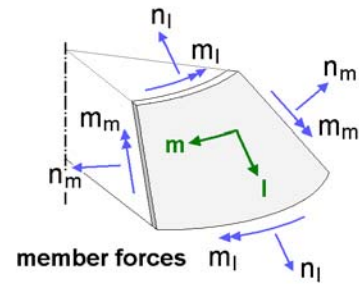
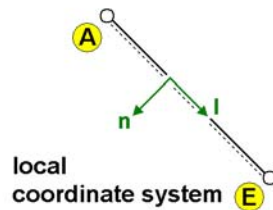
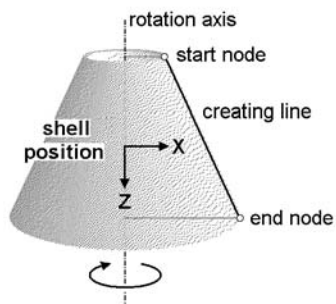


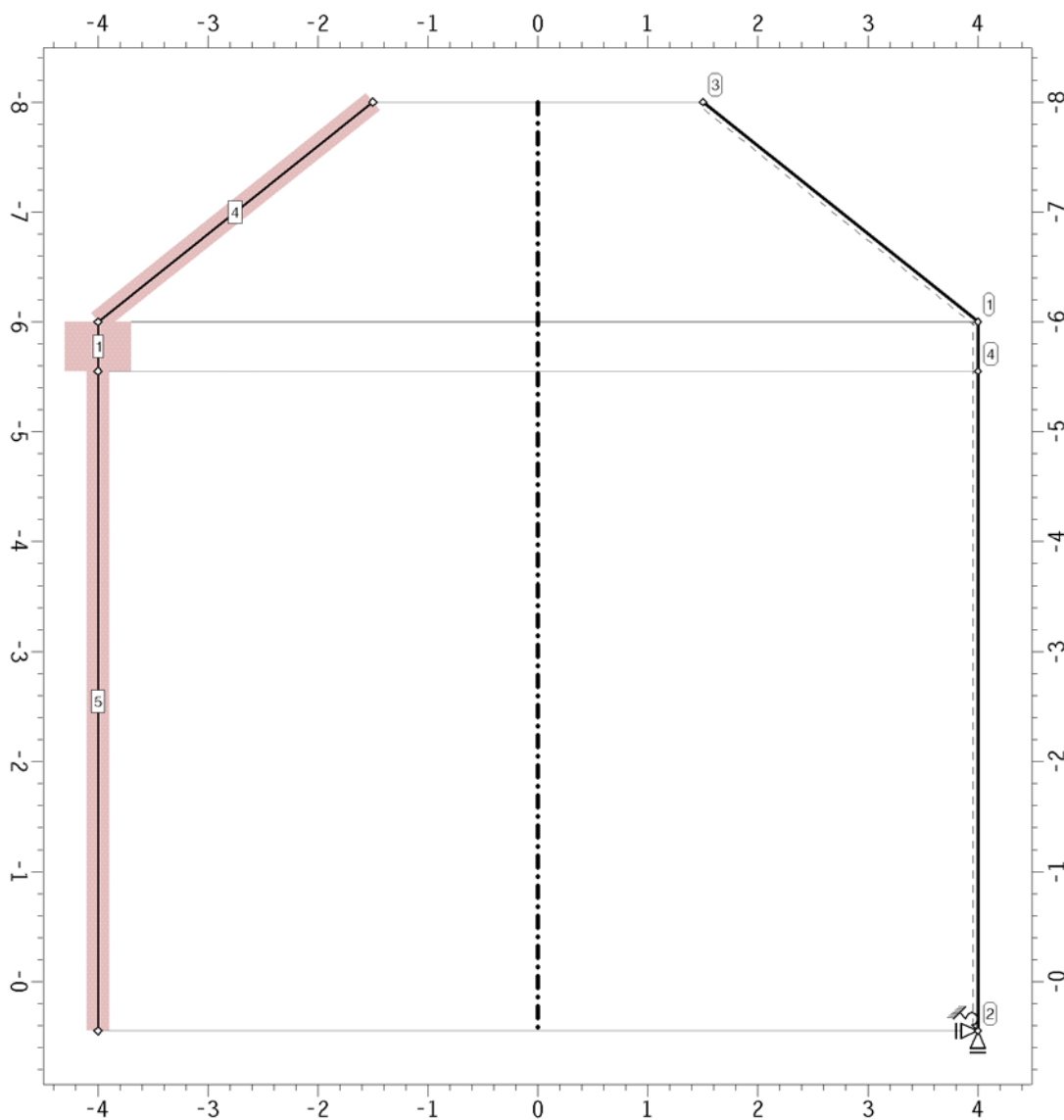
Structural Calculations of rotationally symmetrical shell structures by using the Finite Element Method



