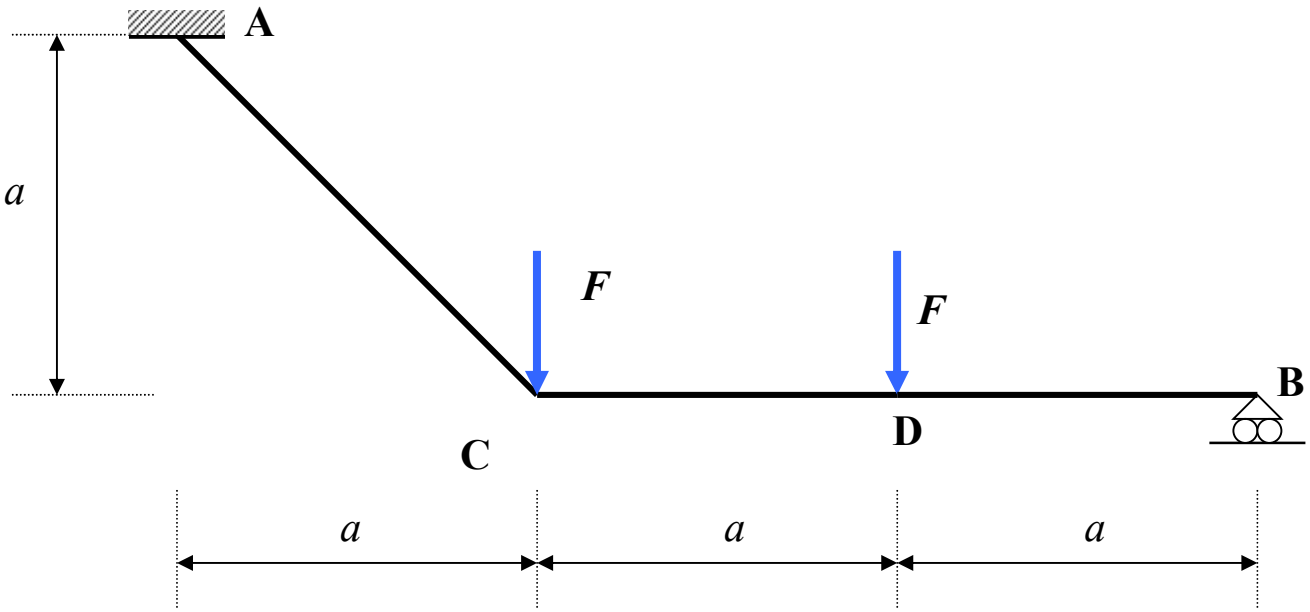
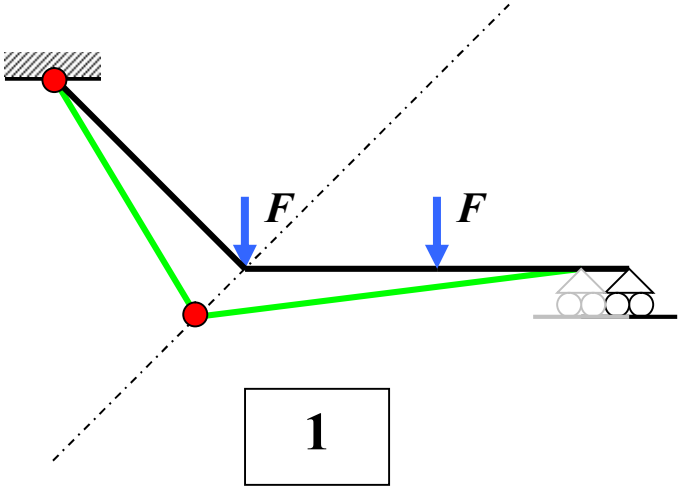
EXAMPLE : BENT STRUCTURE

FIND THE COLLAPSE LOAD F_p

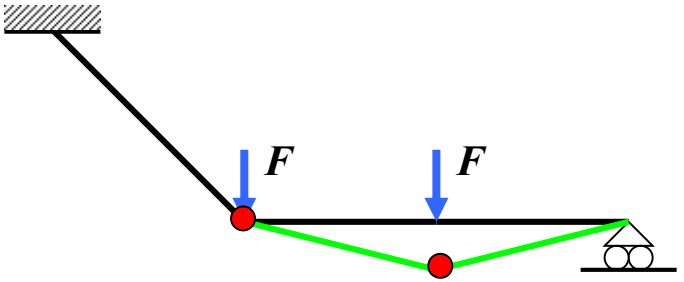


Analysis:

