Theory of structure

Stability and Determinacy of Structures

L1

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Stability and determinacy of structures

Beams

- Total equation of equilibrium of beam

  $\sum F_K = 0$

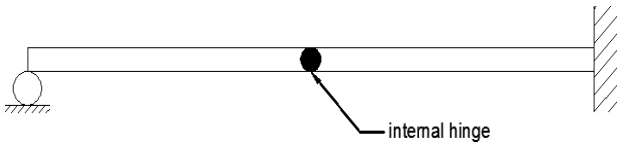
  $\sum F_F = 0$

  $\sum M = 0$

- Equation of condition

  Internal hinge:-

$\sum M = 0$



C=1

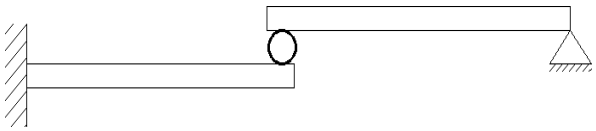
C = m - 1

Roller:-

$\sum M = 0$

$\sum F_K = 0$

C=2



Let r= No. of reaction

1- If r < c+3, unstable

2- r = c+3, determine if stable

3- r> c+3, indeterminate if stable

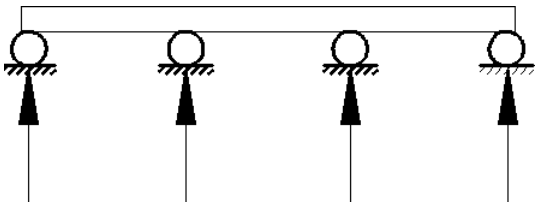
Let (m) degree of indeterminate

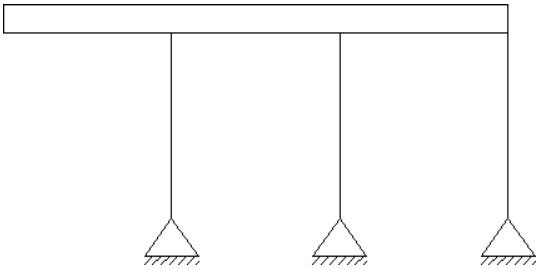
m= r- (c+3)

- the structure is said to be unstable if one of the following facts couter

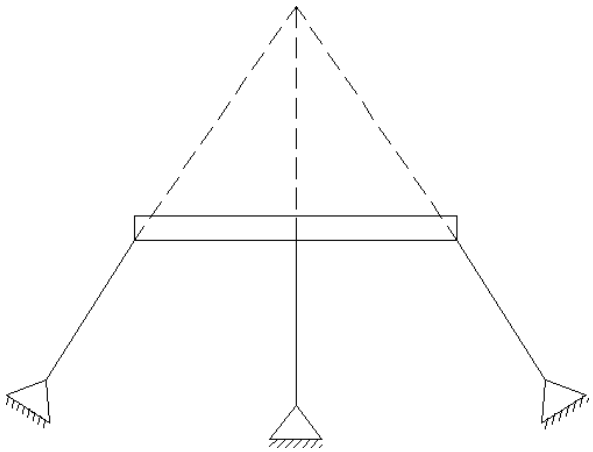
1- $r < c+3$

2- The reaction element constitutes a parallel force system.





3- The reaction element constitutes a concurrent force system.



