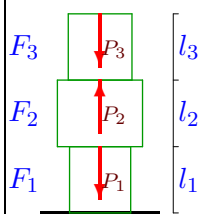


Растяжение и сжатие бруса

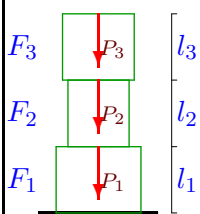
Найти удлинение (в мм) стального прямого призматического бруса кусочно-постоянного сечения под действием собственного веса и сил P_1, P_2, P_3 , приложенных к сечениям бруса. Построить эпюры продольных сил, нормальных напряжений и относительных удлинений. Модуль упругости материала $E = 2 \cdot 10^5 \text{ МПа}$, объемный вес $\gamma = 78 \text{ кН/м}^3$.

Задача 16.1.



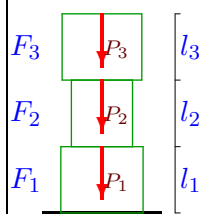
$$P_1 = 120 \text{ кН}, P_2 = 110 \text{ кН}, \\ P_3 = 87 \text{ кН}, F_1 = 23 \text{ см}^2, \\ F_2 = 32 \text{ см}^2, F_3 = 24 \text{ см}^2, \\ l_1 = 2 \text{ м}, l_2 = 4 \text{ м}, l_3 = 2 \text{ м}.$$

Задача 16.2.



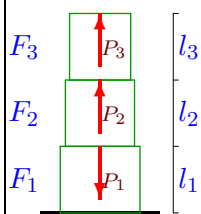
$$P_1 = 63 \text{ кН}, P_2 = 88 \text{ кН}, \\ P_3 = 75 \text{ кН}, F_1 = 32 \text{ см}^2, \\ F_2 = 23 \text{ см}^2, F_3 = 27 \text{ см}^2, \\ l_1 = 2 \text{ м}, l_2 = 2 \text{ м}, l_3 = 2 \text{ м}.$$

Задача 16.3.



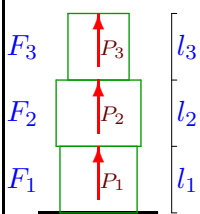
$$P_1 = 42 \text{ кН}, P_2 = 84 \text{ кН}, \\ P_3 = 120 \text{ кН}, F_1 = 31 \text{ см}^2, \\ F_2 = 23 \text{ см}^2, F_3 = 30 \text{ см}^2, \\ l_1 = 2 \text{ м}, l_2 = 2 \text{ м}, l_3 = 2 \text{ м}.$$

Задача 16.4.



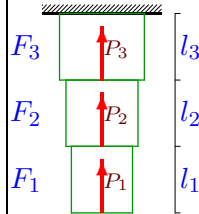
$$P_1 = 29 \text{ кН}, P_2 = 120 \text{ кН}, \\ P_3 = 115 \text{ кН}, F_1 = 30 \text{ см}^2, \\ F_2 = 26 \text{ см}^2, F_3 = 23 \text{ см}^2, \\ l_1 = 2 \text{ м}, l_2 = 3 \text{ м}, l_3 = 4 \text{ м}.$$

Задача 16.5.



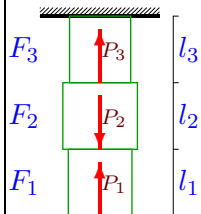
$$P_1 = 77 \text{ кН}, P_2 = 75 \text{ кН}, \\ P_3 = 77 \text{ кН}, F_1 = 29 \text{ см}^2, \\ F_2 = 32 \text{ см}^2, F_3 = 23 \text{ см}^2, \\ l_1 = 3 \text{ м}, l_2 = 3 \text{ м}, l_3 = 3 \text{ м}.$$

Задача 16.6.



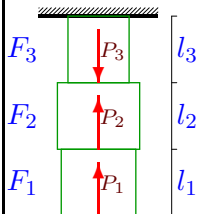
$$P_1 = 26 \text{ кН}, P_2 = 26 \text{ кН}, \\ P_3 = 28 \text{ кН}, F_1 = 23 \text{ см}^2, \\ F_2 = 27 \text{ см}^2, F_3 = 32 \text{ см}^2, \\ l_1 = 3 \text{ м}, l_2 = 3 \text{ м}, l_3 = 3 \text{ м}.$$

Задача 16.7.



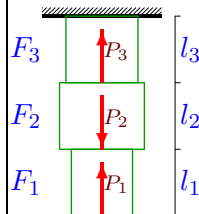
$$P_1 = 44 \text{ кН}, P_2 = 84 \text{ кН}, \\ P_3 = 63 \text{ кН}, F_1 = 24 \text{ см}^2, \\ F_2 = 28 \text{ см}^2, F_3 = 23 \text{ см}^2, \\ l_1 = 3 \text{ м}, l_2 = 2 \text{ м}, l_3 = 3 \text{ м}.$$

Задача 16.8.



