Расчетно-проектировочная работа № 3

Исследование напряженного состояния и расчет на прочность при кручении.

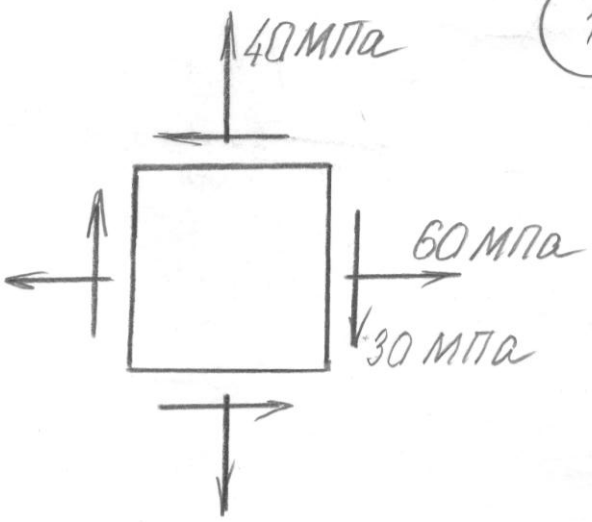
Задача № 1

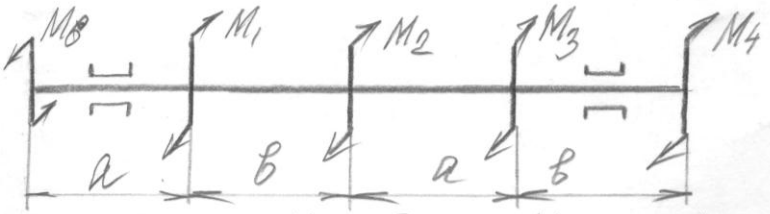
1. Определить аналитически и графически (построением круга Мора) величину и направление главных нормальных напряжений;
2. Вычислить максимальное касательное напряжение.
3. Определить главные относительные линейные и угловые деформации (материал – сталь);
4. Определить относительное изменение объема;
5. Вычислить эквивалентное напряжение по теории прочности, применяемой для пластичного материала;
6. Определить запас прочности, если $\sigma_T = 240$ МПа

Задача № 2

1. Построить эпюру крутящих моментов
2. Определить диаметр вала из условия прочности, если $[\sigma] = 160$ МПа;
3. Определить диаметр вала из условия жесткости, если $[\theta] = 1 \frac{град}{м}$; $G = 8 \cdot 10^4$ МПа;
4. Выбрать размеры вала, удовлетворяющие условиям прочности и жесткости и округлить диаметр вала в соответствии с ГОСТом;
5. Построить эпюру углов закручивания.

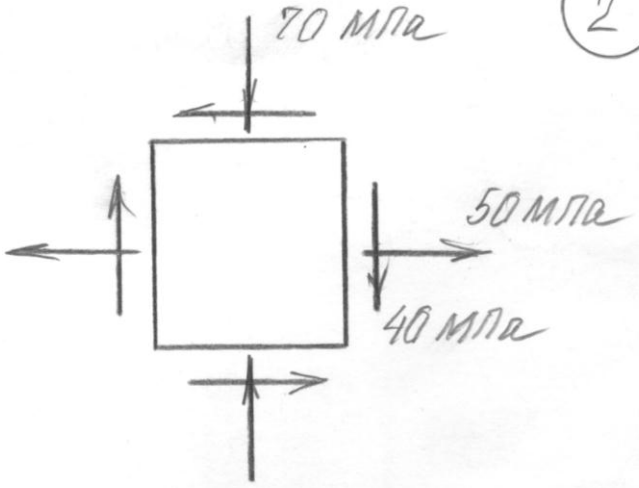
1

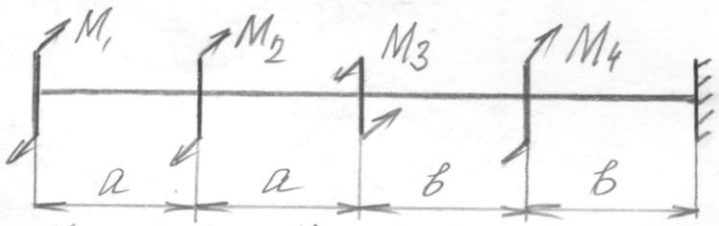




$M_1 = 2$ кНм; $M_2 = 5$ кНм; $M_3 = 3$ кНм;
$M_4 = 7$ кНм; $a = 0{,}4$ м; $в = 0{,}7$ м

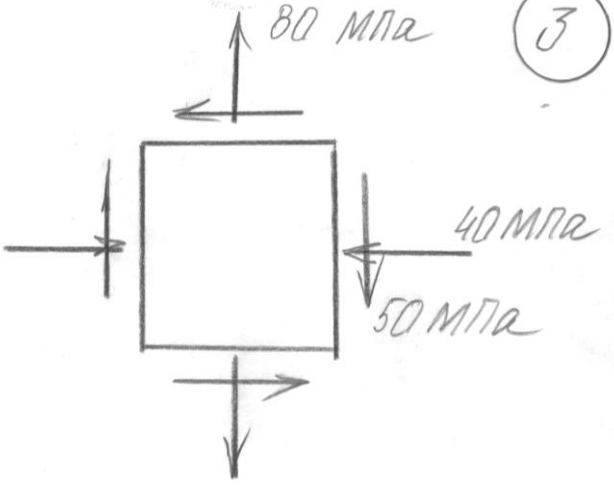
2

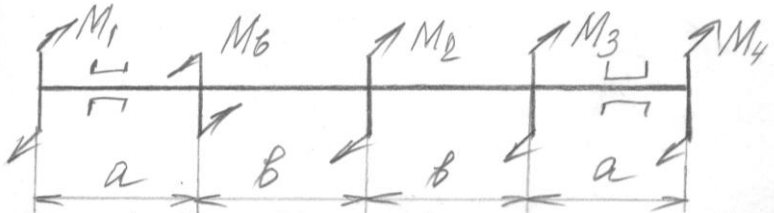




$M_1 = 1$ кНм; $M_2 = 8$ кНм; $M_3 = 10$ кНм;
$M_4 = 2{,}5$ кНм; $a = 0{,}2$ м; $в = 0{,}8$ м.

