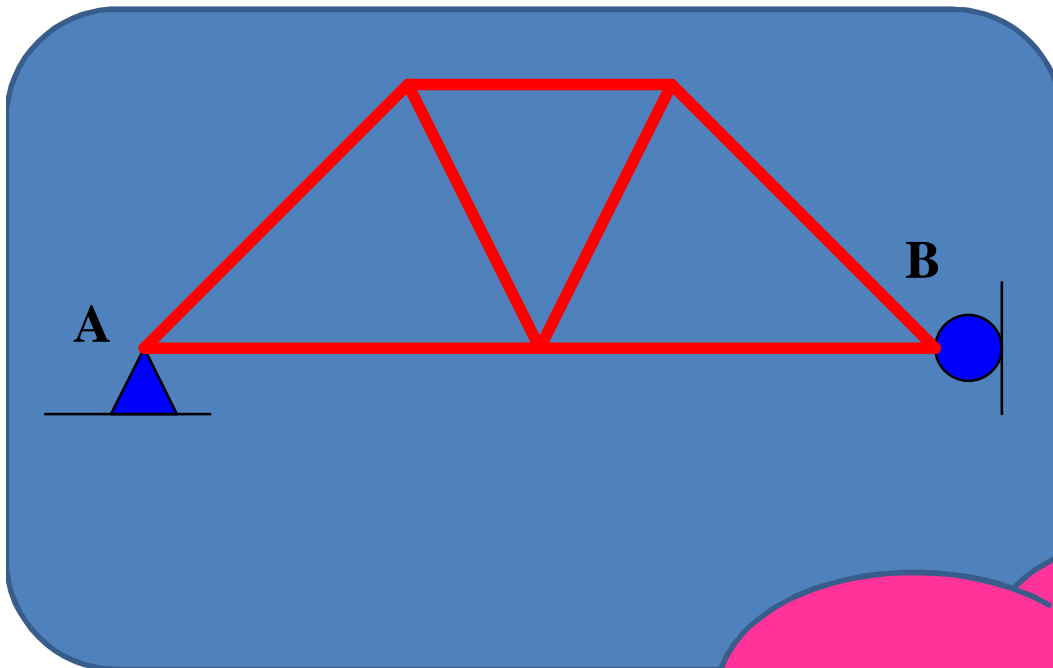
The structure is not stable because the reaction at A and B is concurrent at joint C

Figure B

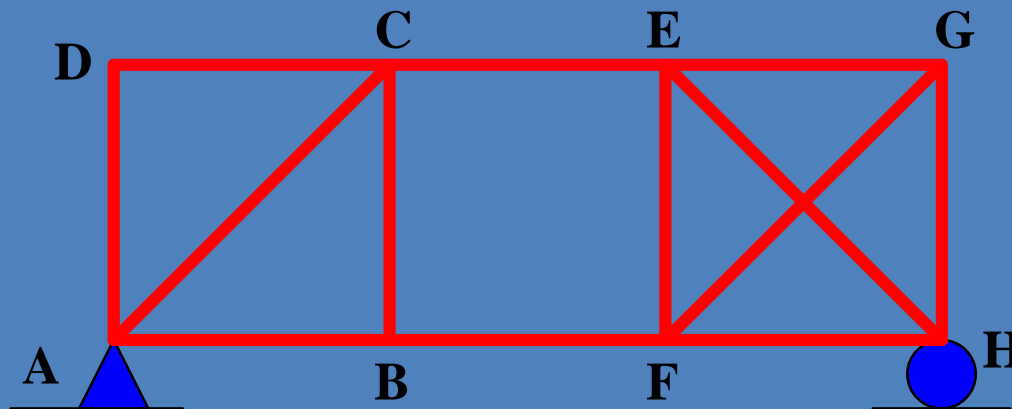
Figure C



The structure is not stable because the reaction at support A, B and C are parallel

