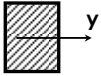
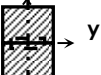

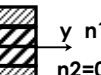
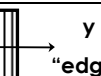
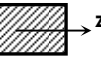

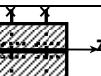
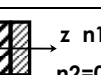
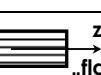


6. táblai gyakorlat kiegészítés -1.

“y” körül (xz síkban)	I_{y0} [mm ⁴]	$I_{y,gyeng}$ [mm ⁴]	$W_{ef,y} = I_{y,gyeng} / Z_{max}$ [mm ³] (gyengített inerciából, α_w -vel, ha szüks.! α_i itt nem!)	$I_{ef,y}$ [mm ⁴] (alakváltozáshoz, gyengítés nélkül, α_i -vel, ha szüks.!)
a) 				
b) 				
c) 	$72,9 \cdot 10^6$	$I_{y,gy} = 72,9 \cdot 10^6 - 2 \cdot 13 \cdot 150 \cdot 40^2 = 72,9 \cdot 10^6 - 6,24 \cdot 10^6 = 66,7 \cdot 10^6$	$\frac{66,7 \cdot 10^6}{90} = 0,741 \cdot 10^6$	$I_{ef,y} = I_{y0} = 72,9 \cdot 10^6$
d) 	$I_{ef,y} = n_1 \cdot I_{1,y} + n_2 \cdot I_{2,y} = 1 \cdot \frac{150 \cdot (180^3 - 90^3)}{12} + 0,73 \cdot \frac{150 \cdot 90^3}{12} = 1 \cdot 63,8 \cdot 10^6 + 0,73 \cdot 9,1 \cdot 10^6 = 70,4 \cdot 10^6$	$I_{ef,y,gyeng} = I_{ef,y0} = 70,4 \cdot 10^6$	$W_{ef,1,y} = \frac{I_{ef,y}}{z_1} = \frac{70,4 \cdot 10^6}{90} = 0,78 \cdot 10^6$ $W_{ef,2,y} = \frac{I_{ef,y}}{z_2} = \frac{70,4 \cdot 10^6}{45} = 1,56 \cdot 10^6$	$I_{ef,y} = I_{y0} = 70,4 \cdot 10^6$
e) 	$I_{y0} = \frac{90 \cdot 180^3}{12} = 43,7 \cdot 10^6$	$I_{y,gyeng} = I_{y0} = 43,7 \cdot 10^6$	$\frac{43,7 \cdot 10^6}{90} = 0,486 \cdot 10^6$	$I_{ef,y} = I_{y0} = 43,7 \cdot 10^6$

“z” körül (xy síkban)	I_{z0} [mm ⁴]	$I_{z,gyeng}$ [mm ⁴]	$W_{ef,z} = I_{z,gyeng} / Y_{max}$ [mm ³] (gyengített inerciából, α_w -vel, ha szüks.! α_i itt nem!)	$I_{ef,z}$ [mm ⁴] (alakváltozáshoz, gyengítés nélkül, α_i -vel, ha szüks.!)
a) 				
b) 				
c) 	$50,6 \cdot 10^6$	$I_{z,gy} = \frac{(180 - 26) \cdot 150^3}{12} = 43,3 \cdot 10^6$	$\alpha_w \cdot \frac{I_{z,gy}}{Y_{max}} = 0,75 \cdot \frac{43,3 \cdot 10^6}{75} = 0,433 \cdot 10^6$	$\alpha_1 \cdot I_{z0} = 0,5 \cdot 50,6 \cdot 10^6 = 25,3 \cdot 10^6$
d) 	$I_{ef,z} = n_1 \cdot I_{1,z} + n_2 \cdot I_{2,z} = 1 \cdot \frac{90 \cdot 150^3}{12} + 0,73 \cdot \frac{90 \cdot 150^3}{12} = 1 \cdot 25,3,8 \cdot 10^6 + 0,73 \cdot 25,3 \cdot 10^6 = 43,8 \cdot 10^6$	$I_{ef,z,gyeng} = I_{ef,z0} = 43,8 \cdot 10^6$	$W_{ef,1,z} = \frac{I_{ef,z}}{y_1} = \frac{43,8 \cdot 10^6}{75} = 0,584 \cdot 10^6$ $W_{ef,2,z} = \frac{I_{ef,z}}{y_2} = \frac{43,8 \cdot 10^6}{75} = 0,584 \cdot 10^6$	$I_{ef,z} = I_{z0} = 43,8 \cdot 10^6$
e) 	$I_{z0} = \frac{180 \cdot 90^3}{12} = 10,94 \cdot 10^6$	$I_{z,gyeng} = I_{z0} = 10,94 \cdot 10^6$	$\frac{10,94 \cdot 10^6}{45} = 0,243 \cdot 10^6$	$I_{ef,z} = I_{z0} = 10,94 \cdot 10^6$

