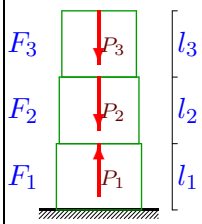
Растяжение и сжатие бруса

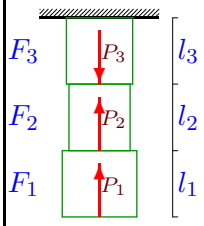
Найти удлинение (в мм) стального прямого призматического бруса кусочно-постоянного сечения под действием собственного веса и сил P_1, P_2, P_3, приложенных к сечениям бруса. Построить эпюры продольных сил, нормальных напряжений и относительных удлинений. Модуль упругости материала $E = 2 \cdot 10^5$МПа,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

Задача 16.1. *3*



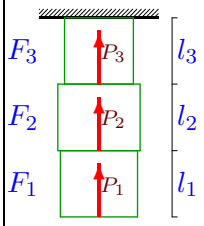
$P_1 = 77$кН, $P_2 = 48$кН, $P_3 = 28$кН, $F_1 = 32$см^2, $F_2 = 30$см^2, $F_3 = 28$см^2, $l_1 = 3$м, $l_2 = 2$м, $l_3 = 2$м.

Задача 16.2. *3*



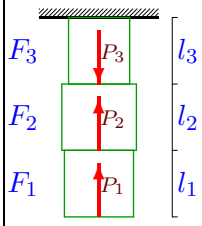
$P_1 = 100$кН, $P_2 = 77$кН, $P_3 = 29$кН, $F_1 = 28$см^2, $F_2 = 23$см^2, $F_3 = 25$см^2, $l_1 = 3$м, $l_2 = 3$м, $l_3 = 2$м.

Задача 16.3. *3*



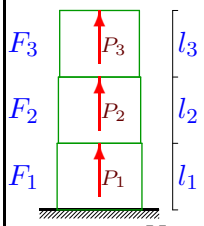
$P_1 = 58$кН, $P_2 = 120$кН, $P_3 = 130$кН, $F_1 = 29$см^2, $F_2 = 31$см^2, $F_3 = 26$см^2, $l_1 = 3$м, $l_2 = 3$м, $l_3 = 4$м.

Задача 16.4. *3*



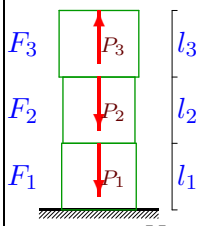
$P_1 = 90$кН, $P_2 = 115$кН, $P_3 = 44$кН, $F_1 = 26$см^2, $F_2 = 28$см^2, $F_3 = 23$см^2, $l_1 = 3$м, $l_2 = 4$м, $l_3 = 2$м.

Задача 16.5. *3*



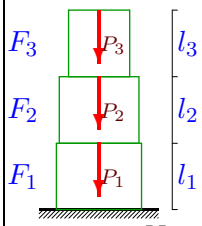
$P_1 = 77$кН, $P_2 = 58$кН, $P_3 = 96$кН, $F_1 = 32$см^2, $F_2 = 31$см^2, $F_3 = 30$см^2, $l_1 = 3$м, $l_2 = 3$м, $l_3 = 3$м.

Задача 16.6. *3*



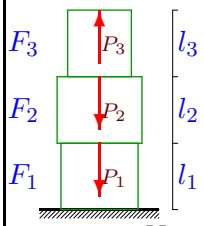
$P_1 = 96$кН, $P_2 = 26$кН, $P_3 = 21$кН, $F_1 = 28$см^2, $F_2 = 27$см^2, $F_3 = 30$см^2, $l_1 = 2$м, $l_2 = 2$м, $l_3 = 3$м.

Задача 16.7. *3*



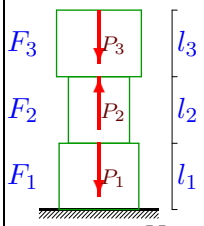
$P_1 = 69$кН, $P_2 = 42$кН, $P_3 = 104$кН, $F_1 = 32$см^2, $F_2 = 30$см^2, $F_3 = 23$см^2, $l_1 = 2$м, $l_2 = 2$м, $l_3 = 2$м.

