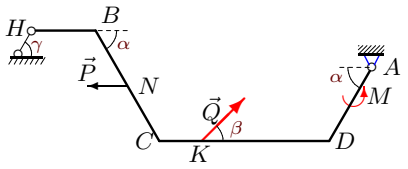
Равновесие тяжелой рамы

Тяжелая однородная рама расположена в вертикальной плоскости и опирается на неподвижный шарнир A и наклонный невесомый стержень H. К раме приложены горизонтальная сила P, наклонная сила Q и момент M. Учитывая погонный вес рамы ρ, найти реакции опор.

Кирсанов М.Н. **Решебник. Теоретическая механика** с. 31.

Вариант 1

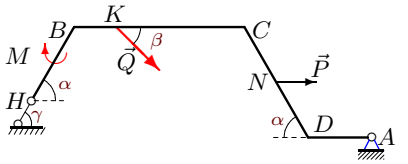
C4.



$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 21$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 3$ м, $BC = 6$ м,
$CD = 8$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 2

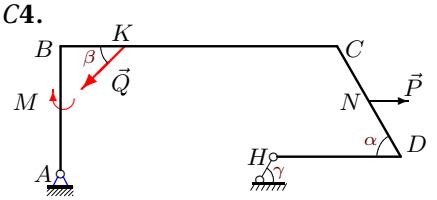
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 25$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 8$ м,
$CD = 6$ м, $DA = 3$ м,
$BK = 2$ м, $CN = 3$ м.

Вариант 3

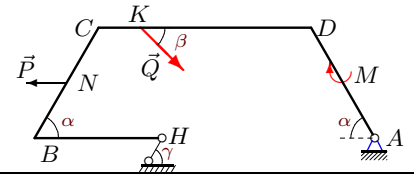
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 34$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 13$ м,
$CD = 6$ м, $DH = 6$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 4

C4.



$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 22$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 6$ м,
$CD = 10$ м, $DA = 6$ м,
$CK = 2$ м, $CN = 3$ м.

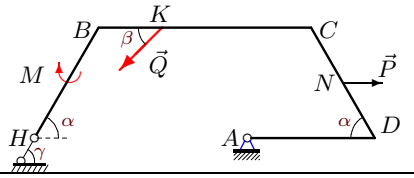
Вариант 5

C4.

$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 27$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 4$ м,
$CD = 14$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 6

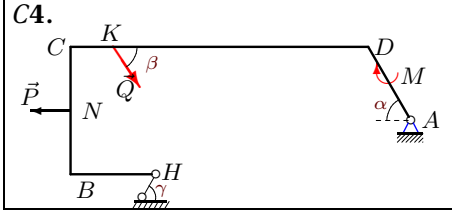
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 25$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 10$ м,
$CD = 6$ м, $DA = 6$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 7

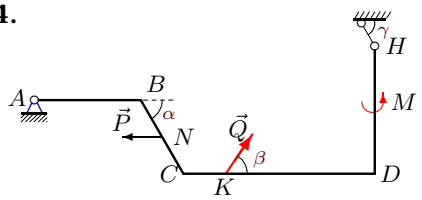
C4.



$\rho = 3$ кН/м, $P = 9$ кН,
$Q = 31$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 6$ м,
$CD = 14$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 8

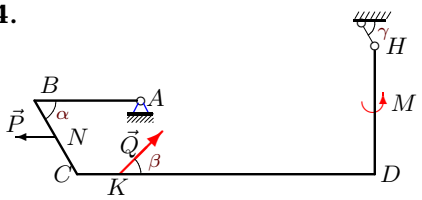
C4.



$\rho = 2$ кН/м, $P = 8$ кН,
$Q = 14$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 45°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 9$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 9

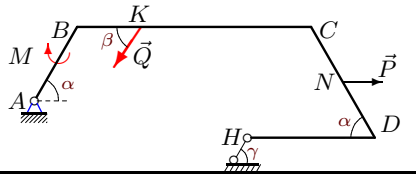
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 12$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 14$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 10

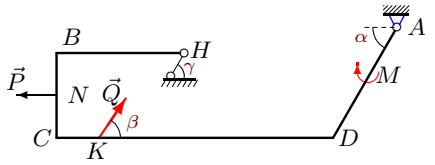
C4.



$\rho = 1$ кН/м, $P = 7$ кН,
$Q = 22$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 30°$,
$AB = 4$ м, $BC = 11$ м,
$CD = 6$ м, $DH = 6$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 11

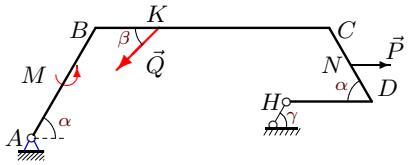
C4.



$\rho = 3$ кН/м, $P = 9$ кН,
$Q = 34$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 4$ м,
$CD = 13$ м, $DA = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 12

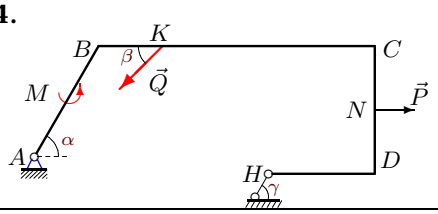
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 21$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 11$ м,
$CD = 4$ м, $DH = 4$ м,
$BK = 3$ м, $CN = 2$ м.

