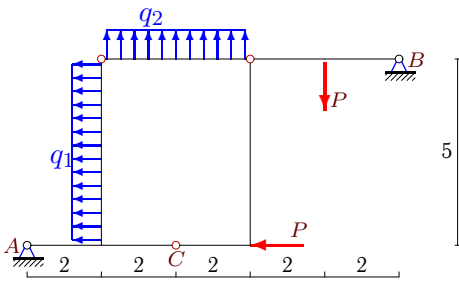


## Статически определимая рама

Построить эпюры  $M$ ,  $Q$ ,  $N$  в раме. Найти горизонтальное ( $\Delta x_C$ ) или вертикальное ( $\Delta y_C$ ) смещение шарнира  $C$ . Все стержни имеют одинаковую жесткость  $EJ$ .

**Задача M21.1.**

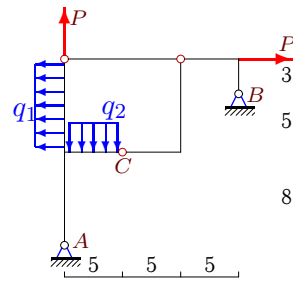
9



$q_1 = 12 \text{ кН/м}$ ,  $q_2 = 3 \text{ кН/м}$ ,  $P = 6 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.2.**

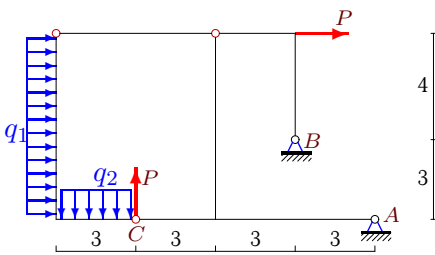
9



$q_1 = 6 \text{ кН/м}$ ,  $q_2 = 9 \text{ кН/м}$ ,  $P = 9 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.3.**

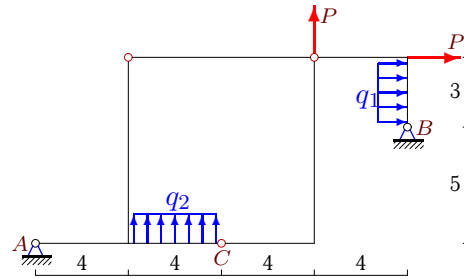
9



$q_1 = 3 \text{ кН/м}$ ,  $q_2 = 18 \text{ кН/м}$ ,  $P = 9 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.4.**

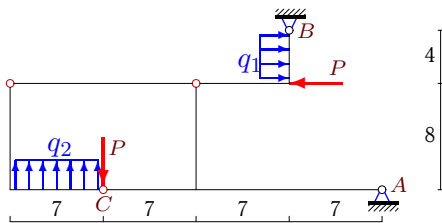
9



$q_1 = 5 \text{ кН/м}$ ,  $q_2 = 30 \text{ кН/м}$ ,  $P = 3 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.5.**

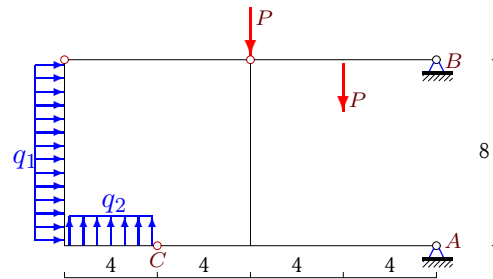
9



$q_1 = 3 \text{ кН/м}$ ,  $q_2 = 9 \text{ кН/м}$ ,  $P = 12 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.6.**

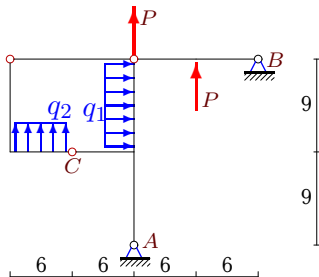
9



$q_1 = 6 \text{ кН/м}$ ,  $q_2 = 33 \text{ кН/м}$ ,  $P = 12 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.7.**

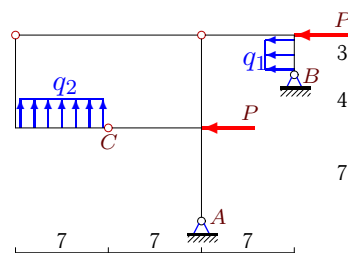
9



$q_1 = 5 \text{ кН/м}$ ,  $q_2 = 3 \text{ кН/м}$ ,  $P = 27 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.8.**

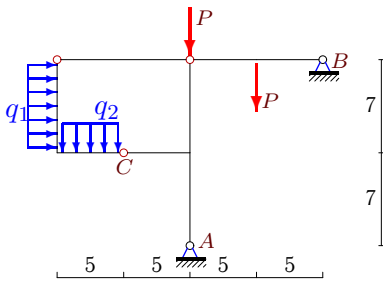
9



$q_1 = 12 \text{ кН/м}$ ,  $q_2 = 30 \text{ кН/м}$ ,  $P = 6 \text{ кН}$ .  $\Delta y_C$ —?

**Задача M21.9.**

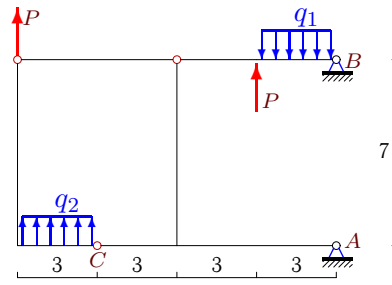
9



$q_1 = 6 \text{ кН/м}$ ,  $q_2 = 9 \text{ кН/м}$ ,  $P = 15 \text{ кН}$ .  $\Delta x_C - ?$