Задача 16.8. *3*



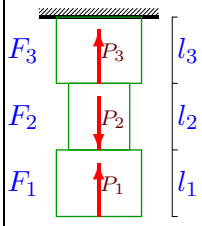
$P_1 = 22$кН, $P_2 = 90$кН, $P_3 = 145$кН, $F_1 = 29$см^2, $F_2 = 32$см^2, $F_3 = 24$см^2, $l_1 = 2$м, $l_2 = 2$м, $l_3 = 4$м.

Задача 16.9. *3*



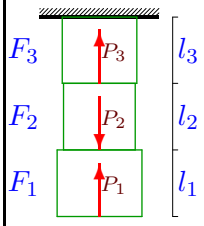
$P_1 = 75$кН, $P_2 = 77$кН, $P_3 = 87$кН, $F_1 = 30$см^2, $F_2 = 23$см^2, $F_3 = 32$см^2, $l_1 = 2$м, $l_2 = 3$м, $l_3 = 2$м.

Задача 16.10. *3*



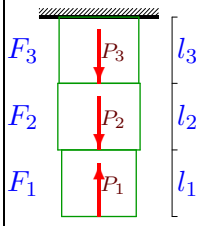
$P_1 = 66$кН, $P_2 = 75$кН, $P_3 = 77$кН, $F_1 = 32$см^2, $F_2 = 23$см^2, $F_3 = 32$см^2, $l_1 = 3$м, $l_2 = 2$м, $l_3 = 3$м.

Задача 16.11. *3*



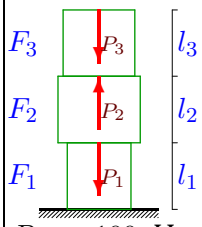
$P_1 = 72$кН, $P_2 = 25$кН, $P_3 = 77$кН, $F_1 = 32$см^2, $F_2 = 27$см^2, $F_3 = 28$см^2, $l_1 = 3$м, $l_2 = 2$м, $l_3 = 3$м.

Задача 16.12. *3*



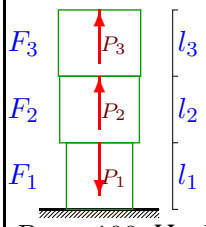
$P_1 = 105$кН, $P_2 = 96$кН, $P_3 = 29$кН, $F_1 = 28$см^2, $F_2 = 31$см^2, $F_3 = 30$см^2, $l_1 = 4$м, $l_2 = 2$м, $l_3 = 2$м.

Задача 16.13. 3



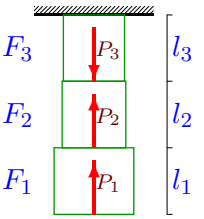
$P_1 = 100$кН, $P_2 = 77$кН,
$P_3 = 22$кН, $F_1 = 24$см^2,
$F_2 = 31$см^2, $F_3 = 27$см^2,
$l_1 = 2$м, $l_2 = 3$м, $l_3 = 2$м.

Задача 16.14. 3



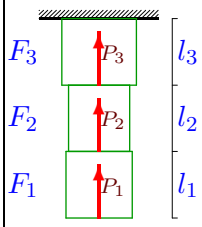
$P_1 = 100$кН, $P_2 = 77$кН,
$P_3 = 77$кН, $F_1 = 25$см^2,
$F_2 = 30$см^2, $F_3 = 31$см^2,
$l_1 = 2$м, $l_2 = 3$м, $l_3 = 3$м.

Задача 16.15. 3



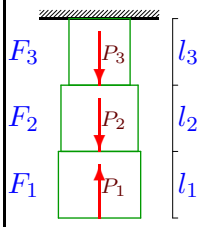
$P_1 = 125$кН, $P_2 = 77$кН,
$P_3 = 92$кН, $F_1 = 30$см^2,
$F_2 = 24$см^2, $F_3 = 23$см^2,
$l_1 = 4$м, $l_2 = 3$м, $l_3 = 2$м.

Задача 16.16. 3



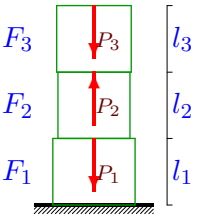
$P_1 = 27$кН, $P_2 = 54$кН,
$P_3 = 42$кН, $F_1 = 25$см^2,
$F_2 = 23$см^2, $F_3 = 28$см^2,
$l_1 = 3$м, $l_2 = 3$м, $l_3 = 3$м.