4- Internal geometric instability:-

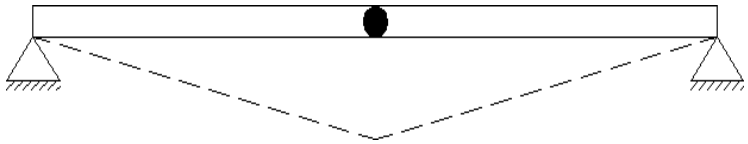
Example

r = 4

c =1

r = c+3

4=4



The beam is unstable because the Internal geometric instability

Example

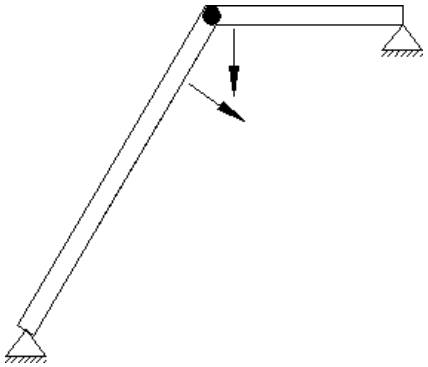
r = 4

c = m-1, c =1

r = c+3

4=4

The beam is determiate if stable



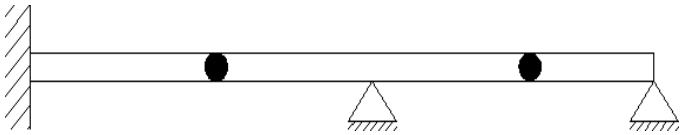
Example

r= 7

c= 2

r>c+3

7>5



The beam is indeterminate 2nd degree if stable

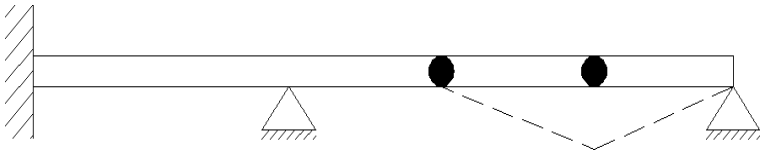
Example

r= 7

c= 2

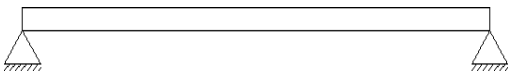
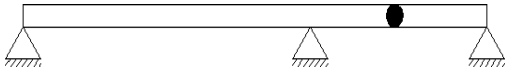
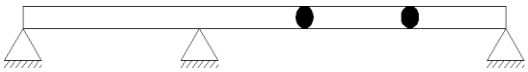
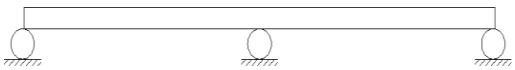
r>c+3

7>5



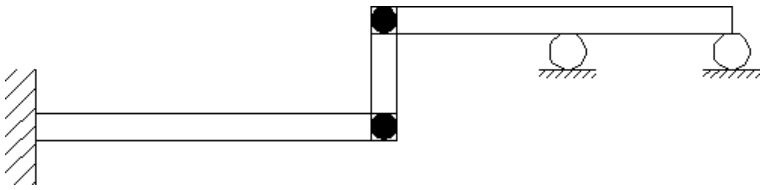
The beam is unstable

Examples:-

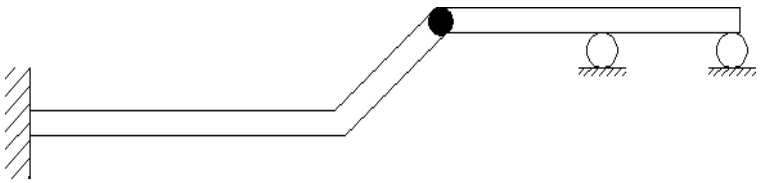
Beam	r	c	c+3	state	Stability & determinate.
	3	0	3	r=c+3	Stable & deter.
	4	0	3	r>c+3	Stable & indeter. First degree
	6	1	4	r>c+3	Stable &indeter. Second degree
	6	2	5	r>c+3	unstable
	3	0	3	r =c+3	unstable

Home Works

H.W1: Find the stability and determinacy of beam.



H.W2: Find the stability and determinacy of beam.



Stability and Determinacy of Trusses

b + r = unknown

j = equations

1- b + r < 2j, the truss is unstable
2- b + r = 2j, the truss is determinate if stable
3- b + r > 2j, the truss is indeterminate if stable

Let (m) equal to the degree of indeterminate
m= (b + r) – 2j

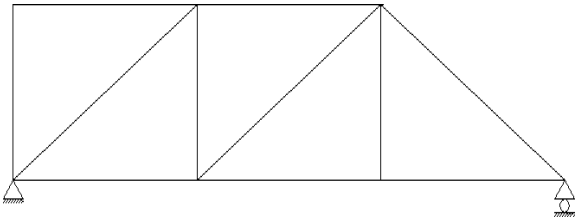
b = No. of bars

r = No. of reactions

j = No. of joints

Examples: - Find the stability and determinacy of trusses below.