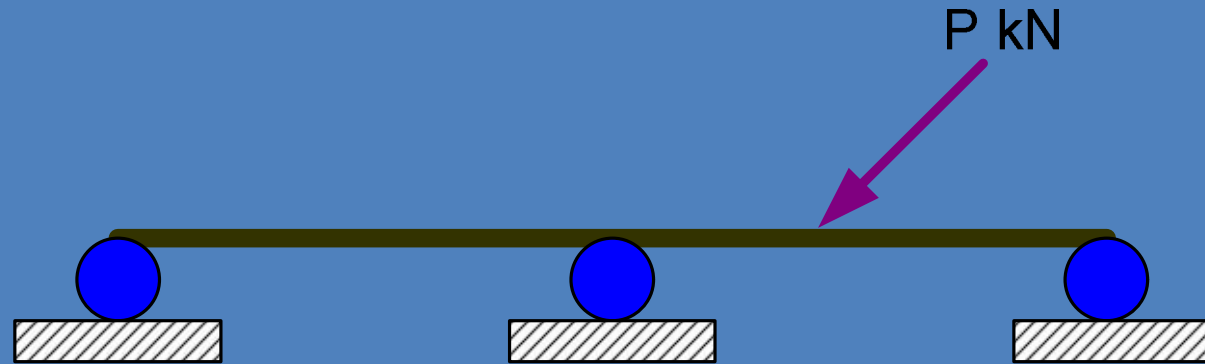


The structure externally unstable because all the reactions at A and B are concurrent at one point



The structure is internally unstable because it can be seen that no restraint or fixity is provided between joint C and F or B and E.