Задача 16.17. 3



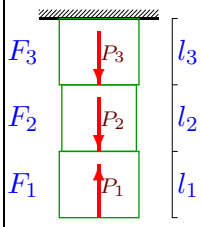
$P_1 = 22$кН, $P_2 = 66$кН,
$P_3 = 84$кН, $F_1 = 31$см^2,
$F_2 = 29$см^2, $F_3 = 23$см^2,
$l_1 = 3$м, $l_2 = 2$м, $l_3 = 2$м.

Задача 16.18. 3



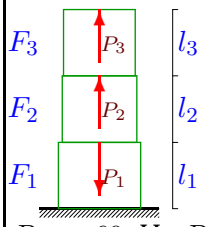
$P_1 = 112$кН, $P_2 = 69$кН,
$P_3 = 42$кН, $F_1 = 31$см^2,
$F_2 = 27$см^2, $F_3 = 28$см^2,
$l_1 = 2$м, $l_2 = 3$м, $l_3 = 2$м.

Задача 16.19. 3



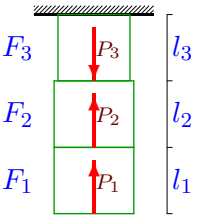
$P_1 = 63$кН, $P_2 = 84$кН,
$P_3 = 88$кН, $F_1 = 30$см^2,
$F_2 = 28$см^2, $F_3 = 30$см^2,
$l_1 = 3$м, $l_2 = 2$м, $l_3 = 2$м.

Задача 16.20. 3



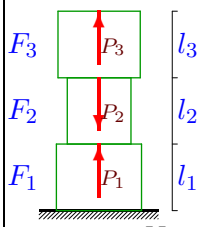
$P_1 = 60$кН, $P_2 = 125$кН,
$P_3 = 77$кН, $F_1 = 31$см^2,
$F_2 = 28$см^2, $F_3 = 27$см^2,
$l_1 = 2$м, $l_2 = 4$м, $l_3 = 3$м.

Задача 16.21. 3



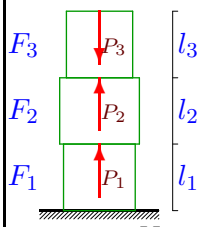
$P_1 = 50$кН, $P_2 = 77$кН,
$P_3 = 84$кН, $F_1 = 30$см^2,
$F_2 = 30$см^2, $F_3 = 27$см^2,
$l_1 = 3$м, $l_2 = 3$м, $l_3 = 2$м.

Задача 16.22. 3



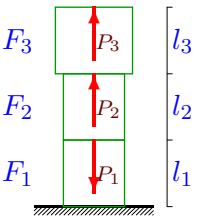
$P_1 = 77$кН, $P_2 = 26$кН,
$P_3 = 27$кН, $F_1 = 32$см^2,
$F_2 = 24$см^2, $F_3 = 31$см^2,
$l_1 = 3$м, $l_2 = 2$м, $l_3 = 3$м.

Задача 16.23. 3



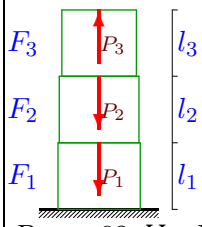
$P_1 = 77$кН, $P_2 = 105$кН,
$P_3 = 88$кН, $F_1 = 27$см^2,
$F_2 = 30$см^2, $F_3 = 25$см^2,
$l_1 = 3$м, $l_2 = 4$м, $l_3 = 2$м.

Задача 16.24. 3



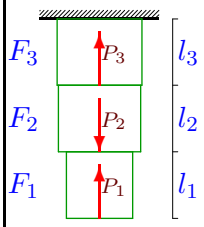
$P_1 = 29$кН, $P_2 = 108$кН,
$P_3 = 46$кН, $F_1 = 23$см^2,
$F_2 = 23$см^2, $F_3 = 29$см^2,
$l_1 = 2$м, $l_2 = 3$м, $l_3 = 3$м.

Задача 16.25.