Вариант 13

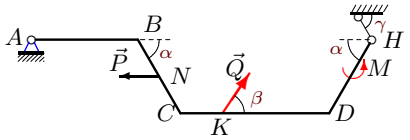
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 13$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 13$ м,
$CD = 6$ м, $DH = 5$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 14

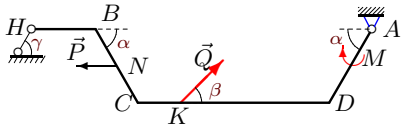
C4.



$\rho = 1$ кН/м, $P = 7$ кН,
$Q = 20$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 30°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 7$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 15

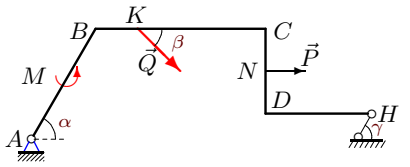
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 25$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 3$ м, $BC = 4$ м,
$CD = 9$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 16

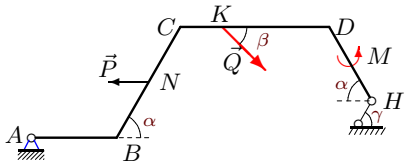
C4.



$\rho = 1$ кН/м, $P = 5$ кН,
$Q = 11$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 30°$,
$AB = 6$ м, $BC = 8$ м,
$CD = 4$ м, $DH = 5$ м,
$BK = 2$ м, $CN = 2$ м.

Вариант 17

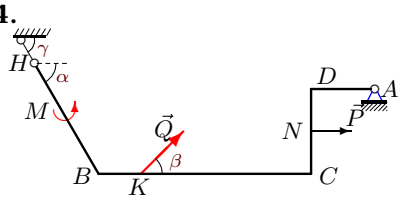
C4.



$\rho = 1$ кН/м, $P = 5$ кН,
$Q = 16$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 30°$,
$AB = 4$ м, $BC = 6$ м,
$CD = 7$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 18

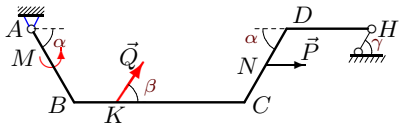
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 11$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 10$ м,
$CD = 4$ м, $DA = 3$ м,
$BK = 2$ м, $CN = 2$ м.

Вариант 19

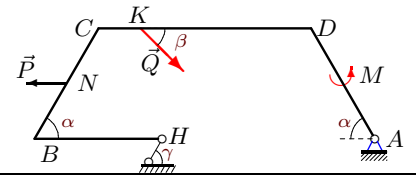
C4.



$\rho = 1$ кН/м, $P = 7$ кН,
$Q = 18$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 30°$,
$AB = 4$ м, $BC = 8$ м,
$CD = 4$ м, $DH = 4$ м,
$BK = 2$ м, $CN = 2$ м.

Вариант 20

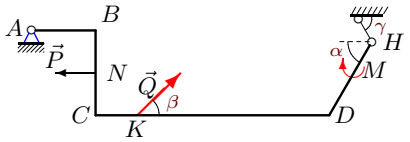
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 18$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 6$ м,
$CD = 10$ м, $DA = 6$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 21

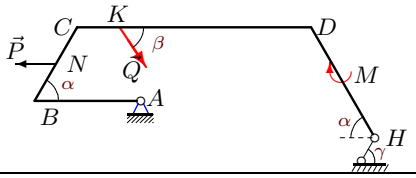
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 31$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 3$ м, $BC = 4$ м,
$CD = 11$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 22

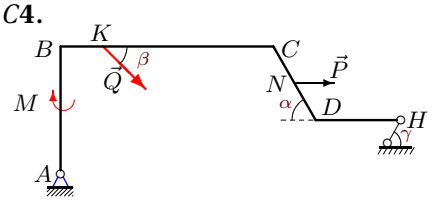
C4.



$\rho = 1$ кН/м, $P = 7$ кН,
$Q = 25$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 30°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 11$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 23

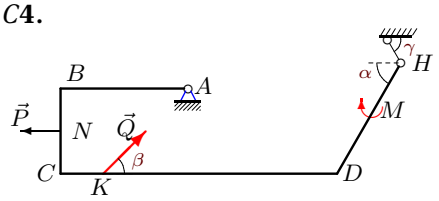
C4.



$\rho = 1$ кН/м, $P = 5$ кН,
$Q = 31$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 30°$,
$AB = 6$ м, $BC = 10$ м,
$CD = 4$ м, $DH = 4$ м,
$BK = 2$ м, $CN = 2$ м.

