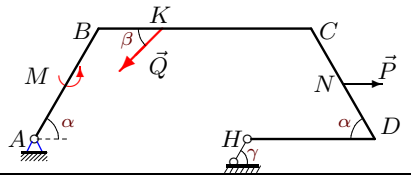
Равновесие тяжелой рамы

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

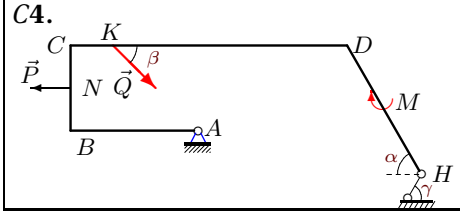
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 17$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 10$ м,
$CD = 6$ м, $DH = 6$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 2

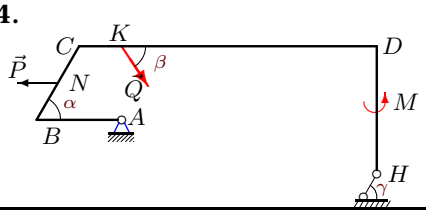
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 33$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 4$ м,
$CD = 13$ м, $DH = 7$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 3

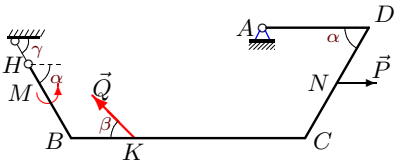
C4.



$\rho = 2$ кН/м, $P = 8$ кН,
$Q = 11$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 45°$,
$AB = 4$ м, $BC = 4$ м,
$CD = 14$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 4

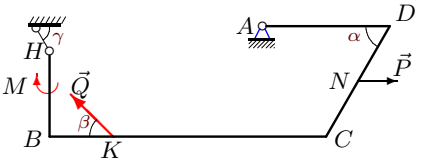
C4.



$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 19$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 11$ м,
$CD = 6$ м, $DA = 5$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 5

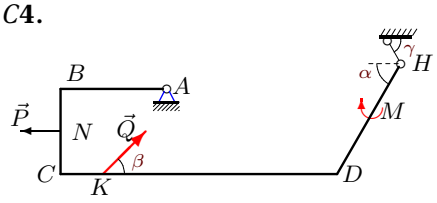
C4.



$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 29$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 13$ м,
$CD = 6$ м, $DA = 6$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 6

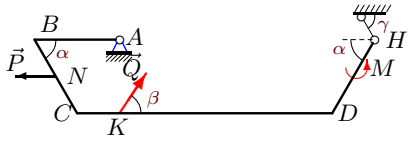
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 28$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 13$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 7

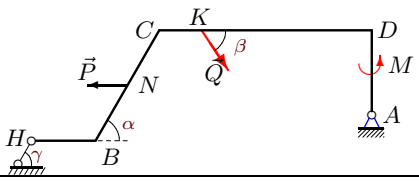
C4.



$\rho = 2$ кН/м, $P = 8$ кН,
$Q = 21$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 45°$,
$AB = 4$ м, $BC = 4$ м,
$CD = 12$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 8

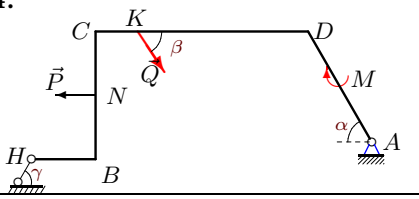
C4.



$\rho = 3$ кН/м, $P = 9$ кН,
$Q = 12$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 60°$,
$HB = 3$ м, $BC = 6$ м,
$CD = 10$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 9

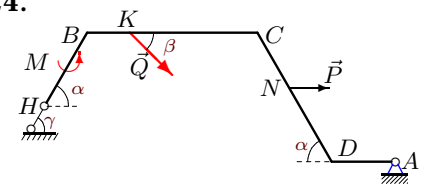
C4.



$\rho = 3$ кН/м, $P = 9$ кН,
$Q = 31$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 60°$,
$HB = 3$ м, $BC = 6$ м,
$CD = 10$ м, $DA = 6$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 10

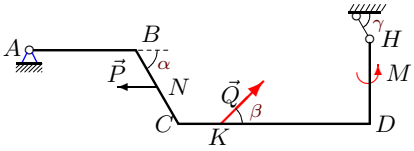
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 20$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 4$ м, $BC = 8$ м,
$CD = 7$ м, $DA = 3$ м,
$BK = 2$ м, $CN = 3$ м.