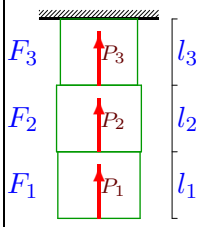
$P_1 = 92$кН, $P_2 = 56$кН,
$P_3 = 90$кН, $F_1 = 31$см^2,
$F_2 = 30$см^2, $F_3 = 28$см^2,
$l_1 = 2$м, $l_2 = 2$м, $l_3 = 3$м.

Задача 16.26.



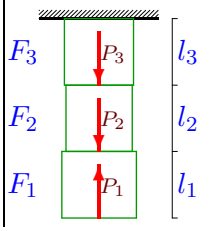
$P_1 = 66$кН, $P_2 = 75$кН,
$P_3 = 77$кН, $F_1 = 25$см^2,
$F_2 = 31$см^2, $F_3 = 32$см^2,
$l_1 = 3$м, $l_2 = 2$м, $l_3 = 3$м.

Задача 16.27.



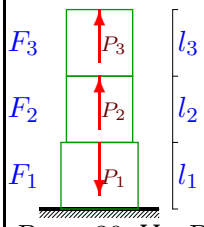
$P_1 = 135$кН, $P_2 = 54$кН,
$P_3 = 58$кН, $F_1 = 31$см^2,
$F_2 = 32$см^2, $F_3 = 29$см^2,
$l_1 = 4$м, $l_2 = 3$м, $l_3 = 3$м.

Задача 16.28.



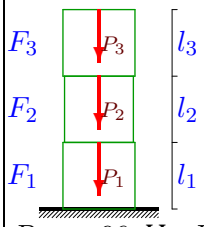
$P_1 = 23$кН, $P_2 = 42$кН,
$P_3 = 112$кН, $F_1 = 28$см^2,
$F_2 = 25$см^2, $F_3 = 26$см^2,
$l_1 = 3$м, $l_2 = 2$м, $l_3 = 2$м.

Задача 16.29.



$P_1 = 30$кН, $P_2 = 125$кН,
$P_3 = 77$кН, $F_1 = 29$см^2,
$F_2 = 25$см^2, $F_3 = 25$см^2,
$l_1 = 2$м, $l_2 = 4$м, $l_3 = 3$м.

Задача 16.30.



$P_1 = 96$кН, $P_2 = 23$кН,
$P_3 = 48$кН, $F_1 = 27$см^2,
$F_2 = 26$см^2, $F_3 = 27$см^2,
$l_1 = 2$м, $l_2 = 2$м, $l_3 = 2$м.

16.3

Растяжение и сжатие бруса

№	δ_1	δ_2	δ_3	δ
1	-0.001	-0.256	-0.101	-0.358
2	-0.534	-1.148	-0.586	-2.269
3	-0.298	-0.856	-2.355	-3.510
4	-0.517	-1.457	-0.693	-2.667
5	1.074	0.740	0.478	2.293
6	-0.366	-0.022	0.103	-0.284
7	-0.675	-0.489	-0.453	-1.617
8	0.109	0.169	1.205	1.483
9	-0.288	-0.070	-0.273	-0.630
10	-0.308	0.043	-0.312	-0.576
11	-0.336	-0.171	-0.656	-1.163
12	-0.747	-0.025	0.072	-0.700
13	-0.193	0.262	-0.082	-0.013
14	0.210	0.765	0.371	1.345
15	-0.830	-1.255	-0.471	-2.556
16	-0.160	-0.523	-0.651	-1.334
17	-0.105	0.155	0.562	0.613
18	-0.278	0.146	-0.151	-0.283
19	-0.313	0.078	0.368	0.133
20	0.452	1.435	0.426	2.314
21	-0.248	-0.630	-0.153	-1.031
22	0.359	0.000	0.129	0.488
23	0.513	0.108	-0.353	0.268
24	0.537	0.998	0.236	1.772
25	-0.192	0.110	0.480	0.399
26	-0.394	0.032	-0.312	-0.675
27	-0.868	-0.880	-1.267	-3.014
28	-0.121	0.079	0.509	0.467
29	0.588	1.608	0.460	2.656
30	-0.622	-0.275	-0.179	-1.076