STRUCTURAL CALCULATION
Deck beams HxB 40x60

CLIENT:	Felix Clercx Handelsonderneming
PROJECT NUMBER:	18.124-3
DATE:	12-2-2019
REVISION:	-
ENGINEER :	ing. E. Rooijackers

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CONTENTS

GENERAL INFORMATION

* Description

This report calculates the aluminium duct profiles that are applied in a deck system. The beams are centred at 400mm.

- max. span = 100 cm in category A buildings (houses and apartments)
- max. span = 45 cm in category B, C and D buildings

* Applicable codes regulations

EN 1990 Eurocode 0: Basis of structural design
EN 1991 Eurocode 1: Actions on structures
EN 1999 Eurocode 9: Design and calculation of aluminium structures

* Material

Aluminium : - EN AW 6060 T5 (permissible stress <= 150 N/mm^2)

* Building data

- Building type :	Category A: Living accommodation Category B: Offices Category C: Meeting function, not category A, B, or D Category D: Shops
- Effect Classes:	CC1 (cat. A) CC2 (cat. B, C and D)
- Reliability class:	RC1, k_{fi} = 0,90 (cat. A) RC2 k_{Fi} = 1.00 (cat. B, C and D)
- Design Lifetime class:	3 (50 years)

* Safety factors

Category A
Permanent: γ_g = 1.22 / 1.08 / 0.9
Imposed : γ_q = 1.35
Time factor : φ_t = 1.0

Category B, C and D
Permanent: $\gamma_g = 1.35 / 1.2 / 0.9$
Imposed : $\gamma_q = 1.5$
Time factor : $\varphi_t = 1.0$

* Loads

- Wood or composite deck parts

$g_k = 0.30$ kN/m^2

- Imposed loads category A

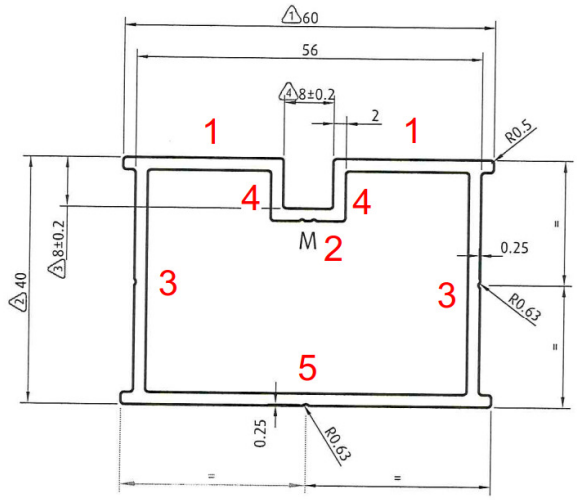
$q_k = 2.50$ kN/m^2
$Q_k = 3.00$ kN on a surface of 0.5x0.5 m^2, $\varphi_0 = 0.4$, $\varphi_1 = 0.5$, $\varphi_2 = 0.3$

- Imposed loads category B, C and D

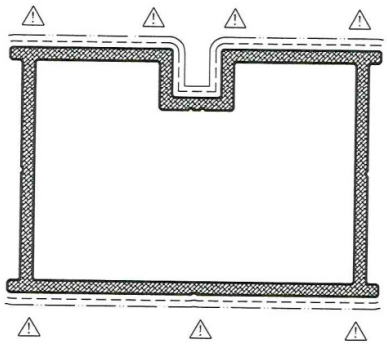
$q_k = 5.00$ kN/m^2
$Q_k = 7.00$ kN on a surface of 0.5x0.5 m^2, $\varphi_0 = 0.5$, $\varphi_1 = 0.5$, $\varphi_2 = 0.3$

BEAMS

Cotas não tolerânciadas de acordo com NP EN 12020-2
Unspecified tolerances according NP EN 12020-2



Esc. 1:1



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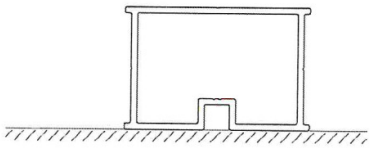


Posição de saída
Run-out position

Rev. Nº Rev. Nº									Des: Des:	Data: Data:	Aprov: Aprov:
Liga Alloy	EN AW 6060	Esp. Geral Unspec. Thickness	2.0 mm	A. Anod. Anod. Area	0,221 m2/m	Ref. Prov. Prov. Ref.	X.07.11.17 - 1		Referência Reference	NZ.664.007	
Trat. Térmico Heat Treatment	T5	Per. Int. Int. Per.	191 mm	A. Polir: Polishing Area	0,135 m2/m	Desen. Drawn	Ana Rosa	Data Date 07.11.17			
Diam. Circunscrito Circumscribed Diam.	Ø 72 mm	Per. Ext. Ext. Per.	221 mm	Ixx: cm4	Iyy: cm4	Verif. Verif.	JPS	Data Date 13.11.2017	Ref. Cliente Client Ref.		
Peso Weight	1,121 kg/m	Per. Total Total Per.	412 mm	Raios n colados mm		Aprov.		Data	Cliente		

