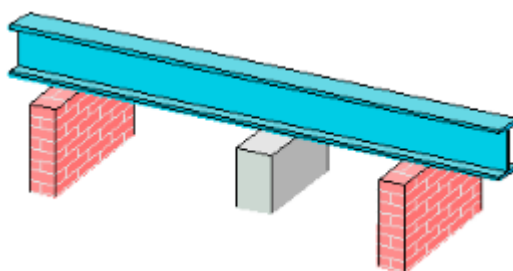


t322 – Стальная балка



Программа предназначена для расчёта многопролетной стальной балки согласно MSZ EN 1993-1-1-2005.

Возможно задание шарниров, консолей, примыкающих стоек, упругих опор, частичного или полного защемления крайних опор.

Могут задаваться распределённые и сосредоточенные нагрузки, а также температурные воздействия и осадки опор. Возможен учёт свободного и/или стеснённого кручения балки при смещённом относительно вертикальной плоскости симметрии положении нагрузки.

Расчётные сочетания усилий определяются автоматически, согласно MSZ EN 1990:2011.

Реализованы симметричные прокатные и несимметричные сварные сечения из швеллеров, двутавра и короба с возможным заданием дополнительных поясных листов.

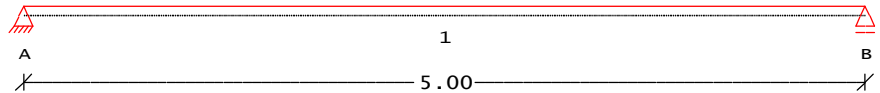
Расчет производится по упругой или упруго-пластической схеме с перераспределением усилий.

Проводятся расчеты прочности и устойчивости плоской формы изгиба балки.

Для балки из прокатного профиля реализован режим подбора минимально номера профиля, удовлетворяющего условиям прочности и ограничению прогибов.

Design scheme

M = 1 : 45



Supports

Support	t [cm]	Support	t [cm]
A	20.0	B	20.0

Actions

Nº	Duration	Description
1	Permanent	Постоянное воздействие постоянное -
2	Variable	Категория D: торговые площади переменное Категория-D

Characteristics

Nº	γ_F	ψ_0 ξ	ψ_1	ψ_2	group incomp.	sign	fields distrib
1	1.35	0.85					
2	1.50	0.70	0.70	0.60			adverse

Factor for reliability differentiation of actions by formula (6.10) EN 1990 $K_{FI} = 1.00$

