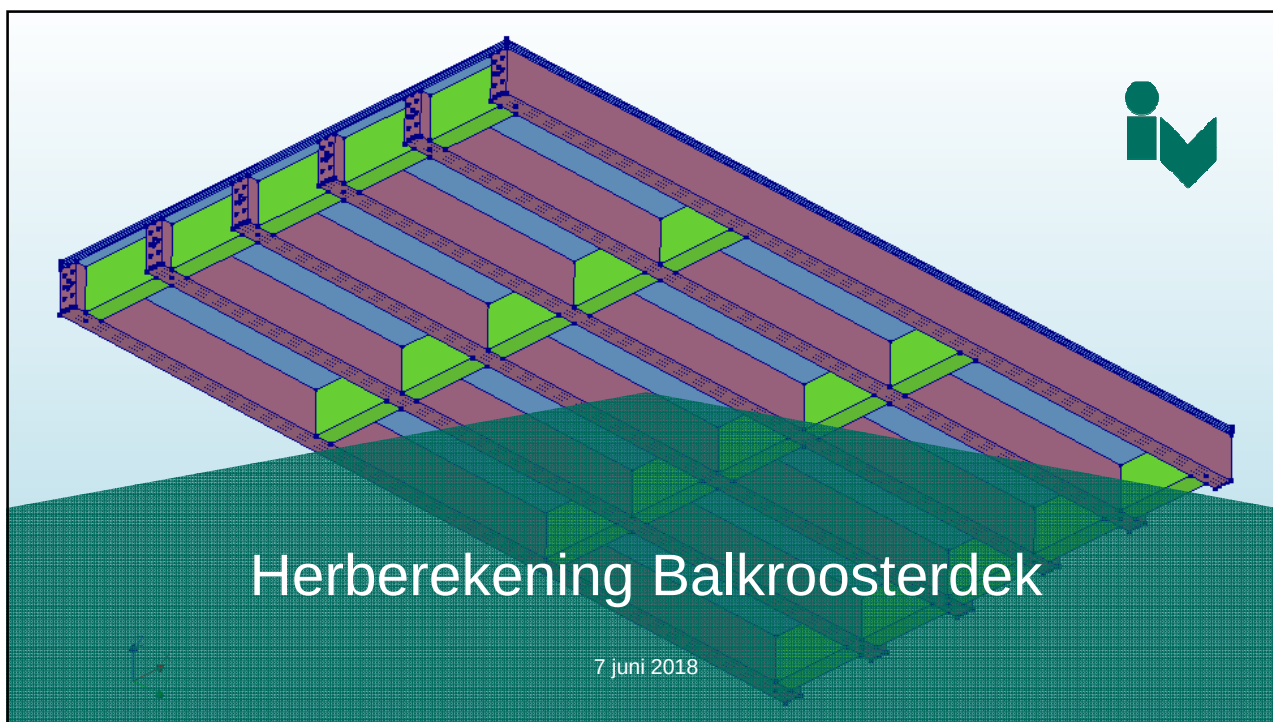


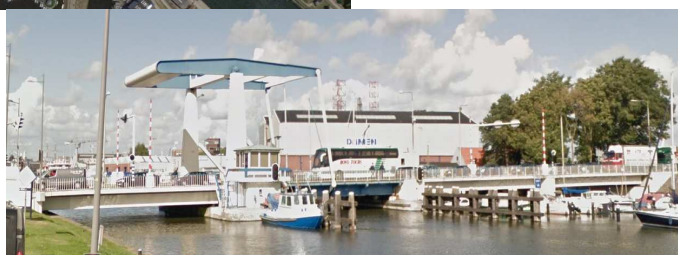


Inhoudsopgave

- Het project
- Geometrie kunstwerk
- Plaatberekening
- 3D model
 - Lineaire analyse
 - Resultaten
- 2D model
 - Niet-lineaire analyse
 - Resultaten



