

$file := "E:\Profile.xlsx"$

$h := \text{READExcel}(file, "mullion!B3:B14")$

$I_{xx} := \text{READExcel}(file, "mullion!D3:D14")$

$Zx := \text{READExcel}(file, "mullion!F3:F14")$

$profile := \text{READExcel}(file, "mullion!A3:A14")$

Selection profile

$$h := \begin{bmatrix} 50 \\ 65 \\ 85 \\ 105 \\ 125 \\ 150 \\ 175 \\ 175 \\ 200 \\ 225 \\ 250 \\ 300 \end{bmatrix} \quad I_{xx} := \begin{bmatrix} 31.35 \\ 55.55 \\ 108.42 \\ 167.25 \\ 278.59 \\ 423.76 \\ 663 \\ 731 \\ 1010.13 \\ 1352.44 \\ 1759.43 \\ 3592.17 \end{bmatrix} \quad \text{cm}^4 \quad profile := \begin{bmatrix} "FW 50/50 322 250" \\ "FW 50/65 322 260" \\ "FW 50/85 322 270" \\ "FW 50/105 322 280" \\ "FW 50/125 322 290" \\ "FW 50/150 322 300" \\ "FW 50/175 322 310" \\ "FW 50/175 326 250" \\ "FW 50/200 326 030" \\ "FW 50/225 336 230" \\ "FW 50/250 336 240" \\ "FW 50/300 903 7712" \end{bmatrix}$$

Given Data

	WL	Lt	w	L
CW2	1.4	1.50	2.100	5100
CW03	1.4	0.50	0.700	5000
CW031	1.4	2.50	3.500	5100

Material Propeties

E_{al}	ρ	γ_m
(MPa)	(MPa)	
70000	160	1.2

$$L_{BR} := \begin{bmatrix} L_{BR1} \\ L_{BR2} \\ L_{BR3} \end{bmatrix} = \begin{bmatrix} 5.1 \\ 5 \\ 5.1 \end{bmatrix} \text{ m} \quad w_{WL} := \begin{bmatrix} w_{case1} \\ w_{case2} \\ w_{case3} \end{bmatrix} = \begin{bmatrix} 2.1 \\ 0.7 \\ 3.5 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

$$\delta_{case1} := \frac{w_{case1} \cdot L_{BR1}^4}{185 E_{al} \cdot I_{xx}} = \begin{bmatrix} 349.939 \\ 197.49 \\ 101.186 \\ 65.594 \\ 39.379 \\ 25.889 \\ 16.547 \\ 15.008 \\ 10.861 \\ 8.112 \\ 6.235 \\ 3.054 \end{bmatrix} \text{ mm} \quad \delta_{case2} := \frac{w_{case2} \cdot L_{BR2}^4}{185 E_{al} \cdot I_{xx}} = \begin{bmatrix} 107.763 \\ 60.817 \\ 31.16 \\ 20.2 \\ 12.127 \\ 7.972 \\ 5.096 \\ 4.622 \\ 3.344 \\ 2.498 \\ 1.92 \\ 0.94 \end{bmatrix} \text{ mm}$$

$$\delta_{case3} := \frac{w_{case3} \cdot L_{BR3}^4}{185 E_{al} \cdot I_{xx}} = \begin{bmatrix} 583.232 \\ 329.151 \\ 168.643 \\ 109.323 \\ 65.632 \\ 43.148 \\ 27.578 \\ 25.013 \\ 18.101 \\ 13.52 \\ 10.392 \\ 5.09 \end{bmatrix} \text{ mm}$$

Step 1

$$\text{TOL} := 10^{-4}$$

$$\Delta_{case1} := \max \left(\text{lookup} \left(\begin{array}{l} \text{if } \frac{L_{BR1}}{175} < 19 \text{ mm} \\ \frac{L_{BR1}}{175} \\ \text{else} \\ 19 \text{ mm} \end{array} \right), \delta_{case1}, \delta_{case1}, \text{"1t"} \right) = 16.547 \text{ mm}$$
$$\frac{L_{BR1}}{175} = 29.143 \text{ mm}$$

$$\Delta_{case2} := \max \left(\text{lookup} \left(\begin{array}{l} \text{if } \frac{L_{BR2}}{175} < 19 \text{ mm} \\ \frac{L_{BR2}}{175} \\ \text{else} \\ 19 \text{ mm} \end{array} \right), \delta_{case2}, \delta_{case2}, \text{"1t"} \right) = 12.127 \text{ mm}$$
$$\frac{L_{BR2}}{175} = 28.571 \text{ mm}$$

$$\Delta_{case3} := \max \left(\text{lookup} \left(\begin{array}{l} \text{if } \frac{L_{BR3}}{175} < 19 \text{ mm} \\ \frac{L_{BR3}}{175} \\ \text{else} \\ 19 \text{ mm} \end{array} \right), \delta_{case3}, \delta_{case3}, \text{"1t"} \right) = 18.101 \text{ mm}$$
$$\frac{L_{BR3}}{175} = 29.143 \text{ mm}$$

Step 2

$$profile_{case1} := \text{lookup} (\Delta_{case1}, \delta_{case1}, profile, \text{"eq"}) = [\text{"FW 50/175 322 310"}]$$

$$profile_{case2} := \text{lookup} (\Delta_{case2}, \delta_{case2}, profile, \text{"eq"}) = [\text{"FW 50/125 322 290"}]$$

$$profile_{case3} := \text{lookup} (\Delta_{case3}, \delta_{case3}, profile, \text{"eq"}) = [\text{"FW 50/200 326 030"}]$$