Вариант 24

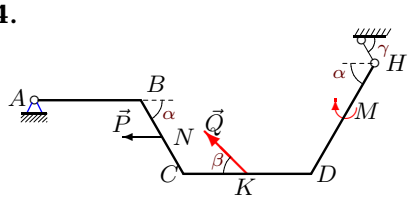
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 35$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 4$ м,
$CD = 13$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 25

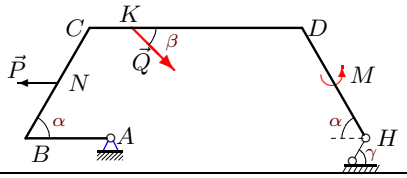
C4.



$\rho = 1$ кН/м, $P = 6$ кН,
$Q = 26$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 30°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 6$ м, $DH = 6$ м,
$CK = 3$ м, $CN = 2$ м.

Вариант 26

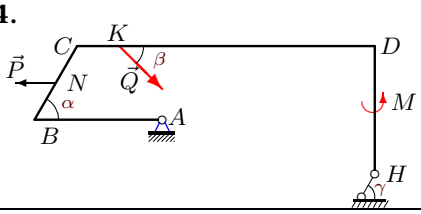
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 20$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 4$ м, $BC = 6$ м,
$CD = 10$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 27

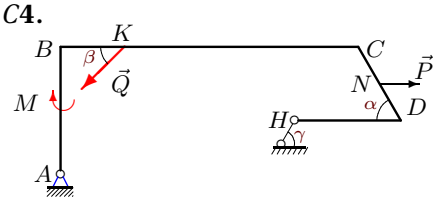
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 13$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 4$ м,
$CD = 14$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 28

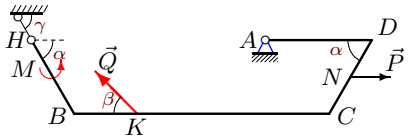
C4.



$\rho = 1$ кН/м, $P = 5$ кН,
$Q = 29$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 30°$,
$AB = 6$ м, $BC = 14$ м,
$CD = 4$ м, $DH = 5$ м,
$BK = 3$ м, $CN = 2$ м.

Вариант 29

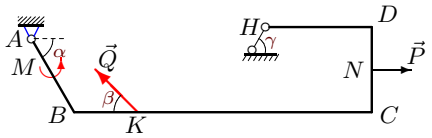
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 17$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 12$ м,
$CD = 4$ м, $DA = 5$ м,
$BK = 3$ м, $CN = 2$ м.

Вариант 30

C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 15$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 4$ м, $BC = 14$ м,
$CD = 4$ м, $DH = 5$ м,
$BK = 3$ м, $CN = 2$ м.

Ответы

	$M_A(Q)$	$M_A(P)$	$\Sigma_k M_A(G_k)$	h	X_A	Y_A	R_H
1	-67.355	-6.928	493.5	-14.722	-23.464	19.373	33.229
2	37.500	-18.187	514.5	-14.722	-45.931	45.570	34.560
3	125.669	-20.412	-499.0	6.503	-21.546	34.009	63.627
4	90.287	20.785	762.0	-8.660	-56.520	14.749	97.927
5	-201.150	-11.713	750.0	-10.660	-35.113	17.303	48.042
6	162.500	-18.187	78.0	-8.660	3.259	76.769	22.784
7	322.161	4.177	846.0	-9.124	-69.372	1.949	125.745
8	133.368	-13.856	-472.0	13.107	17.319	19.557	23.079
9	20.909	-12.124	-187.0	9.571	7.987	40.042	13.396
10	-57.158	-6.062	-251.5	6.500	-39.930	20.689	50.726
11	-323.894	-28.765	823.5	-8.062	-35.650	9.664	55.300
12	31.500	-20.785	-437.0	7.261	-24.460	23.853	51.826
13	19.500	-13.177	-592.0	8.347	-40.123	21.118	64.179
14	190.526	-12.124	-170.0	8.000	-7.157	5.080	-4.800
15	-37.500	-12.124	462.0	-13.856	-28.629	23.289	27.956
16	-77.000	-15.981	-176.5	6.964	-44.307	11.306	34.388
17	-144.000	12.990	-174.5	6.500	-45.564	7.807	42.386
18	-22.395	14.000	550.5	-13.258	6.558	23.518	46.168
19	93.531	12.124	-152.0	8.000	-17.769	3.390	2.043
20	18.000	18.187	762.0	-8.660	-58.713	6.181	100.250
21	197.283	-14.000	-340.0	10.935	-3.493	10.652	16.161
22	-21.651	12.124	-56.0	7.000	-15.463	41.899	11.504
23	-192.081	-21.340	-150.0	5.804	-88.313	6.899	65.202
24	51.244	-12.000	-31.0	7.917	-23.261	39.450	1.485
25	120.161	-10.392	-183.5	9.500	32.474	-2.055	9.340
26	-100.000	15.588	-160.0	8.485	-27.521	45.799	22.912
27	-26.000	10.392	-128.0	8.864	-12.726	59.033	10.560
28	107.188	-21.340	-225.5	3.304	-20.423	20.095	46.809
29	-102.000	12.124	142.5	-9.526	14.159	55.352	12.872
30	-7.500	8.785	-523.0	7.399	-38.089	1.421	63.752