- Category A

Compiled profile

	Width [mm]	Height [mm]	e [mm]	I_y part [mm^4]	I shifted [mm^4]	I tot [mm^4]
part 1	52	2	39	35	34.566	34.600
part 2	12	2	31	8	2.512	2.520
part 3	4	36	20	15.552	85	15.637
part 4	4	6	35	72	4.860	4.932
part 5	60	2	1	40	46.899	46.939

Total Height: 40 mm

Centre of gravity : 20,8 mm

Surface: 416 mm^2

Weight: 3,3 kg/m

I tot : 104.629 mm^4

Wel : 5.038 mm^3

In terms of static values, the profile corresponds to a **RHS 60x40x2**

The beams are centred at 400mm. The support distance may not exceed the maximum of 1000mm

g_k = 0.4 x 0.30 = 0.12 kN/m

Category A
q_k = 0.4 x 2.50 = 1.00 kN/m
Q_k = 3.00 kN

Due to a limitation in the computer calculation program, the strength of the profile is introduced as steel instead of aluminium. It will be taken into account that the stress does not exceed 150 N/mm^2. For the E-modulus, used for calculating the deflection, the value of aluminum is used.

Technosoft Liggers release 6.29 12 feb 2019

Project.....: 18124-1 -
Onderdeel....: liggers 40x24x2, categorie A
Constructeur.: Emiel Rooijackers
Opdrachtgever:
Dimensies....: kN/m/rad
Datum.....: 22/11/2018
Bestand.....: d:\dropbox\projecten\2018\18124\berekeningen\liggers 60x40x2, categorie a.dlw

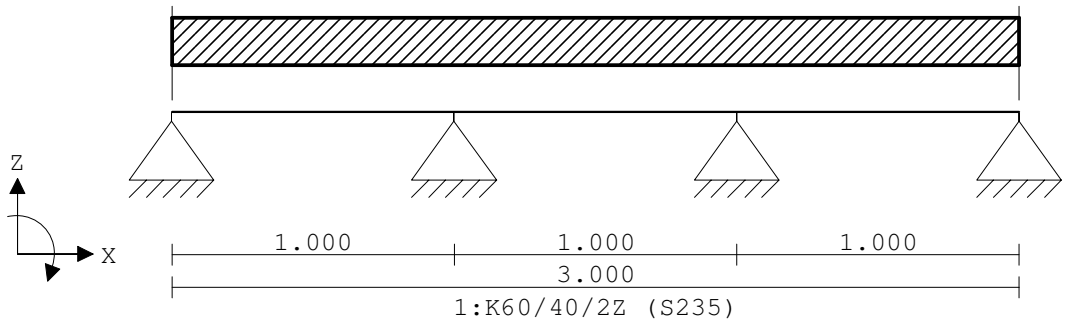
Betrouwbaarheidsklasse : 1 Referentieperiode : 50

Toegepaste normen volgens Eurocode met Nederlandse NB

Belastingen	NEN-EN 1990:2002	C2:2010	NB:2011(nl)
	NEN-EN 1991-1-1:2002	C1:2009	NB:2011(nl)
Staal	NEN-EN 1993-1-1:2006	C2:2011,A1:2016	NB:2016(nl)

GEOMETRIE

Ligger:1



PROFIELVORMEN [mm]

1 K60/40/2Z

BELASTINGGEVALLEN

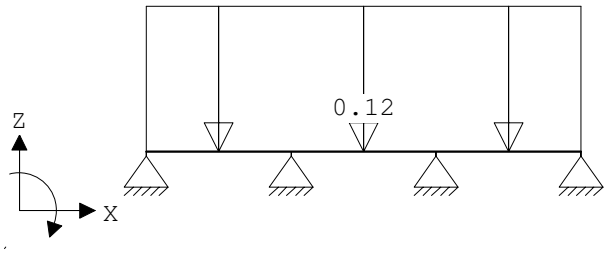
B.G.	Omschrijving	Belast/onbelast	ψ_0	ψ_1	ψ_2	e.g.
1	Permanent	2:Permanent EN1991				-1.00
2	Veranderlijk lijnlas	1:Schaakbord EN1991	0.40	0.50	0.30	0.00
3	Veranderlijk puntlas	3:Kraanbaan	0.40	0.50	0.30	0.00

