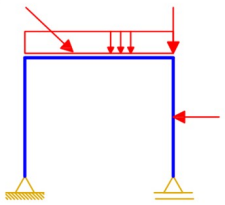
TE1-2.1

Determinar o grau estático.

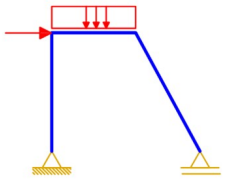
Resolução :

(a)



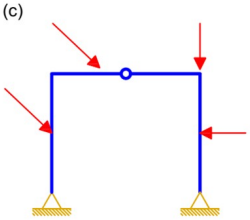
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 3 \quad N_{ri} = 0 \quad N_{ee} = 3$
$h_{EXT} = 3 - 0 - 3 = 0$
$h_{INT} = 3Q = 3 \cdot 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0$ *ISOSTÁTICO*

(b)



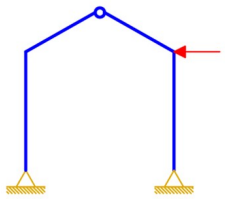
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 3 \quad N_{ri} = 0 \quad N_{ee} = 3$
$h_{EXT} = 3 - 0 - 3 = 0$
$h_{INT} = 3Q = 3 \cdot 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0$ *ISOSTÁTICO*

(c)



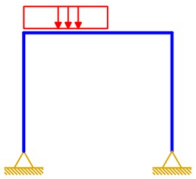
1 *Rótula com 2 barras*
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 1 \quad N_{ee} = 3$
$h_{EXT} = 4 - 1.(2-1) - 3 = 0$
$h_{INT} = 3Q = 3 \cdot 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0$ *ISOSTÁTICO*

(d)



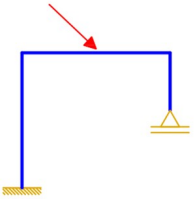
1 *Rótula com 2 barras*
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 1 \quad N_{ee} = 3$
$h_{EXT} = 4 - 1.(2-1) - 3 = 0$
$h_{INT} = 3Q = 3 \cdot 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0$ *ISOSTÁTICO*

(e)



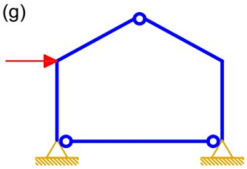
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{ri} = 0 \quad N_{ee} = 3$
$h_{EXT} = 4 - 0 - 3 = 1$
$h_{INT} = 3Q = 3 \cdot 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 1 + 0 = 1$ *HIPERESTÁTICO GRAU* 1

(f)



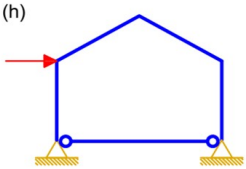
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{ri} = 0 \quad N_{ee} = 3$
$h_{EXT} = 4 - 0 - 3 = 1$
$h_{INT} = 3Q = 3 \cdot 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 1 + 0 = 1$ *HIPERESTÁTICO GRAU* 1

(g)



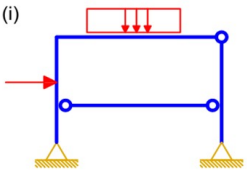
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 3 \quad N_{ee} = 3$
$h_{EXT} = 4 - 3.(2-1) - 3 = -2$
$h_{INT} = 3Q = 3 \cdot 1 = 3$
$h_{TOT} = h_{EXT} + h_{INT} = -2 + 3 = 1$ *HIPERESTÁTICO GRAU* 1

(h)



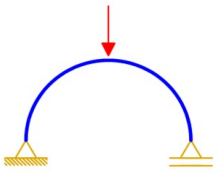
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 2 \quad N_{ee} = 3$
$h_{EXT} = 4 - 2.(2-1) - 3 = -1$
$h_{INT} = 3Q = 3 \,.\, 1 = 3$
$h_{TOT} = h_{EXT} + h_{INT} = -1 + 3 = 2 \quad HIPERESTÁTICO \;\; GRAU \;\; 2$

(i)



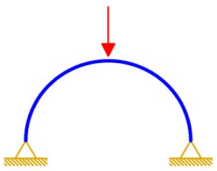
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 3 \quad N_{ee} = 3$
$h_{EXT} = 4 - 3.(2-1) - 3 = -2$
$h_{INT} = 3Q = 3 \,.\, 1 = 3$
$h_{TOT} = h_{EXT} + h_{INT} = -2 + 3 = 1 \quad HIPERESTÁTICO \, GRAU \, 1$

(j)



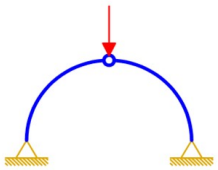
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 3 \quad N_{ri} = 0 \quad N_{ee} = 3$
$h_{EXT} = 3 - 0 - 3 = 0$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0 \quad ISOSTÁTICO$

(k)



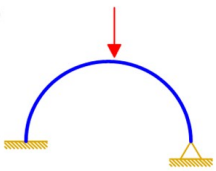
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{ri} = 0 \quad N_{ee} = 3$
$h_{EXT} = 4 - 0 - 3 = 1$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 1 + 0 = 1 \quad HIPERESTÁTICO \;\; GRAU \;\; 1$

(l)



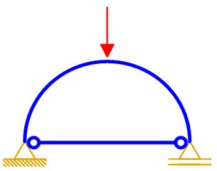
1 *Rótula com 2 barras*
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 1 \quad N_{ee} = 3$
$h_{EXT} = 4 - 1.(2-1) - 3 = 0$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0 \quad ISOSTÁTICO$

(m)



