


















Anhang: Schnittkraft Tabellen

Zusammenstellung: Kombination der Auswertungen für Biegemomente und Normalkräfte für kreisförmige Rohre

Appendix: Table of internal forces

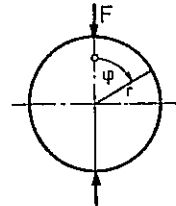
Compilation: Combination of the evaluations for bending moments and axial forces for circular pipes

LOAD	BEDDING REACTION	8	9	10	11	12
		 $\alpha' = 15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ$	 $\alpha' = 15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ$	 $\alpha' = 15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ$	 $\alpha' = 15^\circ, 175^\circ, 30^\circ, 45^\circ, 60^\circ$	 $\alpha' = 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ$
1A 	226	1A.8 235	1A.9 235	1A.10 236	1A.11 236	1A.12 237
1B 	0,3 d 226	—	—	—	—	—
2 	227	2.8 237 ÷ 240	2.9 240 ÷ 243	2.10 243 ÷ 246	2.11 246 ÷ 248	2.12 249 ÷ 250
2A 	227	2A.8 251 ÷ 253	2A.9 254 ÷ 256	2A.10 257 ÷ 259	2A.11 260 ÷ 262	2A.12 262 ÷ 264
2B 	228	2B.8 264 ÷ 267	2B.9 267 ÷ 270	2B.10 270 ÷ 273	2B.11 273 ÷ 275	2B.12 276 ÷ 277
3 	Eigengewicht dead weight 228	3.8 278	3.9 278	3.10 279	3.11 279	3.12 280
4 	Wasserfüllung water filling 229	4.8 280	4.9 281	4.10 281	4.11 282	4.12 282
5 	Wasser- außendruck external water pressure 229	—	—	—	—	—
5A 	Wasser- außendruck external water pressure 230	—	—	—	—	—
6 	230	—	—	—	—	—
7 	231	—	—	—	—	—
13 	234	—	—	—	—	—

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
1A

Zweilinienbelastung
two linear loads



	Biegemoment bending moment			M=m·F·r			Normalkraft axial force			N=n·F				
	ψ	0	15	30	45	60	75	90	105	120	135	150	165	180
M	0.318	0.189	0.068	-0.035	-0.115	-0.165	-0.182	-0.165	-0.115	-0.035	0.068	0.189	0.318	
N	0.000	-0.129	-0.250	-0.354	-0.433	-0.483	-0.500	-0.483	-0.433	-0.354	-0.250	-0.129	0.000	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

4/85

Normalkraft + N ergibt Zug
axial force + N results in tension

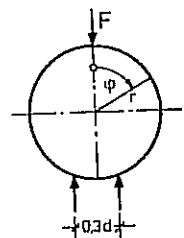
LF 1A

T.E.B. TEST ACCORDING TO DIN

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
1B

Dreilinienbelastung
three linear loads



	Biegemoment bending moment			M=m·F·r			Normalkraft axial force			N=n·F			1000	
	ψ	0	15	30	45	60	75	90	105	120	135	150	165	180
M	0.311	0.182	0.063	-0.038	-0.115	-0.161	-0.174	-0.154	-0.100	-0.018	0.088	0.189	0.190	
N	-0.014	-0.143	-0.262	-0.364	-0.440	-0.487	-0.500	-0.479	-0.426	-0.343	-0.238	0.014	0.014	

per anche pag 236 1A.11 $\alpha' = 17.5^\circ$ (0.3·φ corrisponde ad un angolo al centro di 35°)

se poi si vuole tenere conto anche delle sollecitazioni dovute al peso proprio
per 3.11 pag 249

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

4/85

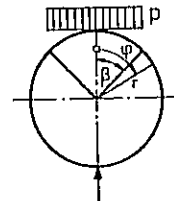
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 1B

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
2

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width



		Biegemoment bending moment $M = m \cdot p \cdot r^2$			Normalkraft axial force $N = n \cdot p \cdot r$									
β	ψ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.134	0.100	0.038	-0.016	-0.058	-0.084	-0.093	-0.085	-0.059	-0.019	0.035	0.097	0.164
	N	0.002	-0.065	-0.128	-0.182	-0.223	-0.250	-0.259	-0.250	-0.225	-0.184	-0.131	-0.069	-0.002
30	M	0.213	0.179	0.087	-0.019	-0.101	-0.155	-0.175	-0.161	-0.115	-0.038	0.064	0.183	0.312
	N	0.013	-0.054	-0.239	-0.344	-0.426	-0.480	-0.500	-0.486	-0.440	-0.363	-0.261	-0.142	-0.013
45	M	0.257	0.222	0.127	-0.004	-0.124	-0.204	-0.238	-0.223	-0.162	-0.057	0.083	0.250	0.432
	N	0.038	-0.031	-0.218	-0.473	-0.594	-0.673	-0.707	-0.693	-0.631	-0.527	-0.386	-0.219	-0.038
60	M	0.281	0.245	0.147	0.011	-0.128	-0.231	-0.279	-0.267	-0.197	-0.074	0.095	0.297	0.518
	N	0.069	0.000	-0.190	-0.451	-0.716	-0.819	-0.866	-0.854	-0.784	-0.661	-0.493	-0.291	-0.069
75	M	0.295	0.258	0.157	0.017	-0.128	-0.243	-0.300	-0.292	-0.219	-0.085	0.100	0.323	0.570
	N	0.096	0.025	-0.167	-0.432	-0.702	-0.908	-0.966	-0.958	-0.884	-0.751	-0.566	-0.342	-0.096
90	M	0.299	0.262	0.160	0.018	-0.129	-0.246	-0.307	-0.300	-0.226	-0.089	0.101	0.332	0.587
	N	0.106	0.036	-0.158	-0.425	-0.697	-0.906	-1.000	-0.993	-0.919	-0.782	-0.592	-0.361	-0.106

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

4/85

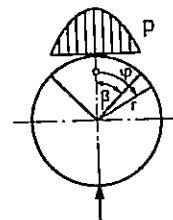
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
2A

Parabolisch verteilte Auflast beliebiger Breite
parabolically distributed surcharge any desired width



β		Biegemoment bending moment			Normalkraft axial force									
		ψ	0	15	30	45	60	75	90	105	120	135	150	165
15	M	0.094	0.066	0.025	-0.011	-0.039	-0.056	-0.062	-0.057	-0.040	-0.012	0.023	0.065	0.109
	N	0.094	0.066	0.025	-0.011	-0.039	-0.056	-0.062	-0.057	-0.040	-0.012	0.023	0.065	0.109
30	M	0.158	0.126	0.053	-0.017	-0.071	-0.106	-0.118	-0.108	-0.076	-0.025	0.044	0.123	0.210
	N	0.158	0.126	0.053	-0.017	-0.071	-0.106	-0.118	-0.108	-0.076	-0.025	0.044	0.123	0.210
45	M	0.198	0.165	0.081	-0.015	-0.093	-0.144	-0.164	-0.151	-0.108	-0.036	0.059	0.171	0.293
	N	0.198	0.165	0.081	-0.015	-0.093	-0.144	-0.164	-0.151	-0.108	-0.036	0.059	0.171	0.293
60	M	0.222	0.188	0.100	-0.008	-0.104	-0.169	-0.196	-0.183	-0.132	-0.046	0.069	0.206	0.354
	N	0.222	0.188	0.100	-0.008	-0.104	-0.169	-0.196	-0.183	-0.132	-0.046	0.069	0.206	0.354
75	M	0.235	0.200	0.110	-0.004	-0.109	-0.182	-0.214	-0.202	-0.147	-0.053	0.075	0.226	0.392
	N	0.235	0.200	0.110	-0.004	-0.109	-0.182	-0.214	-0.202	-0.147	-0.053	0.075	0.226	0.392
90	M	0.239	0.204	0.114	-0.003	-0.110	-0.186	-0.220	-0.208	-0.152	-0.055	0.076	0.233	0.404
	N	0.239	0.204	0.114	-0.003	-0.110	-0.186	-0.220	-0.208	-0.152	-0.055	0.076	0.233	0.404

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

4/85

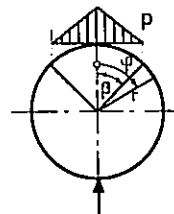
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
2B

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width



		Biegemoment bending moment				Normalkraft axial force				N = n · p · r							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.072	0.050	0.018	-0.009	-0.029	-0.042	-0.047	-0.043	-0.030	-0.009	0.018	0.049	0.082			
	N	0.000	-0.033	-0.064	-0.091	-0.112	-0.125	-0.129	-0.125	-0.112	-0.092	-0.065	-0.034	0.000			
30	M	0.122	0.095	0.039	-0.014	-0.054	-0.080	-0.089	-0.082	-0.057	-0.018	0.033	0.093	0.158			
	N	0.003	-0.046	-0.122	-0.174	-0.215	-0.241	-0.250	-0.242	-0.218	-0.179	-0.128	-0.068	-0.003			
45	M	0.156	0.126	0.059	-0.014	-0.072	-0.109	-0.124	-0.114	-0.081	-0.027	0.045	0.129	0.220			
	N	0.009	-0.046	-0.153	-0.243	-0.301	-0.339	-0.354	-0.344	-0.311	-0.257	-0.185	-0.101	-0.009			
60	M	0.177	0.146	0.074	-0.010	-0.082	-0.129	-0.148	-0.138	-0.099	-0.034	0.053	0.156	0.267			
	N	0.017	-0.040	-0.163	-0.284	-0.366	-0.414	-0.433	-0.423	-0.384	-0.318	-0.231	-0.129	-0.017			
75	M	0.188	0.157	0.082	-0.008	-0.087	-0.140	-0.163	-0.153	-0.110	-0.039	0.058	0.172	0.296			
	N	0.024	-0.035	-0.165	-0.300	-0.402	-0.460	-0.483	-0.473	-0.430	-0.358	-0.262	-0.148	-0.024			
90	M	0.192	0.160	0.084	-0.007	-0.088	-0.144	-0.168	-0.158	-0.114	-0.040	0.059	0.177	0.306			
	N	0.027	-0.033	-0.165	-0.304	-0.412	-0.476	-0.500	-0.490	-0.446	-0.372	-0.273	-0.155	-0.027			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

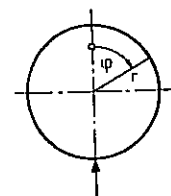
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LF 2B

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
3

Eigengewicht
dead weight



Biegemoment bending moment				Normalkraft axial force											
$M = m \cdot s \cdot \gamma_b \cdot r^2$				$N = n \cdot s \cdot \gamma_b \cdot r$											
	φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
M	0.500	0.449	0.305	0.091	-0.157	-0.394	-0.571	-0.641	-0.564	-0.313	0.124	0.738	1.500		
N	0.500	0.415	0.171	-0.202	-0.657	-1.135	-1.571	-1.900	-2.064	-2.020	-1.742	-1.228	-0.500		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

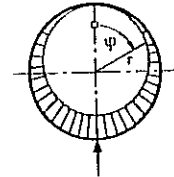
LF 3

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
4

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown

*ho il peso d'acqua ma senza
pressione*



	Biegemoment bending moment			Normalkraft axial force										
	ψ	0	15	30	45	60	75	90	105	120	135	150	165	180
M	0.250	0.225	0.153	0.046	-0.078	-0.197	-0.285	-0.320	-0.282	-0.156	0.062	0.369	0.750	
N	0.750	0.725	0.653	0.546	0.422	0.303	0.215	0.180	0.218	0.344	0.562	0.869	1.250	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

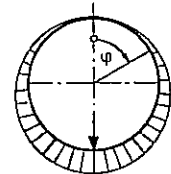
LF 4

*SONO
L'OPPOSTO
L'UNA
DELL'ALTRA*

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
5

Wasseraußendruck bis Rohrscheitel
external water pressure up to pipe crown



	Biegemoment bending moment			Normalkraft axial force										
	ψ	0	15	30	45	60	75	90	105	120	135	150	165	180
M	-0.250	-0.225	-0.153	-0.046	0.078	0.197	0.285	0.320	0.282	0.156	-0.062	-0.369	-0.750	
N	-0.750	-1.131	-1.438	-1.656	-1.782	-1.820	-1.785	-1.647	-1.578	-1.454	-1.347	-1.275	-1.250	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

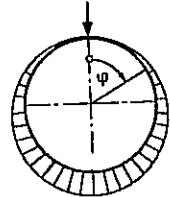
Normalkraft + N ergibt Zug
axial force + N results in tension

10/87

LF 5

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
5A
Wasseraußendruck bis Rohrscheitel
external water pressure up to pipe crown



		Biegemoment bending moment			Normalkraft axial force			N = n · γ _w · r ²									
	φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
M	0.750	0.369	0.062	-0.156	-0.282	-0.320	-0.285	-0.197	-0.078	0.046	0.153	0.225	0.250				
N	-0.750	-1.131	-1.438	-1.656	-1.782	-1.820	-1.785	-1.697	-1.578	-1.454	-1.347	-1.275	-1.250				

Rispetto al caso 5 (pag. 229) i valori sono di segno opposto, ma uguali in valore assoluto se considerati su angoli complementari ($m\phi = -m(180-\phi)$)

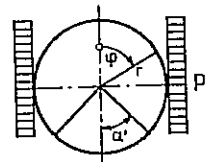
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 5

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
6
Seitlicher Erddruck rechteckig, beliebige Höhe
lateral earth pressure rectangular, any desired height



		Biegemoment bending moment			Normalkraft axial force			N = n · p · r									
	α'	φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
0	M	-0.250	-0.217	-0.125	0.000	0.125	0.217	0.250	0.217	0.125	0.000	-0.125	-0.217	-0.250			
	N	-1.000	-0.933	-0.750	-0.500	-0.250	-0.067	0.000	-0.067	-0.250	-0.500	-0.750	-0.933	-1.000			
15	M	-0.250	-0.216	-0.125	0.000	0.125	0.216	0.250	0.216	0.125	0.000	-0.125	-0.217	-0.249			
	N	-1.000	-0.933	-0.750	-0.500	-0.250	-0.067	0.000	-0.067	-0.250	-0.500	-0.750	-0.933	-0.966			
30	M	-0.249	-0.216	-0.124	0.000	0.125	0.216	0.249	0.215	0.123	-0.002	-0.127	-0.214	-0.243			
	N	-0.998	-0.932	-0.749	-0.499	-0.249	-0.067	0.000	-0.067	-0.251	-0.501	-0.751	-0.838	-0.868			
45	M	-0.245	-0.212	-0.121	0.002	0.125	0.214	0.244	0.208	0.114	-0.013	-0.127	-0.199	-0.224			
	N	-0.989	-0.923	-0.741	-0.492	-0.245	-0.064	0.000	-0.070	-0.255	-0.508	-0.622	-0.693	-0.718			
60	M	-0.232	-0.199	-0.112	0.007	0.123	0.205	0.228	0.185	0.083	-0.029	-0.114	-0.168	-0.187			
	N	-0.960	-0.894	-0.715	-0.472	-0.230	-0.057	0.000	-0.077	-0.270	-0.382	-0.468	-0.522	-0.540			
75	M	-0.204	-0.174	-0.093	0.015	0.119	0.185	0.192	0.131	0.044	-0.031	-0.089	-0.125	-0.138			
	N	-0.896	-0.833	-0.660	-0.426	-0.198	-0.040	0.000	-0.094	-0.181	-0.257	-0.314	-0.350	-0.363			
90	M	-0.163	-0.137	-0.066	0.025	0.106	0.146	0.125	0.070	0.019	-0.025	-0.059	-0.080	-0.087			
	N	-0.788	-0.728	-0.566	-0.350	-0.144	-0.012	0.000	-0.055	-0.106	-0.150	-0.184	-0.205	-0.212			

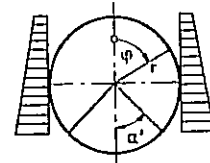
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 6

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
7
Seitlicher Erddruck trapezförmig, beliebige Höhe
lateral earth pressure trapezoidal, any desired height



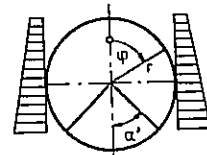
		Biegemoment bending moment													
		$M = [A \cdot (h+r) + B \cdot r] \cdot K \cdot \gamma_b \cdot r^2$													
α'		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
0	A	-0.250	-0.217	-0.125	0.000	0.125	0.217	0.250	0.217	0.125	0.000	-0.125	-0.217	-0.250	
	B	0.042	0.029	0.000	-0.029	-0.042	-0.029	0.000	0.029	0.042	0.029	0.000	-0.029	-0.042	
15	A	-0.250	-0.216	-0.125	0.000	0.125	0.216	0.250	0.216	0.125	0.000	-0.125	-0.217	-0.249	
	B	0.042	0.029	0.000	-0.029	-0.042	-0.029	0.000	0.029	0.042	0.029	0.000	-0.030	-0.041	
30	A	-0.249	-0.216	-0.124	0.000	0.125	0.216	0.249	0.215	0.123	-0.002	-0.127	-0.214	-0.243	
	B	0.042	0.030	0.001	-0.029	-0.042	-0.030	-0.001	0.028	0.040	0.028	-0.002	-0.027	-0.036	
45	A	-0.245	-0.212	-0.121	0.002	0.125	0.214	0.244	0.208	0.114	-0.013	-0.127	-0.199	-0.224	
	B	0.046	0.033	0.003	-0.028	-0.042	-0.032	-0.004	0.023	0.033	0.019	-0.002	-0.016	-0.020	
60	A	-0.232	-0.199	-0.112	0.007	0.123	0.205	0.228	0.185	0.083	-0.029	-0.114	-0.168	-0.187	
	B	0.054	0.041	0.008	-0.025	-0.043	-0.037	-0.014	0.009	0.015	0.010	0.005	0.003	0.002	
75	A	-0.204	-0.174	-0.093	0.015	0.119	0.185	0.192	0.131	0.044	-0.031	-0.089	-0.125	-0.138	
	B	0.064	0.050	0.015	-0.022	-0.044	-0.044	-0.027	-0.011	-0.001	0.008	0.015	0.019	0.020	
90	A	-0.163	-0.137	-0.066	0.025	0.106	0.146	0.125	0.070	0.019	-0.025	-0.059	-0.080	-0.087	
	B	0.069	0.054	0.019	-0.021	-0.046	-0.049	-0.035	-0.019	-0.004	0.009	0.019	0.025	0.027	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface LF 7

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
7
Seitlicher Erddruck trapezförmig, beliebige Höhe
lateral earth pressure trapezoidal, any desired height



		Normalkraft axial force													
		$N = [A (h+r) + B \cdot r] \cdot K \cdot \gamma_b \cdot r$													
α'		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
0	A	-1.000	-0.933	-0.750	-0.500	-0.250	-0.067	0.000	-0.067	-0.250	-0.500	-0.750	-0.933	-1.000	
	B	0.375	0.330	0.217	0.088	0.000	-0.024	0.000	0.024	0.000	-0.088	-0.217	-0.330	-0.375	
15	A	-1.000	-0.933	-0.750	-0.500	-0.250	-0.067	0.000	-0.067	-0.250	-0.500	-0.750	-0.933	-0.966	
	B	0.375	0.330	0.217	0.088	0.000	-0.024	0.000	0.024	0.000	-0.088	-0.217	-0.330	-0.342	
30	A	-0.998	-0.932	-0.749	-0.499	-0.249	-0.067	0.000	-0.067	-0.251	-0.501	-0.751	-0.938	-0.868	
	B	0.376	0.331	0.218	0.089	0.001	-0.023	0.000	0.023	-0.001	-0.089	-0.218	-0.243	-0.251	
45	A	-0.989	-0.923	-0.741	-0.492	-0.245	-0.064	0.000	-0.070	-0.255	-0.508	-0.622	-0.693	-0.718	
	B	0.384	0.338	0.224	0.094	0.004	-0.021	0.000	0.021	-0.004	-0.094	-0.216	-0.129	-0.134	
60	A	-0.960	-0.894	-0.715	-0.472	-0.230	-0.057	0.000	-0.077	-0.270	-0.382	-0.468	-0.522	-0.540	
	B	0.401	0.355	0.239	0.107	0.013	-0.017	0.000	0.017	-0.013	-0.018	-0.022	-0.025	-0.026	
75	A	-0.896	-0.833	-0.660	-0.426	-0.198	-0.040	0.000	-0.094	-0.181	-0.257	-0.314	-0.350	-0.363	
	B	0.424	0.378	0.259	0.123	0.025	-0.011	0.000	0.011	0.021	0.030	0.036	0.041	0.042	
90	A	-0.788	-0.728	-0.566	-0.350	-0.144	-0.012	0.000	-0.055	-0.106	-0.150	-0.184	-0.205	-0.212	
	B	0.438	0.390	0.271	0.133	0.031	-0.008	0.000	0.016	0.031	0.044	0.054	0.060	0.062	

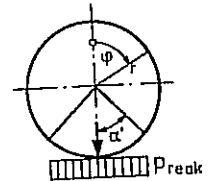
Vorzeichen: Normalkraft + N ergibt Zug
sign axial force + N results in tension LF 7

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
8

Auflagergegendruck rechteckig
bedding reaction pressure rectangular



α'		Biegemoment bending moment				Normalkraft axial force				N=n·P _{reak} ·r					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.003	0.003	-0.031
	N	-0.002	-0.002	-0.002	-0.001	-0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.002
30	M	-0.007	-0.006	-0.005	-0.003	0.000	0.003	0.007	0.010	0.013	0.016	0.018	0.018	-0.010	-0.105
	N	-0.013	-0.013	-0.011	-0.009	-0.007	-0.003	0.000	0.003	0.007	0.009	0.011	0.011	0.007	0.013
45	M	-0.018	-0.017	-0.013	-0.007	0.001	0.010	0.019	0.029	0.038	0.046	0.046	0.030	-0.045	-0.193
	N	-0.038	-0.036	-0.032	-0.027	-0.019	-0.010	0.000	0.010	0.019	0.027	0.036	0.046	0.055	0.038
60	M	-0.033	-0.031	-0.024	-0.013	0.002	0.018	0.036	0.054	0.071	0.072	0.072	0.029	-0.082	-0.270
	N	-0.069	-0.067	-0.060	-0.049	-0.034	-0.018	0.000	0.018	0.034	0.051	0.061	0.072	0.072	0.069
75	M	-0.045	-0.042	-0.032	-0.017	0.003	0.026	0.051	0.076	0.094	0.085	0.085	0.025	-0.107	-0.320
	N	-0.096	-0.092	-0.083	-0.068	-0.048	-0.025	0.000	0.025	0.051	0.076	0.094	0.107	0.107	0.096
90	M	-0.049	-0.046	-0.035	-0.018	0.004	0.029	0.057	0.084	0.101	0.089	0.089	0.024	-0.115	-0.337
	N	-0.106	-0.102	-0.092	-0.075	-0.053	-0.027	0.000	0.060	0.101	0.134	0.169	0.282	0.294	0.106

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

4/85

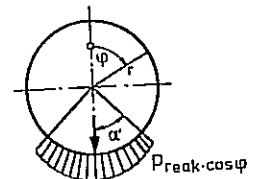
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 8

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
9

Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



α'		Biegemoment bending moment		$M = m \cdot P_{reak} \cdot r^2$		Normalkraft axial force		$N = n \cdot P_{reak} \cdot r$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.003	0.003	-0.031
	N	-0.002	-0.002	-0.002	-0.001	-0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	-0.032
30	M	-0.007	-0.006	-0.005	-0.003	0.000	0.003	0.007	0.010	0.014	0.017	0.019	-0.011	-0.104	
	N	-0.014	-0.013	-0.012	-0.010	-0.007	-0.004	0.000	0.004	0.007	0.010	0.012	-0.018	-0.111	
45	M	-0.019	-0.018	-0.014	-0.008	0.001	0.010	0.021	0.031	0.040	0.049	0.029	-0.050	-0.190	
	N	-0.040	-0.038	-0.034	-0.028	-0.020	-0.010	0.000	0.010	0.020	0.028	0.038	-0.071	-0.210	
60	M	-0.036	-0.033	-0.026	-0.014	0.002	0.020	0.040	0.060	0.078	0.074	0.020	-0.091	-0.259	
	N	-0.076	-0.074	-0.066	-0.054	-0.038	-0.020	0.000	0.020	0.038	0.054	0.074	-0.131	-0.299	
75	M	-0.051	-0.047	-0.036	-0.019	0.004	0.031	0.059	0.088	0.103	0.081	0.010	-0.117	-0.297	
	N	-0.110	-0.106	-0.095	-0.078	-0.055	-0.028	0.000	0.028	0.043	0.061	0.081	-0.176	-0.356	
90	M	-0.057	-0.052	-0.040	-0.020	0.006	0.036	0.068	0.098	0.108	0.081	0.005	-0.125	-0.307	
	N	-0.125	-0.121	-0.108	-0.088	-0.063	-0.032	0.000	0.029	0.039	0.051	0.071	-0.193	-0.375	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

4/85

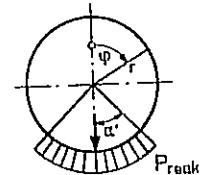
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 9

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
10

Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial



α'		Biegemoment bending moment		$M = m \cdot P_{reak} \cdot r^2$		Normalkraft axial force		$N = n \cdot P_{reak} \cdot r$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.003	0.003	-0.031
	N	-0.002	-0.002	-0.002	-0.001	-0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	-0.032
30	M	-0.007	-0.007	-0.005	-0.003	0.000	0.000	0.004	0.008	0.011	0.015	0.018	0.020	-0.012	-0.112
	N	-0.015	-0.014	-0.013	-0.010	-0.007	-0.004	0.000	0.004	0.007	0.010	0.013	0.013	-0.020	-0.119
45	M	-0.023	-0.022	-0.017	-0.009	0.001	0.012	0.025	0.037	0.049	0.059	0.063	0.063	-0.062	-0.220
	N	-0.048	-0.047	-0.042	-0.034	-0.024	-0.013	0.000	0.013	0.024	0.034	0.034	0.008	-0.087	-0.245
60	M	-0.051	-0.048	-0.037	-0.019	0.003	0.029	0.058	0.086	0.112	0.101	0.018	0.018	-0.130	-0.333
	N	-0.109	-0.105	-0.094	-0.077	-0.054	-0.028	0.000	0.028	0.054	0.043	-0.040	-0.040	-0.188	-0.391
75	M	-0.090	-0.084	-0.064	-0.032	0.009	0.058	0.109	0.161	0.175	0.116	-0.011	-0.198	-0.432	-0.542
	N	-0.200	-0.193	-0.173	-0.141	-0.100	-0.052	0.000	0.052	0.066	0.007	-0.120	-0.307	-0.542	-0.542
90	M	-0.137	-0.126	-0.094	-0.043	0.023	0.099	0.182	0.230	0.207	0.114	-0.043	-0.252	-0.500	-0.682
	N	-0.318	-0.307	-0.276	-0.225	-0.159	-0.082	0.000	0.048	0.025	-0.068	-0.224	-0.434	-0.682	-0.682