BELASTINGGEVALLEN

B.G.	Omschrijving	Type
1	Permanent	1 Permanente belasting
2	Veranderlijk lijnlast	2 Ver. bel. pers. ed. (p_rep)
3	Veranderlijk puntlast	3 Ver. bel. pers. ed. (F-rep)

VELDBELASTINGEN

Ligger:1 B.G:1 Permanent



VELDBELASTINGEN

Ligger:1 B.G:1 Permanent

Last	Ref.	Type	Omschrijving	q1/p/m	q2	psi	Afstand	Lengte
1		1:q-last		-0.120	-0.120		0.000	3.000

REACTIES

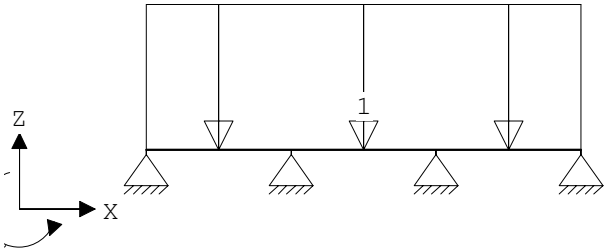
Ligger:1 B.G:1 Permanent

Stp	F	M
1	0.05	0.00
2	0.14	0.00
3	0.14	0.00
4	0.05	0.00

0.39	:	(absoluut) grootste som reacties
-0.39	:	(absoluut) grootste som belastingen

VELDBELASTINGEN

Ligger:1 B.G:2 Veranderlijk lijnlast



VELDBELASTINGEN

Ligger:1 B.G:2 Veranderlijk lijnlast

Last	Ref.	Type	Omschrijving	q1/p/m	q2	psi	Afstand	Lengte
1		1:q-last		-1.000	-1.000		0.000	3.000

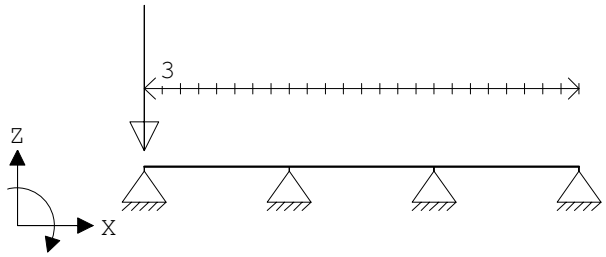
REACTIES

Ligger:1 B.G:2 Veranderlijk lijnlast

Stp	Fmin	Fmax	Mmin	Mmax
1	-0.05	0.45	0.00	0.00
2	0.00	1.20	0.00	0.00
3	0.00	1.20	0.00	0.00
4	-0.05	0.45	0.00	0.00

VELDBELASTINGEN

Ligger:1 B.G:3 Veranderlijk puntlast



VELDBELASTINGEN

Ligger:1 B.G:3 Veranderlijk puntlast

Last	Ref.	Type	Omschrijving	q1/p/m	q2	psi	Afstand	Lengte
1		15:Pass.stelsel		-3.000	0.125		0.000	3.000

REACTIES

Ligger:1 B.G:3 Veranderlijk puntlast

Stp	Fmin	Fmax	Mmin	Mmax
1	-0.24	3.00	0.00	0.00
2	-0.46	3.00	0.00	0.00
3	-0.46	3.00	0.00	0.00
4	-0.24	3.00	0.00	0.00

BELASTINGCOMBINATIES

BC	Type					
1	Fund.	1.22	$G_{k,1}$			
2	Fund.	0.90	$G_{k,1}$			
3	Fund.	1.22	$G_{k,1}$	+	1.35 ψ_0	$Q_{k,2}$
4	Fund.	1.22	$G_{k,1}$	+	1.35 ψ_0	$Q_{k,3}$
5	Fund.	1.08	$G_{k,1}$	+	1.35	$Q_{k,2}$
6	Fund.	1.08	$G_{k,1}$	+	1.35	$Q_{k,3}$
7	Fund.	0.90	$G_{k,1}$	+	1.35 ψ_0	$Q_{k,2}$
8	Fund.	0.90	$G_{k,1}$	+	1.35	$Q_{k,2}$
9	Fund.	0.90	$G_{k,1}$	+	1.35	$Q_{k,3}$
10	Fund.	0.90	$G_{k,1}$	+	1.35 ψ_0	$Q_{k,3}$
11	Kar.	1.00	$G_{k,1}$	+	1.00	$Q_{k,2}$
12	Kar.	1.00	$G_{k,1}$	+	1.00	$Q_{k,3}$
13	Blij.	1.00	$G_{k,1}$			