**Задача M21.10.**

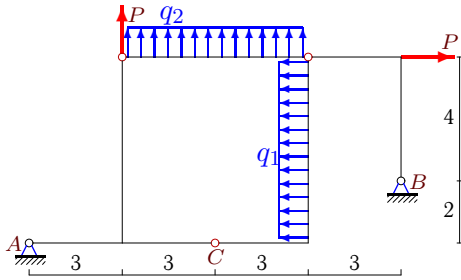
9



$q_1 = 9 \text{ кН/м}$ ,  $q_2 = 7 \text{ кН/м}$ ,  $P = 9 \text{ кН}$ .  $\Delta y_C - ?$

**Задача M21.11.**

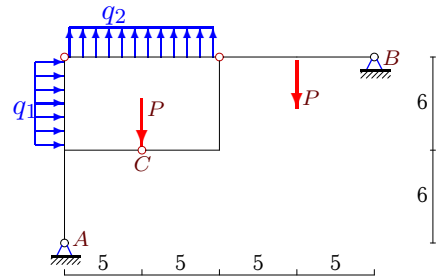
9



$q_1 = 3 \text{ кН/м}$ ,  $q_2 = 9 \text{ кН/м}$ ,  $P = 24 \text{ кН}$ .  $\Delta y_C - ?$

**Задача M21.12.**

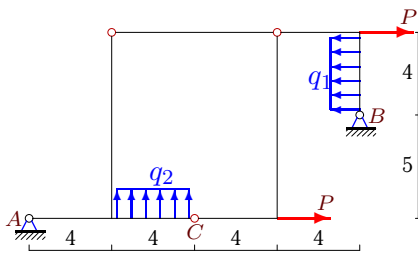
9



$q_1 = 3 \text{ кН/м}$ ,  $q_2 = 7 \text{ кН/м}$ ,  $P = 12 \text{ кН}$ .  $\Delta x_C - ?$

**Задача M21.13.**

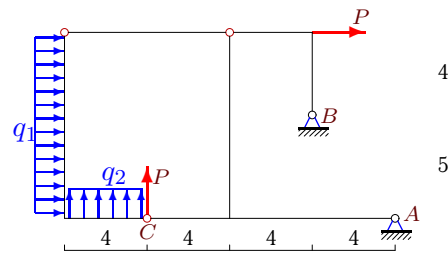
9



$q_1 = 15 \text{ кН/м}$ ,  $q_2 = 39 \text{ кН/м}$ ,  $P = 33 \text{ кН}$ .  $\Delta y_C - ?$

**Задача M21.14.**

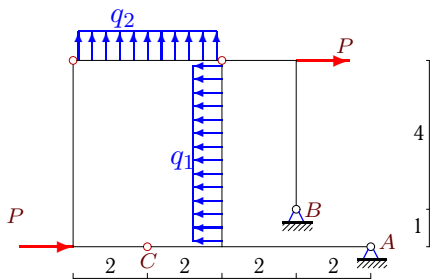
9



$q_1 = 5 \text{ кН/м}$ ,  $q_2 = 3 \text{ кН/м}$ ,  $P = 12 \text{ кН}$ .  $\Delta y_C - ?$

**Задача M21.15.**

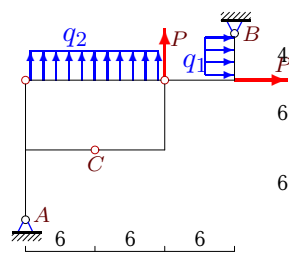
9



$q_1 = 12 \text{ кН/м}$ ,  $q_2 = 30 \text{ кН/м}$ ,  $P = 30 \text{ кН}$ .  $\Delta y_C - ?$

**Задача M21.16.**

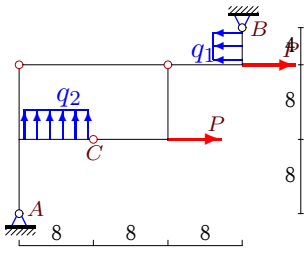
9



$q_1 = 9 \text{ кН/м}$ ,  $q_2 = 12 \text{ кН/м}$ ,  $P = 12 \text{ кН}$ .  $\Delta y_C - ?$

Задача M21.17.

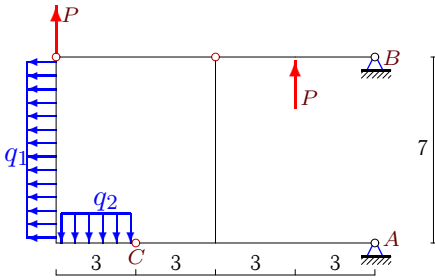
9



$q_1 = 18 \text{ кН/м}, q_2 = 30 \text{ кН/м}, P = 15 \text{ кН}. \Delta y_C - ?$

Задача M21.19.

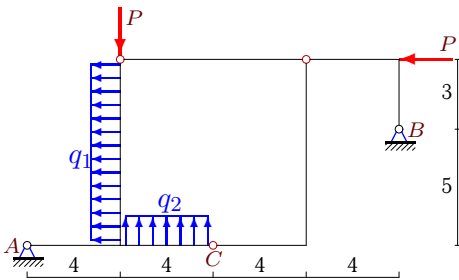
9



$q_1 = 19 \text{ кН/м}, q_2 = 9 \text{ кН/м}, P = 27 \text{ кН}. \Delta y_C - ?$

Задача M21.21.

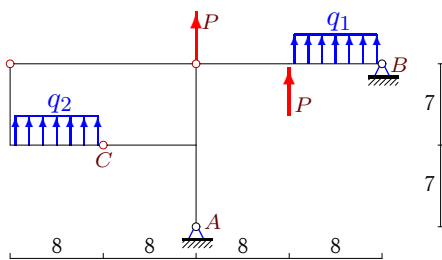
9



$q_1 = 3 \text{ кН/м}, q_2 = 7 \text{ кН/м}, P = 15 \text{ кН}. \Delta y_C - ?$

Задача M21.23.

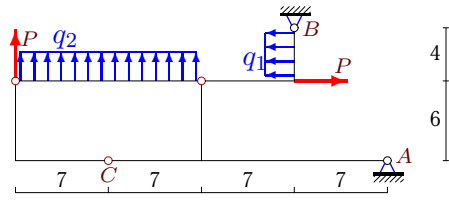
9



$q_1 = 9 \text{ кН/м}, q_2 = 6 \text{ кН/м}, P = 18 \text{ кН}. \Delta y_C - ?$

Задача M21.18.