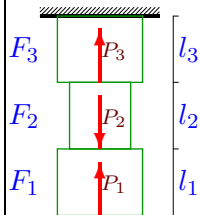
$$P_1 = 90 \text{ кН}, P_2 = 105 \text{ кН}, \\ P_3 = 116 \text{ кН}, F_1 = 28 \text{ см}^2, \\ F_2 = 31 \text{ см}^2, F_3 = 23 \text{ см}^2, \\ l_1 = 3 \text{ м}, l_2 = 4 \text{ м}, l_3 = 2 \text{ м}.$$

Задача 16.9.



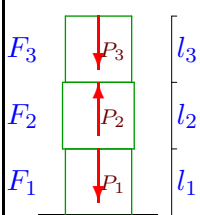
$$P_1 = 96 \text{ кН}, P_2 = 30 \text{ кН}, \\ P_3 = 120 \text{ кН}, F_1 = 23 \text{ см}^2, \\ F_2 = 32 \text{ см}^2, F_3 = 27 \text{ см}^2, \\ l_1 = 3 \text{ м}, l_2 = 2 \text{ м}, l_3 = 4 \text{ м}.$$

Задача 16.10.



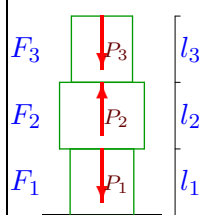
$$P_1 = 115 \text{ кН}, P_2 = 52 \text{ кН}, \\ P_3 = 24 \text{ кН}, F_1 = 32 \text{ см}^2, \\ F_2 = 23 \text{ см}^2, F_3 = 32 \text{ см}^2, \\ l_1 = 4 \text{ м}, l_2 = 2 \text{ м}, l_3 = 3 \text{ м}.$$

Задача 16.11.

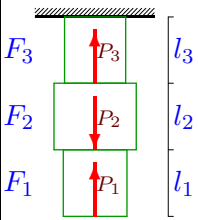


$$P_1 = 104 \text{ кН}, P_2 = 21 \text{ кН}, \\ P_3 = 104 \text{ кН}, F_1 = 25 \text{ см}^2, \\ F_2 = 27 \text{ см}^2, F_3 = 25 \text{ см}^2, \\ l_1 = 2 \text{ м}, l_2 = 3 \text{ м}, l_3 = 2 \text{ м}.$$

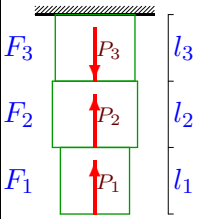
Задача 16.12.



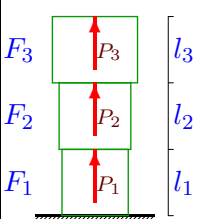
$$P_1 = 30 \text{ кН}, P_2 = 115 \text{ кН}, \\ P_3 = 56 \text{ кН}, F_1 = 24 \text{ см}^2, \\ F_2 = 32 \text{ см}^2, F_3 = 23 \text{ см}^2, \\ l_1 = 2 \text{ м}, l_2 = 4 \text{ м}, l_3 = 2 \text{ м}.$$

Задача 16.13.

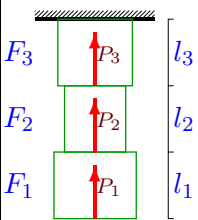
$$P_1 = 21 \text{кН}, P_2 = 104 \text{кН}, P_3 = 30 \text{кН}, F_1 = 24 \text{см}^2, F_2 = 31 \text{см}^2, F_3 = 23 \text{см}^2, l_1 = 3 \text{м}, l_2 = 2 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.16.

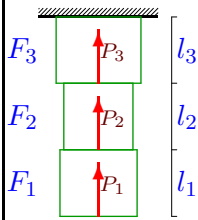
$$P_1 = 100 \text{кН}, P_2 = 77 \text{кН}, P_3 = 54 \text{кН}, F_1 = 26 \text{см}^2, F_2 = 32 \text{см}^2, F_3 = 30 \text{см}^2, l_1 = 3 \text{м}, l_2 = 3 \text{м}, l_3 = 2 \text{м}.$$

Задача 16.19.

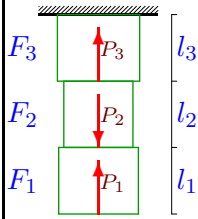
$$P_1 = 77 \text{кН}, P_2 = 77 \text{кН}, P_3 = 29 \text{кН}, F_1 = 25 \text{см}^2, F_2 = 27 \text{см}^2, F_3 = 32 \text{см}^2, l_1 = 3 \text{м}, l_2 = 3 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.22.