GUNSTIGE WERKING PERMANENTE BELASTINGEN

BC	Velden met gunstige werking
1	Geen
2	Alle velden de factor:0.90
3	Geen
4	Geen
5	Geen
6	Geen
7	Alle velden de factor:0.90

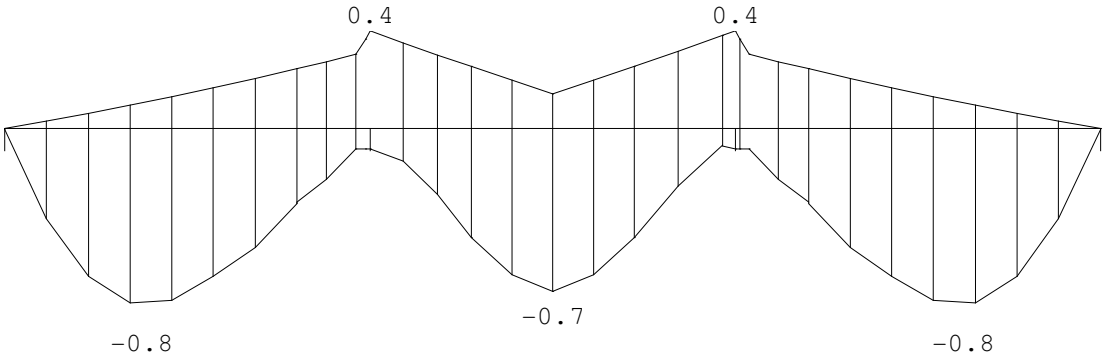
GUNSTIGE WERKING PERMANENTE BELASTINGEN

BC	Velden met gunstige werking
8	Alle velden de factor:0.90
9	Alle velden de factor:0.90
10	Alle velden de factor:0.90

OMHULLENDE VAN DE FUNDAMENTELE COMBINATIES

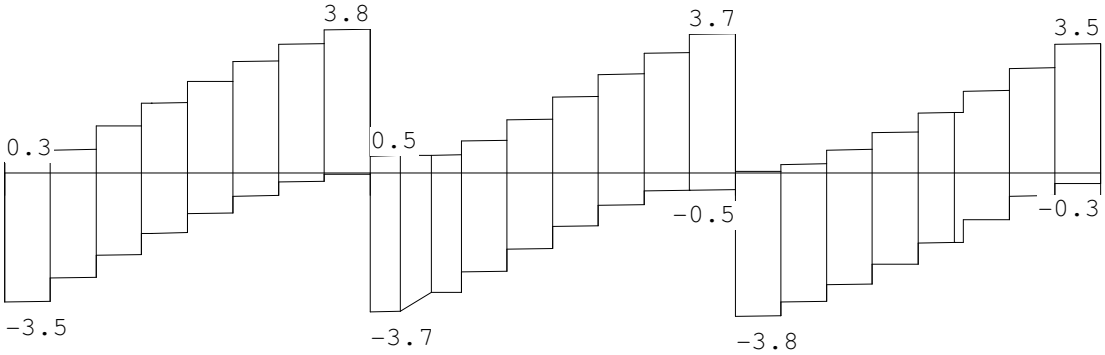
MOMENTEN

Ligger:1 Fundamentele combinatie



DWARSKRACHTEN

Ligger:1 Fundamentele combinatie



Fmin:	-0.28	-0.49	-0.49	-0.28
Fmax:	4.11	4.20	4.20	4.11

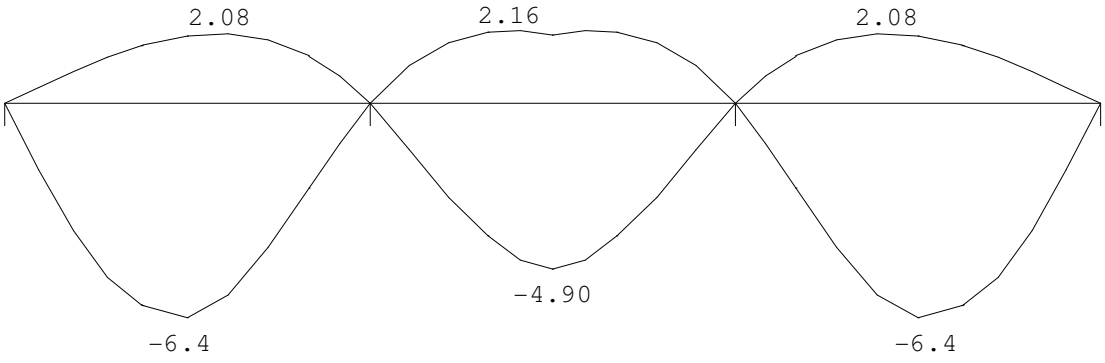
REACTIES

Ligger:1 Fundamentele combinatie

Stp	Fmin	Fmax	Mmin	Mmax
1	-0.28	4.11	0.00	0.00
2	-0.49	4.20	0.00	0.00
3	-0.49	4.20	0.00	0.00
4	-0.28	4.11	0.00	0.00