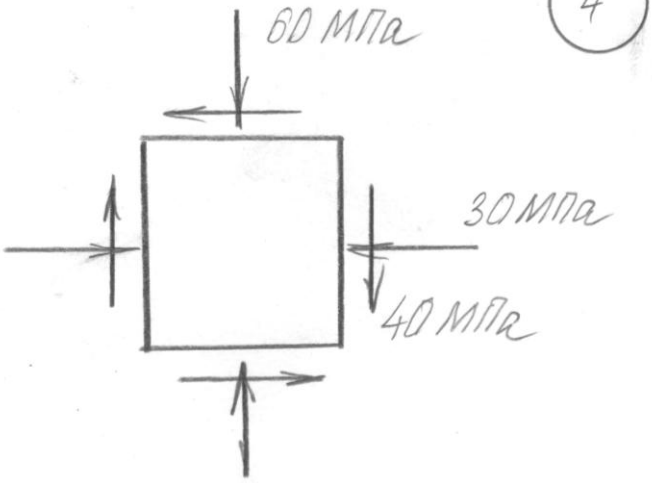
3

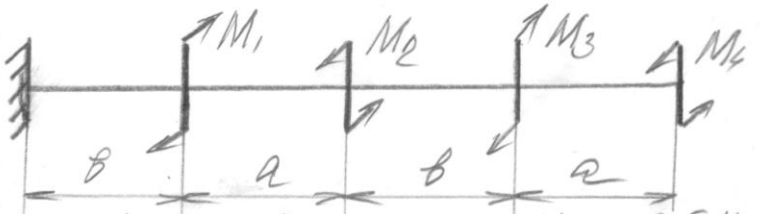




$M_1 = 4$ кНм; $M_2 = 6{,}5$ кНм; $M_3 = 2$ кНм;
$M_4 = 3{,}5$ кНм; $a = 0{,}9$ м; $в = 0{,}5$ м.

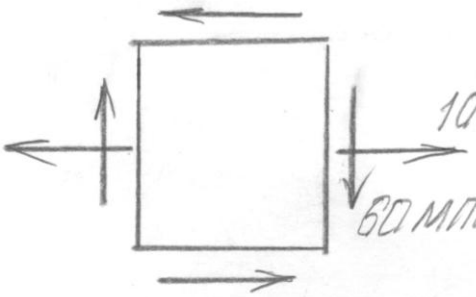
4

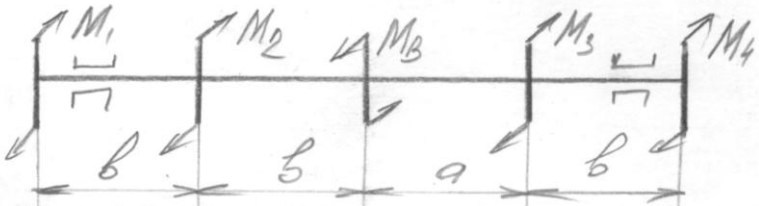




$M_1 = 4$ кНм; $M_2 = 7$ кНм; $M_3 = 8{,}5$ кНм;
$M_4 = 5$ кНм; $a = 0{,}3$ м; $в = 0{,}5$ м.

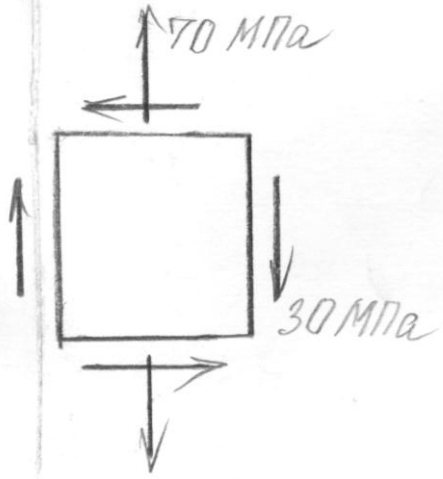
5

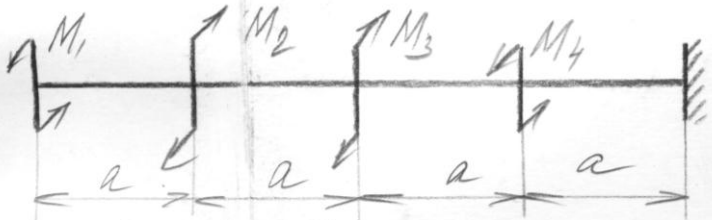




$M_1 = 1{,}5$ кНм; $M_2 = 4{,}4$ кНм; $M_3 = 3$ кНм;
$M_4 = 7{,}5$ кНм; $a = 0{,}6$ м; $в = 0{,}3$ м.

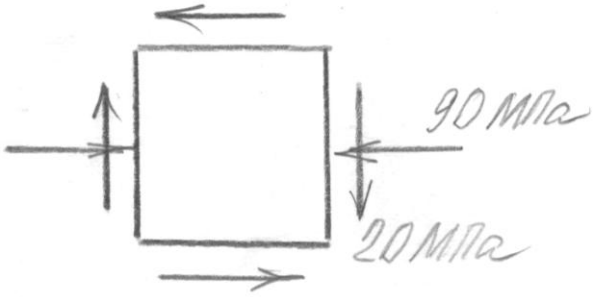
6

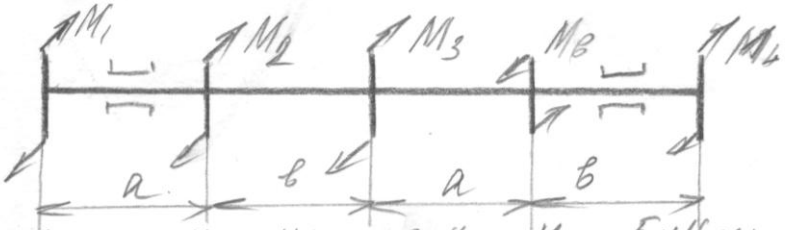




$M_1 = 3{,}2$ кНм; $M_2 = 6$ кНм; $M_3 = 2$ кНм;
$M_4 = 9{,}4$ кНм; $a = 0{,}9$ м; $в = 0{,}5$ м

