Completely constrained, determinate.

$u = m + r$ = nos of unknowns

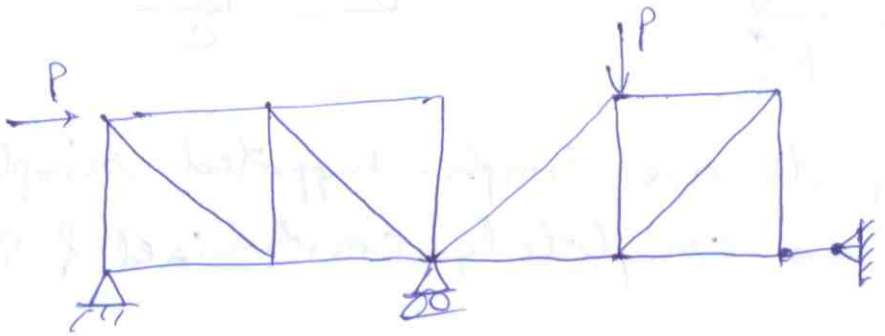
$n = 2j$ = nos of eqns.

$m+r < 2j, u < n \Rightarrow$ partially constrained

$m+r > 2j, u > n \Rightarrow$ statically indeterminate.

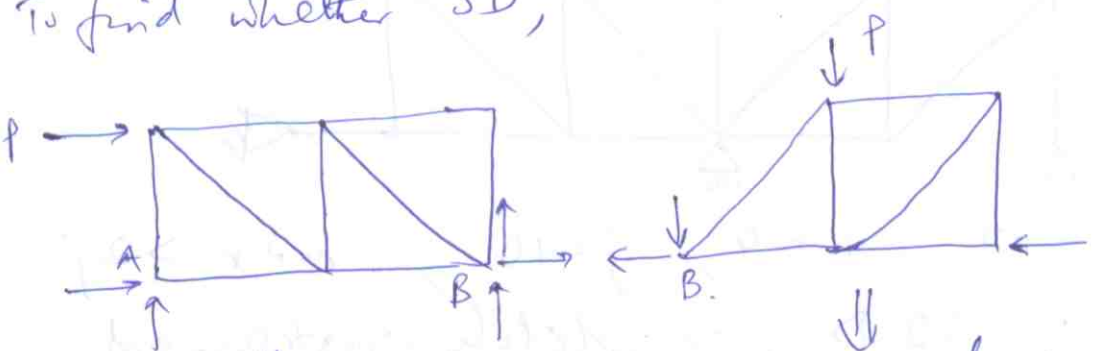
$m+r = 2j, u = n \Rightarrow$ necessary, but not sufficient, condition for statically determinate (hence constrained) truss/structure.

(Eg 1)



$m = 16$, $j = 10$, $r = 4$. $\Rightarrow m + r = 2j$.

To find whether SD,



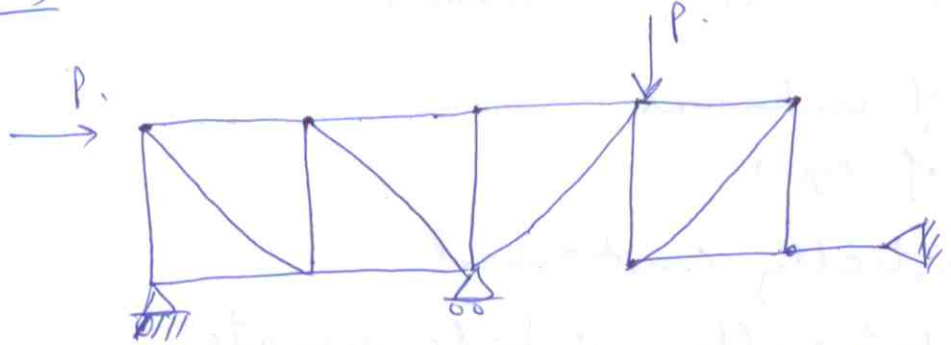
$\Downarrow$ properly supported

$\Downarrow$ improperly supported.