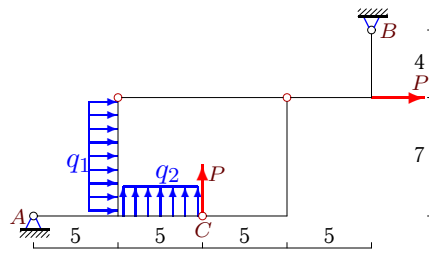
9



$q_1 = 9 \text{ кН/м}, q_2 = 21 \text{ кН/м}, P = 6 \text{ кН}. \Delta y_C - ?$

Задача M21.20.

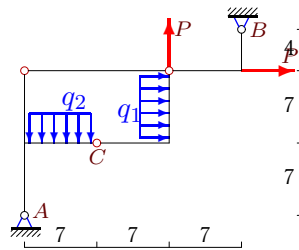
9



$q_1 = 3 \text{ кН/м}, q_2 = 7 \text{ кН/м}, P = 3 \text{ кН}. \Delta y_C - ?$

Задача M21.22.

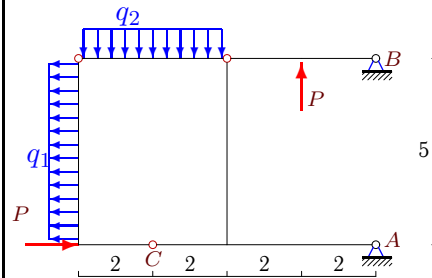
9



$q_1 = 5 \text{ кН/м}, q_2 = 12 \text{ кН/м}, P = 36 \text{ кН}. \Delta y_C - ?$

Задача M21.24.

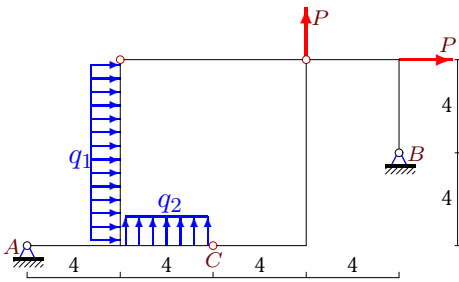
9



$q_1 = 12 \text{ кН/м}, q_2 = 6 \text{ кН/м}, P = 21 \text{ кН}. \Delta y_C - ?$

**Задача M21.25.**

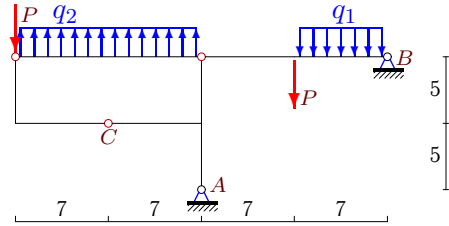
9



$q_1 = 9\text{кН/м}$ ,  $q_2 = 36\text{кН/м}$ ,  $P = 24\text{кН}$ .  $\Delta y_C - ?$

**Задача M21.26.**

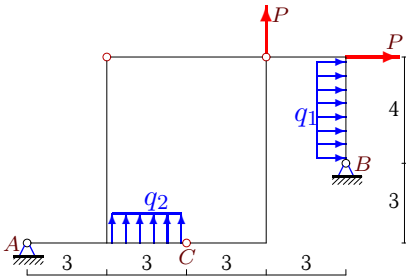
9



$q_1 = 6\text{кН/м}$ ,  $q_2 = 39\text{кН/м}$ ,  $P = 18\text{кН}$ .  $\Delta x_C - ?$

**Задача M21.27.**

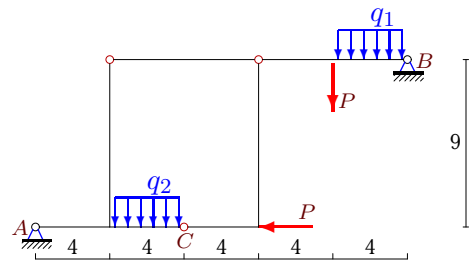
9



$q_1 = 6\text{кН/м}$ ,  $q_2 = 18\text{кН/м}$ ,  $P = 24\text{кН}$ .  $\Delta y_C - ?$

**Задача M21.28.**

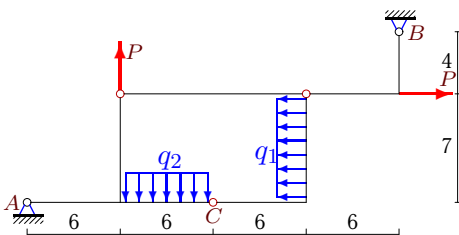
9



$q_1 = 31\text{кН/м}$ ,  $q_2 = 15\text{кН/м}$ ,  $P = 9\text{кН}$ .  $\Delta y_C - ?$

**Задача M21.29.**

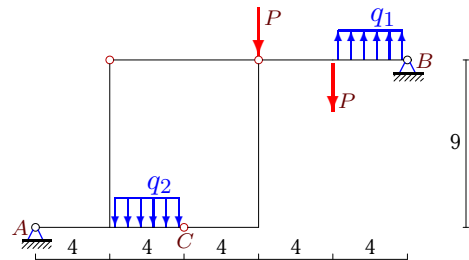
9



$q_1 = 3\text{кН/м}$ ,  $q_2 = 12\text{кН/м}$ ,  $P = 3\text{кН}$ .  $\Delta y_C - ?$

**Задача M21.30.**

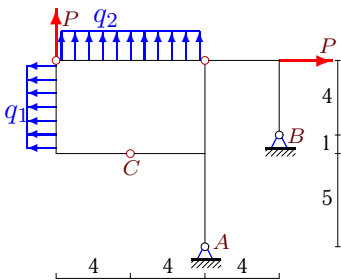
9



$q_1 = 6\text{кН/м}$ ,  $q_2 = 9\text{кН/м}$ ,  $P = 3\text{кН}$ .  $\Delta y_C - ?$

