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STATIČNA PRESOJA
NOSILNE KONSTRUKCIJE

INVESTITOR:	**OBČINA ORMOŽ** **Ptujska cesta 6** **SI – 2270 ORMOŽ**
OBJEKT:	**STAVBA ŠT. 332 599**
ŠTEVILKA PROJEKTA:	**D-19/2024-GK**
KRAJ IN DATUM IZDELAVE PROJEKTA:	**ČRENŠOVCI, avgust 2024**



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1 OBRAZCI NAČRTA

1.1 NASLOVNA STRAN NAČRTA – PRILOGA 1C

1.2 KAZALO VSEBINE NAČRTA

1.3 IZJAVA PROJEKTANTA NAČRTA IN POOBLAČENEGA STROKOVNJAKA - PRILOGA 2C

2 TEHNIČNO POROČILO

3 STATIČNA PRESOJA

4 ZAKLJUČNE OPOMBE

SPLOŠNE OPOMBE

Splošna navodila in opozorila glede uporabe načrta:

- Izdelavo ponudb za izvedbo in izvedbo projekta je potrebno izdelati skladno z načrtom. Načrt je potrebno upoštevati v celoti (risbe, opisi in popisi). V primeru tiskarskih napak, morebitnih neskladij v projektu ali tehničnih pomanjkljivosti izvedbenih detajlov, risb, opisov ali popisov je ponudnik ali izvajalec dolžan na to opozoriti projektanta. Predloge potrdita projektant in investitor.
- V sklop izvajalčeve ponudbe sodijo vsi delavniški načrti, ki jih pred izvedbo glede tehnične pravilnosti, zahtevane kakovosti in videza potrdi projektant.
- Kjer ni opredeljenega izvedbenega industrijskega detajla ali izdelka, ga mora izvajalec pred izvedbo predstaviti, izbor pa potrditi projektant in investitor.
- Vzorce vseh finalnih materialov je ponudnik dolžan predložiti projektantu v potrditev. Kjer so možne alternative v izbiri materiala (finalne obloge površin, njihove obdelave, vidni in nevidni pritrdilni materiali, podkonstrukcije, vzorci potiskov, okovje, obdelave stavbnega pohištva in podobno), je pred izvedbo obvezno predložiti vzorce, ki jih potrdita projektant in investitor.
- Vsi vgrajeni materiali so lahko tudi drugih blagovnih znamk in proizvajalcev vendar morajo biti po kvaliteti in karakteristikah enaki ali boljši! Pred vgradnjo tesnilnih, izravnalnih in lepilnih mas se obvezno posvetovati s proizvajalci!
- Pred izdelavo ponudbe je priporočljiv ogled na terenu! Vse mere je potrebno preveriti na terenu in samem objektu!
- Obračun izvršenih del določenih postavk na osnovi dejansko opravljenih količin in porabljenih ur izvedbe!
- Za vsa odstopanja od projekta in s projektom predvidenih rešitev si mora investitor pridobiti ustrezno soglasje in projektno rešitev odgovornega projektanta, kakor tudi vso ostalo potrebno dokumentacijo in dovoljenja.

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2 TEHNIČNO POROČILO

Splošno

Po naročilu investitorja smo izdelali projekt energetske sanacije večstanovanjske stavbe na naslovu Žigrova ulica 6a, 2270 Ormož (št. stavbe 332 599). Stavba je starejše gradnje (zgrajen leta 1947) in zaradi tega tudi energetsko potratna.

V sklopu projekta energetske sanacije stavbe se je izvedla tudi statična presoja nosilne konstrukcije objekta.

Obstoječe stanje

Objekt je masivne gradnje, grajen kot visokopritličen (K+P+2). Objekt je temeljen na pasovnih temeljih in talni plošči. Vertikalni nosilni elementi so opečne stene debeline 60 cm, ki potekajo od pasovnih temeljev do vrh, kjer nalega nosilna strešna konstrukcija. Horizontalni nosilni elementi so armirano betonska plošča nad kletjo in plošča na pritličjem ter plošča nad 1. nadstropjem, ki je lesene izvedbe, t.i. čakatur. Nosilna strešna konstrukcija oz. ostrešje je sestavljeno iz lesenih elementov, ki so vpeti v opečne stene. Stene so z notranje strani ometane z apneno malto in na zunanji strani zaključene z zaključnim fasadnim slojem – cementno malto. Streha je sestavljena dvokapnica z linijskimi frčadami, z naklonom strešin 45° in krita z opečno kritino.

Obstoječe stanje je prikazano na spodnjih slikah.

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Navedene podrobnosti konstrukcijskih lastnosti objekta so ugotovitvene narave, torej zgolj na podlagi vizualnega pregleda, ter dosedanje prakse. Projektna dokumentacija za pridobivanje gradbenega dovoljenja (PGD), projektna dokumentacija za izvedbo gradnje (PZI) oz. projektna dokumentacija izvedenih del (PID) nam v fazi izdelave statične presoje niso bile na razpolago.

Namen gradnje

Investitor želi s posegom energetske sanacije objekta izboljšati energetsko vrednost objekta.

Predvideno stanje

Potrebno je izvesti naslednje investicijske ukrepe:

A) Ukrepi na ovoju stavbe:
- toplotno zaščito stropa proti podstrešju,
- toplotno zaščito fasade,
- toplotno zaščito stropa nad kletjo,
- menjavo stavbnega pohištva.

B) Ukrepi za povečanje izrabe obnovljivih virov:
- vgradnja fotovoltaičnih celic.

Posledično se bodo izvajala naslednja gradbena in obrtniška dela:

- menjava dotrajanih oken na zunanjih stenah,
- menjava dotrajanih vhodnih in zunanjih vrat na zunanjih stenah,
- izvedba fasade z izolacijo in z zaključnim barvanjem fasade(barvni vzorci fasade se izvedejo po navodilih ZVKDS),
- izvedba toplotne izolacije stropa nad kletjo,
- izvedba toplotne izolacije podstrešja, ki predstavlja strop notranjim prostorom,
- odprava transmisijskih toplotnih mostov.

Izvajala se bodo naslednja elektro in strojna dela:

- vgradnja fotovoltaičnih celic.

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3 STATIČNA PRESOJA

Namen

Zgoraj navedeni predvideni ukrepi bistveno ne vplivajo na nosilno konstrukcijo objekta. Vendar postavitev modulov sončnih elektrarn na streho objekta predstavlja dodatno obremenitev na nosilno konstrukcijo. Obremenitev se preko strešne konstrukcije prenese na vertikalne nosilne elemente (zidane stene), nato pa preko vertikalnih nosilnih elementov v temeljenje objekta. Zato je namen te statične presoje preveritev ali nameravana namestitev modulov sončne elektrarne vpliva na mehansko odpornost in stabilnost nosilne konstrukcije.

Zaradi starosti objekta, je potrebno preveriti ali v primeru potresa, objekt zagotavlja mehansko odpornost in stabilnost po trenutno veljavnih slovenskih standardih EVROCOD. Potresna sila se preko temeljenja prenese na stene objekta in tako povzroči horizontalne pomike celotne konstrukcije. Zato je namen te statične presoje tudi preveritev objekta, kot celote, na potresno silo.

Obtežba na strešno konstrukcijo

Spodaj navedene obtežbe so obtežbe, ki trenutno vplivajo na streho objekta. Stalna obtežba je pridobljena na podlagi strešne sestave. Koristna obtežba, obtežba snega in vetra so določeni s standardom EVROCOD SIST EN 1991-1-1.

- Stalna obtežba $g = 2{,}50\ kN/m^2$
- Koristna obtežba $q = 0{,}40\ kN/m^2$
- Obtežba snega $q_s = 1{,}40\ kN/m^2$
- Obtežba vetra $q_v = 0{,}70\ kN/m^2$

Z namestitvijo modulov sončne elektrarne se stalna obtežba, ki vpliva na objekt, poveča za **0,30 kN/m²**. Novonastala stalna obtežba bo po predvidenem posegu znašala **2,80 kN/m².**

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Preveritev strešne konstrukcije

Ostrešje objekta je sestavljeno iz lesenih elementov, katerim pri pregledu nismo mogli preveriti dimenzije in trenutno stanje. Sklepa se, glede na starost objekta, da je ostrešje dotrajano in potrebno adaptacije oz. sanacije v celoti. Z izvedbo ukrepa namestitve sončne elektrarne, se poveča obremenitev na strešno konstrukcijo, ki pa lahko pripelje do porušitve mehanske odpornosti in stabilnosti trenutnega ostrešja objekta.

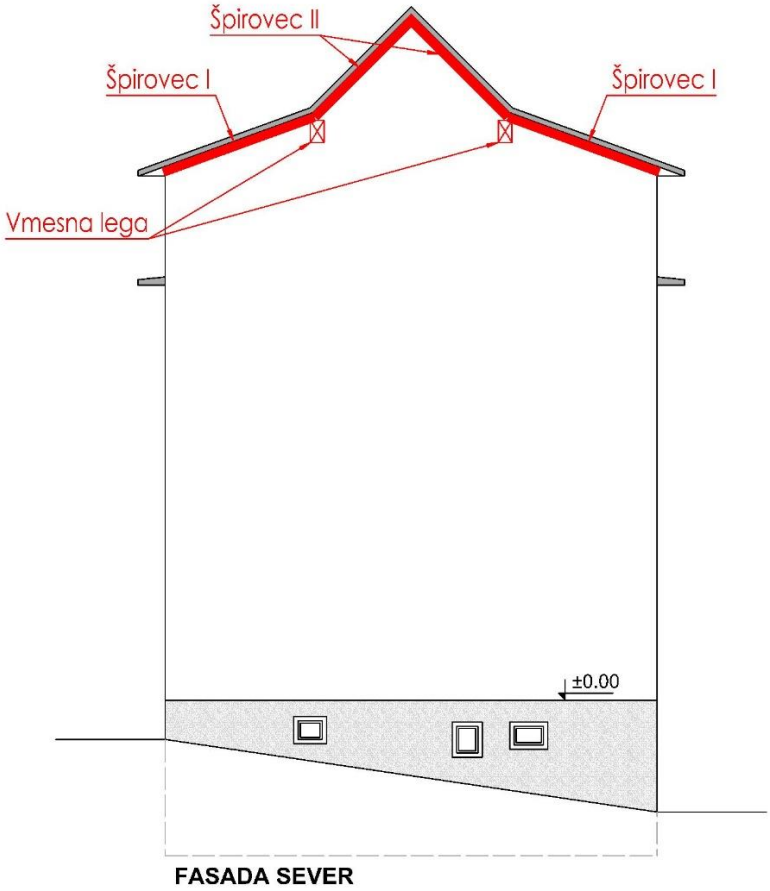
Posledično se je izvedel statični preračun lesenih elementov ostrešja po trenutnih Slovenskih standardih EVROCOD. S statičnim preračunom smo, na podlagi razpona med podporami in obremenitve, določili dimenzije prečnega prereza lesenih elementov.

Glede na obliko strehe objekta je ostrešje sestavljeno iz:

- špirovcev I,
- špirovcev II in
- dveh vmesnih leg.

Zgoraj navedeni elementi so prikazani na spodnji sliki.

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FASADA SEVER

Nosilnost lesenih elementov ostrešja se dokaže s pomočjo izkoriščenosti elementa. Torej na podlagi prečnega prereza elementa, dolžine elementa, razdalje med podporami nosilnega konstrukcijskega elementa in obremenitve, se izračuna izkoriščenost elementa, ki je indikator nosilnosti posameznega elementa.

V prilogah (priloge od 1.1 do 1.3 so del tega dokumenta) so statični izpisi za lesene elemente strešne konstrukcije. Za vsak element je preračunana statika za stanje po predvidenem posegu, torej po namestitvi modulov sončne elektrarne na streho objekta.

V izpisih je moč razbrati katere dimenzije lesenih elementov je potrebno uporabiti pri sanaciji ostrešja. Dimenzije so navedene spodaj.

- Špirovci I morajo biti dimenzij **12/18 cm**, dolžina **3,00 m** in razporejeni v rastru **e = 1,00 m**,
- špirovci II morajo biti dimenzij **8/14 cm**, dolžina **3,00 m** in razporejeni v rastru **e = 1,00 m** in
- vmesni legi morata biti dimenzij **20/26 cm** in podpreti s stebri v rastru **e = 3,30 m**.

Potresna obtežba

Potresno oz. dinamično obremenitev na objekt, program izračuna sam na podlagi:

- pravil, ki jih določa Slovenski standard EVROCOD SIST EN 1998-1,
- geometrije ter gabaritov objekta in
- parametrov, ki jih narekuje EVROCOD SIST EN 1998-1 na podlagi lokacije, kje stoji objekt.

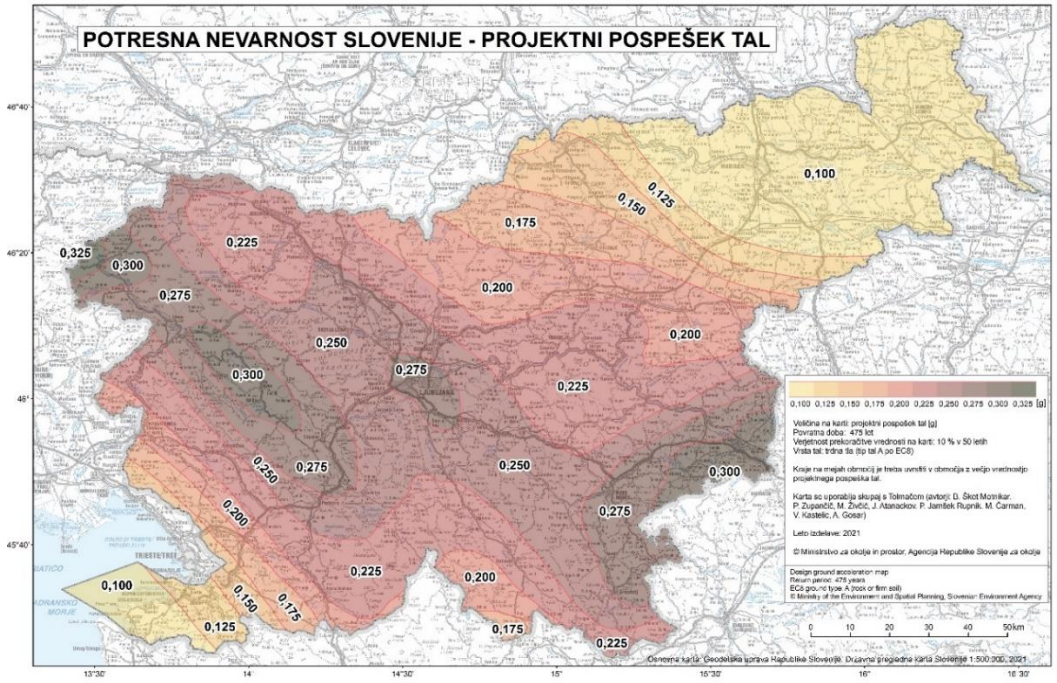
Objekt stoji v naselju Ormož, zato so parametri za določitev potresne sile sledeči:

- projektni pospešek tal a_g = 0,10,
- factor obnašanja q = 1,50,
- tip tal D in
- spekter tipa 1

Potresna obremenitev na objekt se določi za dve pravokotni smeri, in sicer potresna obremenitev v smeri X in v smeri Y.

Karta projektnega pospeška tal za Slovenijo je prikazana na spodnji sliki.

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Za določitev potresne obremenitve in preveritev objekta na potresno silo smo uporabili programski paket SCIA.

Preveritev na potresno obtežbo

Nosilnost in stabilnost objekta, kot celote, na potresno obtežbo, se, v dani situaciji, preveri na podlagi maksimalnih horizontalnih pomikov v času delovanja potresa.

V prilogi (priloga 2 je del tega dokumenta) je statični izpis iz programa, ki prikazuje horizontalne pomike v smeri X in pomike v smeri Y, v času delovanja potresne obremenitve.

V izpisu je moč razbrati, da se največji pomiki, v času potresa, pojavijo v najvišjih točkah konstrukcije (na koti +7.00m). Maksimalni pomiki v smeri X znašajo **15,00 mm,** maksimalni pomiki v smeri Y znašajo **10,00 mm.**

Iz navedenega gre razbrati, da masivni opečni zidovi zagotavljajo majhne horizontalne pomike, v času delovanja potresne sile in posledično zagotavljajo mehansko odpornost in stabilnost po trenutno veljavnih standardih EVROCOD.

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4 ZAKLJUČEK

Ob pregledu stavbe je bilo ugotovljeno, da so nosilne opečne stene nepoškodovane in še vedno služijo svojemu namenu. Stanje medetažnih nosilnih konstrukcij, pasovnih temeljev in lesenega ostrešja, zaradi nedostopnosti, nismo mogli preverit.

S predvideno namestitvijo modulov sončne elektrarne (ter pripadajočo infrastrukturo in inštalacijami) na streho objekta, ki je predmet te statične presoje, se bo povečala stalna obtežba na nosilno konstrukcijo objekta. Ker dimenzije in stanje elementov lesenega ostrešja nismo mogli preverit in sklepamo, da je zaradi starosti ostrešje dotrajalo, predlagamo sledeče:

- adaptacijo obstoječega ostrešja in sicer ojačitev obstoječih prerezov do dimenzij, ki so navedeni v prilogah 1.1-1.3 ali
- sanacijo celotnega ostrešja v obliki zamenjave obstoječega ostrešja, pri tem pa se uporabijo prerezi navedeni v prilogah 1.1-1.3.

Z adaptacijo oz. sanacijo ostrešja bomo dosegli, da zgoraj navedeni, investicijski ukrepi ne ogrožamo mehansko odpornost in stabilnost objekta kot celote in ne ogrožamo mehansko odpornost in stabilnost nosilne strešne konstrukcije.

V fazi montaže sončnih elektrarn je bistvenega pomena, da se **ne uniči oz. poškoduje** nova strešna kritina. V nasprotnem primeru pride do pronicanja vode v notranjost objekta, kar povzroči škodo na konstrukciji, inštalacijah in inventarju.
V fazi montaže modulov sončne elektrarne je prepovedano kopičenje vgradnega materiala na majhnih površinah. Teža nakopičenega materiala, ki je na strehi, lahko poškoduje strešno kritino in omogoči pronicanje vode v notranjost objekta.

Priporočamo, da se vgradni material v fazi montaže, enakomerno razporedi po strehi oz. na streho dostavlja v fazah oz. posamično – po panelih preko dvigala oz. žerjava.

