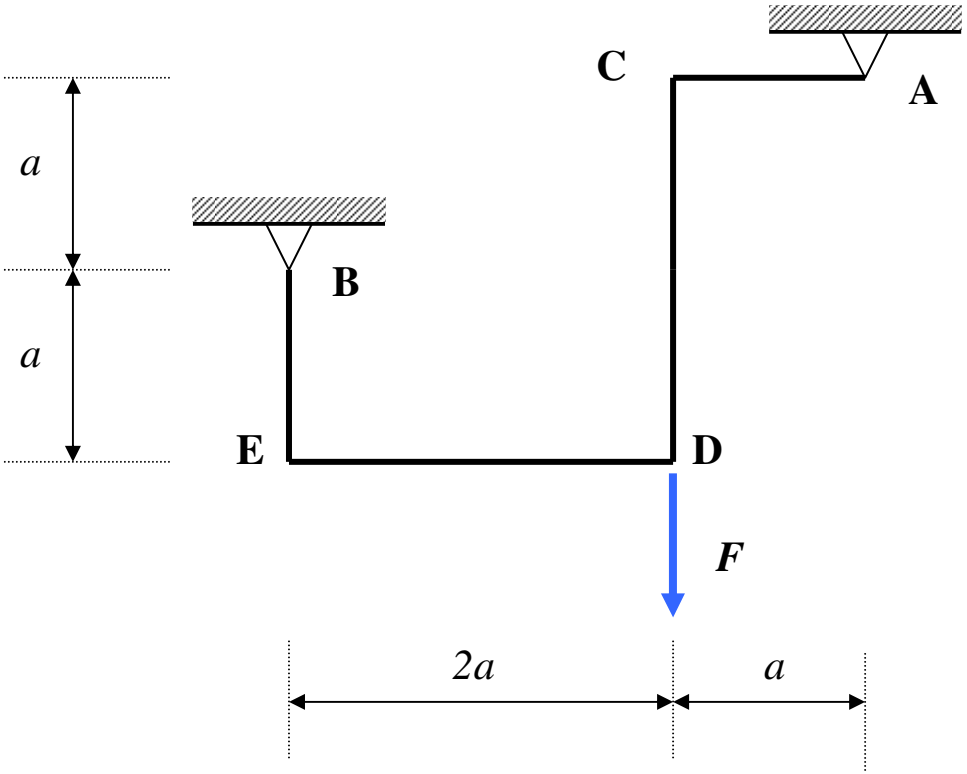
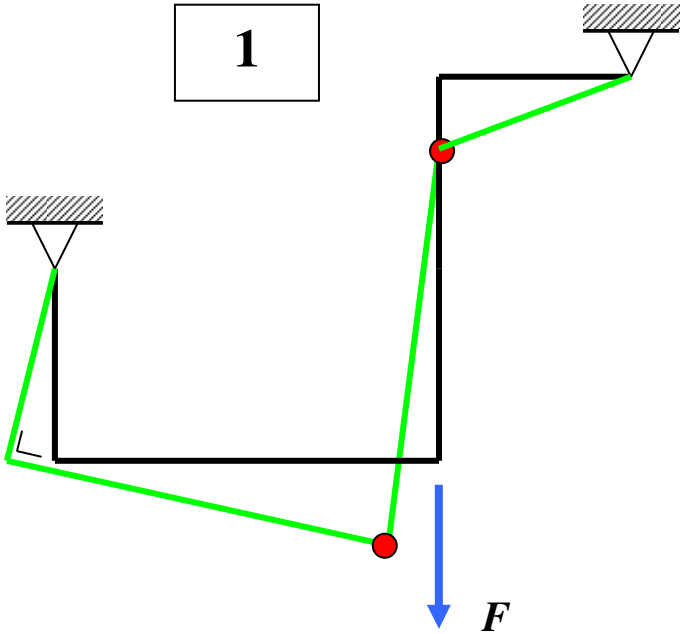
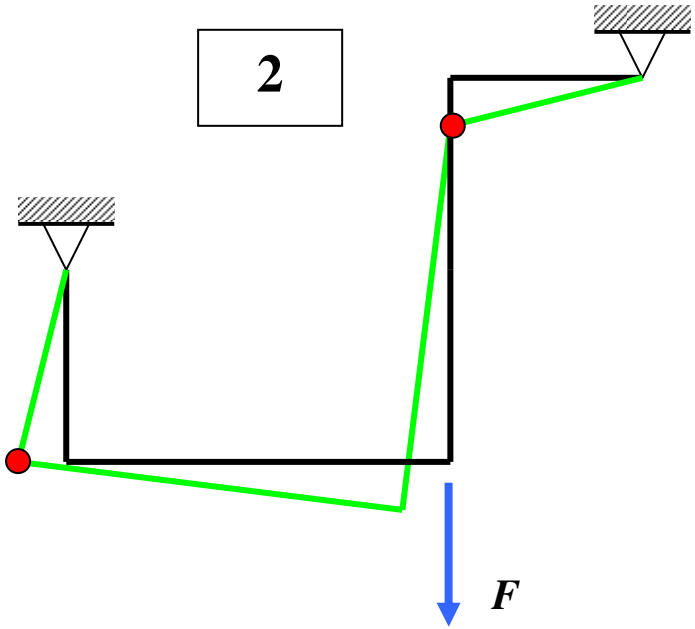
FIND THE COLLAPSE LOAD F_p