**Задача M21.31.**

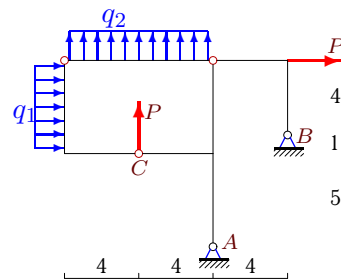
9



$q_1 = 6\text{кН/м}$ ,  $q_2 = 36\text{кН/м}$ ,  $P = 24\text{кН}$ .  $\Delta y_C - ?$

**Задача M21.32.**

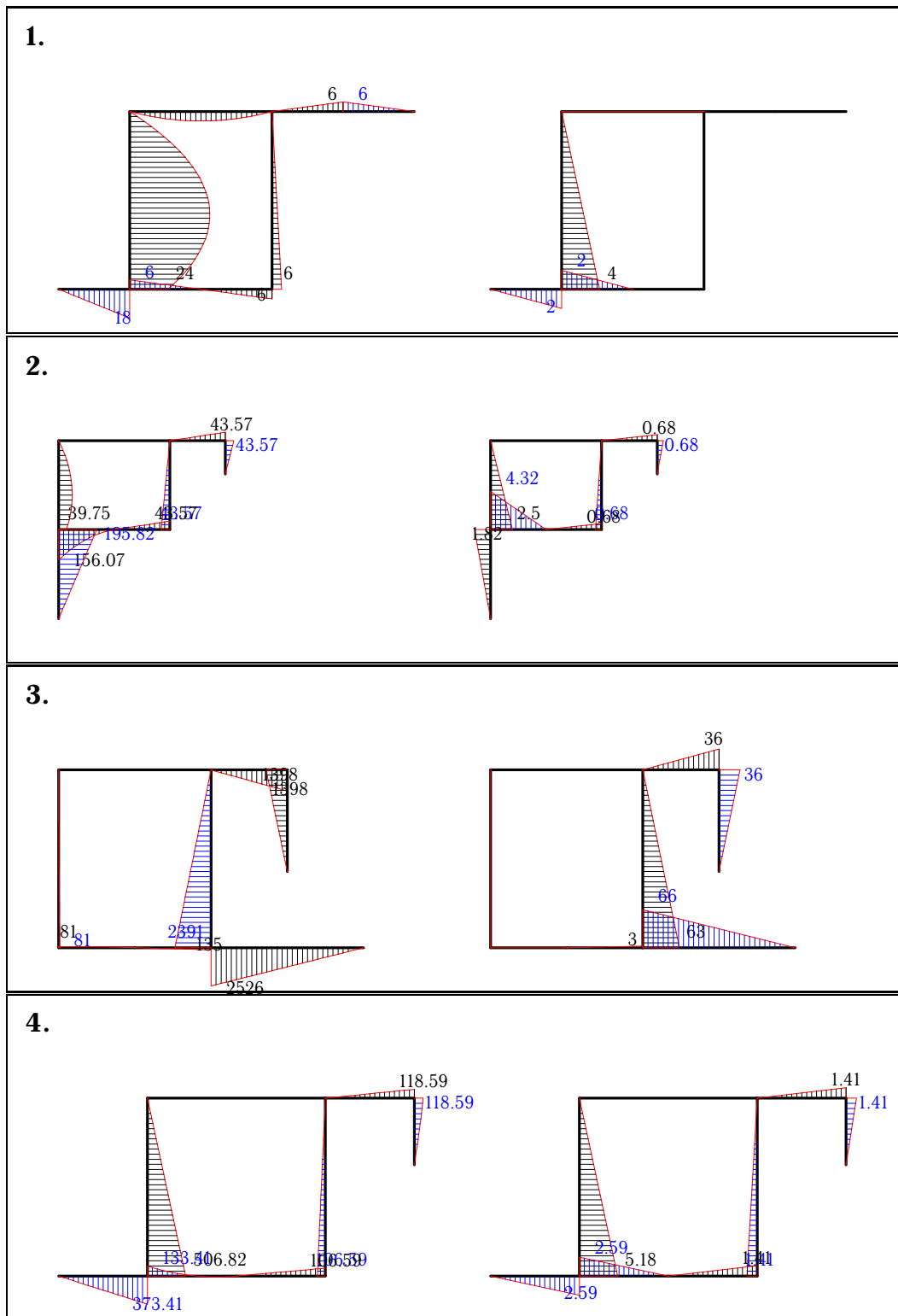
9



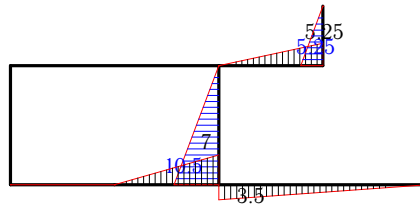
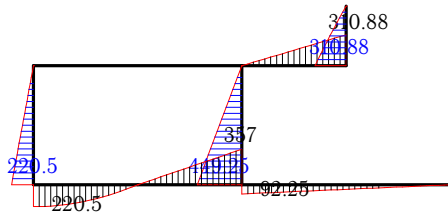
$q_1 = 3\text{кН/м}$ ,  $q_2 = 6\text{кН/м}$ ,  $P = 27\text{кН}$ .  $\Delta y_C - ?$

**M21 Ответы.**  
**Статически определимая рама**

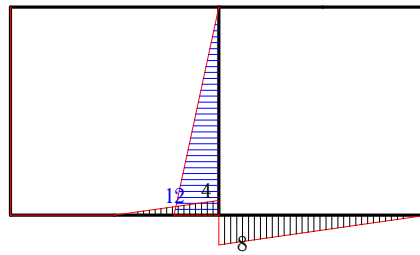
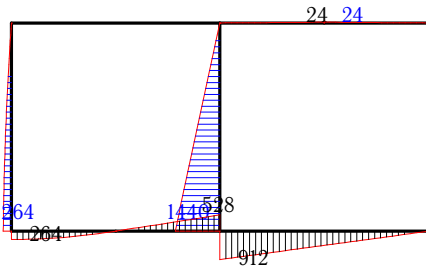
16.04.2013



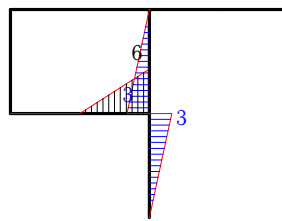
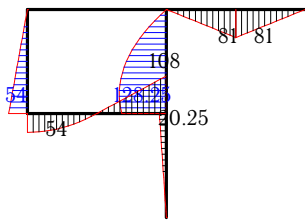
5.