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

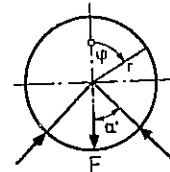
LF 10

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
11

Zweiliniengegendruck radial
two linear support reactions, radial



α'		Biegemoment bending moment		$M = m \cdot F \cdot r$		Normalkraft axial force		$N = n \cdot F$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	-0.006	-0.005	-0.004	-0.002	0.000	0.003	0.006	0.009	0.011	0.014	0.014	0.015	0.016	-0.117
	N	-0.011	-0.011	-0.010	-0.008	-0.006	-0.003	0.000	0.003	0.006	0.008	0.008	0.010	0.011	-0.123
17	M	-0.008	-0.007	-0.006	-0.003	0.000	0.004	0.008	0.012	0.015	0.019	0.021	0.021	0.000	-0.135
	N	-0.015	-0.015	-0.013	-0.011	-0.008	-0.004	0.000	0.004	0.008	0.011	0.011	0.013	-0.008	-0.142
30	M	-0.023	-0.022	-0.017	-0.009	0.001	0.012	0.025	0.037	0.049	0.059	0.063	0.066	-0.078	-0.216
	N	-0.048	-0.046	-0.042	-0.034	-0.024	-0.012	0.000	0.012	0.024	0.034	0.034	0.042	-0.103	-0.241
45	M	-0.059	-0.055	-0.042	-0.022	0.003	0.034	0.066	0.098	0.128	0.154	-0.009	-0.167	-0.309	-0.375
	N	-0.125	-0.121	-0.108	-0.088	-0.063	-0.032	0.000	0.032	0.062	0.088	-0.075	-0.233	-0.375	-0.375
60	M	-0.130	-0.120	-0.091	-0.045	0.015	0.084	0.159	0.234	0.303	0.104	-0.091	-0.269	-0.418	-0.577
	N	-0.289	-0.279	-0.250	-0.204	-0.144	-0.075	0.000	0.075	0.144	-0.055	-0.250	-0.428	-0.577	-0.577

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

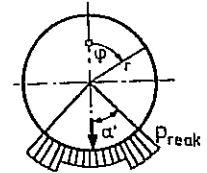
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 11

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+
Lastfall | Auflagergegendruck stufenförmig, radial
load case | bedding reaction pressure gradually shaped, radial
12
-----+



		Biegemoment bending moment			M = m · Preuk · r ²		Normalkraft axial force		N = n · Preuk · r						
α'		0	15	30	45	60	75	90	105	120	135	150	165	180	
30	M	-0.007	-0.006	-0.005	-0.003	0.000	0.003	0.007	0.011	0.014	0.017	0.019	-0.014	-0.096	
	N	-0.014	-0.013	-0.012	-0.010	-0.007	-0.004	0.000	0.004	0.007	0.010	0.012	-0.021	-0.103	
45	M	-0.022	-0.020	-0.016	-0.009	0.001	0.012	0.023	0.035	0.046	0.055	0.028	-0.063	-0.186	
	N	-0.045	-0.044	-0.039	-0.032	-0.023	-0.012	0.000	0.012	0.023	0.032	0.005	-0.066	-0.210	
60	M	-0.048	-0.044	-0.034	-0.018	0.003	0.028	0.054	0.080	0.105	0.092	0.008	-0.124	-0.278	
	N	-0.102	-0.098	-0.088	-0.072	-0.051	-0.026	0.000	0.026	0.051	0.038	-0.046	-0.178	-0.331	
75	M	-0.083	-0.077	-0.059	-0.029	0.009	0.054	0.102	0.150	0.161	0.099	-0.026	-0.181	-0.351	
	N	-0.185	-0.179	-0.161	-0.131	-0.093	-0.048	0.000	0.048	0.059	-0.003	-0.128	-0.283	-0.452	
90	M	-0.125	-0.115	-0.086	-0.039	0.022	0.093	0.169	0.211	0.182	0.084	-0.059	-0.221	-0.390	
	N	-0.294	-0.284	-0.255	-0.208	-0.147	-0.076	0.000	0.042	0.013	-0.085	-0.228	-0.390	-0.559	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
sign bending moment + M results in tension on internal pipe surface

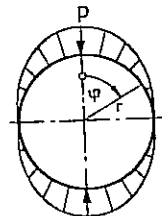
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 12

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Radial wirkende Auflast und Auflagergegendruck \cos^2 -förmig,
Lastfall | radial, über 180° verteilt
load case | surcharge and bedding reaction pressure in radial direction
13
-----+ \cos^2 -shaped, radial, 180° distributed



	Biegemoment bending moment				Normalkraft axial force									
	M = m · p · r ²				N = n · p · r									
	0	15	30	45	60	75	90	105	120	135	150	165	180	
M	0.167	0.144	0.083	0.000	-0.083	-0.144	-0.167	-0.144	-0.083	0.000	0.083	0.144	0.167	
N	-0.333	-0.357	-0.417	-0.500	-0.583	-0.644	-0.667	-0.644	-0.583	-0.500	-0.417	-0.357	-0.333	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
sign bending moment + M results in tension on internal pipe surface

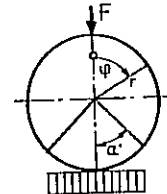
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 13

10/87

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Linienbelastung
Lastfall | linear load
load case |
1A.8 | Auflagergegendruck rechteckig
bedding reaction pressure rectangular



α'		Biegemoment bending moment			Normalkraft axial force			N=n·F								
		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.317	0.187	0.067	-0.036	-0.115	-0.164	-0.180	-0.162	-0.111	-0.031	0.073	0.194	0.259		
	N	-0.004	-0.133	-0.253	-0.356	-0.435	-0.484	-0.500	-0.482	-0.431	-0.351	-0.247	-0.126	0.004		
30	M	0.312	0.183	0.064	-0.038	-0.115	-0.161	-0.175	-0.155	-0.101	-0.019	0.087	0.179	0.213		
	N	-0.013	-0.142	-0.261	-0.363	-0.440	-0.486	-0.500	-0.480	-0.426	-0.344	-0.239	-0.054	0.013		
45	M	0.305	0.177	0.059	-0.040	-0.114	-0.158	-0.168	-0.144	-0.088	-0.003	0.090	0.157	0.182		
	N	-0.027	-0.155	-0.273	-0.372	-0.446	-0.490	-0.500	-0.476	-0.420	-0.335	-0.154	-0.022	0.027		
60	M	0.299	0.171	0.055	-0.043	-0.114	-0.154	-0.161	-0.134	-0.074	0.006	0.085	0.142	0.162		
	N	-0.040	-0.168	-0.284	-0.382	-0.453	-0.493	-0.500	-0.473	-0.413	-0.261	-0.110	0.000	0.040		
75	M	0.295	0.167	0.052	-0.044	-0.113	-0.151	-0.155	-0.126	-0.064	0.009	0.081	0.134	0.153		
	N	-0.049	-0.177	-0.293	-0.389	-0.458	-0.496	-0.500	-0.470	-0.363	-0.224	-0.087	0.013	0.049		
90	M	0.294	0.166	0.051	-0.044	-0.113	-0.150	-0.153	-0.123	-0.064	0.009	0.080	0.131	0.150		
	N	-0.053	-0.181	-0.296	-0.391	-0.460	-0.497	-0.500	-0.453	-0.348	-0.212	-0.079	0.018	0.053		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

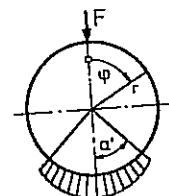
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 1A. 8

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Linienbelastung
Lastfall | linear load
load case |
1A.9 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



α'		Biegemoment bending moment			Normalkraft axial force			N=n·F								
		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.317	0.187	0.067	-0.036	-0.115	-0.164	-0.180	-0.162	-0.111	-0.031	0.073	0.194	0.258		
	N	-0.004	-0.133	-0.253	-0.356	-0.435	-0.484	-0.500	-0.482	-0.431	-0.351	-0.247	-0.126	-0.062		
30	M	0.311	0.182	0.063	-0.038	-0.115	-0.161	-0.174	-0.154	-0.100	-0.018	0.088	0.178	0.209		
	N	-0.014	-0.143	-0.262	-0.364	-0.440	-0.487	-0.500	-0.479	-0.426	-0.343	-0.238	-0.148	-0.116		
45	M	0.303	0.175	0.057	-0.041	-0.114	-0.157	-0.166	-0.141	-0.083	0.003	0.091	0.150	0.171		
	N	-0.031	-0.159	-0.277	-0.375	-0.448	-0.491	-0.500	-0.475	-0.418	-0.332	-0.243	-0.184	-0.164		
60	M	0.294	0.166	0.051	-0.045	-0.113	-0.151	-0.155	-0.124	-0.062	0.015	0.082	0.127	0.143		
	N	-0.051	-0.179	-0.295	-0.390	-0.459	-0.496	-0.500	-0.470	-0.407	-0.330	-0.263	-0.218	-0.202		
75	M	0.286	0.159	0.045	-0.047	-0.112	-0.145	-0.144	-0.108	-0.049	0.017	0.074	0.114	0.128		
	N	-0.071	-0.198	-0.311	-0.403	-0.468	-0.501	-0.500	-0.465	-0.405	-0.340	-0.282	-0.243	-0.229		
90	M	0.282	0.156	0.043	-0.048	-0.111	-0.142	-0.138	-0.102	-0.046	0.016	0.072	0.110	0.123		
	N	-0.080	-0.206	-0.319	-0.410	-0.473	-0.504	-0.500	-0.464	-0.408	-0.346	-0.290	-0.252	-0.239		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

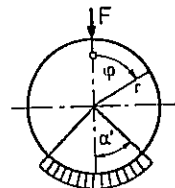
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 1A. 9

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Linienbelastung
linear load
Lastfall
load case
1A.10
Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial



α'		Biegemoment bending moment			M=m·F·r			Normalkraft axial force			N=n·F					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.316	0.187	0.067	-0.036	-0.115	-0.164	-0.180	-0.162	-0.111	-0.031	0.073	0.194	0.258		
	N	-0.004	-0.133	-0.253	-0.356	-0.435	-0.484	-0.500	-0.482	-0.431	-0.351	-0.247	-0.126	-0.062		
30	M	0.311	0.182	0.063	-0.038	-0.115	-0.161	-0.174	-0.153	-0.100	-0.017	0.089	0.177	0.207		
	N	-0.015	-0.144	-0.263	-0.364	-0.440	-0.487	-0.500	-0.479	-0.426	-0.343	-0.237	-0.149	-0.119		
45	M	0.302	0.174	0.056	-0.042	-0.114	-0.156	-0.164	-0.138	-0.080	0.007	0.091	0.145	0.163		
	N	-0.034	-0.162	-0.280	-0.376	-0.450	-0.492	-0.500	-0.474	-0.416	-0.329	-0.245	-0.191	-0.173		
60	M	0.289	0.161	0.047	-0.046	-0.113	-0.148	-0.148	-0.115	-0.050	0.023	0.079	0.114	0.126		
	N	-0.063	-0.190	-0.304	-0.398	-0.464	-0.499	-0.500	-0.467	-0.402	-0.329	-0.273	-0.238	-0.226		
75	M	0.272	0.146	0.035	-0.052	-0.110	-0.135	-0.125	-0.081	-0.024	0.025	0.063	0.086	0.095		
	N	-0.103	-0.229	-0.339	-0.427	-0.485	-0.510	-0.500	-0.456	-0.399	-0.350	-0.312	-0.288	-0.280		
90	M	0.250	0.126	0.021	-0.057	-0.103	-0.115	-0.091	-0.050	-0.011	0.022	0.047	0.063	0.068		
	N	-0.159	-0.283	-0.388	-0.466	-0.513	-0.524	-0.500	-0.459	-0.420	-0.387	-0.362	-0.346	-0.341		

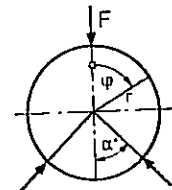
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 1A.10

Schnittkräfte am Kreisring
sectional forces at the circular ring

Linienbelastung
linear load
Lastfall
load case
1A.11
Zweiliniengegendruck radial
two linear support reactions radial



α'		Biegemoment bending moment			M=m·F·r			Normalkraft axial force			N=n·F					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.313	0.184	0.064	-0.038	-0.115	-0.162	-0.176	-0.156	-0.104	-0.022	0.084	0.205	0.201		
	N	-0.011	-0.140	-0.260	-0.361	-0.439	-0.486	-0.500	-0.480	-0.427	-0.346	-0.240	-0.119	-0.123		
17.5	M	0.311	0.182	0.063	-0.038	-0.115	-0.161	-0.174	-0.153	-0.099	-0.017	0.089	0.189	0.184		
	N	-0.015	-0.144	-0.263	-0.364	-0.441	-0.487	-0.500	-0.479	-0.425	-0.343	-0.237	-0.137	-0.142		
30	M	0.295	0.167	0.051	-0.045	-0.114	-0.152	-0.157	-0.128	-0.066	0.023	0.135	0.111	0.102		
	N	-0.048	-0.176	-0.292	-0.388	-0.457	-0.495	-0.500	-0.471	-0.409	-0.320	-0.208	-0.232	-0.241		
45	M	0.259	0.134	0.026	-0.058	-0.111	-0.131	-0.116	-0.066	0.014	0.119	0.059	0.022	0.009		
	N	-0.125	-0.250	-0.358	-0.442	-0.496	-0.515	-0.500	-0.451	-0.371	-0.265	-0.325	-0.362	-0.375		
60	M	0.189	0.069	-0.023	-0.080	-0.100	-0.080	-0.023	0.069	0.189	0.069	-0.023	-0.080	-0.100		
	N	-0.289	-0.408	-0.500	-0.558	-0.577	-0.558	-0.500	-0.408	-0.289	-0.408	-0.500	-0.558	-0.577		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

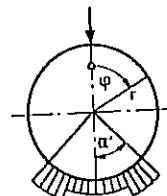
LF 1A.11

T.E.B. TEST
ACCORDING TO
DIN

fr 1B pg 226

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall : Linienbelastung
load case : linear load
1A.12 : Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial



α'		Biegemoment bending moment			M=m·F·r			Normalkraft axial force			N=n·F					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
30	M	0.309	0.180	0.062	-0.039	-0.115	-0.160	-0.172	-0.150	-0.096	-0.013	0.094	0.171	0.189		
	N	-0.019	-0.147	-0.266	-0.367	-0.442	-0.488	-0.500	-0.478	-0.424	-0.340	-0.234	-0.157	-0.139		
45	M	0.297	0.169	0.053	-0.044	-0.114	-0.153	-0.159	-0.131	-0.070	0.018	0.096	0.128	0.138		
	N	-0.044	-0.172	-0.288	-0.384	-0.455	-0.494	-0.500	-0.472	-0.411	-0.323	-0.245	-0.213	-0.203		
60	M	0.280	0.153	0.041	-0.050	-0.112	-0.142	-0.138	-0.100	-0.030	0.039	0.075	0.088	0.093		
	N	-0.082	-0.209	-0.321	-0.412	-0.474	-0.504	-0.500	-0.462	-0.392	-0.323	-0.287	-0.274	-0.269		
75	M	0.255	0.131	0.024	-0.057	-0.108	-0.124	-0.105	-0.051	0.007	0.040	0.049	0.052	0.053		
	N	-0.140	-0.265	-0.371	-0.453	-0.503	-0.519	-0.500	-0.447	-0.389	-0.356	-0.347	-0.343	-0.342		
90	M	0.222	0.100	0.002	-0.065	-0.098	-0.093	-0.051	-0.001	0.026	0.030	0.023	0.018	0.017		
	N	-0.228	-0.349	-0.447	-0.514	-0.547	-0.542	-0.500	-0.450	-0.423	-0.419	-0.427	-0.431	-0.433		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

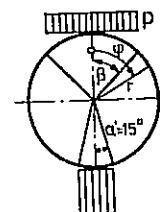
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 1A.12

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall : Rechteckig verteilte Auflast beliebiger Breite
load case : rectangularly distributed surcharge any desired width
2.8.15 : Auflagergegendruck rechteckig
bedding reaction pressure rectangular



β		Biegemoment bending moment			M=m·p·r ²			Normalkraft axial force			N=n·p·r					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.133	0.100	0.037	-0.016	-0.058	-0.083	-0.092	-0.083	-0.058	-0.016	0.037	0.100	0.133		
	N	0.000	-0.067	-0.129	-0.183	-0.224	-0.250	-0.259	-0.250	-0.224	-0.183	-0.129	-0.067	0.000		
30	M	0.212	0.178	0.085	-0.020	-0.101	-0.154	-0.173	-0.159	-0.111	-0.034	0.068	0.186	0.252		
	N	0.010	-0.058	-0.242	-0.347	-0.428	-0.480	-0.500	-0.485	-0.438	-0.360	-0.258	-0.139	-0.010		
45	M	0.254	0.220	0.125	-0.005	-0.124	-0.203	-0.235	-0.219	-0.157	-0.051	0.090	0.258	0.348		
	N	0.032	-0.036	-0.222	-0.477	-0.596	-0.675	-0.707	-0.691	-0.629	-0.523	-0.362	-0.214	-0.032		
60	M	0.278	0.243	0.145	0.010	-0.128	-0.230	-0.276	-0.262	-0.191	-0.066	0.103	0.306	0.416		
	N	0.063	-0.006	-0.196	-0.456	-0.719	-0.820	-0.866	-0.853	-0.781	-0.657	-0.487	-0.285	-0.063		
75	M	0.291	0.255	0.154	0.015	-0.128	-0.241	-0.297	-0.287	-0.212	-0.077	0.109	0.333	0.455		
	N	0.089	0.019	-0.173	-0.437	-0.706	-0.910	-0.966	-0.956	-0.881	-0.746	-0.560	-0.336	-0.089		
90	M	0.296	0.259	0.158	0.017	-0.129	-0.244	-0.303	-0.295	-0.219	-0.080	0.111	0.342	0.468		
	N	0.099	0.029	-0.164	-0.430	-0.701	-0.907	-1.000	-0.992	-0.916	-0.777	-0.586	-0.354	-0.099		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

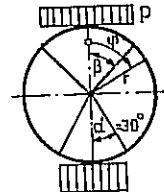
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.8.15

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width
Auflagergegendruck rechteckig
bedding reaction pressure rectangular



		Biegemoment bending moment			M = m · p · r ²		Normalkraft axial force		N = n · p · r							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.131	0.097	0.035	-0.017	-0.057	-0.082	-0.090	-0.080	-0.052	-0.010	0.044	0.092	0.109		
	N	-0.005	-0.072	-0.134	-0.187	-0.227	-0.251	-0.259	-0.249	-0.222	-0.179	-0.125	-0.030	0.005		
30	M	0.207	0.173	0.082	-0.022	-0.101	-0.151	-0.168	-0.151	-0.101	-0.022	0.082	0.173	0.207		
	N	0.000	-0.067	-0.250	-0.354	-0.433	-0.483	-0.500	-0.483	-0.433	-0.354	-0.250	-0.067	0.000		
45	M	0.248	0.214	0.120	-0.008	-0.124	-0.199	-0.228	-0.209	-0.143	-0.034	0.109	0.237	0.283		
	N	0.019	-0.049	-0.234	-0.487	-0.603	-0.678	-0.707	-0.688	-0.622	-0.513	-0.370	-0.113	-0.019		
60	M	0.270	0.235	0.139	0.006	-0.128	-0.226	-0.267	-0.249	-0.174	-0.046	0.126	0.280	0.337		
	N	0.046	-0.023	-0.210	-0.468	-0.727	-0.825	-0.866	-0.848	-0.773	-0.645	-0.473	-0.160	-0.046		
75	M	0.282	0.246	0.148	0.012	-0.128	-0.236	-0.287	-0.272	-0.193	-0.054	0.135	0.305	0.367		
	N	0.070	0.001	-0.189	-0.451	-0.715	-0.915	-0.966	-0.951	-0.872	-0.733	-0.544	-0.197	-0.070		
90	M	0.286	0.250	0.151	0.013	-0.128	-0.239	-0.293	-0.280	-0.199	-0.057	0.138	0.313	0.377		
	N	0.080	0.010	-0.181	-0.444	-0.710	-0.912	-1.000	-0.987	-0.906	-0.763	-0.569	-0.211	-0.080		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

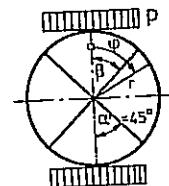
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 8.30

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width
Auflagergegendruck rechteckig
bedding reaction pressure rectangular



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.127	0.094	0.033	-0.019	-0.057	-0.080	-0.086	-0.074	-0.045	-0.002	0.046	0.080	0.093		
	N	-0.012	-0.078	-0.140	-0.191	-0.230	-0.253	-0.259	-0.247	-0.218	-0.175	-0.081	-0.013	0.012		
30	M	0.200	0.167	0.077	-0.024	-0.101	-0.148	-0.161	-0.141	-0.088	-0.006	0.085	0.151	0.175		
	N	-0.013	-0.080	-0.261	-0.363	-0.440	-0.486	-0.500	-0.480	-0.426	-0.344	-0.165	-0.035	0.013		
45	M	0.239	0.205	0.114	-0.011	-0.124	-0.194	-0.218	-0.194	-0.124	-0.011	0.114	0.205	0.239		
	N	0.000	-0.067	-0.250	-0.500	-0.612	-0.683	-0.707	-0.683	-0.612	-0.500	-0.250	-0.067	0.000		
60	M	0.259	0.225	0.131	0.002	-0.128	-0.220	-0.255	-0.231	-0.150	-0.018	0.132	0.242	0.282		
	N	0.023	-0.045	-0.230	-0.484	-0.739	-0.831	-0.866	-0.842	-0.761	-0.629	-0.326	-0.104	-0.023		
75	M	0.270	0.235	0.139	0.007	-0.127	-0.229	-0.274	-0.252	-0.167	-0.022	0.141	0.262	0.306		
	N	0.044	-0.024	-0.212	-0.469	-0.728	-0.922	-0.966	-0.944	-0.859	-0.714	-0.380	-0.134	-0.044		
90	M	0.274	0.238	0.142	0.008	-0.128	-0.232	-0.279	-0.259	-0.172	-0.024	0.144	0.268	0.314		
	N	0.053	-0.016	-0.204	-0.462	-0.723	-0.919	-1.000	-0.980	-0.893	-0.745	-0.399	-0.146	-0.053		

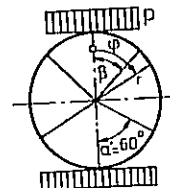
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 8.45

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulär distributed surcharge any desired width
| load case |
| 2.8.60 | Auflagergegendruck rechteckig
| | bedding reaction pressure rectangular

β		Biegemoment bending moment			Normalkraft axial force			N = n · p · r								
		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.124	0.091	0.031	-0.020	-0.057	-0.078	-0.082	-0.069	-0.038	0.003	0.043	0.072	0.083	0.019	
	N	-0.019	-0.085	-0.146	-0.196	-0.234	-0.255	-0.259	-0.245	-0.215	-0.136	-0.058	-0.002			
30	M	0.194	0.162	0.073	-0.026	-0.100	-0.144	-0.154	-0.130	-0.074	0.004	0.080	0.136	0.156	0.027	
	N	-0.027	-0.093	-0.273	-0.372	-0.446	-0.490	-0.500	-0.476	-0.420	-0.270	-0.121	-0.013			
45	M	0.230	0.197	0.108	-0.014	-0.123	-0.189	-0.208	-0.179	-0.104	0.002	0.107	0.183	0.211	0.019	
	N	-0.019	-0.085	-0.266	-0.513	-0.622	-0.688	-0.707	-0.676	-0.603	-0.395	-0.188	-0.037			
60	M	0.248	0.215	0.123	-0.002	-0.127	-0.213	-0.243	-0.213	-0.127	-0.002	0.123	0.215	0.248	0.000	
	N	0.000	-0.067	-0.250	-0.500	-0.750	-0.837	-0.866	-0.837	-0.750	-0.500	-0.250	-0.067			
75	M	0.258	0.224	0.131	0.003	-0.126	-0.222	-0.260	-0.232	-0.140	-0.004	0.132	0.232	0.269	0.019	
	N	0.019	-0.049	-0.234	-0.487	-0.741	-0.928	-0.966	-0.938	-0.846	-0.571	-0.295	-0.093			
90	M	0.261	0.227	0.133	0.004	-0.127	-0.225	-0.265	-0.238	-0.144	-0.006	0.135	0.238	0.275	0.027	
	N	0.027	-0.041	-0.227	-0.481	-0.737	-0.926	-1.000	-0.973	-0.879	-0.596	-0.312	-0.103			

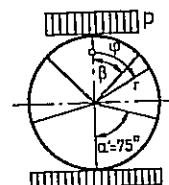
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 8.60

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulär distributed surcharge any desired width
| load case |
| 2.8.75 | Auflagergegendruck rechteckig
| | bedding reaction pressure rectangular

β		Biegemoment bending moment			Normalkraft axial force			N = n · p · r								
		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.122	0.089	0.029	-0.021	-0.057	-0.077	-0.080	-0.065	-0.034	0.004	0.041	0.068	0.078	0.024	
	N	-0.024	-0.090	-0.150	-0.200	-0.236	-0.256	-0.259	-0.244	-0.189	-0.117	-0.046	0.005			
30	M	0.190	0.158	0.070	-0.028	-0.100	-0.141	-0.149	-0.122	-0.066	0.006	0.077	0.127	0.146	0.036	
	N	-0.036	-0.102	-0.281	-0.379	-0.451	-0.492	-0.500	-0.474	-0.370	-0.233	-0.098	0.000			
45	M	0.224	0.192	0.103	-0.016	-0.122	-0.185	-0.200	-0.168	-0.093	0.005	0.102	0.172	0.198	0.032	
	N	-0.032	-0.098	-0.278	-0.523	-0.629	-0.691	-0.707	-0.675	-0.533	-0.343	-0.155	-0.018			
60	M	0.241	0.208	0.118	-0.004	-0.126	-0.208	-0.233	-0.199	-0.113	0.002	0.117	0.201	0.231	0.017	
	N	-0.017	-0.083	-0.265	-0.512	-0.758	-0.841	-0.866	-0.832	-0.664	-0.436	-0.210	-0.044			
75	M	0.250	0.216	0.125	0.000	-0.125	-0.217	-0.249	-0.217	-0.125	0.000	0.125	0.216	0.250	0.000	
	N	0.000	-0.067	-0.250	-0.500	-0.750	-0.933	-0.966	-0.933	-0.750	-0.500	-0.250	-0.067			
90	M	0.253	0.219	0.127	0.001	-0.126	-0.219	-0.254	-0.222	-0.129	-0.001	0.127	0.221	0.256	0.007	
	N	0.007	-0.060	-0.244	-0.495	-0.746	-0.931	-1.000	-0.968	-0.780	-0.523	-0.265	-0.076			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

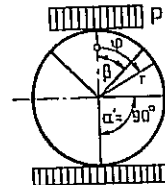
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 8.75

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width
Auflagergegendruck rechteckig
bedding reaction pressure rectangular