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Iz potresne analize objekta je razvidno, da so maksimalni pomiki v času delovanja potresa majhni. **Zato je objekt kot celota mehansko odporen in stabilen.**

Poročilo izdelal:
Zdenko Bilić,
mag. inž. grad., IZS PI G-4825

Direktor:
Aleksander PLEJ,
dipl. inž. grad.

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SEZNAM PRILOG

- PRILOGA 1.1
- PRILOGA 1.2
- PRILOGA 1.3
- PRILOGA 2

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PRILOGA 1.1

Item: PRILOGA 1.1 ... Spirovec I

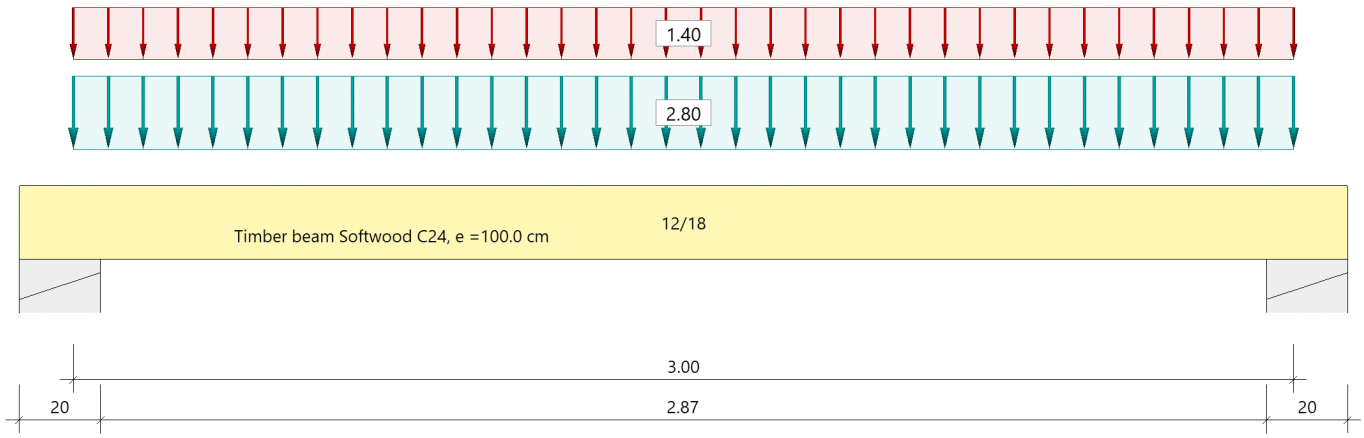
Continuous Beam (x64) DLT+ 02/24B (FRILO R-2024-2/P07)

Basic parameters

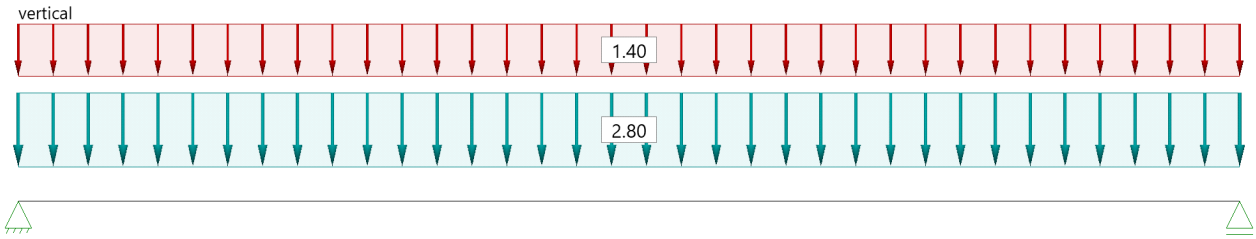
Timber beam Softwood C24 DIN EN 1995-1-1/NA:2013-08

System

System image



Statikansicht



Material

Softwood C24, acc.to EN 338:2016

$f_{m,k}$ $f_{v,k}$ [N/mm²]	$f_{t,0,k}$ $f_{c,0,k}$ [N/mm²]	$f_{t,90,k}$ $f_{c,90,k}$ [N/mm²]	$E_{0,mean}$ $E_{0,05}$ [N/mm²]	$E_{90,mean}$ $E_{90,05}$ [N/mm²]	G_{mean} G_{05} [N/mm²]	ρ_k ρ_m [kg/m³]
24.00	14.50	0.40	11000	370	690	350
4.00	21.00	2.50	7400	247	460	420

$f_{m,k}$	:	characteristic value of bending strength
$f_{t,0,k}$	:	characteristic value of tensile strength parallel to grain
$f_{t,90,k}$	:	characteristic value of tensile strength perpendicular to the grain
$E_{0,mean}$	:	Average value of modulus of elasticity parallel to the fiber
$E_{90,mean}$	:	Average value of the modulus of elasticity perpendicular to the grain
G_{mean}	:	Average value of the shear modulus
ρ_k	:	Characteristic value of gross density
$f_{v,k}$	:	characteristic value of shear strength
$f_{c,0,k}$	:	characteristic value of compressive strength parallel to grain
$f_{c,90,k}$	:	characteristic value of compressive strength perpendicular to the grain
$E_{0,05}$	:	5% fractile value of the modulus of elasticity parallel to grain
$E_{90,05}$	:	5% fractile value of the modulus of elasticity perpendicular to the grain
G_{05}	:	5% fractile value of the shear modulus
ρ_m	:	Average value of the density

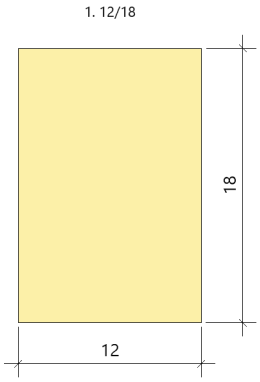
Geometry

Cross-sections

Name	I_y [cm^4]	I_z [cm^4]	W_y [cm^3]	W_z [cm^3]	A [cm^2]
12/18	5832	2592	648	432	216.0

Cross-section is constant over the entire length of the beam.

used cross sections



Support (Bearing conditions)

No	x [m]	Width [cm]	Depth [cm]	k_{c90}	uy [kN/m]	uz [kN/m]	Rotations*) Φ_x [kNm/rad]	Φ_y [kNm/rad]	Φ_z [kNm/rad]
1	0.00	20.0	12.0	1.00	-1	-1	-1	0.0	0.0
2	3.00	20.0	12.0	1.00	-1	-1	0.0	0.0	0.0

*) -1 = fixed, 0 = free, > 0 = elastically restraint

Loads

Line loads from distributed loads

Reference	No.	Type	A [m]	L1 [m]	L2 [m]	W1 [kN/m^2]	W2 [kN/m^2]	acting Span by span	GF	Sim	Alt
System	1	UDL		3.00		2.80		No	Permanent		
	2	UDL		3.00		1.40		Yes	Snow		

Reference : System-related (front edge of beam) or span load
Type : 1 - uniformly distributed load (GL), 4 - trapezoidal load (TL), 5 - triangular load (DL)
A : Distance to the load from the beginning of the span or the front edge of the beam
GF : Load effect
Sim : Combined group
Alt : Alternate group

Lastbezeichnungen

Nr	Bezeichnung
1	width 1.00 m
2	width 1.00 m

The load values are multiplied internally by the girder spacing e = 1.00 m.

Self-weight

Total weight = 27 kg taken into account with gamma = 4.20 kN/m^3.

Overview of the actions used

Actions

Description	ψ_0	ψ_1	ψ_2	$\gamma_{F,inf}$	$\gamma_{F,sup}$	KLED
Permanent loads				1.00	1.35	
Snow loads H < 1000 m	0.50	0.20	0.00		1.50	short

Consequences class CC 2 according to EN 1990 Tab. B1 -> K_{Fi} = 1.0 Tab. B3

Results

Design parameter

Design code	:	DIN EN 1995-1-1/NA:2013-08
Basis	:	EN 1995-1-1/A2:2014
Safety concept / load combinatorics	:	DIN EN 1990/NA:2010-12
Consequence class	:	CC 2
Ψ_2 = 0.5 for snow (AE)	:	not considered
Permanent loads	:	all equal γ_F ($\gamma_{G,sup}$ or $\gamma_{G,inf}$)
CLED ati wind	:	very short

Design parameter Timber

Service class	2	:	roofed, open Rel. air humidity ~ 85%	Equilibrium moisture content < 20%
Shear stresses		=	Tau with red. Q	
Initial deflection	w_{inst}	=	l/300	
Final deflection	$w_{net,fin}$	=	l/300	
	w_{fin}	=	l/200	

Summary

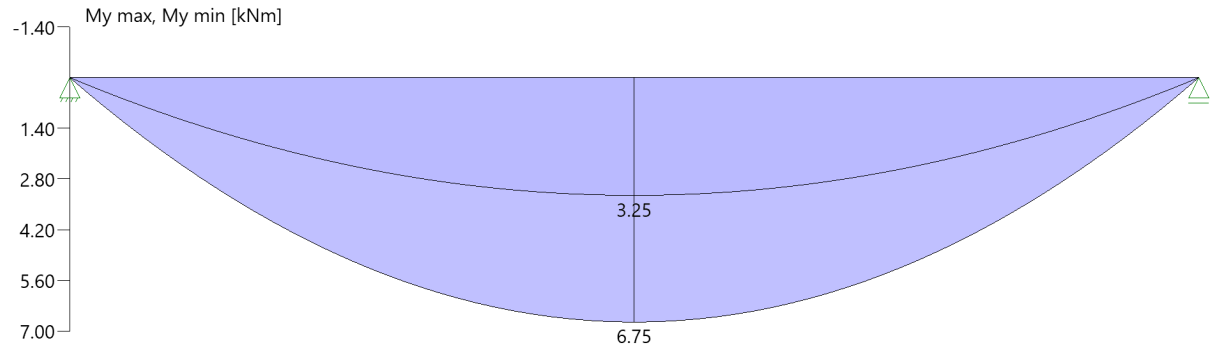
Verification	Design situation	$\eta_{Bending}$	η_{Shear}	$\eta_{c,90}$	η_{Stabi}	$\eta_{Deformation}$
Bearing capacity	persistent/transient	0.63	0.38	0.19	[1]	
Serviceability	characteristic					0.86

[1] Stability check was not carried out because the upper chord is held continuously.

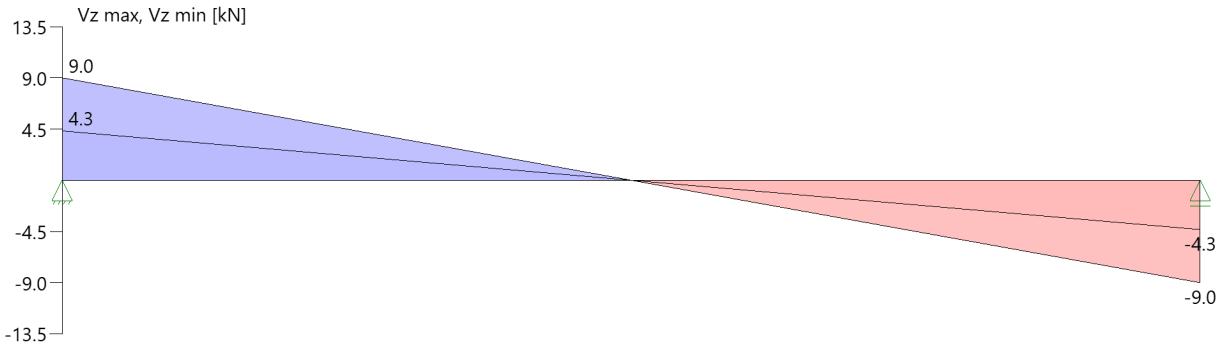
Structural safety - Load combination persistent/transient

Internal forces

Envelope of the moments



Envelope of the transverse forces



Internal forces

Span	x_{rel} [m]	x [m]	$M_{y,Ed}$ [kNm]	$V_{z,Ed}$ [kN]	LC
Span 1	0.00	0.00	0.00	9.0	2
	0.00	0.00	0.00	4.3	3
	1.50	1.50	6.75	0.0	2
	3.00	3.00	0.00	-4.3	3
	3.00	3.00	0.00	-9.0	2

Bending

Span	x [m]	$M_{y,d}$ [kNm]	σ_{myd} [N/mm²]	$k_{crit,y}$	$k_{h,My}$	k_{mod}	$f_{m,y,d}$ [N/mm²]	η	LC
Span 1	1.50	6.75	10.42	1.00	1.00	0.90	16.62	0.63	2

The coefficient kh was taken into account in the calculation of fmyd according to DIN EN 1995 3.2(3).

Shear

Column [No.]		x_{rel} [m]	x_{abs} [m]	$V_{z,d}$ [kN]	τ_d [N/mm²]	k_{mod}	$f_{v,z,d}$ [N/mm²]	η	LC
1	right	0.25	0.25	7.5	0.52	0.90	2.77	0.38	2
2	left	0.25	2.75	-7.5	-0.52	0.90	2.77	0.38	2

Der Beiwert kcr = 0.50 wurde bei der Berechnung nach DIN EN 1995-1-1 NDP 6.1.7 (2) berücksichtigt.

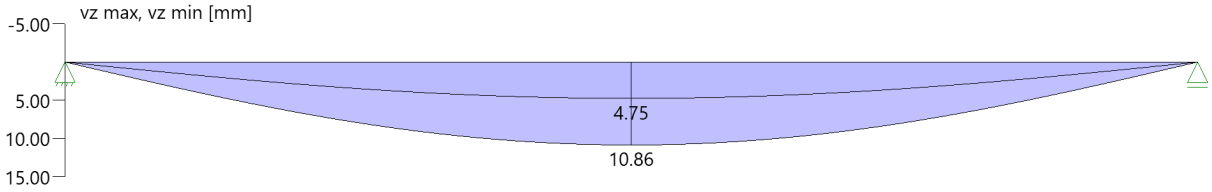
Bearing stress

Column	b eff [cm]	d eff [cm]	max F [kN]	$\sigma_{c,90,d}$ [N/mm²]	k_{c90}	k_{mod}	$f_{c,90,d}$ [N/mm²]	η	LC
1	23.0*	12.0	9.0	0.33	1.00	0.90	1.73	0.19	2
2	23.0*	12.0	9.0	0.33	1.00	0.90	1.73	0.19	2

* Contact area according to DIN EN 1995-1-1, Chapter 6.1.5 (1) P widened by 30mm per side

Deformations

Envelope of the deformations - Serviceability



Check of SLS

	l_{eff} [m]	Position [m]	Verification		w_g	w_q [mm]	w	w_{lim}	η	Lk
Span 1	3.00	1.50	inst	z	4.75	2.30	7.05	10.00	0.71	5
	3.00	1.50	net,fin	z	8.55	0.00	8.55	10.00	0.86	4
	3.00	1.50	fin	z	8.55	2.30	10.86	15.00	0.72	6

l_{eff} : effective length
Position : Location of deflection
Verification : Initial/final deformation (direction)
w_g : Deformation due to constant load
w_q : Deformation due to changing load
w : Total deformation
w_{lim} : permissible deformation
η : utilization ratio
Lk : No. of load combination

Support reactions

Support reactions pro [m] - characteristic of each action

No.	x [m]	Action	$R_{z,min}$ [kN/m]	$R_{z,max}$ [kN/m]	$M_{y,min}$ [kNm/m]	$M_{y,max}$ [kNm/m]
1	0.00	Permanent loads	4.34	4.34		
		Snow loads H < 1000 m		2.10		
2	3.00	Permanent loads	4.34	4.34		
		Snow loads H < 1000 m		2.10		

Decisive Combination

The following table shows the loads with the internal number. The subsequent The table of the decisive combinations refers to these numbers.

generated load	Span	Act	orig. Load	W1	W2	A [m]	L [m]
L 1	*	Permanent	1	2.80	2.80	0.00	3.00
L 2	1	Snow	2	1.40	1.40	0.00	3.00

gen. Load	Lc 2	Lc 3	Lc 4	Lc 5	Lc 6
L 1	1.35	1.00	1.80	1.00	1.80
L 2	**1.50**			**1.00**	**1.00**
Self-weight	1.35	1.00	1.80	1.00	1.80

The deformation coefficient kdef = 0.80 is taken into account in the factors of the combinations for serviceability.

