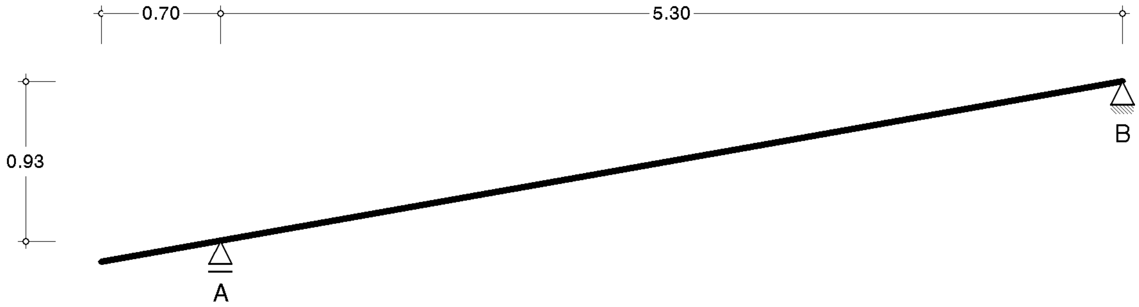
1. System description

1.1. structural system



1.2. system parameters

roof pitch:	10.00°
rafter distan.:	0.700 m
material:	coniferous timber: C24
cross-section:	b/h in cm: 12.0/20.0
notches:	no notches defined.
roof overhangs:	left side: 0.70 m, right side: none
design codes:	Eurocode: EN 1990 (load factors), EN 1991 (wind and snow loads), EN 1995 (timber constr.)
nat. Annex:	NA-DE (Deutschland)

1.3. elastic design values

beam	length	$E_{0,mean}$	h	b	A	I	W
-	m	N/mm²	cm	cm	cm²	cm^4	cm^3
rafter	6.093	11000	20.0	12.0	240.0	8000.0	800.0

1.4. Loading structure

On the left-hand side, the relationship between the actions effects and load cases are shown in a tree structure. The right-hand side shows the characteristics of the superposition to the associated objects on the left-hand.

used symbols: action effect load case

permanent loads	**permanent**
1: dead load	additive (dead load of supporting structure)
2: outer skin	additive (dead load of outer skin)
man loads	**category H: roofs**
3: man load(1)	alternative (on protruding roof (left side))
4: man load(2)	alternative (on rafter span 1)
wind loads	**wind loads**
5: wind from left side (1)	alternative (centre area (pressure))
6: wind from left side (2)	alternative (centre area (suction))
7: wind from left side (4)	alternative (centre area (suction))
8: wind from right side (2)	alternative (centre area (suction))
9: wind from right side (4)	alternative (edge region (suction))
10: wind on gable (1)	alternative (edge region)
11: wind on gable (2)	alternative (centre area)
12: wind on gable (3)	alternative (backside area)
snow loads	**locations up to NN+1000m**
13: snow fully	alternative

2. permanent loads

2.1. load case 1: dead load

dead load of supporting structure

densitiy γ = **5.00 kN/m³** (for all members)

2.2. load case 2: outer skin

dead load of outer skin

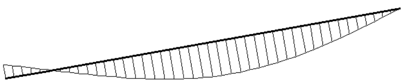
load value: q = load sum * distance between rafters = **0.441 kN/m**

description	value
int. tiles acc. to DIN 456 incl. lathing	0.550 kN/m²
plastic sheet vapour barrier	0.020 kN/m²
6 cm fibre ins. mat. acc. DIN 18 165	0.060 kN/m²
load sum :	**0.630 kN/m²**

2.3. Extremal from action effect permanent loads

extremal deflections

deformations perpendicular to the member centre-line
sum of all permanent loads



(max w = 6.6 mm, min w = -2.7 mm)

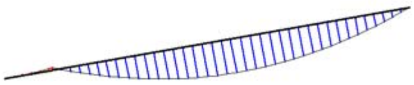
extremal support reactions

sum of all permanent loads in kN

supp.	H	V
A	-	1.93
B	0.00	1.48

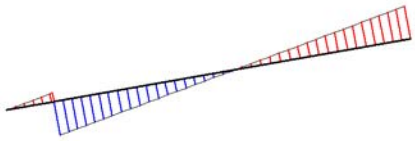
extremal internal forces

sum of all permanent loads



max M = 1.93 kNm, min M = -0.14 kNm

max N = 0.26 kN, min N = -0.27 kN



max V = 1.51 kN, min V = -1.46 kN

3. man loads

3.1. Action effect of man loads

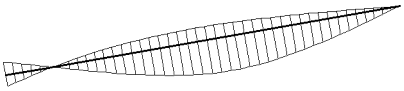
Man loads are arranged in the middle of the considered section, resp. at the cantilevers end. load value: P = 1.00 kN.
The following alternative load cases are analysed.

LF	description	explanation
3	man load(1)	on protruding roof (left side)
4	man load(2)	on rafter span 1

3.2. Extremal from action effect man loads

extremal deflections

deformations perpendicular to the member centre-line
Extremal from all load cases of the action effect man loads



(max w = 3.6 mm, min w = -1.5 mm)

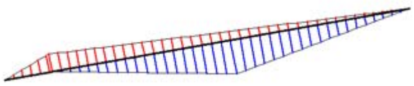
extremal support reactions

Extremal from all load cases of the action effect man loads in kN

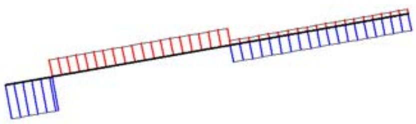
supp.	H min	H max	V min	V max
A	-	-	0.00	1.13
B	0.00	0.00	-0.13	0.50

extremal internal forces

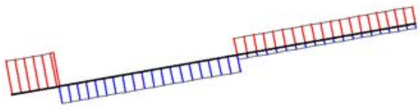
Extremal from all load cases of the action effect man loads



max M = 1.32 kNm, min M = -0.70 kNm



max N = 0.17 kN, min N = -0.09 kN



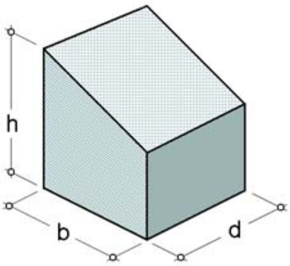
max V = 0.49 kN, min V = -0.98 kN

4. wind loads

4.1. Action effect of wind loads

ground roughness profile acc. to EC 1-1-4\NA-DE: inland

wind zone:	2
h + NN:	60 m
factor:	1.0000
qref:	0.39 kN/m²
h:	3.30 m
b:	6.00 m
d:	12.00 m
⇒ q(h):	**0.58 kN/m²**



The following alternative load cases are analysed.

LF	description	explanation
5	wind from left side (1)	centre area (pressure)
6	wind from left side (2)	centre area (suction)
7	wind from left side (4)	centre area (suction)
8	wind from right side (2)	centre area (suction)
9	wind from right side (4)	edge region (suction)
10	wind on gable (1)	edge region
11	wind on gable (2)	centre area
12	wind on gable (3)	backside area

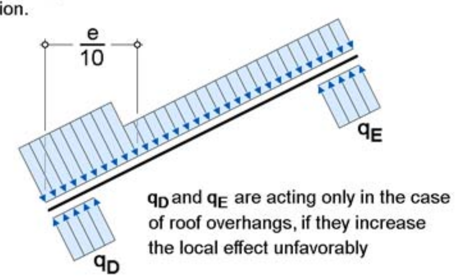
wind from left side

The arrows in the adjacent sketch represent positive load directions (pressure).
In case of negative q-values (suction) the load acts in the reverse direction.

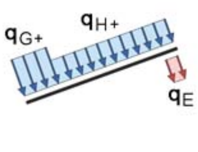
$e = \min(d, 2h) = 6.60 \quad \Rightarrow \quad \frac{e}{10} = 0.66$

EC 1-1-4	Tabel 7.3a			Tabel 7.1	
Input value	α = 10.00°			h/b = 0.55	
Zone	F	G	H	D	E
$c_{pe.10}$ (-)	-1.30	-1.00	-0.45	+0.74	
q()- kN/m	**-0.53**	**-0.41**	**-0.18**	**+0.30**	
$c_{pe.10}$ (+)	+0.10	+0.10	+0.10		
q()+ kN/m	**+0.04**	**+0.04**	**+0.04**		

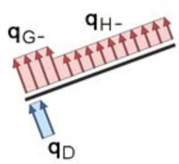
$q = c_{pe.10} * q(h) *$ distance between rafters in kN/m



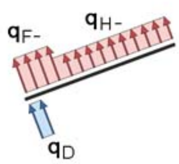
considered load cases (wind from left side)



wind from left side (1)
centre area (pressure)



wind from left side (2)
centre area (suction)



wind from left side (4)
centre area (suction)

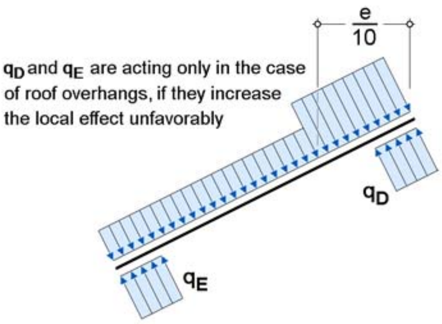
wind from right side

The arrows in the adjacent sketch represent positive load directions (pressure).
In case of negative q-values (suction) the load acts in the reverse direction.