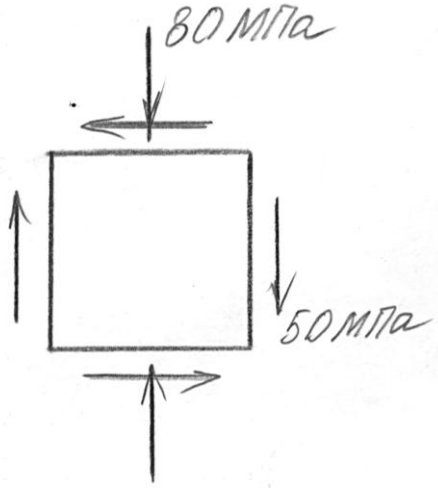
7

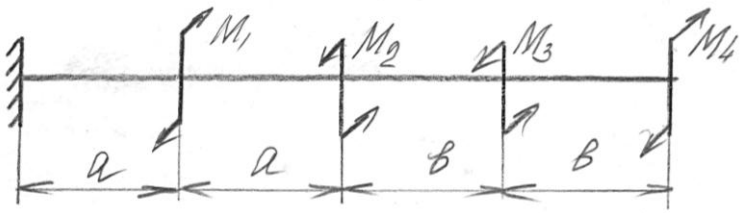




$M_1 = 2{,}2$ кНм; $M_2 = 4{,}6$ кНм; $M_3 = 5$ кНм;
$M_4 = 6$ кНм; $a = 0{,}2$ м; $в = 0{,}3$ м

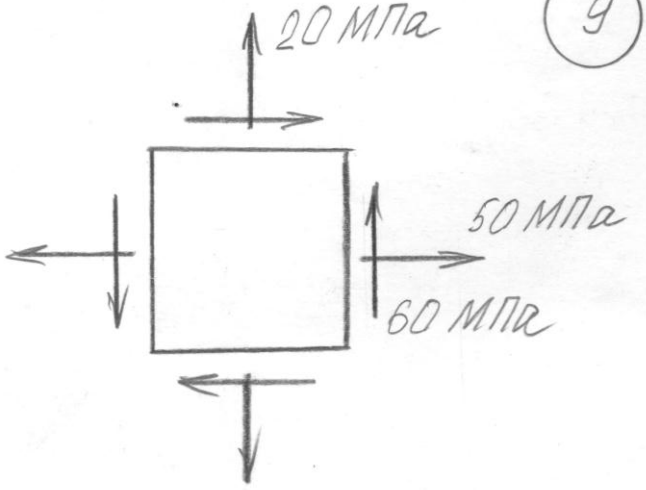
8

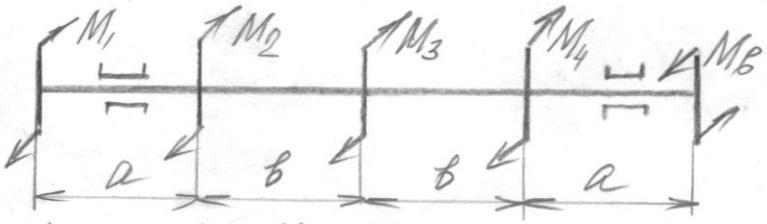




$M_1 = 5{,}3$ кНм; $M_2 = 3{,}7$ кНм; $M_3 = 9$ кНм;
$M_4 = 4$ кНм; $a = 0{,}6$ м; $в = 0{,}5$ м.

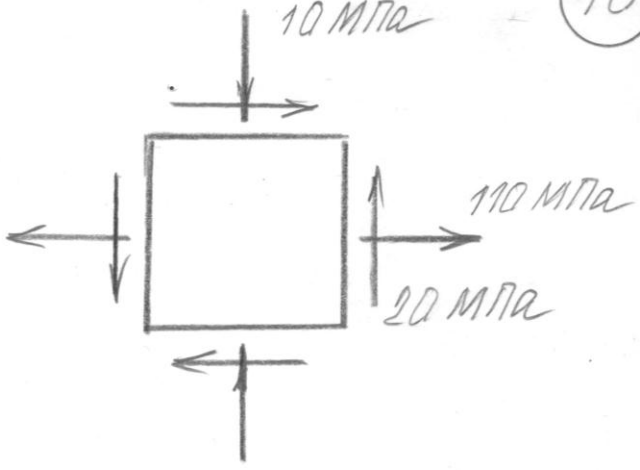
9

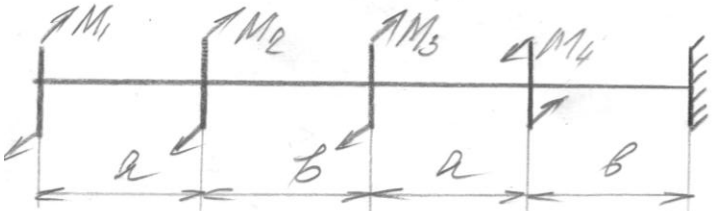




$M_1 = 1{,}2$ кНм; $M_2 = 3{,}4$ кНм; $M_3 = 5{,}6$ кНм;
$M_4 = 4{,}1$ кНм; $a = 0{,}4$ м; $в = 0{,}9$ м

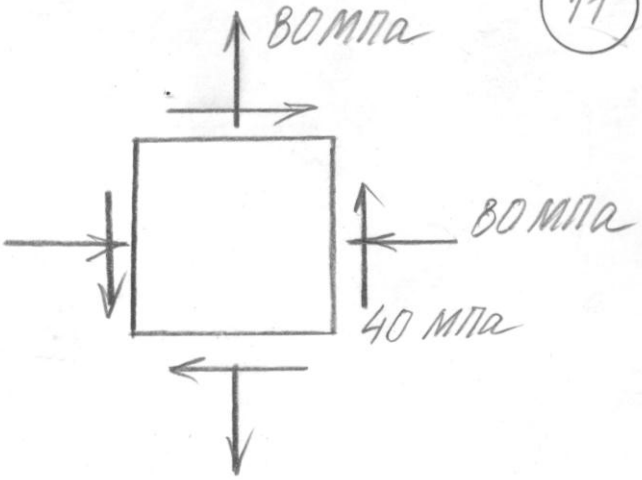
10

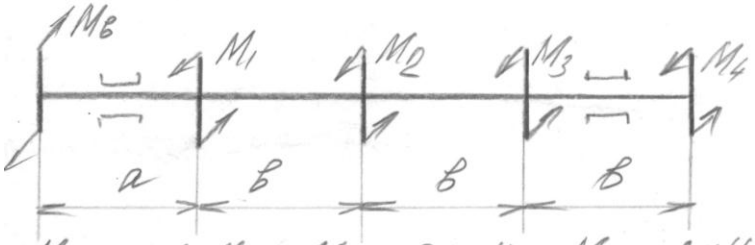




$M_1 = 2{,}8$ кНм; $M_2 = 4{,}2$ кНм; $M_3 = 3$ кНм;
$M_4 = 12$ кНм; $a = 0{,}5$ м; $в = 0{,}7$ м