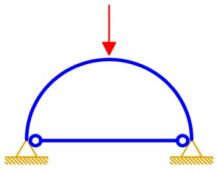
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 5 \quad N_{rl} = 0 \quad N_{ee} = 3$
$h_{EXT} = 5 - 0 - 3 = 2$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 2 + 0 = 2 \quad HIPERESTÁTICO \;\; GRAU \;\; 2$

(n)



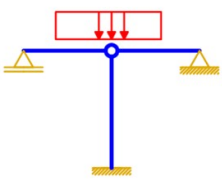
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 3 \quad N_{r2} = 2 \quad N_{ee} = 3$
$h_{EXT} = 3 - 2.(2-1) - 3 = -2$
$h_{INT} = 3Q = 3 \,.\, 1 = 3$
$h_{TOT} = h_{EXT} + h_{INT} = -2 + 3 = 1 \quad HIPERESTÁTICO \;\; GRAU \;\; 1$

(o)



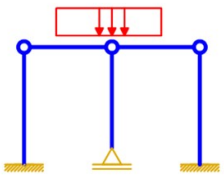
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 4 \quad N_{r2} = 2 \quad N_{ee} = 3$
$h_{EXT} = 4 - 2.(2-1) - 3 = -1$
$h_{INT} = 3Q = 3 \,.\, 1 = 3$
$h_{TOT} = h_{EXT} + h_{INT} = -1 + 3 = 2 \quad HIPERESTÁTICO \;\; GRAU \;\; 2$

(p)



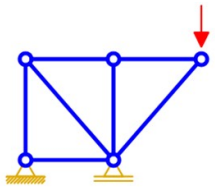
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 6 \quad N_{r3} = 1 \quad N_{ee} = 3$
$h_{EXT} = 6 - 1.(3-1) - 3 = 1$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 1 + 0 = 1 \quad HIPERESTÁTICO \;\; GRAU \;\; 1$

(q)



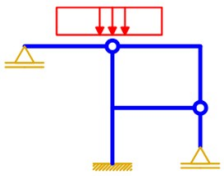
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 7 \quad N_{r3} = 1 \quad N_{r2} = 2 \quad N_{ee} = 3$
$h_{EXT} = 7 - [1.(3-1) + 2.(2-1)] - 3 = 0$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 0 + 0 = 0$ *ISOSTÁTICO*

(r)



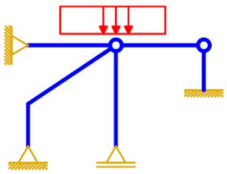
Treliça Plana
$h_{TREL} = R + b - 2n$
$R = 3 \quad b\ (barras) = 7 \quad n\ (nós) = 5$
$h_{TREL} = 3 + 7 - 2.5 = 0$ *ISOSTÁTICO*

(s)



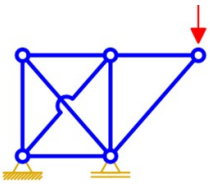
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 5 \quad N_{r3} = 2 \quad N_{ee} = 3$
$h_{EXT} = 5 - 2.(3-1) - 3 = -2$
$h_{INT} = 3Q = 3 \,.\, 1 = 3$
$h_{TOT} = h_{EXT} + h_{INT} = -2 + 3 = 1$ *HIPERESTÁTICA GRAU* 1

(t)



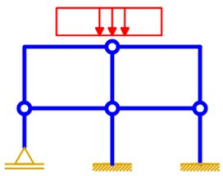
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 8 \quad N_{r4} = 1 \quad N_{r2} = 1 \quad N_{ee} = 3$
$h_{EXT} = 8 - [1.(4-1) + 1(2-1)] - 3 = 1$
$h_{INT} = 3Q = 3 \,.\, 0 = 0$
$h_{TOT} = h_{EXT} + h_{INT} = 1 + 0 = 1$ *HIPERESTÁTICA GRAU* 1

(u)



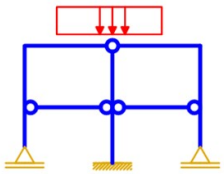
Treliça Plana
$h_{TREL} = R + b - 2n$
$R = 3 \quad b\ (barras) = 8 \quad n\ (nós) = 5$
$h_{TREL} = 3 + 8 - 2.5 = 1$ *HIPERESTÁTICO GRAU* 1

(v)



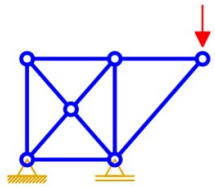
$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 7 \quad N_{r4} = 1 \quad N_{r3} = 3 \quad N_{ee} = 3$
$h_{EXT} = 7 - [1.(4-1) + 3(3-1)] - 3 = -5$
$h_{INT} = 3Q = 3 \,.\, 2 = 6$
$h_{TOT} = h_{EXT} + h_{INT} = -5 + 6 = 1$ *HIPERESTÁTICA GRAU* 1

(w)



$h_{EXT} = R - \sum N_{ri}(ri-1) - N_{ee}$
$R = 5 \quad N_{r3} = 1 \quad N_{r2} = 4 \quad N_{ee} = 3$
$h_{EXT} = 5 - [1.(3-1) + 4(2-1)] - 3 = -4$
$h_{INT} = 3Q = 3 \,.\, 2 = 6$
$h_{TOT} = h_{EXT} + h_{INT} = -4 + 6 = 2$ *HIPERESTÁTICA GRAU* 2

(x)



Treliça Plana
$h_{TREL} = R + b - 2n$
$R = 3 \quad b\ (barras) = 10 \quad n\ (nós) = 6$
$h_{TREL} = 3 + 10 - 2.6 = 1$ *HIPERESTÁTICO GRAU* 1