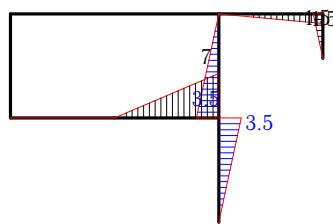
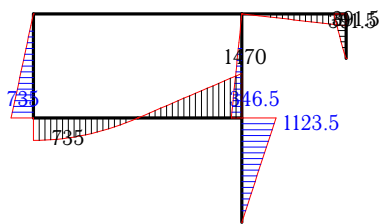
6.



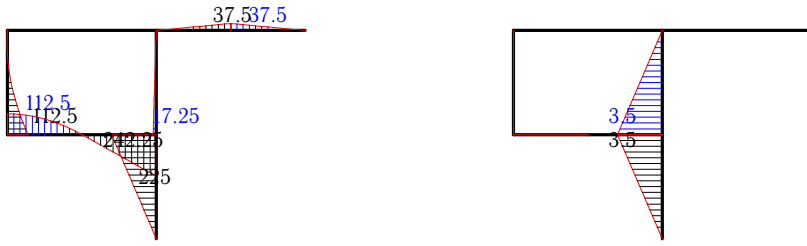
7.



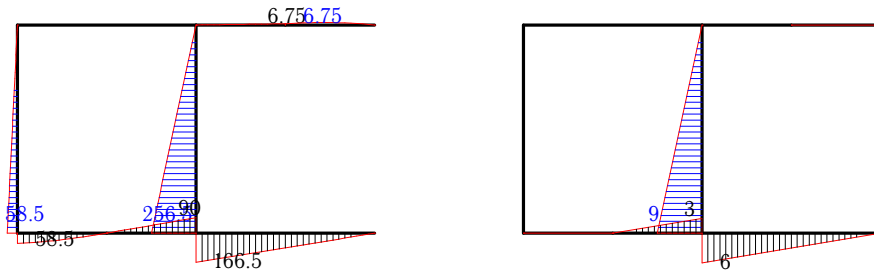
8.



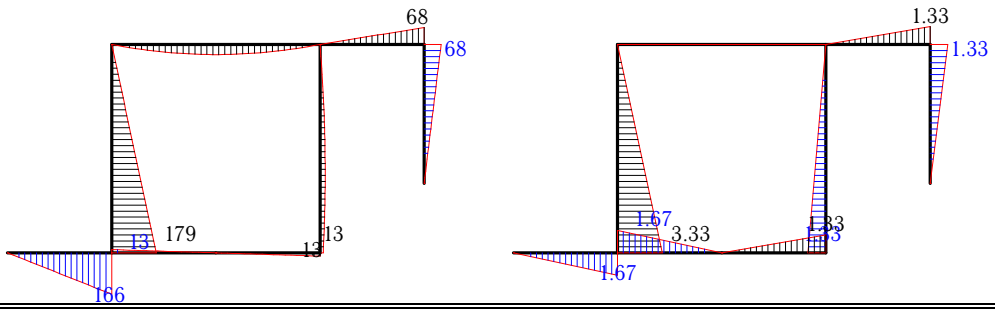
9.



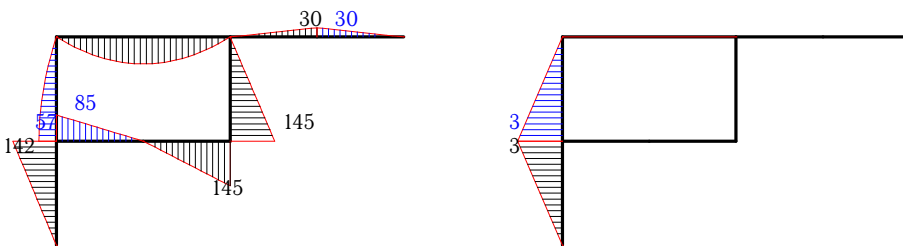
10.



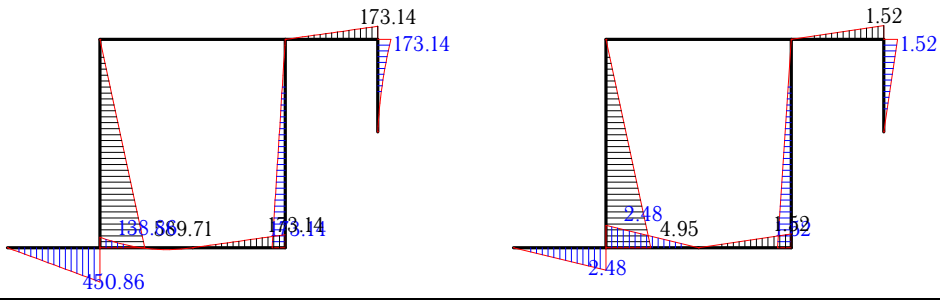
11.