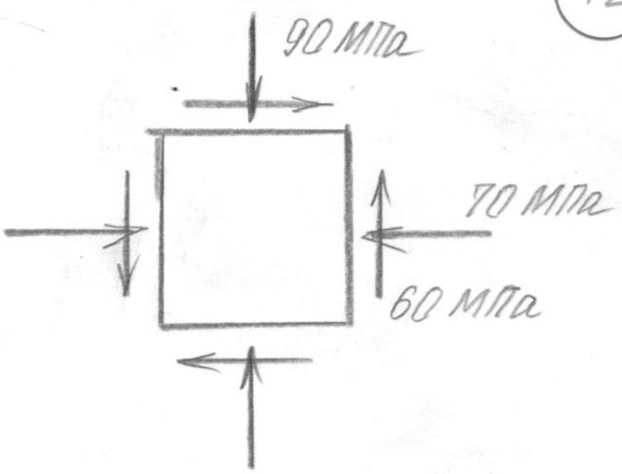
11

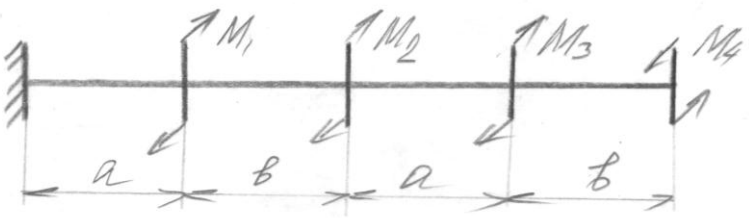




$M_1 = 3{,}1$ кНм; $M_2 = 6{,}3$ кНм; $M_3 = 2$ кНм;
$M_4 = 1{,}9$ кНм; $a = 0{,}3$ м; $в = 0{,}8$ м.

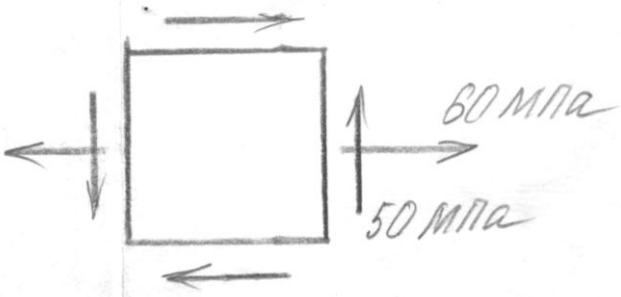
12

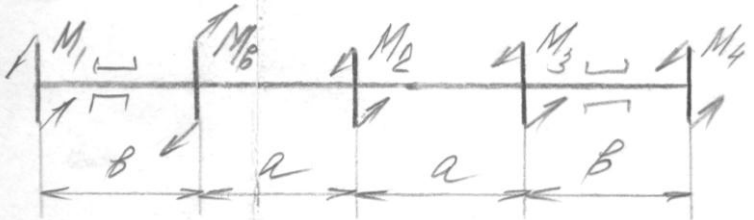




$M_1 = 7{,}5$ кНм; $M_2 = 4{,}3$ кНм; $M_3 = 5$ кНм;
$M_4 = 2{,}5$ кНм; $a = 0{,}2$ м; $в = 0{,}4$ м.

13

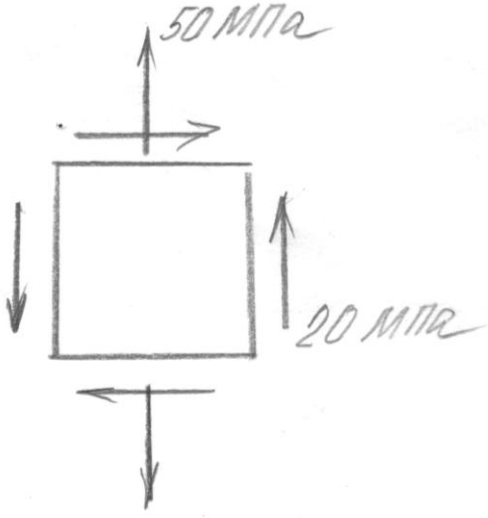


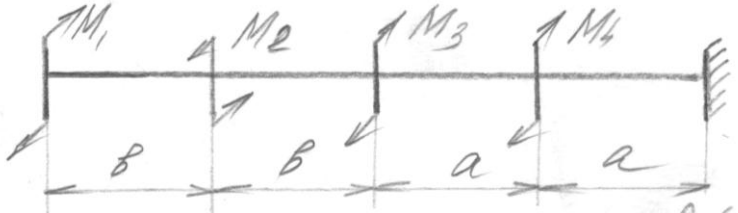


$M_1 = 8{,}2$ кНм; $M_2 = 3{,}1$ кНм; $M_3 = 1{,}8$ кНм

$M_4 = 2{,}6$ кНм; $a = 0{,}5$ м; $b = 0{,}2$ м

14

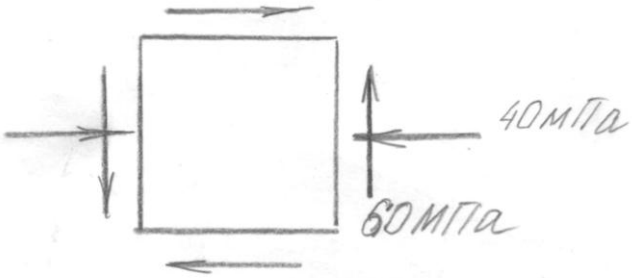


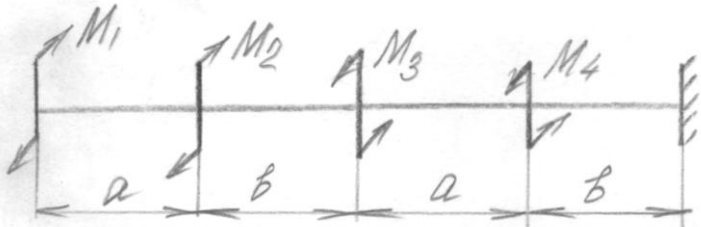


$M_1 = 4{,}7$ кНм; $M_2 = 8$ кНм; $M_3 = 2{,}4$ кНм;