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PRILOGA 1.2

Item: PRILOGA 1.2 ... Spirovec II

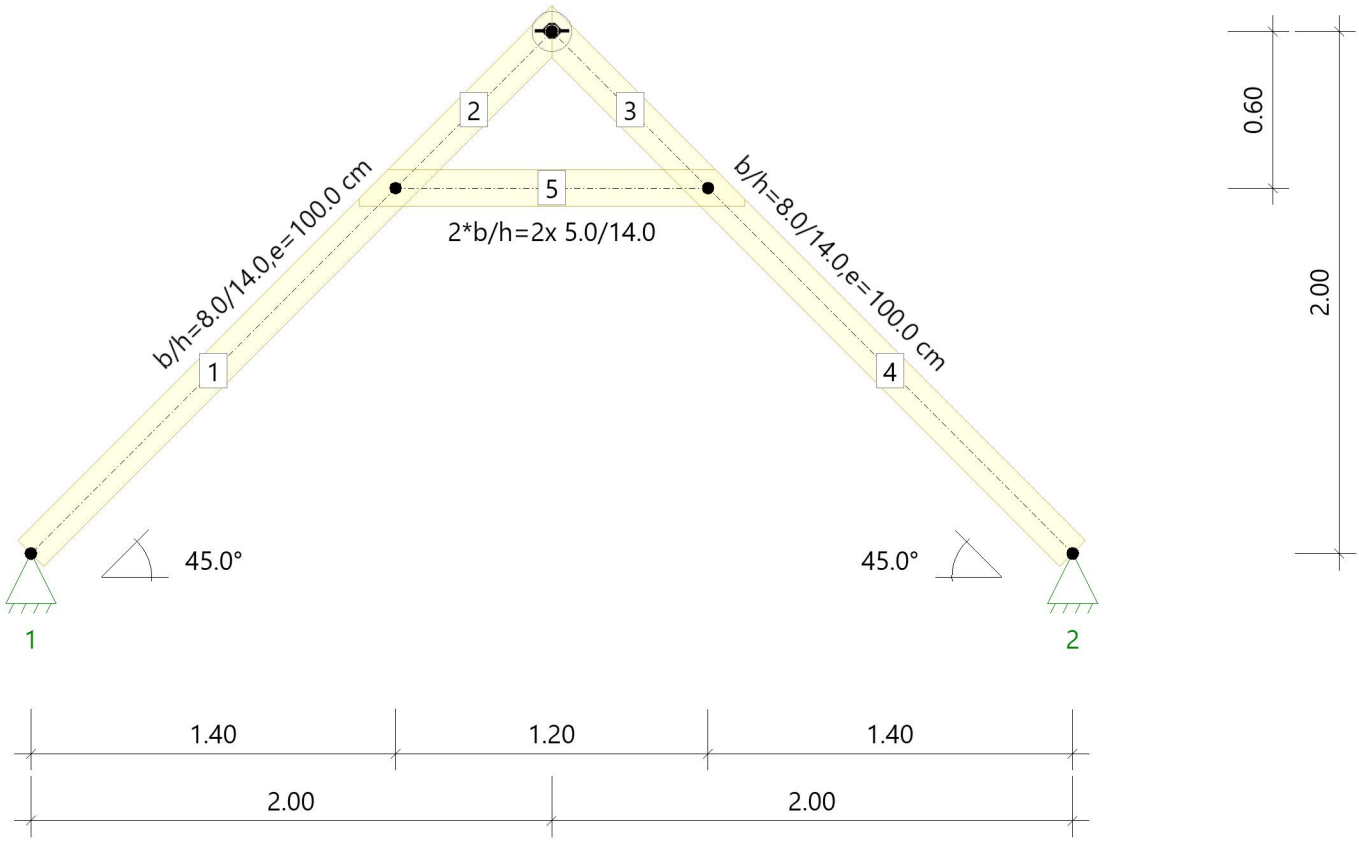
Design of Roofs (x64) Dach+ 02/24D (FRILO R-2024-2/P07)

System

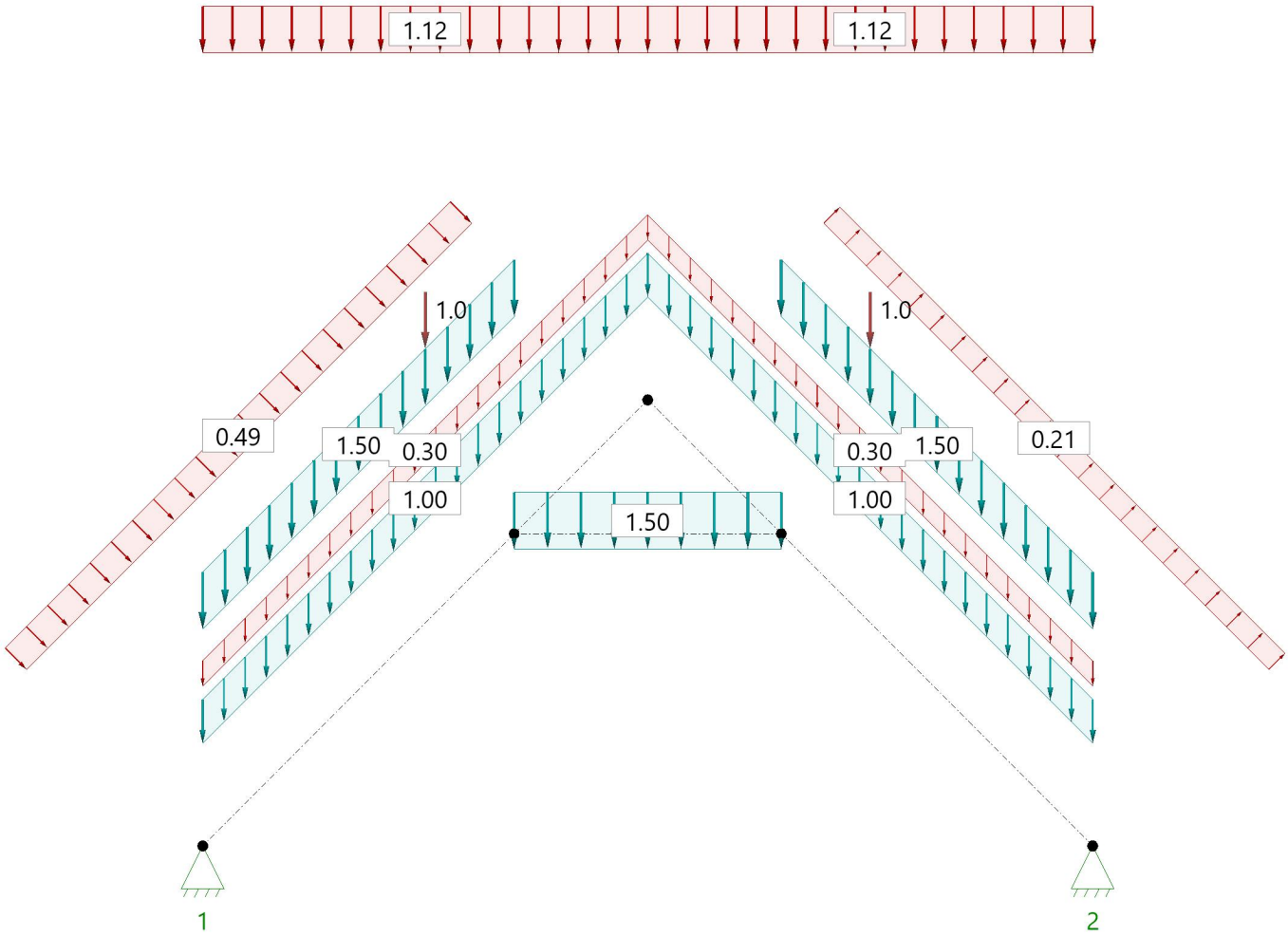
Common

Softwood C24, Service class roofed, open; AH<85%; BMC<20%, CC 2

System Graphics



Load graphics



Material

Material values Timber

Softwood C24 acc.to EN 338:2016 $E_{0,mean}$ = 11000 N/mm² ρ_k = 350 kg/m³
G_{mean} = 690 N/mm²

Material Characteristics

$f_{m,k}$ $f_{v,k}$ N/mm²	$f_{t,0,k}$ $f_{c,0,k}$ N/mm²	$f_{t,90,k}$ $f_{c,90,k}$ N/mm²	$E_{0,mean}$ $E_{0,05}$ N/mm²	$E_{90,mean}$ $E_{90,05}$ N/mm²	G_{mean} G_{05} N/mm²	ρ_k ρ_m kg/m³	γ kN/m³
24.00	14.50	0.40	11000	370	690	350	4.20
4.00	21.00	2.50	7400	247	460	420	

Geometry

Collar beam roof

Rafter Spacing e = 100.0 cm Total ridge height h = 12.80 m
Length of Roof b,Roof = 24.60 m Building length b, Wall = 24.60 m

Rafter

Span	Length BAR [m]	Length RAR [m]	Page	Slope [°]	Cross-section [cm]
1	2.00	2.83	left	45.0	8.0/14.0
1	2.00	2.83	right	45.0	8.0/14.0
with ridge					

Collar beam, dispalaceable

Span	Length [m]	Ho [m]	[1] Cross-section [cm]
1	1.20	0.60	2x 5.0/14.0

1 : Distance to the ridge

Support

No.	Member	Cx [kN/m]	Cz [kN/m]	Depth of birdsmouth joints t [cm]
1	Rafter left	Rigid	Rigid	0.0
2	Rafter right	Rigid	Rigid	0.0

Cross-section Properties

Cross-section Properties

Member	Description	A [cm²]	Iy [cm⁴]	Wy [cm³]
Rafter left	8.0/14.0	112.0	1829	261
Collar beam	2x 5.0/14.0	70.0	1143	163

Tilt-/ Buckling-Lengths

Rafter left

Buckling in plane: from eingenvalue limited to...0.90*L
Buckling out of plane: kept continuously
Tilting: kept continuously

Rafter right

Buckling in plane: from eingenvalue limited to...0.90*L
Buckling out of plane: kept continuously
Tilting: kept continuously

Collar beam

Buckling in plane: from eingenvalue limited to...0.90*L
Buckling out of plane: kept continuously
Tilting: kept continuously

Calculation Rules

Deflections are always taken into account on the cantilever.
The rod length is always used as the reference length for the total deflection verification.
Caution! If bars are connected without a support, their bar lengths are added up.
Wind loads from undergrate blast are assumed to be dependent.
Wind loads from internal wind pressure are assumed to be dependent.
Live loads on the collar beam are assumed to be dependent on the span.
Load cases with loads whose expected deformations are opposite are not included.
Combinations of load cases whose expected deformations are opposite are not used.
The stiffness should be reduced as a result of creep from permanent and quasi-permanent load components.
With wind, kmod is set as the mean value of short and very short.
Wind loads for lateral flow in Inconvenient area
Snow on the left roof surface is prevented from sliding off.
Snow on the right roof surface is prevented from sliding off.
Roof live loads of the category H are only considered as individual loads.
Roof live loads of the category H are not considered in reaction forces.

Loads

Load Pre-settings

Rafter

Roofing g1 = 1.00 kN/m² Act = 99
Construction g2 = 0.00 kN/m²
Loft conversion g3 = 0.00 kN/m²
Loft Conversion bottom gb = 1.50 kN/m²
With dead weight of members, γ = 4.20 kN/m³
Roofload Cat.H Q = 1.0 kN Act = 8
PV-system left = 0.30 kN/m²
a = 0.00 m l = 2.00 m PV-System right = 0.30 kN/m²
a = 0.00 m l = 2.00 m

Collar beam

Persistent load gk = 1.50 kN/m² Act = 99
Live load pk = 0.00 kN/m² Act = 1

Boundary conditions

Total ridge height h = 12.80 m
Length of Roof b,Roof = 24.60 m
Building length b, Wall = 24.60 m

Snow / wind loads for the calculation - User-defined value

EN 1991-1-3:2010, EN 1991-1-4:2010
Terrain elevation Altitude = 0.00 m
Ground Snow Load sk = 1.40 kN/m²
Wind pressure qp,0(h) = 0.70 kN/m²
Wind pressure qp,90(h) = 0.70 kN/m²

Auxiliary values

Wind pressure reference area A_{ref} = 10.00 m²
Wind reference length (Roof) e_0 = 24.60 m e_{90} = 4.00 m
Wind reference length (Wall) e_0 = 24.60 m e_{90} = 4.00 m
h/d = 3.200 h/b = 0.520 d/b = 0.163
for gable-side flow: h/d = 0.520 h/b = 3.200 d/b = 6.150

Classification of Actions

No.	Name	γ_{sup}	γ_{inf}	ψ_0	ψ_1	ψ_2	KLED
99	Permanent loads	1.35	1.00	1.00	1.00	1.00	permanent
8	Cat. H: roofs	1.50	0.00	0.00	0.00	0.00	short-term
9	Wind loads	1.50	0.00	0.60	0.20	0.00	short/instant
10	Snow loads H < 1000 m	1.50	0.00	0.50	0.20	0.00	short-term
29	permanent, removable (pv)	1.35	0.00	1.00	1.00	1.00	permanent

Load values

Snow load

Name	Page	μ			Load value (according to standard)	
Roof load	left	0.80	0.00	0.00	1.12	1.12 kN/m²
Non-blown portion (for blown load cases)	left	0.80	0.00	0.00	1.12	1.12 kN/m²
Blown portion (for blown load cases)	left	0.80	0.00	0.00	0.56	0.56 kN/m²
Roof load	right	0.80	0.00	0.00	1.12	1.12 kN/m²
Non-blown portion (for blown load cases)	right	0.80	0.00	0.00	1.12	1.12 kN/m²
Blown portion (for blown load cases)	right	0.80	0.00	0.00	0.56	0.56 kN/m²

Wind loads

Name	Page	cp+	cp-	Pressure [kN/m²]	Suction [kN/m²]	Pressure (Standard) [kN/m²]	Suction (Standard) [kN/m²]
F	from left	0.70	0.00	0.49	0.00	0.49	0.00
G	from left	0.70	0.00	0.49	0.00	0.49	0.00
H	from left	0.60	0.00	0.42	0.00	0.42	0.00
I	from left	0.00	-0.20	0.00	-0.14	0.00	-0.14
J	from left	0.00	-0.30	0.00	-0.21	0.00	-0.21
D	from left	0.80	0.00	0.56	0.00	0.56	0.00
E	from left	0.00	-0.61	0.00	-0.43	0.00	-0.43
I	from the right	0.00	-0.20	0.00	-0.14	0.00	-0.14
J	from the right	0.00	-0.30	0.00	-0.21	0.00	-0.21
F	from the right	0.70	0.00	0.49	0.00	0.49	0.00
G	from the right	0.70	0.00	0.49	0.00	0.49	0.00
H	from the right	0.60	0.00	0.42	0.00	0.42	0.00
D	from the right	0.80	0.00	0.56	0.00	0.56	0.00
E	from the right	0.00	-0.61	0.00	-0.43	0.00	-0.43

Load Cases

Standard Load Cases

No.	Name	Short Name	Act	AltGrp	Loads
1	Dead Load	g	99	0	5
2	Photovoltaic-SYstem	pv	29	0	2
3	Snow on rafter	s	10	110	2
4	Drifftet snow on rafter leftsides	sDl	10	110	2
5	Blown snow on rafter right	sDr	10	110	2
6	Wind from left luv(Pressure)+lee(Pressure)	(wlLuv+)+(wlLee+)	9	109	1
7	Wind from left luv(Pressure)+lee(Suction)	(wlLuv+)+(wlLee-)	9	109	2
8	Wind from left luv(Suction)+lee(Suction)	(wlLuv-)+(wlLee-)	9	109	2
9	Wind from right luv(Pressure)+lee(Pressure)	(wrLuv+)+(wrLee+)	9	109	1
10	Wind from right luv(Pressure)+lee(Suction)	(wrLuv+)+(wrLee-)	9	109	2
11	Wind from right luv(Suction)+lee(Suction)	(wrLuv-)+(wrLee-)	9	109	2
12	Manload lefttside on span 1	FmL1	8	108	1
13	Man load rightside on span 1	FmR1	8	108	1

Combinations

LC Combinations

No.	Name		Sit	KLED
1	1.35*g+1.35*pv	ULS[1]	p/t[2]	1[3]
9	1.35*g+1.35*pv+1.50*s+0.90*(wlLuv+)+(wlLee+)	ULS[1]	p/t[2]	6[4]
12	1.35*g+1.35*pv+0.75*s+1.50*(wlLuv+)+(wlLee-)	ULS[1]	p/t[2]	6[4]
13	1.35*g+1.35*pv+1.50*s+0.90*(wrLuv+)+(wrLee+)	ULS[1]	p/t[2]	6[4]
15	1.35*g+1.35*pv+1.50*s+0.90*(wrLuv+)+(wrLee-)	ULS[1]	p/t[2]	6[4]
16	1.35*g+1.35*pv+0.75*s+1.50*(wrLuv+)+(wrLee-)	ULS[1]	p/t[2]	6[4]
20	1.35*g+1.35*pv+1.50*sDl+0.90*(wrLuv+)+(wrLee+)	ULS[1]	p/t[2]	6[4]
22	1.35*g+1.35*pv+1.50*sDl+0.90*(wrLuv+)+(wrLee-)	ULS[1]	p/t[2]	6[4]
23	1.35*g+1.35*pv+0.75*sDl+1.50*(wrLuv+)+(wrLee-)	ULS[1]	p/t[2]	6[4]
25	1.35*g+1.35*pv+1.50*sDr+0.90*(wlLuv+)+(wlLee+)	ULS[1]	p/t[2]	6[4]
27	1.35*g+1.35*pv+1.50*sDr+0.90*(wlLuv+)+(wlLee-)	ULS[1]	p/t[2]	6[4]
28	1.35*g+1.35*pv+0.75*sDr+1.50*(wlLuv+)+(wlLee-)	ULS[1]	p/t[2]	6[4]
37	1.35*g+1.50*(wrLuv+)+(wrLee-)	ULS[1]	p/t[2]	6[4]
61	1.00*g+1.00*pv	SLS[5]	char[6]	1[3]
62	1.00*g+1.00*pv+1.00*(wlLuv+)+(wlLee+)	SLS[5]	char[6]	6[4]
63	1.00*g+1.00*pv+1.00*(wlLuv+)+(wlLee-)	SLS[5]	char[6]	6[4]
64	1.00*g+1.00*pv+1.00*(wrLuv+)+(wrLee+)	SLS[5]	char[6]	6[4]
65	1.00*g+1.00*pv+1.00*(wrLuv+)+(wrLee-)	SLS[5]	char[6]	6[4]
70	1.00*g+1.00*pv+0.50*s+1.00*(wlLuv+)+(wlLee-)	SLS[5]	char[6]	6[4]
74	1.00*g+1.00*pv+0.50*s+1.00*(wrLuv+)+(wrLee-)	SLS[5]	char[6]	6[4]
81	1.00*g+1.00*pv+0.50*sDl+1.00*(wrLuv+)+(wrLee-)	SLS[5]	char[6]	6[4]
86	1.00*g+1.00*pv+0.50*sDr+1.00*(wlLuv+)+(wlLee-)	SLS[5]	char[6]	6[4]

The assignment of the short case names can be found in the table of load cases.
Es wurden nicht alle Kombinationen gebildet. Siehe dazu Einstellungen unter Berechnungsregeln.

1 : ULS=Structural failure
2 : p/t=persistent/transient (Persistent/Transient Situation)
3 : Load duration class:1=permanent
4 : Load duration class:6=short/instant
5 : SLS=Serviceability
6 : char=characteristic (Characteristic Situation)

Results

Rafter left 8.0/14.0 e = 100.0 cm

ULS acc.to DIN EN 1995:2013, based on EN 1995:2014, Consequence class 2

Checks in Persistent/Transient Situation

Combi	Sit	Check	$N_{x,d}$ [kN]	$M_{y,d}$ [kNm]	$V_{z,d}$ [kN]	$\sigma_{n,d}$ [N/mm²]	$\sigma_{m,y,d}$ [N/mm²]	τ_d [N/mm²]	η	Sky [m]	Skz [m]	Sb [m]
28	p/t[1]	Stress (Span)	-10.9	1.61	-0.1	-0.97	6.16		**0.33**			
23	p/t[1]	Stress (Column)	-9.3	-1.65	-3.4	-0.83	-6.32		**0.34**			
1	p/t[1]	Stability	-12.5	-0.93	0.0	-1.12	-3.57		**0.56**	2.35	0.00	0.00
1	p/t[1]	Shear	-7.1	-0.93	-3.2			-0.42	**0.46**			

The composition of the load case combinations can be found in the table of load case combinations.