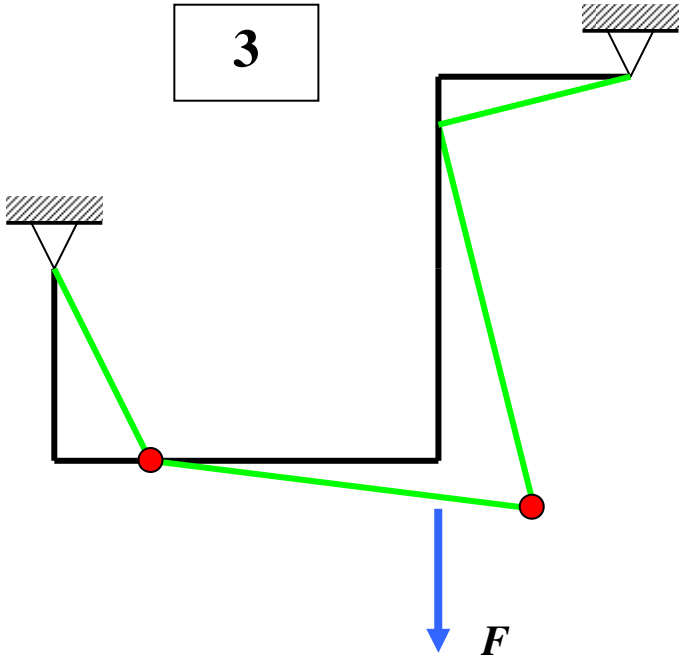


Analysis:

- Static indeterminate
  $n = 1$
- Max 2 hinges required for a mechanism
- 3 possible positions for hinges (C, D and E)
- Thus:
  3 possible failure mechanisms