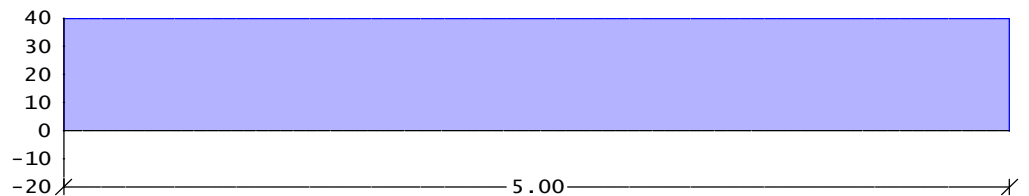
Factor

Combination

Loads

Action 1
M = 1 : 40

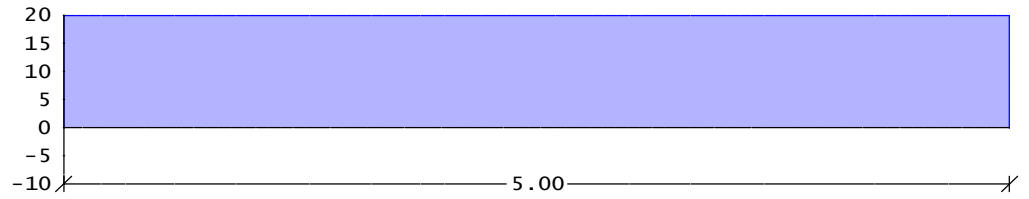
постоянное - $\gamma_f = 1.35$



N.	Field	a [m]	s [m]	p_1 / P [kN/m, kN, kNm]	p_n / M
Uniform	1	1		40.00	

Action 2
M = 1 : 40

переменное Категория-D $\gamma_f = 1.50$



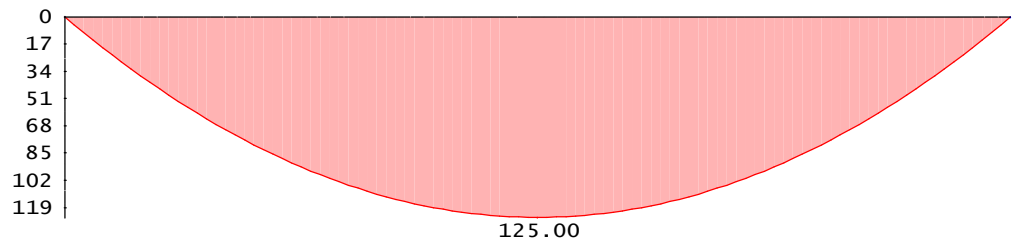
N.	Field	a	s	p ₁ / P	p _n / M
	support	[m]	[m]	[kN/m, kN, kNm]	
Uniform	1	1		20.00	

Internal forces

by linear elastic method

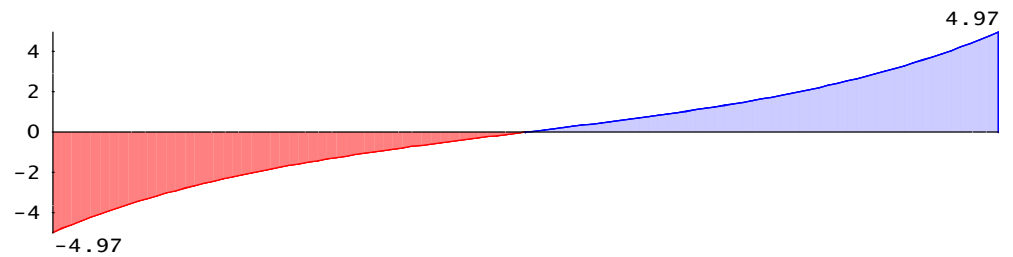
Action 1
M = 1 : 40

moments M_{e1} [kNm]



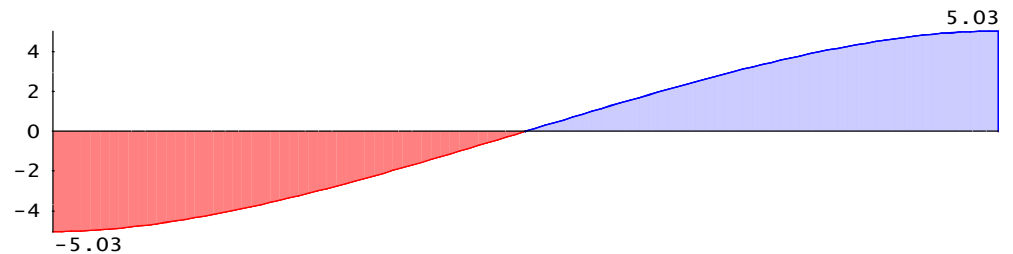
Action 1
M = 1 : 40

moments M_w corresponded to M_{e1} [kNm]



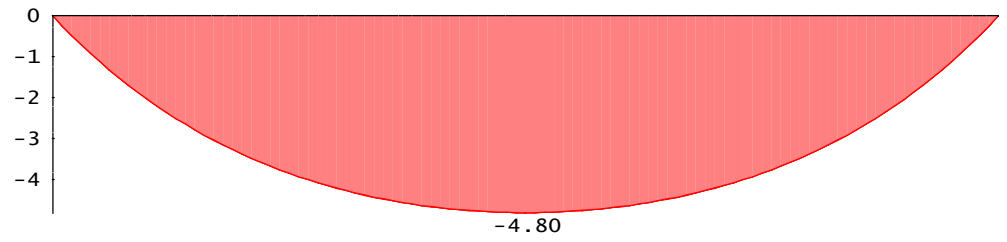
Action 1
M = 1 : 40

moments M_t corresponded to M_{e1} [kNm]