1 : p/t=persistent/transient (Persistent/Transient Situation)

SLS checks acc.to DIN EN 1995:2013, based on EN 1995:2014, Consequence class 2

Combi	Check			Beam	x [m]	$w_{G,inst}$ [mm]	$w_{G,fin}$ [mm]	$w_{Q,inst,char}$ [mm]	$w_{Q,inst,qprm}$ [mm]	$w_{Q,fin}$ [mm]	w_{tot} [mm]		w_{lim} [mm]	L/..	η
86	w_{inst}	1	local	1	0.94	1.17		0.91			2.08	<	6.60	300	**0.31**
86	w_{inst}	1	total	2	0.00	0.15		1.32			1.47	<	2.83	300	**0.52**
61	w_{net}	2	local	1	0.87	(1.17)	2.11		(0.00)	0.00	2.11	<	6.60	300	**0.32**
61	w_{net}	2	total	1	0.94	(1.24)	2.23		(0.00)	0.00	2.23	<	6.60	300	**0.34**
86	w_{fin}	3	local	1	0.94	(1.17)	2.10	(0.91)		0.91	3.01	<	9.90	200	**0.30**
86	w_{fin}	3	total	1	0.99	(1.23)	2.22	(1.57)		1.57	3.79	<	9.90	200	**0.38**

Values in () are only informative.
The rod length is always used as the reference length for the total deflection verification.
For the local deflection verification, the member length is always used as the reference length.
Member lengths of members that are connected to each other without support are added up.

1 : $w_{inst} = w_{G,inst} + w_{Q,inst,char}$
2 : $w_{net} = w_{G,fin} + w_{Q,fin,qprm} - w_c$
3 : $w_{fin} = w_{G,fin} + w_{Q,fin,char}$

Rafter right 8.0/14.0 e = 100.0 cm

ULS acc.to DIN EN 1995:2013, based on EN 1995:2014, Consequence class 2

Checks in Persistent/Transient Situation

Combi	Sit	Check	$N_{x,d}$ [kN]	$M_{y,d}$ [kNm]	$V_{z,d}$ [kN]	$\sigma_{n,d}$ [N/mm²]	$\sigma_{m,y,d}$ [N/mm²]	T_d [N/mm²]	η	Sky [m]	Skz [m]	Sb [m]
23	p/t[1]	Stress (Span)	-10.9	1.61	0.1	-0.97	6.16		**0.33**			
28	p/t[1]	Stress (Column)	-9.3	-1.65	3.4	-0.83	-6.32		**0.34**			
1	p/t[1]	Stability	-12.5	-0.93	0.0	-1.12	-3.57		**0.56**	2.35	0.00	0.00
1	p/t[1]	Shear	-7.1	-0.93	3.2			0.42	**0.46**			

The composition of the load case combinations can be found in the table of load case combinations.

1 : p/t=persistent/transient (Persistent/Transient Situation)

SLS checks acc.to DIN EN 1995:2013, based on EN 1995:2014, Consequence class 2

Combi	Check			Beam	x [m]	$w_{G,inst}$ [mm]	$w_{G,fin}$ [mm]	$w_{Q,inst,char}$ [mm]	$w_{Q,inst,qprm}$ [mm]	$w_{Q,fin}$ [mm]	w_{tot} [mm]		w_{lim} [mm]	L/..	η
81	w_{inst}	1	local	4	1.04	1.17		0.91			2.08	<	6.60	300	**0.31**
81	w_{inst}	1	total	3	0.85	0.15		1.32			1.47	<	2.83	300	**0.52**
61	w_{net}	2	local	4	1.11	(1.17)	2.11		(0.00)	0.00	2.11	<	6.60	300	**0.32**
61	w_{net}	2	total	4	1.04	(1.24)	2.23		(0.00)	0.00	2.23	<	6.60	300	**0.34**
81	w_{fin}	3	local	4	1.04	(1.17)	2.10	(0.91)		0.91	3.01	<	9.90	200	**0.30**
81	w_{fin}	3	total	4	0.99	(1.23)	2.22	(1.57)		1.57	3.79	<	9.90	200	**0.38**

Values in () are only informative.
The rod length is always used as the reference length for the total deflection verification.
For the local deflection verification, the member length is always used as the reference length.
Member lengths of members that are connected to each other without support are added up.

1 : $w_{inst} = w_{G,inst} + w_{Q,inst,char}$
2 : $w_{net} = w_{G,fin} + w_{Q,fin,qprm} - w_c$
3 : $w_{fin} = w_{G,fin} + w_{Q,fin,char}$

Collar beam 2x 5.0/14.0 e = 100.0 cm

ULS acc.to DIN EN 1995:2013, based on EN 1995:2014, Consequence class 2

Checks in Persistent/Transient Situation

Combi	Sit	Check	$N_{x,d}$ [kN]	$M_{y,d}$ [kNm]	$V_{z,d}$ [kN]	$\sigma_{n,d}$ [N/mm²]	$\sigma_{m,y,d}$ [N/mm²]	T_d [N/mm²]	η	Sky [m]	Skz [m]	Sb [m]
1	p/t[1]	Stress (Span)	-8.1	0.38	0.0	-0.58	1.16		**0.11**			
1	p/t[1]	Stress (Column)	-8.1	0.00	1.3	-0.58	0.00		**0.06**			
1	p/t[1]	Stability	-8.1	0.38	0.0	-0.58	1.16		**0.17**	1.08	0.00	0.00
1	p/t[1]	Shear	-8.1	0.00	1.3			0.14	**0.15**			

The composition of the load case combinations can be found in the table of load case combinations.

1 : p/t=persistent/transient (Persistent/Transient Situation)

SLS checks acc.to DIN EN 1995:2013, based on EN 1995:2014, Consequence class 2

Combi	Check			Beam	x [m]	$w_{G,inst}$ [mm]	$w_{G,fin}$ [mm]	$w_{Q,inst,char}$ [mm]	$w_{Q,inst,qprm}$ [mm]	$w_{Q,fin}$ [mm]	w_{tot} [mm]		w_{lim} [mm]	L/..	η
61	w_{inst}	1	local	5	0.60	0.17		0.00			0.17	<	4.00	300	**0.04**
86	w_{inst}	1	total	5	0.00	0.19		0.94			1.12	<	4.00	300	**0.28**
61	w_{net}	2	local	5	0.60	(0.17)	0.30		(0.00)	0.00	0.30	<	4.00	300	**0.08**
61	w_{net}	2	total	5	0.60	(0.36)	0.64		(0.00)	0.00	0.64	<	4.00	300	**0.16**
61	w_{fin}	3	local	5	0.60	(0.17)	0.30	(0.00)		0.00	0.30	<	6.00	200	**0.05**
86	w_{fin}	3	total	5	0.00	(0.19)	0.34	(0.94)		0.94	1.27	<	6.00	200	**0.21**

Values in () are only informative.
The rod length is always used as the reference length for the total deflection verification.
For the local deflection verification, the member length is always used as the reference length.
Member lengths of members that are connected to each other without support are added up.

1 : $w_{inst} = w_{G,inst} + w_{Q,inst,char}$
2 : $w_{net} = w_{G,fin} + w_{Q,fin,qprm} - w_c$
3 : $w_{fin} = w_{G,fin} + w_{Q,fin,char}$

Support

Support Reactions per Act

Act		Support 1 max [kN/m]	Support 1 min [kN/m]	Support 2 max [kN/m]	Support 2 min [kN/m]
99	vertical	6.87[1]	6.87[1]	6.87[1]	6.87[1]
	horizontal	4.79[1]	4.79[1]	-4.79[1]	-4.79[1]
9	vertical	0.49[2]	0.28[3]	0.49[8]	0.28[4]
	horizontal	0.82[3]	-0.58[4]	0.58[3]	-0.82[4]
10	vertical	2.24[5]	1.40[6]	2.24[5]	1.40[9]
	horizontal	1.60[5]	1.20[6]	-1.20[9]	-1.60[5]
29	vertical	0.85[7]	0.85[7]	0.85[7]	0.85[7]
	horizontal	0.61[7]	0.61[7]	-0.61[7]	-0.61[7]

all values are characteristic values
Support forces are always positive in the direction of the global and local axes.

1 : Load Cases:g
2 : Load Cases:(wlLuv+)+(wlLee+)
3 : Load Cases:(wrLuv+)+(wrLee-)
4 : Load Cases:(wlLuv+)+(wlLee-)
5 : Load Cases:s
6 : Load Cases:sDl
7 : Load Cases:pv
8 : Load Cases:(wrLuv+)+(wrLee+)
9 : Load Cases:sDr

Collar beams connection forces

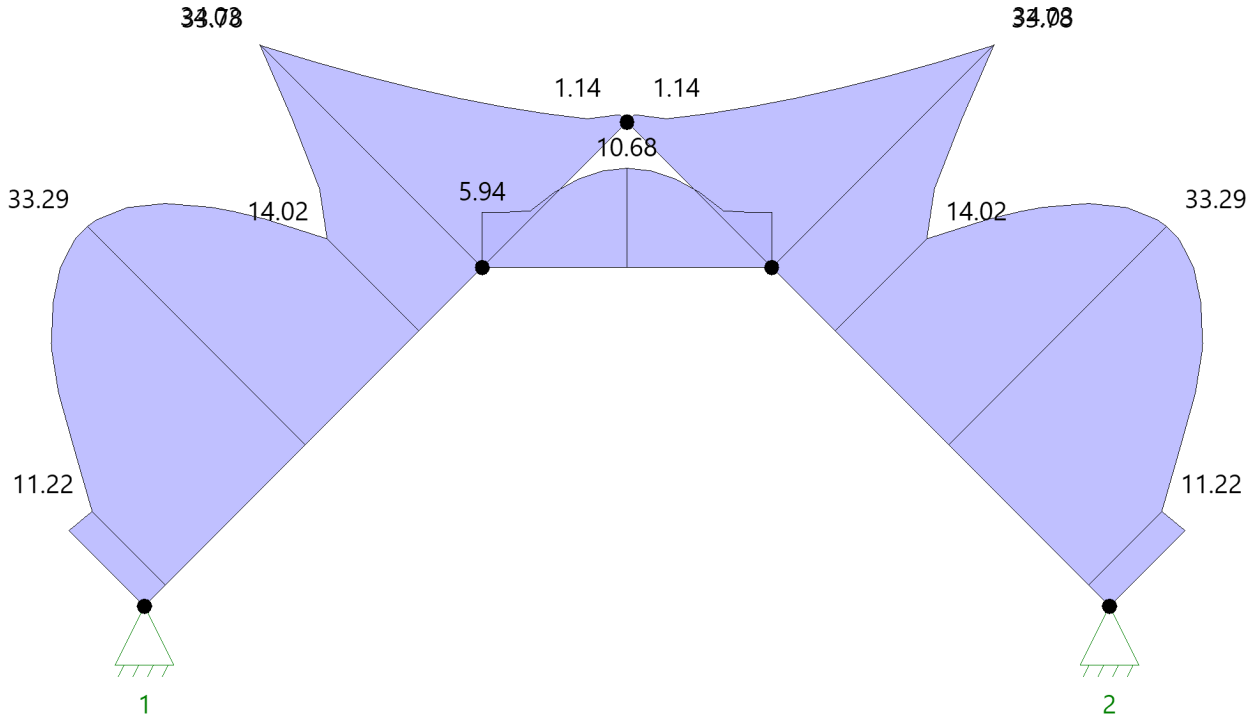
Max/min collar beam Connection forces at Collar Beam

left LcComb	N_d [kN]	V_d [kN]	right LcComb	N_d [kN]	V_d [kN]
LfK.13	-11.1	1.3	LfK.13	-11.1	-1.3