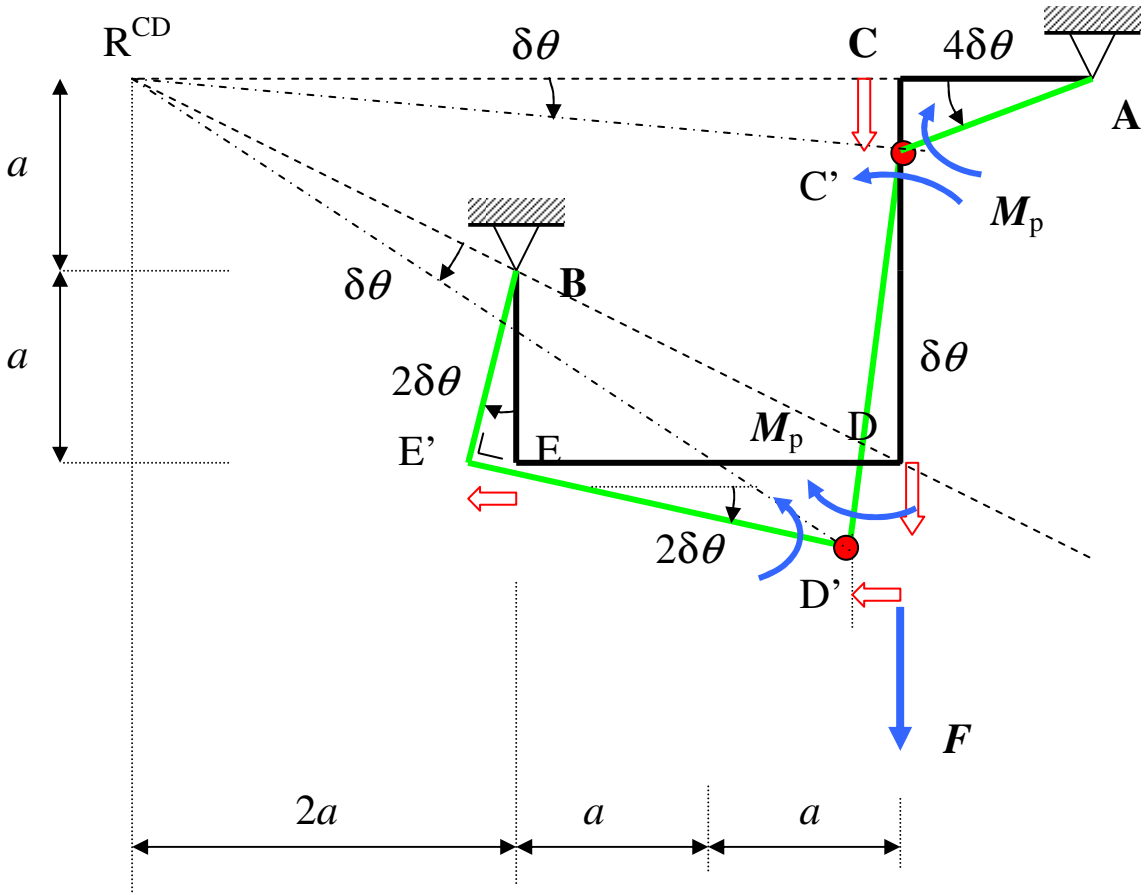

1
F


2
F

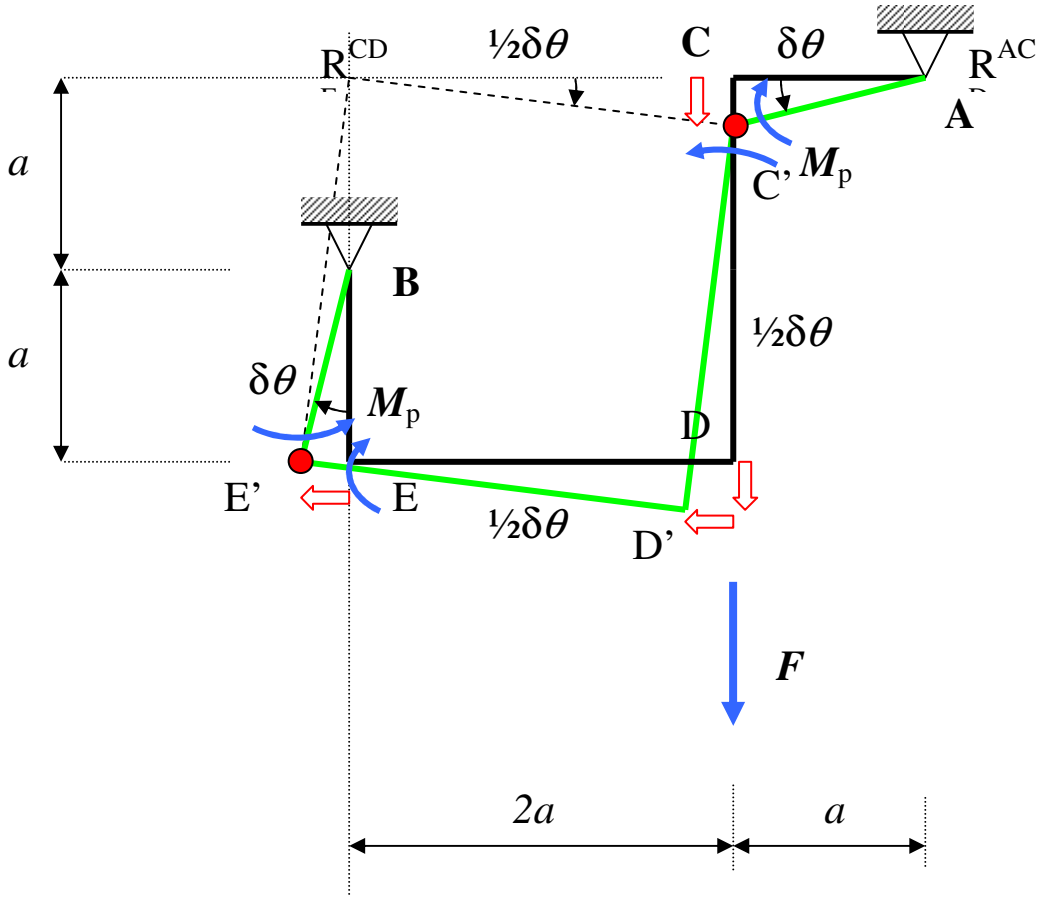

3
F

TU Delft

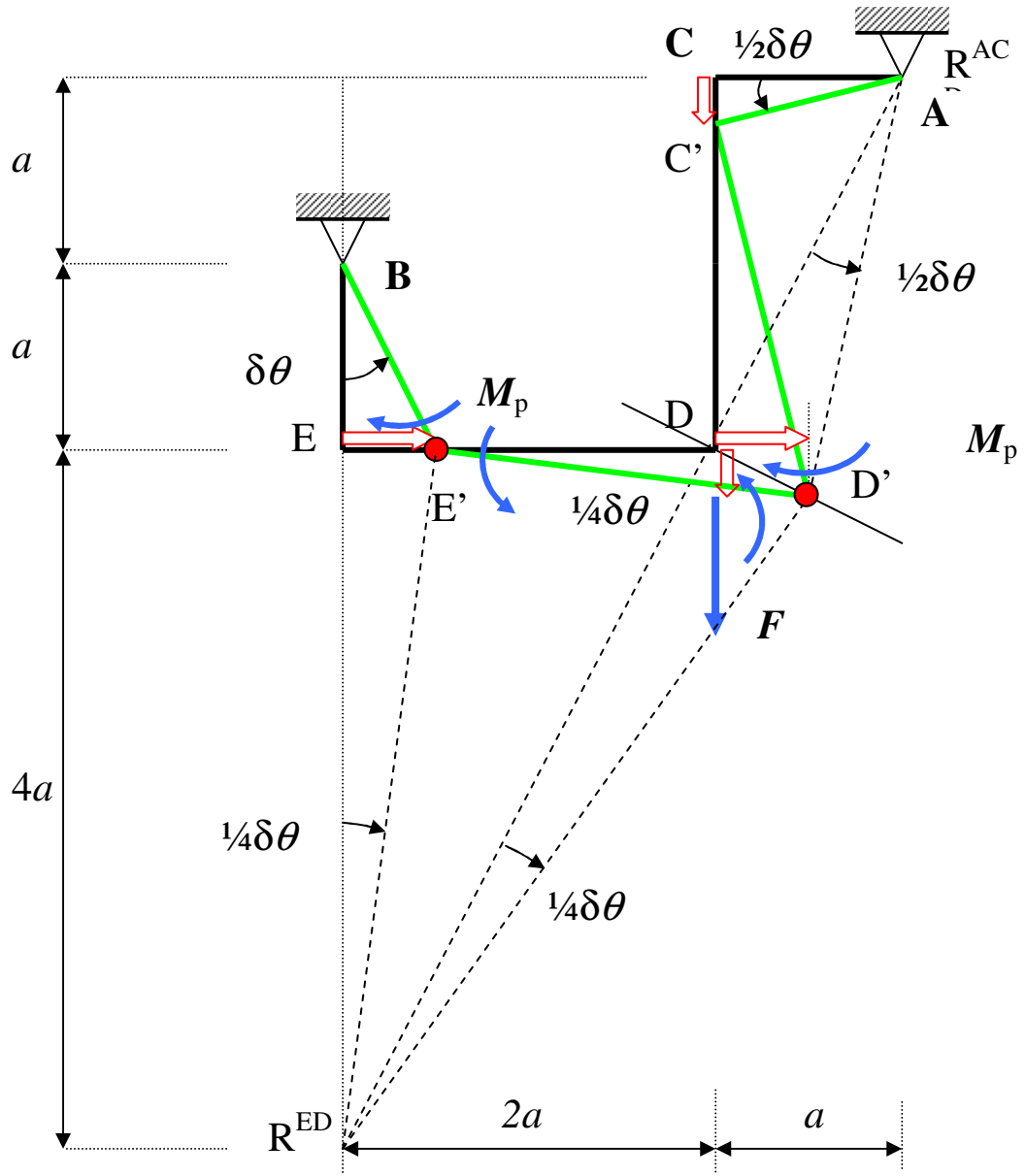
Mechanism 1



Mechanism 2



Mechanism 3



TU Delft

Virtual work

Mechanism 1

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

$$F_p = \frac{1,5M_p}{a}$$

COLLAPSE LOAD

Mechanism 2

$$\delta A = -M_p \times \delta\theta - M_p \times \tfrac{1}{2}\delta\theta + M_p \times \tfrac{1}{2}\delta\theta - M_p \times \delta\theta + F \times \delta\theta \times a = 0$$