		Biegemoment bending moment				M = m · p · r ²				Normalkraft axial force				N = n · p · r			
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M		0.121	0.089	0.029	-0.021	-0.057	-0.076	-0.078	-0.063	-0.033	0.004	0.041	0.067	0.077		
	N		-0.026	-0.092	-0.152	-0.201	-0.237	-0.257	-0.259	-0.235	-0.181	-0.111	-0.043	0.007	0.026		
30	M		0.189	0.156	0.069	-0.028	-0.100	-0.140	-0.147	-0.120	-0.064	0.007	0.075	0.125	0.143		
	N		-0.040	-0.105	-0.284	-0.382	-0.453	-0.493	-0.500	-0.456	-0.355	-0.222	-0.091	0.005	0.040		
45	M		0.222	0.190	0.102	-0.017	-0.122	-0.183	-0.198	-0.164	-0.090	0.006	0.100	0.169	0.193		
	N		-0.038	-0.103	-0.282	-0.527	-0.631	-0.693	-0.707	-0.650	-0.512	-0.327	-0.144	-0.011	0.038		
60	M		0.238	0.206	0.117	-0.005	-0.125	-0.206	-0.230	-0.195	-0.110	0.003	0.115	0.197	0.226		
	N		-0.023	-0.089	-0.270	-0.516	-0.761	-0.842	-0.866	-0.802	-0.638	-0.417	-0.197	-0.036	0.023		
75	M		0.247	0.214	0.123	-0.001	-0.124	-0.214	-0.245	-0.211	-0.121	0.001	0.123	0.212	0.244		
	N		-0.007	-0.074	-0.256	-0.505	-0.753	-0.935	-0.966	-0.899	-0.721	-0.478	-0.236	-0.058	0.007		
90	M		0.250	0.217	0.125	0.000	-0.125	-0.217	-0.250	-0.217	-0.125	0.000	0.125	0.217	0.250		
	N		0.000	-0.067	-0.250	-0.500	-0.750	-0.933	-1.000	-0.933	-0.750	-0.500	-0.250	-0.067	0.000		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohriinnenseite
sign bending moment + M results in tension on internal pipe surface

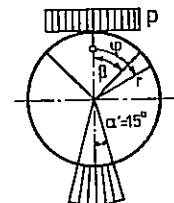
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 8.90

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width
Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force									$N = n \cdot p \cdot r$	
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.133	0.100	0.037	-0.016	-0.058	-0.083	-0.092	-0.083	-0.057	-0.016	0.037	0.100	0.133			
	N	0.000	-0.067	-0.129	-0.183	-0.224	-0.250	-0.259	-0.250	-0.224	-0.183	-0.129	-0.067	-0.034			
30	M	0.211	0.178	0.085	-0.020	-0.101	-0.154	-0.173	-0.159	-0.111	-0.034	0.068	0.168	0.252			
	N	0.010	-0.058	-0.242	-0.347	-0.428	-0.480	-0.500	-0.485	-0.438	-0.360	-0.258	-0.139	-0.075			
45	M	0.254	0.220	0.125	-0.005	-0.124	-0.203	-0.235	-0.219	-0.157	-0.051	0.090	0.258	0.347			
	N	0.032	-0.036	-0.222	-0.477	-0.596	-0.675	-0.707	-0.691	-0.629	-0.523	-0.382	-0.214	-0.125			
60	M	0.278	0.243	0.145	0.010	-0.128	-0.230	-0.276	-0.262	-0.191	-0.066	0.103	0.306	0.415			
	N	0.063	-0.006	-0.196	-0.456	-0.719	-0.820	-0.866	-0.853	-0.781	-0.657	-0.487	-0.285	-0.176			
75	M	0.291	0.255	0.154	0.015	-0.128	-0.241	-0.297	-0.287	-0.212	-0.076	0.109	0.334	0.454			
	N	0.089	0.019	-0.173	-0.437	-0.706	-0.910	-0.966	-0.956	-0.881	-0.746	-0.560	-0.336	-0.215			
90	M	0.296	0.259	0.158	0.017	-0.129	-0.244	-0.303	-0.295	-0.219	-0.080	0.111	0.343	0.467			
	N	0.099	0.029	-0.164	-0.430	-0.701	-0.907	-1.000	-0.992	-0.915	-0.777	-0.586	-0.354	-0.230			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohriinnenseite
sign bending moment + M results in tension on internal pipe surface

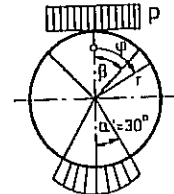
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 9.15

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
Lastfall | rectangulary distributed surcharge any desired width
load case | Auflagergegendruck cos-förmig, radial
2.9.30 | bedding reaction pressure cos-shaped, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force $N = n \cdot p \cdot r$							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.130	0.097	0.035	-0.017	-0.057	-0.082	-0.089	-0.079	-0.052	-0.010	0.045	0.091	0.107	
	N	-0.006	-0.072	-0.134	-0.187	-0.227	-0.251	-0.259	-0.249	-0.221	-0.179	-0.125	-0.078	-0.062	
30	M	0.206	0.173	0.081	-0.022	-0.101	-0.151	-0.168	-0.150	-0.100	-0.021	0.083	0.172	0.203	
	N	-0.001	-0.068	-0.251	-0.354	-0.434	-0.483	-0.500	-0.483	-0.433	-0.353	-0.249	-0.161	-0.130	
45	M	0.247	0.213	0.120	-0.008	-0.124	-0.199	-0.227	-0.208	-0.141	-0.033	0.111	0.234	0.277	
	N	0.017	-0.050	-0.235	-0.468	-0.604	-0.679	-0.707	-0.688	-0.621	-0.512	-0.369	-0.245	-0.202	
60	M	0.269	0.234	0.138	0.006	-0.128	-0.225	-0.266	-0.248	-0.172	-0.044	0.129	0.277	0.329	
	N	0.044	-0.024	-0.212	-0.469	-0.728	-0.825	-0.866	-0.848	-0.772	-0.644	-0.471	-0.323	-0.271	
75	M	0.281	0.245	0.147	0.011	-0.128	-0.236	-0.286	-0.271	-0.191	-0.052	0.138	0.302	0.359	
	N	0.068	-0.001	-0.191	-0.452	-0.716	-0.915	-0.966	-0.951	-0.871	-0.731	-0.542	-0.378	-0.321	
90	M	0.285	0.249	0.150	0.013	-0.128	-0.239	-0.292	-0.278	-0.197	-0.054	0.141	0.310	0.369	
	N	0.078	0.008	-0.183	-0.445	-0.711	-0.913	-1.000	-0.986	-0.905	-0.762	-0.567	-0.398	-0.339	

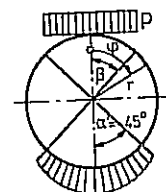
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 9.30

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
Lastfall | rectangulary distributed surcharge any desired width
load case | Auflagergegendruck cos-förmig, radial
2.9.45 | bedding reaction pressure cos-shaped, radial



β		Biegemoment bending moment			M = m · p · r ²		Normalkraft axial force		N = n · p · r						
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.126	0.093	0.032	-0.019	-0.057	-0.080	-0.085	-0.072	-0.043	0.001	0.046	0.077	0.087	
	N	-0.014	-0.081	-0.142	-0.193	-0.231	-0.254	-0.259	-0.246	-0.217	-0.173	-0.128	-0.097	-0.086	
30	M	0.198	0.165	0.076	-0.025	-0.101	-0.147	-0.159	-0.137	-0.083	0.000	0.086	0.144	0.164	
	N	-0.018	-0.084	-0.265	-0.366	-0.442	-0.488	-0.500	-0.478	-0.424	-0.341	-0.255	-0.197	-0.177	
45	M	0.236	0.202	0.112	-0.012	-0.124	-0.193	-0.215	-0.189	-0.117	-0.004	0.115	0.195	0.223	
	N	-0.006	-0.073	-0.255	-0.504	-0.616	-0.685	-0.707	-0.681	-0.609	-0.496	-0.377	-0.297	-0.269	
60	M	0.255	0.221	0.128	0.001	-0.127	-0.218	-0.251	-0.225	-0.143	-0.008	0.134	0.229	0.263	
	N	0.015	-0.052	-0.237	-0.489	-0.742	-0.833	-0.866	-0.840	-0.758	-0.623	-0.481	-0.386	-0.352	
75	M	0.266	0.231	0.136	0.005	-0.127	-0.227	-0.269	-0.246	-0.158	-0.012	0.143	0.248	0.285	
	N	0.036	-0.032	-0.219	-0.475	-0.732	-0.924	-0.966	-0.942	-0.854	-0.708	-0.553	-0.448	-0.412	
90	M	0.269	0.234	0.138	0.006	-0.128	-0.230	-0.275	-0.252	-0.163	-0.013	0.146	0.254	0.292	
	N	0.044	-0.024	-0.212	-0.469	-0.728	-0.922	-1.000	-0.977	-0.888	-0.738	-0.579	-0.471	-0.433	

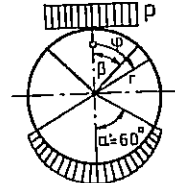
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2. 9.45

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
Lastfall | rectangulärly distributed surcharge any desired width
load case |
2.9.60 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force										$N = n \cdot p \cdot r$	
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.121	0.089	0.029	-0.021	-0.057	-0.077	-0.079	-0.064	-0.032	0.007	0.042	0.065	0.073			
	N	-0.025	-0.091	-0.151	-0.201	-0.237	-0.256	-0.259	-0.244	-0.212	-0.172	-0.138	-0.115	-0.106			
30	M	0.189	0.157	0.069	-0.028	-0.100	-0.141	-0.148	-0.121	-0.062	0.012	0.077	0.121	0.137			
	N	-0.038	-0.104	-0.283	-0.381	-0.452	-0.493	-0.500	-0.473	-0.414	-0.340	-0.275	-0.231	-0.215			
45	M	0.223	0.190	0.102	-0.017	-0.122	-0.184	-0.199	-0.166	-0.087	0.014	0.103	0.163	0.185			
	N	-0.035	-0.101	-0.280	-0.525	-0.630	-0.692	-0.707	-0.674	-0.595	-0.494	-0.405	-0.344	-0.323			
60	M	0.239	0.206	0.117	-0.005	-0.126	-0.207	-0.232	-0.197	-0.106	0.013	0.119	0.190	0.216			
	N	-0.020	-0.086	-0.267	-0.514	-0.760	-0.842	-0.866	-0.831	-0.740	-0.621	-0.516	-0.444	-0.419			
75	M	0.248	0.214	0.123	-0.001	-0.125	-0.216	-0.248	-0.214	-0.117	0.012	0.127	0.205	0.232			
	N	-0.004	-0.071	-0.253	-0.503	-0.752	-0.934	-0.966	-0.932	-0.835	-0.706	-0.591	-0.513	-0.486			
90	M	0.251	0.217	0.125	0.000	-0.126	-0.218	-0.253	-0.219	-0.120	0.012	0.129	0.209	0.238			
	N	0.003	-0.064	-0.247	-0.498	-0.748	-0.932	-1.000	-0.967	-0.868	-0.736	-0.618	-0.538	-0.510			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

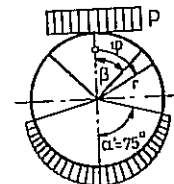
Normalkraft + N ergibt Zug
axial force + N results in tension

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LF 2. 9.60

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
Lastfall | rectangulärly distributed surcharge any desired width
load case |
2.9.75 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$					Normalkraft axial force					$N = n \cdot p \cdot r$				
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.117	0.085	0.026	-0.022	-0.056	-0.074	-0.073	-0.056	-0.025	0.008	0.038	0.058	0.065				
	N	-0.035	-0.101	-0.159	-0.208	-0.242	-0.259	-0.259	-0.241	-0.211	-0.177	-0.148	-0.127	-0.120				
30	M	0.181	0.149	0.063	-0.031	-0.099	-0.135	-0.137	-0.105	-0.049	0.014	0.070	0.108	0.121				
	N	-0.057	-0.122	-0.300	-0.394	-0.462	-0.498	-0.500	-0.468	-0.412	-0.349	-0.293	-0.255	-0.242				
45	M	0.211	0.180	0.094	-0.021	-0.120	-0.176	-0.184	-0.144	-0.068	0.016	0.092	0.144	0.162				
	N	-0.062	-0.127	-0.304	-0.544	-0.644	-0.699	-0.707	-0.667	-0.592	-0.507	-0.431	-0.379	-0.361				
60	M	0.225	0.193	0.107	-0.009	-0.123	-0.197	-0.213	-0.169	-0.083	0.016	0.105	0.167	0.188				
	N	-0.053	-0.119	-0.296	-0.538	-0.777	-0.850	-0.866	-0.823	-0.736	-0.637	-0.548	-0.487	-0.465				
75	M	0.232	0.200	0.112	-0.006	-0.123	-0.204	-0.227	-0.183	-0.091	0.015	0.112	0.178	0.202				
	N	-0.041	-0.106	-0.285	-0.529	-0.770	-0.944	-0.966	-0.922	-0.831	-0.724	-0.627	-0.561	-0.537				
90	M	0.234	0.202	0.114	-0.005	-0.123	-0.206	-0.231	-0.187	-0.094	0.015	0.114	0.182	0.206				
	N	-0.035	-0.101	-0.280	-0.525	-0.768	-0.942	-1.000	-0.957	-0.863	-0.755	-0.656	-0.588	-0.563				

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

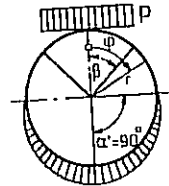
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2. 9.75

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.9.90 | Auflagergegendruck cos-förmig, radial
| | bedding reaction pressure cos-shaped, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.115	0.083	0.025	-0.023	-0.056	-0.072	-0.071	-0.053	-0.024	0.008	0.036	0.056	0.063		
	N	-0.039	-0.105	-0.163	-0.211	-0.244	-0.260	-0.259	-0.241	-0.212	-0.180	-0.152	-0.132	-0.125		
30	M	0.177	0.146	0.061	-0.032	-0.098	-0.132	-0.131	-0.099	-0.046	0.014	0.067	0.104	0.117		
	N	-0.066	-0.131	-0.307	-0.400	-0.466	-0.500	-0.500	-0.468	-0.415	-0.353	-0.302	-0.265	-0.252		
45	M	0.206	0.175	0.091	-0.022	-0.119	-0.171	-0.176	-0.135	-0.065	0.016	0.088	0.138	0.156		
	N	-0.075	-0.139	-0.315	-0.553	-0.650	-0.702	-0.707	-0.666	-0.596	-0.515	-0.443	-0.393	-0.375		
60	M	0.219	0.188	0.103	-0.011	-0.122	-0.192	-0.203	-0.159	-0.079	0.015	0.101	0.159	0.180		
	N	-0.069	-0.134	-0.310	-0.549	-0.784	-0.854	-0.866	-0.822	-0.741	-0.647	-0.562	-0.503	-0.482		
75	M	0.225	0.194	0.108	-0.008	-0.121	-0.198	-0.216	-0.172	-0.086	0.014	0.106	0.170	0.193		
	N	-0.058	-0.123	-0.300	-0.541	-0.779	-0.948	-0.966	-0.922	-0.836	-0.735	-0.643	-0.580	-0.557		
90	M	0.227	0.196	0.109	-0.007	-0.121	-0.200	-0.220	-0.176	-0.089	0.014	0.108	0.173	0.197		
	N	-0.053	-0.118	-0.296	-0.538	-0.777	-0.947	-1.000	-0.956	-0.869	-0.766	-0.672	-0.607	-0.584		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

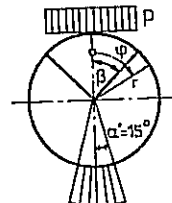
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.9.90

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Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.10.15 | Auflagergegendruck gleichförmig, radial
| | bedding reaction pressure uniform, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.133	0.100	0.037	-0.016	-0.058	-0.083	-0.092	-0.083	-0.057	-0.016	0.037	0.100	0.133		
	N	0.000	-0.067	-0.129	-0.183	-0.224	-0.250	-0.259	-0.250	-0.224	-0.183	-0.129	-0.067	-0.034		
30	M	0.211	0.178	0.085	-0.020	-0.101	-0.154	-0.173	-0.159	-0.111	-0.033	0.069	0.188	0.251		
	N	0.010	-0.058	-0.242	-0.347	-0.428	-0.480	-0.500	-0.485	-0.438	-0.360	-0.258	-0.139	-0.075		
45	M	0.254	0.220	0.125	-0.005	-0.124	-0.203	-0.235	-0.219	-0.157	-0.051	0.090	0.258	0.347		
	N	0.032	-0.036	-0.222	-0.477	-0.596	-0.675	-0.707	-0.691	-0.629	-0.523	-0.382	-0.214	-0.125		
60	M	0.278	0.243	0.145	0.010	-0.128	-0.230	-0.275	-0.262	-0.191	-0.066	0.103	0.306	0.414		
	N	0.063	-0.007	-0.196	-0.456	-0.719	-0.820	-0.866	-0.853	-0.781	-0.657	-0.487	-0.285	-0.177		
75	M	0.291	0.255	0.154	0.015	-0.128	-0.241	-0.297	-0.287	-0.212	-0.076	0.110	0.334	0.453		
	N	0.089	0.019	-0.173	-0.437	-0.706	-0.910	-0.966	-0.956	-0.881	-0.746	-0.560	-0.336	-0.216		
90	M	0.296	0.259	0.158	0.017	-0.129	-0.244	-0.303	-0.295	-0.218	-0.080	0.111	0.343	0.467		
	N	0.099	0.028	-0.164	-0.430	-0.701	-0.907	-1.000	-0.991	-0.915	-0.777	-0.586	-0.354	-0.230		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

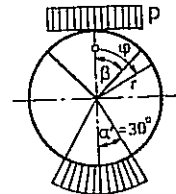
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.10.15

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Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.10.30 | Auflagergegendruck gleichförmig, radial
| | bedding reaction pressure uniform, radial
+-----



β		Biegemoment bending moment				Normalkraft axial force				N = n · p · r					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.130	0.097	0.035	-0.018	-0.057	-0.082	-0.089	-0.079	-0.052	-0.009	0.045	0.091	0.106	
	N	-0.006	-0.073	-0.134	-0.187	-0.227	-0.252	-0.259	-0.248	-0.221	-0.179	-0.124	-0.079	-0.064	
30	M	0.206	0.173	0.081	-0.022	-0.101	-0.151	-0.167	-0.150	-0.100	-0.020	0.084	0.171	0.200	
	N	-0.002	-0.068	-0.251	-0.355	-0.434	-0.483	-0.500	-0.483	-0.432	-0.352	-0.249	-0.162	-0.132	
45	M	0.247	0.213	0.119	-0.008	-0.124	-0.199	-0.227	-0.207	-0.141	-0.032	0.112	0.233	0.274	
	N	0.017	-0.051	-0.236	-0.488	-0.604	-0.679	-0.707	-0.687	-0.621	-0.512	-0.368	-0.247	-0.206	
60	M	0.269	0.234	0.138	0.006	-0.128	-0.225	-0.266	-0.247	-0.171	-0.043	0.130	0.275	0.325	
	N	0.043	-0.025	-0.213	-0.469	-0.728	-0.825	-0.866	-0.848	-0.772	-0.643	-0.470	-0.325	-0.275	
75	M	0.281	0.245	0.147	0.011	-0.128	-0.235	-0.286	-0.270	-0.190	-0.050	0.139	0.300	0.354	
	N	0.067	-0.002	-0.192	-0.453	-0.717	-0.916	-0.966	-0.950	-0.870	-0.730	-0.541	-0.381	-0.326	
90	M	0.285	0.249	0.150	0.012	-0.128	-0.238	-0.292	-0.277	-0.196	-0.053	0.142	0.308	0.364	
	N	0.076	0.007	-0.184	-0.446	-0.712	-0.913	-1.000	-0.986	-0.904	-0.761	-0.566	-0.401	-0.344	

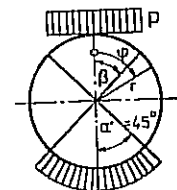
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2.10.30

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.10.45 | Auflagergegendruck gleichförmig, radial
| | bedding reaction pressure uniform, radial
+-----



β		Biegemoment bending moment				Normalkraft axial force				N = n · p · r					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.125	0.093	0.032	-0.019	-0.057	-0.079	-0.084	-0.071	-0.041	0.003	0.047	0.074	0.083	
	N	-0.016	-0.082	-0.143	-0.194	-0.232	-0.254	-0.259	-0.246	-0.216	-0.172	-0.128	-0.101	-0.091	
30	M	0.197	0.164	0.075	-0.026	-0.101	-0.146	-0.157	-0.135	-0.080	0.004	0.087	0.139	0.156	
	N	-0.021	-0.087	-0.268	-0.368	-0.443	-0.488	-0.500	-0.478	-0.423	-0.339	-0.256	-0.204	-0.186	
45	M	0.234	0.200	0.110	-0.013	-0.123	-0.191	-0.213	-0.186	-0.113	0.002	0.116	0.188	0.212	
	N	-0.011	-0.077	-0.259	-0.508	-0.618	-0.686	-0.707	-0.680	-0.607	-0.492	-0.378	-0.307	-0.282	
60	M	0.253	0.219	0.126	0.000	-0.127	-0.216	-0.248	-0.221	-0.137	-0.001	0.135	0.220	0.249	
	N	0.010	-0.058	-0.242	-0.493	-0.745	-0.834	-0.866	-0.839	-0.755	-0.619	-0.483	-0.398	-0.368	
75	M	0.263	0.228	0.134	0.004	-0.127	-0.226	-0.266	-0.241	-0.152	-0.004	0.145	0.238	0.270	
	N	0.030	-0.038	-0.224	-0.479	-0.735	-0.925	-0.966	-0.941	-0.851	-0.704	-0.555	-0.462	-0.430	
90	M	0.266	0.232	0.136	0.005	-0.128	-0.228	-0.271	-0.247	-0.156	-0.005	0.148	0.244	0.277	
	N	0.038	-0.030	-0.217	-0.473	-0.731	-0.923	-1.000	-0.976	-0.885	-0.734	-0.581	-0.485	-0.452	

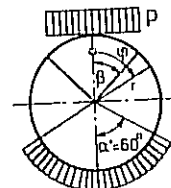
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2.10.45

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.10.60 | Auflagergegendruck gleichförmig, radial
-----+ bedding reaction pressure uniform, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$						
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.119	0.086	0.027	-0.022	-0.057	-0.075	-0.076	-0.059	-0.026	0.011	0.040	0.058	0.064	
	N	-0.031	-0.097	-0.156	-0.205	-0.240	-0.258	-0.259	-0.242	-0.209	-0.171	-0.143	-0.125	-0.119	
30	M	0.184	0.152	0.065	-0.030	-0.100	-0.137	-0.142	-0.112	-0.050	0.020	0.074	0.108	0.119	
	N	-0.050	-0.115	-0.293	-0.389	-0.458	-0.496	-0.500	-0.470	-0.408	-0.338	-0.284	-0.251	-0.239	
45	M	0.215	0.183	0.097	-0.020	-0.122	-0.180	-0.191	-0.153	-0.070	0.025	0.098	0.144	0.160	
	N	-0.051	-0.117	-0.295	-0.536	-0.638	-0.696	-0.707	-0.670	-0.587	-0.491	-0.418	-0.372	-0.357	
60	M	0.230	0.198	0.110	-0.008	-0.125	-0.202	-0.221	-0.181	-0.085	0.027	0.113	0.167	0.185	
	N	-0.040	-0.106	-0.285	-0.528	-0.770	-0.847	-0.866	-0.826	-0.730	-0.618	-0.532	-0.478	-0.460	
75	M	0.238	0.205	0.116	-0.005	-0.124	-0.210	-0.236	-0.196	-0.094	0.027	0.120	0.178	0.198	
	N	-0.026	-0.092	-0.272	-0.518	-0.763	-0.940	-0.966	-0.926	-0.824	-0.703	-0.610	-0.552	-0.532	
90	M	0.240	0.207	0.118	-0.004	-0.125	-0.212	-0.240	-0.201	-0.096	0.027	0.122	0.182	0.202	
	N	-0.020	-0.086	-0.267	-0.514	-0.760	-0.938	-1.000	-0.961	-0.856	-0.732	-0.638	-0.578	-0.558	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

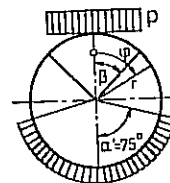
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.10.60

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Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.10.75 | Auflagergegendruck gleichförmig, radial
-----+ bedding reaction pressure uniform, radial



		Biegemoment bending moment				$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$					
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.110	0.078	0.021	-0.025	-0.055	-0.068	-0.064	-0.042	-0.012	0.013	0.032	0.044	0.048	
	N	-0.052	-0.117	-0.174	-0.220	-0.250	-0.263	-0.259	-0.237	-0.207	-0.182	-0.163	-0.151	-0.147	
30	M	0.166	0.136	0.054	-0.036	-0.096	-0.125	-0.118	-0.078	-0.024	0.022	0.058	0.080	0.088	
	N	-0.090	-0.154	-0.328	-0.417	-0.478	-0.506	-0.500	-0.460	-0.406	-0.359	-0.324	-0.301	-0.294	
45	M	0.191	0.161	0.080	-0.027	-0.117	-0.162	-0.158	-0.106	-0.034	0.028	0.075	0.105	0.115	
	N	-0.109	-0.172	-0.344	-0.577	-0.667	-0.711	-0.707	-0.655	-0.583	-0.521	-0.474	-0.444	-0.434	
60	M	0.200	0.170	0.090	-0.018	-0.120	-0.180	-0.181	-0.123	-0.040	0.031	0.085	0.119	0.131	
	N	-0.110	-0.173	-0.345	-0.578	-0.805	-0.865	-0.866	-0.808	-0.726	-0.655	-0.600	-0.566	-0.554	
75	M	0.204	0.174	0.093	-0.015	-0.119	-0.185	-0.191	-0.131	-0.044	0.031	0.089	0.125	0.138	
	N	-0.104	-0.167	-0.340	-0.574	-0.802	-0.960	-0.966	-0.906	-0.819	-0.743	-0.686	-0.650	-0.637	
90	M	0.206	0.176	0.094	-0.015	-0.119	-0.186	-0.194	-0.134	-0.045	0.032	0.090	0.127	0.140	
	N	-0.101	-0.164	-0.337	-0.571	-0.800	-0.959	-1.000	-0.940	-0.851	-0.775	-0.716	-0.679	-0.667	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

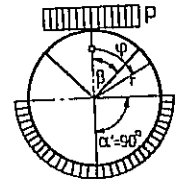
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.10.75

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width
Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial



β		Biegemoment bending moment				Normalkraft axial force				N = n · p · r							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.099	0.068	0.014	-0.027	-0.052	-0.058	-0.046	-0.025	-0.006	0.011	0.024	0.032	0.034			
	N	-0.081	-0.145	-0.199	-0.240	-0.264	-0.271	-0.259	-0.238	-0.219	-0.202	-0.189	-0.181	-0.178			
30	M	0.145	0.116	0.040	-0.041	-0.090	-0.105	-0.084	-0.046	-0.011	0.019	0.042	0.057	0.062			
	N	-0.146	-0.208	-0.376	-0.457	-0.506	-0.521	-0.500	-0.462	-0.427	-0.397	-0.374	-0.359	-0.354			
45	M	0.160	0.133	0.060	-0.035	-0.108	-0.134	-0.109	-0.061	-0.015	0.023	0.053	0.072	0.078			
	N	-0.188	-0.248	-0.412	-0.633	-0.706	-0.732	-0.707	-0.659	-0.613	-0.574	-0.545	-0.526	-0.520			
60	M	0.163	0.137	0.066	-0.026	-0.109	-0.145	-0.121	-0.068	-0.018	0.025	0.058	0.078	0.085			
	N	-0.207	-0.267	-0.429	-0.646	-0.853	-0.890	-0.866	-0.813	-0.763	-0.720	-0.687	-0.666	-0.659			
75	M	0.163	0.137	0.066	-0.025	-0.106	-0.147	-0.125	-0.070	-0.019	0.025	0.059	0.080	0.087			
	N	-0.212	-0.272	-0.433	-0.650	-0.856	-0.988	-0.966	-0.911	-0.860	-0.816	-0.782	-0.761	-0.754			
90	M	0.163	0.137	0.066	-0.025	-0.106	-0.146	-0.125	-0.070	-0.019	0.025	0.059	0.080	0.087			
	N	-0.212	-0.272	-0.434	-0.650	-0.856	-0.988	-1.000	-0.945	-0.894	-0.850	-0.816	-0.795	-0.788			