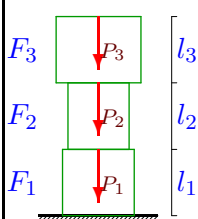
$$P_1 = 50 \text{кН}, P_2 = 77 \text{кН}, P_3 = 44 \text{кН}, F_1 = 31 \text{см}^2, F_2 = 23 \text{см}^2, F_3 = 28 \text{см}^2, l_1 = 3 \text{м}, l_2 = 3 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.14.

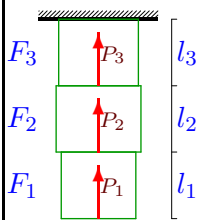
$$P_1 = 50 \text{кН}, P_2 = 77 \text{кН}, P_3 = 22 \text{кН}, F_1 = 29 \text{см}^2, F_2 = 26 \text{см}^2, F_3 = 32 \text{см}^2, l_1 = 3 \text{м}, l_2 = 3 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.17.

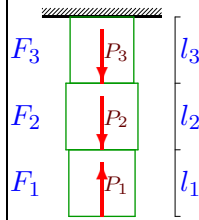
$$P_1 = 120 \text{кН}, P_2 = 27 \text{кН}, P_3 = 50 \text{кН}, F_1 = 30 \text{см}^2, F_2 = 26 \text{см}^2, F_3 = 31 \text{см}^2, l_1 = 4 \text{м}, l_2 = 2 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.20.

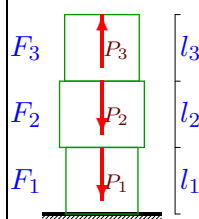
$$P_1 = 63 \text{кН}, P_2 = 84 \text{кН}, P_3 = 108 \text{кН}, F_1 = 27 \text{см}^2, F_2 = 23 \text{см}^2, F_3 = 32 \text{см}^2, l_1 = 2 \text{м}, l_2 = 2 \text{м}, l_3 = 2 \text{м}.$$

Задача 16.23.

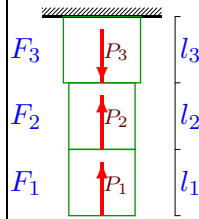
$$P_1 = 145 \text{кН}, P_2 = 100 \text{кН}, P_3 = 77 \text{кН}, F_1 = 28 \text{см}^2, F_2 = 32 \text{см}^2, F_3 = 30 \text{см}^2, l_1 = 4 \text{м}, l_2 = 3 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.15.

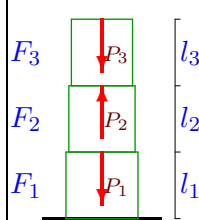
$$P_1 = 63 \text{кН}, P_2 = 84 \text{кН}, P_3 = 112 \text{кН}, F_1 = 25 \text{см}^2, F_2 = 27 \text{см}^2, F_3 = 24 \text{см}^2, l_1 = 3 \text{м}, l_2 = 2 \text{м}, l_3 = 2 \text{м}.$$

Задача 16.18.

$$P_1 = 22 \text{кН}, P_2 = 87 \text{кН}, P_3 = 92 \text{кН}, F_1 = 27 \text{см}^2, F_2 = 32 \text{см}^2, F_3 = 28 \text{см}^2, l_1 = 2 \text{м}, l_2 = 2 \text{м}, l_3 = 3 \text{м}.$$

Задача 16.21.

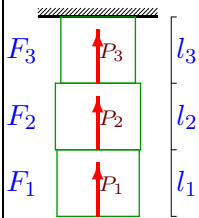
$$P_1 = 54 \text{кН}, P_2 = 42 \text{кН}, P_3 = 88 \text{кН}, F_1 = 25 \text{см}^2, F_2 = 25 \text{см}^2, F_3 = 29 \text{см}^2, l_1 = 3 \text{м}, l_2 = 3 \text{м}, l_3 = 2 \text{м}.$$

Задача 16.24.

$$P_1 = 54 \text{кН}, P_2 = 44 \text{кН}, P_3 = 84 \text{кН}, F_1 = 27 \text{см}^2, F_2 = 25 \text{см}^2, F_3 = 23 \text{см}^2, l_1 = 2 \text{м}, l_2 = 3 \text{м}, l_3 = 2 \text{м}.$$

Задача 16.25.