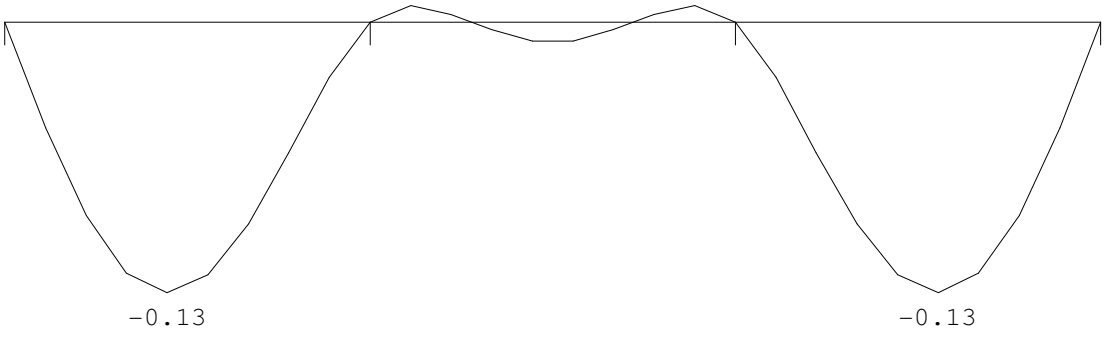
OMHULLENDE VAN DE KARAKTERISTIEKE COMBINATIES

VERPLAATSINGEN [mm] Ligger:1 Karakteristieke combinatie



OMHULLENDE VAN DE BLIJVENDE COMBINATIES

VERPLAATSINGEN [mm] Ligger:1 Blijvende combinatie



STAALPROFIELEN – ALGEMENE GEGEVENS Ligger:1

Stabiliteit: Classificatie gehele constructie: Geschoord

MATERIAAL

Mat nr.	Profielnaam	Vloeisp. [N/mm^2]	Productie methode	Min. drsn. klasse
1	K60/40/2Z	235	Warmgewalst	1

Partiële veiligheidsfactoren:
Gamma M;0 : 1.00 Gamma M;1 : 1.00

KIPSTABILITEIT Ligger:1

Staaf	Plts. aangr.		l gaffel [m]	Kipsteunafstanden [m]
1	1.0*h	boven:	1.00	1.000
		onder:	1.00	1.000
2	1.0*h	boven:	1.00	1.000
		onder:	1.00	1.000
3	1.0*h	boven:	1.00	1.000
		onder:	1.00	1.000

TOETSING SPANNINGEN

Ligger:1

Staaf	Mat nr.	BC	Sit	Kl	Plaats	Norm	Artikel	Formule	Hoogste toetsing U.C.	[N/mm^2]	Opm.
1	1	6	4	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.612	144	**< 150**
2	1	6	13	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.526	124	
3	1	6	22	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.612	144	

- Category B, C and D

The beams are centred at 400mm. The support distance may not exceed the maximum of 450mm

g_k = 0.4 x 0.30 = 0.12 kN/m

Category B, C and D
q_k = 0.4 x 5.00 = 2.00 kN/m
Q_k = 7.00 kN

Due to a limitation in the computer calculation program, the strength of the profile is introduced as steel instead of aluminium. It will be taken into account that the stress does not exceed 150 N/mm^2. For the E-modulus, used for calculating the deflection, the value of aluminum is used.