$M_4 = 5{,}1$ кНм; $a = 0{,}4$ м; $b = 0{,}6$ м

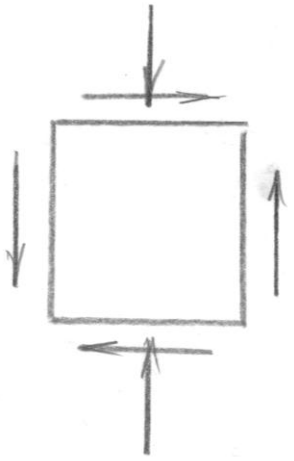
15

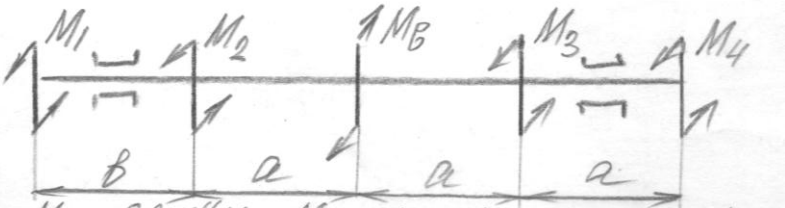




$M_1 = 4{,}3$кНм; $M_2 = 3{,}5$кНм; $M_3 = 10$кНм;
$M_4 = 2{,}9$кНм; $a = 0{,}5$м; $b = 0{,}7$м.

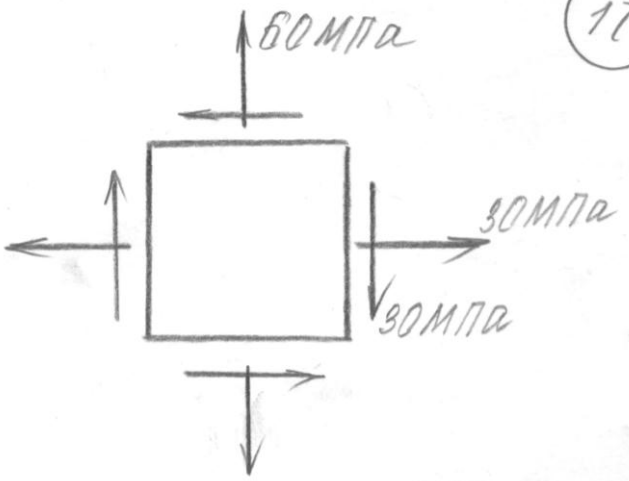
16

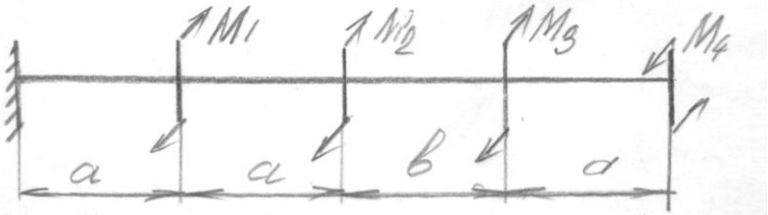




$M_1 = 6{,}2$кНм; $M_2 = 3{,}4$кНм; $M_3 = 7{,}9$кНм;
$M_4 = 5{,}1$кНм; $a = 0{,}4$м; $b = 0{,}6$м

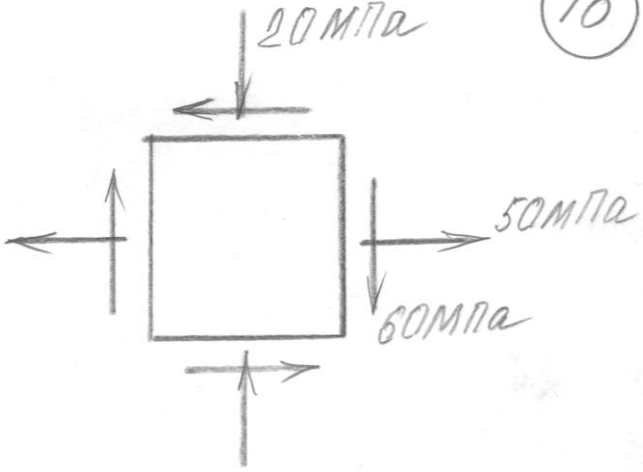
17

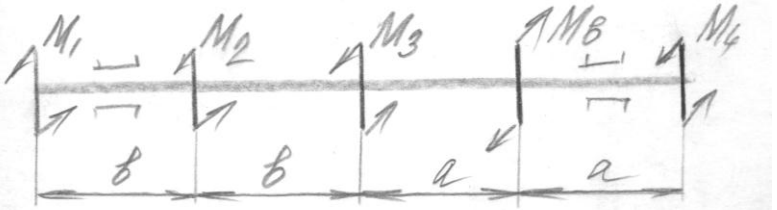




$M_1 = 2{,}5$кНм; $M_2 = 4{,}8$кНм; $M_3 = 7$кНм;
$M_4 = 5$кНм; $a = 0{,}6$м; $в = 1{,}0$м

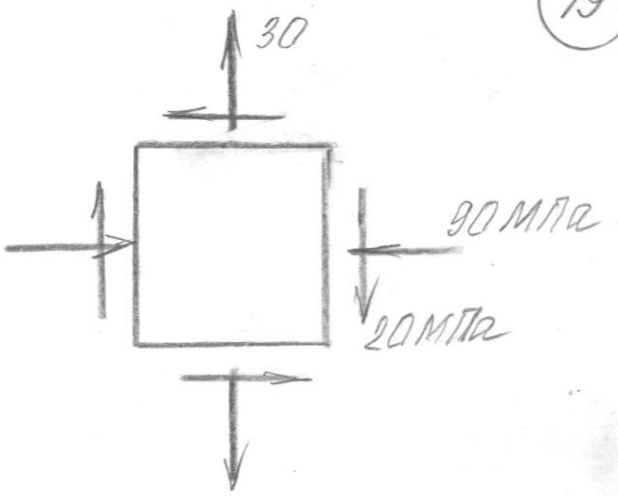
18

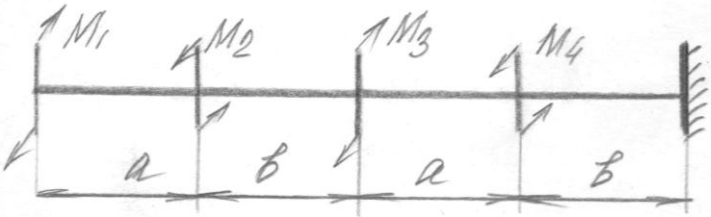




$M_1 = 4{,}8$кНм; $M_2 = 3{,}0$кНм; $M_3 = 6{,}6$кНм;
$M_4 = 10$кНм; $a = 0{,}3$м; $в = 0{,}4$м