DETERMINACY AND STABILITY



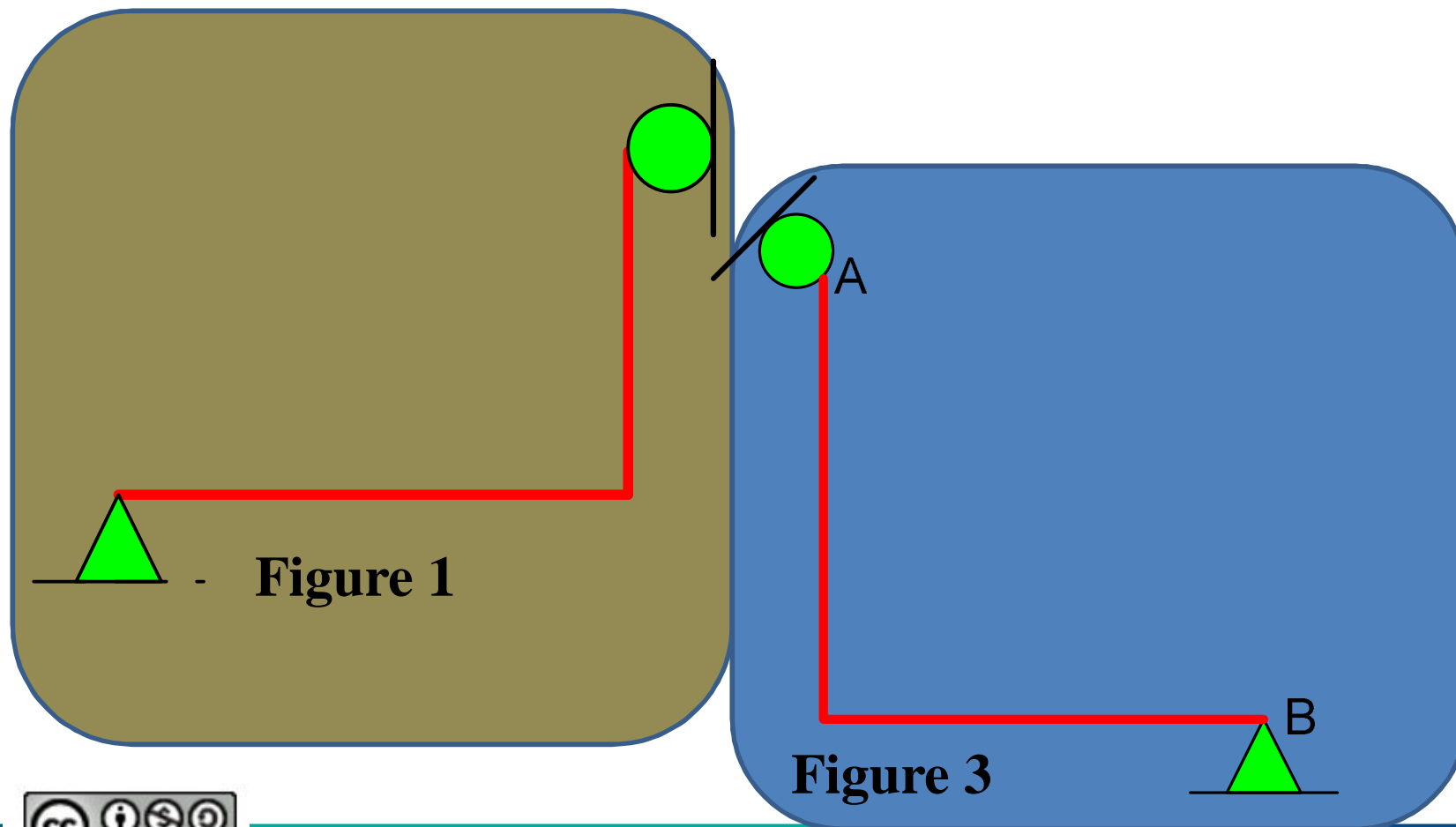
$$r = 3 \quad n = 1$$

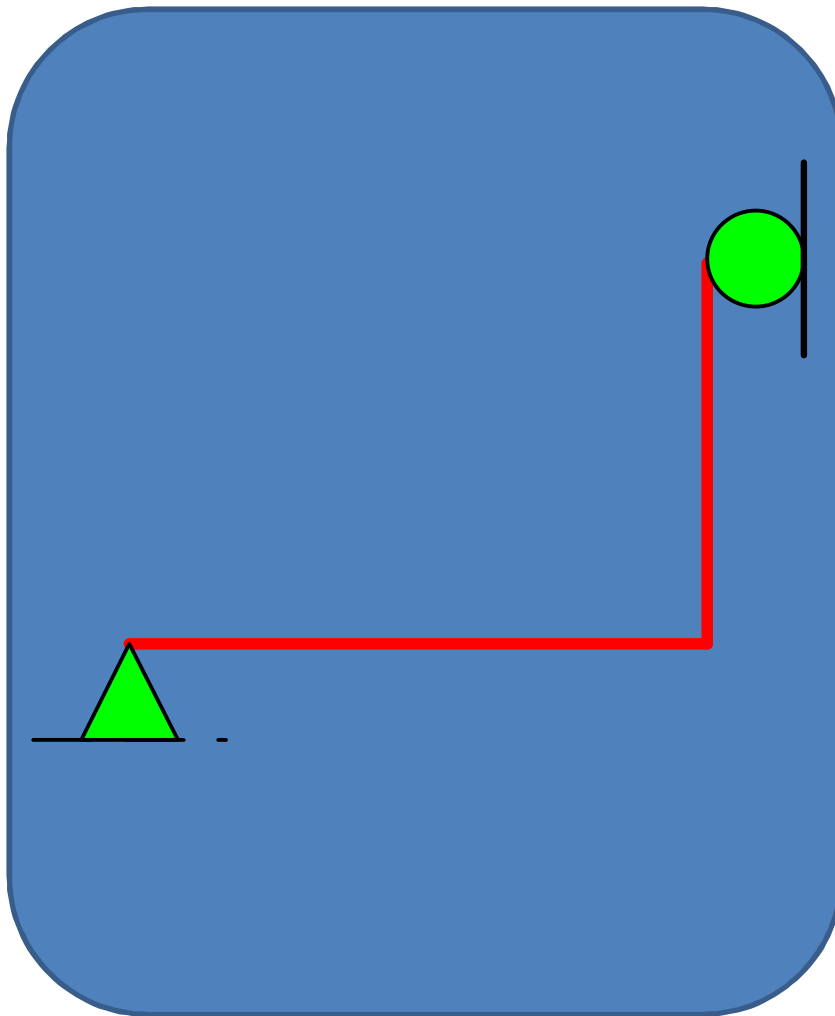
$$r = 3n$$

$$3 = 3$$

The structure is statically determinate but unstable because all reactions are parallel.