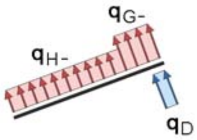
$e = \min(d,2h) = 6.60 \quad \Rightarrow \quad \frac{e}{10} = 0.66$

EC 1-1-4	Tabel 7.3a			Tabel 7.1	
Input value	$\alpha = 10.00°$			h/b = 0.55	
Zone	**F**	**G**	**H**	**D**	**E**
$c_{pe.10}$ (-)	-2.40	-1.30	-0.85	+0.74	
$q_{()-}$ kN/m	**-0.98**	**-0.53**	**-0.35**	**+0.30**	
$c_{pe.10}$ (+)	+0.00	+0.00	+0.00		
$q_{()+}$ kN/m	+0.00	+0.00	+0.00		

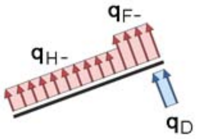
$q = c_{pe.10} * q(h) * \text{distance between rafters}$ in kN/m



considered load cases (wind from right side)



wind from right side (2)
centre area (suction)



wind from right side (4)
edge region (suction)

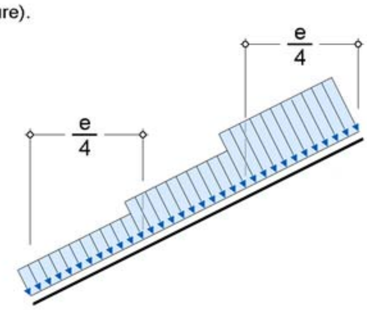
wind on gable

The arrows in the adjacent sketch represent positive load directions (pressure).
In case of negative q-values (suction) the load acts in the reverse direction.

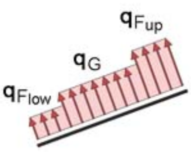
$e = \min(b,2h) = 6.00 \text{ m} \quad \Rightarrow \quad \frac{e}{4} = 1.50 \text{ m}$

Input value	$\alpha = 10.00°$				
Zone	F_{up}	F_{low}	G	H	I
$c_{pe.10}$	-2.25	-1.85	-1.85	-0.70	-0.60
q kN/m	**-0.92**	**-0.76**	**-0.76**	**-0.29**	**-0.25**

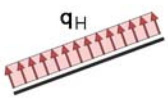
$q = c_{pe.10} * q(h) * \text{distance between rafters}$ in kN/m



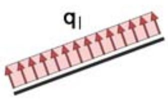
considered load cases (wind on gable)



wind on gable (1)
edge region



wind on gable (2)
centre area

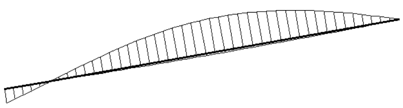


wind on gable (3)
backside area

4.2. Extremal from action effect wind loads

extremal deflections

deformations perpendicular to the member centre-line
Extremal from all load cases of the action effect wind loads



(max w = 3.8 mm, min w = -9.4 mm)

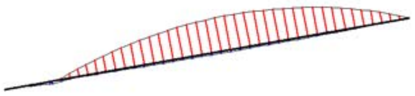
extremal support reactions

Extremal from all load cases of the action effect wind loads in kN

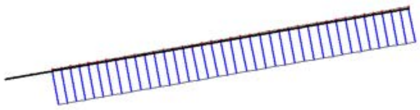
supp.	H min	H max	V min	V max
A	-	-	-2.69	0.14
B	-0.84	0.04	-2.10	0.10

extremal internal forces

Extremal from all load cases of the action effect wind loads



max M = 0.21 kNm, min M = -2.74 kNm



max N = 0.47 kN, min N = -0.02 kN

max V = 2.22 kN, min V = -2.11 kN

5. snow loads

5.1. Action effect of snow loads

snow load zone:	1
h + NN:	60 m
$\Rightarrow s_k$:	0.65 kN/m²
building model:	free-standing

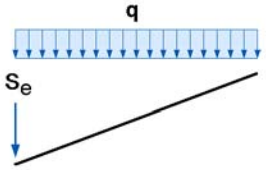
The following alternative load cases are analysed.

LF	description
13	snow fully

5.2. load case 13: snow fully

line load: $\alpha = 10°$ $\mu_1(\alpha) = 0.80$ $\rightarrow$ $\mathbf{q} = a\ \mu_1(\alpha)\ s_k = 0.36$ kN/m

point load: $S_e = 0.4\ a\ (\mu_1(\alpha)\ s_k)^2/\gamma = 0.03$ kN
(only in case of roof overhangs)

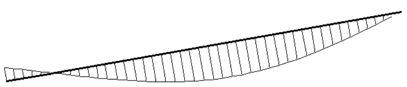


a = distance between rafters, $\gamma = 3.0$ kN/m³
load determination acc. to DIN 1055-5, par. 4.2.3 and 5.1, and Musterliste der techn. Baubestimmungen Feb. 2007 as well as EC 1-1-3

5.3. Extremal from action effect snow loads

extremal deflections

deformations perpendicular to the member centre-line
Extremal from all load cases of the action effect snow loads



(max w = 4.2 mm, min w = -1.7 mm)

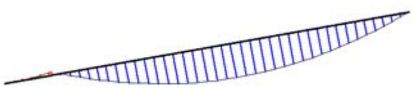
extremal support reactions

Extremal from all load cases of the action effect snow loads in kN

supp.	H		V	
	min	max	min	max
A	-	-	0.00	1.26
B	0.00	0.00	0.00	0.94

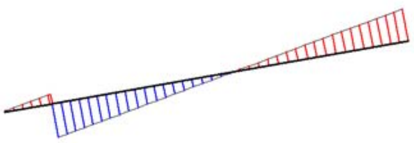
extremal internal forces

Extremal from all load cases of the action effect snow loads



max M = 1.22 kNm, min M = -0.11 kNm

max N = 0.16 kN, min N = -0.17 kN



max V = 0.97 kN, min V = -0.93 kN

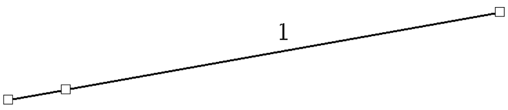
6. Verifications

6.1. Verification of ultimate limit state

6.1.1. stability

System stability is calculated within the verification of load-carrying capacity using the method of fictitious bars
(not in the range of notches)

sections



β = coeff. of eff. column length, l_{ef} = fict. bar length, k_c = instab. factor acc. to EC5(1) 6.3.2.

section	length	β	l_{ef}	⇒ k_c
1	5.38	1.00	5.38	0.3433

6.1.2. main verification

verification of load-carrying capacity for permanent and transient design situations

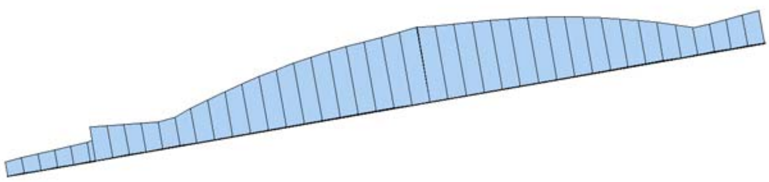
service class of building	1
material safety factor	1.30
combination of internal forces	acc. to Eurocode

safety and combination coefficients, classes of duration of load

action effect	γ_{sup}	γ_{inf}	Ψ_{dom}	Ψ_{sub}	KLED	k_{mod}
permanent loads	1.35	1.00	1.00	1.00	permanent	0.60
man loads	1.50	0.00	1.00	0.00	sh.-term	0.90
wind loads	1.50	0.00	1.00	0.60	sh.-v.sh.	1.00
snow loads	1.50	0.00	1.00	0.50	sh.-term	0.90

6.1.2.1. maximal utilization

max U = 0.35



6.1.3. special verification "Norddeutsche Tiefebene"

verification of load-carrying capacity for accidental design situations

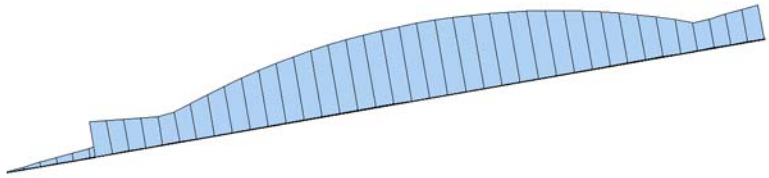
service class of building	1
material safety factor	1.00
combination of internal forces	acc. to Eurocode EN 1990

safety and combination coefficients, classes of duration of load

action effect	γ_{sup}	γ_{inf}	Ψ_{dom}	Ψ_{sub}	KLED	k_{mod}
permanent loads	1.00	1.00	1.00	1.00	permanent	0.60
man loads	1.00	0.00	0.00	0.00	sh.-term	0.90
wind loads	1.00	0.00	0.20	0.00	sh.-v.sh.	1.00
snow loads	2.30	2.30	1.00	1.00	sh.-term	0.90

6.1.3.1. maximal utilization

max U = 0.27



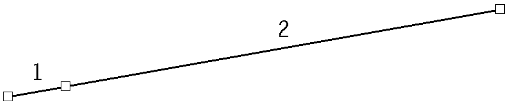
6.2. verifications of serviceability limit states

6.2.1. comparative lengths

for calculation of degree of utilization

section	length	l_v
-	m	m
1	0.71	0.71
2	5.38	5.38

sections



6.2.2. limit values

deformation	(in span)	(at cantilever)
w_{inst}	$l_v/300$	$l_v/150$
w_{fin}	$l_v/200$	$l_v/100$
$w_{net,fin}$	$l_v/300$	$l_v/150$