SYSTEM DESCRIPTION

System graphic

on r.h. side: node numbers, bearing information, orientation of the pos.; on l.h. side: number, thickness of the pos.



Coordinates and bearing information

node -	X m	Z m	Cf-X MN/m ²	Cf-Z MN/m ²	Cm-Y MNm/m	designat ion -
1	4.000	-6.000	-	-	-	
2	4.000	0.450	fest	fest	fest	
3	1.500	-8.000	-	-	-	
4	4.000	-5.550	-	-	-	

Calculation values of position 1:

Material designation: generallyyes, user definedes Material

Geom. characteristic values	Phys. characteristic values	elastic bedding
Start node: 1	E-modulus: 30000.00 MN/m2	no
End node: 4	Poisson's ratio: 0.20 -	
Length: 0.45 m	Temp. coeff.: 1.00 10 ⁻⁵ /K	
Thickn.: 60.00 cm		

Calculation values of position 4:

Material designation: generallyyes, user definedes Material

Geom. characteristic values	Phys. characteristic values	elastic bedding
Start node: 3	E-modulus: 30000.00 MN/m2	no
End node: 1	Poisson's ratio: 0.20 -	
Length: 3.20 m	Temp. coeff.: 1.00 10 ⁻⁵ /K	
Thickn.: 20.00 cm		

Calculation values of position 5:

Material designation: generallyyes, user definedes Material

Geom. characteristic values	Phys. characteristic values	elastic bedding
Start node: 4	E-modulus: 30000.00 MN/m2	no
End node: 2	Poisson's ratio: 0.20 -	
Length: 6.00 m	Temp. coeff.: 1.00 10 ⁻⁵ /K	
Thickn.: 20.00 cm		

Description of loading structure

On the left-hand side, the relationship between the actions effects, load case file 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. In terms of the superposition, a load case file is equivalent to an extreme rule of the defined objects therein and can be additive or alternatively superpositioned.

Used symbols:



Action effect



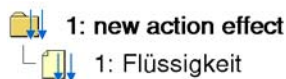
Load case file



Load case

Description of loading structure

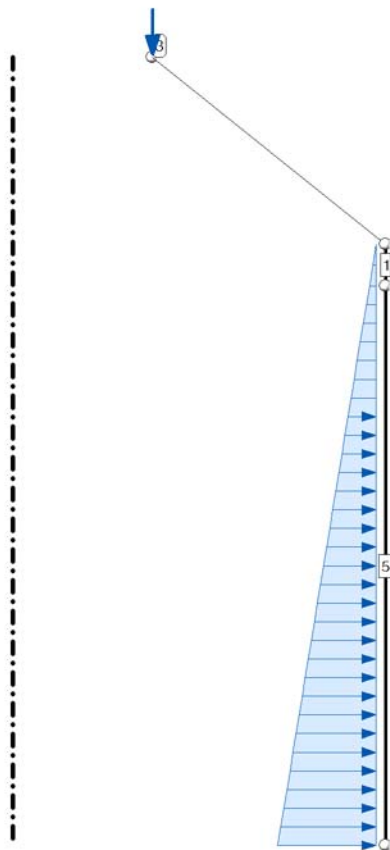
On the left-hand side, the relationship between the actions effects, load case file and load cases are shown in a tree structure. The right-hand side shows the characteristics of the superposition to the associated objects on the left-hand. In terms of the superposition, a load case file is equivalent to an extreme rule of the defined objects therein and can be additive or alternatively superpositioned.