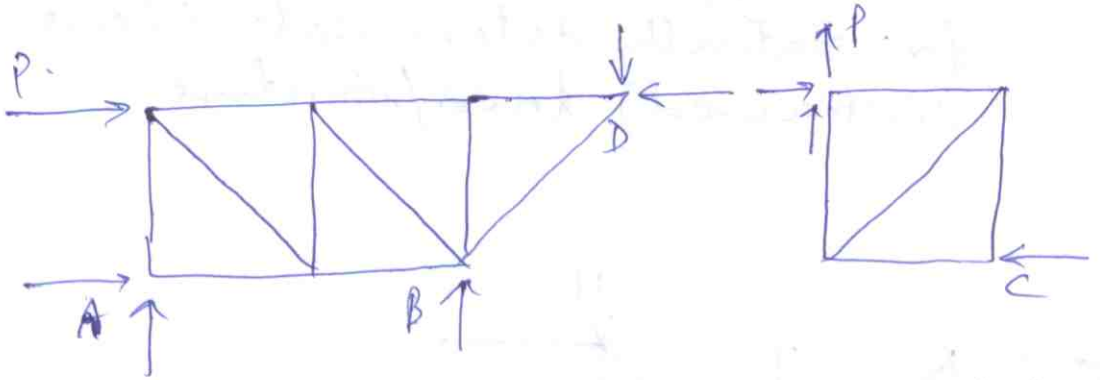
$\Sigma M_B \neq 0$.

$\Rightarrow$ IMPROPERLY CONSTRAINED

(Eg 2)

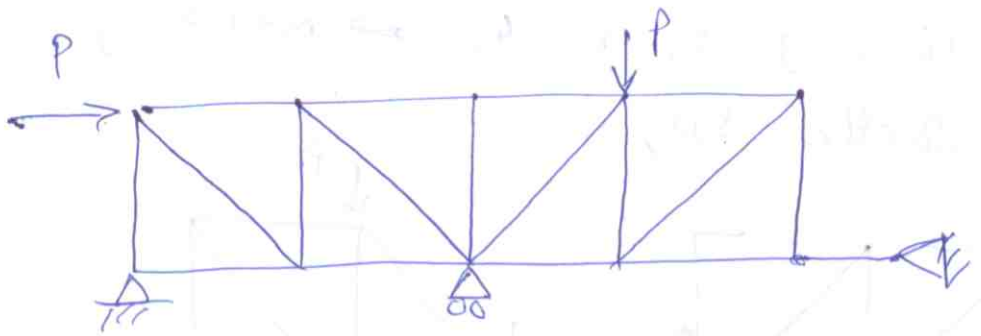


$m = 16, \quad j = 10, \quad r = 4 \quad , \Rightarrow m + r = 2j.$



Both parts are simply-supported simple trusses $\Rightarrow$ completely constrained & S.D.

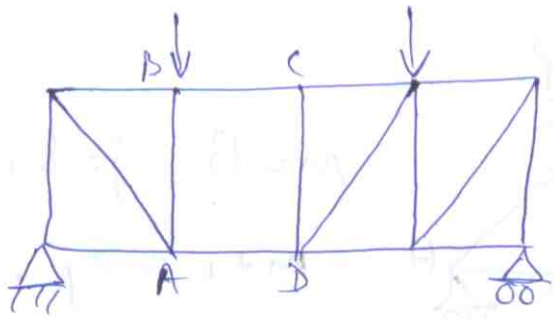
(Eg 3)



$m = 17, \quad r = 4, \quad j = 10, \quad m + r > 2j$

So <u>S I D</u>, completely constrained.
(it is a simple truss with 4 support reactions).

(Eg 4)



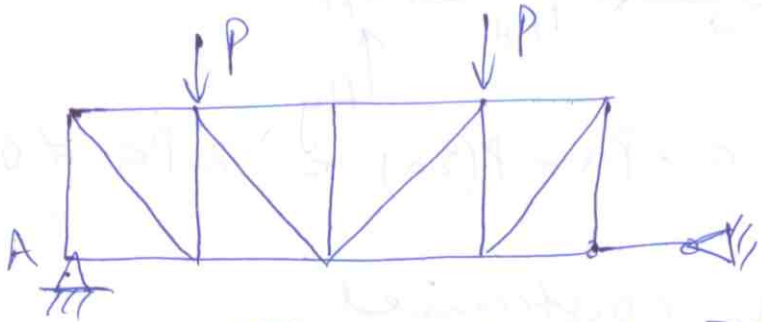
$m = 16,\ j = 10,\ r = 3$

$m + r < 2j$

$\Rightarrow$ partially constrained.