6.2.3. design situation w_{inst}

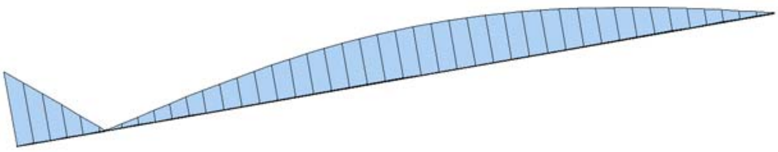
combination coefficients

action effect	Ψ_0
man loads	0.00
wind loads	0.60
snow loads	0.50

service class 1
⇒ k_{def} = 0.60

6.2.3.1. maximal utilization

max U = 0.94



6.2.4. design situation w_{fin}

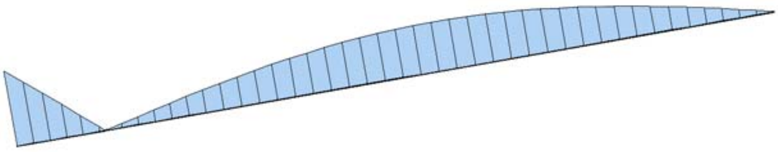
combination coefficients

action effect	Ψ_0	Ψ_2
man loads	0.00	0.00
wind loads	0.60	0.00
snow loads	0.50	0.00

service class 1
⇒ k_{def} = 0.60

6.2.4.1. maximal utilization

max U = 0.86



6.2.5. design situation $w_{net,fin}$

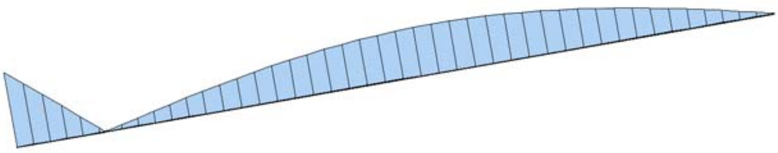
combination coefficients

action effect	Ψ_2
man loads	0.00
wind loads	0.00
snow loads	0.00

service class 1
$\Rightarrow k_{def} = 0.60$

6.2.5.1. maximal utilization

max U = 0.90



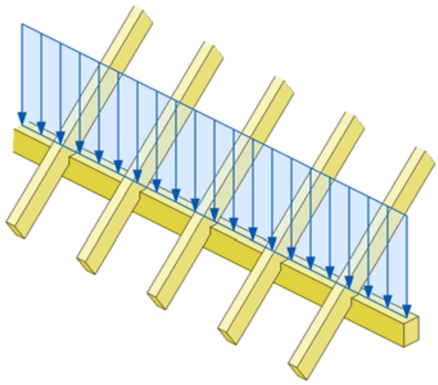
7. Supportsreaktionen and internal forces to be connected

extremal support reactions

on characteristic load level

Positive vertical reaction forces (V) are acting from bottom to top.
Positive horizontal reaction forces (H) are acting from right side to left side.

	G	Q		G+Q	
		H	V	H	V
	kN/m	kN/m	kN/m	kN/m	kN/m
support A					
min A_V	2.76	0.00	-3.84	0.00	-1.08
max A_V	2.76	0.00	2.01	0.00	4.78
support B					
min B_H	0.00	-1.21	-1.65	-1.21	0.46
max B_H	0.00	0.06	0.15	0.06	2.27
min B_V	2.12	-1.21	-3.00	-1.21	-0.88
max B_V	2.12	0.06	1.50	0.06	3.61

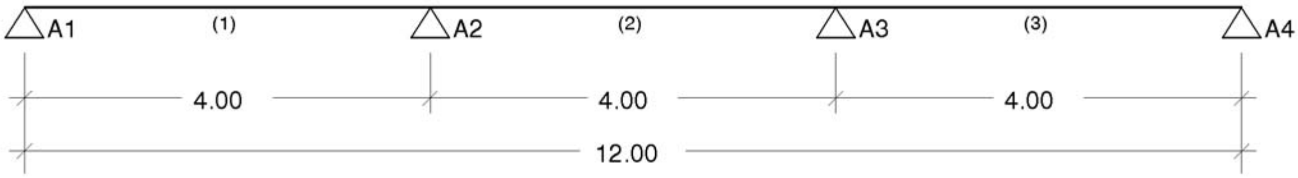


The values describe a line load in purlin running direction. Man loads that are to be applied only once per roof are not taken into account here.

8. purlin A

8.1. position, characteristic values and structural system

material: coniferous timber: C24
cross-section: b = 12.0 cm, h = 18.0 cm
char.valu: EI = 642 kN/m², W = 648.0 cm³, γ = 5.00 kN/m³
fm,k = 24.0 N/mm², fv,k = 4.0 N/mm²
design codes: Eurocode: EN 1990, EN 1991, EN 1995



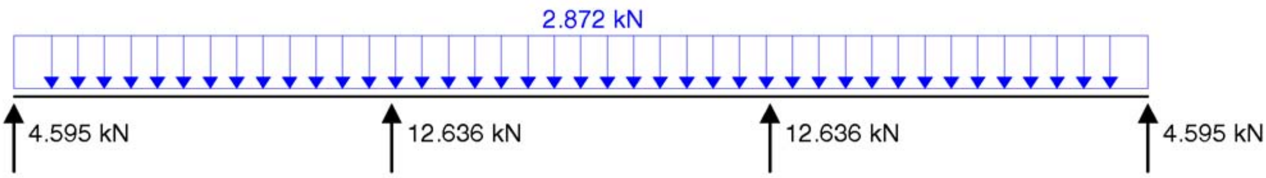
8.2. Loading

The structure of the load corresponds to that of the rafter calculation. Exception: The permanent loads are combined into one load case.The loads are essentially recruited from the bearing reaction forces (support A) of the rafter calculation. Exception: man loads.
Only the relevant load cases are logged here that make a significant contribution to the extrema of the assigned action.

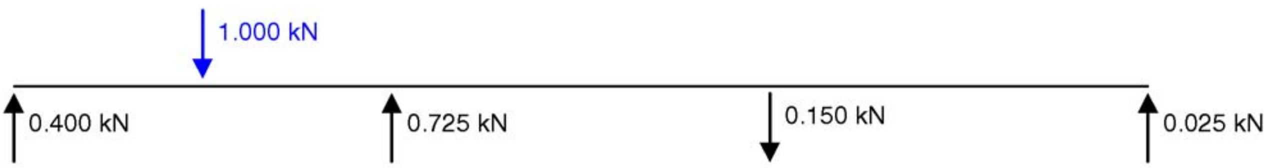
8.2.1. permanent loads

System, loading + support reactions from vertical loads

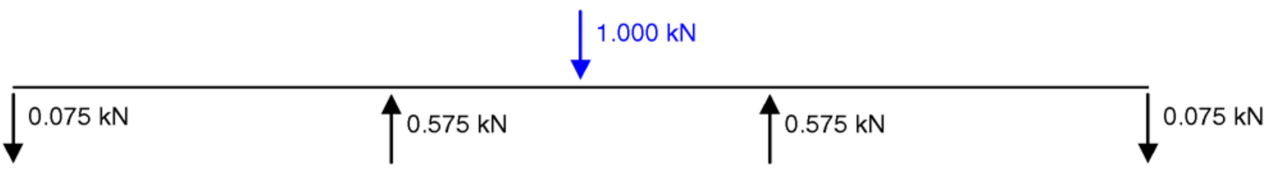
from support force (s A) from rafter load c. dead load	0.414 kN / 0.700 m	0.591 kN/m
from support force (s A) from rafter l. c. outer skin	1.521 kN / 0.700 m	2.173 kN/m
dead load purlin (5.000 kN/m³ * 0.180 m * 0.120 m)		0.108 kN/m
sum permanent loads (vertical)		**2.872 kN/m**



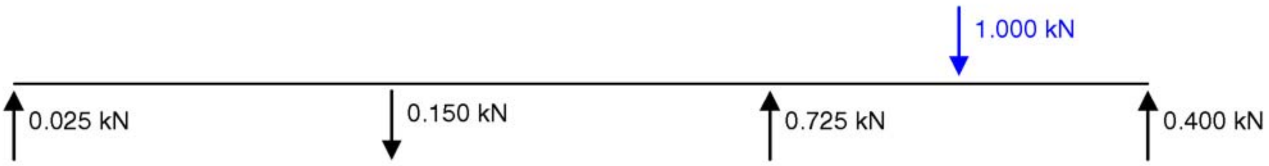
8.2.2. man load position 1



8.2.3. man load position 2



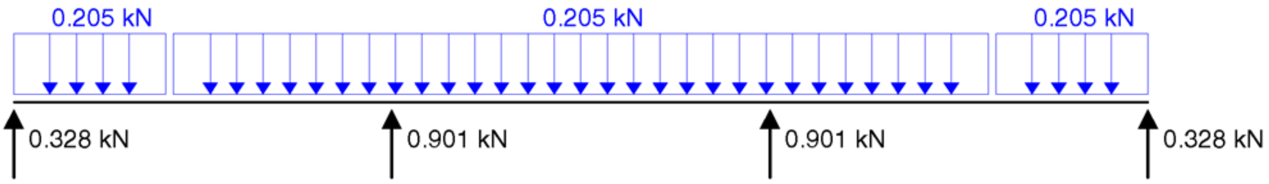
8.2.4. man load position 3



8.2.5. wind from left side (1)

System, loading + support reactions from vertical loads

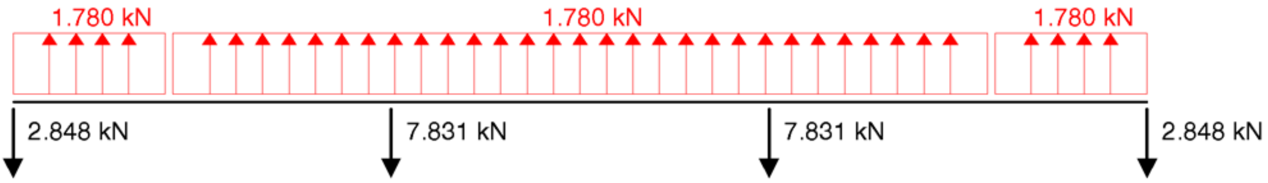
```
q1 from support force (s A) from rafter l.c. wind from left s (1)     0.143 kN / 0.700 m     0.205 kN/m
q2 from support force (s A) from rafter l.c. wind from left s (1)     0.143 kN / 0.700 m     0.205 kN/m
q3 from support force (s A) from rafter l.c. wind from left s (1)     0.143 kN / 0.700 m     0.205 kN/m
```



8.2.6. wind from right side (4)