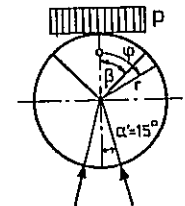
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.10.90

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width
Zweiliniengegendruck radial
two linear support, radial



		Biegemoment bending moment				M = m · p · r ²		Normalkraft axial force									N = n · p · r		
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180				
15	M	0.131	0.098	0.036	-0.017	-0.058	-0.082	-0.090	-0.080	-0.054	-0.012	0.043	0.105	0.103					
	N	-0.004	-0.071	-0.133	-0.186	-0.226	-0.251	-0.259	-0.249	-0.222	-0.180	-0.126	-0.063	-0.065					
30	M	0.208	0.174	0.082	-0.021	-0.101	-0.152	-0.169	-0.153	-0.103	-0.024	0.079	0.199	0.195					
	N	0.002	-0.065	-0.248	-0.352	-0.432	-0.482	-0.500	-0.484	-0.434	-0.355	-0.252	-0.131	-0.136					
45	M	0.249	0.215	0.121	-0.007	-0.124	-0.200	-0.230	-0.211	-0.146	-0.038	0.105	0.273	0.266					
	N	0.022	-0.046	-0.231	-0.485	-0.602	-0.677	-0.707	-0.689	-0.623	-0.515	-0.372	-0.204	-0.211					
60	M	0.272	0.236	0.140	0.007	-0.128	-0.227	-0.269	-0.252	-0.178	-0.050	0.121	0.325	0.315					
	N	0.050	-0.019	-0.207	-0.465	-0.725	-0.824	-0.866	-0.849	-0.775	-0.647	-0.476	-0.272	-0.282					
75	M	0.284	0.248	0.149	0.012	-0.128	-0.237	-0.289	-0.276	-0.197	-0.059	0.129	0.355	0.344					
	N	0.074	0.005	-0.186	-0.448	-0.713	-0.914	-0.966	-0.952	-0.874	-0.735	-0.547	-0.322	-0.333					
90	M	0.288	0.252	0.152	0.014	-0.129	-0.240	-0.295	-0.283	-0.203	-0.062	0.132	0.365	0.353					
	N	0.084	0.014	-0.177	-0.441	-0.708	-0.911	-1.000	-0.988	-0.908	-0.766	-0.573	-0.340	-0.352					

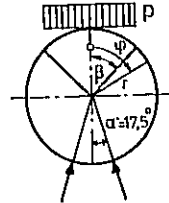
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.11.15

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangularly distributed surcharge any desired width
| load case |
| 2.11.17,5 | Zweiliniengegendruck radial
| | two linear support, radial



β		Biegemoment bending moment			Normalkraft axial force									
		φ	0	15	30	45	60	75	90	105	120	135	150	165
15	M	0.130	0.097	0.035	-0.018	-0.058	-0.082	-0.089	-0.079	-0.051	-0.009	0.046	0.097	0.094
	N	-0.006	-0.073	-0.135	-0.187	-0.227	-0.252	-0.259	-0.248	-0.221	-0.179	-0.124	-0.073	-0.076
30	M	0.206	0.172	0.081	-0.022	-0.101	-0.151	-0.167	-0.150	-0.099	-0.019	0.085	0.182	0.177
	N	-0.002	-0.069	-0.252	-0.355	-0.434	-0.483	-0.500	-0.482	-0.432	-0.352	-0.248	-0.150	-0.156
45	M	0.246	0.212	0.119	-0.008	-0.124	-0.199	-0.227	-0.207	-0.140	-0.031	0.113	0.250	0.242
	N	0.016	-0.052	-0.236	-0.489	-0.604	-0.679	-0.707	-0.687	-0.620	-0.511	-0.367	-0.231	-0.239
60	M	0.268	0.233	0.137	0.006	-0.128	-0.225	-0.265	-0.247	-0.170	-0.042	0.131	0.296	0.285
	N	0.042	-0.026	-0.213	-0.470	-0.729	-0.826	-0.866	-0.847	-0.771	-0.642	-0.470	-0.305	-0.315
75	M	0.280	0.244	0.146	0.011	-0.128	-0.235	-0.285	-0.269	-0.189	-0.049	0.140	0.323	0.310
	N	0.066	-0.003	-0.193	-0.453	-0.717	-0.916	-0.966	-0.950	-0.870	-0.730	-0.540	-0.358	-0.371
90	M	0.284	0.248	0.149	0.012	-0.129	-0.238	-0.291	-0.277	-0.195	-0.052	0.143	0.331	0.318
	N	0.075	0.006	-0.185	-0.447	-0.712	-0.913	-1.000	-0.985	-0.904	-0.760	-0.565	-0.377	-0.391

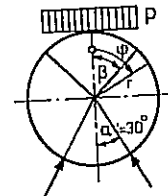
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.11.175

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangularly distributed surcharge any desired width
| load case |
| 2.11.30 | Zweiliniengegendruck radial
| | two linear support, radial



		Biegemoment bending moment				M = m · p · r ²		Normalkraft axial force								N = n · p · r			
β		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180				
15	M	0.122	0.089	0.029	-0.021	-0.057	-0.078	-0.080	-0.066	-0.034	0.012	0.069	0.056	0.052					
	N	-0.023	-0.089	-0.149	-0.199	-0.236	-0.256	-0.259	-0.244	-0.213	-0.167	-0.109	-0.122	-0.126					
30	M	0.190	0.157	0.069	-0.029	-0.101	-0.142	-0.150	-0.124	-0.066	0.021	0.130	0.104	0.096					
	N	-0.035	-0.101	-0.280	-0.378	-0.450	-0.492	-0.500	-0.474	-0.416	-0.329	-0.220	-0.245	-0.254					
45	M	0.224	0.191	0.103	-0.017	-0.123	-0.187	-0.203	-0.171	-0.093	0.026	0.177	0.139	0.127					
	N	-0.031	-0.096	-0.276	-0.522	-0.628	-0.691	-0.707	-0.675	-0.597	-0.478	-0.327	-0.365	-0.378					
60	M	0.241	0.208	0.118	-0.005	-0.127	-0.210	-0.236	-0.203	-0.113	0.028	0.209	0.161	0.144					
	N	-0.014	-0.081	-0.262	-0.510	-0.757	-0.840	-0.866	-0.833	-0.743	-0.602	-0.421	-0.469	-0.486					
75	M	0.249	0.216	0.124	-0.001	-0.127	-0.219	-0.253	-0.220	-0.125	0.028	0.228	0.172	0.153					
	N	0.003	-0.064	-0.248	-0.498	-0.749	-0.932	-0.966	-0.934	-0.838	-0.685	-0.485	-0.541	-0.560					
90	M	0.252	0.219	0.126	0.000	-0.128	-0.221	-0.257	-0.226	-0.128	0.028	0.234	0.175	0.155					
	N	0.010	-0.057	-0.241	-0.493	-0.745	-0.930	-1.000	-0.968	-0.871	-0.714	-0.509	-0.567	-0.587					

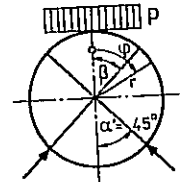
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.11.30

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----> Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangularly distributed surcharge any desired width
| load case |
| 2.11.45 | Zweiliniengegendruck radial
|-----> two linear support, radial



β		Biegemoment bending moment			Normalkraft axial force			N = n · p · r							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.103	0.072	0.016	-0.028	-0.056	-0.066	-0.059	-0.034	0.007	0.061	0.030	0.011	0.004	
	N	-0.063	-0.128	-0.184	-0.227	-0.256	-0.266	-0.259	-0.234	-0.193	-0.139	-0.170	-0.189	-0.196	
30	M	0.154	0.125	0.044	-0.042	-0.098	-0.121	-0.109	-0.063	0.014	0.116	0.055	0.016	0.003	
	N	-0.112	-0.175	-0.347	-0.433	-0.489	-0.512	-0.500	-0.454	-0.377	-0.275	-0.336	-0.375	-0.388	
45	M	0.173	0.145	0.067	-0.036	-0.119	-0.156	-0.144	-0.084	0.020	0.161	0.071	0.014	-0.005	
	N	-0.139	-0.202	-0.371	-0.598	-0.682	-0.719	-0.707	-0.647	-0.543	-0.402	-0.492	-0.548	-0.568	
60	M	0.179	0.151	0.074	-0.028	-0.122	-0.173	-0.164	-0.097	0.025	0.194	0.079	0.008	-0.017	
	N	-0.148	-0.210	-0.378	-0.604	-0.824	-0.875	-0.866	-0.798	-0.676	-0.508	-0.622	-0.694	-0.718	
75	M	0.181	0.152	0.075	-0.027	-0.121	-0.178	-0.173	-0.102	0.029	0.213	0.083	0.001	-0.027	
	N	-0.146	-0.208	-0.376	-0.603	-0.823	-0.971	-0.966	-0.895	-0.764	-0.580	-0.710	-0.792	-0.820	
90	M	0.181	0.153	0.076	-0.027	-0.122	-0.179	-0.175	-0.104	0.031	0.220	0.084	-0.002	-0.031	
	N	-0.144	-0.206	-0.375	-0.602	-0.822	-0.970	-1.000	-0.929	-0.794	-0.605	-0.741	-0.827	-0.856	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

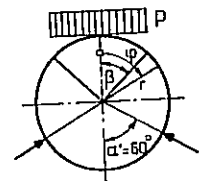
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.11.45

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----> Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangularly distributed surcharge any desired width
| load case |
| 2.11.60 | Zweiliniengegendruck radial
|-----> two linear support, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$						
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.067	0.039	-0.009	-0.049	-0.050	-0.040	-0.011	0.036	0.098	0.035	-0.012	-0.042	-0.053	
	N	-0.148	-0.210	-0.257	-0.287	-0.298	-0.288	-0.259	-0.212	-0.150	-0.213	-0.260	-0.290	-0.301	
30	M	0.084	0.060	-0.004	-0.064	-0.087	-0.070	-0.016	0.073	0.189	0.067	-0.027	-0.086	-0.106	
	N	-0.275	-0.333	-0.489	-0.548	-0.571	-0.554	-0.500	-0.412	-0.295	-0.418	-0.511	-0.570	-0.591	
45	M	0.074	0.053	-0.002	-0.068	-0.103	-0.084	-0.013	0.107	0.268	0.091	-0.045	-0.130	-0.159	
	N	-0.371	-0.425	-0.571	-0.762	-0.798	-0.779	-0.707	-0.587	-0.427	-0.604	-0.740	-0.825	-0.854	
60	M	0.057	0.038	-0.010	-0.067	-0.103	-0.085	-0.003	0.138	0.329	0.107	-0.063	-0.169	-0.206	
	N	-0.431	-0.483	-0.623	-0.805	-0.966	-0.948	-0.866	-0.725	-0.534	-0.756	-0.926	-1.032	-1.069	
75	M	0.045	0.027	-0.019	-0.070	-0.099	-0.079	0.007	0.160	0.368	0.117	-0.076	-0.197	-0.238	
	N	-0.462	-0.513	-0.650	-0.827	-0.981	-1.053	-0.966	-0.813	-0.605	-0.856	-1.049	-1.170	-1.211	
90	M	0.040	0.023	-0.021	-0.072	-0.099	-0.077	0.012	0.168	0.381	0.120	-0.080	-0.206	-0.249	
	N	-0.471	-0.522	-0.658	-0.833	-0.986	-1.055	-1.000	-0.844	-0.630	-0.892	-1.092	-1.218	-1.261	

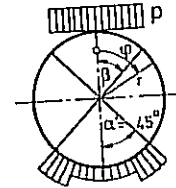
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2.11.60

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2.12.45

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width

Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0	0.123	0.090	0.030	-0.020	-0.057	-0.078	-0.081	-0.067	-0.036	0.009	0.049	0.065	0.070
	N	0	-0.021	-0.087	-0.147	-0.198	-0.235	-0.255	-0.259	-0.245	-0.214	-0.168	-0.128	-0.112	-0.107
30	M	0	0.192	0.160	0.071	-0.027	-0.101	-0.143	-0.152	-0.127	-0.070	0.016	0.091	0.122	0.131
	N	0	-0.030	-0.096	-0.276	-0.375	-0.448	-0.491	-0.500	-0.475	-0.418	-0.332	-0.257	-0.226	-0.217
45	M	0	0.227	0.194	0.105	-0.016	-0.123	-0.188	-0.206	-0.175	-0.099	0.019	0.122	0.164	0.176
	N	0	-0.024	-0.091	-0.271	-0.517	-0.625	-0.689	-0.707	-0.677	-0.600	-0.483	-0.379	-0.337	-0.325
60	M	0	0.245	0.211	0.121	-0.003	-0.127	-0.212	-0.239	-0.208	-0.120	0.019	0.142	0.191	0.206
	N	0	-0.007	-0.074	-0.256	-0.505	-0.753	-0.838	-0.866	-0.835	-0.747	-0.608	-0.484	-0.435	-0.421
75	M	0	0.254	0.220	0.127	0.001	-0.127	-0.221	-0.257	-0.227	-0.133	0.019	0.153	0.206	0.221
	N	0	-0.011	-0.056	-0.240	-0.492	-0.744	-0.930	-0.966	-0.936	-0.842	-0.691	-0.556	-0.504	-0.488
90	M	0	0.257	0.223	0.130	0.002	-0.127	-0.223	-0.261	-0.232	-0.137	0.018	0.156	0.210	0.224
	N	0	-0.019	-0.049	-0.234	-0.487	-0.741	-0.928	-1.000	-0.971	-0.875	-0.720	-0.582	-0.528	-0.513

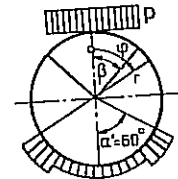
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Lf 2.12.45

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2.12.60

Rechteckig verteilte Auflast beliebiger Breite
rectangularly distributed surcharge any desired width

Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0	0.114	0.082	0.024	-0.024	-0.056	-0.072	-0.070	-0.051	-0.015	0.020	0.038	0.045	0.047
	N	0	-0.041	-0.106	-0.165	-0.212	-0.245	-0.261	-0.259	-0.239	-0.204	-0.168	-0.150	-0.143	-0.141
30	M	0	0.175	0.143	0.059	-0.034	-0.099	-0.132	-0.131	-0.096	-0.030	0.037	0.070	0.082	0.087
	N	0	-0.069	-0.134	-0.310	-0.402	-0.468	-0.501	-0.500	-0.465	-0.398	-0.332	-0.299	-0.286	-0.282
45	M	0	0.202	0.171	0.088	-0.025	-0.121	-0.172	-0.176	-0.131	-0.041	0.048	0.092	0.108	0.113
	N	0	-0.079	-0.143	-0.318	-0.556	-0.652	-0.703	-0.707	-0.663	-0.573	-0.483	-0.439	-0.423	-0.418
60	M	0	0.214	0.183	0.099	-0.014	-0.124	-0.192	-0.203	-0.154	-0.050	0.055	0.106	0.123	0.128
	N	0	-0.074	-0.138	-0.314	-0.552	-0.787	-0.856	-0.866	-0.817	-0.713	-0.608	-0.557	-0.541	-0.535
75	M	0	0.220	0.189	0.104	-0.011	-0.123	-0.199	-0.216	-0.166	-0.054	0.059	0.112	0.129	0.135
	N	0	-0.064	-0.128	-0.305	-0.545	-0.782	-0.949	-0.966	-0.917	-0.805	-0.691	-0.638	-0.621	-0.615
90	M	0	0.222	0.191	0.105	-0.011	-0.124	-0.201	-0.219	-0.170	-0.056	0.060	0.114	0.131	0.137
	N	0	-0.059	-0.124	-0.301	-0.542	-0.779	-0.948	-1.000	-0.951	-0.837	-0.721	-0.667	-0.650	-0.644

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

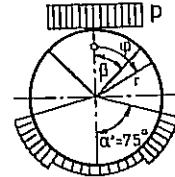
Normalkraft + N ergibt Zug
axial force + N results in tension

Lf 2.12.60

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Schnittkräfte am Kreisring
sectional forces at the circular ring

-----> Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.12.75 | Auflagergegendruck stufenförmig, radial
-----> bedding reaction pressure gradually shaped, radial



		Biegemoment bending moment				M = m · p · r ²				Normalkraft axial force				N = n · p · r			
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.101	0.070	0.015	-0.027	-0.054	-0.063	-0.053	-0.026	0.003	0.020	0.024	0.026	0.027			
	N	-0.071	-0.135	-0.191	-0.233	-0.259	-0.268	-0.259	-0.232	-0.202	-0.185	-0.181	-0.179	-0.179			
30	M	0.150	0.121	0.042	-0.041	-0.094	-0.114	-0.098	-0.048	0.007	0.037	0.044	0.046	0.047			
	N	-0.127	-0.190	-0.360	-0.443	-0.496	-0.516	-0.500	-0.450	-0.395	-0.365	-0.358	-0.356	-0.355			
45	M	0.168	0.140	0.064	-0.035	-0.114	-0.146	-0.129	-0.063	0.010	0.049	0.055	0.057	0.057			
	N	-0.161	-0.222	-0.389	-0.614	-0.693	-0.725	-0.707	-0.641	-0.568	-0.530	-0.523	-0.522	-0.521			
60	M	0.172	0.144	0.070	-0.027	-0.116	-0.161	-0.145	-0.071	0.013	0.056	0.060	0.060	0.060			
	N	-0.174	-0.235	-0.400	-0.623	-0.837	-0.881	-0.866	-0.792	-0.708	-0.665	-0.660	-0.661	-0.661			
75	M	0.173	0.145	0.071	-0.026	-0.115	-0.164	-0.151	-0.073	0.016	0.060	0.062	0.059	0.058			
	N	-0.175	-0.236	-0.402	-0.624	-0.838	-0.978	-0.966	-0.888	-0.799	-0.755	-0.753	-0.755	-0.756			
90	M	0.173	0.146	0.072	-0.026	-0.115	-0.164	-0.153	-0.073	0.017	0.061	0.062	0.058	0.057			
	N	-0.174	-0.235	-0.401	-0.623	-0.837	-0.978	-1.000	-0.921	-0.830	-0.787	-0.785	-0.789	-0.790			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

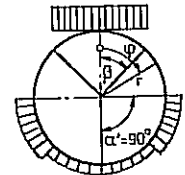
Normalkraft + N ergibt Zug
axial force + N results in tension

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LF 2.12.75

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----> Rechteckig verteilte Auflast beliebiger Breite
| Lastfall | rectangulary distributed surcharge any desired width
| load case |
| 2.12.90 | Auflagergegendruck stufenförmig, radial
-----> bedding reaction pressure gradually shaped, radial



		Biegemoment bending moment				Normalkraft axial force											
		M = m · p · r ²				N = n · p · r											
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.084	0.054	0.004	-0.032	-0.049	-0.047	-0.025	0.000	0.014	0.015	0.011	0.009	0.008			
	N	-0.116	-0.179	-0.230	-0.265	-0.282	-0.280	-0.259	-0.234	-0.220	-0.218	-0.222	-0.225	-0.226			
30	M	0.117	0.090	0.020	-0.049	-0.084	-0.082	-0.044	0.002	0.026	0.027	0.018	0.012	0.010			
	N	-0.214	-0.274	-0.436	-0.505	-0.540	-0.538	-0.500	-0.454	-0.430	-0.429	-0.438	-0.444	-0.446			
45	M	0.120	0.096	0.033	-0.046	-0.100	-0.102	-0.053	0.008	0.038	0.035	0.019	0.009	0.005			
	N	-0.284	-0.342	-0.496	-0.701	-0.754	-0.757	-0.707	-0.647	-0.617	-0.619	-0.636	-0.646	-0.649			
60	M	0.114	0.092	0.032	-0.041	-0.098	-0.107	-0.052	0.016	0.047	0.039	0.016	0.001	-0.004			
	N	-0.325	-0.381	-0.532	-0.730	-0.913	-0.921	-0.866	-0.798	-0.767	-0.775	-0.798	-0.813	-0.818			
75	M	0.108	0.086	0.029	-0.041	-0.095	-0.103	-0.047	0.024	0.054	0.041	0.012	-0.007	-0.013			
	N	-0.344	-0.399	-0.548	-0.743	-0.922	-1.022	-0.966	-0.895	-0.865	-0.877	-0.907	-0.925	-0.931			
90	M	0.106	0.085	0.028	-0.042	-0.094	-0.102	-0.045	0.027	0.056	0.042	0.010	-0.010	-0.016			
	N	-0.349	-0.404	-0.552	-0.747	-0.924	-1.023	-1.000	-0.928	-0.899	-0.913	-0.945	-0.965	-0.971			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

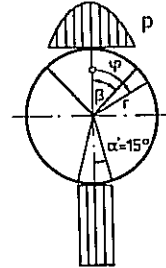
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2.12.90

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.8.15 | Auflagergegendruck rechteckig
bedding reaction rectangular



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$					
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.093	0.065	0.024	-0.012	-0.039	-0.056	-0.061	-0.055	-0.038	-0.010	0.026	0.068	0.079		
	N	-0.001	-0.046	-0.260	-0.367	-0.449	-0.500	-0.518	-0.500	-0.448	-0.365	-0.258	-0.133	-0.001		
30	M	0.156	0.124	0.052	-0.018	-0.071	-0.105	-0.117	-0.106	-0.073	-0.020	0.048	0.129	0.150		
	N	0.002	-0.059	-0.165	-0.706	-0.865	-0.965	-1.000	-0.966	-0.867	-0.708	-0.502	-0.261	-0.002		
45	M	0.195	0.162	0.079	-0.016	-0.093	-0.142	-0.161	-0.148	-0.103	-0.030	0.066	0.179	0.209		
	N	0.010	-0.054	-0.200	-0.326	-1.220	-1.363	-1.414	-1.369	-1.230	-1.007	-0.716	-0.376	-0.010		
60	M	0.219	0.185	0.098	-0.010	-0.104	-0.167	-0.192	-0.178	-0.126	-0.039	0.078	0.215	0.251		
	N	0.021	-0.044	-0.204	-0.374	-0.489	-1.667	-1.732	-1.679	-1.511	-1.240	-0.885	-0.469	-0.021		
75	M	0.231	0.197	0.108	-0.005	-0.109	-0.181	-0.211	-0.197	-0.140	-0.044	0.084	0.236	0.277		
	N	0.031	-0.035	-0.200	-0.388	-0.533	-0.614	-1.932	-1.874	-1.689	-1.388	-0.993	-0.530	-0.031		
90	M	0.235	0.201	0.111	-0.004	-0.110	-0.185	-0.217	-0.203	-0.145	-0.046	0.086	0.243	0.285		
	N	0.035	-0.031	-0.199	-0.392	-0.545	-0.634	-0.667	-1.941	-1.750	-1.439	-1.031	-0.552	-0.035		

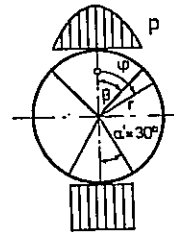
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A. 8.15

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Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.8.30 | Auflagergegendruck rechteckig
bedding reaction pressure rectangular



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$					
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.091	0.063	0.022	-0.013	-0.039	-0.055	-0.059	-0.051	-0.033	-0.004	0.033	0.060	0.055		
	N	-0.006	-0.051	-0.264	-0.370	-0.451	-0.502	-0.518	-0.498	-0.445	-0.362	-0.254	-0.096	0.006		
30	M	0.151	0.119	0.048	-0.020	-0.071	-0.102	-0.112	-0.098	-0.063	-0.008	0.062	0.114	0.105		
	N	-0.008	-0.069	-0.174	-0.713	-0.870	-0.968	-1.000	-0.964	-0.862	-0.701	-0.493	-0.189	0.008		
45	M	0.189	0.156	0.074	-0.019	-0.093	-0.139	-0.154	-0.137	-0.089	-0.013	0.085	0.158	0.144		
	N	-0.004	-0.068	-0.212	-0.336	-1.227	-1.367	-1.414	-1.365	-1.223	-0.997	-0.704	-0.274	0.004		
60	M	0.210	0.177	0.092	-0.013	-0.104	-0.163	-0.184	-0.165	-0.109	-0.018	0.101	0.189	0.172		
	N	0.005	-0.061	-0.218	-0.386	-0.498	-1.672	-1.732	-1.674	-1.502	-1.228	-0.870	-0.345	-0.005		
75	M	0.222	0.189	0.101	-0.009	-0.109	-0.176	-0.201	-0.182	-0.121	-0.021	0.110	0.208	0.189		
	N	0.013	-0.053	-0.217	-0.402	-0.543	-0.619	-1.932	-1.869	-1.679	-1.375	-0.977	-0.392	-0.013		
90	M	0.226	0.192	0.104	-0.008	-0.110	-0.180	-0.207	-0.188	-0.125	-0.023	0.113	0.214	0.194		
	N	0.016	-0.050	-0.215	-0.405	-0.555	-0.639	-0.667	-1.936	-1.740	-1.425	-1.014	-0.408	-0.016		

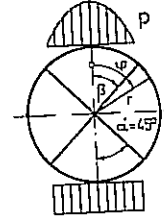
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A. 8.30

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Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.8.45 | Auflagergegendruck rechteckig
-----+ bedding reaction pressure rectangular



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.088	0.060	0.020	-0.014	-0.039	-0.053	-0.055	-0.046	-0.026	0.004	0.034	0.048	0.039		
	N	-0.013	-0.057	-0.270	-0.375	-0.455	-0.503	-0.518	-0.497	-0.442	-0.357	-0.210	-0.079	0.013		
30	M	0.145	0.114	0.043	-0.022	-0.071	-0.099	-0.105	-0.088	-0.050	0.008	0.065	0.092	0.073		
	N	-0.021	-0.082	-0.185	-0.272	-0.377	-0.471	-0.500	-0.460	-0.355	-0.192	-0.048	-0.156	0.021		
45	M	0.180	0.148	0.068	-0.022	-0.092	-0.134	-0.144	-0.122	-0.070	0.010	0.089	0.126	0.100		
	N	-0.023	-0.086	-0.228	-0.349	-0.436	-0.472	-0.414	-0.360	-0.213	-0.084	-0.584	-0.228	0.023		
60	M	0.200	0.167	0.084	-0.017	-0.104	-0.157	-0.172	-0.148	-0.085	0.010	0.106	0.151	0.118		
	N	-0.018	-0.083	-0.238	-0.402	-0.509	-0.578	-0.632	-0.668	-0.691	-0.612	-0.423	-0.288	0.018		
75	M	0.210	0.177	0.092	-0.014	-0.108	-0.169	-0.188	-0.162	-0.095	0.010	0.116	0.165	0.128		
	N	-0.013	-0.078	-0.239	-0.420	-0.556	-0.625	-0.632	-0.583	-0.467	-0.357	-0.213	-0.083	0.013		
90	M	0.213	0.180	0.095	-0.013	-0.110	-0.173	-0.193	-0.167	-0.098	0.010	0.119	0.169	0.131		
	N	-0.011	-0.076	-0.238	-0.424	-0.568	-0.646	-0.667	-0.629	-0.497	-0.377	-0.247	-0.133	0.011		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