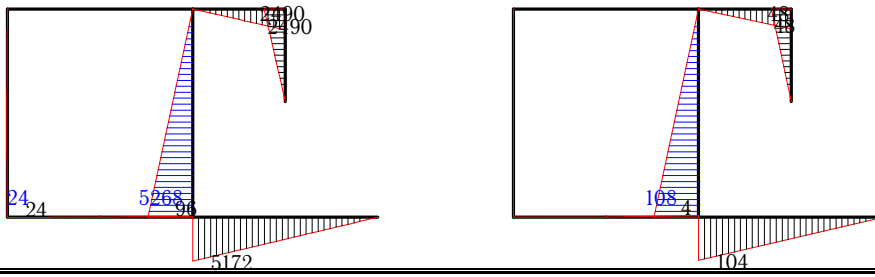
12.



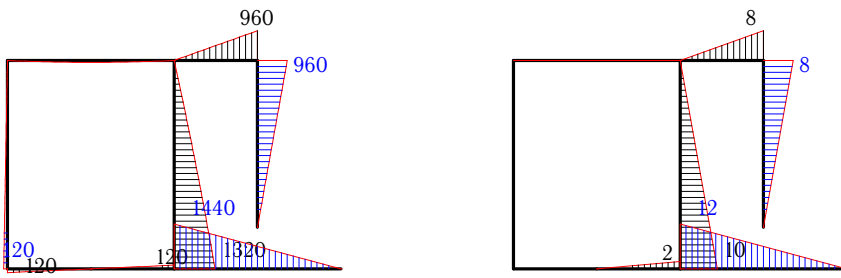
13.



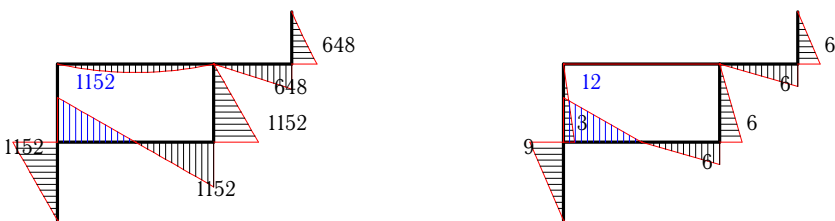
14.



15.

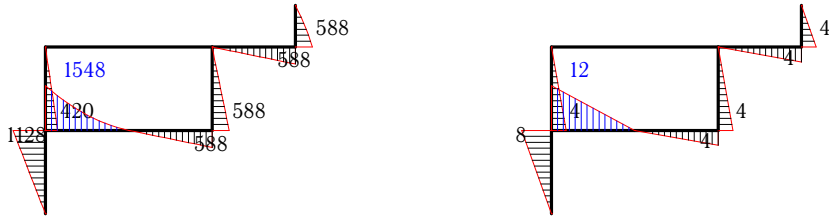


16.

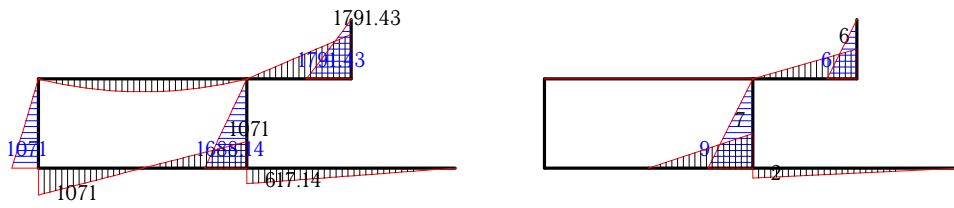




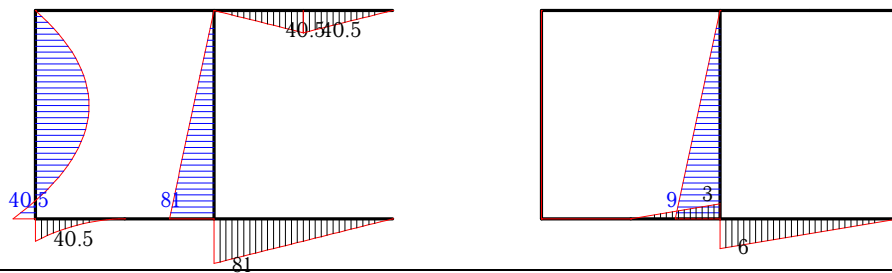
17.



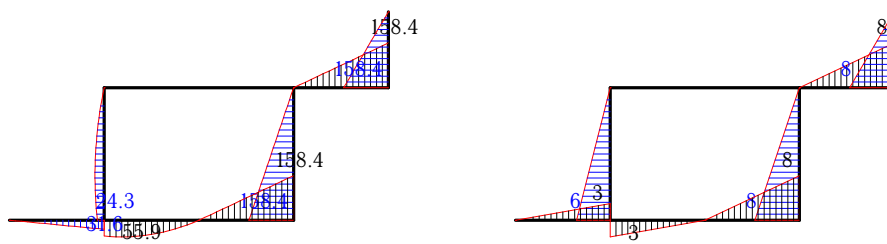
18.



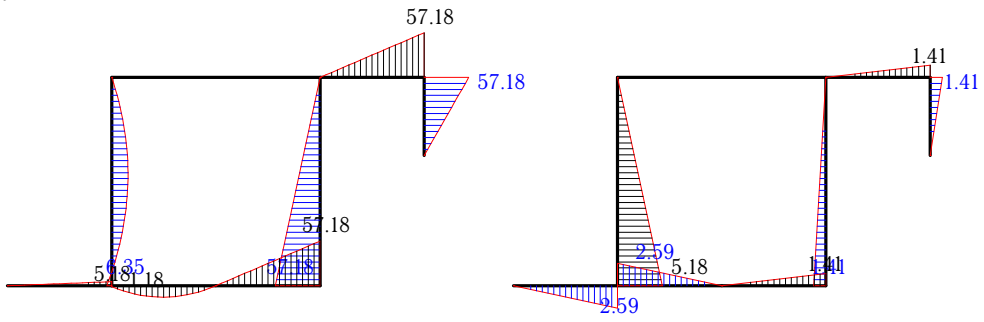
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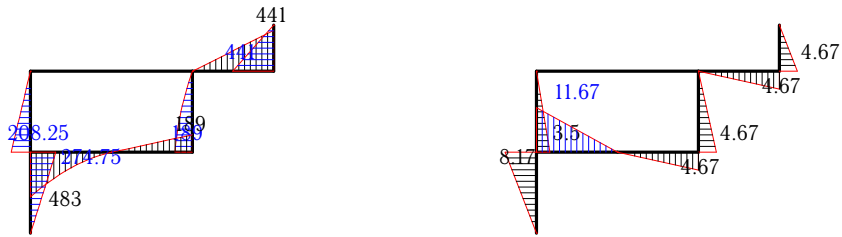
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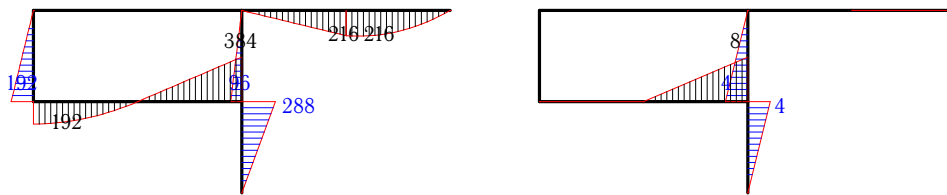
21.