System, loading + support reactions from vertical loads

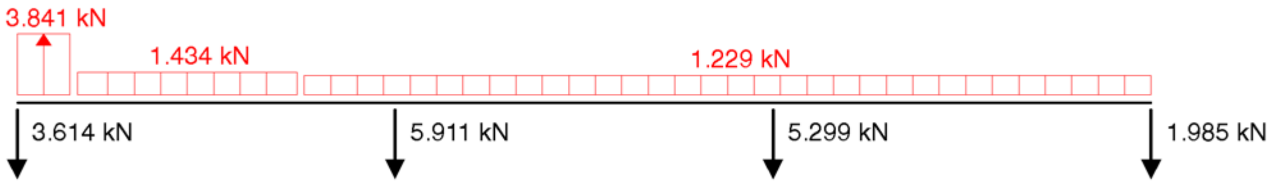
```
q1 from support force (s A) from rafter l.c. wind from right s (4)   -1.246 kN / 0.700 m    -1.780 kN/m
q2 from support force (s A) from rafter l.c. wind from right s (4)   -1.246 kN / 0.700 m    -1.780 kN/m
q3 from support force (s A) from rafter l.c. wind from right s (4)   -1.246 kN / 0.700 m    -1.780 kN/m
```



8.2.7. wind from the front

System, loading + support reactions from vertical loads

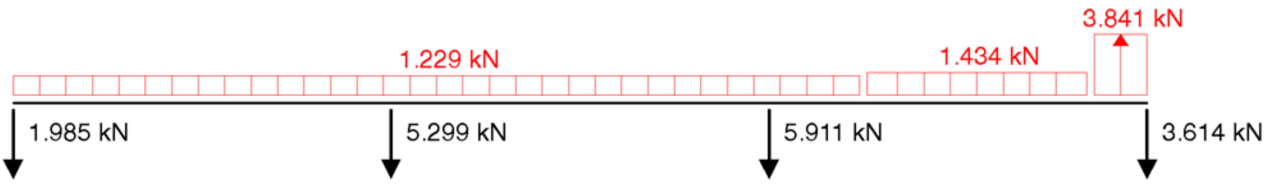
```
q1 from support force (s A) from rafter load c.  wind on gable (1)   -2.689 kN / 0.700 m    -3.841 kN/m
q2 from support force (s A) from rafter load c.  wind on gable (2)   -1.004 kN / 0.700 m    -1.434 kN/m
q3 from support force (s A) from rafter load c.  wind on gable (3)   -0.860 kN / 0.700 m    -1.229 kN/m
```



8.2.8. wind from behind

System, loading + support reactions from vertical loads

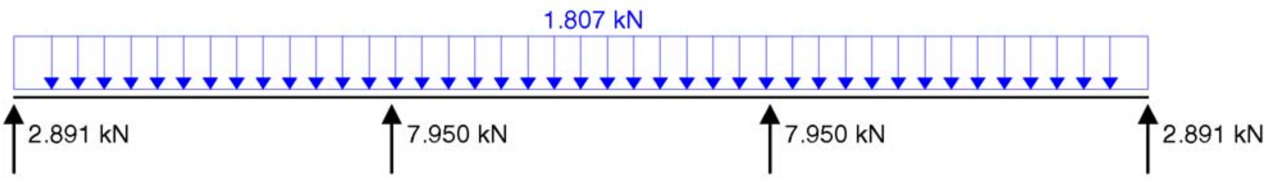
```
q1 from support force (s A) from rafter load c.  wind on gable (3)   -0.860 kN / 0.700 m    -1.229 kN/m
q2 from support force (s A) from rafter load c.  wind on gable (2)   -1.004 kN / 0.700 m    -1.434 kN/m
q3 from support force (s A) from rafter load c.  wind on gable (1)   -2.689 kN / 0.700 m    -3.841 kN/m
```



8.2.9. snow (1)

System, loading + support reactions from vertical loads

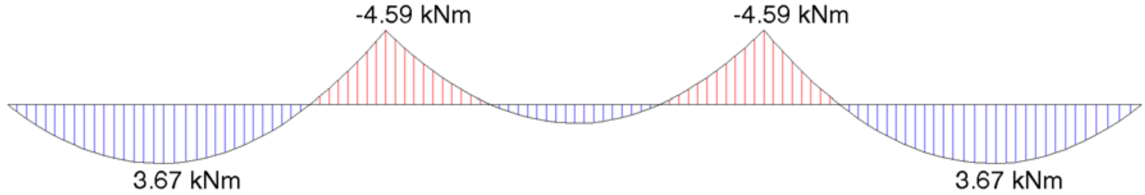
`from support force (s A) from rafter l. c.  snow fully          1.265 kN / 0.700 m     1.807 kN/m`



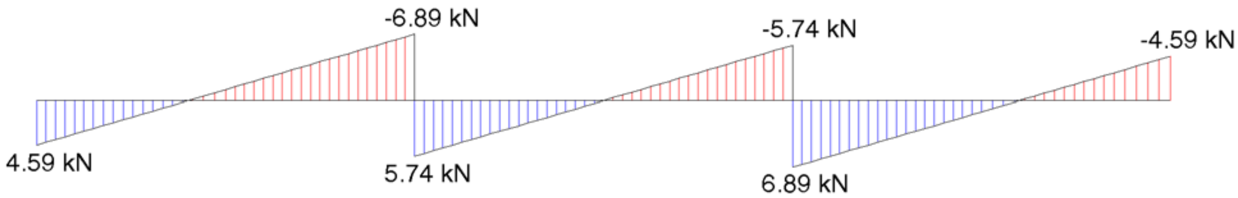
8.3. Extremal from action effects

8.3.1. permanent loads

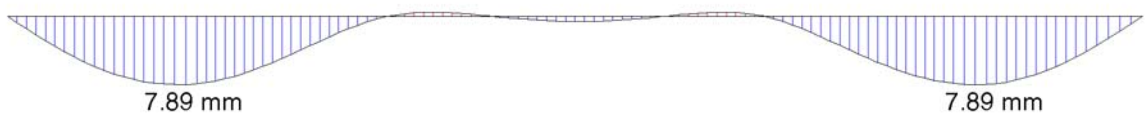
extremal flectural moments from vertical loads (permanent loads)



extremal shear forces from vertical loads (permanent loads)

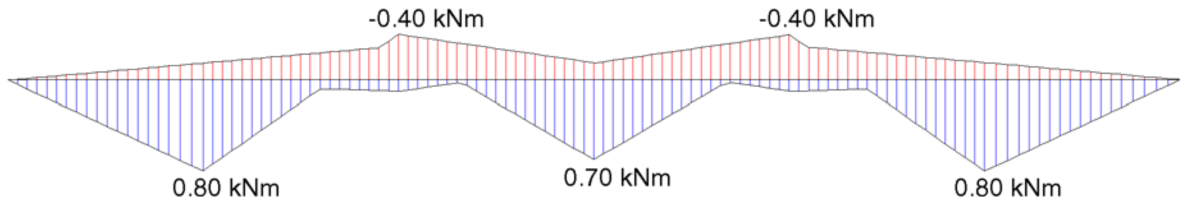


extremal deformations from vertical loads (permanent loads)

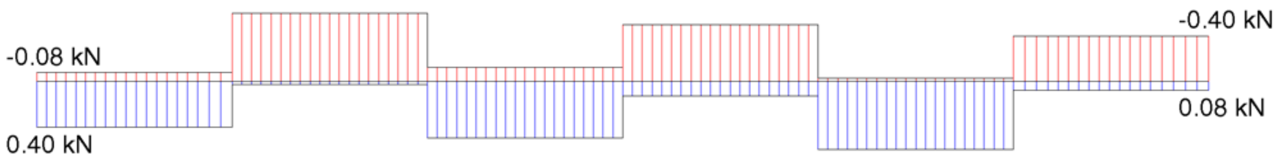


8.3.2. extremal man loads

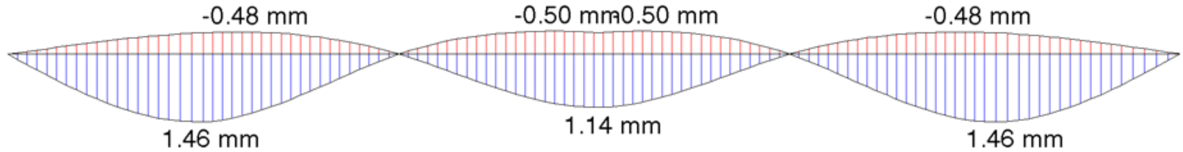
extremal flectural moments from vertical loads (man loads)



extremal shear forces from vertical loads (man loads)

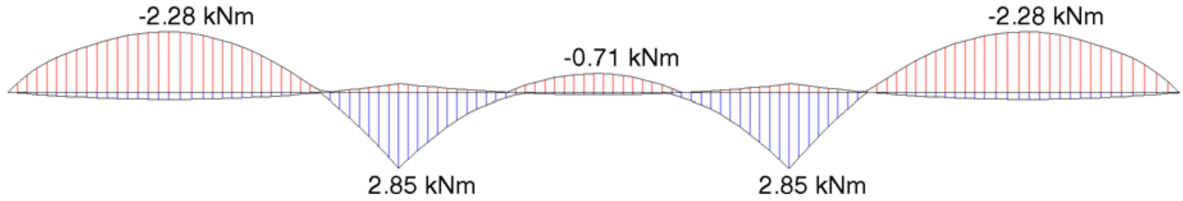


extremal deformations from vertical loads (man loads)

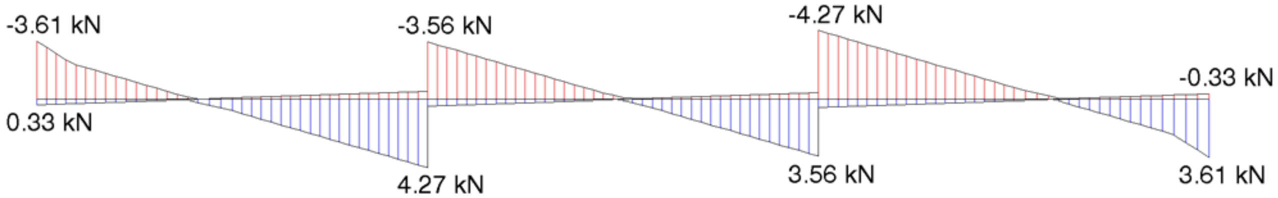


8.3.3. extremal wind loads

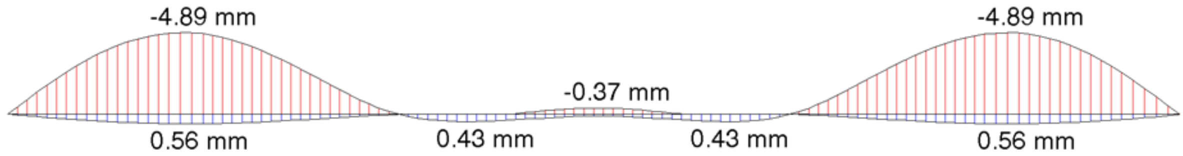
extremal flectural moments from vertical loads (wind)



extremal shear forces from vertical loads (wind)