1



$$P_1 = 150\text{кН}, P_2 = 145\text{кН},$$

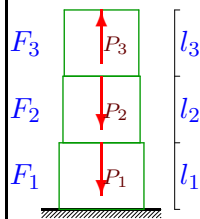
$$P_3 = 120\text{кН}, F_1 = 31\text{см}^2,$$

$$F_2 = 32\text{см}^2, F_3 = 28\text{см}^2,$$

$$l_1 = 4\text{м}, l_2 = 4\text{м}, l_3 = 3\text{м}.$$

Задача 16.26.

1



$$P_1 = 23\text{кН}, P_2 = 60\text{кН},$$

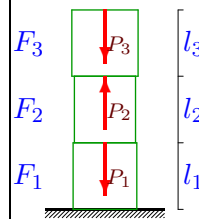
$$P_3 = 150\text{кН}, F_1 = 32\text{см}^2,$$

$$F_2 = 29\text{см}^2, F_3 = 28\text{см}^2,$$

$$l_1 = 2\text{м}, l_2 = 2\text{м}, l_3 = 4\text{м}.$$

Задача 16.27.

1



$$P_1 = 104\text{кН}, P_2 = 24\text{кН},$$

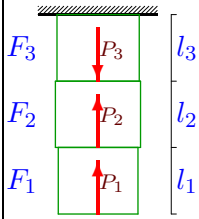
$$P_3 = 24\text{кН}, F_1 = 24\text{см}^2,$$

$$F_2 = 23\text{см}^2, F_3 = 25\text{см}^2,$$

$$l_1 = 2\text{м}, l_2 = 3\text{м}, l_3 = 2\text{м}.$$

Задача 16.28.

1



$$P_1 = 30\text{кН}, P_2 = 115\text{кН},$$

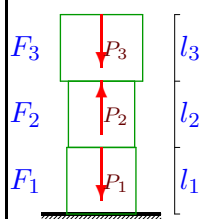
$$P_3 = 56\text{кН}, F_1 = 30\text{см}^2,$$

$$F_2 = 32\text{см}^2, F_3 = 31\text{см}^2,$$

$$l_1 = 3\text{м}, l_2 = 4\text{м}, l_3 = 2\text{м}.$$

Задача 16.29.

1



$$P_1 = 30\text{кН}, P_2 = 105\text{кН},$$

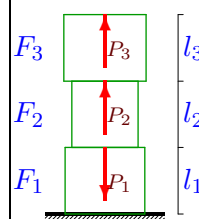
$$P_3 = 120\text{кН}, F_1 = 26\text{см}^2,$$

$$F_2 = 25\text{см}^2, F_3 = 31\text{см}^2,$$

$$l_1 = 2\text{м}, l_2 = 4\text{м}, l_3 = 2\text{м}.$$

Задача 16.30.

1



$$P_1 = 60\text{кН}, P_2 = 150\text{кН},$$

$$P_3 = 150\text{кН}, F_1 = 30\text{см}^2,$$

$$F_2 = 25\text{см}^2, F_3 = 31\text{см}^2,$$

$$l_1 = 2\text{м}, l_2 = 4\text{м}, l_3 = 4\text{м}.$$

Растяжение и сжатие бруса

№	δ_1	δ_2	δ_3	δ
1	-0.428	0.138	-0.363	-0.653
2	-0.709	-0.711	-0.279	-1.699
3	-0.797	-0.890	-0.401	-2.088
4	0.681	1.350	0.997	3.028
5	1.176	0.708	0.500	2.385
6	-0.168	-0.284	-0.368	-0.820
7	-0.273	0.146	-0.142	-0.269
8	-0.480	-1.251	-0.336	-2.067
9	-0.624	-0.204	-1.367	-2.195
10	-0.716	-0.269	-0.400	-1.384
11	-0.753	-0.465	-0.417	-1.635
12	0.114	0.363	-0.244	0.234
13	-0.129	0.270	0.354	0.495
14	-0.257	-0.727	-0.691	-1.675
15	-0.376	0.081	0.559	0.264
16	-0.575	-0.825	-0.405	-1.805
17	-0.797	-0.353	-0.684	-1.834
18	-0.068	0.013	0.491	0.436
19	1.088	0.583	0.134	1.805
20	-0.948	-0.838	-0.338	-2.124
21	-0.322	-0.571	-0.023	-0.916
22	-0.240	-0.822	-0.908	-1.970
23	-1.033	-1.143	-1.600	-3.775
24	-0.352	-0.244	-0.366	-0.962
25	-0.965	-1.835	-2.211	-5.010
26	0.204	0.307	1.068	1.579
27	-0.438	-0.004	-0.097	-0.539
28	-0.148	-0.899	-0.281	-1.328
29	-0.179	-0.127	-0.388	-0.694
30	0.793	2.389	0.965	4.147