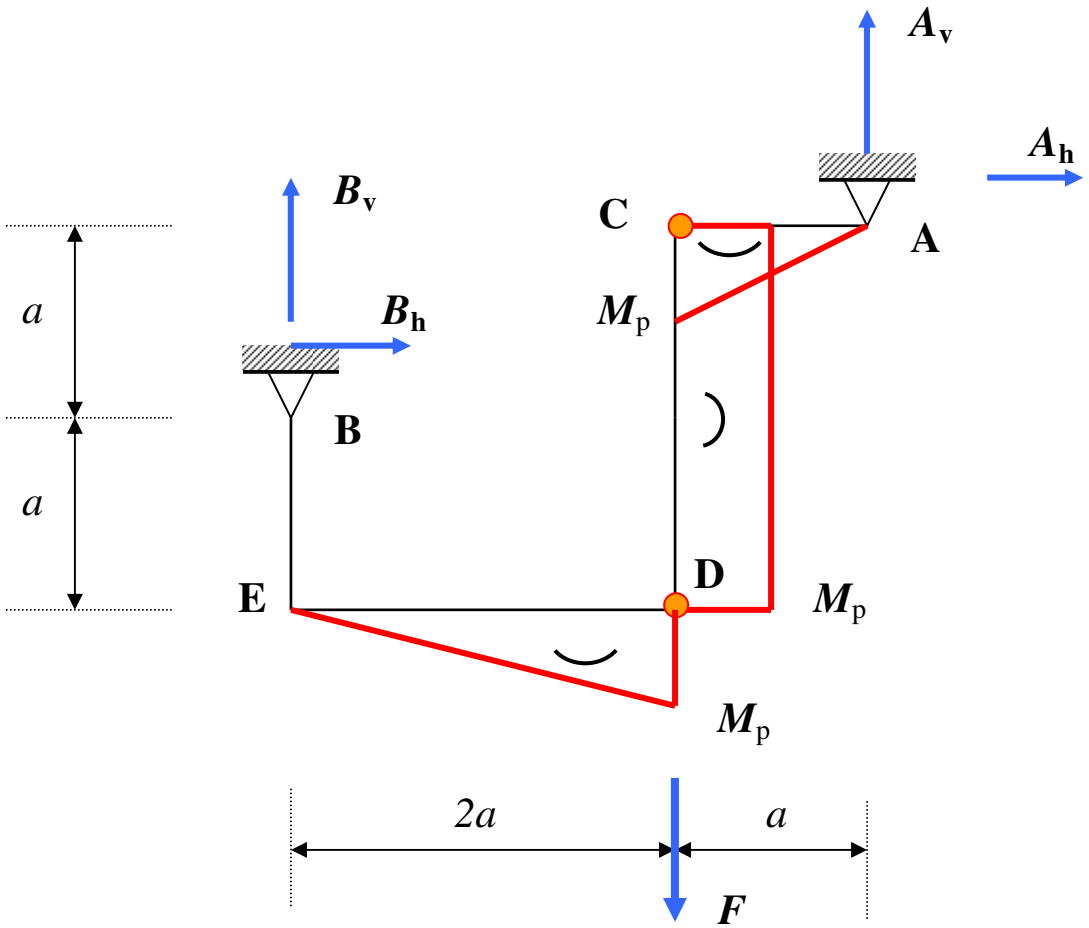
$$F_p = \frac{2M_p}{a}$$

Mechanism 3

$$\delta A = -M_p \times \tfrac{1}{2}\delta\theta - M_p \times \tfrac{1}{4}\delta\theta - M_p \times \tfrac{1}{4}\delta\theta - M_p \times \delta\theta + F \times \tfrac{1}{2}\delta\theta \times a = 0$$

$$F_p = \frac{4M_p}{a}$$

MOMENT DISTRIBUTION MECHANISM 1 $F_p = \frac{1{,}5M_p}{a}$



Find the moment at **E** ?

1 Determine the vertical reactions at A:

$$\sum T|C = 0 \quad \Rightarrow \quad A_v \times a = M_p \quad \Rightarrow \quad A_v = \frac{M_p}{a}$$

$$A_v = \frac{4F_p}{6}$$

2 Find the horizontal reaction at A based on moment equilibrium with respect to B:

$$\sum T|B = 0 \quad \Rightarrow \quad \frac{4F_p}{6} \times 3a - F_p \times 2a - A_h \times a = 0$$

$$A_h = 0$$

3 Find the moment at E:

$$\sum T|E \quad \Rightarrow \quad \frac{4F_p}{6} \times 3a - F_p \times 2a + M_E = 0$$

$$M_E = 0$$