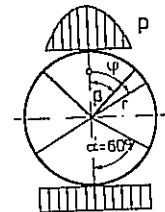
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A. 8.45

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Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.8.60 | Auflagergegendruck rechteckig
-----+ bedding reaction pressure rectangular



		Biegemoment bending moment				M = m · p · r ²				Normalkraft axial force				N = n · p · r			
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.084	0.057	0.018	-0.015	-0.038	-0.051	-0.052	-0.041	-0.019	0.009	0.032	0.040	0.029			
	N	-0.020	-0.064	-0.276	-0.380	-0.458	-0.505	-0.518	-0.495	-0.438	-0.318	-0.187	-0.068	0.020			
30	M	0.139	0.108	0.039	-0.024	-0.070	-0.095	-0.098	-0.077	-0.036	0.017	0.060	0.076	0.054			
	N	-0.034	-0.094	-0.197	-0.271	-0.383	-0.475	-0.500	-0.457	-0.349	-0.218	-0.084	-0.135	0.034			
45	M	0.171	0.140	0.062	-0.025	-0.092	-0.129	-0.134	-0.107	-0.050	0.023	0.083	0.105	0.072			
	N	-0.041	-0.104	-0.244	-0.363	-0.445	-0.477	-0.414	-0.355	-0.204	-0.079	-0.522	-0.198	0.041			
60	M	0.189	0.157	0.076	-0.021	-0.103	-0.151	-0.160	-0.129	-0.062	0.026	0.098	0.124	0.084			
	N	-0.041	-0.105	-0.258	-0.418	-0.521	-0.584	-0.632	-0.662	-0.679	-0.683	-0.647	-0.551	0.041			
75	M	0.198	0.166	0.084	-0.018	-0.107	-0.162	-0.174	-0.142	-0.068	0.028	0.107	0.135	0.090			
	N	-0.039	-0.103	-0.261	-0.438	-0.568	-0.632	-0.632	-0.583	-0.467	-0.357	-0.213	-0.083	0.039			
90	M	0.201	0.169	0.086	-0.017	-0.108	-0.165	-0.178	-0.146	-0.071	0.028	0.110	0.139	0.092			
	N	-0.037	-0.101	-0.261	-0.443	-0.581	-0.652	-0.667	-0.629	-0.497	-0.377	-0.247	-0.133	0.037			

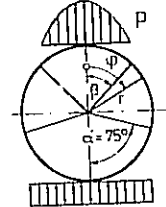
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A. 8.60

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2A.8.75

Parabolisch verteilte Auflast beliebiger Breite
parabolically distributed surcharge any desired width
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

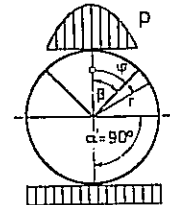
		Biegemoment bending moment			M = m · p · r ²			Normalkraft axial force			N = n · p · r					
β		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.082	0.055	0.016	-0.016	-0.038	-0.049	-0.049	-0.036	-0.015	0.010	0.030	0.036	0.024	0.025	
	N	-0.025	-0.069	-0.280	-0.384	-0.461	-0.506	-0.518	-0.494	-0.413	-0.299	-0.175	-0.061			
30	M	0.134	0.104	0.036	-0.026	-0.070	-0.092	-0.092	-0.069	-0.028	0.019	0.057	0.068	0.044	0.044	
	N	-0.044	-0.104	-0.205	-0.738	-0.888	-0.977	-1.000	-0.954	-0.799	-0.581	-0.341	-0.121			
45	M	0.165	0.134	0.058	-0.027	-0.091	-0.125	-0.126	-0.096	-0.039	0.026	0.077	0.093	0.058	0.058	
	N	-0.055	-0.117	-0.256	-0.372	-1.252	-1.380	-1.414	-1.352	-1.134	-0.827	-0.489	-0.179			
60	M	0.182	0.151	0.071	-0.024	-0.102	-0.145	-0.150	-0.115	-0.048	0.030	0.092	0.110	0.067	0.067	
	N	-0.058	-0.121	-0.273	-0.430	-0.529	-1.688	-1.732	-1.658	-1.393	-1.020	-0.607	-0.228		0.058	
75	M	0.190	0.159	0.078	-0.021	-0.106	-0.156	-0.163	-0.127	-0.053	0.032	0.100	0.119	0.071	0.071	
	N	-0.057	-0.121	-0.277	-0.451	-0.578	-0.637	-1.932	-1.851	-1.558	-1.142	-0.683	-0.262		0.057	
90	M	0.193	0.161	0.080	-0.020	-0.107	-0.159	-0.168	-0.130	-0.055	0.033	0.102	0.122	0.073	0.073	
	N	-0.057	-0.120	-0.278	-0.457	-0.591	-0.657	-0.667	-1.917	-1.614	-1.185	-0.710	-0.274		0.057	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 8.75

Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2A.8.90

Parabolisch verteilte Auflast beliebiger Breite
parabolically distributed surcharge any desired width
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

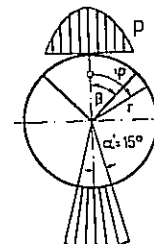
		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$						
β		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.081	0.054	0.015	-0.016	-0.038	-0.049	-0.048	-0.035	-0.014	0.011	0.029	0.035	0.022	
	N	-0.027	-0.070	-0.282	-0.385	-0.462	-0.507	-0.518	-0.485	-0.405	-0.294	-0.171	-0.059	0.027	
30	M	0.133	0.103	0.035	-0.026	-0.069	-0.091	-0.090	-0.067	-0.026	0.020	0.055	0.066	0.041	
	N	-0.048	-0.107	-0.208	-0.741	-0.890	-0.978	-1.000	-0.937	-0.784	-0.570	-0.334	-0.117	0.048	
45	M	0.163	0.132	0.056	-0.028	-0.090	-0.123	-0.124	-0.092	-0.037	0.027	0.076	0.090	0.054	
	N	-0.060	-0.122	-0.260	-0.376	-1.255	-1.382	-1.414	-1.327	-1.113	-0.811	-0.478	-0.172	0.060	
60	M	0.179	0.148	0.070	-0.024	-0.101	-0.143	-0.146	-0.111	-0.045	0.031	0.090	0.106	0.062	
	N	-0.064	-0.127	-0.278	-0.434	-0.532	-1.690	-1.732	-1.628	-1.367	-1.000	-0.594	-0.220	0.064	
75	M	0.187	0.156	0.076	-0.022	-0.106	-0.154	-0.159	-0.121	-0.050	0.033	0.098	0.115	0.066	
	N	-0.064	-0.127	-0.283	-0.456	-0.581	-0.639	-1.932	-1.818	-1.529	-1.121	-0.669	-0.253	0.064	
90	M	0.190	0.159	0.078	-0.021	-0.107	-0.157	-0.163	-0.125	-0.051	0.034	0.100	0.118	0.067	
	N	-0.064	-0.127	-0.284	-0.462	-0.594	-0.659	-0.667	-1.882	-1.584	-1.162	-0.695	-0.264	0.064	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 8.90

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.9.15 | Auflagergegendruck cos-förmig, radial
+ bedding reaction pressure cos-shaped, radial

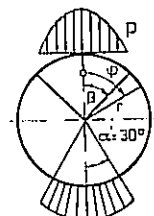
		Biegemoment bending moment			M = m · p · r ²			Normalkraft axial force			N = n · p · r					
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.093	0.065	0.024	-0.012	-0.039	-0.056	-0.061	-0.055	-0.038	-0.010	0.026	0.068	0.078		
	N	-0.001	-0.046	-0.260	-0.367	-0.449	-0.500	-0.518	-0.500	-0.448	-0.365	-0.258	-0.133	-0.033		
30	M	0.156	0.124	0.051	-0.018	-0.071	-0.105	-0.117	-0.106	-0.073	-0.020	0.049	0.129	0.150		
	N	0.002	-0.059	-0.165	-0.706	-0.865	-0.965	-1.000	-0.966	-0.867	-0.708	-0.501	-0.260	-0.067		
45	M	0.195	0.162	0.079	-0.016	-0.093	-0.142	-0.161	-0.148	-0.103	-0.030	0.046	0.179	0.208		
	N	0.010	-0.054	-0.200	-0.326	-1.220	-1.363	-1.414	-1.369	-1.230	-1.007	-0.716	-0.376	-0.102		
60	M	0.219	0.185	0.098	-0.010	-0.104	-0.167	-0.192	-0.178	-0.126	-0.038	0.078	0.215	0.250		
	N	0.021	-0.044	-0.204	-0.374	-0.489	-1.668	-1.732	-1.679	-1.511	-1.240	-0.884	-0.469	-0.135		
75	M	0.231	0.197	0.108	-0.005	-0.109	-0.181	-0.211	-0.197	-0.140	-0.044	0.084	0.237	0.276		
	N	0.031	-0.035	-0.201	-0.389	-0.533	-0.614	-1.932	-1.874	-1.689	-1.388	-0.993	-0.530	-0.158		
90	M	0.235	0.201	0.111	-0.004	-0.110	-0.185	-0.216	-0.203	-0.145	-0.046	0.086	0.244	0.284		
	N	0.035	-0.031	-0.199	-0.392	-0.545	-0.634	-0.667	-1.941	-1.750	-1.439	-1.030	-0.552	-0.166		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 9.15

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.9.30 | Auflagergegendruck cos-förmig, radial
+ bedding reaction pressure cos-shaped, radial

		Biegemoment bending moment				M = m · p · r ²				Normalkraft axial force				N = n · p · r			
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.091	0.063	0.022	-0.013	-0.039	-0.054	-0.059	-0.051	-0.032	-0.003	0.033	0.059	0.053			
	N	-0.007	-0.051	-0.265	-0.371	-0.452	-0.502	-0.518	-0.498	-0.445	-0.361	-0.253	-0.144	-0.061			
30	M	0.151	0.119	0.048	-0.020	-0.071	-0.102	-0.111	-0.098	-0.062	-0.007	0.063	0.112	0.100			
	N	-0.009	-0.070	-0.174	-0.713	-0.870	-0.968	-1.000	-0.964	-0.862	-0.701	-0.492	-0.282	-0.122			
45	M	0.188	0.155	0.074	-0.019	-0.093	-0.139	-0.153	-0.136	-0.088	-0.012	0.087	0.155	0.138			
	N	-0.005	-0.069	-0.213	-0.337	-1.227	-1.367	-1.414	-1.365	-1.222	-0.996	-0.703	-0.407	-0.180			
60	M	0.210	0.177	0.091	-0.013	-0.104	-0.163	-0.183	-0.164	-0.107	-0.016	0.103	0.186	0.165			
	N	0.003	-0.062	-0.220	-0.387	-0.499	-1.672	-1.732	-1.674	-1.501	-1.227	-0.869	-0.507	-0.229			
75	M	0.221	0.188	0.100	-0.010	-0.109	-0.175	-0.200	-0.181	-0.119	-0.019	0.113	0.205	0.181			
	N	0.011	-0.055	-0.218	-0.403	-0.544	-0.619	-1.932	-1.869	-1.678	-1.374	-0.975	-0.573	-0.263			
90	M	0.225	0.191	0.103	-0.008	-0.110	-0.179	-0.206	-0.187	-0.123	-0.020	0.116	0.211	0.186			
	N	0.014	-0.052	-0.217	-0.407	-0.556	-0.639	-0.667	-1.935	-1.739	-1.424	-1.012	-0.596	-0.275			

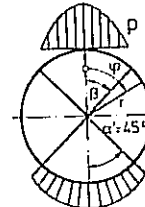
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 9.30

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.9.45 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



β		Biegemoment bending moment				Normalkraft axial force											
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.086	0.059	0.019	-0.014	-0.039	-0.052	-0.054	-0.044	-0.023	0.007	0.035	0.045	0.033	0.085		
	N	-0.015	-0.059	-0.272	-0.377	-0.456	-0.504	-0.518	-0.496	-0.441	-0.355	-0.256	-0.163	-0.085	-0.062		
30	M	0.143	0.112	0.042	-0.023	-0.071	-0.098	-0.102	-0.085	-0.045	0.013	0.066	0.085	0.062	0.169		
	N	-0.026	-0.086	-0.189	-0.725	-0.879	-0.973	-1.000	-0.959	-0.853	-0.689	-0.498	-0.319	-0.169	-0.084		
45	M	0.177	0.145	0.066	-0.023	-0.092	-0.132	-0.141	-0.118	-0.064	0.017	0.091	0.116	0.084	0.246		
	N	-0.029	-0.092	-0.233	-0.354	-1.239	-1.373	-1.414	-1.359	-1.210	-0.980	-0.711	-0.458	-0.246	-0.099		
60	M	0.196	0.164	0.081	-0.019	-0.104	-0.155	-0.168	-0.142	-0.078	0.020	0.108	0.138	0.099	0.311		
	N	-0.026	-0.090	-0.245	-0.407	-0.513	-1.680	-1.732	-1.666	-1.487	-1.206	-0.879	-0.570	-0.311	-0.106		
75	M	0.206	0.174	0.089	-0.015	-0.108	-0.167	-0.183	-0.156	-0.086	0.021	0.118	0.151	0.106	0.354		
	N	-0.022	-0.086	-0.246	-0.426	-0.560	-0.628	-1.932	-1.860	-1.662	-1.351	-0.986	-0.643	-0.354	-0.109		
90	M	0.209	0.177	0.092	-0.014	-0.109	-0.171	-0.188	-0.160	-0.089	0.021	0.121	0.155	0.109	0.370		
	N	-0.019	-0.084	-0.246	-0.430	-0.572	-0.648	-0.667	-1.927	-1.722	-1.400	-1.024	-0.668	-0.370	-0.109		

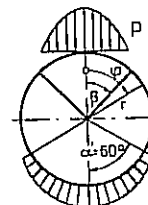
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 9.45

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.9.60 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial



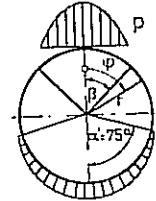
β		Biegemoment bending moment				Normalkraft axial force											
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.082	0.055	0.016	-0.016	-0.038	-0.049	-0.048	-0.036	-0.012	0.014	0.030	0.033	0.019	0.105		
	N	-0.026	-0.070	-0.281	-0.384	-0.461	-0.507	-0.518	-0.493	-0.435	-0.355	-0.266	-0.181	-0.105	-0.035		
30	M	0.133	0.103	0.035	-0.026	-0.070	-0.092	-0.091	-0.068	-0.024	0.026	0.057	0.062	0.035	0.207		
	N	-0.046	-0.106	-0.207	-0.740	-0.889	-0.978	-1.000	-0.954	-0.843	-0.688	-0.518	-0.352	-0.207	-0.045		
45	M	0.163	0.133	0.056	-0.028	-0.091	-0.124	-0.125	-0.094	-0.033	0.035	0.079	0.084	0.045	0.301		
	N	-0.058	-0.120	-0.258	-0.374	-1.254	-1.381	-1.414	-1.351	-1.196	-0.978	-0.739	-0.506	-0.301	-0.051		
60	M	0.180	0.149	0.070	-0.025	-0.102	-0.145	-0.149	-0.113	-0.041	0.041	0.093	0.099	0.051	0.377		
	N	-0.062	-0.124	-0.275	-0.432	-0.531	-1.689	-1.732	-1.657	-1.469	-1.204	-0.913	-0.628	-0.377	-0.054		
75	M	0.188	0.157	0.077	-0.022	-0.106	-0.156	-0.162	-0.124	-0.045	0.045	0.101	0.108	0.054	0.428		
	N	-0.061	-0.124	-0.281	-0.454	-0.580	-0.638	-1.932	-1.850	-1.642	-1.348	-1.025	-0.708	-0.428	-0.054		
90	M	0.190	0.159	0.079	-0.021	-0.108	-0.159	-0.166	-0.128	-0.046	0.046	0.104	0.110	0.054	0.446		
	N	-0.060	-0.124	-0.281	-0.459	-0.593	-0.658	-0.667	-1.916	-1.702	-1.398	-1.063	-0.736	-0.446	-0.054		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 9.60

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Parabolisch verteilte Auflast beliebiger Breite
Lastfall | parabolically distributed surcharge any desired width
load case |
2A.9.75 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial

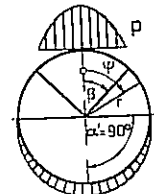
		Biegemoment bending moment				Normalkraft axial force				N = n · p · r							
		M = m · p · r ²															
β	φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.077	0.051	0.013	-0.017	-0.037	-0.046	-0.043	-0.027	-0.005	0.015	0.026	0.026	0.011			
	N	-0.036	-0.079	-0.290	-0.391	-0.466	-0.509	-0.518	-0.491	-0.434	-0.359	-0.276	-0.193	-0.119			
30	M	0.125	0.095	0.030	-0.029	-0.068	-0.086	-0.080	-0.052	-0.011	0.027	0.050	0.048	0.019			
	N	-0.065	-0.124	-0.223	-0.753	-0.899	-0.983	-1.000	-0.949	-0.841	-0.697	-0.537	-0.377	-0.234			
45	M	0.152	0.122	0.048	-0.032	-0.089	-0.116	-0.110	-0.072	-0.015	0.037	0.068	0.065	0.023			
	N	-0.085	-0.146	-0.282	-0.393	-1.267	-1.388	-1.414	-1.344	-1.193	-0.991	-0.765	-0.541	-0.338			
60	M	0.165	0.136	0.060	-0.029	-0.100	-0.135	-0.130	-0.085	-0.018	0.044	0.080	0.076	0.024			
	N	-0.095	-0.157	-0.304	-0.456	-0.547	-1.698	-1.732	-1.649	-1.466	-1.220	-0.945	-0.671	-0.424			
75	M	0.172	0.142	0.066	-0.027	-0.104	-0.144	-0.141	-0.093	-0.020	0.048	0.087	0.081	0.024			
	N	-0.098	-0.160	-0.313	-0.480	-0.598	-0.647	-1.932	-1.841	-1.638	-1.366	-1.061	-0.756	-0.480			
90	M	0.174	0.144	0.067	-0.026	-0.105	-0.147	-0.144	-0.096	-0.020	0.049	0.089	0.083	0.023			
	N	-0.099	-0.161	-0.315	-0.487	-0.612	-0.668	-0.667	-1.906	-1.698	-1.417	-1.101	-0.785	-0.500			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 9.75

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Parabolisch verteilte Auflast beliebiger Breite
Lastfall | parabolically distributed surcharge any desired width
load case |
2A.9.90 | Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial

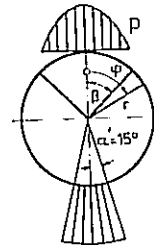
		Biegemoment bending moment				$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$							
β	φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.076	0.049	0.011	-0.018	-0.037	-0.044	-0.040	-0.024	-0.004	0.014	0.025	0.024	0.008			
	N	-0.040	-0.084	-0.294	-0.395	-0.469	-0.510	-0.518	-0.491	-0.436	-0.362	-0.280	-0.198	-0.124			
30	M	0.122	0.092	0.027	-0.030	-0.067	-0.083	-0.075	-0.046	-0.008	0.027	0.047	0.044	0.014			
	N	-0.074	-0.133	-0.231	-0.760	-0.903	-0.985	-1.000	-0.949	-0.844	-0.703	-0.545	-0.387	-0.244			
45	M	0.147	0.117	0.045	-0.033	-0.088	-0.111	-0.102	-0.064	-0.011	0.037	0.064	0.059	0.017			
	N	-0.098	-0.158	-0.293	-0.402	-1.274	-1.391	-1.414	-1.343	-1.197	-0.999	-0.777	-0.554	-0.353			
60	M	0.159	0.130	0.056	-0.031	-0.098	-0.129	-0.120	-0.075	-0.013	0.043	0.075	0.068	0.016			
	N	-0.110	-0.172	-0.318	-0.467	-0.555	-1.702	-1.732	-1.648	-1.471	-1.230	-0.959	-0.688	-0.441			
75	M	0.165	0.136	0.061	-0.029	-0.102	-0.138	-0.130	-0.082	-0.015	0.047	0.081	0.073	0.014			
	N	-0.115	-0.177	-0.328	-0.492	-0.607	-0.652	-1.932	-1.840	-1.644	-1.378	-1.076	-0.774	-0.499			
90	M	0.167	0.138	0.063	-0.028	-0.103	-0.141	-0.133	-0.084	-0.015	0.048	0.083	0.075	0.014			
	N	-0.117	-0.178	-0.330	-0.499	-0.621	-0.673	-0.667	-1.905	-1.703	-1.428	-1.117	-0.804	-0.520			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A. 9.90

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+
Lastfall | parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.10.15 | Auflagergegendruck gleichförmig, radial
-----+ | bedding reaction pressure uniform, radial

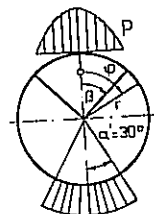
		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.093	0.065	0.024	-0.012	-0.039	-0.056	-0.061	-0.055	-0.038	-0.010	0.026	0.068	0.078		
	N	-0.001	-0.046	-0.260	-0.367	-0.449	-0.500	-0.518	-0.500	-0.448	-0.365	-0.258	-0.133	-0.033		
30	M	0.156	0.124	0.051	-0.018	-0.071	-0.105	-0.117	-0.106	-0.073	-0.020	0.049	0.129	0.149		
	N	0.002	-0.059	-0.165	-0.704	-0.865	-0.965	-1.000	-0.966	-0.867	-0.708	-0.501	-0.260	-0.067		
45	M	0.195	0.162	0.079	-0.016	-0.093	-0.142	-0.161	-0.148	-0.103	-0.030	0.066	0.179	0.207		
	N	0.010	-0.054	-0.200	-0.326	-1.220	-1.363	-1.414	-1.369	-1.230	-1.007	-0.716	-0.376	-0.103		
60	M	0.219	0.185	0.098	-0.010	-0.104	-0.167	-0.192	-0.178	-0.126	-0.038	0.078	0.215	0.250		
	N	0.021	-0.044	-0.204	-0.374	-0.489	-1.668	-1.732	-1.679	-1.511	-1.240	-0.884	-0.469	-0.135		
75	M	0.231	0.197	0.108	-0.005	-0.109	-0.181	-0.211	-0.197	-0.140	-0.044	0.084	0.237	0.275		
	N	0.031	-0.035	-0.201	-0.389	-0.533	-0.614	-1.932	-1.874	-1.689	-1.388	-0.993	-0.530	-0.158		
90	M	0.235	0.201	0.111	-0.004	-0.110	-0.185	-0.216	-0.203	-0.145	-0.046	0.086	0.244	0.283		
	N	0.035	-0.032	-0.199	-0.392	-0.545	-0.634	-0.667	-1.941	-1.750	-1.439	-1.030	-0.552	-0.167		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A.10.15

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+
Lastfall | parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.10.30 | Auflagergegendruck gleichförmig, radial
-----+ | bedding reaction pressure uniform, radial

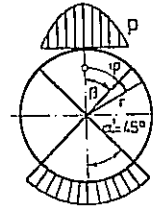
		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$									
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.090	0.063	0.022	-0.013	-0.039	-0.054	-0.058	-0.051	-0.032	-0.003	0.034	0.059	0.052				
	N	-0.007	-0.051	-0.265	-0.371	-0.452	-0.502	-0.518	-0.498	-0.445	-0.361	-0.253	-0.145	-0.062				
30	M	0.150	0.119	0.047	-0.020	-0.071	-0.102	-0.111	-0.097	-0.062	-0.007	0.064	0.111	0.098				
	N	-0.010	-0.070	-0.175	-0.714	-0.871	-0.968	-1.000	-0.963	-0.861	-0.700	-0.492	-0.284	-0.124				
45	M	0.187	0.155	0.074	-0.019	-0.093	-0.139	-0.153	-0.135	-0.087	-0.011	0.088	0.154	0.135				
	N	-0.006	-0.070	-0.213	-0.338	-1.228	-1.368	-1.414	-1.364	-1.222	-0.996	-0.702	-0.408	-0.184				
60	M	0.209	0.176	0.091	-0.014	-0.104	-0.162	-0.183	-0.163	-0.106	-0.015	0.104	0.184	0.161				
	N	0.002	-0.063	-0.221	-0.388	-0.499	-1.673	-1.732	-1.674	-1.501	-1.226	-0.868	-0.509	-0.234				
75	M	0.221	0.187	0.100	-0.010	-0.109	-0.175	-0.200	-0.180	-0.118	-0.018	0.114	0.203	0.176				
	N	0.010	-0.056	-0.219	-0.404	-0.544	-0.620	-1.932	-1.869	-1.678	-1.373	-0.974	-0.575	-0.268				
90	M	0.224	0.191	0.103	-0.009	-0.110	-0.179	-0.205	-0.186	-0.122	-0.019	0.117	0.209	0.181				
	N	0.013	-0.053	-0.218	-0.408	-0.556	-0.640	-0.667	-1.935	-1.738	-1.423	-1.011	-0.598	-0.281				

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A.10.30

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+
Lastfall | parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.10.45 | Auflagergegendruck gleichförmig, radial
-----+ bedding reaction pressure uniform, radial

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0.086	0.058	0.018	-0.015	-0.039	-0.052	-0.053	-0.043	-0.022	0.009	0.035	0.042	0.029	
	N	-0.017	-0.061	-0.273	-0.378	-0.457	-0.504	-0.518	-0.496	-0.440	-0.354	-0.257	-0.167	-0.090	
30	M	0.141	0.110	0.041	-0.024	-0.071	-0.097	-0.101	-0.082	-0.042	0.017	0.067	0.079	0.054	
	N	-0.029	-0.089	-0.192	-0.728	-0.880	-0.973	-1.000	-0.958	-0.852	-0.687	-0.499	-0.326	-0.178	
45	M	0.174	0.143	0.064	-0.024	-0.092	-0.131	-0.139	-0.114	-0.059	0.023	0.092	0.109	0.073	
	N	-0.033	-0.096	-0.237	-0.357	-1.241	-1.375	-1.414	-1.357	-1.208	-0.976	-0.712	-0.468	-0.260	
60	M	0.193	0.161	0.079	-0.020	-0.104	-0.154	-0.165	-0.137	-0.072	0.026	0.109	0.129	0.085	
	N	-0.032	-0.096	-0.250	-0.411	-0.516	-1.681	-1.732	-1.665	-1.484	-1.202	-0.880	-0.582	-0.327	
75	M	0.203	0.171	0.087	-0.017	-0.108	-0.165	-0.180	-0.151	-0.080	0.028	0.119	0.141	0.092	
	N	-0.028	-0.092	-0.252	-0.430	-0.563	-0.629	-1.932	-1.859	-1.659	-1.346	-0.988	-0.656	-0.372	
90	M	0.206	0.174	0.090	-0.016	-0.109	-0.169	-0.185	-0.155	-0.083	0.029	0.123	0.145	0.093	
	N	-0.026	-0.090	-0.252	-0.435	-0.575	-0.650	-0.667	-1.925	-1.719	-1.396	-1.026	-0.682	-0.388	

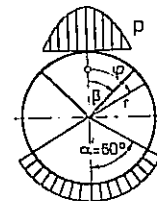
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A.10.45

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+
Lastfall | parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.10.60 | Auflagergegendruck gleichförmig, radial
-----+ bedding reaction pressure uniform, radial