Het kunstwerk en projectlocatie



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Kunstwerk en locatie



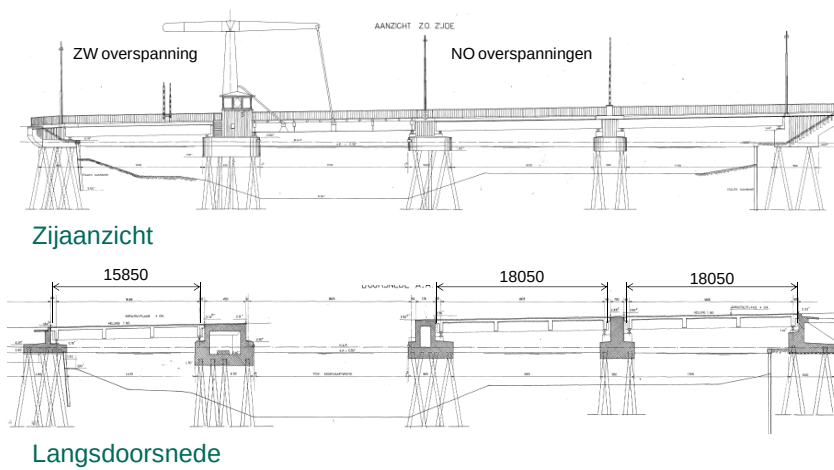
4

Bouw van het kunstwerk in 1961



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Geometrie kunstwerk

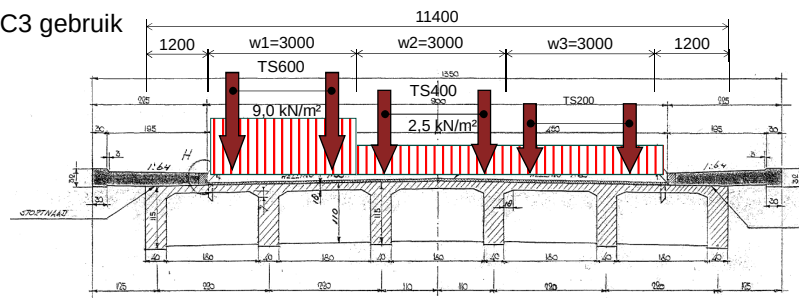


6



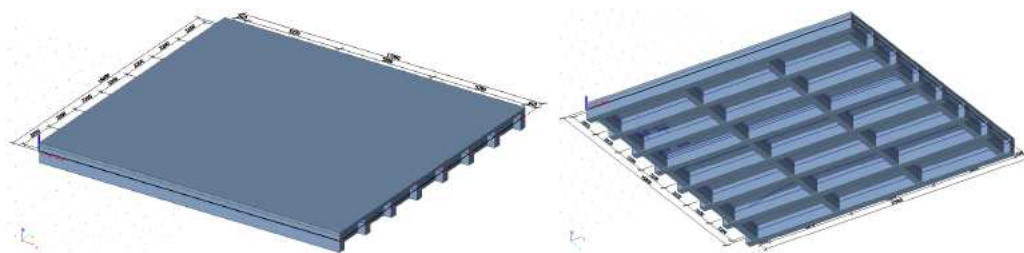
Belastingen en belastingscombinatie

- Belastingen conform de RBK
- Belastingsmodel LM1 en LM2 (voor lokale effecten)
- Situatie AI – theoretische rijbaanindeling
- Nobs < 200.000 per jaar
- Belastingscombinatie CC3 gebruik