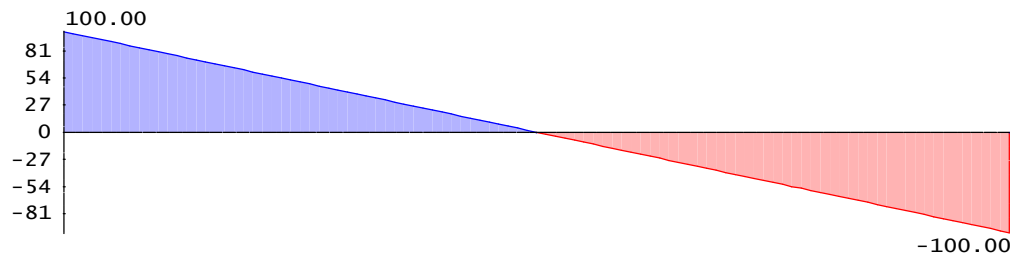
Action 1
M = 1 : 40

bimoments B corresponded to M_{e1} [kNm²]



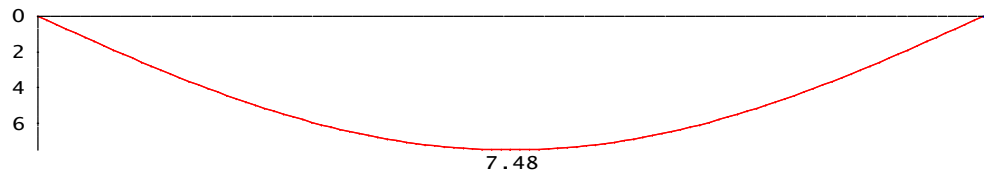
Action 1
M = 1 : 40

shear forces Q_{e1} [kN]



Action 1
M = 1 : 40

deflections f_{e1} [mm]

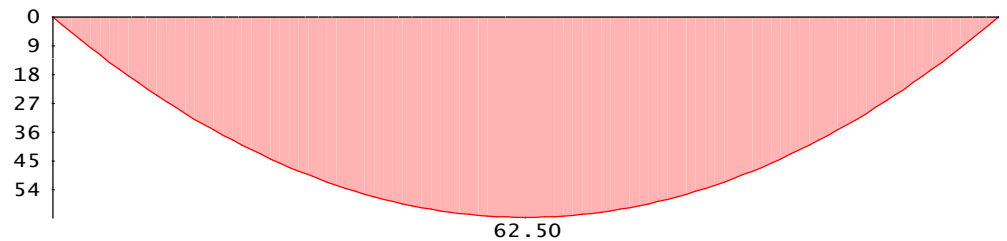


Action 1

Field	x [m]	max			min		
		M_1 [kNm]	Q_1 [kN]	w_1 [mm]	M_1 [kNm]	Q_1 [kN]	w_1 [mm]
1	0.00	0.0	100.0	0.00	0.0	100.0	0.00
1	1.25	93.8	50.0	5.33	93.8	50.0	5.33
1	2.50*	125.0	0.0	7.48	125.0	0.0	7.48
1	3.75	93.8	-50.0	5.33	93.8	-50.0	5.33
1	5.00	0.0	-100.0	0.00	0.0	-100.0	0.00

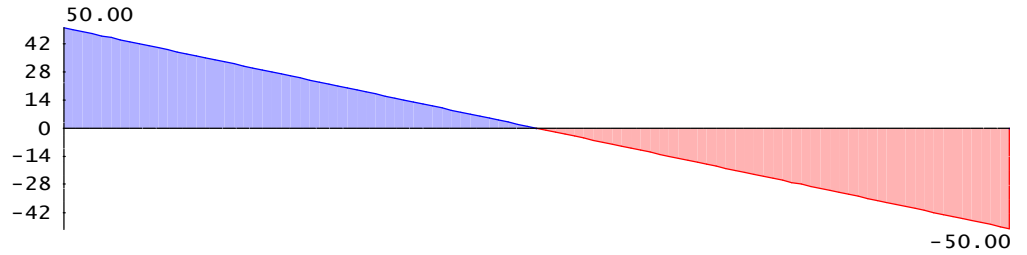
Action 2
M = 1 : 40

envelope of moments M_{e1} [kNm]