6. táblai gyakorlat kiegészítés/2.

$$f_{m,d} = 30 \cdot (0,9/1,3) = 20,77 \text{ N/mm}^2$$

$$M_{y,Ed} = 12,38 \cdot 10^6 \text{ Nmm}$$

$$M_{z,Ed} = 2,32 \cdot 10^6 \text{ Nmm}$$

c)

$$W_y = 0,741 \cdot 10^6 \text{ mm}^3$$

$$W_z = 0,473 \cdot 10^6 \text{ mm}^3$$

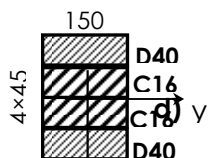
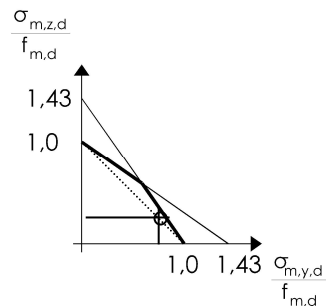
$$\sigma_{m,y,d} = \frac{12,38 \cdot 10^6 \text{ Nmm}}{0,741 \cdot 10^6 \text{ mm}^3} = 16,71 \text{ N/mm}^2$$

$$\sigma_{m,z,d} = \frac{2,32 \cdot 10^6 \text{ Nmm}}{0,473 \cdot 10^6 \text{ mm}^3} = 5,36 \text{ N/mm}^2$$

$$\frac{\sigma_{m,y,d}}{f_{m,d}} + \frac{\sigma_{m,z,d}}{f_{m,d}} = \frac{16,71}{20,77} + \frac{5,36}{20,77} = 0,804 + 0,258 = 1,06 > 1 < 1,2 \rightarrow \text{két képletes vizsgálat!}$$

$$k_m \cdot \frac{\sigma_{m,y,d}}{f_{m,d}} + \frac{\sigma_{m,z,d}}{f_{m,d}} = 0,7 \cdot 0,804 + 0,258 = 0,82$$

$$\frac{\sigma_{m,y,d}}{f_{m,d}} + k_m \cdot \frac{\sigma_{m,z,d}}{f_{m,d}} = 0,804 + 0,7 \cdot 0,258 = 0,985 < 1 \text{ MF!}$$



1)

Mindkét anyagra külön vizsgálat kell!

1) D40 $n_1 = 1$ $f_{m,1,d} = 40 \cdot (0,9/1,3) = 27,7 \text{ N/mm}^2$

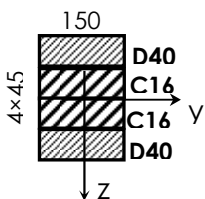
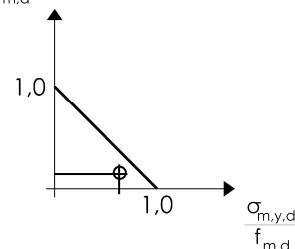
$$W_{ef,1,y} = 0,78 \cdot 10^6 \text{ mm}^3$$

$$W_{ef,1,z} = 0,584 \cdot 10^6 \text{ mm}^3$$

$$\sigma_{m,1,y,d} = \frac{12,38 \cdot 10^6 \text{ Nmm}}{0,78 \cdot 10^6 \text{ mm}^3} = 15,87 \text{ N/mm}^2$$

$$\sigma_{m,1,z,d} = \frac{2,32 \cdot 10^6 \text{ Nmm}}{0,584 \cdot 10^6 \text{ mm}^3} = 3,97 \text{ N/mm}^2$$

$$\frac{\sigma_{m,1,y,d}}{f_{m,1,d}} + \frac{\sigma_{m,1,z,d}}{f_{m,1,d}} = \frac{15,87}{27,7} + \frac{3,97}{27,7} = 0,573 + 0,143 = 0,716 < 1 \text{ MF!}$$