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Resultaten plaatberekening



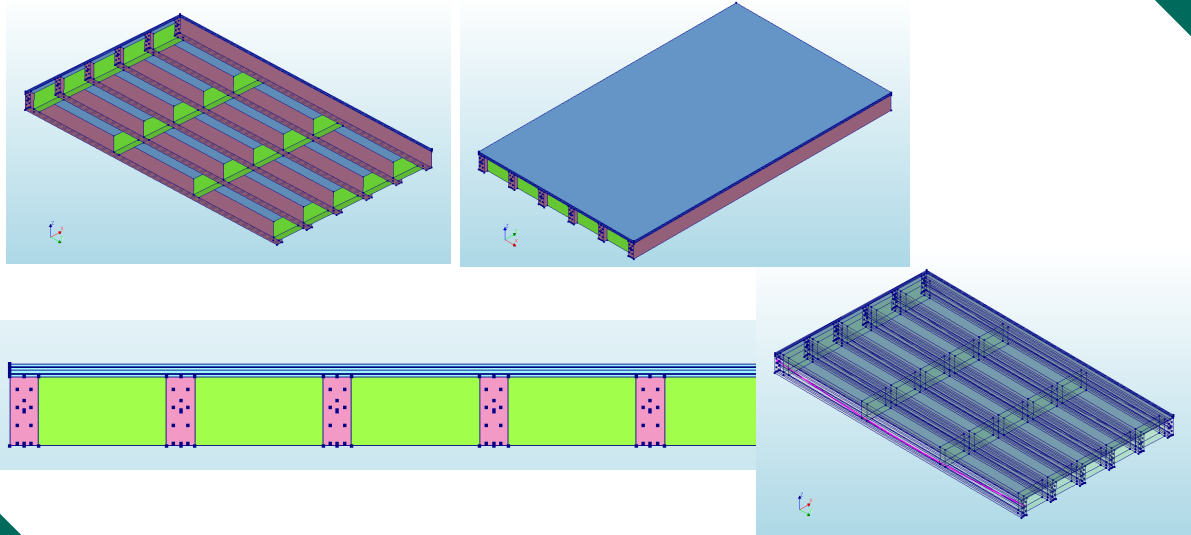
SCIA-model

Zuidwestelijke overspanning

Onderdeel	Snede §8.2	Controle	UC [-]	Conclusie
Langsligger	Dx2	Dwarskracht	1,01	Acceptabel
	Mx2	Moment	0,67	Voldoet
Rijdek	Dy3	Dwarskracht	0,94	Voldoet
	My2	Veldmoment	1,50	Voldoet niet!
	My3	Stp. Moment	0,69	Voldoet
Uitkraging BM4 - mensenmenigte	Dy4	Dwarskracht	0,07	Voldoet
	My4	Moment	0,29	Voldoet
	Dy4,ASR	ASR (dwarskr.)	0,17	Voldoet

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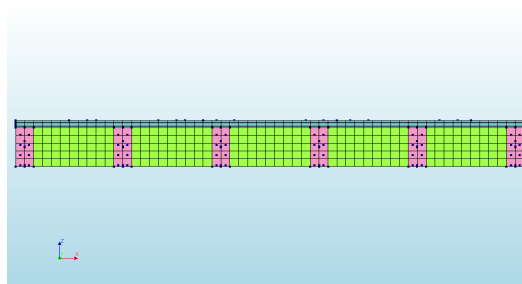
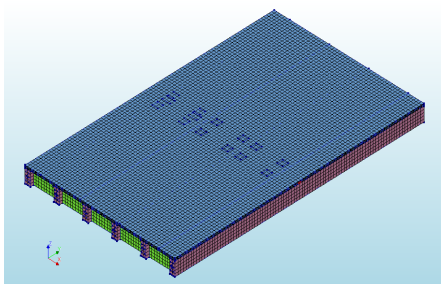
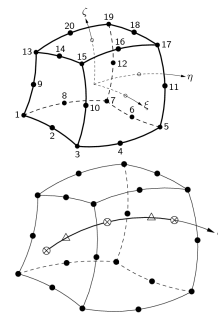
3D model – geometrie



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3D-model – elementen

- Volume-elementen CHX60
- Wapening en voorspanning ('embedded bar elements')
- Elementgrootte $0.2 \times 0.2 \times 0.2 \text{ m}^3$ (liggers)
- Elementgrootte $0.2 \times 0.2 \times 0.09 \text{ m}^3$ (dek)

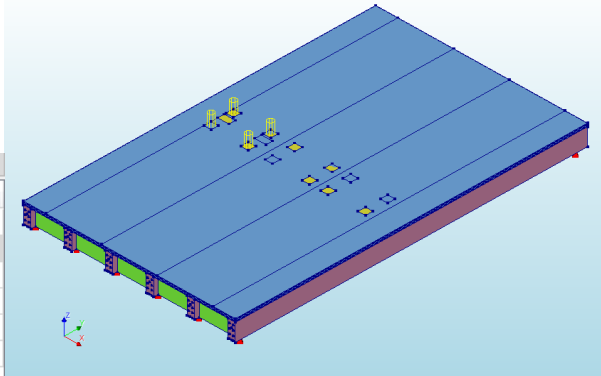


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3D-model - verkeersbelastingen