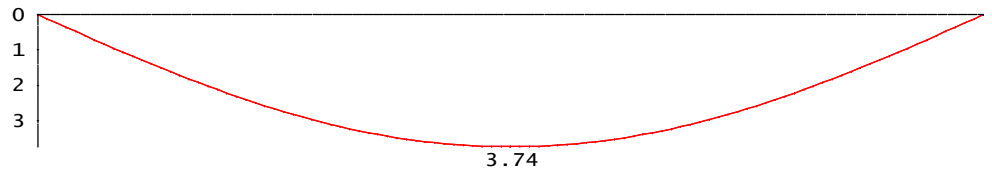
Loading 2
M = 1 : 40

envelope of shear forces Q_{e1} [kN]



Action 2
M = 1 : 40

envelope of deflections f_{e1} [mm]



Action 2

Field	x [m]	max			min		
		M_2 [kNm]	Q_2 [kN]	w_2 [mm]	M_2 [kNm]	Q_2 [kN]	w_2 [mm]
1	0.00	0.00	50.00	0.00	0.00	0.00	
1	1.25	46.88	25.00	2.67	46.88	25.00	
1	2.50*	62.50	0.00	3.74	62.50	0.00	
1	3.75	46.88	-25.00	2.67	46.88	-25.00	
1	5.00	0.00	-50.00	0.00	0.00	-50.00	

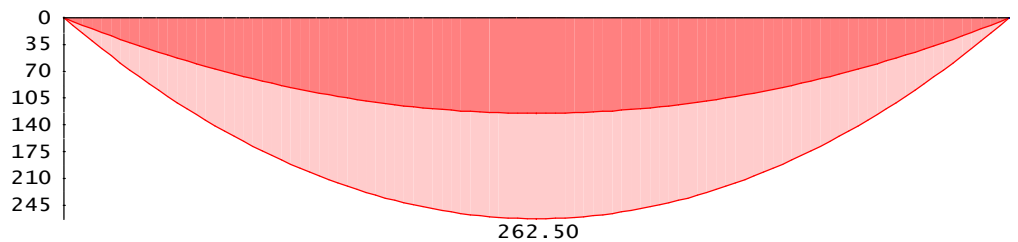
Support reactions

Action	support	max		min	
		[kN]		[kN]	
1	A	100.00	100.00		
	B	100.00	100.00		
2	A	50.00	50.00		
	B	50.00	50.00		

Load combinations

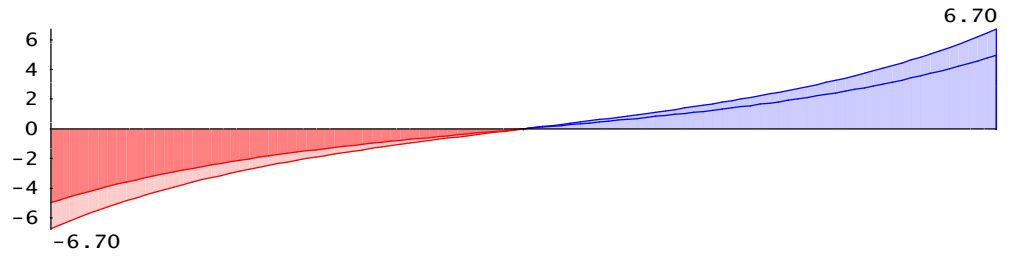
Combinations of loads by p. 6.4.3 MSZ EN 1990:2011
Basis of structural design.
fundamental combinations [kNm]