Technosoft Liggers release 6.29 12 feb 2019

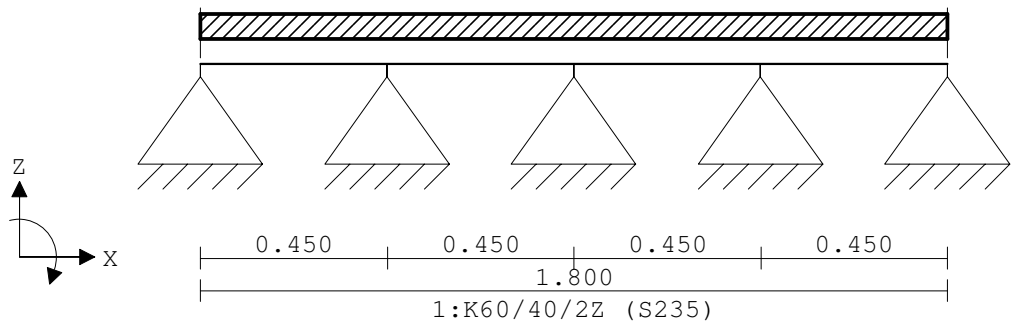
```
Project......: 18124-1 -
Onderdeel....: liggers 40x24x2, categorie A
Constructeur.: Emiel Rooijackers
Opdrachtgever:
Dimensies....: kN/m/rad
Datum........: 22/11/2018
Bestand......: d:\dropbox\projecten\2018\18124\berekeningen\liggers
               60x40x2, categorie b, c en d.dlw

Betrouwbaarheidsklasse        : 1        Referentieperiode          : 50
```

Toegepaste normen volgens Eurocode met Nederlandse NB

Belastingen	NEN-EN 1990:2002	C2:2010	NB:2011(nl)
	NEN-EN 1991-1-1:2002	C1:2009	NB:2011(nl)
Staal	NEN-EN 1993-1-1:2006	C2:2011,A1:2016	NB:2016(nl)

GEOMETRIE

Ligger:1



PROFIELVORMEN [mm]

1 K60/40/2Z

BELASTINGGEVALLEN

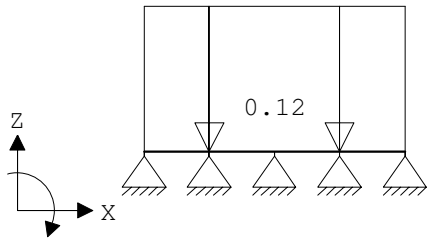
B.G.	Omschrijving	Belast/onbelast	ψ_0	ψ_1	ψ_2	e.g.
1	Permanent	2:Permanent EN1991				-1.00
2	Veranderlijk lijnlas	1:Schaakbord EN1991	0.50	0.50	0.30	0.00
3	Veranderlijk puntlas	3:Kraanbaan	0.40	0.50	0.30	0.00

BELASTINGGEVALLEN

B.G.	Omschrijving	Type
1	Permanent	1 Permanente belasting
2	Veranderlijk lijnlast	2 Ver. bel. pers. ed. (p_rep)
3	Veranderlijk puntlast	3 Ver. bel. pers. ed. (F-rep)

VELDBELASTINGEN

Ligger:1 B.G:1 Permanent



VELDBELASTINGEN

Ligger:1 B.G:1 Permanent

Last	Ref.	Type	Omschrijving	q1/p/m	q2	psi	Afstand	Lengte
1		1:q-last		-0.120	-0.120		0.000	1.800

REACTIES

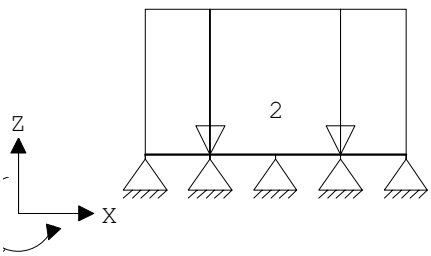
Ligger:1 B.G:1 Permanent

Stp	F	M
1	0.02	0.00
2	0.07	0.00
3	0.05	0.00
4	0.07	0.00
5	0.02	0.00

0.23	:	(absoluut) grootste som reacties
-0.23	:	(absoluut) grootste som belastingen

VELDBELASTINGEN

Ligger:1 B.G:2 Veranderlijk lijnlast



VELDBELASTINGEN

Ligger:1 B.G:2 Veranderlijk lijnlast

Last	Ref.	Type	Omschrijving	q1/p/m	q2	psi	Afstand	Lengte
1		1:q-last		-2.000	-2.000		0.000	1.800

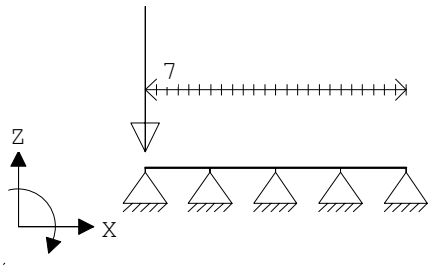
REACTIES

Ligger:1 B.G:2 Veranderlijk lijnlast

Stp	Fmin	Fmax	Mmin	Mmax
1	-0.05	0.40	0.00	0.00
2	0.00	1.10	0.00	0.00
3	0.00	1.03	0.00	0.00
4	0.00	1.10	0.00	0.00
5	-0.05	0.40	0.00	0.00