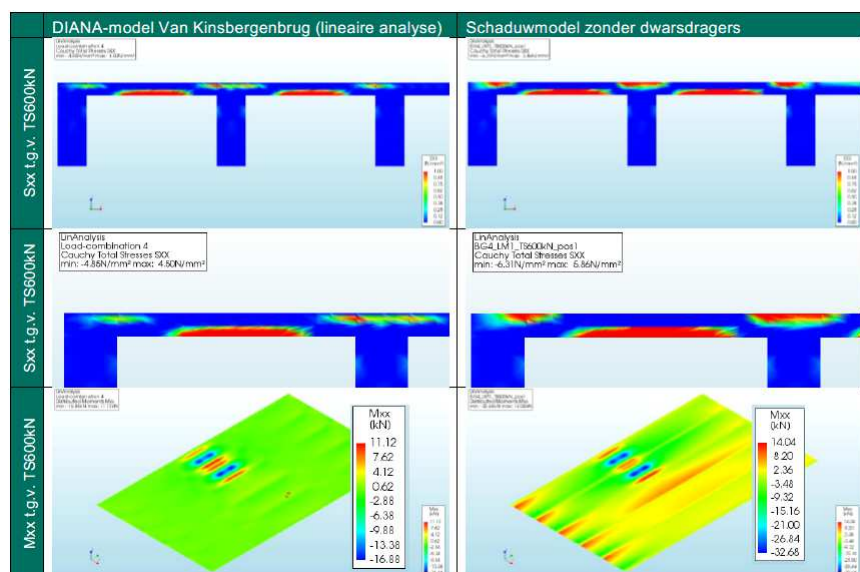
► Verkeersbelastingen: quadrilateral loads

Properties	
Description	Value
Load type	Quadrilateral force
Loaded surface	4 faces
Surface force value	-150 kN
Force load direction	Z
Area of interest	1 face



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3D-model – resultaten lineaire analyse



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3D-model – resultaten lineaire analyse

► Doorsnedecontrole op basis van DIANA model van u.c. 1.5 naar 1.17

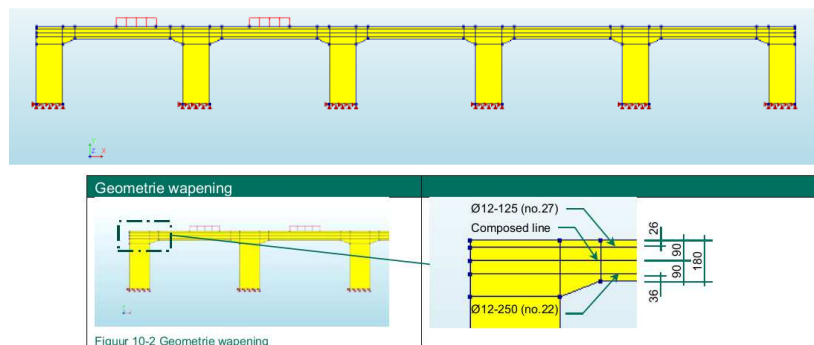
Snede	M_{Ed} [kNm/m]	$M_{Ed,herf}$ [kNm/m]	$M_{Ed,herf}$ [kNm/m]	M_{Rd} [kNm/m]	UC [-]	Conclusie
My2	28	-6	22	19	1.17	Voldoet niet!
My3	15	6	21	38	0.55	Voldoet

Zuidwestelijke overspanning

Onderdeel	Snede §8.2	Controle	UC [-]	Conclusie
Langsligger	Dx2	Dwarskracht	1.01	Acceptabel
	Mx2	Moment	0.67	Voldoet
Rijdek	Dy3	Dwarskracht	0.94	Voldoet
	My2	Veldmoment	1.50	Voldoet niet!
	My3	Stp. Moment	0.69	Voldoet
Uitkraging BM4 - mensenmenigte	Dy4	Dwarskracht	0.07	Voldoet
	My4	Moment	0.29	Voldoet
	Dy4,ASR	ASR (dwarskr.)	0.17	Voldoet

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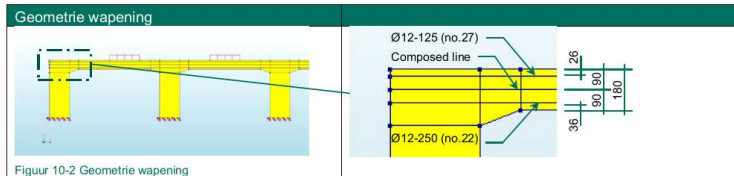
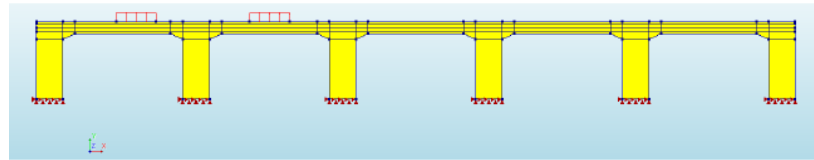
2D model – niet-lineaire analyse - geometrie