Moment M
M = 1 : 40



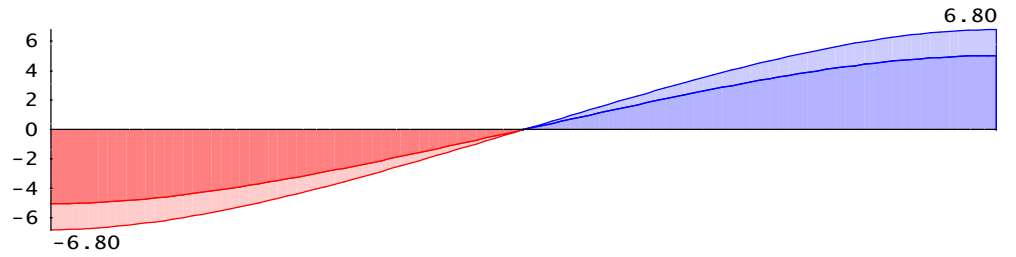
Moment Mw
M = 1 : 40

corresponded to moment M [kNm]



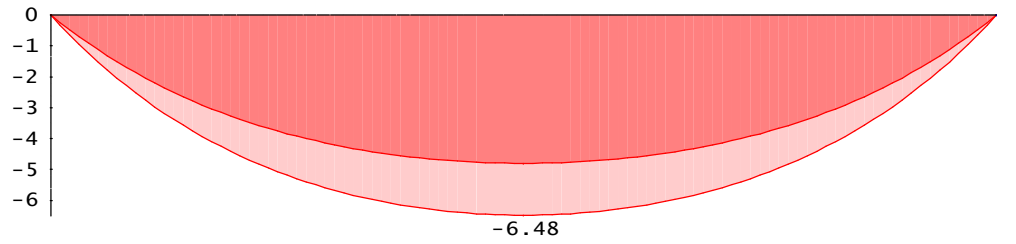
Moment Mk
M = 1 : 40

corresponded to moment M [kNm]



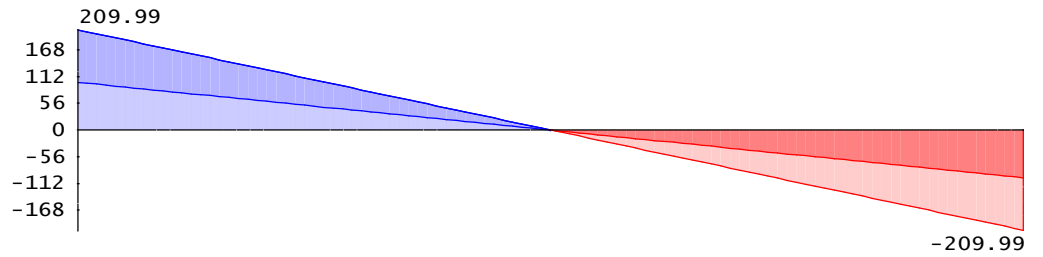
Bimoment B
M = 1 : 40

corresponded to moment M [kNm²]



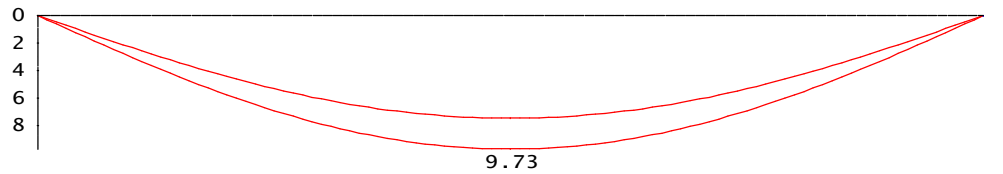
Shear force Q
M = 1 : 40

fundamental combinations [kN]



Deflections w
M = 1 : 40

quasi-permanent combinations [mm]