2)

2) C16 $n_2 = 0,73$ $f_{m,2,d} = 16 \cdot (0,9/1,3) = 11,08 \text{ N/mm}^2$

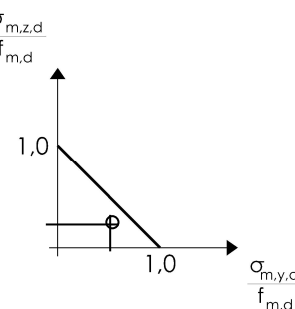
$$W_{ef,2,y} = 1,56 \cdot 10^6 \text{ mm}^3$$

$$W_{ef,2,z} = 0,584 \cdot 10^6 \text{ mm}^3$$

$$\sigma_{m,2,y,d} = 0,73 \cdot \frac{12,38 \cdot 10^6 \text{ Nmm}}{1,56 \cdot 10^6 \text{ mm}^3} = 5,79 \text{ N/mm}^2$$

$$\sigma_{m,2,z,d} = 0,73 \cdot \frac{2,32 \cdot 10^6 \text{ Nmm}}{0,584 \cdot 10^6 \text{ mm}^3} = 2,90 \text{ N/mm}^2$$

$$\frac{\sigma_{m,2,y,d}}{f_{m,d}} + \frac{\sigma_{m,2,z,d}}{f_{m,d}} = \frac{5,79}{11,08} + \frac{2,90}{11,08} = 0,523 + 0,262 = 0,785 < 1 \text{ MF!}$$



6. táblai gyakorlat kiegészítés/3.

$$f_{m,y,d} = f_{m,edge,d} = 44 \cdot (0,9/1,2!) = 33,0 \text{ N/mm}^2 \quad f_{m,z,d} = f_{m,flat,d} = 50 \cdot (0,9/1,2!) = 37,5 \text{ N/mm}^2$$

$$M_{y,Ed} = 12,38 \cdot 10^6 \text{ Nmm} \quad M_{z,Ed} = 2,32 \cdot 10^6 \text{ Nmm}$$

$$e) \quad W_y = 0,486 \cdot 10^6 \text{ mm}^3$$

$$W_z = 0,243 \cdot 10^6 \text{ mm}^3$$

$$\sigma_{m,y,d} = \frac{12,38 \cdot 10^6 \text{ Nmm}}{0,486 \cdot 10^6 \text{ mm}^3} = 25,47 \text{ N/mm}^2 \quad \sigma_{m,z,d} = \frac{2,32 \cdot 10^6 \text{ Nmm}}{0,243 \cdot 10^6 \text{ mm}^3} = 9,55 \text{ N/mm}^2$$

$$\frac{\sigma_{m,y,d}}{f_{m,d}} + \frac{\sigma_{m,z,d}}{f_{m,d}} = \frac{25,47}{33,0} + \frac{9,55}{37,5} = 0,772 + 0,255 = 1,03 > 1 < 1,2 \rightarrow \text{két képletes vizsgálat!}$$

$$k_m \cdot \frac{\sigma_{m,y,d}}{f_{m,d}} + \frac{\sigma_{m,z,d}}{f_{m,d}} = 0,7 \cdot 0,772 + 0,255 = 0,795$$

$$\frac{\sigma_{m,y,d}}{f_{m,d}} + k_m \cdot \frac{\sigma_{m,z,d}}{f_{m,d}} = 0,772 + 0,7 \cdot 0,255 = 0,95 < 1 \text{ MF!}$$