Step 3

Check for bending moment

$$Z_x := Zx \cdot \text{cm}^3 = \begin{bmatrix} 8.27 \\ 12.61 \\ 19.96 \\ 27.05 \\ 37.18 \\ 48.89 \\ 66.9 \\ 75.98 \\ 92.23 \\ 110.4 \\ 129.91 \\ 217.444 \end{bmatrix} \text{cm}^3$$

$$R_1 = V_1 = R_3 = V_3 \dots \dots \dots = \frac{3w\ell}{8}$$

$$R_2 \dots \dots \dots = \frac{10w\ell}{8}$$

$$V_2 = V_{\max} \dots \dots \dots = \frac{5w\ell}{8}$$

$$M_1 \dots \dots \dots = \frac{w\ell^2}{8}$$

$$M_2 \left(\text{at } \frac{3\ell}{8} \right) \dots \dots \dots = \frac{9w\ell^2}{128}$$

$$\Delta_{\max} \text{ (at } 0.4215 \ell, \text{ approx. from } R_1 \text{ and } R_3) \dots \dots = \frac{w\ell^4}{185EI}$$

$$Zx_{\text{case1}} := \text{lookup}(\Delta_{\text{case1}}, \delta_{\text{case1}}, Z_x, \text{"eq"}) = [66.9] \text{cm}^3$$

$$Zx_{\text{case2}} := \text{lookup}(\Delta_{\text{case2}}, \delta_{\text{case2}}, Z_x, \text{"eq"}) = [37.18] \text{cm}^3$$

$$Zx_{\text{case3}} := \text{lookup}(\Delta_{\text{case3}}, \delta_{\text{case3}}, Z_x, \text{"eq"}) = [92.23] \text{cm}^3$$

$$Zx := \begin{bmatrix} \|Zx_{\text{case1}}\| \\ \|Zx_{\text{case2}}\| \\ \|Zx_{\text{case3}}\| \end{bmatrix} = \begin{bmatrix} 66.9 \\ 37.18 \\ 92.23 \end{bmatrix} \text{cm}^3$$

Bending moment

$$\phi m1_{case1} := \frac{1.2 \cdot \overrightarrow{w_{WL}} \cdot L_{BR}^2}{8} = \begin{bmatrix} 8.193 \\ 2.625 \\ 13.655 \end{bmatrix} \text{ kN} \cdot \text{m} \quad Mx_{RS} := \frac{p_o \cdot Zx}{\gamma m} = \begin{bmatrix} 8.92 \\ 4.957 \\ 12.297 \end{bmatrix} \text{ kN} \cdot \text{m}$$

$$\phi m2_{case1} := \frac{1.2 \cdot 9 \cdot \overrightarrow{w_{WL}} \cdot L_{BR}^2}{128} = \begin{bmatrix} 4.609 \\ 1.477 \\ 7.681 \end{bmatrix} \text{ kN} \cdot \text{m}$$

Step 4

Utilization

Bending Moment

Condition 2

$$m1 := \frac{\overrightarrow{\phi m1_{case1}}}{Mx_{RS}} = \begin{bmatrix} 0.919 \\ 0.53 \\ 1.11 \end{bmatrix} \quad \begin{array}{l} \text{pass} \\ \text{pass} \\ \text{fail} \end{array} \quad \blacksquare \leq 1$$

$profile_{case1} = ["FW 50/175 322 310"]$

$profile_{case2} = ["FW 50/125 322 290"]$

$profile_{case3} = ["FW 50/200 326 030"]$

$$m2 := \frac{\overrightarrow{\phi m2_{case1}}}{Mx_{RS}} = \begin{bmatrix} 0.517 \\ 0.298 \\ 0.625 \end{bmatrix} \quad \begin{array}{l} \text{pass} \\ \text{pass} \\ \text{pass} \end{array} \quad \blacksquare \leq 1$$

$profile_{case1} = ["FW 50/175 322 310"]$

$profile_{case2} = ["FW 50/125 322 290"]$

$profile_{case3} = ["FW 50/200 326 030"]$

$$\Delta 1 := \begin{bmatrix} \Delta_{case1} \\ \Delta_{case2} \\ \Delta_{case3} \end{bmatrix} = \begin{bmatrix} 16.547 \\ 12.127 \\ 18.101 \end{bmatrix} \text{ mm} \quad L_{BR} = \begin{bmatrix} 5100 \\ 5000 \\ 5100 \end{bmatrix} \text{ mm}$$

$$def(L) := \begin{cases} \text{if } \frac{L}{175} \leq 19 \text{ mm} \\ \left| \frac{L}{175} \right| \\ \text{else} \\ 19 \text{ mm} \end{cases}$$

$$\delta_{limit} := \overrightarrow{def(L_{BR})} = \begin{bmatrix} 19 \\ 19 \\ 19 \end{bmatrix} \text{ mm}$$

Condition 1

$$def := \frac{\overrightarrow{\Delta 1}}{\delta_{limit}} = \begin{bmatrix} 0.871 \\ 0.638 \\ 0.953 \end{bmatrix} \quad \mathbb{1} \leq 1$$

$$profile_{case1} = ["FW 50/175 322 310"]$$

$$profile_{case2} = ["FW 50/125 322 290"]$$

$$profile_{case3} = ["FW 50/200 326 030"]$$