Design combinations
of momets, shear
forces & deflections

Field	x [m]	max			min		
		M_{Ed} [kNm]	Q_{Ed} [kN]	w_{Ed} [mm]	M_{Ed} [kNm]	Q_{Ed} [kN]	w_{Ed} [mm]
1	0.00	0.0	210.0	0.00	0.0	100.0	0.00
1	1.25	196.9	105.0	6.93	93.8	50.0	5.33
1	2.50*	262.5	0.0	9.73	125.0	0.0	7.48
1	3.75	196.9	-50.0	6.93	93.8	-105.0	5.33
1	5.00	0.0	-100.0	0.00	0.0	-210.0	0.00

 Combinations of
support reactions

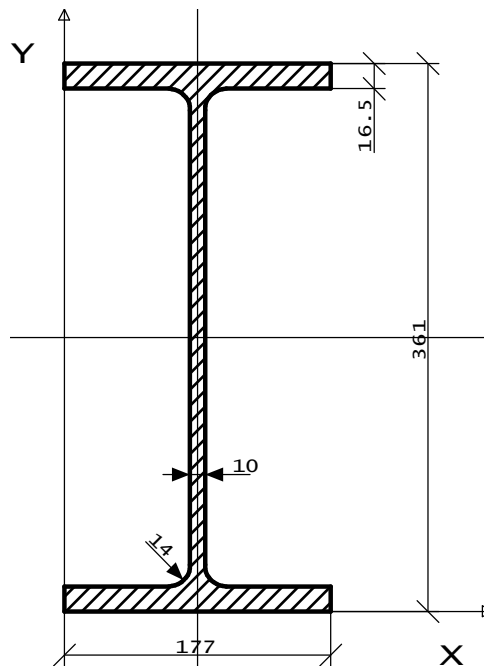
Combination	support	max	min
		[kN]	[kN]
fundamental comb	A	210.00	100.00
	B	210.00	100.00

Beam crossection

Profile 35Б4

M = 1 : 5

I-beam, GOST R 57837-2017



height	h =	361mm	width	b =	177mm
flan thick.t	t =	16.5mm	wall thick. t _w	=	10.0mm
area	A =	92.9cm ²	2nd. moment I _x	=	2.072e4cm ⁴
1s.moment S _x	=	651 cm ³	2nd. moment I _y	=	1529 cm ⁴
StV tors. I _t	=	69.4cm ⁴	warp.const. I _ω	=	4.477e5cm ⁶
pl.modul. W _{p1}	=	1.30e3cm ³	warp. area ω	=	158.4cm ²
shearArea A _v	=	40.8cm ²			

Material of the beam S 275N/NL

 mod. elas. E = 210 GPa shear modul. G = 80.8 GPa
 yield st. f_y = 275 MPa shear str. f_s = 159 MPa

Partial safety factors

 $\gamma_{M0} = 1$
 $\gamma_{M1} = 1$

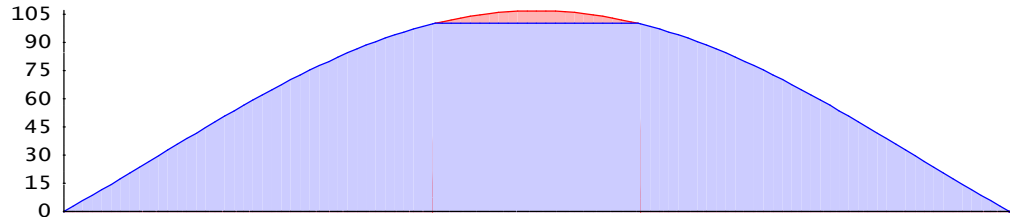
Calculation results

beam of class 1 by MSZ EN 1993-1-1-2005.