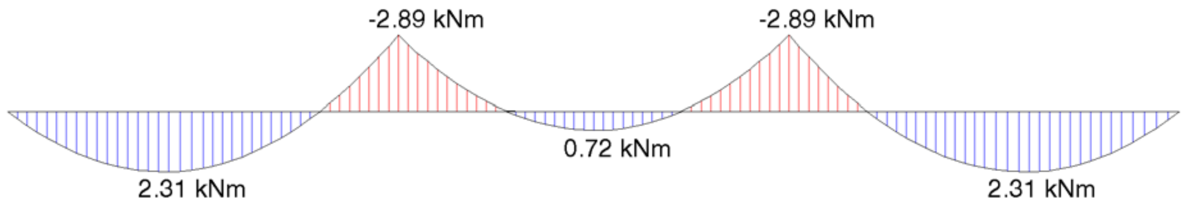


extremal deformations from vertical loads (wind)

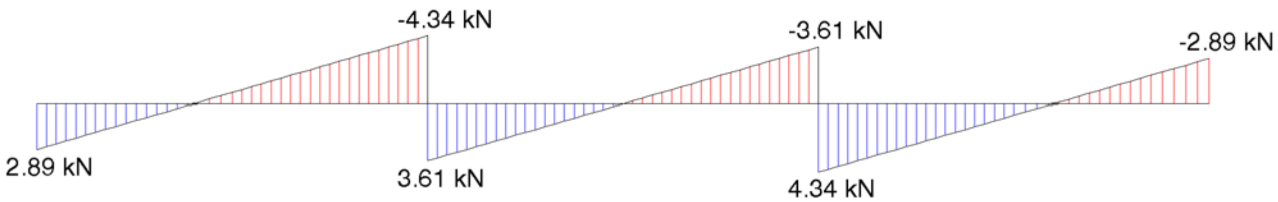


8.3.4. extremal snow loads

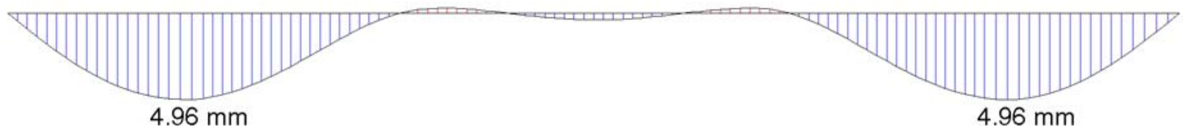
extremal flectural moments from vertical loads (snow)



extremal shear forces from vertical loads (snow)



extremal deformations from vertical loads (snow)



8.4. Verifications

8.4.1. degree of utilizations in the permanent and transienten design situation

The determination of the extreme values for the permanent and temporary design situation is carried out kmod-group-wise under variation of the guiding action with the partial safety and combination coefficients shown in the rafter calculation. For details see chapter 6.1.2. The utilisation rates are determined acc. to EC5 (6.1.6 bending and 6.1.7 thrust) with γ_M = 1.30. They result as shown below

max U = 98% ⇒ verification successful.

8.4.2. Utilisation rates in the exceptional design situation "Nordeutsche Tiefebene"

The determination of the extreme values for the exceptional design situation is carried out kmod-group-wise under variation of the guiding action with the partial safety and combination coefficients shown in the rafter calculation. For details see chapter 6.1.3. The utilisation rates are determined acc. to EC5 (6.1.6 bending and 6.1.7 thrust) with γ_M = 1.00. They result as shown below

max U = 80% ⇒ verification successful.

8.4.3. Serviceability utilisation rates without creep influence (w_{inst})

Comparison lengths = field lengths. For limit values and combination coefficients see chapter 6.2.3. The utilisation rates are determined for the characteristic combination. They result as shown below.

max U = 99% ⇒ verification successful.

8.4.4. Serviceability utilisation rates with creep influence (w_{fin})

Comparison lengths = field lengths. For limit values and combination coefficients see chapter 6.2.3. The utilisation rates are determined for the characteristic combination. They result as shown below with k_{def} = 0.60

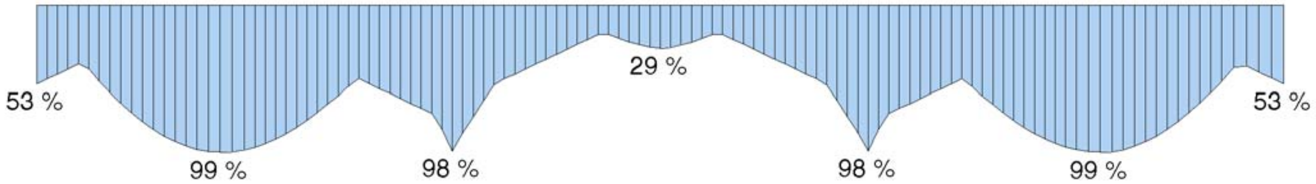
max U = 90% ⇒ verification successful.

8.4.5. Serviceability utilisation rates with creep influence ($w_{fin,net}$)

Comparison lengths = field lengths. For limit values and combination coefficients see chapter 6.2.3. The utilisation rates are determined for the quasi-permanent combination. They result as shown below with k_{def} = 0.60

max U = 95% ⇒ verification successful.

8.4.6. maximum utilization of all verifications



max U = 99% ⇒ all verifications successful.

8.5. extremal support reactions

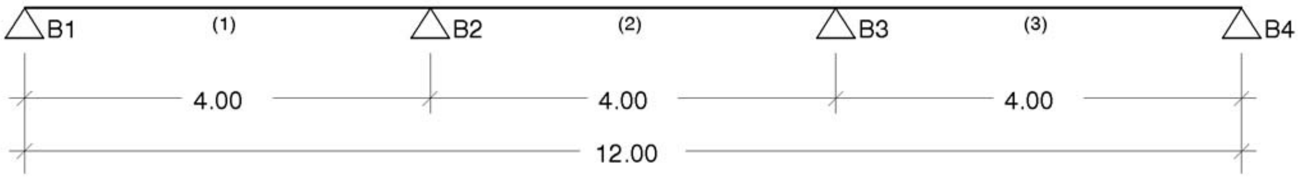
Abbreviations: G: permanent loads, M: man loads, N: live loads, W: wind loads, S: snow loads

support	G	M	N	W	S	Σ
	kN	kN	kN	kN	kN	kN
maximal vertical:						
A1	4.595	0.400	---	0.328	2.891	8.214
A2	12.636	0.725	---	0.901	7.950	22.213
A3	12.636	0.725	---	0.901	7.950	22.213
A4	4.595	0.400	---	0.328	2.891	8.214
minimal vertical:						
A1	4.595	-0.075	---	-3.614	0.000	0.906
A2	12.636	-0.150	---	-7.831	0.000	4.655
A3	12.636	-0.150	---	-7.831	0.000	4.655
A4	4.595	-0.075	---	-3.614	0.000	0.906

9. purlin B

9.1. position, characteristic values and structural system

material:	coniferous timber: C24
cross-section:	b = 12.0 cm, h = 18.0 cm
char.valu:	EI = 642 kN/m², W = 648.0 cm³, γ = 5.00 kN/m³
	fm,k = 24.0 N/mm², fv,k = 4.0 N/mm²
design codes:	Eurocode: EN 1990, EN 1991, EN 1995



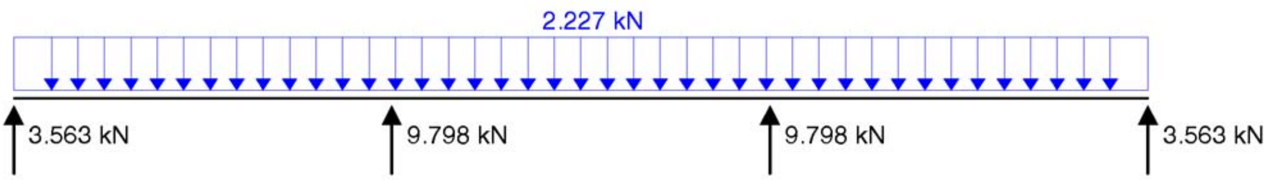
9.2. Loading

The structure of the load corresponds to that of the rafter calculation. Exception: The permanent loads are combined into one load case.The loads are essentially recruited from the bearing reaction forces (support B) of the rafter calculation. Exception: man loads. The purlin is stressed to double bending.
Only the relevant load cases are logged here that make a significant contribution to the extrema of the assigned action.