Check the determinacy criteria for structure and classified it as stable or unstable.





- The structure is statically determinate
- Stable since

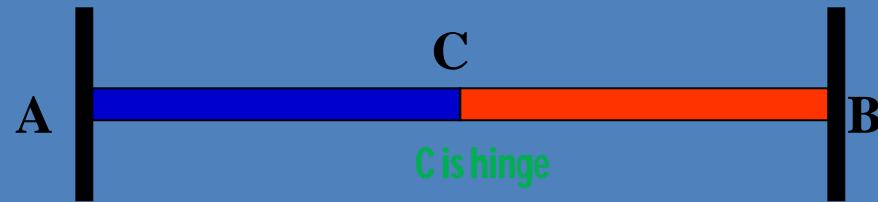
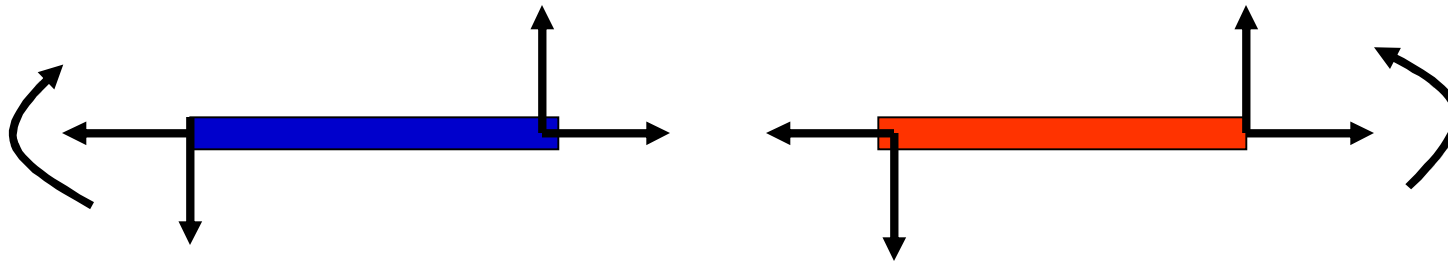
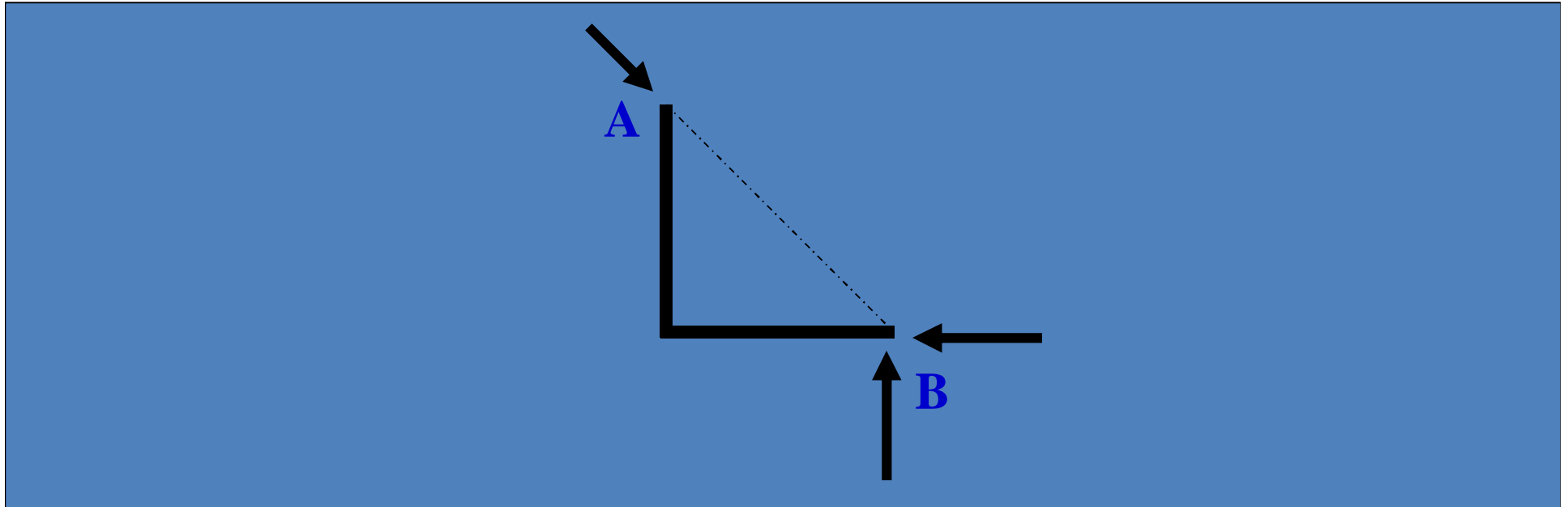