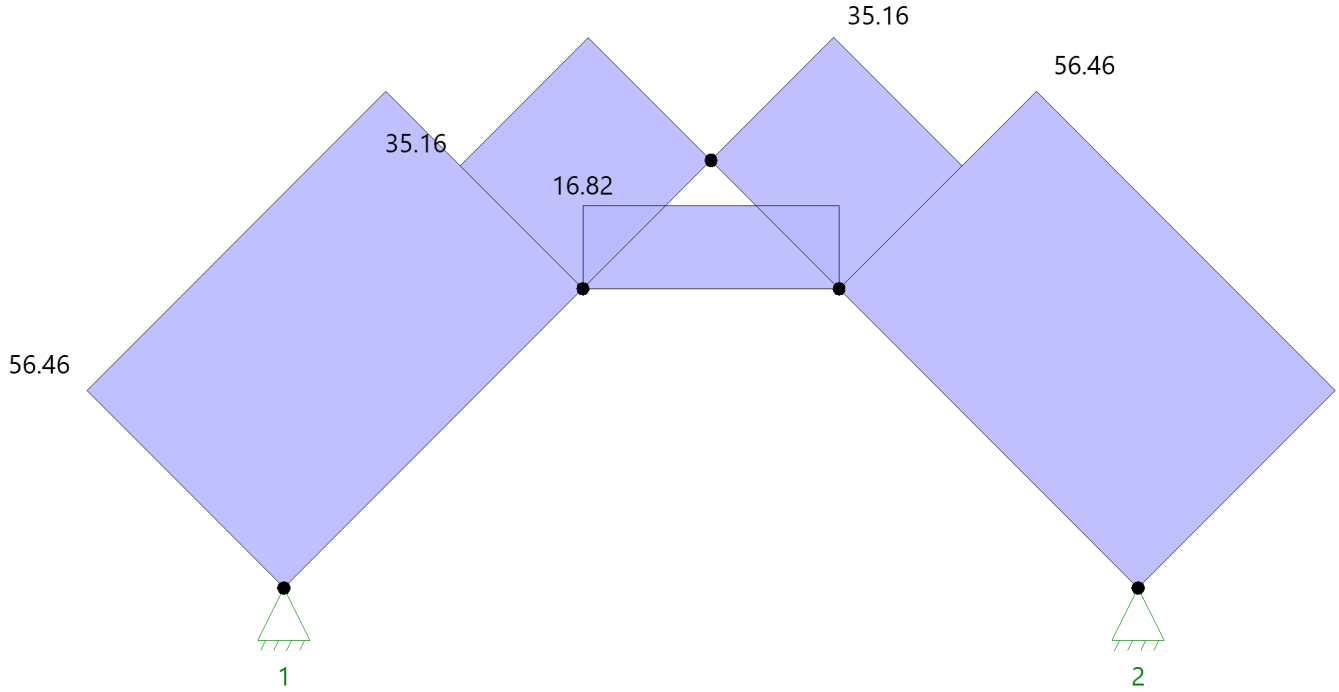
all values are design values

GraphicsLevel of Capacity

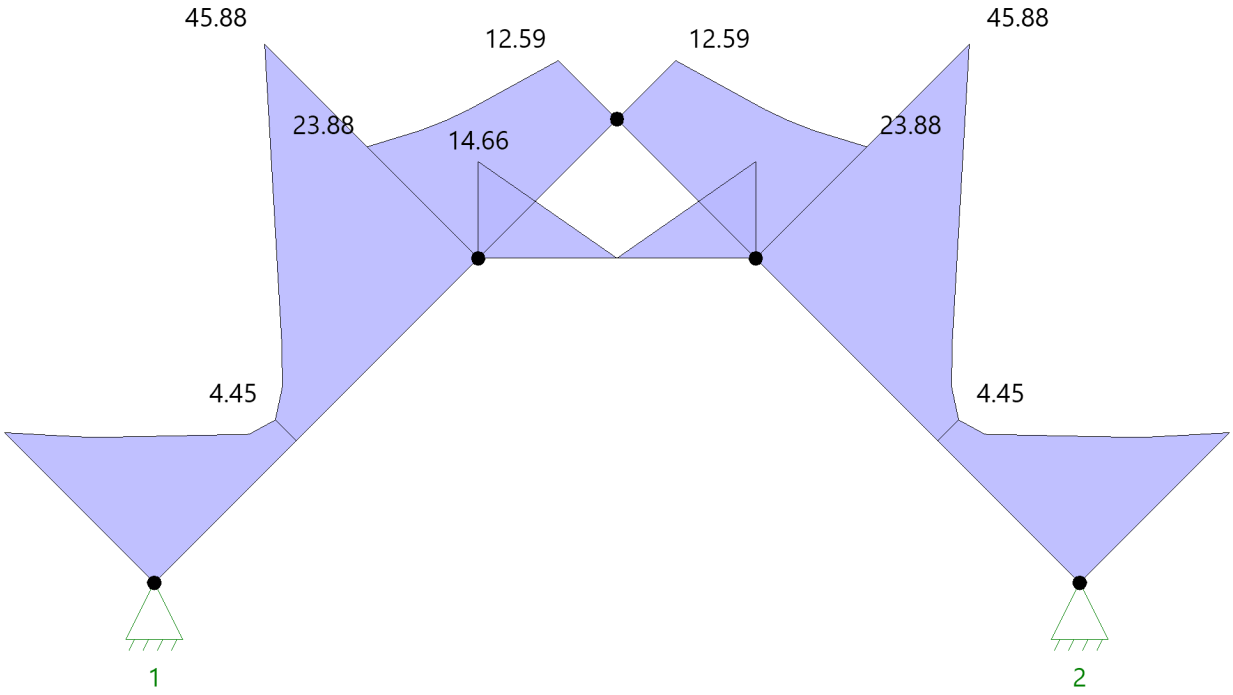
Envelope Eta Stress



Envelope Eta Stability

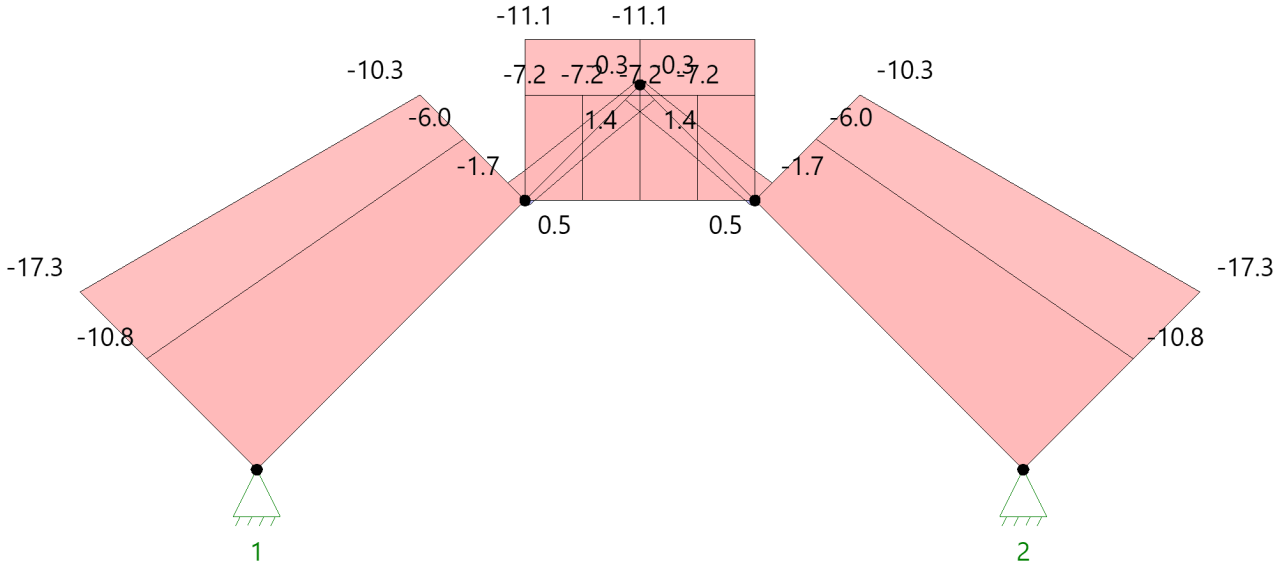


Envelope Eta Shear

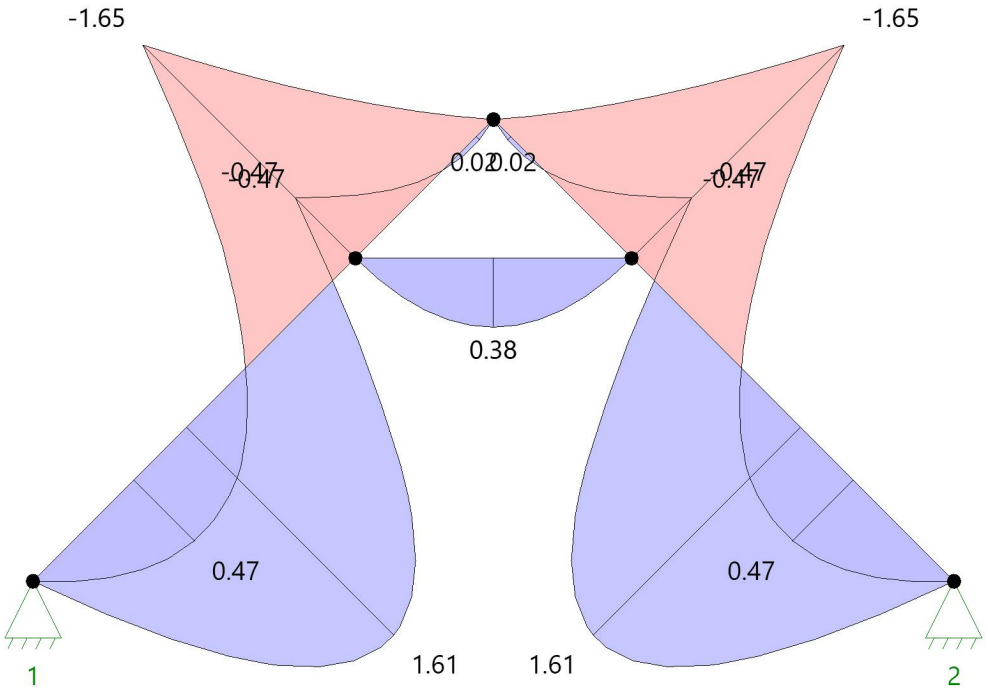


Graphics Normal Forces

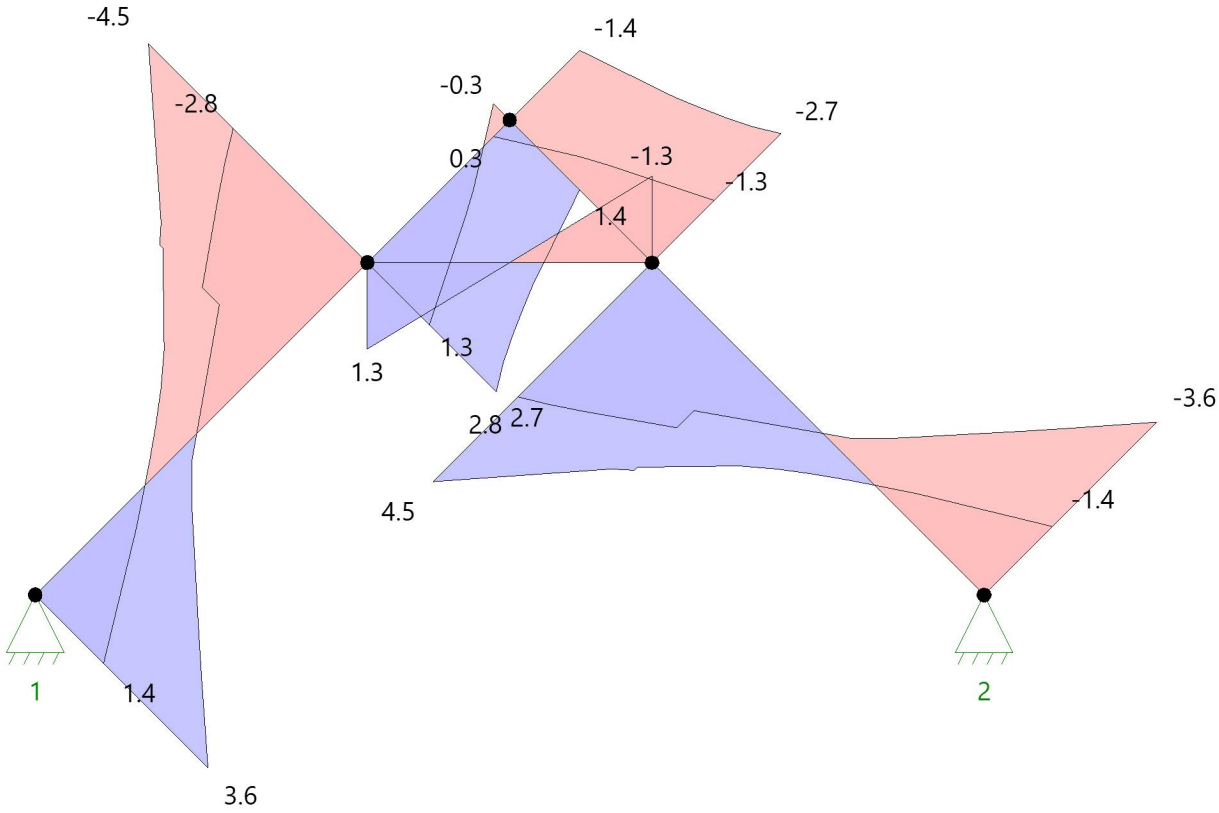
Nd [kN]



Myd [kNm]

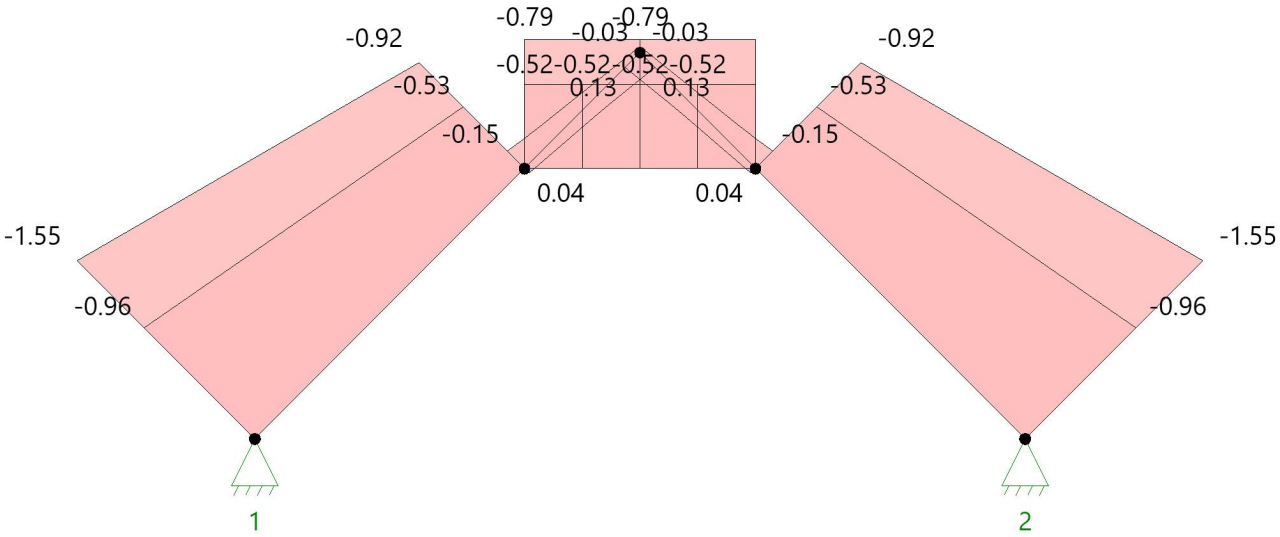


Vzd [kN]

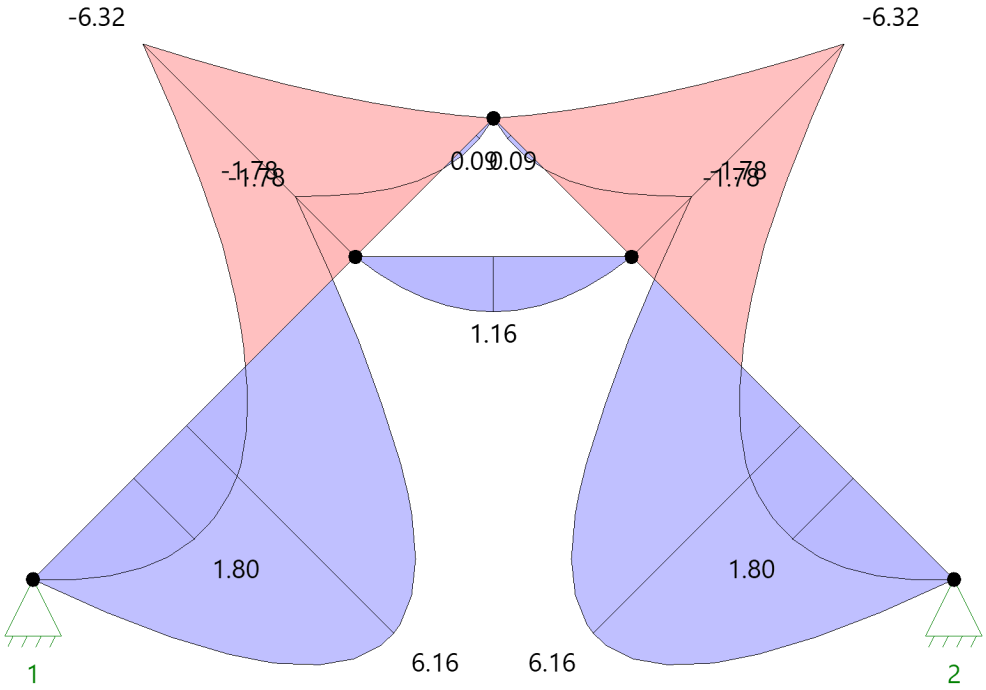


Graphic Stresses

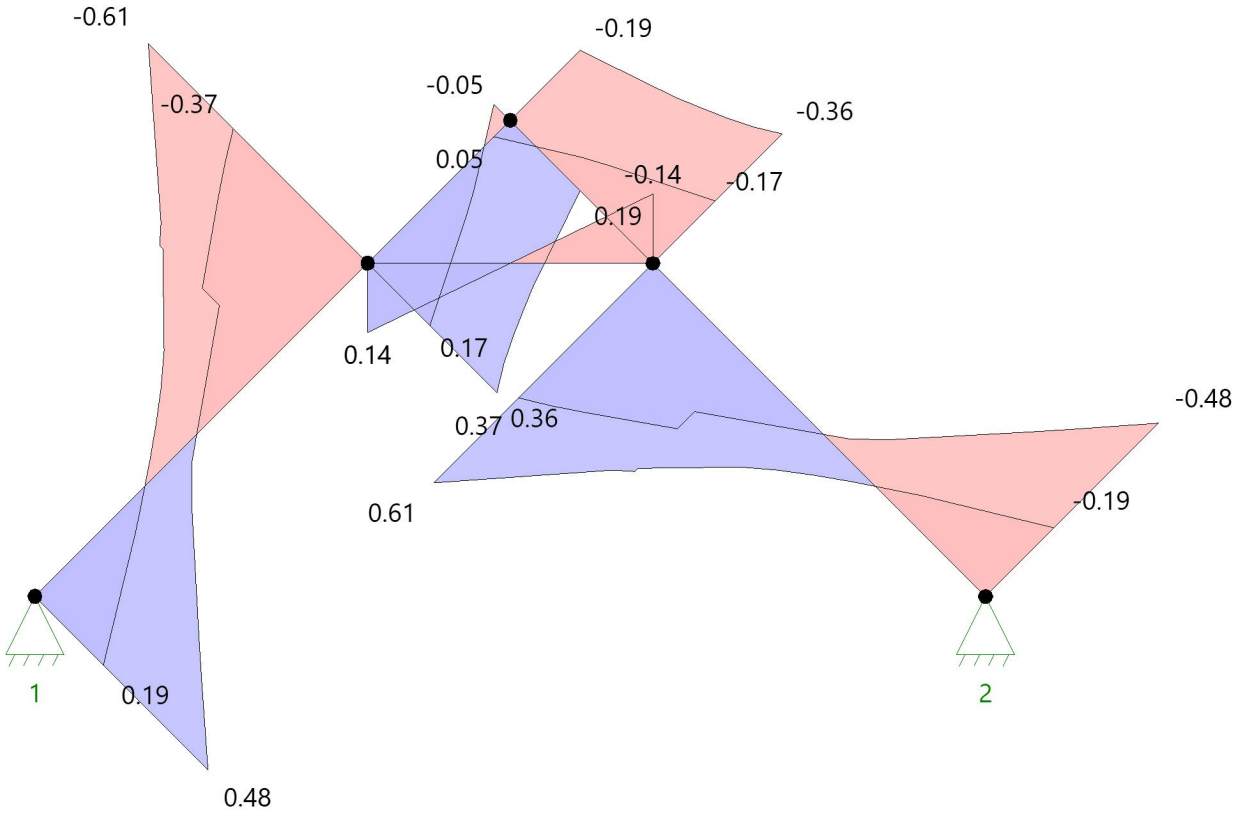
Enveloping Sigma Nd [N/mm²]



Enveloping Sigma Myd [N/mm²]

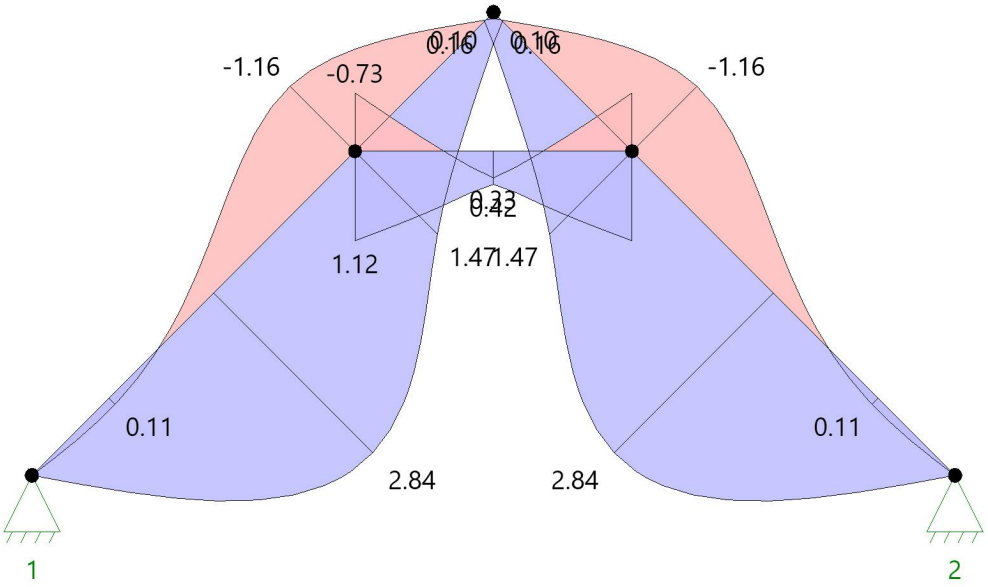


Envelope for Taud [N/mm^2]

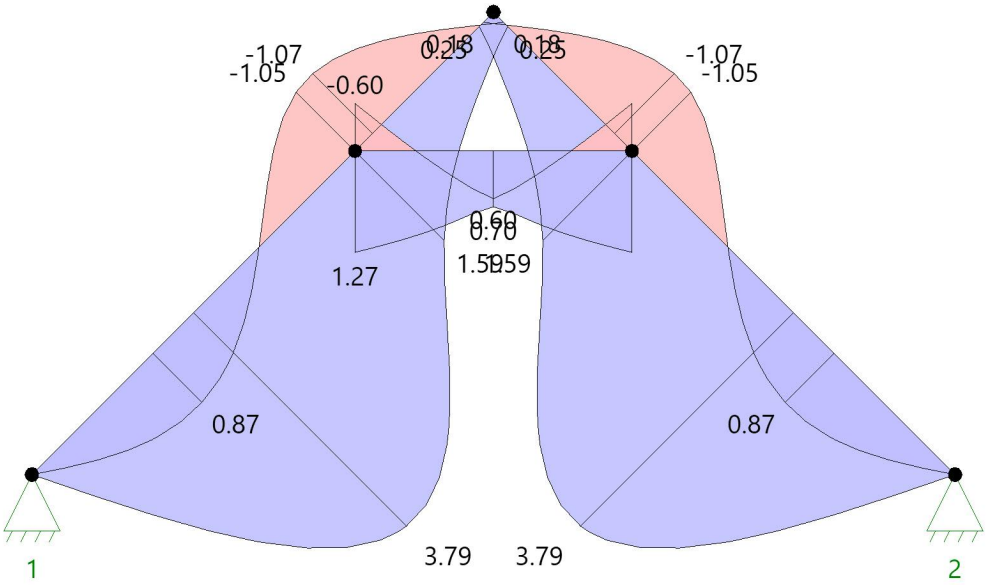


Graphics Deformation

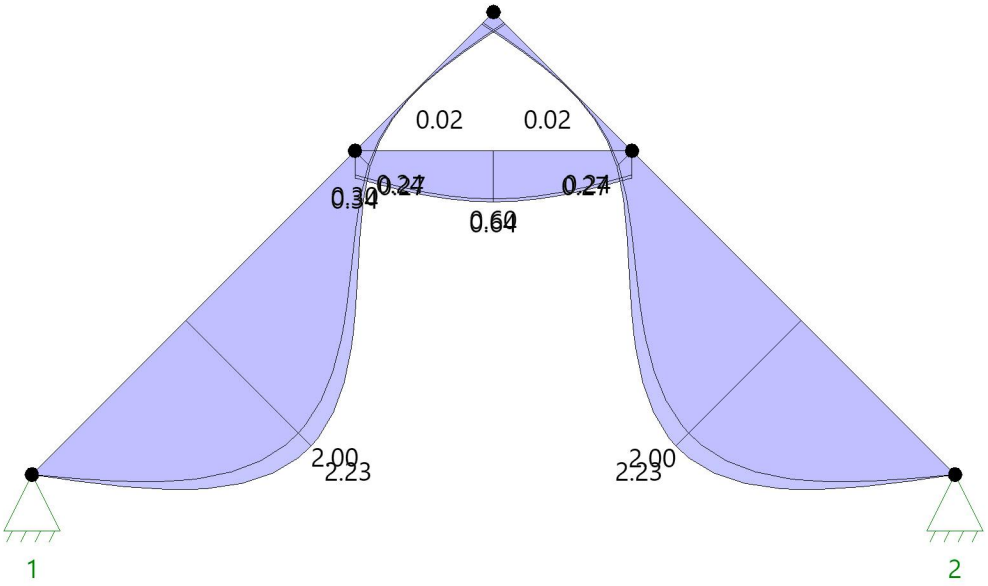
Envelope u inst [cm]