Вариант 11

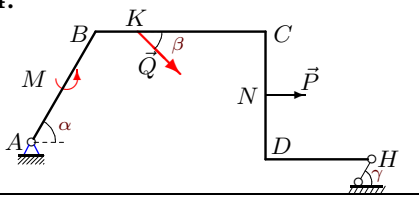
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 11$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 9$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 12

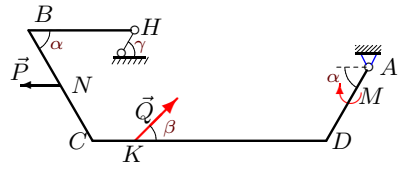
C4.



$\rho = 1$ кН/м, $P = 5$ кН,
$Q = 14$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 30°$,
$AB = 6$ м, $BC = 8$ м,
$CD = 6$ м, $DH = 5$ м,
$BK = 2$ м, $CN = 3$ м.

Вариант 13

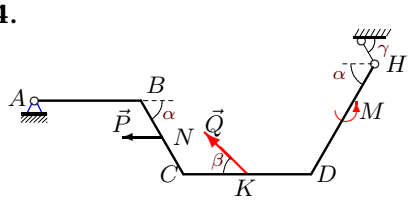
C4.



$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 25$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 5$ м, $BC = 6$ м,
$CD = 11$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 14

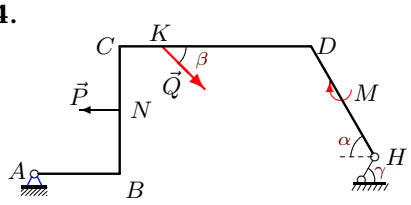
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 16$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 5$ м, $BC = 4$ м,
$CD = 6$ м, $DH = 6$ м,
$CK = 3$ м, $CN = 2$ м.

Вариант 15

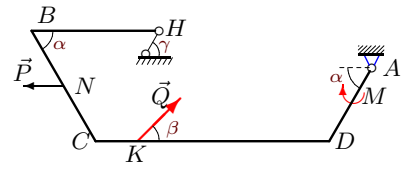
C4.



$\rho = 1$ кН/м, $P = 6$ кН,
$Q = 28$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 30°$,
$AB = 4$ м, $BC = 6$ м,
$CD = 9$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 16

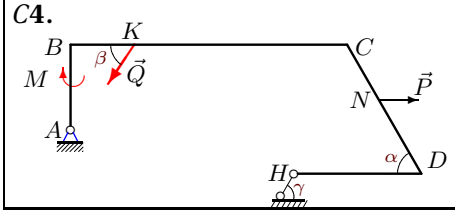
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 24$ кН, $M = 25$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 6$ м,
$CD = 11$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 17

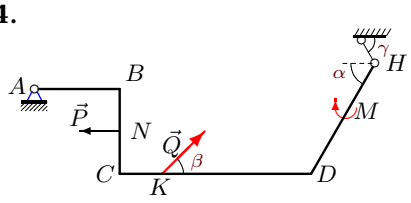
C4.



$\rho = 1$ кН/м, $P = 7$ кН,
$Q = 35$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 30°$,
$AB = 4$ м, $BC = 13$ м,
$CD = 7$ м, $DH = 6$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 18

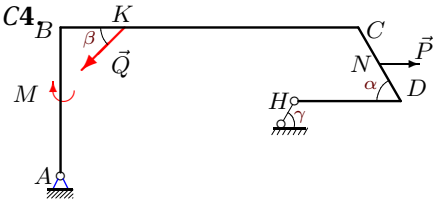
C4.



$\rho = 1$ кН/м, $P = 6$ кН,
$Q = 35$ кН, $M = 15$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 30°$,
$AB = 4$ м, $BC = 4$ м,
$CD = 9$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 19

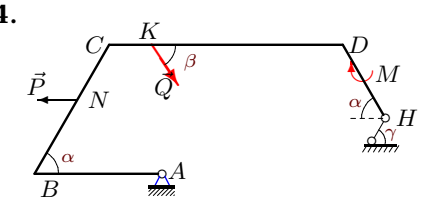
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 28$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 7$ м, $BC = 14$ м,
$CD = 4$ м, $DH = 5$ м,
$BK = 3$ м, $CN = 2$ м.