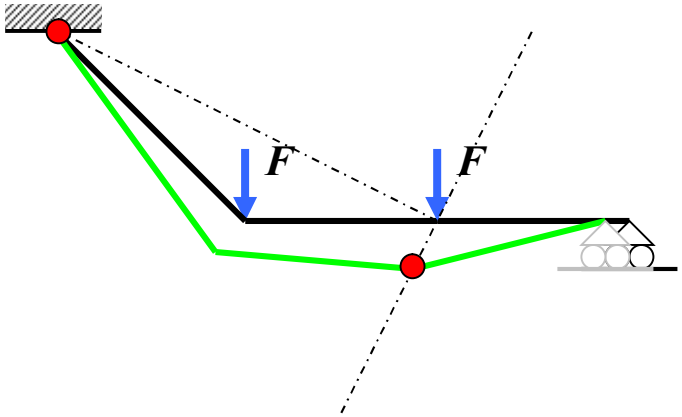
- Statically indeterminate structure $n = 1$
- Max 2 hinges required to obtain a mechanism
- 3 possible positions for hinges (A,C,D)
- Investigate 3 possible failure mechanisms



1

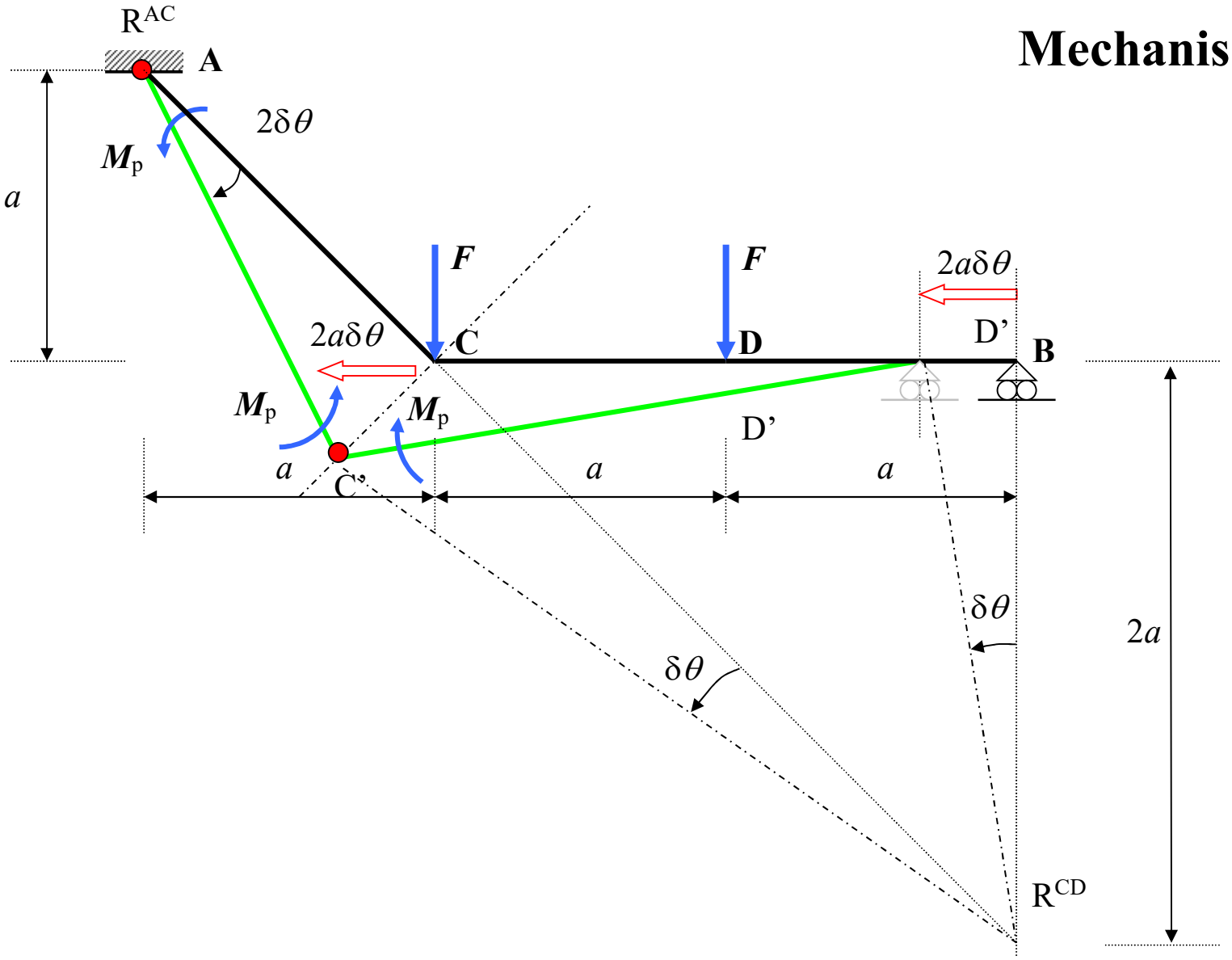