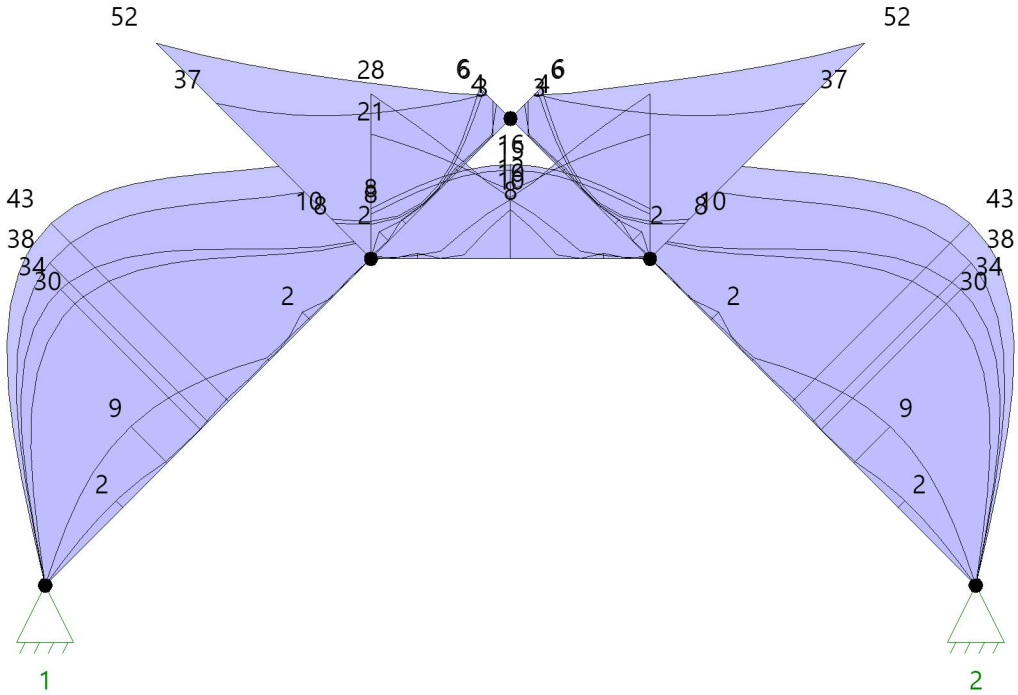
Envelope u fin [cm]



Envelope u net,fin [cm]

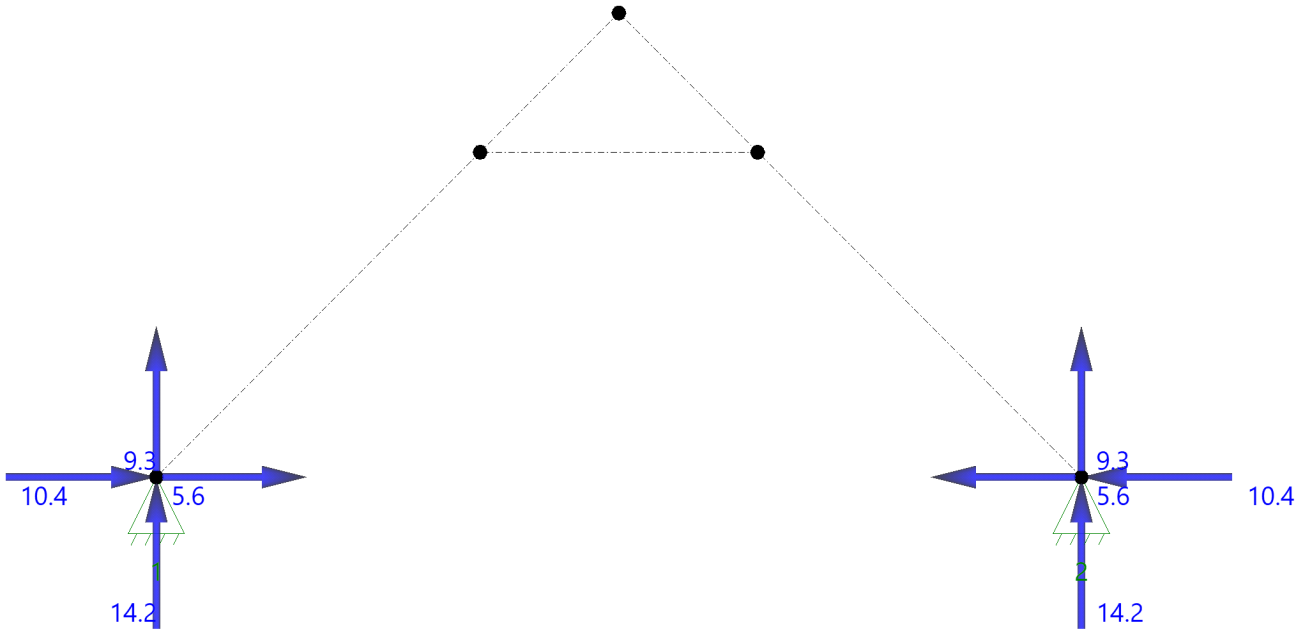


Levels of Capacity



Graphics Support Reactions

Support Reactions [kN/m]



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PRILOGA 1.3

Item: PRILOGA 1.3 ... Vmesna lega

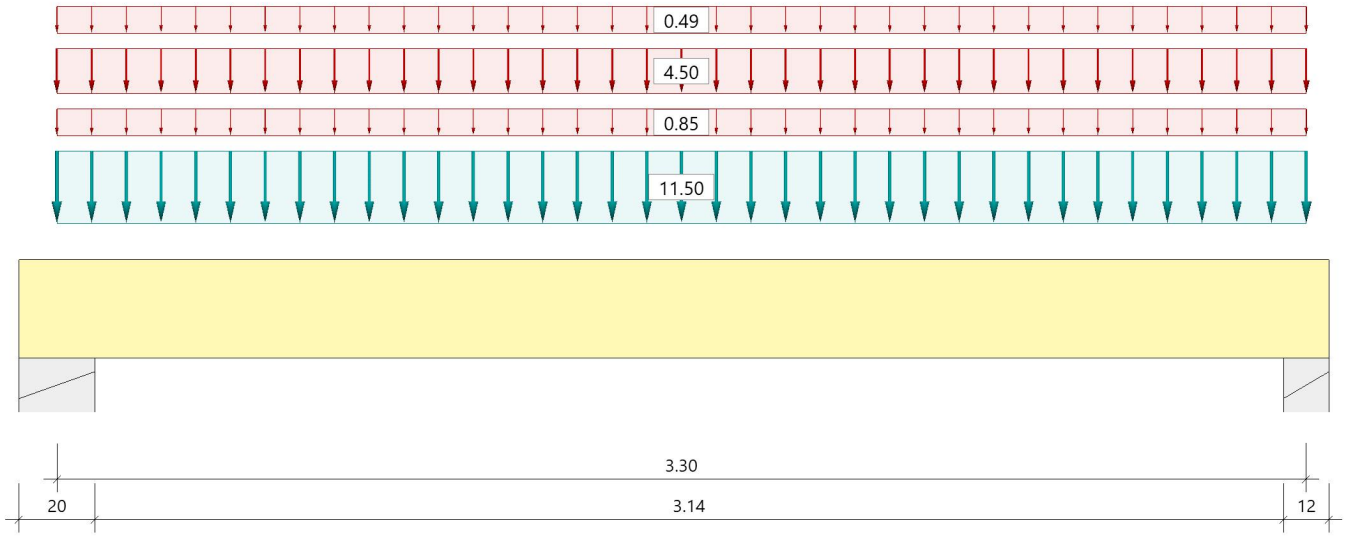
Continuous Beam Timber (x64) HTM+ 02/24B (FRILO R-2024-2/P07)

Basic parameters

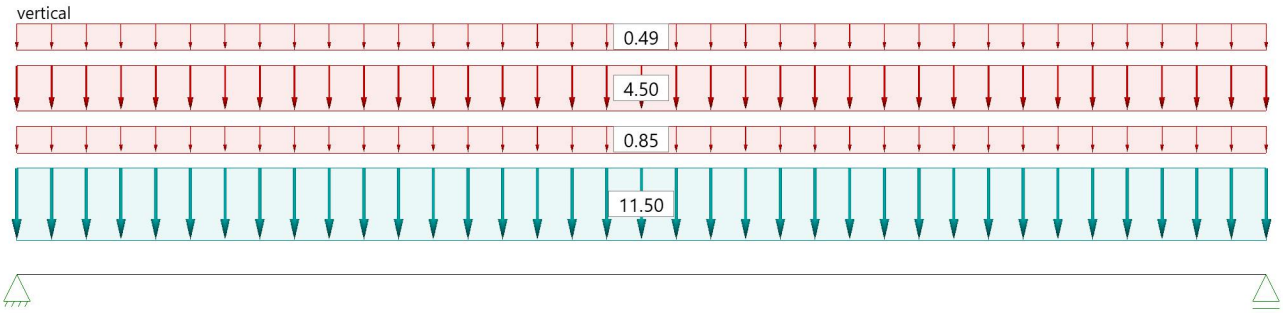
Timber beam Softwood C24 DIN EN 1995-1-1/NA:2013-08

System

System image



Statikansicht



Material

Softwood C24, acc.to EN 338:2016

	$f_{m,k}$ $f_{v,k}$ [N/mm²]	$f_{t,0,k}$ $f_{c,0,k}$ [N/mm²]	$f_{t,90,k}$ $f_{c,90,k}$ [N/mm²]	$E_{0,mean}$ $E_{0,05}$ [N/mm²]	$E_{90,mean}$ $E_{90,05}$ [N/mm²]	G_{mean} G_{05} [N/mm²]	ρ_k ρ_m [kg/m³]
	24.00 4.00	14.50 21.00	0.40 2.50	11000 7400	370 247	690 460	350 420

$f_{m,k}$	:	characteristic value of bending strength
$f_{t,0,k}$	:	characteristic value of tensile strength parallel to grain
$f_{t,90,k}$	:	characteristic value of tensile strength perpendicular to the grain
$E_{0,mean}$	:	Average value of modulus of elasticity parallel to the fiber
$E_{90,mean}$	:	Average value of the modulus of elasticity perpendicular to the grain
G_{mean}	:	Average value of the shear modulus
ρ_k	:	Characteristic value of gross density
$f_{v,k}$	:	characteristic value of shear strength
$f_{c,0,k}$	:	characteristic value of compressive strength parallel to grain
$f_{c,90,k}$	:	characteristic value of compressive strength perpendicular to the grain
$E_{0,05}$	:	5% fractile value of the modulus of elasticity parallel to grain
$E_{90,05}$	:	5% fractile value of the modulus of elasticity perpendicular to the grain
G_{05}	:	5% fractile value of the shear modulus
ρ_m	:	Average value of the density

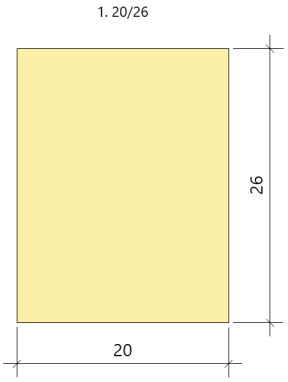
Geometry

Cross-sections

Name	I_y [cm⁴]	I_z [cm⁴]	W_y [cm³]	W_z [cm³]	A [cm²]
20/26	29293	17333	2253	1733	520.0

Cross-section is constant over the entire length of the beam.

used cross sections



Support (Bearing conditions)

No	x [m]	Width [cm]	Depth [cm]	k_{c90}	uy [kN/m]	uz [kN/m]	Rotations*) Φ_x [kNm/rad]	Φ_y [kNm/rad]	Φ_z [kNm/rad]
1	0.00	20.0	20.0	1.00	-1	-1	-1	0.0	0.0
2	3.30	12.0	20.0	1.00	-1	-1	0.0	0.0	0.0

*) -1 = fixed, 0 = free, > 0 = elastically restraint

Loads

Line loads

Reference	No.	Type	A [m]	L1 [m]	L2 [m]	W1 [kN/m]	W2 [kN/m]	acting Span by span	GF	Sim	Alt
System	1	UDL	3.30			11.50		No	Permanent		
	2	UDL	3.30			0.85		No	permanent, removable (pv)	2	
	3	UDL	3.30			4.50		No	Snow	3	110
	4	UDL	3.30			0.49		No	Wind	6	109

Reference : System-related (front edge of beam) or span load
Type : 1 - uniformly distributed load (GL), 4 - trapezoidal load (TL), 5 - triangular load (DL)
A : Distance to the load from the beginning of the span or the front edge of the beam
GF : Load effect
Sim : Combined group
Alt : Alternate group

Lastbezeichnungen

Nr	Bezeichnung
1	aus 'Dead Load'
2	aus 'Photovoltaic-SYstem'
3	aus 'Snow on rafter '
4	aus 'Wind from left luv(Pressure)+lee(Pressure)'

Self-weight

Total weight = 72 kg taken into account with gamma = 4.20 kN/m³.

Overview of the actions used

Actions

Description	ψ_0	ψ_1	ψ_2	$\gamma_{F,inf}$	$\gamma_{F,sup}$	KLED
Permanent loads				1.00	1.35	
Wind loads	0.60	0.20	0.00		1.50	short/very short
Snow loads H < 1000 m	0.50	0.20	0.00		1.50	short
permanent, removable (pv)	1.00	1.00	1.00		1.35	permanent

Consequences class CC 2 according to EN 1990 Tab. B1 -> K_{Fi} = 1.0 Tab. B3

Results

Design parameter

Design code	:	DIN EN 1995-1-1/NA:2013-08
Basis	:	EN 1995-1-1/A2:2014
Safety concept / load combinatorics	:	DIN EN 1990/NA:2010-12
Consequence class	:	CC 2
Ψ_2 = 0.5 for snow (AE)	:	not considered
Permanent loads	:	all equal γ_F ($\gamma_{G,sup}$ or $\gamma_{G,inf}$)
CLED ati wind	:	Average of short and very short

Design parameter Timber

Service class	2	:	roofed, open Rel. air humidity ~ 85%	Equilibrium moisture content < 20%
Shear stresses		=	Tau with red. Q	
Initial deflection	w_{inst}	=	l/300	
Final deflection	$w_{net,fin}$	=	l/300	
	w_{fin}	=	l/200	

Summary

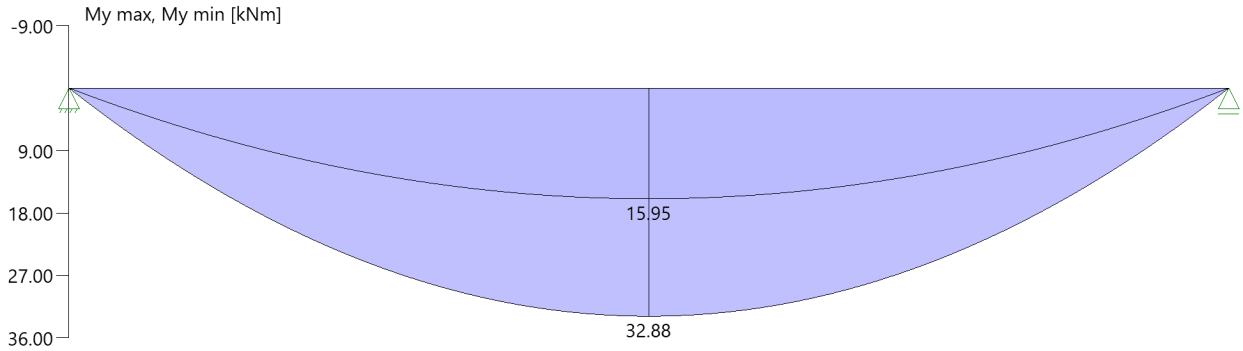
Verification	Design situation	$\eta_{Bending}$	η_{Shear}	$\eta_{c,90}$	η_{Stabi}	$\eta_{Deformation}$
Bearing capacity	persistent/transient	0.93	0.71	0.81	1)	
Serviceability	characteristic					0.99

1) Stability check was not carried out because the upper chord is held continuously.