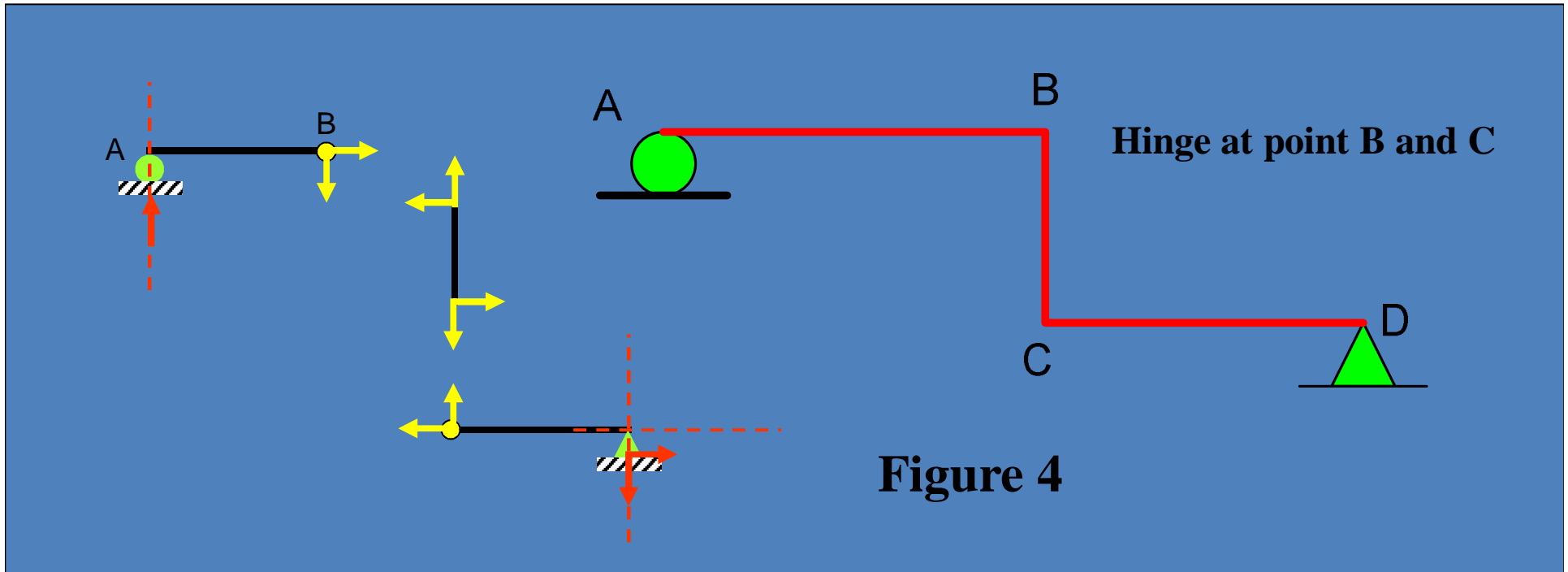
Figure 2



The compound beam is stable.



The member is unstable since the three reaction is concurrent at B.



The structure is unstable

THANKS



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