Note two simple trusses with parallel connecting links. These links will rotate, ie parallelogram ABCD must stay rigid

(Eg 5)

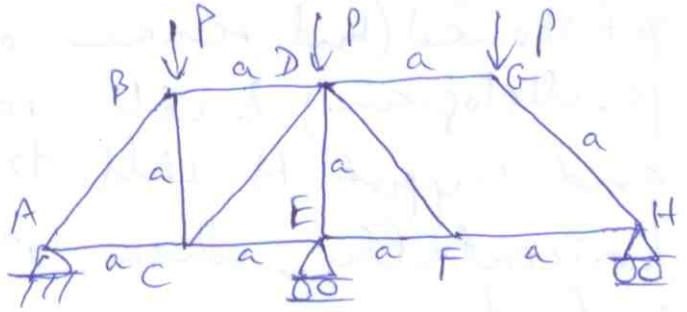


$m = 17,\ j = 10,\ r = 3$

$m + r = 2j.$

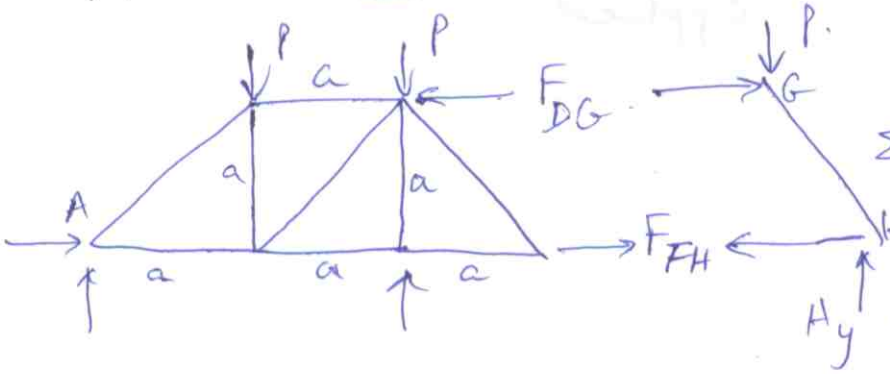
$\Sigma M_A \neq 0. \Rightarrow$ IMPROPERLY CONSTR.

(Eg 6)



$m = 12,\ j = 8,\ r = 4.$

$m + r = 2j.$



FBD GH:

$\Sigma M_H = 0: F_{DG}\, a = Pa.$

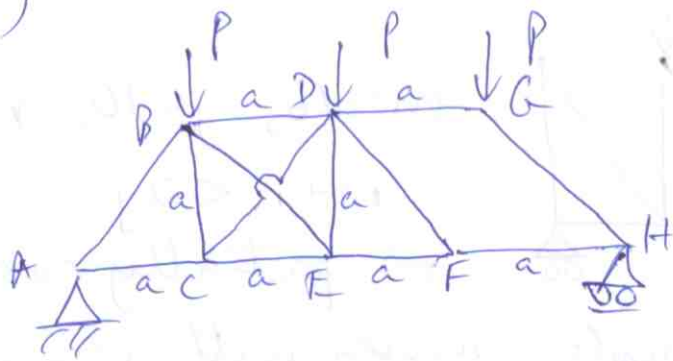
$F_{DG} = P$

$\Sigma F_x = 0: F_{FH} = F_{DG} = P.$

$\Sigma F_y = 0: H_y = P.$

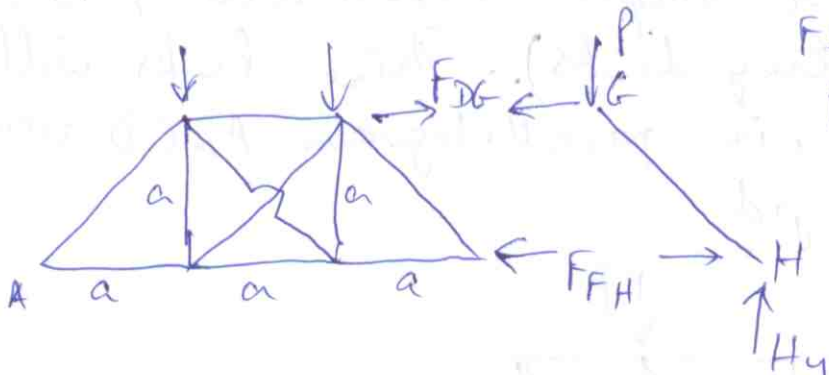
$\Rightarrow$ Completely constr & determinate.

(Eg. 7)



$m = 13$, $j = 8$, $r = 3$

$m + r = 2j$.



FBD of GH:

$F_{DG} = F_{FH} = H_y = P$

$$\sum M_A = F_{DG}\, a - Pa - P(2a) = 2Pa \neq 0$$

Improperly constrained.

Physically: parallelogram DGHF will get skewed (but remain a parallelogram) & will rotate and support H will translate horizontally, when load applied.