9.2.1. permanent loads

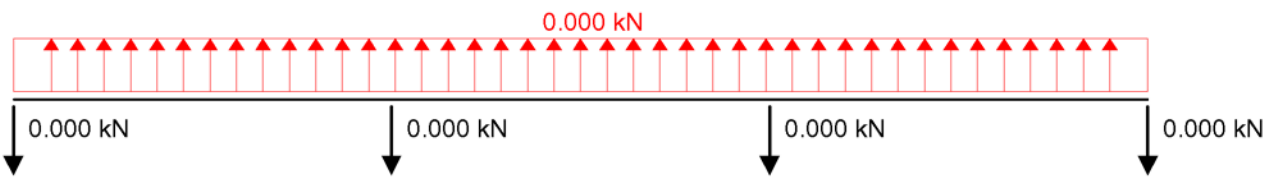
System, loading + support reactions from vertical loads

from support force (s B) from rafter load c. dead load	0.317 kN / 0.700 m	0.453 kN/m
from support force (s B) from rafter l. c. outer skin	1.166 kN / 0.700 m	1.666 kN/m
dead load purlin (5.000 kN/m³ * 0.180 m * 0.120 m)		0.108 kN/m
sum permanent loads (vertical)		**2.227 kN/m**

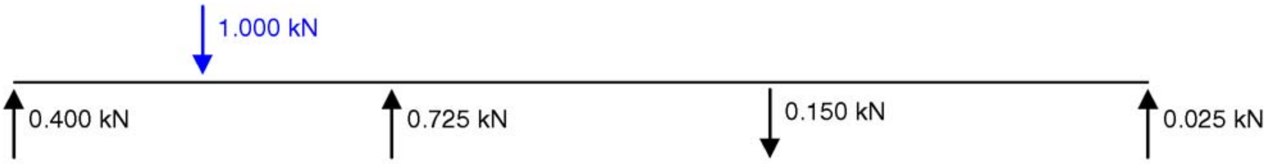


System, loading + support reactions from horizontal loads

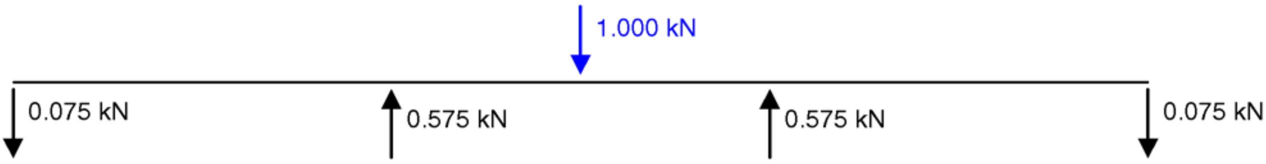
from support force (s B) from rafter load c. dead load	0.000 kN / 0.700 m	0.000 kN/m
from support force (s B) from rafter l. c. outer skin	0.000 kN / 0.700 m	0.000 kN/m
sum permanent loads (horizontal)		**0.000 kN/m**



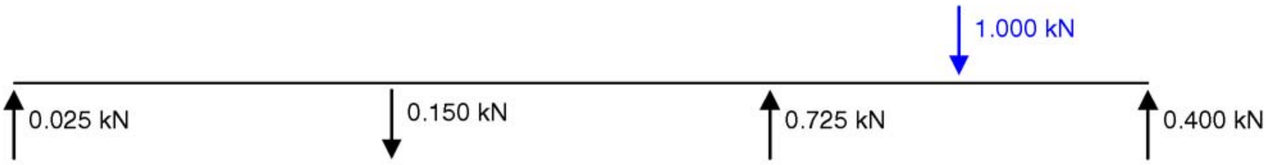
9.2.2. man load position 1



9.2.3. man load position 2



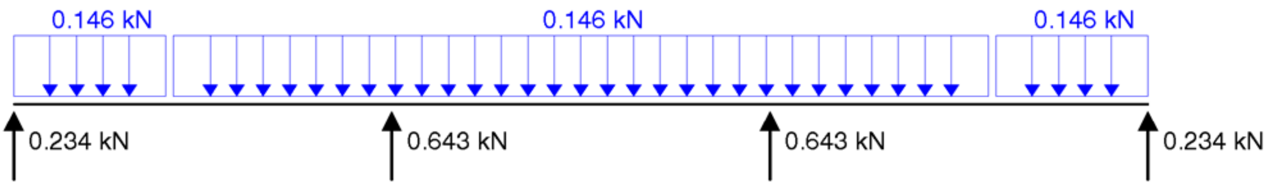
9.2.4. man load position 3



9.2.5. wind from left side (1)

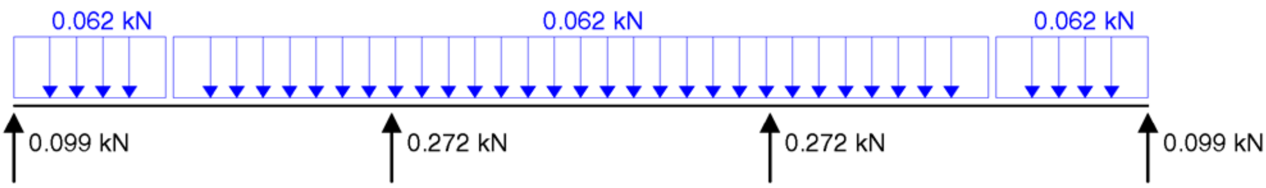
System, loading + support reactions from vertical loads

q1	from support force (s B) from rafter l.c. wind from left s (1)	0.102 kN / 0.700 m	**0.146 kN/m**
q2	from support force (s B) from rafter l.c. wind from left s (1)	0.102 kN / 0.700 m	**0.146 kN/m**
q3	from support force (s B) from rafter l.c. wind from left s (1)	0.102 kN / 0.700 m	**0.146 kN/m**



System, loading + support reactions from horizontal loads

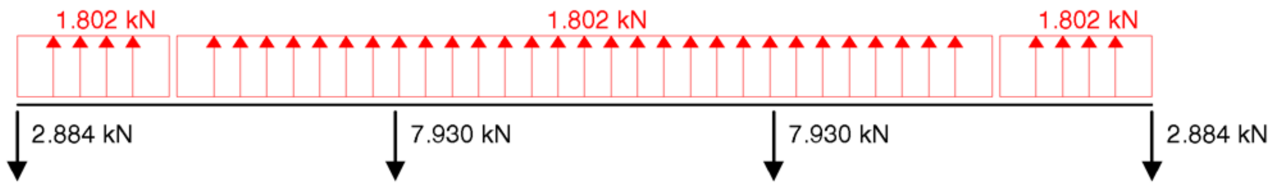
q1	from support force (s B) from rafter l.c. wind from left s (1)	0.043 kN / 0.700 m	**0.062 kN/m**
q2	from support force (s B) from rafter l.c. wind from left s (1)	0.043 kN / 0.700 m	**0.062 kN/m**
q3	from support force (s B) from rafter l.c. wind from left s (1)	0.043 kN / 0.700 m	**0.062 kN/m**



9.2.6. wind from right side (4)

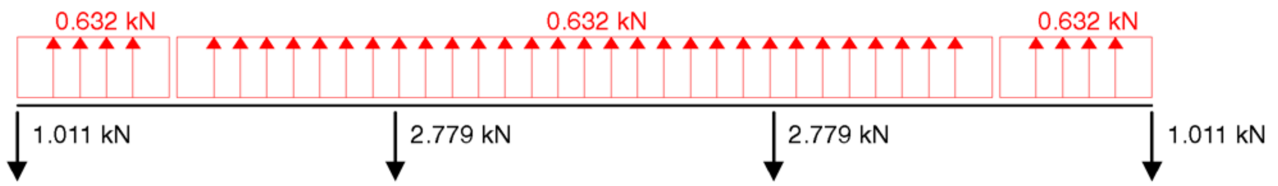
System, loading + support reactions from vertical loads

q1 from support force (s B) from rafter l.c. wind from right s (4) -1.262 kN / 0.700 m **-1.802 kN/m**
q2 from support force (s B) from rafter l.c. wind from right s (4) -1.262 kN / 0.700 m **-1.802 kN/m**
q3 from support force (s B) from rafter l.c. wind from right s (4) -1.262 kN / 0.700 m **-1.802 kN/m**



System, loading + support reactions from horizontal loads

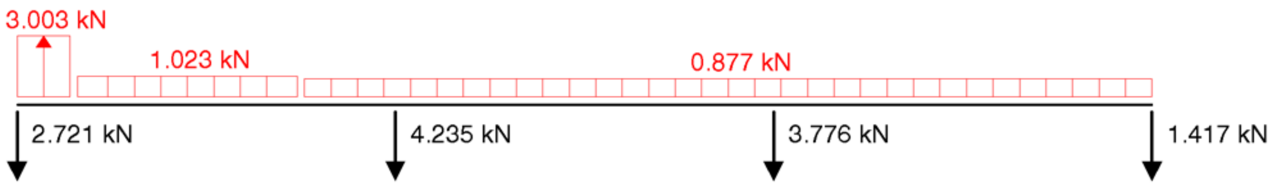
q1 from support force (s B) from rafter l.c. wind from right s (4) -0.442 kN / 0.700 m **-0.632 kN/m**
q2 from support force (s B) from rafter l.c. wind from right s (4) -0.442 kN / 0.700 m **-0.632 kN/m**
q3 from support force (s B) from rafter l.c. wind from right s (4) -0.442 kN / 0.700 m **-0.632 kN/m**



9.2.7. wind from the front

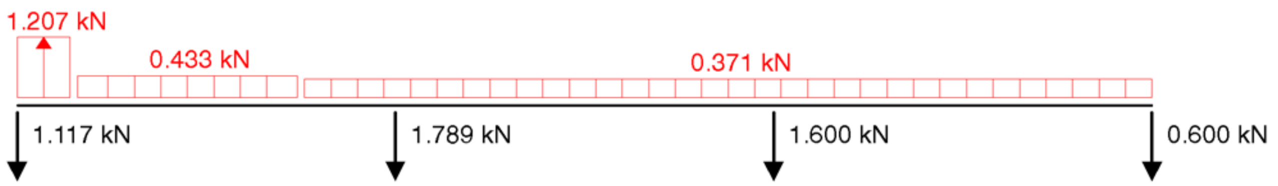
System, loading + support reactions from vertical loads

q1 from support force (s B) from rafter load c. wind on gable (1) -2.102 kN / 0.700 m **-3.003 kN/m**
q2 from support force (s B) from rafter load c. wind on gable (2) -0.716 kN / 0.700 m **-1.023 kN/m**
q3 from support force (s B) from rafter load c. wind on gable (3) -0.614 kN / 0.700 m **-0.877 kN/m**