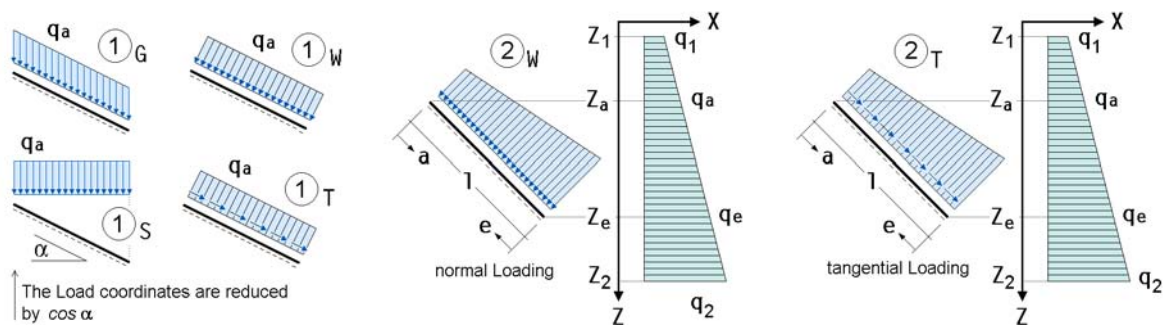
permanent loads
additive

LOAD PICTURES IN LOAD CASE 1: FLÜSSIGKEIT

Loaded objects in load case 1



Explanation of load types and load directions



Area loads in load case 1

Loads depending on Z-coordinate (type 2), Z_1 and Z_2 define the load interval. Thereby the positions are u.c. partially loaded. Subscript A refers to the load distance of the start node and subscript E to the load distance of the end node. l is the loaded section.

pos.	type	q_a kN/m ²	q_e kN/m ²	a m	l m	e m	z1 m	q1 kN/m ²	z2 m	q2 kN/m ²
1	2W	0.000	-4.500	0.000	0.450	0.000	-6.000	0.000	0.450	-64.500
5	2W	-4.500	-64.500	0.000	6.000	0.000	-6.000	0.000	0.450	-64.500

Ring loads in load case 1

point	syst.	Px	Pz	My	length
-	-	kN/m	kN/m	kNm/m	m
3	X-Y-Z	0.000	30.000	0.000	9.425

VERIFICATIONS

meanings in case of application of superposition rule acc. to Eurocode:

Ψ_{dom}	Combination coefficient of a leading traffic load action	(leading load action)
Ψ_{sub}	Combination coefficient of a non-leading traffic load action	(accompanying load action)
γ_{sup}	Partial safety factor for unfavourable load positions	
γ_{inf}	Partial safety factor for favourable load positions	

meanings in case of application of superposition rule acc. to DIN 18800:

Ψ_{dom}	Combination coefficient of a main combination
Ψ_{sub}	Combination coefficient of a minor combination

Superposition rules of bridge construction and DIN 1055-100 behave like Eurocode.
In non-linear analysis, rules of extremization will not be considered

If verifications according to Eurocode are listed below, the following applies:
The national annex "Germany" is taken into account.

Verification 1: Analysis

Analysis: Analysis no Verifications

1: Standard combination

Rules of extremization of verification 1, type: standard, rule of superposition: charakteristisch

action	γ_{sup}	γ_{inf}
1	1.00	1.00

List of beams of verification 1:

Line numbers ...
1 4 5

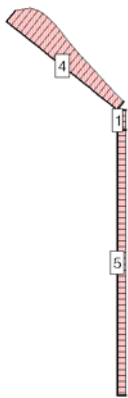
REGULATIONS

VERIFICATION 1: SUMMARY

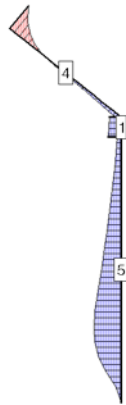
Extremal Reactions of supported nodes (γ_F -fach)

node type	apx	apz	amy
-	kN/m	kN/m	kNm/m
2 Min	-41.56	-11.25	13.14
Max	-41.56	-11.25	13.14
Minimum	-41.56	-11.25	13.14
Maximum	-41.56	-11.25	13.14

Normal force n_l
Min/Max: -38.72/-11.25 kN/m



Normal force n_m
Min/Max: -213.47/197.55 kN/m



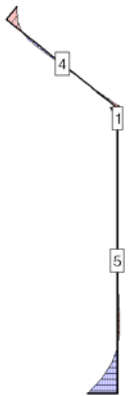
Internal moment m_l
Min/Max: -3.40/13.14 kNm/m



Internal moment m_m
Min/Max: -0.68/2.63 kNm/m



Shear force q_l
Min/Max: -23.43/41.56 kN/m



Extremal member forces

node	s	type	n _l	n _m	m _l	m _m	q _l
-	m		kN/m	kN/m	kNm/m	kNm/m	kN/m
Shell 1							
1	0.00	Min	-11.25	80.81	-1.29	-0.26	8.72
		Max	-11.25	80.81	-1.29	-0.26	8.72
4	0.45	Min	-11.25	91.74	0.65	0.13	0.02
		Max	-11.25	91.74	0.65	0.13	0.02
Shell 4							
3	0.00	Min	-18.74	-213.47	0.00	1.59	-23.43
		Max	-18.74	-213.47	0.00	1.59	-23.43
	0.22	Min	-33.54	-118.07	-2.89	0.68	-7.64
		Max	-33.54	-118.07	-2.89	0.68	-7.64
	0.44	Min	-38.58	-58.06	-3.30	0.19	-0.39
		Max	-38.58	-58.06	-3.30	0.19	-0.39
	0.66	Min	-38.72	-22.76	-2.74	-0.03	2.38
		Max	-38.72	-22.76	-2.74	-0.03	2.38
	0.88	Min	-36.73	-4.02	-1.93	-0.09	3.03
		Max	-36.73	-4.02	-1.93	-0.09	3.03
	1.54	Min	-28.69	9.88	-0.12	0.04	1.63
		Max	-28.69	9.88	-0.12	0.04	1.63
	2.20	Min	-22.22	14.34	0.36	0.16	-0.14
		Max	-22.22	14.34	0.36	0.16	-0.14
	2.64	Min	-18.41	20.38	0.00	0.10	-1.46
		Max	-18.41	20.38	0.00	0.10	-1.46
1	3.20	Min	-13.83	24.79	-1.29	-0.24	-3.34
		Max	-13.83	24.79	-1.29	-0.24	-3.34
Shell 5							
4	0.00	Min	-11.25	28.89	0.65	0.13	0.02
		Max	-11.25	28.89	0.65	0.13	0.02
	4.31	Min	-11.25	197.55	-1.75	-0.35	-3.13

Extremal member forces

node	s	type	n _l	n _m	m _l	m _m	q _l
-	m		kN/m	kN/m	kNm/m	kNm/m	kN/m
2	4.98	Max	-11.25	197.55	-1.75	-0.35	-3.13
		Min	-11.25	161.52	-3.40	-0.68	0.06
	5.32	Max	-11.25	161.52	-3.40	-0.68	0.06
		Min	-11.25	106.29	-2.25	-0.45	7.72
	5.66	Max	-11.25	106.29	-2.25	-0.45	7.72
		Min	-11.25	37.15	2.54	0.51	21.77
	6.00	Max	-11.25	37.15	2.54	0.51	21.77
		Min	-11.25	-3.08	13.14	2.63	41.56
	Max	-11.25	-3.08	13.14	2.63	41.56	
	Minimum		-38.72	-213.47	-3.40	-0.68	-23.43
Maximum		-11.25	197.55	13.14	2.63	41.56	