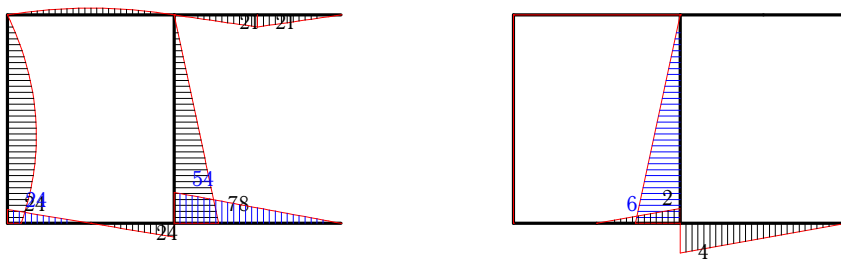
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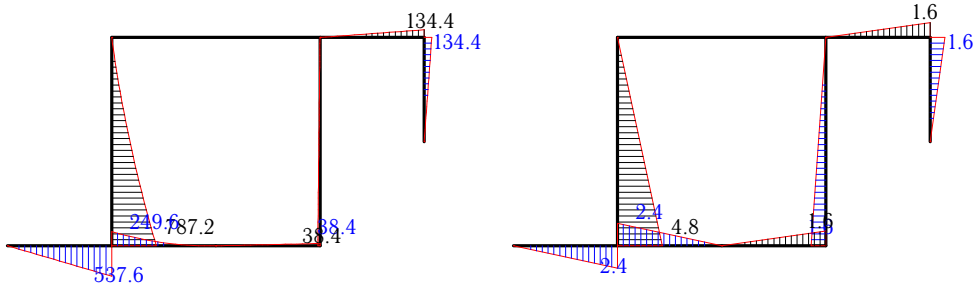
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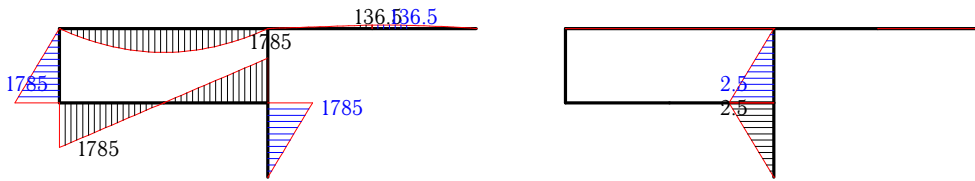
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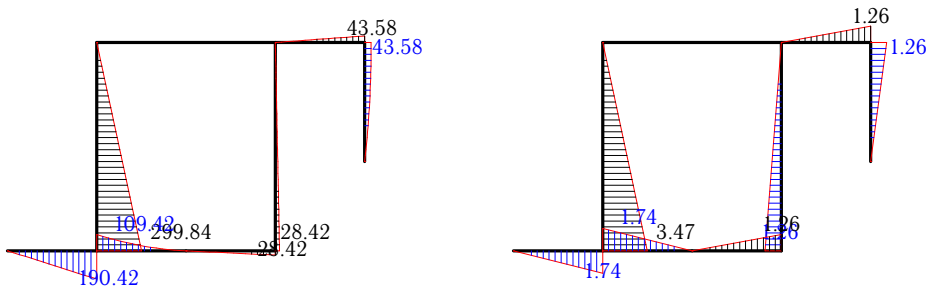
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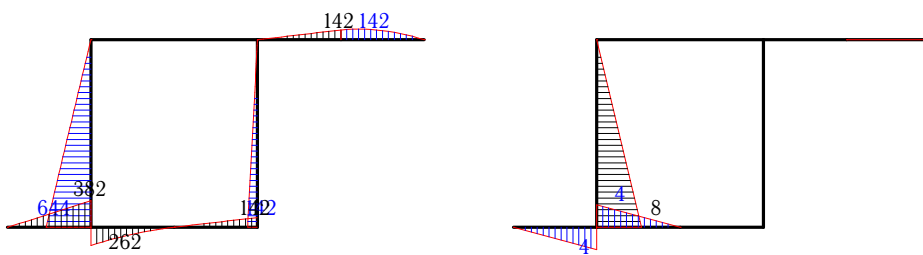
26.



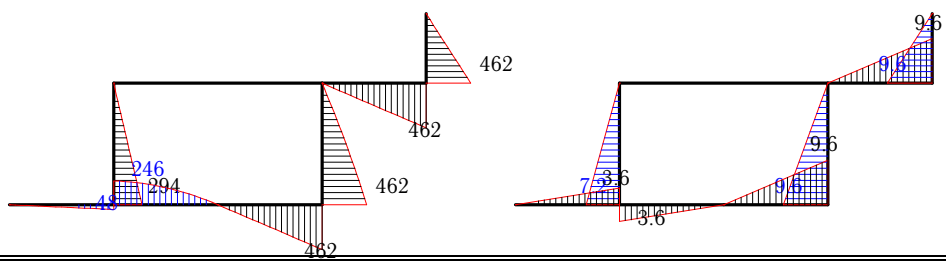
27.