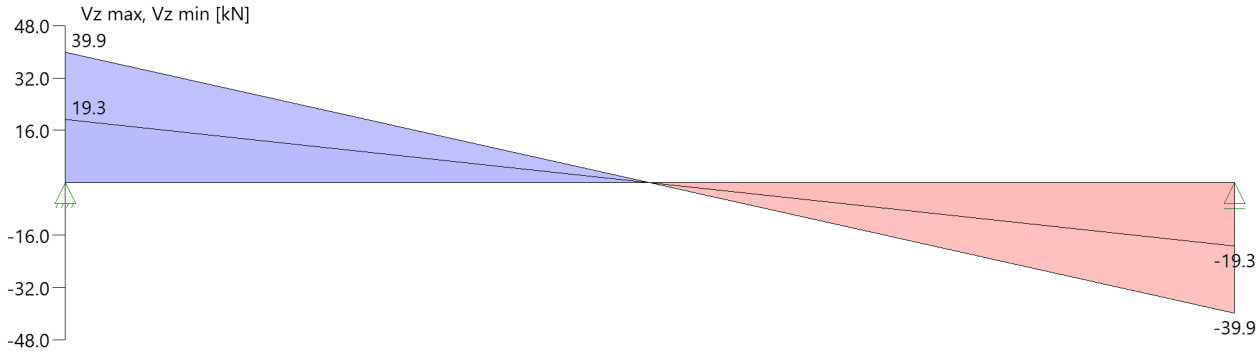
Structural safety - Load combination persistent/transient

Internal forces

Envelope of the moments



Envelope of the transverse forces



Internal forces

Span	xrel [m]	x [m]	My,Ed [kNm]	Vz,Ed [kN]	LC
Span 1	0.00	0.00	0.00	39.9	3
	0.00	0.00	0.00	19.3	4
	1.65	1.65	32.88	0.0	3
	3.30	3.30	0.00	-19.3	4
	3.30	3.30	0.00	-39.9	3

Bending

Span	x [m]	My,d [kNm]	σmyd [N/mm²]	kcrit,y	kh,My	kmod	fm,y,d [N/mm²]	η	LC
Span 1	1.65	23.09	10.25	1.00	1.00	0.60	11.08	0.93	1

The coefficient kh was taken into account in the calculation of fmyd according to DIN EN 1995 3.2(3).

Shear

Column [No.]		xrel [m]	xabs [m]	Vz,d [kN]	Td [N/mm²]	kmod	fv,z,d [N/mm²]	η	LC
1	right	0.36	0.36	21.9	0.63	0.60	1.85	0.68	1
2	left	0.32	2.98	-22.6	-0.65	0.60	1.85	0.71	1

Der Beiwert kcr = 0.50 wurde bei der Berechnung nach DIN EN 1995-1-1 NDP 6.1.7 (2) berücksichtigt.

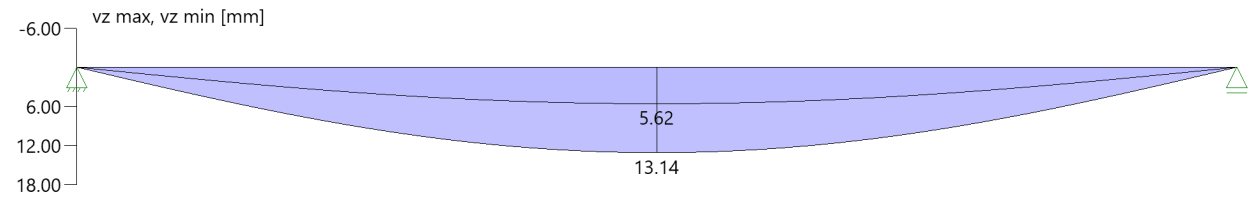
Bearing stress

Column	b eff [cm]	d eff [cm]	max F [kN]	σc,90,d [N/mm²]	kc90	kmod	fc,90,d [N/mm²]	η	LC
1	23.0*	20.0	28.0	0.61	1.00	0.60	1.15	0.53	1
2	15.0*	20.0	28.0	0.93	1.00	0.60	1.15	0.81	1

* Contact area according to DIN EN 1995-1-1, Chapter 6.1.5 (1) P widened by 30mm per side

Deformations

Envelope of the deformations - Serviceability



Check of SLS

	l_{eff} [m]	Position [m]	Verification		w_g	w_q [mm]	w	w_{lim}	η	Lk
Span 1	3.30	1.65	inst	z	5.62	2.70	8.32	11.00	0.76	5
	3.30	1.65	net,fin	z	10.11	0.73	10.84	11.00	0.99	7
	3.30	1.65	fin	z	10.11	3.03	13.14	16.50	0.80	6

l_{eff} : effective length
Position : Location of deflection
Verification : Initial/final deformation (direction)
w_g : Deformation due to constant load
w_q : Deformation due to changing load
w : Total deformation
w_{lim} : permissible deformation
η : utilization ratio
Lk : No. of load combination

Support reactions

Support reactions - characteristic of each action

No.	x [m]	Action	$R_{z,min}$ [kN]	$R_{z,max}$ [kN]	$M_{y,min}$ [kNm]	$M_{y,max}$ [kNm]
1	0.00	Permanent loads	19.3	19.3		
		permanent, removable (pv)		1.4		
		Wind loads		0.8		
		Snow loads H < 1000 m		7.4		
2	3.30	Permanent loads	19.3	19.3		
		permanent, removable (pv)		1.4		
		Wind loads		0.8		
		Snow loads H < 1000 m		7.4		

Decisive Combination

The following table shows the loads with the internal number. The subsequent
The table of the decisive combinations refers to these numbers.

generated load	Span	Act	Grp	orig. Load	W1	W2	A [m]	L [m]
L 1	*	Permanent	0	1	11.50	11.50	0.00	3.30
L 2	*	permanent, removable (pv)	2	2	0.85	0.85	0.00	3.30
L 3	*	Snow	3	3	4.50	4.50	0.00	3.30
L 4	*	Wind	6	4	0.49	0.49	0.00	3.30

gen. Load	Lc 1	Lc 3	Lc 4	Lc 5	Lc 6	Lc 7
L 1	1.35	1.35	1.00	1.00	1.80	1.80
L 2	1.35	1.35		1.00	1.80	1.80
L 3		**1.50**		**1.00**	**1.00**	
L 4		0.90		0.60	0.60	
Self-weight	1.35	1.35	1.00	1.00	1.80	1.80

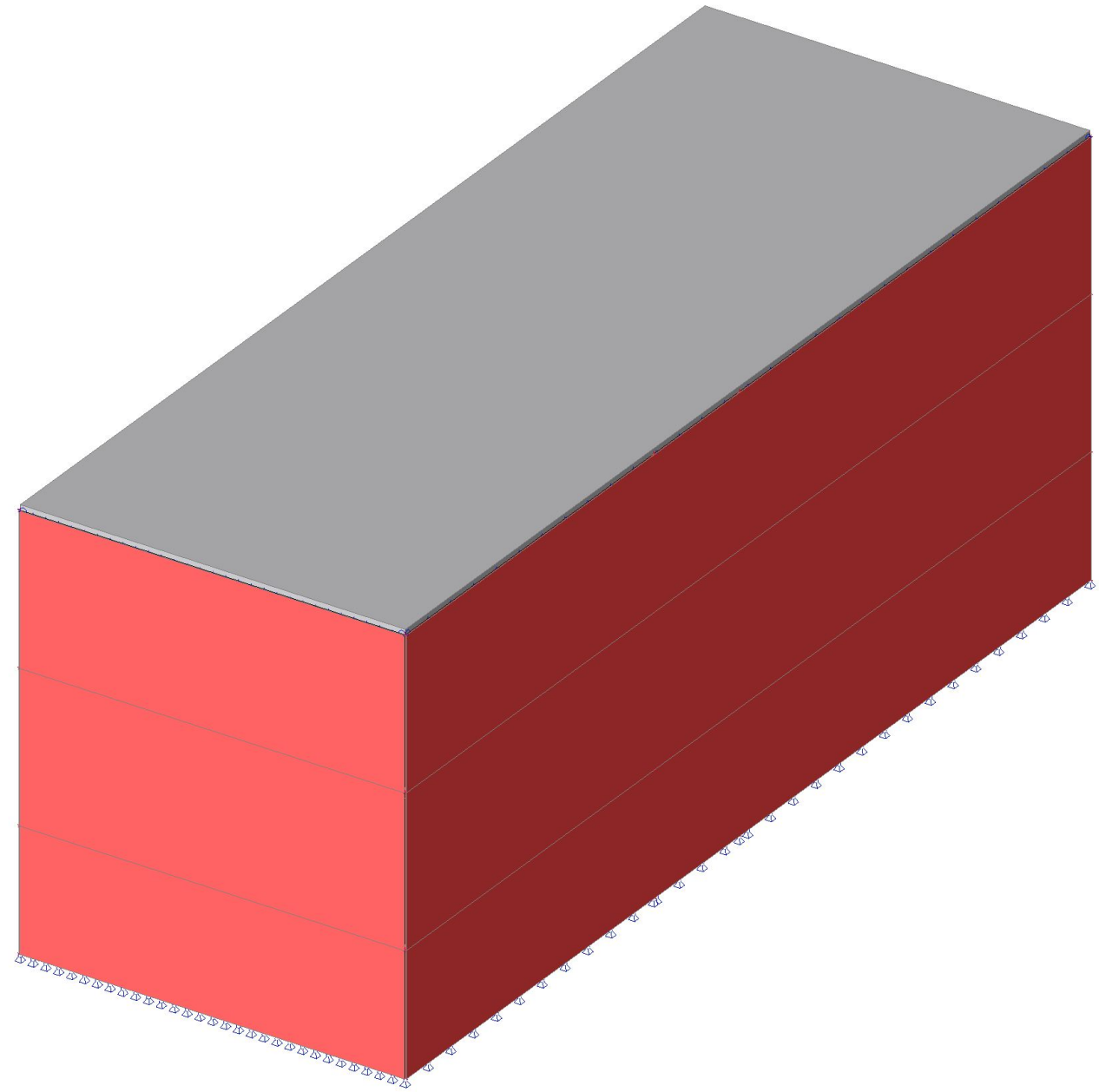
The deformation coefficient kdef = 0.80 is taken into account in the factors of the combinations for serviceability.

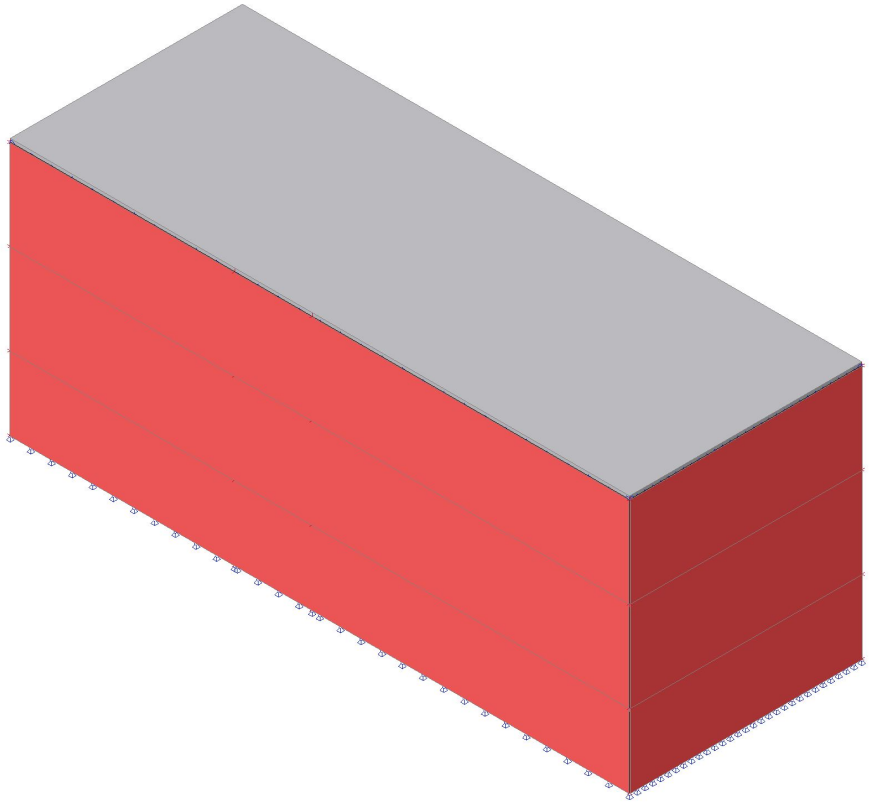
ASPA-ING, d.o.o.
Ulica Prekmurske čete 71
SI-9232 ČRENŠOVCI
M:+386 41 756 758

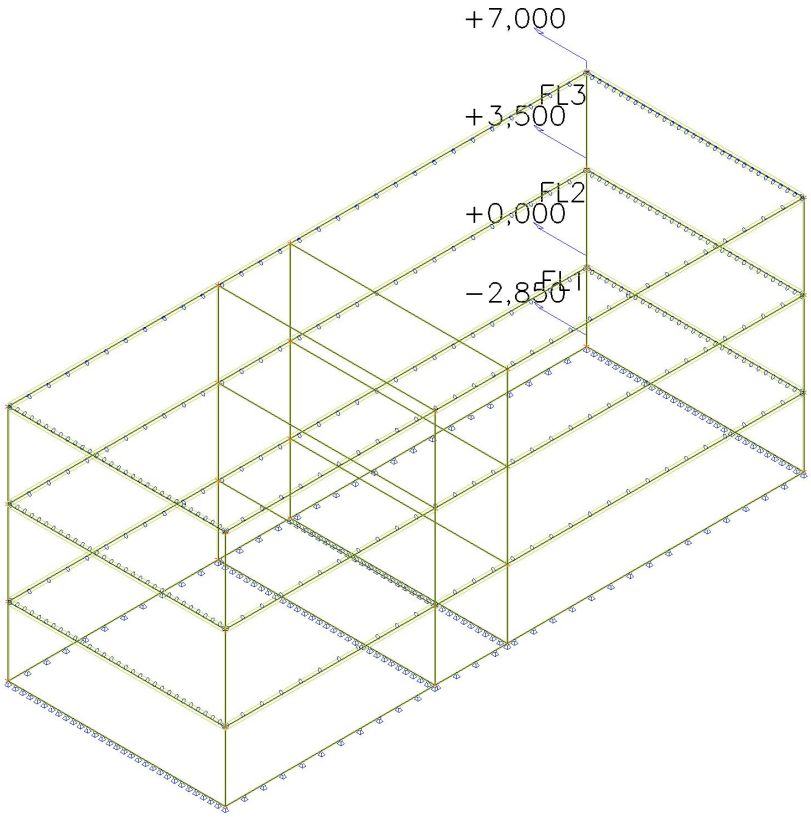
PRILOGA 2

1.1. Vhodni podatki za izačun konstrukcije

1.1.1. Statični model






+7,000
FL3
+3,500
FL2
+0,000
FL1
−2,850

1.1.2. Uporabljeni materiali

Reinforcement EC2

Name	Type	ρ [kg/m³]	E_{mod} [MPa]	G_{mod} [MPa]	α [m/mK]	$f_{y.k}$ [MPa]
B 400A	Reinforcement steel	7850,00	2,0000e+05	8,3333e+04	0,01e-003	400,0

Masonry

Name	Type	ρ [kg/m³]	E_{mod} [MPa]	μ	G_{mod} [MPa]	α [m/mK]	f_k [MPa]	Colour
Masonry	Masonry	1600,00	3,1000e+03	0.25	1,2400e+03	0,01e-003	3,1	

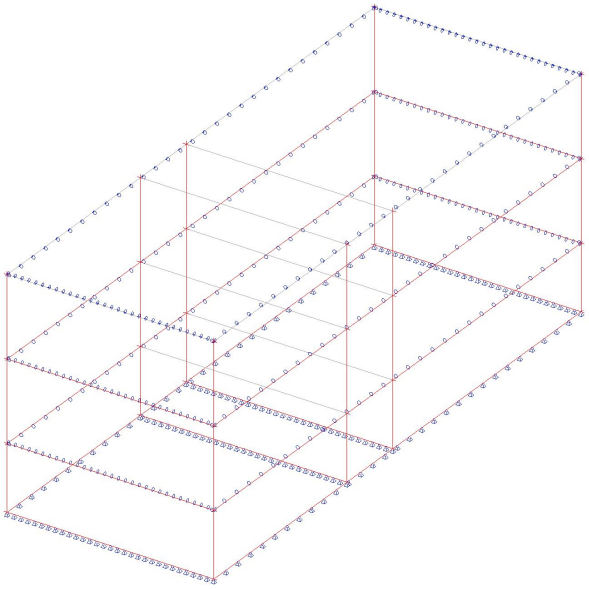
Concrete EN 1992-2

Name	Type	Unit mass [kg/m³]	E mod [MPa]	Poisson - nu	G mod [MPa]	Thermal exp [m/mK]	Colour
C25/30(EN1992-2)	Concrete	2500,00	3,1500e+04	0.2	1,3125e+04	0,01e-003	

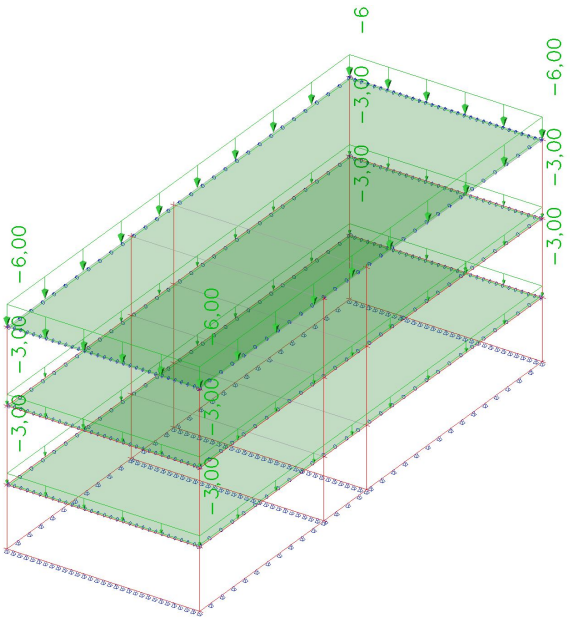
1.1.3. Seznam obtežnih primerov

Name	Description	Action type	Load group	Direction	Duration	Master load case
	Spec	Load type				
LT	Lastna teža	Permanent	LG99	-Z		
		Self weight				
ST	Stalna obtežba	Permanent	LG99			
		Standard				
KO	Cat. A	Variable	Cat. A		Long	None
	Standard	Static				
Px		Variable	EQ			None
	Seismicity	Static equivalent				
Py		Variable	EQ			None
	Seismicity	Static equivalent				
Px_AE	Accidental eccentricity for Px	Variable	Px_AE		Short	Px
	Seismic accidental eccentricity	Static				
Py_AE	Accidental eccentricity for Py	Variable	Py_AE		Short	Py
	Seismic accidental eccentricity	Static				