Вариант 20

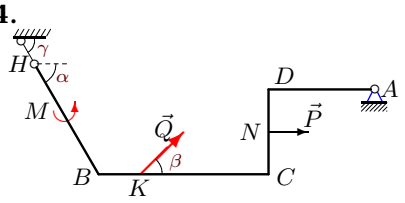
C4.



$\rho = 2$ кН/м, $P = 8$ кН,
$Q = 26$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 45°$,
$AB = 6$ м, $BC = 7$ м,
$CD = 11$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 21

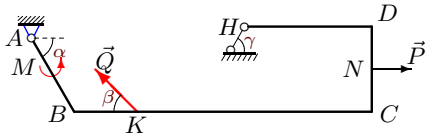
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 15$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 8$ м,
$CD = 4$ м, $DA = 5$ м,
$BK = 2$ м, $CN = 2$ м.

Вариант 22

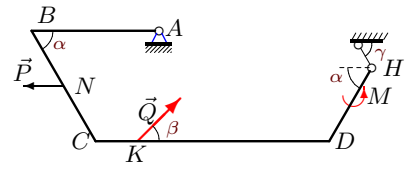
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 12$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 4$ м, $BC = 14$ м,
$CD = 4$ м, $DH = 6$ м,
$BK = 3$ м, $CN = 2$ м.

Вариант 23

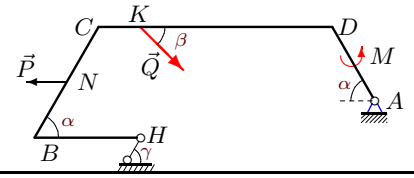
C4.



$\rho = 1$ кН/м, $P = 6$ кН,
$Q = 18$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 30°$,
$AB = 6$ м, $BC = 6$ м,
$CD = 11$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 24

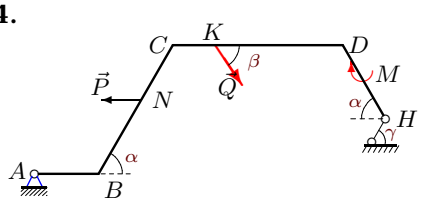
C4.



$\rho = 3$ кН/м, $P = 8$ кН,
$Q = 18$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 60°$,
$HB = 5$ м, $BC = 6$ м,
$CD = 11$ м, $DA = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 25

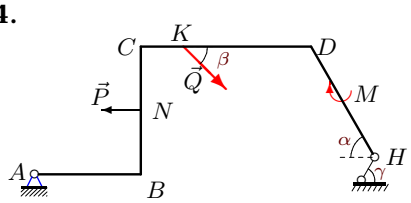
C4.



$\rho = 2$ кН/м, $P = 8$ кН,
$Q = 23$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 45°$,
$AB = 3$ м, $BC = 7$ м,
$CD = 8$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 26

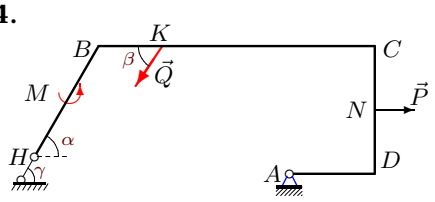
C4.



$\rho = 2$ кН/м, $P = 6$ кН,
$Q = 33$ кН, $M = 20$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 45°$,
$AB = 5$ м, $BC = 6$ м,
$CD = 8$ м, $DH = 6$ м,
$CK = 2$ м, $CN = 3$ м.

Вариант 27

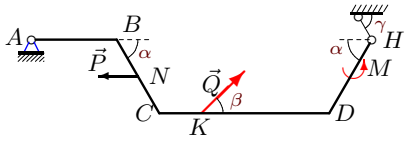
C4.



$\rho = 3$ кН/м, $P = 9$ кН,
$Q = 14$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 13$ м,
$CD = 6$ м, $DA = 4$ м,
$BK = 3$ м, $CN = 3$ м.