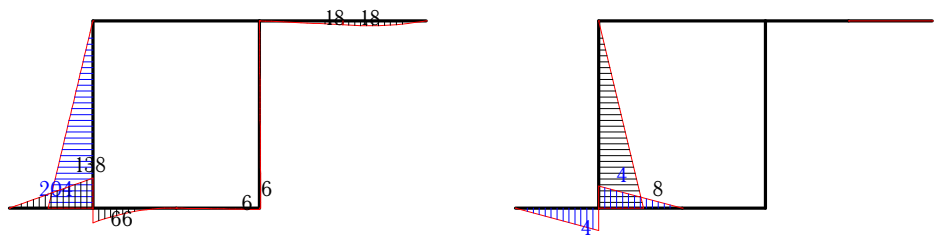
28.



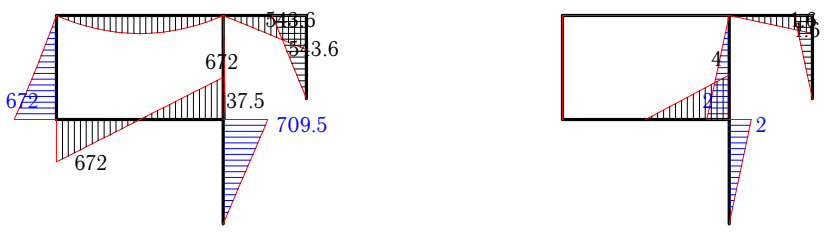
29.



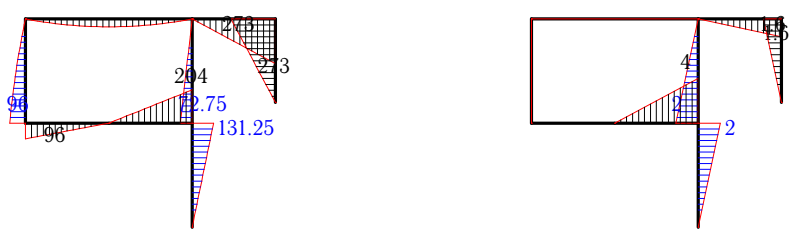
30.



31.



32.



№	$X_A$	$X_B$	$Y_A$	$Y_B$	$x_A$	$x_B$	$y_A$	$y_B$	$EJ\Delta \cdot 10^{-3}$
1	30.000	36.000	-9.000	3.000	-0.800	0.800	-1.000	0.000	-0.058
2	24.477	14.523	44.714	-8.714	-0.227	0.227	-0.864	-0.136	-1.717
3	319.500	-349.500	-421.000	466.000	-9.000	9.000	11.000	-12.000	-802.746
4	-50.029	32.029	-93.353	-29.647	-0.471	0.471	-0.647	-0.353	9.523
5	83.719	-83.719	-6.589	-44.411	1.313	-1.313	-0.250	-0.750	25.859
6	189.000	-237.000	-114.000	6.000	1.500	-1.500	-1.000	0.000	68.352
7	-2.250	-42.750	-58.500	-13.500	0.333	-0.333	-1.000	0.000	1.812
8	160.500	-112.500	-265.929	55.929	0.500	-0.500	-1.214	0.214	37.952
9	-34.607	-7.393	67.500	7.500	-0.500	-0.500	0.000	0.000	2.119
10	45.000	-45.000	-27.750	15.750	1.286	-1.286	-1.000	0.000	7.655
11	-23.000	17.000	-55.333	-22.667	-0.333	0.333	-0.556	-0.444	1.687
12	-23.667	5.667	-52.000	6.000	-0.500	-0.500	0.000	0.000	1.113
13	-79.286	73.286	-112.714	-43.286	-0.381	0.381	-0.619	-0.381	12.359
14	565.500	-622.500	-646.500	622.500	12.000	-12.000	-13.000	12.000	3460.432
15	-240.000	240.000	360.000	-480.000	-2.000	2.000	3.000	-4.000	59.935
16	-192.000	144.000	-264.000	108.000	-1.500	1.500	-2.000	1.000	89.136
17	-141.000	183.000	-313.500	73.500	-1.000	1.000	-1.500	0.500	92.160
18	459.857	-429.857	-44.082	-255.918	1.500	-1.500	-0.143	-0.857	93.195
19	83.857	49.143	-13.500	-13.500	1.286	-1.286	-1.000	0.000	2.673
20	15.600	-39.600	-6.320	-31.680	2.000	-2.000	0.600	-1.600	9.184
21	19.941	19.059	1.294	-14.294	-0.471	0.471	-0.647	-0.353	0.022
22	39.250	-110.250	111.000	-63.000	-1.167	1.167	-1.667	0.667	-29.412
23	41.143	-41.143	-93.000	-63.000	0.571	-0.571	-1.000	0.000	11.776
24	-11.400	50.400	13.500	-10.500	1.200	-1.200	-1.000	0.000	-1.100
25	-129.600	33.600	-134.400	-33.600	-0.400	0.400	-0.600	-0.400	14.106
26	357.000	-357.000	-508.500	40.500	-0.500	-0.500	0.000	0.000	-7.438
27	-46.895	-1.105	-63.474	-14.526	-0.316	0.316	-0.579	-0.421	2.904
28	96.333	-87.333	95.500	97.500	-0.889	0.889	-1.000	0.000	-18.731
29	-97.500	115.500	-8.000	77.000	2.400	-2.400	0.600	-1.600	-41.036
30	22.000	-22.000	34.500	-16.500	-0.889	0.889	-1.000	0.000	-5.888
31	141.900	-135.900	-447.900	135.900	0.400	-0.400	-1.400	0.400	8.143
32	26.250	-68.250	-143.250	68.250	0.400	-0.400	-1.400	0.400	2.933