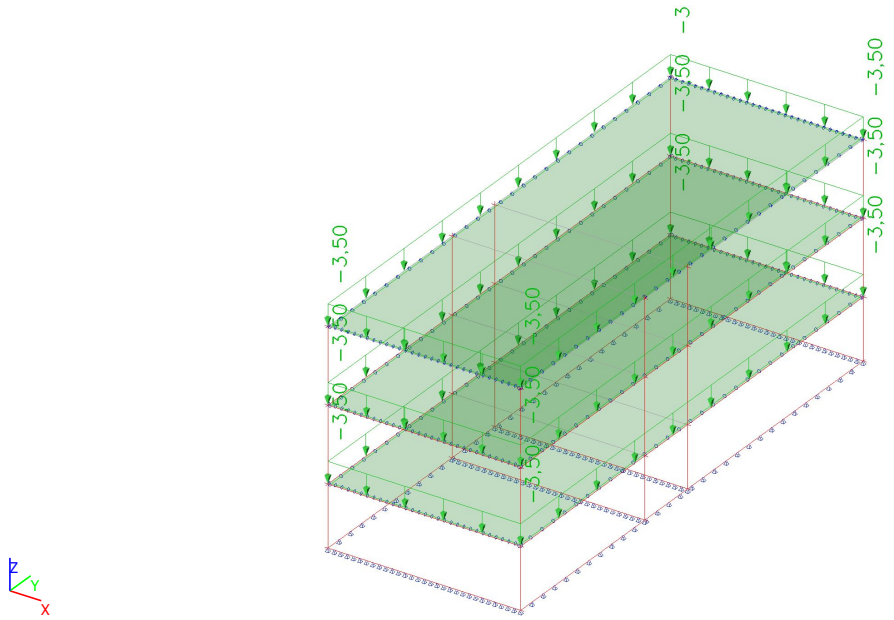
Name	Description	Action type	Load group	Direction
	Spec	Load type		
LT	Lastna teža	Permanent	LG99	-Z
		Self weight		

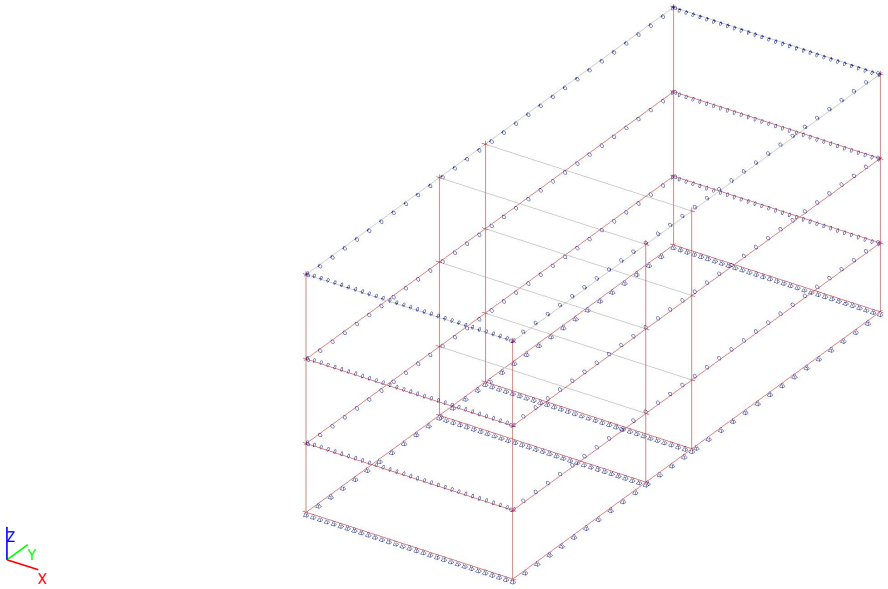


Name	Description	Action type	Load group
	Spec	Load type	
ST	Stalna obtežba	Permanent	LG99
		Standard	

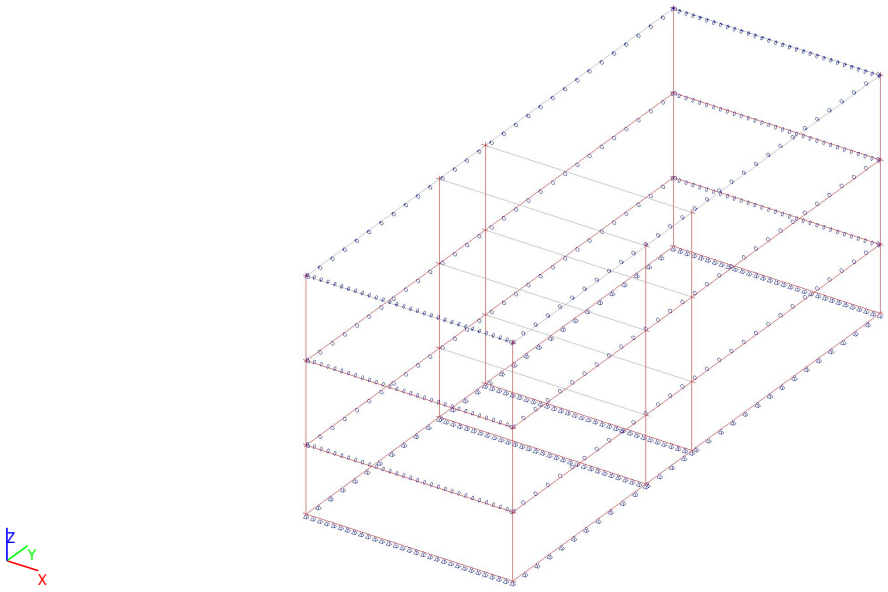


Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
KO	Cat. A	Variable	Cat. A	Long	None
	Standard	Static			

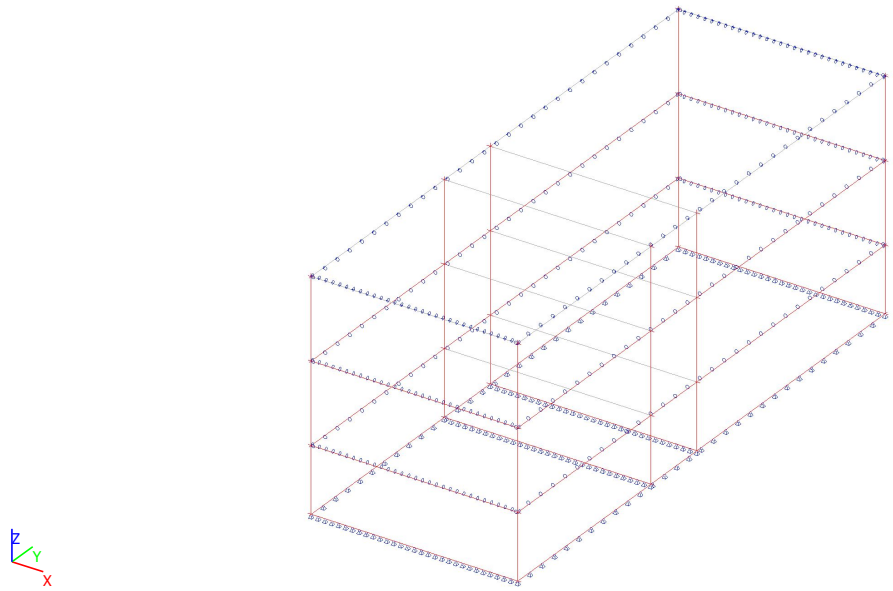

3,50
3,50
3,50



Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
Px_AE	Accidental eccentricity for Px	Variable	Px_AE	Short	Px
	Seismic accidental eccentricity	Static			



Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
Py_AE	Accidental eccentricity for Py	Variable	Py_AE	Short	Py
	Seismic accidental eccentricity	Static			



1.1.4. Kombinacije po MSN in MSU

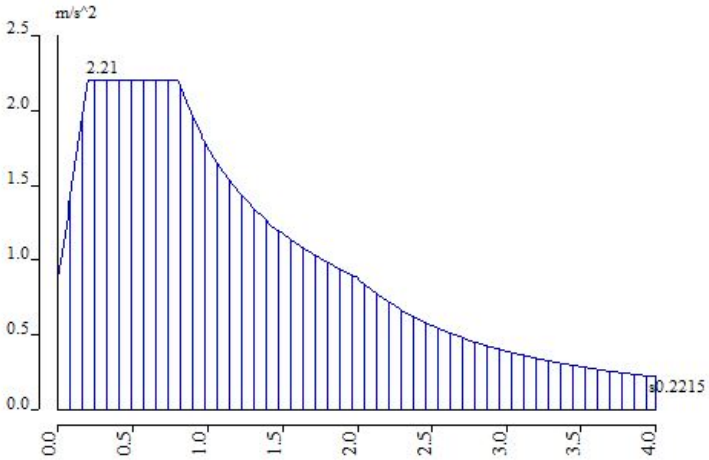
Name	Description	Type	Load cases	Coeff. [-]
ULS-Set B (auto)		EN-ULS (STR/GEO) Set B	LT - Lastna teža	1,000
			ST - Stalna obtežba	1,000
			KO - Cat. A	1,000
SLS-Char (auto)		EN-SLS Characteristic	LT - Lastna teža	1,000
			ST - Stalna obtežba	1,000
			KO - Cat. A	1,000
SLS-Quasi (auto)		EN-SLS Quasi-permanent	LT - Lastna teža	1,000
			ST - Stalna obtežba	1,000
			KO - Cat. A	1,000
ULS-Seis (auto)		EN-Seismic	LT - Lastna teža	1,000
			ST - Stalna obtežba	1,000
			KO - Cat. A	1,000
			Px	1,000
			Py	1,000
			Px_AE - Accidental eccentricity for Px	1,000
			Py_AE - Accidental eccentricity for Py	1,000
Px	Seismic load case "Px" with accidental eccentricity effects	Envelope - ultimate	Px	1,000
			Px_AE - Accidental eccentricity for Px	1,000
Py	Seismic load case "Py" with accidental eccentricity effects	Envelope - ultimate	Py	1,000
			Py_AE - Accidental eccentricity for Py	1,000
Py1		EN-Seismic	Px	1,000
			Py	1,000
			Px_AE - Accidental eccentricity for Px	1,000
			Py_AE - Accidental eccentricity for Py	1,000

1.1.5. Ovojnice

Name	List
All ULS	ULS-Set B (auto) - EN-ULS (STR/GEO) Set B

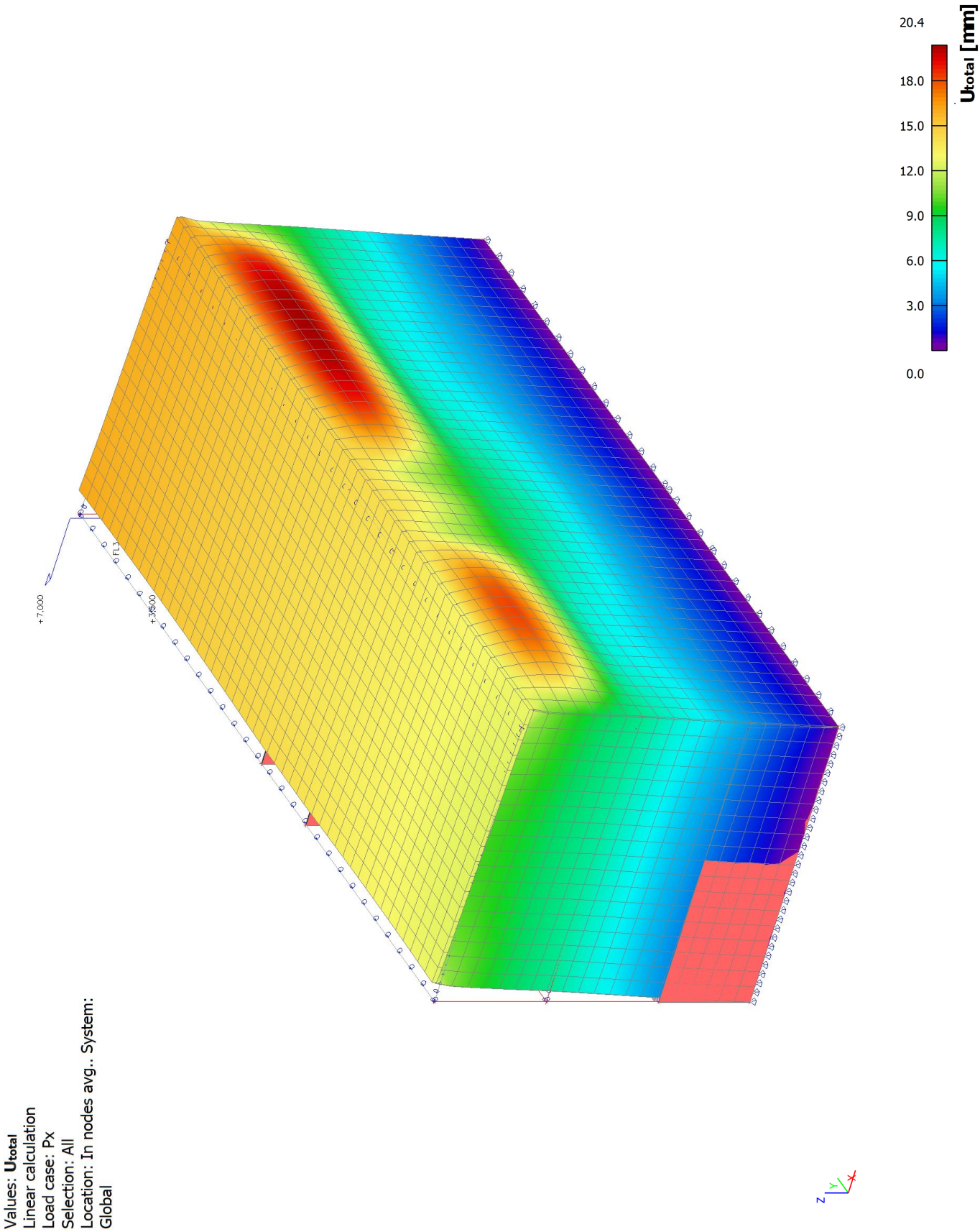
Name	List
	ULS-Seis (auto) - EN-Seismic
	Px - Envelope - ultimate
	Py - Envelope - ultimate
	Py1 - EN-Seismic
All SLS	SLS-Char (auto) - EN-SLS Characteristic
	SLS-Quasi (auto) - EN-SLS Quasi-permanent
All ULS+SLS	ULS-Set B (auto) - EN-ULS (STR/GEO) Set B
	ULS-Seis (auto) - EN-Seismic
	Px - Envelope - ultimate
	Py - Envelope - ultimate
	Py1 - EN-Seismic
	SLS-Char (auto) - EN-SLS Characteristic
	SLS-Quasi (auto) - EN-SLS Quasi-permanent

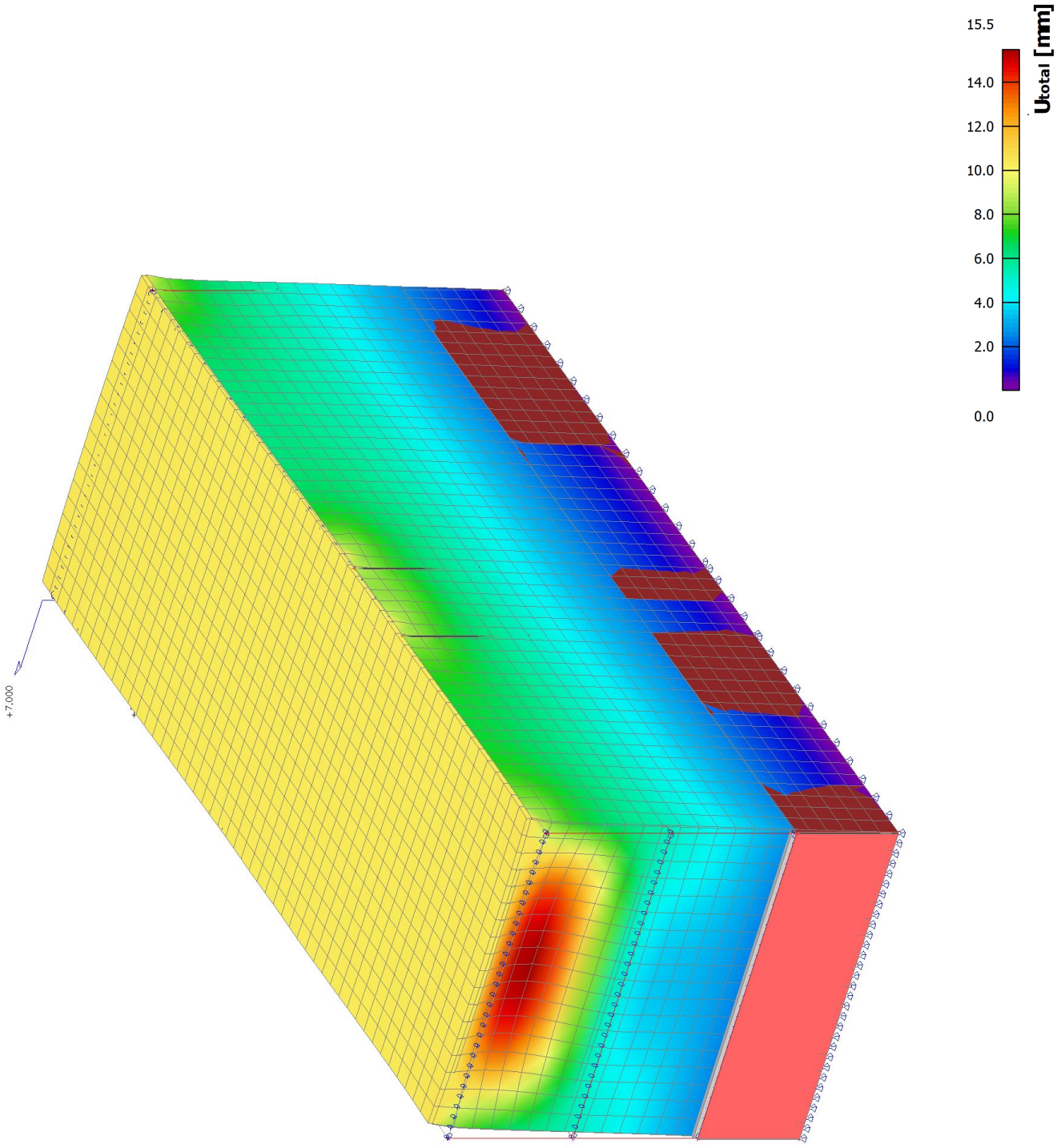
1.1.6. Potresni spekter

Name UniqueID	Type drawing	Info	Drawing
FS1	Period	Type code - EN 1998-1:2004 – Eurocode Subsoil type - D Direction - Horizontal Spectrum type - type 1 coeff accel. ag - 0.1 ag - design acceleration - 0.981 beta - 0.2 q - behaviour factor - 1.5	

1.2. Izračun za stalno in začasno projektno stanje

1.2.1. Izračun elastičnih pomikov




15.5
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Utotal [mm]
+7.000
Values: Utotal
Linear calculation
Load case: Py
Selection: All
Location: In nodes avg.. System:
Global
Z
Y
X