Ex1



r = 3, b = 11, j = 7

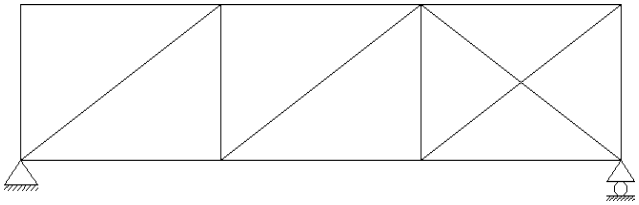
b+r =14

2j= 14

b+r = 2j

The truss is stable &determinate

Ex2



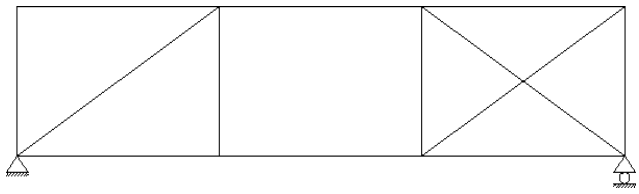
r = 3, b =14, j = 8

b+r = 17

2j = 16

b+r > 2j, the truss is stable& indeterminate 1st degree

Ex3

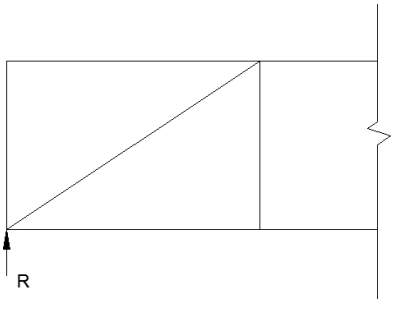


r = 3

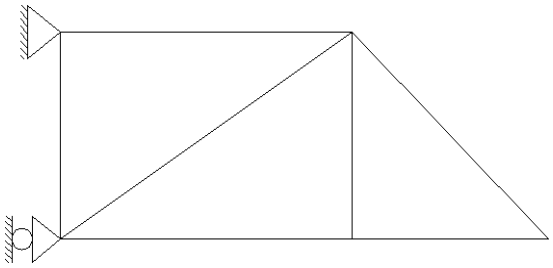
b = 13

2j = 16

b+r = 2j, the truss is unstable because of $\sum F_y$ G 0, in this section



Ex4



r = 3, b = 7, j = 5

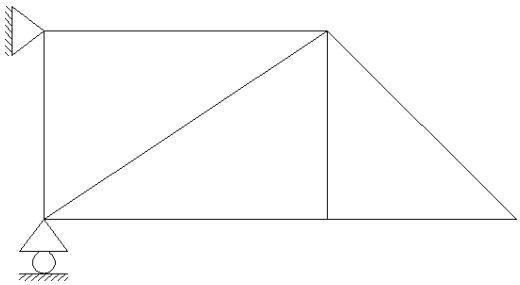
b + r = 10

2 j = 10

b + r = 2j

The truss is stable & determinate

Ex5



r = 3, b = 7, j = 5

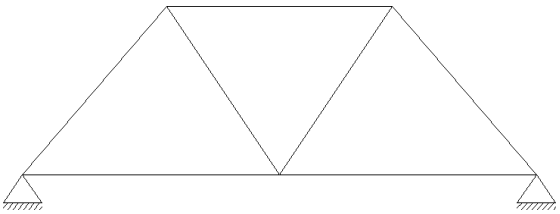
b + r = 10

2 j = 10

b + r = 2j

The truss is unstable

Ex6



r = 4, b = 7, j = 5

b + r = 11

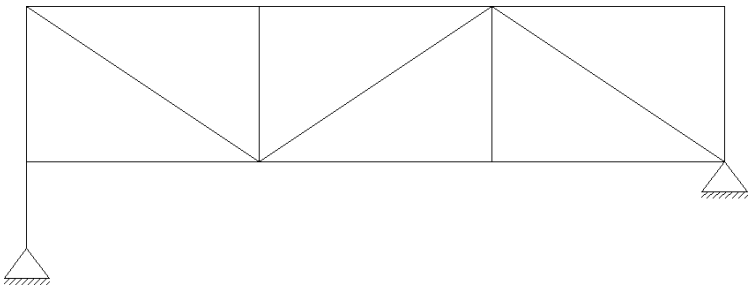
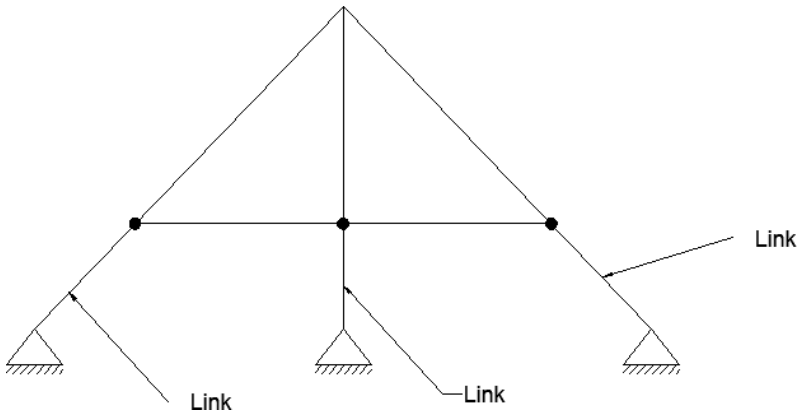
2 j = 10

b + r > 2j

The truss is stable & indeterminate 1st degree

Home works

H.W1



H.W2