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0.079	0.052	0.014	-0.017	-0.038	-0.047	-0.045	-0.031	-0.006	0.018	0.029	0.026	0.010	
	N	-0.032	-0.075	-0.286	-0.389	-0.464	-0.508	-0.518	-0.492	-0.432	-0.354	-0.271	-0.191	-0.118	
30	M	0.128	0.098	0.032	-0.028	-0.069	-0.089	-0.085	-0.059	-0.012	0.034	0.054	0.048	0.017	
	N	-0.058	-0.117	-0.217	-0.748	-0.895	-0.981	-1.000	-0.951	-0.837	-0.686	-0.527	-0.372	-0.231	
45	M	0.156	0.126	0.051	-0.031	-0.090	-0.120	-0.117	-0.081	-0.016	0.046	0.074	0.065	0.021	
	N	-0.074	-0.135	-0.272	-0.386	-1.262	-1.385	-1.414	-1.347	-1.188	-0.976	-0.752	-0.534	-0.334	
60	M	0.171	0.140	0.063	-0.028	-0.101	-0.139	-0.138	-0.097	-0.020	0.055	0.087	0.076	0.021	
	N	-0.081	-0.144	-0.293	-0.446	-0.541	-1.694	-1.732	-1.652	-1.459	-1.201	-0.929	-0.663	-0.419	
75	M	0.178	0.147	0.069	-0.026	-0.105	-0.149	-0.150	-0.106	-0.022	0.060	0.095	0.081	0.020	
	N	-0.083	-0.146	-0.300	-0.470	-0.591	-0.644	-1.932	-1.844	-1.631	-1.345	-1.043	-0.746	-0.474	
90	M	0.180	0.149	0.071	-0.025	-0.107	-0.152	-0.153	-0.109	-0.022	0.061	0.097	0.083	0.019	
	N	-0.083	-0.146	-0.301	-0.476	-0.604	-0.664	-0.667	-1.910	-1.690	-1.395	-1.082	-0.775	-0.494	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

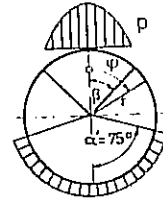
LF 2A.10.60

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Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.10.75 | Auflagergegendruck gleichförmig, radial

bedding reaction pressure uniform, radial



β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0.070	0.044	0.008	-0.020	-0.036	-0.041	-0.033	-0.014	0.007	0.019	0.020	0.012	-0.006	-0.006
	N	-0.053	-0.096	-0.305	-0.403	-0.475	-0.514	-0.518	-0.486	-0.431	-0.365	-0.292	-0.217	-0.146	-0.071
30	M	0.111	0.082	0.020	-0.034	-0.066	-0.076	-0.062	-0.025	0.014	0.036	0.038	0.021	-0.014	-0.014
	N	-0.098	-0.156	-0.252	-0.776	-0.915	-0.991	-1.000	-0.941	-0.835	-0.707	-0.567	-0.423	-0.286	-0.146
45	M	0.132	0.103	0.035	-0.038	-0.086	-0.102	-0.084	-0.034	0.020	0.049	0.051	0.026	-0.024	-0.024
	N	-0.131	-0.191	-0.322	-0.426	-1.290	-1.400	-1.414	-1.332	-1.184	-1.005	-0.808	-0.605	-0.411	-0.217
60	M	0.141	0.113	0.043	-0.037	-0.096	-0.117	-0.098	-0.039	0.025	0.058	0.060	0.028	-0.033	-0.033
	N	-0.151	-0.211	-0.353	-0.496	-0.576	-0.630	-1.712	-1.732	-1.634	-1.455	-1.238	-0.998	-0.750	-0.513
75	M	0.144	0.117	0.047	-0.036	-0.100	-0.125	-0.105	-0.041	0.028	0.064	0.064	0.028	-0.041	-0.041
	N	-0.161	-0.221	-0.367	-0.525	-0.630	-0.664	-1.932	-1.824	-1.626	-1.386	-1.119	-0.844	-0.580	-0.315
90	M	0.145	0.118	0.048	-0.036	-0.101	-0.127	-0.107	-0.042	0.029	0.066	0.065	0.028	-0.043	-0.043
	N	-0.164	-0.224	-0.371	-0.533	-0.645	-0.685	-0.667	-1.889	-1.685	-1.437	-1.161	-0.877	-0.603	-0.338

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

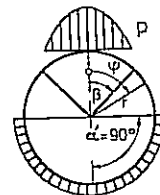
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LF 2A.10.75

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.10.90 | Auflagergegendruck gleichförmig, radial

bedding reaction pressure uniform, radial



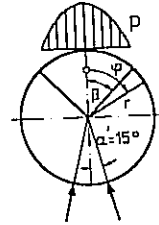
β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0.059	0.034	0.000	-0.023	-0.033	-0.031	-0.015	0.003	0.014	0.017	0.012	0.000	-0.020	-0.020
	N	-0.082	-0.124	-0.330	-0.424	-0.489	-0.521	-0.518	-0.488	-0.442	-0.384	-0.318	-0.247	-0.177	-0.102
30	M	0.089	0.063	0.006	-0.039	-0.060	-0.056	-0.028	0.007	0.027	0.032	0.022	-0.003	-0.040	-0.040
	N	-0.154	-0.210	-0.300	-0.816	-0.943	-1.006	-1.000	-0.943	-0.856	-0.745	-0.617	-0.481	-0.346	-0.211
45	M	0.101	0.076	0.015	-0.046	-0.077	-0.073	-0.035	0.011	0.038	0.044	0.029	-0.007	-0.061	-0.061
	N	-0.210	-0.267	-0.390	-0.482	-1.330	-1.420	-1.414	-1.336	-1.214	-1.059	-0.879	-0.687	-0.497	-0.302
60	M	0.104	0.079	0.019	-0.046	-0.085	-0.083	-0.038	0.016	0.047	0.053	0.032	-0.013	-0.079	-0.079
	N	-0.248	-0.305	-0.437	-0.564	-0.624	-1.737	-1.732	-1.638	-1.492	-1.303	-1.084	-0.851	-0.618	-0.385
75	M	0.103	0.079	0.020	-0.046	-0.087	-0.086	-0.039	0.020	0.053	0.057	0.034	-0.017	-0.091	-0.091
	N	-0.269	-0.325	-0.461	-0.601	-0.684	-0.692	-1.932	-1.829	-1.668	-1.459	-1.216	-0.956	-0.697	-0.438
90	M	0.102	0.079	0.020	-0.046	-0.088	-0.087	-0.038	0.022	0.055	0.059	0.034	-0.019	-0.096	-0.096
	N	-0.276	-0.332	-0.468	-0.612	-0.700	-0.714	-0.667	-1.895	-1.728	-1.512	-1.261	-0.992	-0.724	-0.459

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.10.90

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Parabolisch verteilte Auflast beliebiger Breite
| Lastfall | parabolically distributed surcharge any desired width
| load case |
| 2A.11.15 | Zweiliniengegendruck radial
-----+ two linear support, radial

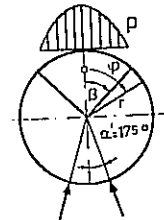
β		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$			150	165	180
		ψ	0	15	30	45	60	75	90	105	120	135				
15	M	0.091	0.064	0.022	-0.012	-0.039	-0.055	-0.059	-0.052	-0.034	-0.005	0.031	0.073	0.049		
	N	-0.005	-0.050	-0.263	-0.370	-0.451	-0.501	-0.518	-0.499	-0.446	-0.362	-0.254	-0.129	-0.064		
30	M	0.152	0.120	0.049	-0.019	-0.071	-0.103	-0.113	-0.100	-0.065	-0.011	0.059	0.140	0.092		
	N	-0.006	-0.067	-0.172	-0.711	-0.869	-0.967	-1.000	-0.964	-0.863	-0.703	-0.495	-0.253	-0.128		
45	M	0.190	0.157	0.075	-0.018	-0.093	-0.140	-0.156	-0.139	-0.092	-0.017	0.081	0.194	0.127		
	N	-0.001	-0.065	-0.209	-0.334	-1.225	-1.366	-1.414	-1.366	-1.224	-0.999	-0.706	-0.365	-0.189		
60	M	0.212	0.179	0.093	-0.012	-0.104	-0.164	-0.186	-0.168	-0.113	-0.023	0.096	0.234	0.151		
	N	0.008	-0.057	-0.215	-0.383	-0.496	-1.671	-1.732	-1.675	-1.504	-1.231	-0.873	-0.456	-0.240		
75	M	0.224	0.190	0.102	-0.008	-0.109	-0.177	-0.203	-0.186	-0.125	-0.026	0.104	0.258	0.165		
	N	0.017	-0.049	-0.213	-0.399	-0.541	-0.618	-1.932	-1.870	-1.681	-1.378	-0.980	-0.516	-0.275		
90	M	0.228	0.194	0.105	-0.007	-0.110	-0.181	-0.209	-0.191	-0.130	-0.028	0.107	0.266	0.170		
	N	0.020	-0.046	-0.212	-0.402	-0.552	-0.638	-0.667	-1.937	-1.742	-1.428	-1.017	-0.537	-0.288		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
bending moment + M results in tension on internal pipe surface
sign
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A.11.15

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Parabolisch verteilte Auflast beliebiger Breite
| Lastfall | parabolically distributed surcharge any desired width
| load case |
| 2A.11.17.51 | Zweiliniengegendruck radial
-----+ two linear support, radial

		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$						
β		ψ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.090	0.063	0.022	-0.013	-0.039	-0.054	-0.058	-0.051	-0.032	-0.003	0.034	0.065	0.040			
	N	-0.007	-0.052	-0.265	-0.371	-0.452	-0.502	-0.518	-0.498	-0.445	-0.361	-0.253	-0.139	-0.074			
30	M	0.150	0.118	0.047	-0.020	-0.071	-0.102	-0.111	-0.097	-0.061	-0.006	0.065	0.123	0.075			
	N	-0.010	-0.071	-0.175	-0.714	-0.871	-0.969	-1.000	-0.963	-0.861	-0.700	-0.491	-0.272	-0.148			
45	M	0.187	0.154	0.073	-0.019	-0.093	-0.138	-0.153	-0.135	-0.086	-0.010	0.089	0.171	0.102			
	N	-0.007	-0.070	-0.214	-0.338	-1.228	-1.368	-1.414	-1.364	-1.221	-0.995	-0.701	-0.392	-0.216			
60	M	0.209	0.176	0.090	-0.014	-0.104	-0.162	-0.182	-0.163	-0.105	-0.014	0.106	0.205	0.121			
	N	0.001	-0.064	-0.221	-0.388	-0.499	-1.673	-1.732	-1.673	-1.501	-1.225	-0.867	-0.489	-0.274			
75	M	0.220	0.187	0.100	-0.010	-0.109	-0.175	-0.199	-0.179	-0.117	-0.017	0.115	0.226	0.132			
	N	0.009	-0.057	-0.220	-0.405	-0.545	-0.620	-1.932	-1.868	-1.677	-1.372	-0.973	-0.553	-0.313			
90	M	0.224	0.190	0.102	-0.009	-0.110	-0.179	-0.205	-0.185	-0.121	-0.018	0.118	0.232	0.135			
	N	0.012	-0.054	-0.219	-0.408	-0.557	-0.640	-0.667	-1.935	-1.738	-1.423	-1.010	-0.575	-0.327			

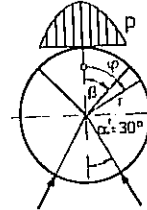
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
bending moment + M results in tension on internal pipe surface
sign
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2A.11.175

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Parabolisch verteilte Auflast beliebiger Breite
Lastfall | parabolically distributed surcharge any desired width
load case |
2A.11.30 | Zweiliniengegendruck radial
two linear support, radial



		Biegemoment bending moment				Normalkraft axial force									
		$M = m \cdot p \cdot r^2$				$N = n \cdot p \cdot r$									
β	φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.082	0.055	0.016	-0.016	-0.039	-0.050	-0.050	-0.037	-0.014	0.018	0.058	0.024	-0.002	
	N	-0.024	-0.068	-0.280	-0.383	-0.460	-0.506	-0.518	-0.494	-0.436	-0.349	-0.238	-0.188	-0.125	
30	M	0.134	0.104	0.036	-0.026	-0.071	-0.094	-0.094	-0.071	-0.028	0.034	0.110	0.045	-0.006	
	N	-0.043	-0.102	-0.204	-0.737	-0.887	-0.977	-1.000	-0.955	-0.845	-0.677	-0.463	-0.367	-0.246	
45	M	0.165	0.134	0.057	-0.028	-0.092	-0.126	-0.129	-0.099	-0.039	0.047	0.153	0.060	-0.013	
	N	-0.053	-0.115	-0.254	-0.371	-1.251	-1.380	-1.414	-1.352	-1.198	-0.962	-0.661	-0.526	-0.355	
60	M	0.181	0.150	0.071	-0.025	-0.103	-0.148	-0.153	-0.119	-0.048	0.056	0.184	0.070	-0.020	
	N	-0.056	-0.119	-0.271	-0.428	-0.528	-1.687	-1.732	-1.659	-1.472	-1.185	-0.818	-0.653	-0.444	
75	M	0.189	0.158	0.077	-0.022	-0.108	-0.159	-0.167	-0.130	-0.053	0.061	0.203	0.075	-0.026	
	N	-0.055	-0.118	-0.275	-0.449	-0.576	-0.636	-1.932	-1.852	-1.646	-1.327	-0.919	-0.736	-0.503	
90	M	0.192	0.161	0.079	-0.021	-0.109	-0.162	-0.171	-0.134	-0.055	0.062	0.209	0.076	-0.028	
	N	-0.054	-0.117	-0.276	-0.455	-0.589	-0.657	-0.667	-1.918	-1.705	-1.376	-0.953	-0.765	-0.524	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

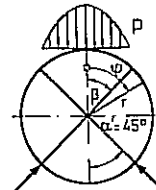
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.11.30

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Parabolisch verteilte Auflast beliebiger Breite
Lastfall | parabolically distributed surcharge any desired width
load case |
2A.11.45 | Zweiliniengegendruck radial
two linear support, radial



β		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M		0.064	0.038	0.003	-0.023	-0.037	-0.039	-0.028	-0.006	0.027	0.068	0.019	-0.022	-0.051	
	N		-0.064	-0.106	-0.314	-0.411	-0.480	-0.517	-0.518	-0.483	-0.416	-0.321	-0.298	-0.255	-0.195	
30	M		0.099	0.071	0.010	-0.040	-0.068	-0.072	-0.053	-0.010	0.052	0.130	0.035	-0.043	-0.099	
	N		-0.120	-0.177	-0.270	-0.792	-0.926	-0.997	-1.000	-0.935	-0.806	-0.622	-0.579	-0.497	-0.380	
45	M		0.114	0.087	0.021	-0.047	-0.088	-0.096	-0.070	-0.012	0.074	0.182	0.047	-0.065	-0.144	
	N		-0.162	-0.220	-0.348	-0.448	-1.306	-1.408	-1.414	-1.324	-1.144	-0.886	-0.826	-0.710	-0.545	
60	M		0.120	0.093	0.027	-0.047	-0.099	-0.111	-0.081	-0.013	0.090	0.221	0.054	-0.083	-0.181	
	N		-0.189	-0.247	-0.386	-0.522	-0.594	-1.722	-1.732	-1.624	-1.406	-1.091	-1.019	-0.878	-0.677	
75	M		0.121	0.095	0.029	-0.047	-0.102	-0.117	-0.087	-0.012	0.101	0.246	0.058	-0.096	-0.205	
	N		-0.203	-0.262	-0.404	-0.554	-0.651	-0.675	-1.932	-1.813	-1.571	-1.222	-1.143	-0.987	-0.763	
90	M		0.121	0.095	0.029	-0.048	-0.103	-0.119	-0.088	-0.012	0.105	0.254	0.059	-0.101	-0.214	
	N		-0.208	-0.266	-0.409	-0.563	-0.666	-0.697	-0.667	-1.878	-1.628	-1.267	-1.186	-1.024	-0.792	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

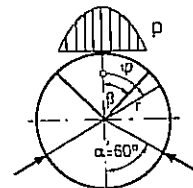
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.11.45

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.11.60 | Zweiliniengegendruck radial
-----+ two linear support, radial



β		Biegemoment bending moment				Normalkraft axial force											
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.027	0.004	-0.022	-0.035	-0.031	-0.013	0.020	0.064	0.118	0.042	-0.024	-0.074	-0.107	-0.107		
	N	-0.149	-0.188	-0.388	-0.471	-0.523	-0.538	-0.518	-0.462	-0.374	-0.395	-0.389	-0.356	-0.300	-0.300		
30	M	0.028	0.006	-0.038	-0.062	-0.056	-0.021	0.041	0.125	0.227	0.080	-0.047	-0.146	-0.209	-0.209		
	N	-0.283	-0.335	-0.412	-0.907	-1.008	-1.039	-1.000	-0.893	-0.724	-0.766	-0.755	-0.692	-0.583	-0.583		
45	M	0.015	-0.005	-0.047	-0.079	-0.072	-0.024	0.061	0.179	0.321	0.112	-0.069	-0.209	-0.299	-0.299		
	N	-0.393	-0.444	-0.549	-0.611	-1.421	-1.468	-1.414	-1.264	-1.028	-1.088	-1.074	-0.986	-0.832	-0.832		
60	M	-0.003	-0.019	-0.057	-0.086	-0.079	-0.023	0.080	0.222	0.394	0.135	-0.088	-0.260	-0.370	-0.370		
	N	-0.472	-0.521	-0.631	-0.723	-0.736	-1.795	-1.732	-1.551	-1.264	-1.339	-1.323	-1.217	-1.028	-1.028		
75	M	-0.015	-0.031	-0.065	-0.091	-0.080	-0.019	0.093	0.250	0.439	0.149	-0.101	-0.294	-0.416	-0.416		
	N	-0.519	-0.567	-0.678	-0.778	-0.809	-0.756	-1.932	-1.732	-1.413	-1.499	-1.482	-1.364	-1.154	-1.154		
90	M	-0.020	-0.035	-0.068	-0.093	-0.081	-0.018	0.098	0.259	0.455	0.154	-0.105	-0.305	-0.432	-0.432		
	N	-0.535	-0.582	-0.692	-0.795	-0.830	-0.781	-0.667	-1.793	-1.465	-1.554	-1.537	-1.415	-1.197	-1.197		

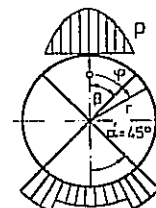
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.11.60

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.12.45 | Auflagergegendruck stufenförmig, radial
-----+ bedding reaction pressure gradually shaped, radial



β		Biegemoment bending moment				Normalkraft axial force											
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.083	0.056	0.017	-0.016	-0.038	-0.050	-0.051	-0.039	-0.017	0.015	0.038	0.033	0.016	0.016		
	N	-0.022	-0.066	-0.278	-0.382	-0.459	-0.506	-0.518	-0.494	-0.437	-0.351	-0.257	-0.178	-0.106	-0.106		
30	M	0.137	0.106	0.038	-0.025	-0.070	-0.094	-0.096	-0.075	-0.032	0.029	0.071	0.063	0.029	0.029		
	N	-0.038	-0.098	-0.200	-0.734	-0.885	-0.976	-1.000	-0.956	-0.847	-0.680	-0.500	-0.347	-0.209	-0.209		
45	M	0.168	0.137	0.060	-0.027	-0.092	-0.128	-0.132	-0.103	-0.045	0.040	0.098	0.085	0.037	0.037		
	N	-0.047	-0.109	-0.249	-0.366	-1.248	-1.378	-1.414	-1.354	-1.201	-0.967	-0.713	-0.499	-0.302	-0.302		
60	M	0.185	0.154	0.074	-0.023	-0.103	-0.149	-0.156	-0.124	-0.055	0.047	0.117	0.100	0.041	0.041		
	N	-0.048	-0.112	-0.264	-0.423	-0.524	-1.686	-1.732	-1.661	-1.476	-1.191	-0.881	-0.619	-0.380	-0.380		
75	M	0.194	0.162	0.081	-0.020	-0.108	-0.160	-0.170	-0.136	-0.061	0.051	0.128	0.109	0.043	0.043		
	N	-0.046	-0.110	-0.268	-0.443	-0.572	-0.634	-1.932	-1.854	-1.650	-1.333	-0.990	-0.698	-0.431	-0.431		
90	M	0.197	0.165	0.083	-0.019	-0.109	-0.164	-0.175	-0.140	-0.063	0.052	0.131	0.111	0.043	0.043		
	N	-0.045	-0.109	-0.268	-0.449	-0.585	-0.655	-0.667	-1.920	-1.710	-1.382	-1.027	-0.726	-0.449	-0.449		

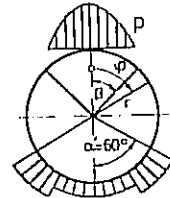
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.12.45

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+
Lastfall | parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.12.60 | Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial



β		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force $N = n \cdot p \cdot r$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.074	0.048	0.010	-0.019	-0.038	-0.045	-0.040	-0.023	0.004	0.026	0.027	0.013	-0.007	
	N	-0.042	-0.085	-0.295	-0.396	-0.469	-0.511	-0.518	-0.489	-0.427	-0.351	-0.279	-0.209	-0.140	
30	M	0.119	0.090	0.025	-0.032	-0.069	-0.083	-0.075	-0.043	0.009	0.050	0.050	0.023	-0.016	
	N	-0.077	-0.136	-0.233	-0.762	-0.905	-0.986	-1.000	-0.946	-0.827	-0.680	-0.542	-0.408	-0.274	
45	M	0.143	0.114	0.042	-0.036	-0.089	-0.112	-0.102	-0.059	0.012	0.069	0.068	0.029	-0.026	
	N	-0.102	-0.162	-0.296	-0.405	-1.276	-1.392	-1.414	-1.340	-1.174	-0.967	-0.773	-0.585	-0.395	
60	M	0.155	0.126	0.052	-0.034	-0.100	-0.130	-0.120	-0.070	0.015	0.083	0.080	0.032	-0.036	
	N	-0.115	-0.176	-0.322	-0.470	-0.558	-1.703	-1.732	-1.643	-1.442	-1.191	-0.955	-0.725	-0.493	
75	M	0.160	0.131	0.057	-0.032	-0.104	-0.139	-0.130	-0.076	0.017	0.091	0.087	0.032	-0.044	
	N	-0.121	-0.182	-0.332	-0.496	-0.610	-0.653	-1.932	-1.835	-1.613	-1.334	-1.071	-0.816	-0.558	
90	M	0.162	0.133	0.058	-0.032	-0.105	-0.142	-0.133	-0.078	0.018	0.094	0.089	0.032	-0.046	
	N	-0.122	-0.184	-0.335	-0.503	-0.624	-0.675	-0.667	-1.900	-1.671	-1.383	-1.111	-0.847	-0.580	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

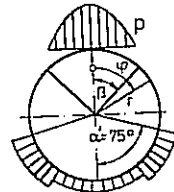
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.12.60

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+
Lastfall | Parabolisch verteilte Auflast beliebiger Breite
load case | parabolically distributed surcharge any desired width
2A.12.75 | Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$					
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.062	0.036	0.002	-0.023	-0.035	-0.035	-0.022	0.002	0.023	0.026	0.013	-0.006	-0.028		
	N	-0.072	-0.114	-0.321	-0.417	-0.484	-0.519	-0.518	-0.481	-0.426	-0.368	-0.310	-0.245	-0.178		
30	M	0.095	0.067	0.009	-0.039	-0.064	-0.065	-0.041	0.005	0.045	0.050	0.024	-0.013	-0.055		
	N	-0.135	-0.191	-0.283	-0.802	-0.933	-1.001	-1.000	-0.931	-0.824	-0.713	-0.601	-0.478	-0.347		
45	M	0.109	0.082	0.019	-0.046	-0.083	-0.086	-0.055	0.009	0.064	0.070	0.031	-0.022	-0.082		
	N	-0.183	-0.241	-0.367	-0.463	-1.316	-1.413	-1.414	-1.319	-1.170	-1.014	-0.857	-0.683	-0.499		
60	M	0.113	0.087	0.023	-0.047	-0.092	-0.098	-0.062	0.013	0.078	0.084	0.035	-0.031	-0.105		
	N	-0.215	-0.273	-0.409	-0.541	-0.608	-1.729	-1.732	-1.617	-1.437	-1.248	-1.058	-0.845	-0.620		
75	M	0.113	0.088	0.025	-0.047	-0.096	-0.103	-0.065	0.017	0.087	0.092	0.037	-0.038	-0.120		
	N	-0.232	-0.290	-0.429	-0.575	-0.665	-0.682	-1.932	-1.806	-1.607	-1.397	-1.186	-0.950	-0.699		
90	M	0.113	0.088	0.025	-0.047	-0.096	-0.105	-0.066	0.018	0.091	0.095	0.037	-0.040	-0.126		
	N	-0.238	-0.295	-0.435	-0.585	-0.681	-0.704	-0.667	-1.870	-1.665	-1.449	-1.230	-0.986	-0.726		

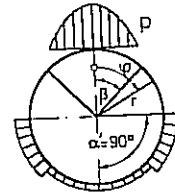
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.12.75

Schnittkräfte am Kreisring
sectional forces at the circular ring



Parabolisch verteilte Auflast beliebiger Breite
parabolically distributed surcharge any desired width
Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial

Lastfall
load case
2A.12.90

β		Biegemoment bending moment				Normalkraft axial force				N = n · p · r							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.044	0.020	-0.010	-0.027	-0.030	-0.019	0.005	0.028	0.033	0.021	0.000	-0.024	-0.047			
	N	-0.117	-0.158	-0.360	-0.449	-0.507	-0.530	-0.518	-0.483	-0.443	-0.401	-0.351	-0.291	-0.225			
30	M	0.061	0.037	-0.013	-0.047	-0.054	-0.034	0.012	0.055	0.065	0.041	-0.002	-0.047	-0.092			
	N	-0.222	-0.276	-0.359	-0.864	-0.977	-1.023	-1.000	-0.935	-0.859	-0.777	-0.681	-0.566	-0.438			
45	M	0.061	0.039	-0.012	-0.057	-0.069	-0.042	0.021	0.080	0.091	0.056	-0.005	-0.070	-0.134			
	N	-0.307	-0.360	-0.474	-0.550	-1.378	-1.445	-1.414	-1.324	-1.218	-1.103	-0.970	-0.807	-0.627			
60	M	0.054	0.034	-0.014	-0.060	-0.075	-0.044	0.031	0.100	0.112	0.067	-0.010	-0.090	-0.168			
	N	-0.367	-0.419	-0.540	-0.648	-0.683	-1.768	-1.732	-1.624	-1.496	-1.358	-1.196	-0.997	-0.777			
75	M	0.048	0.029	-0.017	-0.062	-0.076	-0.043	0.039	0.114	0.125	0.073	-0.013	-0.104	-0.191			
	N	-0.401	-0.453	-0.575	-0.694	-0.750	-0.726	-1.932	-1.813	-1.673	-1.520	-1.340	-1.120	-0.874			
90	M	0.046	0.027	-0.019	-0.063	-0.076	-0.042	0.042	0.118	0.130	0.076	-0.015	-0.109	-0.199			
	N	-0.413	-0.464	-0.586	-0.708	-0.769	-0.750	-0.667	-1.878	-1.733	-1.576	-1.390	-1.162	-0.908			