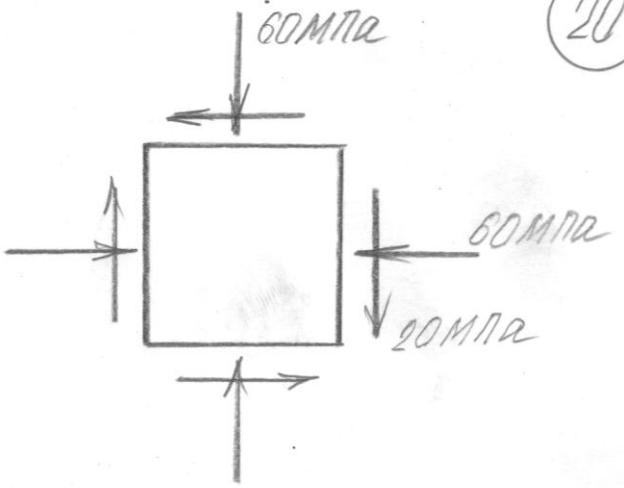
19

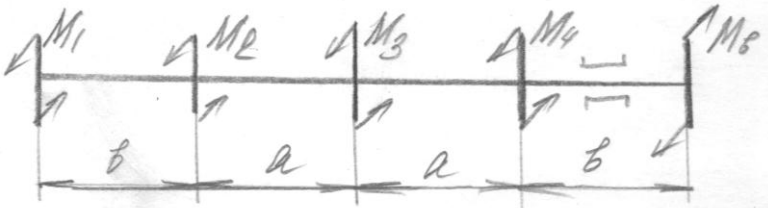




$M_1 = 4\,кНм$; $M_2 = 2{,}5\,кНм$; $M_3 = 1{,}5\,кНм$;
$M_4 = 8{,}2\,кНм$; $a = 0{,}5\,м$; $b = 0{,}3\,м$.

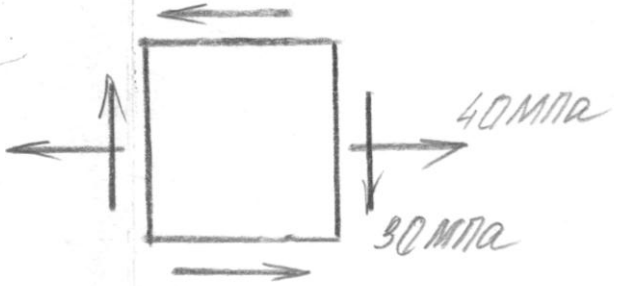
20

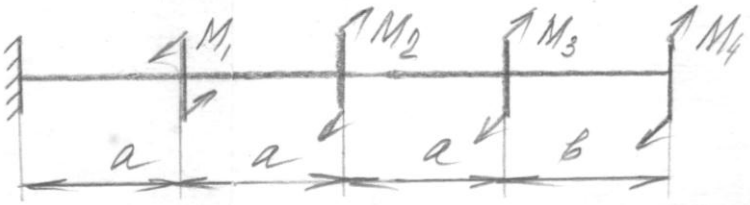




$M_1 = 3{,}7\,кНм$; $M_2 = 1{,}4\,кНм$; $M_3 = 5{,}3\,кНм$;
$M_4 = 2{,}6\,кНм$; $a = 0{,}4\,м$; $b = 0{,}8\,м$

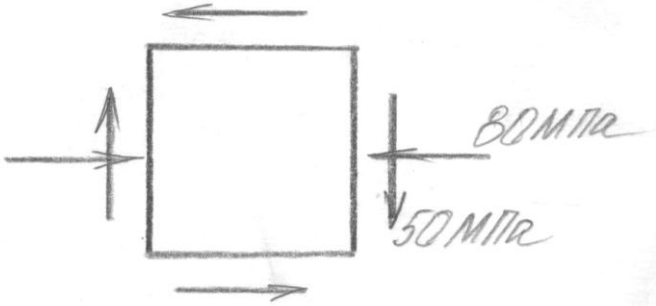
21

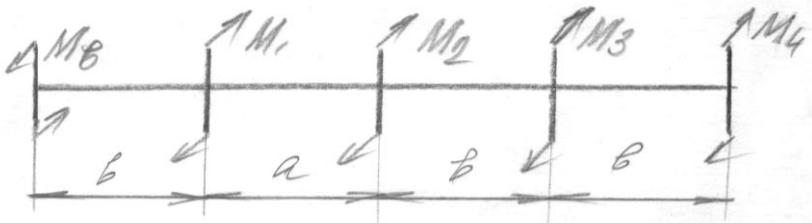




$M_1 = 12$кНм; $M_2 = 6{,}4$кНм; $M_3 = 4{,}6$кНм;
$M_4 = 1{,}5$кНм; $a = 0{,}5$м; $в = 1$м.