2

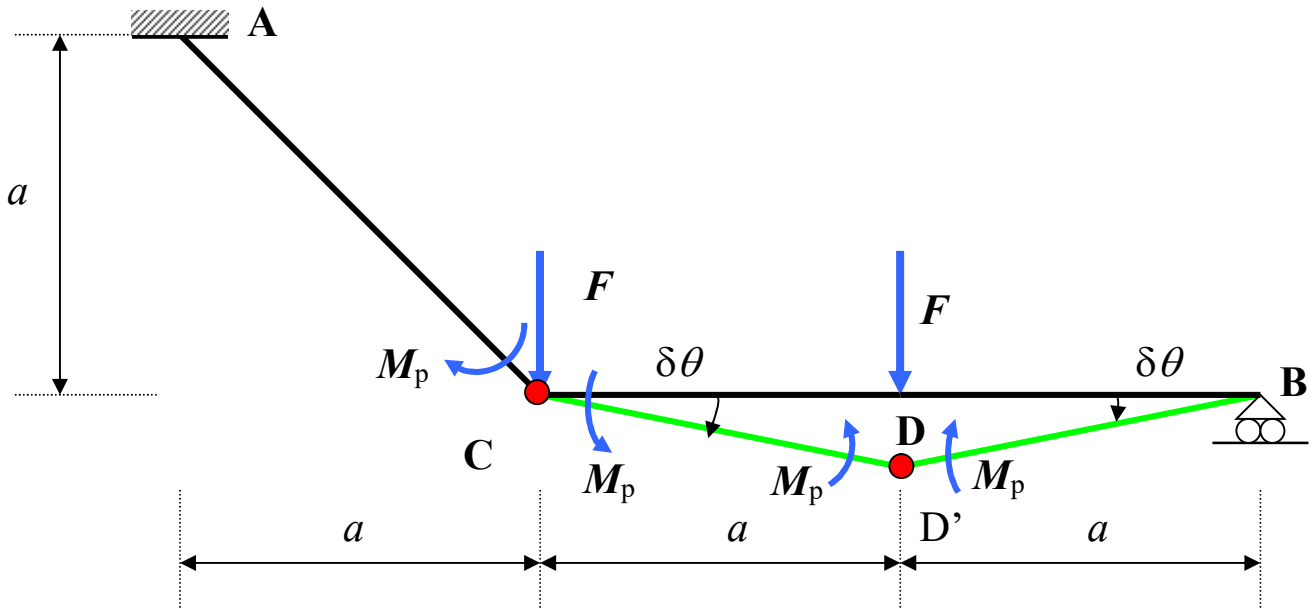


3

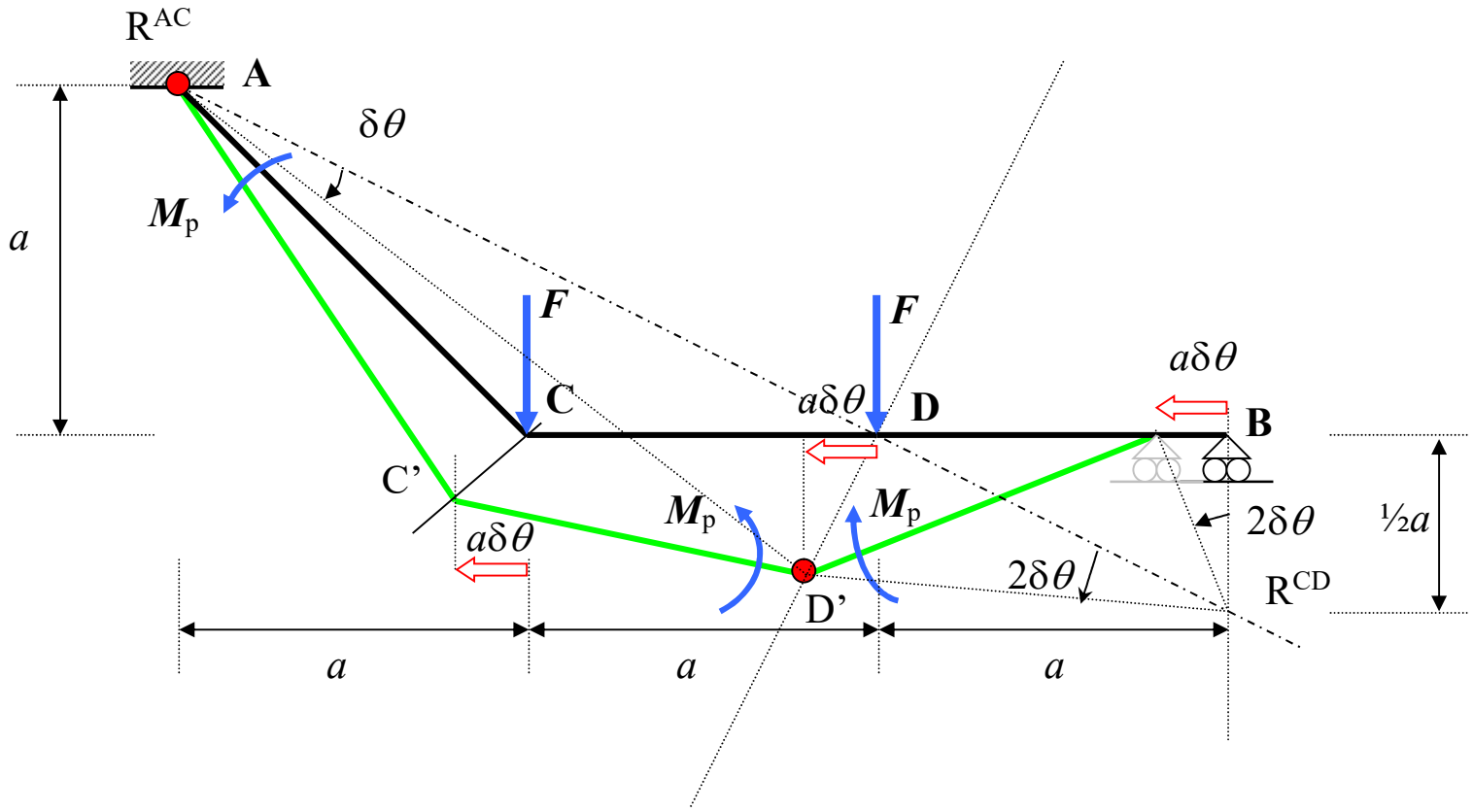
Mechanism 1



Mechanism 2



Mechanism 3



TU Delft

Virtual work

Mechanism 1

$$\delta A = -M_p \times 2\delta\theta - M_p \times 2\delta\theta - M_p \times \delta\theta + F \times 2a \times \delta\theta + F \times a \times \delta\theta = 0$$

$$F_{p\text{-}1} = \frac{5M_p}{3a}$$

Mechanism 2

$$\delta A = -M_p \times \delta\theta - M_p \times 2\delta\theta + F \times a \times \delta\theta = 0$$