VELDBELASTINGEN

Ligger:1 B.G:3 Veranderlijk puntlast



VELDBELASTINGEN

Ligger:1 B.G:3 Veranderlijk puntlast

Last	Ref.	Type	Omschrijving	q1/p/m	q2	psi	Afstand	Lengte
1		15:Pass.stelsel		-7.000	0.075		0.000	1.800

REACTIES

Ligger:1 B.G:3 Veranderlijk puntlast

Stp	Fmin	Fmax	Mmin	Mmax
1	-0.55	7.00	0.00	0.00
2	-0.89	7.00	0.00	0.00
3	-1.13	7.00	0.00	0.00
4	-0.89	7.00	0.00	0.00
5	-0.55	7.00	0.00	0.00

BELASTINGCOMBINATIES

BC	Type					
1	Fund.	$1.22\ G_{k,1}$				
2	Fund.	$0.90\ G_{k,1}$				
3	Fund.	$1.22\ G_{k,1}$	+	$1.35\ \psi_0$	$Q_{k,2}$	
4	Fund.	$1.22\ G_{k,1}$	+	$1.35\ \psi_0$	$Q_{k,3}$	
5	Fund.	$1.08\ G_{k,1}$	+	1.35	$Q_{k,2}$	
6	Fund.	$1.08\ G_{k,1}$	+	1.35	$Q_{k,3}$	
7	Fund.	$0.90\ G_{k,1}$	+	$1.35\ \psi_0$	$Q_{k,2}$	
8	Fund.	$0.90\ G_{k,1}$	+	1.35	$Q_{k,2}$	
9	Fund.	$0.90\ G_{k,1}$	+	1.35	$Q_{k,3}$	
10	Fund.	$0.90\ G_{k,1}$	+	$1.35\ \psi_0$	$Q_{k,3}$	
11	Kar.	$1.00\ G_{k,1}$	+	1.00	$Q_{k,2}$	
12	Kar.	$1.00\ G_{k,1}$	+	1.00	$Q_{k,3}$	
13	Blij.	$1.00\ G_{k,1}$				

GUNSTIGE WERKING PERMANENTE BELASTINGEN

BC	Velden met gunstige werking
1	Geen
2	Alle velden de factor:0.90
3	Geen
4	Geen
5	Geen
6	Geen

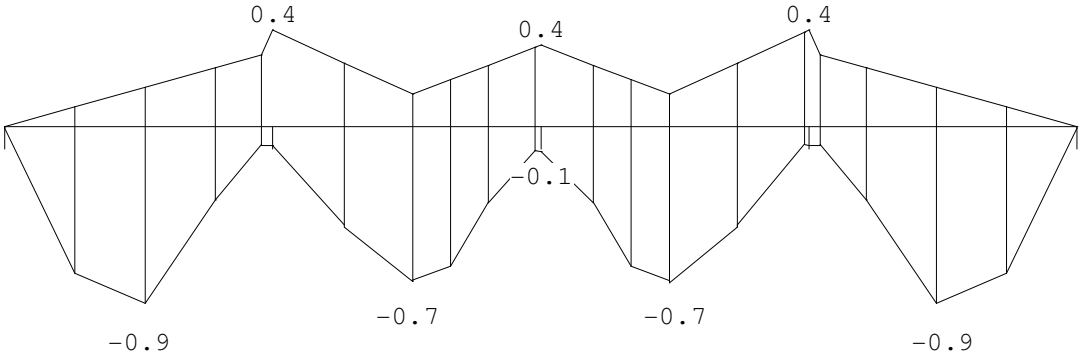
GUNSTIGE WERKING PERMANENTE BELASTINGEN

BC	Velden met gunstige werking
7	Alle velden de factor:0.90
8	Alle velden de factor:0.90
9	Alle velden de factor:0.90
10	Alle velden de factor:0.90