Вариант 28

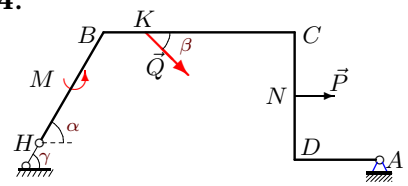
C4.



$\rho = 2$ кН/м, $P = 7$ кН,
$Q = 20$ кН, $M = 50$ кНм,
$\alpha = 60°$, $\beta = 45°$, $\gamma = 45°$,
$AB = 4$ м, $BC = 4$ м,
$CD = 8$ м, $DH = 4$ м,
$CK = 2$ м, $CN = 2$ м.

Вариант 29

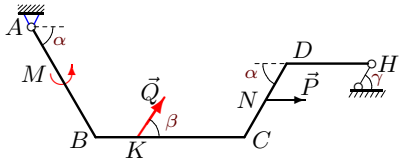
C4.



$\rho = 3$ кН/м, $P = 7$ кН,
$Q = 14$ кН, $M = 70$ кНм,
$\alpha = 60°$, $\beta = 30°$, $\gamma = 60°$,
$HB = 6$ м, $BC = 9$ м,
$CD = 6$ м, $DA = 4$ м,
$BK = 2$ м, $CN = 3$ м.

Вариант 30

C4.



$\rho = 1$ кН/м, $P = 7$ кН,
$Q = 19$ кН, $M = 30$ кНм,
$\alpha = 60°$, $\beta = 60°$, $\gamma = 30°$,
$AB = 6$ м, $BC = 7$ м,
$CD = 4$ м, $DH = 4$ м,
$BK = 2$ 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	25.500	-15.588	-508.0	7.071	-36.086	19.691	63.369
2	0.000	14.000	-51.5	8.883	-20.912	78.757	6.473
3	-19.053	13.856	-244.0	10.278	-11.204	51.823	19.380
4	-150.421	20.785	135.0	-10.392	9.061	58.285	7.252
5	-250.095	20.785	121.5	-9.258	5.334	78.917	-14.345
6	54.995	-12.000	-88.0	8.624	-12.919	36.670	7.538
7	36.373	-13.856	-144.0	8.485	3.457	23.857	8.424
8	59.138	12.617	487.5	-13.258	-20.731	38.290	47.461
9	214.774	19.765	631.5	-13.454	-37.755	47.712	62.510
10	20.000	-24.249	551.3	-15.588	-44.111	41.722	39.581
11	96.948	-12.124	-408.0	11.693	15.742	19.702	23.363
12	-98.000	-10.981	-198.5	8.696	-44.758	16.046	31.908
13	-133.217	-6.928	723.0	-10.392	-36.517	13.834	53.680
14	73.945	-12.124	-367.0	12.538	32.705	16.295	20.352
15	-237.588	18.000	-195.5	7.304	-64.795	15.356	58.885
16	-60.000	-6.062	754.5	-9.526	-48.606	8.687	69.643
17	-20.933	-9.813	-268.8	7.036	-28.210	37.961	44.699
18	247.487	-12.000	-187.5	9.036	-21.910	0.077	-3.651
19	127.741	-31.608	-451.0	5.278	-31.974	23.777	71.026
20	-67.550	27.713	-46.5	5.588	-18.457	65.060	19.031
21	-30.538	14.000	574.5	-13.258	3.691	20.482	47.364
22	13.033	10.249	-544.0	6.692	-48.252	-2.223	70.339
23	53.408	-15.588	-18.5	3.500	-18.931	21.318	-14.091
24	95.916	6.928	723.0	-8.660	-56.450	1.143	103.443
25	-239.023	27.713	-367.5	9.830	-46.574	20.845	60.916
26	-286.973	18.000	-403.0	10.745	-68.115	20.964	64.398
27	114.746	-27.000	190.5	-10.794	-18.131	71.184	32.262
28	162.127	-12.124	-336.0	11.314	1.358	17.358	12.021
29	4.254	-21.000	586.5	-14.258	-41.559	43.142	44.869
30	131.636	24.249	-154.5	9.500	-13.639	6.197	-3.304