System, loading + support reactions from horizontal loads

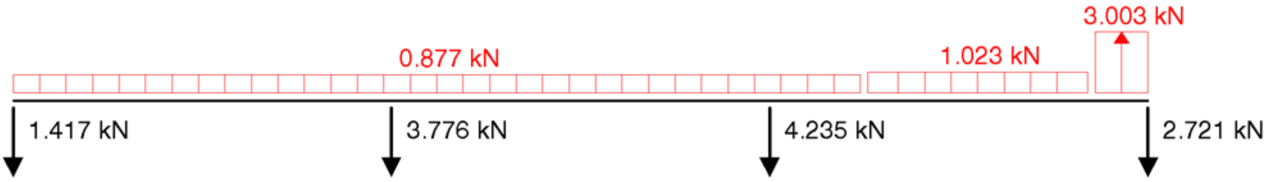
q1 from support force (s B) from rafter load c. wind on gable (1) -0.845 kN / 0.700 m **-1.207 kN/m**
q2 from support force (s B) from rafter load c. wind on gable (2) -0.303 kN / 0.700 m **-0.433 kN/m**
q3 from support force (s B) from rafter load c. wind on gable (3) -0.260 kN / 0.700 m **-0.371 kN/m**



9.2.8. wind from behind

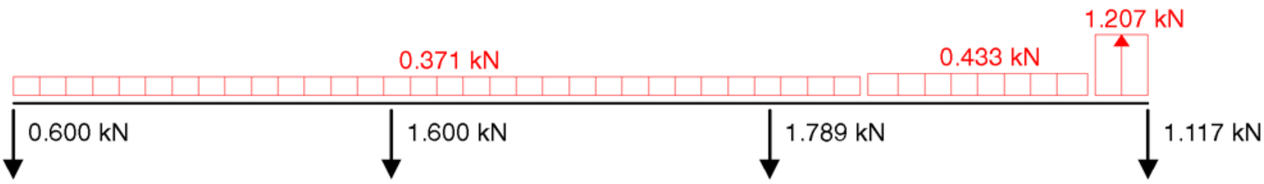
System, loading + support reactions from vertical loads

q1 from support force (s B) from rafter load c. wind on gable (3) -0.614 kN / 0.700 m **-0.877 kN/m**
q2 from support force (s B) from rafter load c. wind on gable (2) -0.716 kN / 0.700 m **-1.023 kN/m**
q3 from support force (s B) from rafter load c. wind on gable (1) -2.102 kN / 0.700 m **-3.003 kN/m**



System, loading + support reactions from horizontal loads

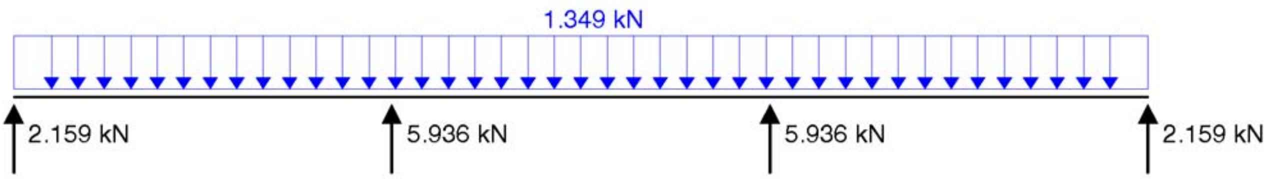
q1 from support force (s B) from rafter load c. wind on gable (3) -0.260 kN / 0.700 m **-0.371 kN/m**
q2 from support force (s B) from rafter load c. wind on gable (2) -0.303 kN / 0.700 m **-0.433 kN/m**
q3 from support force (s B) from rafter load c. wind on gable (1) -0.845 kN / 0.700 m **-1.207 kN/m**



9.2.9. snow (1)

System, loading + support reactions from vertical loads

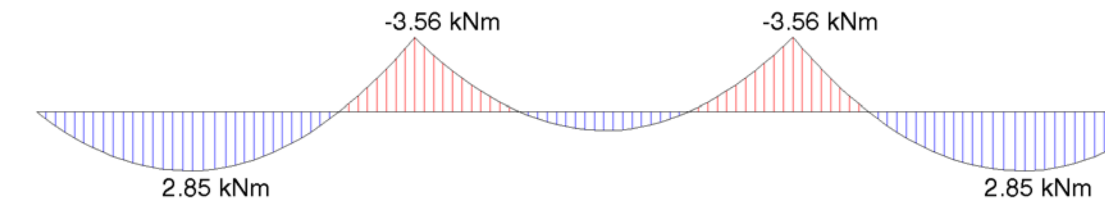
from support force (s B) from rafter l. c. snow fully 0.944 kN / 0.700 m **1.349 kN/m**



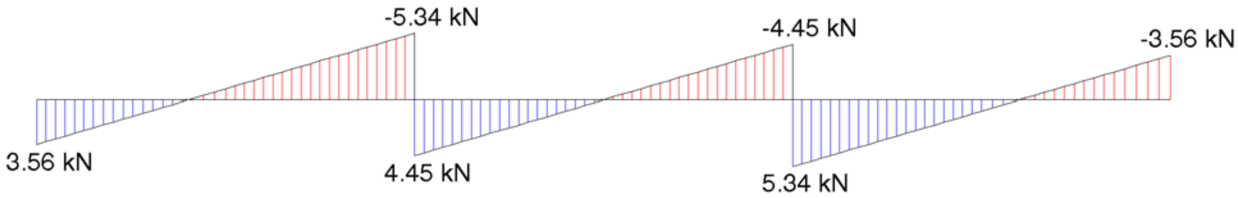
9.3. Extremal from action effects

9.3.1. permanent loads

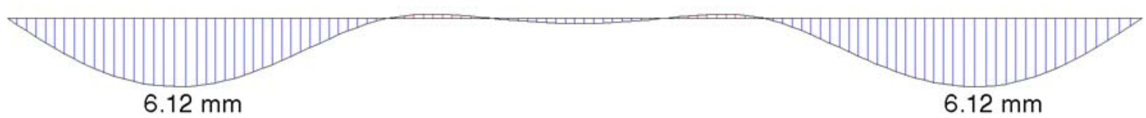
extremal flectural moments from vertical loads (permanent loads)



extremal shear forces from vertical loads (permanent loads)

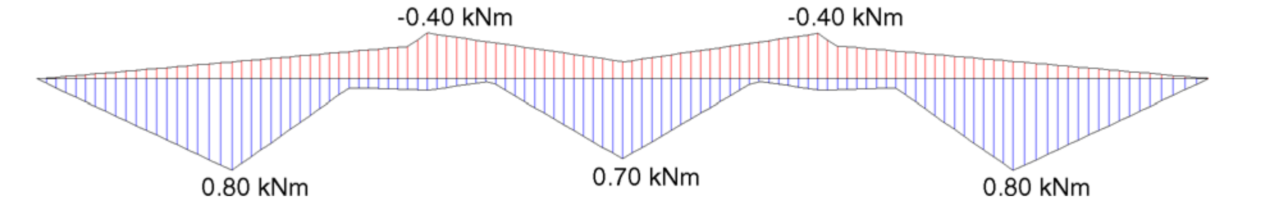


extremal deformations from vertical loads (permanent loads)

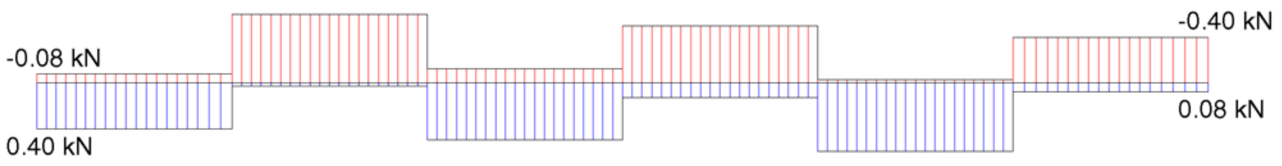


9.3.2. extremal man loads

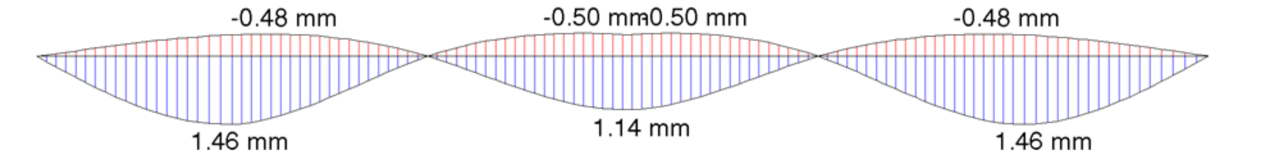
extremal flectural moments from vertical loads (man loads)



extremal shear forces from vertical loads (man loads)

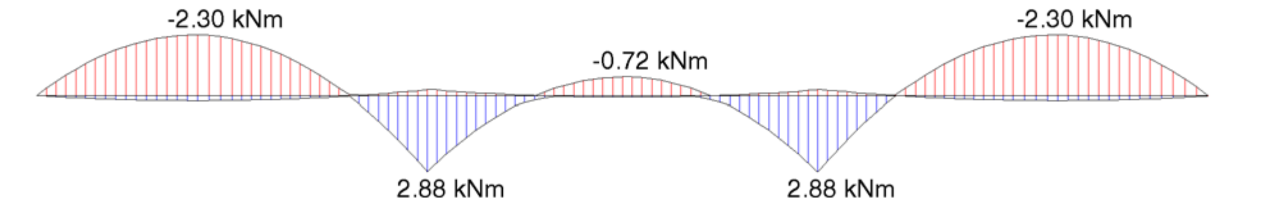


extremal deformations from vertical loads (man loads)