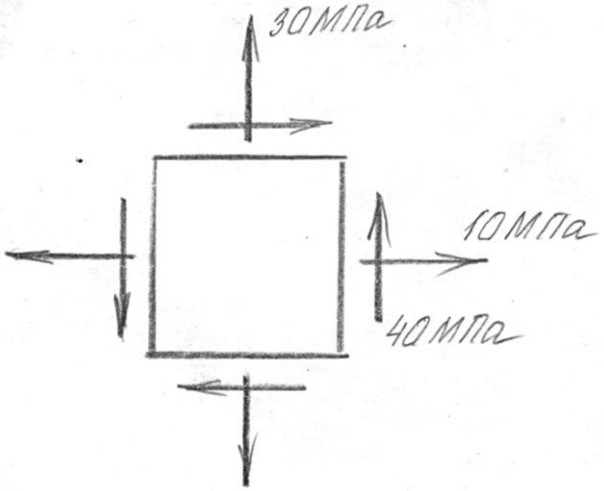
22

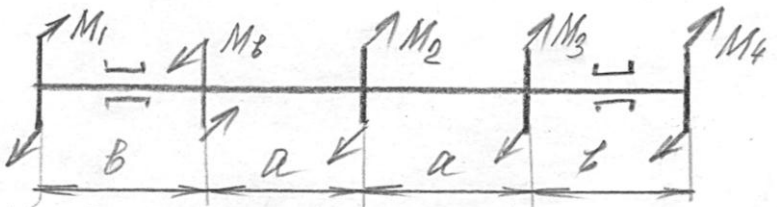




$M_1 = 4{,}1$кНм; $M_2 = 2{,}8$кНм; $M_3 = 3$кНм;
$M_4 = 6$кНм; $a = 0{,}3$м; $в = 0{,}4$м

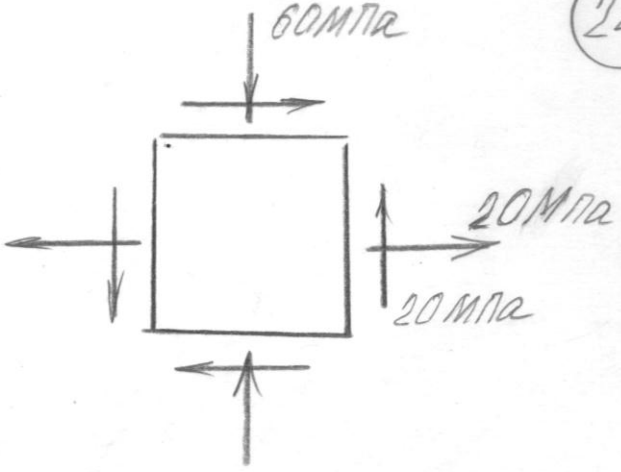
23

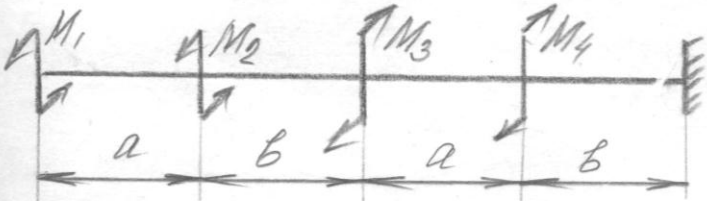




$M_1 = 5{,}4$ кНм; $M_2 = 1{,}9$ кНм; $M_3 = 2{,}8$ кНм;
$M_4 = 4$ кНм; $a = 0{,}8$ м; $b = 0{,}6$ м

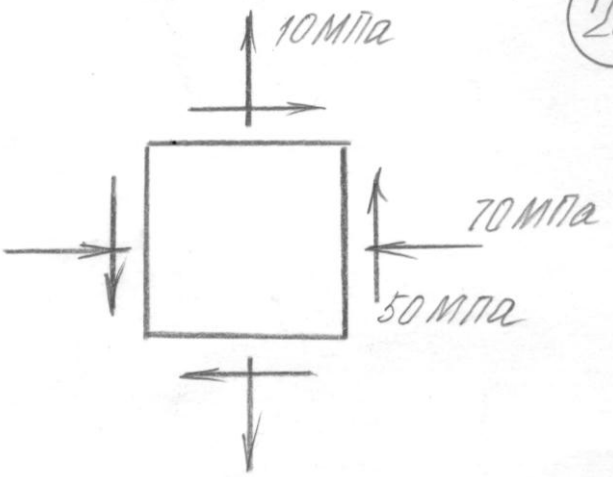
24

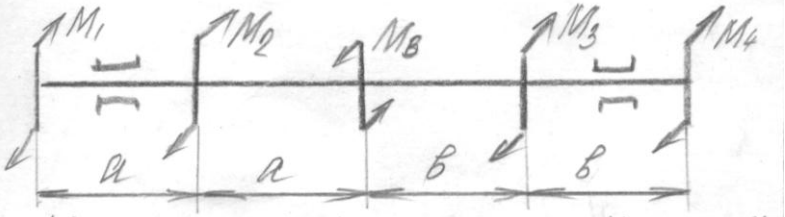




$M_1 = 6{,}2$ кНм; $M_2 = 1{,}8$ кНм; $M_3 = 5$ кНм;
$M_4 = 9$ кНм; $a = 0{,}8$ м; $b = 0{,}2$ м

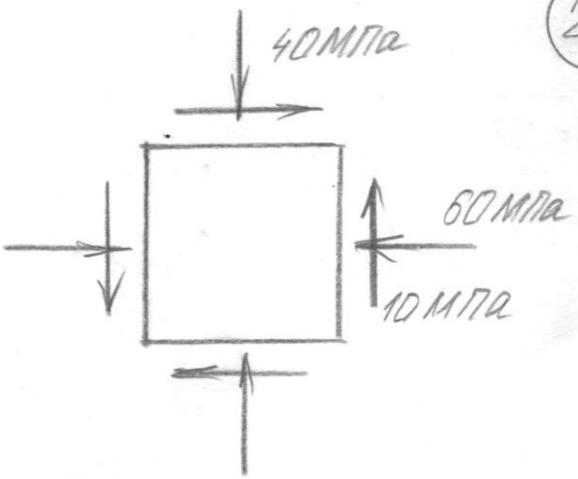
25

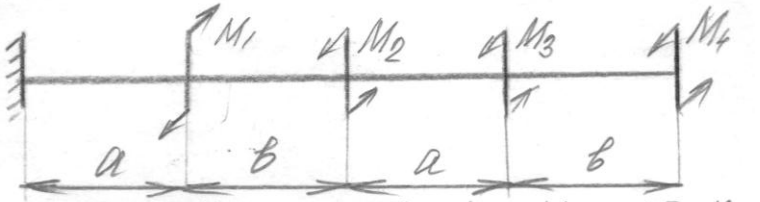




$M_1 = 1{,}7$ кНм; $M_2 = 7{,}2$ кНм; $M_3 = 4$ кНм
$M_4 = 8$ кНм; $a = 0{,}5$ м; $в = 0{,}7$ м.