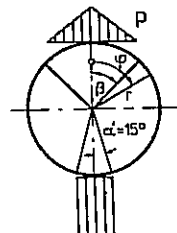
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2A.12.90

Schnittkräfte am Kreisring
sectional forces at the circular ring



Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Lastfall
load case
2B.8.15

		Biegemoment bending moment			M = m · p · r ²	Normalkraft axial force			N = n · p · r						
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.071	0.049	0.018	-0.009	-0.029	-0.042	-0.046	-0.041	-0.028	-0.007	0.020	0.051	0.051	
	N	-0.001	-0.035	-0.066	-0.092	-0.113	-0.125	-0.129	-0.125	-0.111	-0.091	-0.064	-0.032	0.001	
30	M	0.121	0.093	0.037	-0.014	-0.054	-0.079	-0.087	-0.079	-0.054	-0.014	0.038	0.098	0.098	
	N	0.000	-0.050	-0.125	-0.177	-0.217	-0.242	-0.250	-0.241	-0.216	-0.177	-0.125	-0.064	0.000	
45	M	0.153	0.124	0.057	-0.015	-0.072	-0.108	-0.121	-0.110	-0.076	-0.021	0.052	0.137	0.137	
	N	0.004	-0.051	-0.158	-0.247	-0.304	-0.340	-0.354	-0.343	-0.308	-0.253	-0.181	-0.096	-0.004	
60	M	0.174	0.143	0.071	-0.012	-0.082	-0.128	-0.145	-0.134	-0.093	-0.026	0.062	0.165	0.164	
	N	0.011	-0.046	-0.168	-0.288	-0.369	-0.415	-0.433	-0.421	-0.381	-0.314	-0.226	-0.123	-0.011	
75	M	0.185	0.154	0.079	-0.009	-0.087	-0.139	-0.160	-0.148	-0.103	-0.030	0.067	0.182	0.181	
	N	0.017	-0.042	-0.171	-0.305	-0.405	-0.462	-0.483	-0.471	-0.427	-0.354	-0.256	-0.141	-0.017	
90	M	0.188	0.157	0.082	-0.008	-0.088	-0.142	-0.164	-0.152	-0.107	-0.032	0.069	0.188	0.187	
	N	0.019	-0.040	-0.171	-0.309	-0.416	-0.477	-0.500	-0.488	-0.443	-0.367	-0.267	-0.148	-0.019	

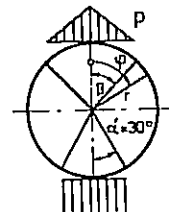
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B.8.15

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | triangularly distributed surcharge any desired width
| load case |
| 2B.8.30 | Auflagergegendruck rechteckig
| | bedding reaction pressure rectangular

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		ψ	0	15	30	45	60	75	90						
15	M	0.069	0.046	0.016	-0.010	-0.029	-0.041	-0.043	-0.037	-0.023	-0.001	0.027	0.044	0.028	
	N	-0.006	-0.040	-0.070	-0.096	-0.115	-0.127	-0.129	-0.123	-0.109	-0.087	-0.059	0.005	0.006	
30	M	0.116	0.089	0.034	-0.016	-0.054	-0.077	-0.082	-0.071	-0.044	-0.002	0.051	0.083	0.052	
	N	-0.010	-0.059	-0.134	-0.184	-0.221	-0.244	-0.250	-0.239	-0.212	-0.170	-0.116	0.007	0.010	
45	M	0.147	0.118	0.052	-0.017	-0.072	-0.105	-0.114	-0.100	-0.062	-0.004	0.071	0.116	0.072	
	N	-0.009	-0.064	-0.170	-0.257	-0.311	-0.344	-0.354	-0.339	-0.301	-0.243	-0.169	0.006	0.009	
60	M	0.165	0.135	0.065	-0.015	-0.082	-0.124	-0.137	-0.121	-0.076	-0.006	0.085	0.139	0.085	
	N	-0.006	-0.063	-0.183	-0.300	-0.378	-0.420	-0.433	-0.417	-0.372	-0.302	-0.212	0.002	0.006	
75	M	0.176	0.145	0.072	-0.013	-0.086	-0.134	-0.150	-0.133	-0.085	-0.007	0.093	0.153	0.093	
	N	-0.002	-0.060	-0.187	-0.318	-0.415	-0.467	-0.483	-0.466	-0.417	-0.340	-0.240	-0.003	0.002	
90	M	0.179	0.148	0.075	-0.012	-0.088	-0.137	-0.154	-0.137	-0.087	-0.008	0.096	0.158	0.096	
	N	0.000	-0.058	-0.187	-0.323	-0.425	-0.482	-0.500	-0.483	-0.433	-0.354	-0.250	-0.005	0.000	

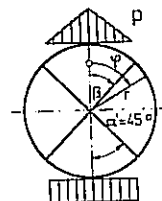
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B. 8.30

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Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | triangularly distributed surcharge any desired width
| load case |
| 2B.8.45 | Auflagergegendruck rechteckig
| | bedding reaction pressure rectangular

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		ψ	0	15	30	45	60	75	90						
15	M	0.065	0.043	0.013	-0.011	-0.029	-0.039	-0.040	-0.032	-0.016	0.008	0.029	0.032	0.011	
	N	-0.013	-0.046	-0.076	-0.101	-0.119	-0.128	-0.129	-0.122	-0.105	-0.082	-0.015	0.022	0.013	
30	M	0.110	0.083	0.029	-0.019	-0.054	-0.073	-0.076	-0.061	-0.030	0.014	0.054	0.061	0.021	
	N	-0.023	-0.072	-0.145	-0.193	-0.228	-0.247	-0.250	-0.235	-0.205	-0.160	-0.032	0.040	0.023	
45	M	0.138	0.109	0.046	-0.021	-0.071	-0.100	-0.104	-0.085	-0.043	0.019	0.075	0.084	0.027	
	N	-0.028	-0.082	-0.186	-0.270	-0.320	-0.349	-0.354	-0.334	-0.292	-0.230	-0.049	0.052	0.028	
60	M	0.154	0.125	0.057	-0.019	-0.081	-0.118	-0.125	-0.103	-0.052	0.022	0.090	0.101	0.031	
	N	-0.029	-0.085	-0.203	-0.316	-0.389	-0.426	-0.433	-0.411	-0.361	-0.286	-0.065	0.058	0.029	
75	M	0.163	0.134	0.064	-0.018	-0.086	-0.127	-0.137	-0.113	-0.058	0.024	0.099	0.110	0.032	
	N	-0.027	-0.084	-0.209	-0.336	-0.427	-0.474	-0.483	-0.459	-0.405	-0.322	-0.076	0.060	0.027	
90	M	0.166	0.137	0.066	-0.017	-0.087	-0.130	-0.141	-0.117	-0.060	0.025	0.102	0.114	0.032	
	N	-0.027	-0.084	-0.210	-0.342	-0.439	-0.489	-0.500	-0.476	-0.420	-0.335	-0.081	0.060	0.027	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

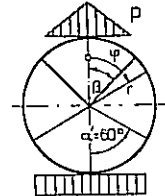
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B. 8.45

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | | triangularly distributed surcharge any desired width
| load case | |
| 2B.8.60 | | Auflagergegendruck rechteckig
| | | bedding reaction pressure rectangular
+-----+



β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$					Normalkraft axial force					$N = n \cdot p \cdot r$				
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.062	0.040	0.011	-0.012	-0.029	-0.037	-0.036	-0.026	-0.009	0.012	0.026	0.024	0.001				
	N	-0.020	-0.053	-0.082	-0.106	-0.122	-0.130	-0.129	-0.120	-0.102	-0.044	0.007	0.033	0.020				
30	M	0.103	0.077	0.025	-0.021	-0.053	-0.069	-0.068	-0.050	-0.017	0.023	0.050	0.046	0.002				
	N	-0.036	-0.085	-0.157	-0.203	-0.235	-0.251	-0.250	-0.232	-0.198	-0.086	0.012	0.061	0.036				
45	M	0.129	0.101	0.040	-0.024	-0.070	-0.094	-0.094	-0.070	-0.023	0.032	0.068	0.063	0.000				
	N	-0.047	-0.100	-0.202	-0.283	-0.330	-0.354	-0.354	-0.329	-0.283	-0.125	0.013	0.082	0.047				
60	M	0.144	0.115	0.050	-0.023	-0.080	-0.111	-0.112	-0.084	-0.029	0.038	0.082	0.074	-0.003				
	N	-0.052	-0.107	-0.223	-0.332	-0.401	-0.432	-0.433	-0.405	-0.349	-0.157	0.011	0.095	0.052				
75	M	0.152	0.123	0.055	-0.022	-0.085	-0.120	-0.123	-0.093	-0.032	0.042	0.090	0.081	-0.005				
	N	-0.053	-0.109	-0.231	-0.354	-0.440	-0.480	-0.483	-0.453	-0.392	-0.179	0.009	0.101	0.053				
90	M	0.154	0.125	0.057	-0.022	-0.086	-0.123	-0.126	-0.095	-0.033	0.043	0.092	0.083	-0.006				
	N	-0.053	-0.110	-0.233	-0.361	-0.452	-0.496	-0.500	-0.469	-0.406	-0.186	0.007	0.103	0.053				

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

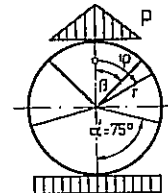
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B. 8.60

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | | triangularly distributed surcharge any desired width
| load case | |
| 2B.8.75 | | Auflagergegendruck rechteckig
| | | bedding reaction pressure rectangular
+-----+



β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$					Normalkraft axial force					$N = n \cdot p \cdot r$				
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.060	0.038	0.010	-0.013	-0.028	-0.035	-0.033	-0.022	-0.005	0.014	0.024	0.020	-0.004				
	N	-0.025	-0.058	-0.086	-0.109	-0.125	-0.132	-0.129	-0.118	-0.076	-0.025	0.020	0.040	0.025				
30	M	0.099	0.073	0.022	-0.022	-0.052	-0.066	-0.063	-0.042	-0.009	0.026	0.046	0.038	-0.008				
	N	-0.046	-0.094	-0.165	-0.209	-0.240	-0.253	-0.250	-0.230	-0.149	-0.049	0.036	0.075	0.046				
45	M	0.123	0.096	0.036	-0.026	-0.069	-0.090	-0.087	-0.059	-0.013	0.035	0.063	0.051	-0.014				
	N	-0.061	-0.113	-0.214	-0.293	-0.336	-0.357	-0.354	-0.326	-0.213	-0.073	0.046	0.101	0.061				
60	M	0.137	0.109	0.045	-0.025	-0.079	-0.106	-0.103	-0.070	-0.015	0.042	0.076	0.060	-0.020				
	N	-0.069	-0.123	-0.237	-0.344	-0.409	-0.436	-0.433	-0.401	-0.263	-0.094	0.052	0.118	0.069				
75	M	0.143	0.115	0.050	-0.025	-0.084	-0.114	-0.112	-0.077	-0.017	0.046	0.083	0.065	-0.024				
	N	-0.072	-0.127	-0.247	-0.368	-0.450	-0.485	-0.483	-0.448	-0.296	-0.108	0.054	0.127	0.072				
90	M	0.146	0.117	0.051	-0.024	-0.085	-0.117	-0.115	-0.080	-0.017	0.048	0.085	0.066	-0.026				
	N	-0.072	-0.128	-0.250	-0.374	-0.461	-0.501	-0.500	-0.464	-0.307	-0.113	0.054	0.130	0.072				

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

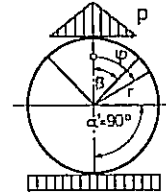
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B. 8.75

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Dreieckig verteilte Auflast beliebiger Breite
load case | triangularly distributed surcharge any desired width
2B.8.90 | Auflagergegendruck rechteckig
----- | bedding reaction pressure rectangular



		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$						
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.059	0.038	0.009	-0.013	-0.028	-0.035	-0.032	-0.021	-0.004	0.014	0.024	0.019	-0.005	
	N	-0.027	-0.060	-0.088	-0.111	-0.126	-0.132	-0.129	-0.109	-0.069	-0.019	0.023	0.042	0.027	
30	M	0.098	0.072	0.021	-0.023	-0.052	-0.065	-0.061	-0.040	-0.007	0.026	0.045	0.035	-0.011	
	N	-0.050	-0.098	-0.168	-0.212	-0.241	-0.254	-0.250	-0.212	-0.134	-0.038	0.043	0.079	0.050	
45	M	0.121	0.094	0.034	-0.026	-0.069	-0.089	-0.084	-0.055	-0.010	0.036	0.062	0.048	-0.018	
	N	-0.066	-0.118	-0.218	-0.296	-0.339	-0.358	-0.354	-0.301	-0.191	-0.057	0.057	0.108	0.066	
60	M	0.134	0.106	0.043	-0.026	-0.079	-0.104	-0.099	-0.066	-0.012	0.043	0.074	0.056	-0.025	
	N	-0.075	-0.129	-0.242	-0.349	-0.412	-0.438	-0.433	-0.370	-0.237	-0.074	0.065	0.126	0.075	
75	M	0.141	0.113	0.048	-0.025	-0.083	-0.112	-0.108	-0.072	-0.013	0.047	0.080	0.060	-0.030	
	N	-0.079	-0.134	-0.253	-0.373	-0.453	-0.487	-0.483	-0.414	-0.267	-0.086	0.068	0.136	0.079	
90	M	0.143	0.115	0.049	-0.025	-0.084	-0.115	-0.111	-0.074	-0.013	0.049	0.083	0.062	-0.032	
	N	-0.080	-0.135	-0.256	-0.379	-0.465	-0.503	-0.500	-0.429	-0.277	-0.090	0.069	0.139	0.080	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

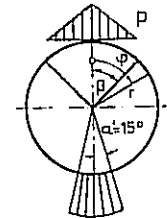
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B. 8.90

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall | Dreieckig verteilte Auflast beliebiger Breite
load case | triangularly distributed surcharge any desired width
2B.9.15 | Auflagergegendruck cos-förmig, radial
----- | bedding reaction pressure cos-shaped, radial



β		Biegemoment bending moment			M = m · p · r ²			Normalkraft axial force			N = n · p · r					
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.071	0.049	0.018	-0.009	-0.029	-0.042	-0.046	-0.041	-0.028	-0.007	0.020	0.051	0.051		
	N	-0.001	-0.035	-0.066	-0.093	-0.113	-0.125	-0.129	-0.125	-0.111	-0.091	-0.063	-0.032	-0.032		
30	M	0.121	0.093	0.037	-0.014	-0.054	-0.079	-0.087	-0.079	-0.054	-0.014	0.038	0.098	0.098		
	N	0.000	-0.050	-0.125	-0.177	-0.217	-0.242	-0.250	-0.241	-0.216	-0.177	-0.125	-0.064	-0.065		
45	M	0.153	0.124	0.057	-0.015	-0.072	-0.108	-0.121	-0.110	-0.076	-0.021	0.052	0.137	0.136		
	N	0.004	-0.051	-0.158	-0.247	-0.304	-0.340	-0.354	-0.343	-0.308	-0.253	-0.180	-0.096	-0.097		
60	M	0.174	0.143	0.071	-0.012	-0.082	-0.128	-0.145	-0.133	-0.093	-0.026	0.062	0.165	0.163		
	N	0.011	-0.046	-0.168	-0.288	-0.370	-0.415	-0.433	-0.421	-0.380	-0.314	-0.226	-0.123	-0.124		
75	M	0.185	0.154	0.079	-0.009	-0.087	-0.139	-0.160	-0.148	-0.103	-0.030	0.067	0.182	0.180		
	N	0.017	-0.042	-0.171	-0.305	-0.405	-0.462	-0.483	-0.471	-0.427	-0.353	-0.256	-0.141	-0.143		
90	M	0.188	0.157	0.082	-0.008	-0.088	-0.142	-0.164	-0.152	-0.107	-0.031	0.069	0.188	0.186		
	N	0.019	-0.040	-0.171	-0.310	-0.416	-0.477	-0.500	-0.488	-0.443	-0.367	-0.267	-0.148	-0.150		

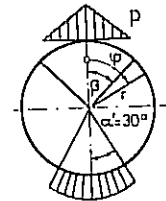
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B. 9.15

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
load case | triangularly distributed surcharge any desired width
2B.9.30 | Auflagergegendruck cos-förmig, radial
-----+ bedding reaction pressure cos-shaped, radial

β		Biegemoment bending moment			Normalkraft axial force									
		φ	0	15	30	45	60	75	90	105	120	135	150	165
15	M	0.068	0.046	0.016	-0.010	-0.029	-0.040	-0.043	-0.037	-0.022	0.000	0.028	0.043	0.026
	N	-0.007	-0.040	-0.071	-0.096	-0.116	-0.127	-0.129	-0.123	-0.109	-0.087	-0.059	-0.043	-0.061
30	M	0.115	0.088	0.034	-0.016	-0.054	-0.076	-0.082	-0.071	-0.043	-0.001	0.053	0.082	0.048
	N	-0.011	-0.060	-0.134	-0.185	-0.222	-0.244	-0.250	-0.239	-0.211	-0.169	-0.116	-0.086	-0.120
45	M	0.146	0.117	0.052	-0.018	-0.072	-0.104	-0.113	-0.099	-0.061	-0.002	0.073	0.113	0.066
	N	-0.011	-0.065	-0.171	-0.258	-0.312	-0.344	-0.354	-0.339	-0.301	-0.242	-0.167	-0.127	-0.174
60	M	0.165	0.135	0.065	-0.015	-0.082	-0.123	-0.136	-0.119	-0.074	-0.004	0.087	0.136	0.078
	N	-0.007	-0.064	-0.184	-0.301	-0.379	-0.420	-0.433	-0.416	-0.371	-0.301	-0.210	-0.161	-0.219
75	M	0.175	0.144	0.072	-0.013	-0.086	-0.134	-0.149	-0.132	-0.083	-0.005	0.095	0.150	0.085
	N	-0.004	-0.061	-0.188	-0.320	-0.416	-0.467	-0.483	-0.466	-0.416	-0.339	-0.238	-0.184	-0.249
90	M	0.178	0.147	0.074	-0.013	-0.088	-0.137	-0.153	-0.136	-0.085	-0.006	0.098	0.155	0.087
	N	-0.002	-0.060	-0.189	-0.325	-0.426	-0.483	-0.500	-0.482	-0.432	-0.352	-0.248	-0.192	-0.259

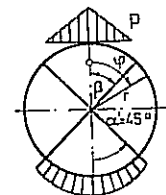
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B. 9.30

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
load case | triangularly distributed surcharge any desired width
2B.9.45 | Auflagergegendruck cos-förmig, radial
-----+ bedding reaction pressure cos-shaped, radial

		Biegemoment bending moment				Normalkraft axial force				N = n · p · r							
		M = m · p · r ²				N = n · p · r											
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
15	M	0.064	0.042	0.013	-0.012	-0.029	-0.038	-0.039	-0.030	-0.013	0.010	0.029	0.029	0.006			
	N	-0.016	-0.049	-0.078	-0.103	-0.120	-0.129	-0.129	-0.121	-0.104	-0.081	-0.062	-0.062	-0.085			
30	M	0.107	0.081	0.028	-0.020	-0.054	-0.072	-0.073	-0.058	-0.026	0.020	0.055	0.054	0.010			
	N	-0.028	-0.076	-0.149	-0.196	-0.230	-0.249	-0.250	-0.234	-0.203	-0.157	-0.121	-0.123	-0.167			
45	M	0.135	0.106	0.044	-0.022	-0.071	-0.098	-0.101	-0.080	-0.037	0.027	0.077	0.074	0.012			
	N	-0.034	-0.088	-0.191	-0.274	-0.323	-0.350	-0.354	-0.333	-0.289	-0.226	-0.176	-0.178	-0.241			
60	M	0.151	0.122	0.055	-0.021	-0.081	-0.116	-0.121	-0.097	-0.045	0.032	0.092	0.088	0.012			
	N	-0.036	-0.092	-0.209	-0.322	-0.393	-0.428	-0.433	-0.409	-0.357	-0.280	-0.220	-0.224	-0.300			
75	M	0.159	0.130	0.061	-0.019	-0.086	-0.125	-0.132	-0.107	-0.050	0.035	0.101	0.097	0.011			
	N	-0.036	-0.093	-0.216	-0.342	-0.432	-0.476	-0.483	-0.457	-0.400	-0.316	-0.250	-0.254	-0.340			
90	M	0.162	0.133	0.063	-0.019	-0.087	-0.128	-0.136	-0.110	-0.051	0.035	0.104	0.099	0.010			
	N	-0.035	-0.092	-0.218	-0.348	-0.443	-0.492	-0.500	-0.474	-0.415	-0.329	-0.260	-0.265	-0.354			

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B. 9.45

A diagram of a circular sector with radius r and central angle $\alpha = 60^\circ$. A shaded segment is defined by a radius and an angle φ . The segment is shaded with diagonal lines. The angle β is also indicated between the radius and the chord of the segment.

Biegemoment $M = m \cdot p \cdot r^2$ Normalkraft $N = n \cdot p \cdot r$
bending moment axial force

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 20. 9.60

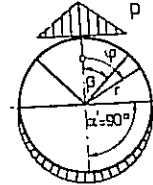
Biegemoment $M = m \cdot p \cdot r^2$ Normalkraft $N = n \cdot p \cdot r$
bending moment axial force

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B. 9.75

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
load case | triangularly distributed surcharge any desired width
2B.9.90 | Auflagergegendruck cos-förmig, radial
-----+ bedding reaction pressure cos-shaped, radial

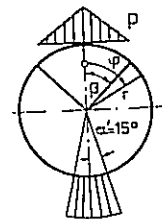
		Biegemoment bending moment			M = m · p · r ²		Normalkraft axial force		N = n · p · r									
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
β																		
15	M	0.053	0.032	0.005	-0.015	-0.027	-0.030	-0.024	-0.010	0.006	0.017	0.019	0.008	-0.019				
	N	-0.041	-0.073	-0.100	-0.120	-0.132	-0.136	-0.129	-0.115	-0.099	-0.088	-0.086	-0.097	-0.124				
30	M	0.086	0.061	0.013	-0.026	-0.050	-0.057	-0.046	-0.019	0.011	0.033	0.036	0.014	-0.038				
	N	-0.076	-0.123	-0.191	-0.231	-0.255	-0.261	-0.250	-0.224	-0.193	-0.171	-0.168	-0.191	-0.242				
45	M	0.105	0.079	0.023	-0.032	-0.066	-0.077	-0.062	-0.026	0.016	0.046	0.050	0.017	-0.056				
	N	-0.103	-0.154	-0.251	-0.323	-0.358	-0.368	-0.354	-0.317	-0.276	-0.245	-0.242	-0.274	-0.347				
60	M	0.114	0.088	0.029	-0.032	-0.075	-0.090	-0.073	-0.030	0.019	0.055	0.059	0.019	-0.071				
	N	-0.121	-0.173	-0.282	-0.381	-0.435	-0.449	-0.433	-0.390	-0.340	-0.305	-0.301	-0.341	-0.431				
75	M	0.119	0.092	0.033	-0.032	-0.079	-0.096	-0.079	-0.033	0.022	0.061	0.064	0.019	-0.081				
	N	-0.130	-0.183	-0.298	-0.409	-0.479	-0.500	-0.483	-0.437	-0.382	-0.343	-0.340	-0.385	-0.485				
90	M	0.120	0.094	0.033	-0.032	-0.081	-0.098	-0.081	-0.033	0.023	0.063	0.066	0.019	-0.085				
	N	-0.133	-0.186	-0.302	-0.417	-0.492	-0.517	-0.500	-0.452	-0.396	-0.356	-0.353	-0.401	-0.504				

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B. 9.90

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Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
load case | triangularly distributed surcharge any desired width
2B.10.15 | Auflagergegendruck gleichförmig, radial
-----+ bedding reaction pressure uniform, radial

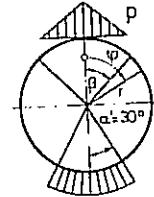
		Biegemoment bending moment		M = m · p · r ²		Normalkraft axial force		N = n · p · r							
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.071	0.049	0.018	-0.009	-0.029	-0.042	-0.046	-0.041	-0.028	-0.007	0.020	0.051	0.051	
	N	-0.001	-0.035	-0.066	-0.093	-0.113	-0.125	-0.129	-0.125	-0.111	-0.090	-0.063	-0.032	-0.033	
30	M	0.121	0.093	0.037	-0.014	-0.054	-0.079	-0.087	-0.079	-0.054	-0.014	0.038	0.098	0.097	
	N	0.000	-0.050	-0.125	-0.177	-0.217	-0.242	-0.250	-0.241	-0.216	-0.177	-0.125	-0.064	-0.065	
45	M	0.153	0.124	0.057	-0.015	-0.072	-0.108	-0.121	-0.110	-0.076	-0.021	0.052	0.137	0.135	
	N	0.004	-0.051	-0.158	-0.247	-0.304	-0.340	-0.354	-0.343	-0.308	-0.253	-0.180	-0.096	-0.097	
60	M	0.174	0.143	0.071	-0.012	-0.082	-0.128	-0.145	-0.133	-0.093	-0.026	0.062	0.165	0.163	
	N	0.011	-0.046	-0.168	-0.288	-0.370	-0.415	-0.433	-0.421	-0.380	-0.314	-0.226	-0.123	-0.125	
75	M	0.185	0.154	0.079	-0.009	-0.087	-0.139	-0.160	-0.147	-0.103	-0.030	0.067	0.182	0.179	
	N	0.017	-0.042	-0.171	-0.305	-0.405	-0.462	-0.483	-0.471	-0.427	-0.353	-0.256	-0.141	-0.144	
90	M	0.188	0.157	0.082	-0.008	-0.088	-0.142	-0.164	-0.152	-0.107	-0.031	0.069	0.188	0.185	
	N	0.019	-0.040	-0.171	-0.310	-0.416	-0.477	-0.500	-0.488	-0.443	-0.367	-0.267	-0.148	-0.151	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.10.15

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2B.10.30

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width

Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		120	135	150	165	180
		φ	0	15	30	45	60	75	90					
15	M	0.068	0.046	0.016	-0.010	-0.029	-0.040	-0.043	-0.037	-0.022	0.000	0.028	0.042	0.024
	N	-0.007	-0.040	-0.071	-0.097	-0.116	-0.127	-0.129	-0.123	-0.108	-0.086	-0.058	-0.044	-0.062
30	M	0.115	0.088	0.033	-0.017	-0.054	-0.076	-0.082	-0.070	-0.042	0.000	0.053	0.081	0.046
	N	-0.012	-0.061	-0.135	-0.185	-0.222	-0.244	-0.250	-0.239	-0.211	-0.169	-0.115	-0.088	-0.122
45	M	0.146	0.117	0.052	-0.018	-0.071	-0.104	-0.113	-0.098	-0.060	-0.001	0.074	0.112	0.063
	N	-0.012	-0.066	-0.172	-0.258	-0.312	-0.345	-0.354	-0.339	-0.300	-0.242	-0.167	-0.129	-0.178
60	M	0.164	0.134	0.064	-0.015	-0.082	-0.123	-0.135	-0.119	-0.073	-0.003	0.088	0.135	0.074
	N	-0.008	-0.065	-0.185	-0.302	-0.379	-0.420	-0.433	-0.416	-0.371	-0.300	-0.209	-0.163	-0.224
75	M	0.174	0.144	0.071	-0.013	-0.086	-0.133	-0.149	-0.131	-0.082	-0.004	0.097	0.148	0.080
	N	-0.005	-0.063	-0.189	-0.320	-0.416	-0.468	-0.483	-0.465	-0.416	-0.338	-0.237	-0.186	-0.254
90	M	0.177	0.147	0.074	-0.013	-0.088	-0.137	-0.153	-0.135	-0.084	-0.004	0.100	0.153	0.082
	N	-0.003	-0.061	-0.190	-0.325	-0.427	-0.483	-0.500	-0.482	-0.431	-0.351	-0.247	-0.195	-0.265