OMHULLENDE VAN DE FUNDAMENTELE COMBINATIES

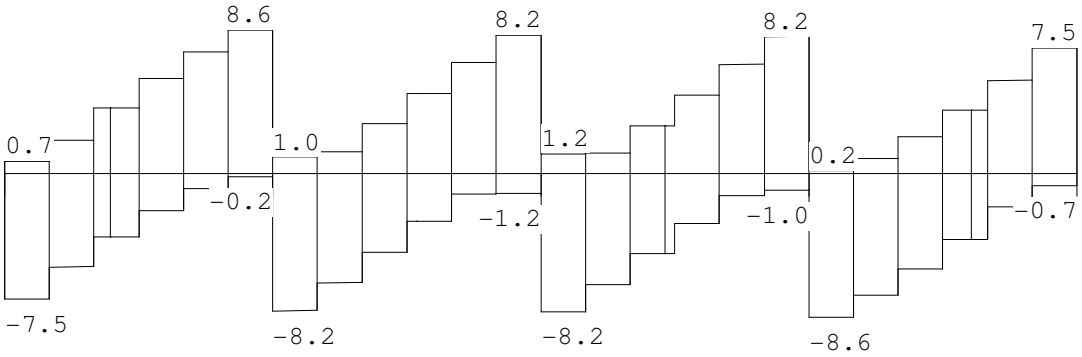
MOMENTEN

Ligger:1 Fundamentele combinatie



DWARSKRACHTEN

Ligger:1 Fundamentele combinatie



Fmin:	-0.72	-1.14	-1.47	-1.14	-0.72
Fmax:	9.5	9.5	9.5	9.5	9.5

REACTIES

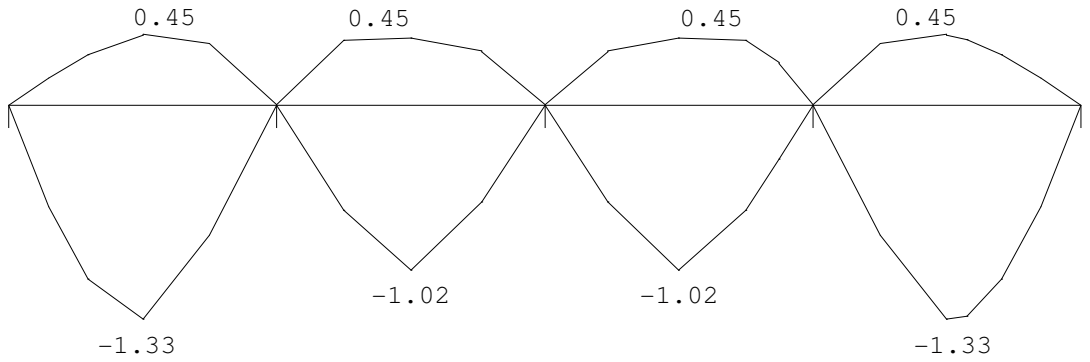
Ligger:1 Fundamentele combinatie

Stp	Fmin	Fmax	Mmin	Mmax

1	-0.72	9.47	0.00	0.00
2	-1.14	9.52	0.00	0.00
3	-1.47	9.51	0.00	0.00
4	-1.14	9.52	0.00	0.00
5	-0.72	9.47	0.00	0.00

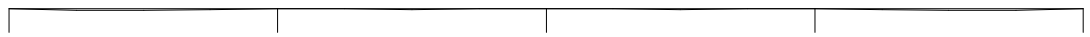
OMHULLENDE VAN DE KARAKTERISTIEKE COMBINATIES

VERPLAATSINGEN [mm] Ligger:1 Karakteristieke combinatie



OMHULLENDE VAN DE BLIJVENDE COMBINATIES

VERPLAATSINGEN [mm] Ligger:1 Blijvende combinatie



STAALPROFIELEN – ALGEMENE GEGEVENS Ligger:1

Stabiliteit: Classificatie gehele constructie: Geschoord

MATERIAAL

Mat nr.	Profielnaam	Vloeisp. [N/mm^2]	Productie methode	Min. drsn. klasse
1	K60/40/2Z	235	Warmgewalst	1

Partiële veiligheidsfactoren:
Gamma M;0 : 1.00 Gamma M;1 : 1.00

KIPSTABILITEIT Ligger:1

Staaf	Plts. aangr.		l gaffel [m]	Kipsteunafstanden [m]
1	1.0*h	boven:	0.45	0.450
		onder:	0.45	0.450
2	1.0*h	boven:	0.45	0.450
		onder:	0.45	0.450
3	1.0*h	boven:	0.45	0.450
		onder:	0.45	0.450
4	1.0*h	boven:	0.45	0.450
		onder:	0.45	0.450

TOETSING SPANNINGEN

Ligger:1

Staaf	Mat nr.	BC	Sit	Kl	Plaats	Norm	Artikel	Formule	Hoogste toetsing U.C.	[N/mm^2]	Opm.
1	1	6	4	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.628	148	**< 150**
2	1	6	10	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.544	128	
3	1	6	16	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.544	128	
4	1	6	22	1	Mz-max	EN3-1-1	6.2.8	(6.29)	0.628	148	