Zone	Zijde	Richting	Laag	Ø [mm]	hoh [mm]	kenmerk	Y [mm t.o.v. o.k]
Rijdek	Onder	Dwarsrichting	1e laag	Ø12	-250	no. 22	970+30+12/2 = 1006
	Boven	Dwarsrichting	1e laag	Ø12	-125	no. 27	1115-20-12/2 = 1089

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2D model – niet-lineaire analyse - geometrie



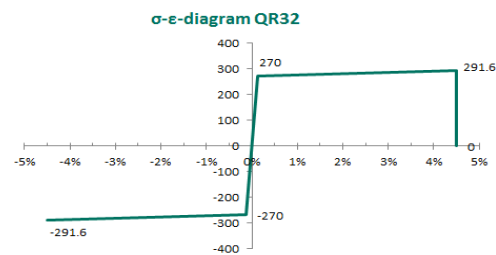
Zone	Zijde	Richting	Laag	Ø [mm]	hoh [mm]	kenmerk	Y [mm t.o.v. o.k.]
Rijdek	Onder	Dwarsrichting	1e laag	Ø12	-250	no. 22	$970+30+12/2 = 1006$
	Boven	Dwarsrichting	1e laag	Ø12	-125	no. 27	$1115-20-12/2 = 1089$

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C.J.A. van der Wilt

2D model – materiaaleigenschappen

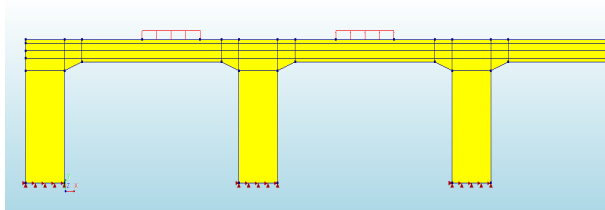
- Total strain based model with Rotating crack orientation;
- Hordijk tensile curve;
- Damage based poisson ratio reduction;
- Parabolic compression curve;
- Vecchio and Collins 1993 reduction model due to lateral cracking;
- No bond-slip failure.



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2D-model – belastingen en randvoorwaarden

- Verkeersbelasting als lijnlast (enige belastingsgeval)
- Liggers verticaal, horizontaal vast en rotatie vrij



Properties	
Description	Value
Load type	Distributed force
Force	
Loaded line	2 lines
Distributed force value	-1667 N/m
Force load direction	Normal

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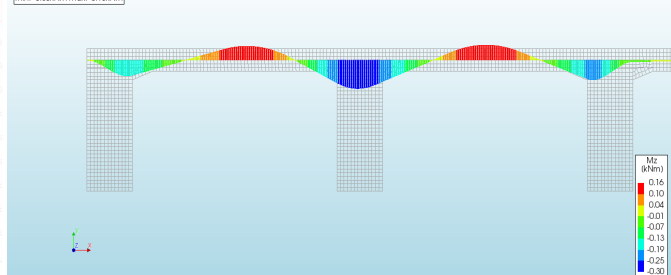
2D-model – resultaten niet-lineaire analyse

- Belastingen t.g.v. EG, rustende belasting verdisconteert naar een load-factor
- 20 Load-steps van 10 kN en 20 load-steps van 5 kN
- Force control (belastingsgestuurd)
- F_{NL} bij $f_{s,d}=270 \text{ N/mm}^2$

F_{Ed} [kN]	F_{NL} [kN]	UC [-]	Conclusie
211.9	230	0,92	Voldoet

Load-step	Load-factor [kN]	$\sigma_{s,max}$ [N/mm ²]	σ_c [N/mm ²]	$M_{E,yield}$ [kNm]	$M_{E,sp}$ [kNm]	$E_{w,xx}$ [mm]
1	10	0.52	-0.37	1.60	-3.05	-
15	150	8.14	-5.58	23.91	-45.82	-
19	190	12.94	-7.28	29.73	-58.25	-
24	220	248.54	-10.29	31.54	-67.75	0.17
26	230	267.83	-14.22	31.34	-71.81	0.38
28	240	292.16	-17.08	33.25	-73.60	0.48
30	250	300.20	-21.96	33.84	-78.12	0.66
38	290	300.56	-29.95	38.77	-91.54	0.97
40	300	325.47	-37.31	39.03	-99.48	2.18
42	310	468.83	-74.44	50.42	-597.44	15110

(Unbraced)
Geometry load case 1
Cross section Moments M_z
min: -0.30kNm max: 0.16kNm



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Technology*