$$F_{p\text{-}2} = \frac{3M_p}{a}$$

Mechanism 3

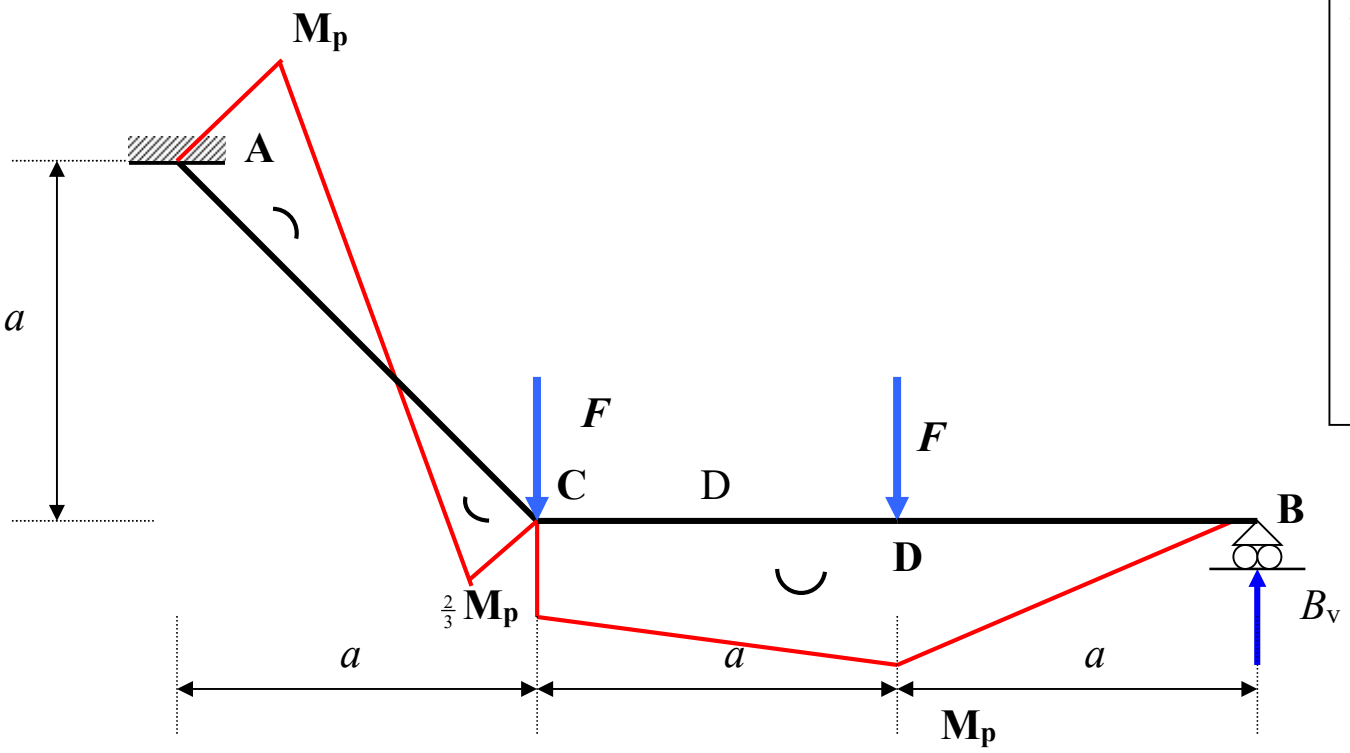
$$\delta A = -4M_p \times \delta\theta + F \times \delta\theta \times a + F \times \delta\theta \times 2a = 0$$

$$F_{p\text{-}3} = \frac{4M_p}{3a}$$

COLLAPSE LOAD

TU Delft

MOMENT DISTRIBUTION MECHANISM 3 $F_p = \frac{4M_p}{3a}$



Find the moment at **C** ?

1 Vertical reaction at B:

$$\sum T\,|D = 0 \quad \Rightarrow \quad B_v \times l = M_p \quad \Rightarrow \quad B_v = \frac{M_p}{a}$$

2 Compute the moment at C (left assumed +):

$$-M_C - \tfrac{4}{3}\frac{M_p}{a} \times a + 2a \times \frac{M_p}{a} = 0 \quad \Rightarrow \quad M_C = \tfrac{2}{3}M_p$$

Check on Uniqueness Theorem