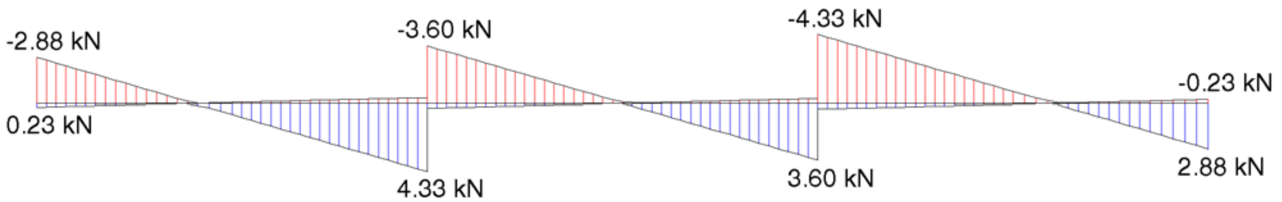


9.3.3. extremal wind loads

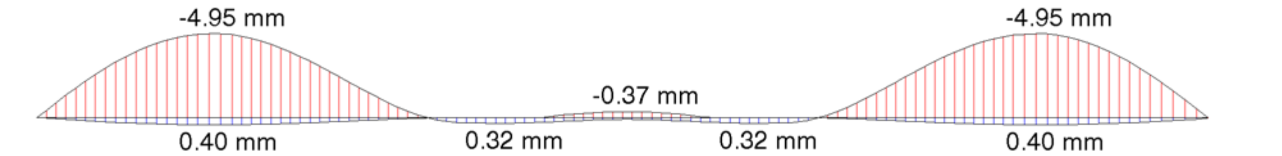
extremal flectural moments from vertical loads (wind)



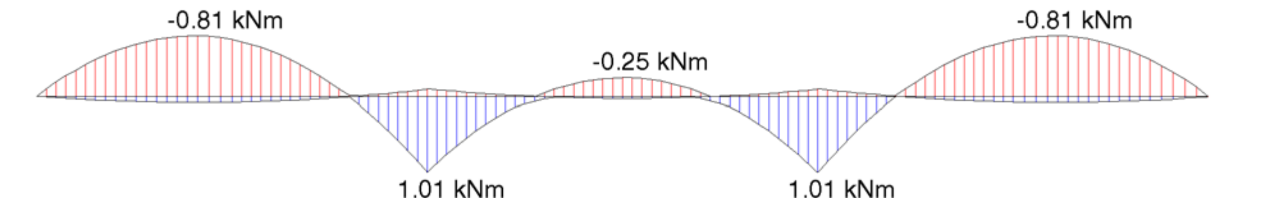
extremal shear forces from vertical loads (wind)



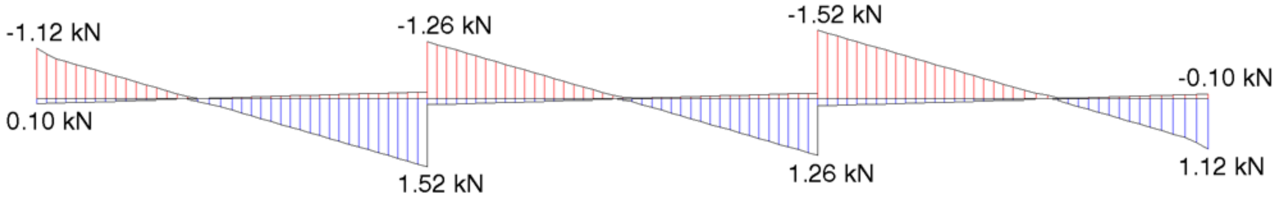
extremal deformations from vertical loads (wind)



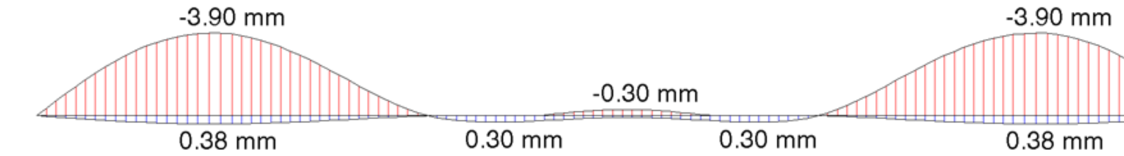
extremal flectural moments from horizontal loads (wind)



extremal shear forces from horizontal loads (wind)

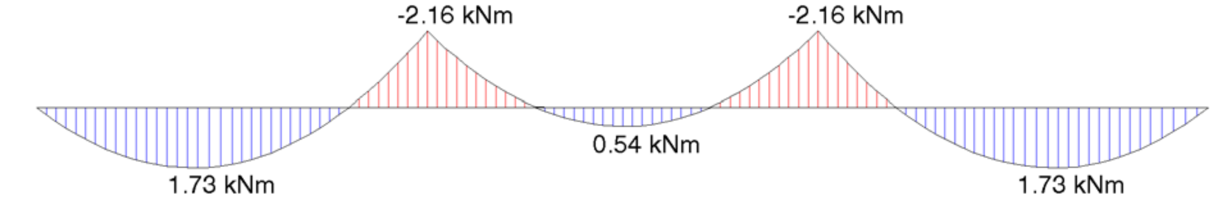


extremal deformations from horizontal loads (wind)

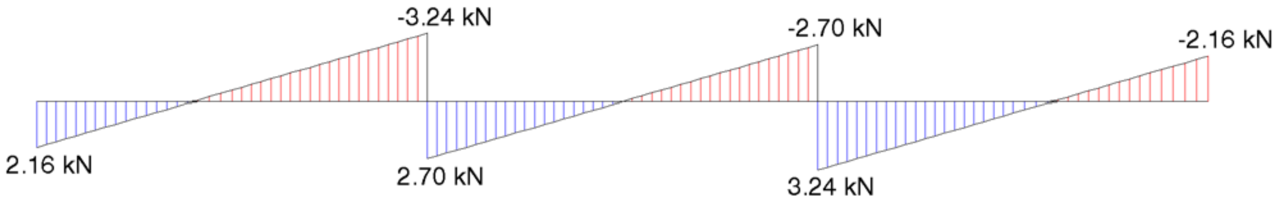


9.3.4. extremal snow loads

extremal flectural moments from vertical loads (snow)



extremal shear forces from vertical loads (snow)



extremal deformations from vertical loads (snow)

9.4. Verifications

9.4.1. degree of utilizations in the permanent and transienten design situation

The determination of the extreme values for the permanent and temporary design situation is carried out kmod-group-wise under variation of the guiding action with the partial safety and combination coefficients shown in the rafter calculation. For details see chapter 6.1.2. The utilisation rates are determined acc. to EC5 (6.1.6 bending and 6.1.7 thrust) with $\gamma_M = 1.30$. They result as shown below

max U = 77% $\Rightarrow$ verification successful.

9.4.2. Utilisation rates in the exceptional design situation "Nordeutsche Tiefebene"

The determination of the extreme values for the exceptional design situation is carried out kmod-group-wise under variation of the guiding action with the partial safety and combination coefficients shown in the rafter calculation. For details see chapter 6.1.3. The utilisation rates are determined acc. to EC5 (6.1.6 bending and 6.1.7 thrust) with γ_M = 1.00. They result as shown below

max U = 61% ⇒ verification successful.

9.4.3. Serviceability utilisation rates without creep influence (w_{inst})

Comparison lengths = field lengths. For limit values and combination coefficients see chapter 6.2.3. The utilisation rates are determined for the characteristic combination. They result as shown below.

max U = 77% ⇒ verification successful.

9.4.4. Serviceability utilisation rates with creep influence (w_{fin})

Comparison lengths = field lengths. For limit values and combination coefficients see chapter 6.2.3. The utilisation rates are determined for the characteristic combination. They result as shown below with k_{def} = 0.60

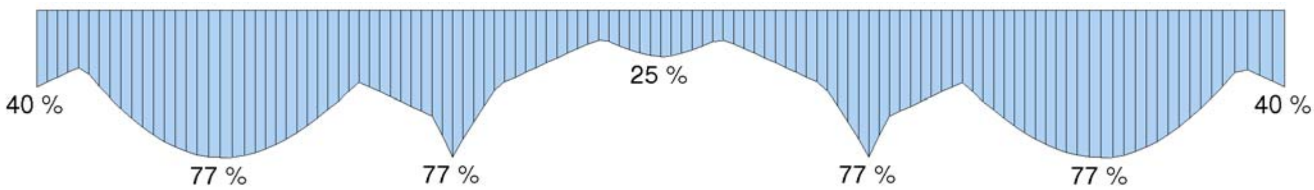
max U = 70% ⇒ verification successful.

9.4.5. Serviceability utilisation rates with creep influence ($w_{fin,net}$)

Comparison lengths = field lengths. For limit values and combination coefficients see chapter 6.2.3. The utilisation rates are determined for the quasi-permanent combination. They result as shown below with k_{def} = 0.60

max U = 73% ⇒ verification successful.

9.4.6. maximum utilization of all verifications



max U = 77% ⇒ all verifications successful.

9.5. extremal support reactions

Abbreviations: G: permanent loads, M: man loads, N: live loads, W: wind loads, S: snow loads

support	G kN	M kN	N kN	W kN	S kN	Σ kN
maximal vertical:						
B1	3.563	0.400	---	0.234	2.159	6.356
B2	9.798	0.725	---	0.643	5.936	17.103
B3	9.798	0.725	---	0.643	5.936	17.103
B4	3.563	0.400	---	0.234	2.159	6.356
minimal vertical:						
B1	3.563	-0.075	---	-2.884	0.000	0.604
B2	9.798	-0.150	---	-7.930	0.000	1.719
B3	9.798	-0.150	---	-7.930	0.000	1.719
B4	3.563	-0.075	---	-2.884	0.000	0.604
maximal horizontal:						
B1	0.000	0.000	---	0.099	0.000	0.099
B2	0.000	0.000	---	0.272	0.000	0.272
B3	0.000	0.000	---	0.272	0.000	0.272
B4	0.000	0.000	---	0.099	0.000	0.099
minimal horizontal:						
B1	0.000	0.000	---	-1.117	0.000	-1.117
B2	0.000	0.000	---	-2.779	0.000	-2.779
B3	0.000	0.000	---	-2.779	0.000	-2.779
B4	0.000	0.000	---	-1.117	0.000	-1.117