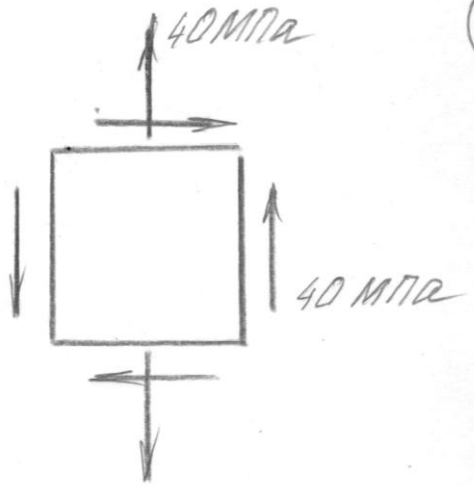
26

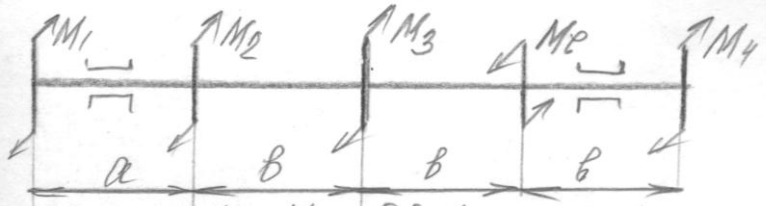




$M_1 = 10$ кНм; $M_2 = 2$ кНм; $M_3 = 1{,}5$ кНм,
$M_4 = 3{,}5$ кНм; $a = 0{,}2$ м; $в = 0{,}5$ м.

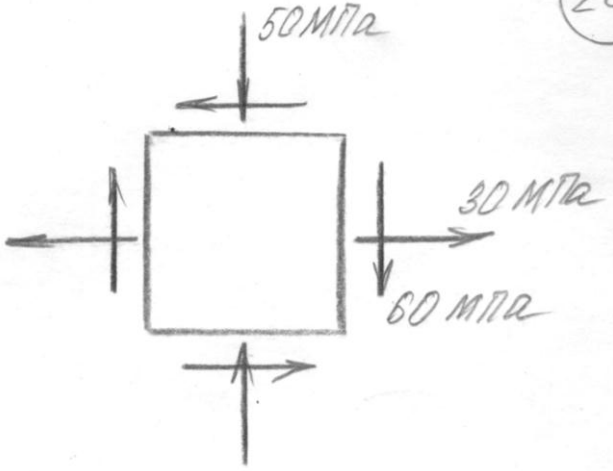
27

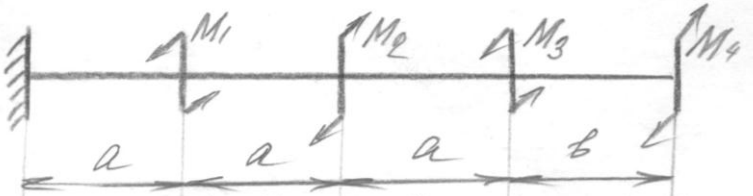




$M_1 = 2{,}6$ кНм; $M_2 = 5{,}5$ кНм; $M_3 = 4$ кНм;
$M_4 = 9$ кНм; $a = 1{,}0$ м; $в = 0{,}3$ м.

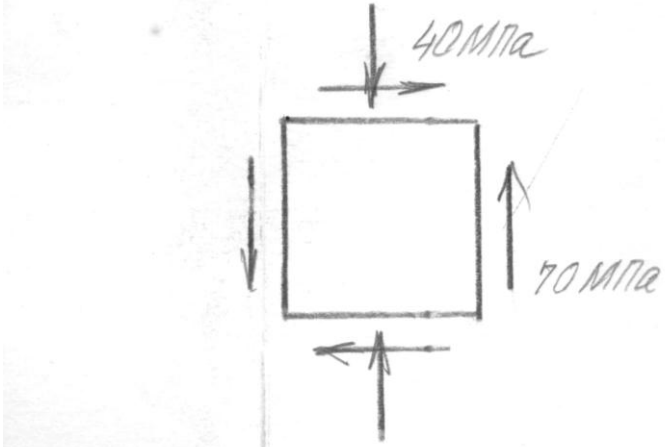
28

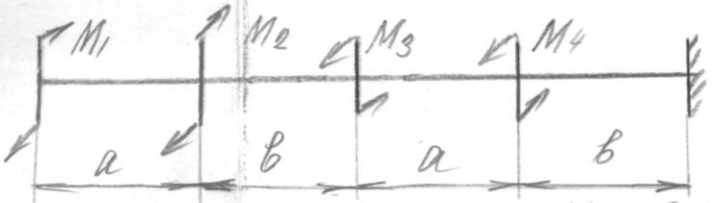




$M_1 = 6{,}5$ кНм; $M_2 = 8$ кНм; $M_3 = 4{,}5$ кНм;
$M_4 = 1{,}2$ кНм; $a = 0{,}6$ м; $в = 0{,}9$ м.

29

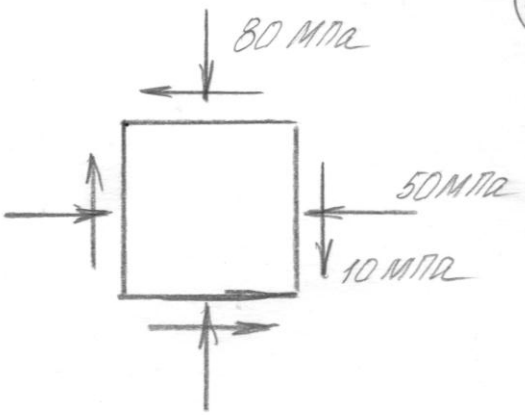


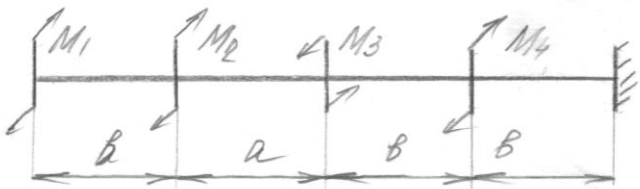


$M_1 = 7{,}3$ кНм; $M_2 = 5$ кНм; $M_3 = 8{,}2$ кНм

$M_4 = 6{,}5$ кНм; $a = 0{,}5$ м; $b = 0{,}7$ м

34





$M_1 = 2{,}2$ кНм; $M_2 = 5{,}6$ кНм; $M_3 = 9$ кНм;

$M_4 = 7{,}1$ кНм; $a = 0{,}8$ м; $b = 0{,}2$ м