Critic. combinations	N	act.	coef.	fields
	1	1	1.35	1
	2		1.50	1

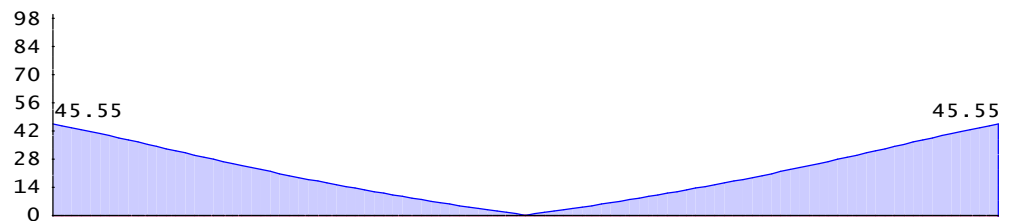
Strength calculation max moment $M = 262\text{kNm}$ is achieved in field 1
 bimoment $B = 6.48\text{kNm}^2$
 in cross-section with $x = 2.50\text{m}$ combination N 1
 strength condition $B_{\omega}/W_{\omega}/(f_y/\gamma_{M0}) + (M/W/(f_y/\gamma_{M0}))^2 = 1.07$ **NOT COMPLETE!**

Utilization factor by bending moment and bimoment [%]
 $M = 1 : 40$



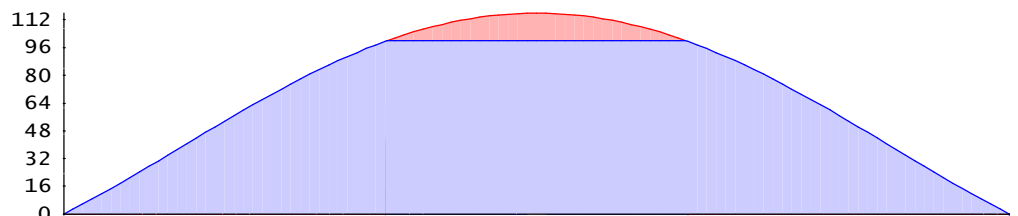
max shear force $Q = 210\text{kN}$ in supp. B combin. N 1
 corresp. moment $M_t = 6.8\text{kNm}$
 condition (6.17) $Q/(A_v * f_s / \gamma_{M0}) = 0.46$ condition completed

Utilization factor by shear force and torsion moment [%]
 $M = 1 : 40$



critical design situation are in the field N 1
 in cross-section with $x = 2.50\text{m}$ combination N 1
 $M = 262.5\text{kNm}$ $Q = 0.0\text{kN}$ $M_{\omega} = 0.0\text{kNm}^2$ $B = 6.5\text{kNm}^2$
 $M_f = 18.8\text{kNm}$ $N_f = 637.3\text{kN}$ $\tau_f = 0.00\text{MPa}$ $\rho = 0.00$
 Condition (6.32) for top flange $M_f/M_{fp1, Rd} + (N_f/N_{f, Rd})^2 = 1.16$ **COND. NOT COMPLETED!**

Utilization factor by bending moment shear force & torsion moment [%]
 $M = 1 : 40$



Stability of beam critical combination N 1 max moment $M = 262\text{kNm}$
 $M_{cr} = 287.9\text{kNm}$ $\lambda_{LT} = 1.12$ $\chi_{LT} = 0.53$
 condition (6.54) $M/(\chi_{LT} * W * f_y / \gamma_{M1}) = 1.39$ **COND. NOT COMPLETED!**



Обозн.проект. **Тест всех модулей**

Стр.

РФ, Москва

Позиция

t322

Дата **11.03.2021**

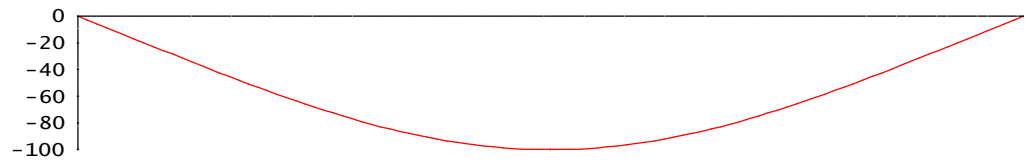
Комплекс СТАТИКА 2021.010

Проект

СТАТИКА_2021

Bucling form
M = 1 : 40

[conventional units]



Расчет выполнен модулем t322 программы СТАТИКА 2021 © ООО Техсофт