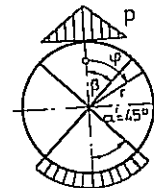
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.10.30

4/85

Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2B.10.45

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width

Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial

β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		120	135	150	165	180
		φ	0	15	30	45	60	75	90					
15	M	0.063	0.042	0.012	-0.012	-0.029	-0.038	-0.038	-0.029	-0.012	0.012	0.029	0.026	0.002
	N	-0.017	-0.050	-0.080	-0.104	-0.121	-0.129	-0.129	-0.121	-0.103	-0.079	-0.062	-0.066	-0.090
30	M	0.106	0.079	0.027	-0.020	-0.053	-0.071	-0.072	-0.055	-0.023	0.023	0.056	0.049	0.002
	N	-0.031	-0.079	-0.152	-0.199	-0.232	-0.249	-0.250	-0.233	-0.201	-0.155	-0.122	-0.130	-0.176
45	M	0.133	0.104	0.042	-0.023	-0.071	-0.097	-0.099	-0.077	-0.032	0.032	0.078	0.067	0.001
	N	-0.039	-0.092	-0.195	-0.278	-0.326	-0.352	-0.354	-0.331	-0.287	-0.222	-0.177	-0.188	-0.254
60	M	0.148	0.119	0.053	-0.022	-0.081	-0.114	-0.118	-0.092	-0.039	0.039	0.093	0.079	-0.002
	N	-0.042	-0.097	-0.214	-0.326	-0.396	-0.429	-0.433	-0.407	-0.354	-0.277	-0.222	-0.236	-0.317
75	M	0.156	0.127	0.059	-0.020	-0.086	-0.123	-0.129	-0.102	-0.043	0.042	0.102	0.087	-0.004
	N	-0.042	-0.099	-0.222	-0.347	-0.435	-0.477	-0.483	-0.456	-0.397	-0.312	-0.252	-0.267	-0.358
90	M	0.159	0.130	0.060	-0.020	-0.087	-0.126	-0.133	-0.105	-0.045	0.043	0.105	0.089	-0.005
	N	-0.042	-0.099	-0.224	-0.353	-0.446	-0.493	-0.500	-0.472	-0.412	-0.324	-0.262	-0.279	-0.372

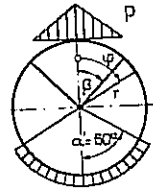
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.10.45

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Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2B.10.60

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width

Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial

β	ϕ	Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		120	135	150	165	180
		0	15	30	45	60	75	90	105					
15	M	0.057	0.035	0.007	-0.014	-0.028	-0.033	-0.030	-0.017	0.004	0.021	0.023	0.010	-0.017
	N	-0.032	-0.065	-0.093	-0.114	-0.128	-0.133	-0.129	-0.117	-0.096	-0.079	-0.077	-0.090	-0.117
30	M	0.093	0.067	0.017	-0.025	-0.052	-0.063	-0.056	-0.032	0.007	0.040	0.043	0.018	-0.035
	N	-0.060	-0.107	-0.177	-0.219	-0.246	-0.257	-0.250	-0.226	-0.187	-0.154	-0.151	-0.176	-0.229
45	M	0.114	0.087	0.029	-0.029	-0.069	-0.085	-0.077	-0.044	0.011	0.055	0.060	0.023	-0.052
	N	-0.080	-0.132	-0.231	-0.306	-0.346	-0.362	-0.354	-0.321	-0.266	-0.222	-0.217	-0.254	-0.329
60	M	0.125	0.098	0.037	-0.030	-0.079	-0.100	-0.091	-0.052	0.013	0.067	0.071	0.026	-0.066
	N	-0.092	-0.146	-0.257	-0.361	-0.421	-0.442	-0.433	-0.395	-0.329	-0.275	-0.271	-0.316	-0.408
75	M	0.131	0.104	0.041	-0.029	-0.083	-0.108	-0.099	-0.057	0.015	0.074	0.078	0.027	-0.076
	N	-0.098	-0.152	-0.270	-0.386	-0.463	-0.492	-0.483	-0.441	-0.369	-0.310	-0.306	-0.357	-0.460
90	M	0.133	0.105	0.042	-0.029	-0.084	-0.110	-0.101	-0.059	0.015	0.076	0.080	0.027	-0.079
	N	-0.099	-0.154	-0.274	-0.393	-0.475	-0.508	-0.500	-0.457	-0.383	-0.323	-0.319	-0.372	-0.478

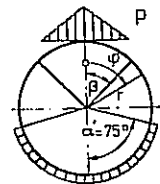
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.10.60

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Schnittkräfte am Kreisring
sectional forces at the circular ring



Lastfall
load case
2B.10.75

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width

Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial

β	ϕ	Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		120	135	150	165	180
		0	15	30	45	60	75	90	105					
15	M	0.048	0.027	0.001	-0.017	-0.027	-0.027	-0.018	0.001	0.017	0.022	0.015	-0.004	-0.034
	N	-0.053	-0.085	-0.111	-0.129	-0.139	-0.139	-0.129	-0.111	-0.095	-0.090	-0.097	-0.116	-0.146
30	M	0.076	0.051	0.006	-0.030	-0.049	-0.050	-0.033	0.002	0.033	0.042	0.027	-0.010	-0.066
	N	-0.100	-0.146	-0.212	-0.247	-0.267	-0.267	-0.250	-0.216	-0.184	-0.175	-0.190	-0.227	-0.284
45	M	0.090	0.065	0.012	-0.037	-0.065	-0.067	-0.044	0.004	0.047	0.058	0.037	-0.016	-0.096
	N	-0.137	-0.187	-0.280	-0.347	-0.375	-0.377	-0.354	-0.306	-0.263	-0.251	-0.273	-0.325	-0.406
60	M	0.096	0.071	0.016	-0.039	-0.073	-0.078	-0.051	0.006	0.058	0.071	0.043	-0.022	-0.120
	N	-0.162	-0.213	-0.318	-0.410	-0.456	-0.460	-0.433	-0.376	-0.325	-0.312	-0.339	-0.404	-0.503
75	M	0.098	0.073	0.018	-0.040	-0.077	-0.083	-0.054	0.008	0.065	0.078	0.047	-0.026	-0.136
	N	-0.176	-0.228	-0.337	-0.441	-0.502	-0.512	-0.483	-0.421	-0.364	-0.351	-0.382	-0.455	-0.565
90	M	0.098	0.074	0.018	-0.040	-0.078	-0.084	-0.055	0.009	0.067	0.080	0.048	-0.028	-0.142
	N	-0.180	-0.232	-0.344	-0.451	-0.515	-0.529	-0.500	-0.436	-0.378	-0.365	-0.397	-0.473	-0.587

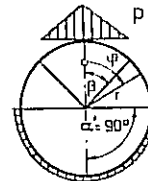
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.10.75

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Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | triangularly distributed surcharge any desired width
| load case |
| 2B.10.90 | Auflagergegendruck gleichförmig, radial
| | bedding reaction pressure uniform, radial
-----+

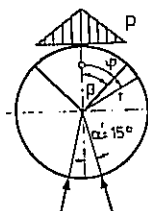
β		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force $N = n \cdot p \cdot r$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.037	0.017	-0.006	-0.020	-0.023	-0.017	0.000	0.017	0.024	0.020	0.006	-0.017	-0.047	
	N	-0.082	-0.113	-0.136	-0.149	-0.153	-0.146	-0.129	-0.113	-0.106	-0.109	-0.123	-0.146	-0.177	
30	M	0.054	0.032	-0.008	-0.035	-0.043	-0.030	0.002	0.033	0.046	0.039	0.012	-0.033	-0.092	
	N	-0.156	-0.200	-0.260	-0.287	-0.294	-0.282	-0.250	-0.218	-0.206	-0.213	-0.240	-0.285	-0.344	
45	M	0.059	0.037	-0.007	-0.044	-0.056	-0.039	0.005	0.049	0.065	0.054	0.015	-0.049	-0.133	
	N	-0.216	-0.263	-0.348	-0.403	-0.414	-0.397	-0.354	-0.310	-0.293	-0.305	-0.344	-0.407	-0.491	
60	M	0.058	0.037	-0.008	-0.048	-0.062	-0.043	0.009	0.061	0.080	0.065	0.016	-0.062	-0.166	
	N	-0.258	-0.307	-0.402	-0.479	-0.504	-0.485	-0.433	-0.381	-0.362	-0.377	-0.426	-0.504	-0.608	
75	M	0.056	0.035	-0.009	-0.050	-0.065	-0.045	0.012	0.069	0.089	0.071	0.016	-0.072	-0.187	
	N	-0.284	-0.332	-0.431	-0.517	-0.556	-0.540	-0.483	-0.426	-0.406	-0.424	-0.479	-0.567	-0.682	
90	M	0.055	0.035	-0.010	-0.050	-0.065	-0.045	0.014	0.072	0.093	0.074	0.017	-0.075	-0.194	
	N	-0.292	-0.340	-0.440	-0.530	-0.571	-0.558	-0.500	-0.442	-0.421	-0.440	-0.497	-0.589	-0.708	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

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LF 2B.10.90

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | triangularly distributed surcharge any desired width
| load case |
| 2B.11.15 | Zweiliniengedruck radial
| | two linear support, radial
-----+

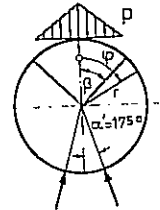
β		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$				
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.069	0.047	0.016	-0.010	-0.029	-0.041	-0.044	-0.038	-0.024	-0.002	0.025	0.057	0.021	
	N	-0.005	-0.039	-0.069	-0.095	-0.115	-0.126	-0.129	-0.124	-0.109	-0.088	-0.060	-0.028	-0.064	
30	M	0.117	0.089	0.035	-0.016	-0.054	-0.077	-0.084	-0.073	-0.046	-0.005	0.048	0.109	0.040	
	N	-0.008	-0.057	-0.132	-0.182	-0.220	-0.244	-0.250	-0.239	-0.213	-0.171	-0.118	-0.057	-0.126	
45	M	0.148	0.119	0.053	-0.017	-0.072	-0.105	-0.116	-0.102	-0.065	-0.008	0.067	0.152	0.055	
	N	-0.006	-0.061	-0.167	-0.255	-0.309	-0.343	-0.354	-0.340	-0.303	-0.245	-0.171	-0.085	-0.183	
60	M	0.167	0.137	0.066	-0.014	-0.082	-0.125	-0.139	-0.123	-0.080	-0.010	0.080	0.184	0.064	
	N	-0.002	-0.059	-0.180	-0.297	-0.376	-0.419	-0.433	-0.418	-0.374	-0.305	-0.215	-0.110	-0.230	
75	M	0.178	0.147	0.074	-0.012	-0.087	-0.135	-0.152	-0.136	-0.089	-0.012	0.087	0.203	0.070	
	N	0.002	-0.056	-0.183	-0.315	-0.413	-0.466	-0.483	-0.467	-0.419	-0.343	-0.244	-0.127	-0.261	
90	M	0.181	0.150	0.076	-0.011	-0.088	-0.139	-0.157	-0.141	-0.092	-0.013	0.090	0.210	0.071	
	N	0.004	-0.054	-0.184	-0.320	-0.423	-0.481	-0.500	-0.484	-0.435	-0.357	-0.254	-0.133	-0.272	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

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LF 2B.11.15

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | triangularly distributed surcharge any desired width
| load case |
| 2B.11.17,5 | Zweiliniengegendruck radial
|-----+ two linear support, radial

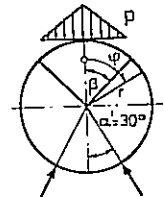
		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$						
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.068	0.046	0.015	-0.010	-0.029	-0.040	-0.043	-0.036	-0.022	0.000	0.028	0.049	0.012	
	N	-0.007	-0.041	-0.071	-0.097	-0.116	-0.127	-0.129	-0.123	-0.108	-0.086	-0.058	-0.038	-0.074	
30	M	0.115	0.088	0.033	-0.017	-0.054	-0.076	-0.081	-0.070	-0.042	0.000	0.054	0.093	0.023	
	N	-0.012	-0.061	-0.135	-0.185	-0.223	-0.245	-0.250	-0.236	-0.211	-0.168	-0.115	-0.076	-0.146	
45	M	0.145	0.116	0.051	-0.018	-0.072	-0.104	-0.113	-0.098	-0.059	-0.001	0.075	0.129	0.030	
	N	-0.012	-0.067	-0.172	-0.259	-0.312	-0.345	-0.354	-0.338	-0.300	-0.241	-0.166	-0.112	-0.211	
60	M	0.164	0.134	0.064	-0.016	-0.082	-0.123	-0.135	-0.118	-0.072	-0.002	0.089	0.155	0.034	
	N	-0.009	-0.066	-0.186	-0.302	-0.380	-0.421	-0.433	-0.416	-0.370	-0.300	-0.208	-0.143	-0.264	
75	M	0.174	0.143	0.071	-0.014	-0.086	-0.133	-0.148	-0.130	-0.081	-0.003	0.098	0.171	0.036	
	N	-0.006	-0.064	-0.190	-0.321	-0.417	-0.468	-0.483	-0.465	-0.415	-0.337	-0.237	-0.164	-0.299	
90	M	0.177	0.146	0.073	-0.013	-0.088	-0.136	-0.152	-0.134	-0.083	-0.003	0.101	0.176	0.036	
	N	-0.004	-0.062	-0.191	-0.326	-0.427	-0.483	-0.500	-0.482	-0.431	-0.351	-0.246	-0.171	-0.311	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.11.175

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Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | triangularly distributed surcharge any desired width
| load case |
| 2B.11.30 | Zweiliniengegendruck radial
|-----+ two linear support, radial

		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$					
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.060	0.038	0.009	-0.013	-0.029	-0.036	-0.034	-0.023	-0.004	0.021	0.052	0.008	-0.030		
	N	-0.024	-0.057	-0.086	-0.109	-0.124	-0.131	-0.129	-0.119	-0.100	-0.074	-0.044	-0.087	-0.125		
30	M	0.099	0.073	0.022	-0.023	-0.053	-0.068	-0.065	-0.044	-0.009	0.040	0.099	0.015	-0.058		
	N	-0.045	-0.093	-0.164	-0.208	-0.239	-0.253	-0.250	-0.230	-0.194	-0.145	-0.086	-0.171	-0.244		
45	M	0.123	0.095	0.035	-0.027	-0.071	-0.092	-0.089	-0.062	-0.012	0.056	0.139	0.019	-0.085		
	N	-0.059	-0.111	-0.212	-0.291	-0.336	-0.357	-0.354	-0.326	-0.277	-0.209	-0.126	-0.246	-0.350		
60	M	0.136	0.108	0.044	-0.027	-0.081	-0.108	-0.106	-0.074	-0.015	0.068	0.168	0.020	-0.107		
	N	-0.066	-0.121	-0.235	-0.343	-0.408	-0.435	-0.433	-0.401	-0.342	-0.259	-0.159	-0.307	-0.434		
75	M	0.143	0.115	0.049	-0.026	-0.086	-0.117	-0.116	-0.081	-0.016	0.075	0.186	0.020	-0.121		
	N	-0.069	-0.125	-0.245	-0.366	-0.448	-0.484	-0.483	-0.449	-0.384	-0.293	-0.182	-0.347	-0.489		
90	M	0.145	0.117	0.050	-0.026	-0.087	-0.120	-0.119	-0.084	-0.017	0.077	0.192	0.020	-0.126		
	N	-0.070	-0.126	-0.248	-0.373	-0.460	-0.500	-0.500	-0.465	-0.398	-0.304	-0.190	-0.361	-0.508		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.11.30

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		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$									
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180		
β																	
15	M	0.041	0.021	-0.004	-0.020	-0.027	-0.025	-0.013	0.008	0.037	0.071	0.013	-0.038	-0.078			
	N	-0.064	-0.096	-0.120	-0.137	-0.144	-0.142	-0.129	-0.108	-0.080	-0.046	-0.104	-0.154	-0.195			
30	M	0.063	0.040	-0.004	-0.036	-0.051	-0.046	-0.023	0.017	0.071	0.136	0.024	-0.074	-0.152			
	N	-0.122	-0.167	-0.230	-0.263	-0.277	-0.273	-0.250	-0.210	-0.156	-0.091	-0.203	-0.301	-0.378			
45	M	0.072	0.049	-0.001	-0.045	-0.067	-0.062	-0.030	0.025	0.101	0.191	0.032	-0.107	-0.217			
	N	-0.167	-0.216	-0.307	-0.368	-0.390	-0.385	-0.354	-0.298	-0.222	-0.132	-0.291	-0.430	-0.540			
60	M	0.074	0.051	0.000	-0.049	-0.076	-0.071	-0.034	0.032	0.123	0.233	0.038	-0.133	-0.268			
	N	-0.199	-0.249	-0.350	-0.437	-0.475	-0.470	-0.433	-0.367	-0.275	-0.165	-0.361	-0.532	-0.667			
75	M	0.074	0.051	0.000	-0.051	-0.080	-0.076	-0.036	0.037	0.138	0.260	0.041	-0.151	-0.301			
	N	-0.218	-0.268	-0.374	-0.471	-0.523	-0.523	-0.483	-0.410	-0.309	-0.188	-0.407	-0.598	-0.748			
90	M	0.074	0.051	0.000	-0.052	-0.081	-0.077	-0.036	0.039	0.143	0.268	0.041	-0.157	-0.313			
	N	-0.223	-0.274	-0.381	-0.481	-0.537	-0.540	-0.500	-0.425	-0.321	-0.196	-0.422	-0.621	-0.777			

LF 28.11.45

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		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$							
			0	15	30	45	60	75	90	105	120	135	150	165	180			
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180			
15	M	0.005	-0.012	-0.029	-0.032	-0.022	-0.001	0.036	0.079	0.127	0.045	-0.030	-0.091	-0.134				
	N	-0.149	-0.177	-0.194	-0.197	-0.187	-0.164	-0.129	-0.086	-0.038	-0.120	-0.195	-0.256	-0.299				
30	M	-0.007	-0.025	-0.052	-0.059	-0.039	0.005	0.070	0.152	0.246	0.086	-0.058	-0.176	-0.261				
	N	-0.285	-0.325	-0.372	-0.379	-0.359	-0.315	-0.250	-0.168	-0.074	-0.234	-0.378	-0.496	-0.581				
45	M	-0.027	-0.043	-0.069	-0.077	-0.051	0.010	0.101	0.217	0.348	0.121	-0.084	-0.251	-0.371				
	N	-0.399	-0.440	-0.507	-0.532	-0.506	-0.445	-0.354	-0.238	-0.107	-0.334	-0.538	-0.706	-0.826				
60	M	-0.048	-0.061	-0.084	-0.088	-0.056	0.017	0.127	0.267	0.427	0.147	-0.104	-0.310	-0.457				
	N	-0.483	-0.523	-0.596	-0.637	-0.616	-0.543	-0.433	-0.293	-0.134	-0.413	-0.664	-0.870	-1.017				
75	M	-0.062	-0.074	-0.094	-0.095	-0.058	0.023	0.144	0.299	0.476	0.163	-0.118	-0.348	-0.512				
	N	-0.534	-0.574	-0.648	-0.694	-0.681	-0.605	-0.483	-0.328	-0.151	-0.464	-0.745	-0.975	-1.139				
90	M	-0.067	-0.079	-0.097	-0.097	-0.058	0.025	0.150	0.310	0.493	0.169	-0.123	-0.361	-0.531				
	N	-0.551	-0.590	-0.665	-0.713	-0.701	-0.625	-0.500	-0.340	-0.158	-0.482	-0.773	-1.012	-1.181				

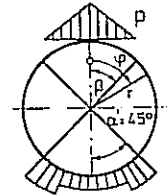
LF 2B-11-60

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Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
2B.12.45

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width
Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial



β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0.061	0.039	0.010	-0.013	-0.029	-0.036	-0.035	-0.025	-0.007	0.019	0.032	0.017	-0.011	
	N	-0.022	-0.055	-0.084	-0.107	-0.123	-0.131	-0.129	-0.119	-0.101	-0.076	-0.063	-0.077	-0.106	
30	M	0.101	0.075	0.023	-0.022	-0.053	-0.069	-0.067	-0.048	-0.013	0.035	0.060	0.032	-0.023	
	N	-0.040	-0.089	-0.160	-0.205	-0.237	-0.252	-0.250	-0.231	-0.196	-0.148	-0.123	-0.151	-0.207	
45	M	0.126	0.098	0.037	-0.025	-0.071	-0.093	-0.092	-0.066	-0.018	0.049	0.084	0.043	-0.035	
	N	-0.053	-0.105	-0.207	-0.287	-0.332	-0.355	-0.354	-0.328	-0.280	-0.213	-0.178	-0.219	-0.297	
60	M	0.140	0.112	0.047	-0.025	-0.081	-0.110	-0.109	-0.079	-0.022	0.059	0.101	0.050	-0.046	
	N	-0.059	-0.114	-0.229	-0.337	-0.404	-0.433	-0.433	-0.403	-0.346	-0.265	-0.223	-0.273	-0.369	
75	M	0.147	0.119	0.052	-0.024	-0.085	-0.119	-0.119	-0.087	-0.024	0.065	0.111	0.054	-0.053	
	N	-0.061	-0.117	-0.238	-0.360	-0.444	-0.482	-0.483	-0.451	-0.388	-0.299	-0.253	-0.309	-0.417	
90	M	0.150	0.121	0.054	-0.024	-0.087	-0.121	-0.123	-0.090	-0.025	0.067	0.114	0.055	-0.056	
	N	-0.061	-0.117	-0.240	-0.366	-0.456	-0.498	-0.500	-0.467	-0.403	-0.310	-0.263	-0.322	-0.433	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

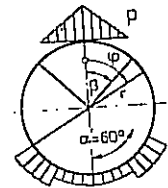
LF 2B.12.45

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Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
2B.12.60

Dreieckig verteilte Auflast beliebiger Breite
triangularly distributed surcharge any desired width
Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial



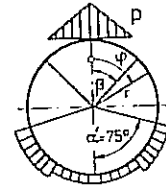
β		Biegemoment bending moment		$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$		105	120	135	150	165	180
		φ	0	15	30	45	60	75	90						
15	M	0.052	0.031	0.004	-0.016	-0.028	-0.031	-0.024	-0.009	0.014	0.029	0.021	-0.003	-0.034	
	N	-0.042	-0.074	-0.101	-0.121	-0.133	-0.136	-0.129	-0.114	-0.091	-0.076	-0.084	-0.109	-0.140	
30	M	0.084	0.059	0.011	-0.028	-0.051	-0.057	-0.045	-0.016	0.028	0.056	0.039	-0.008	-0.068	
	N	-0.079	-0.122	-0.194	-0.233	-0.256	-0.262	-0.250	-0.221	-0.177	-0.148	-0.165	-0.212	-0.272	
45	M	0.101	0.075	0.020	-0.034	-0.068	-0.078	-0.062	-0.022	0.039	0.078	0.054	-0.013	-0.098	
	N	-0.107	-0.158	-0.254	-0.326	-0.360	-0.369	-0.354	-0.314	-0.253	-0.213	-0.238	-0.305	-0.390	
60	M	0.110	0.084	0.026	-0.035	-0.077	-0.090	-0.073	-0.025	0.048	0.095	0.064	-0.018	-0.123	
	N	-0.126	-0.178	-0.287	-0.385	-0.438	-0.451	-0.433	-0.386	-0.312	-0.265	-0.296	-0.379	-0.483	
75	M	0.114	0.088	0.028	-0.036	-0.082	-0.097	-0.079	-0.027	0.054	0.105	0.070	-0.022	-0.139	
	N	-0.135	-0.189	-0.303	-0.413	-0.481	-0.502	-0.483	-0.431	-0.351	-0.299	-0.334	-0.427	-0.544	
90	M	0.115	0.089	0.029	-0.036	-0.083	-0.099	-0.080	-0.028	0.056	0.109	0.072	-0.024	-0.145	
	N	-0.138	-0.192	-0.307	-0.421	-0.494	-0.518	-0.500	-0.447	-0.364	-0.311	-0.348	-0.444	-0.565	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 2B.12.60

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Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | | triangularly distributed surcharge any desired width
| load case |
| 2B.12.75 | Auflagergegendruck stufenförmig, radial
| | bedding reaction pressure gradually shaped, radial

β		Biegemoment bending moment			$M = m \cdot p \cdot r^2$			Normalkraft axial force			$N = n \cdot p \cdot r$			
		φ	0	15	30	45	60	75	90	105	120	135	150	165
15	M	0.039	0.019	-0.005	-0.020	-0.026	-0.021	-0.007	0.016	0.033	0.030	0.007	-0.022	-0.055
	N	-0.072	-0.103	-0.127	-0.142	-0.148	-0.144	-0.129	-0.106	-0.089	-0.093	-0.115	-0.145	-0.177
30	M	0.059	0.036	-0.006	-0.036	-0.047	-0.039	-0.012	0.032	0.064	0.057	0.013	-0.044	-0.107
	N	-0.137	-0.182	-0.243	-0.274	-0.285	-0.277	-0.250	-0.206	-0.174	-0.181	-0.225	-0.282	-0.345
45	M	0.067	0.044	-0.004	-0.045	-0.062	-0.052	-0.015	0.046	0.091	0.079	0.017	-0.064	-0.154
	N	-0.189	-0.237	-0.325	-0.383	-0.401	-0.390	-0.354	-0.293	-0.248	-0.260	-0.322	-0.403	-0.493
60	M	0.068	0.045	-0.003	-0.046	-0.070	-0.059	-0.015	0.058	0.111	0.096	0.019	-0.081	-0.192
	N	-0.225	-0.275	-0.373	-0.455	-0.488	-0.477	-0.433	-0.360	-0.307	-0.322	-0.399	-0.499	-0.610
75	M	0.066	0.044	-0.004	-0.050	-0.073	-0.062	-0.014	0.066	0.124	0.106	0.019	-0.092	-0.216
	N	-0.247	-0.296	-0.399	-0.491	-0.537	-0.530	-0.483	-0.403	-0.345	-0.363	-0.449	-0.561	-0.685
90	M	0.066	0.044	-0.004	-0.051	-0.074	-0.062	-0.014	0.069	0.129	0.110	0.020	-0.096	-0.224
	N	-0.254	-0.303	-0.407	-0.503	-0.552	-0.548	-0.500	-0.417	-0.358	-0.377	-0.467	-0.583	-0.711

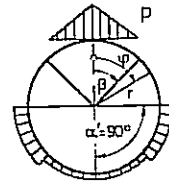
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B.12.75

Schnittkräfte am Kreisring
sectional forces at the circular ring



-----+ Dreieckig verteilte Auflast beliebiger Breite
| Lastfall | | triangularly distributed surcharge any desired width
| load case |
| 2B.12.90 | Auflagergegendruck stufenförmig, radial
| | bedding reaction pressure gradually shaped, radial

		Biegemoment bending moment			$M = m \cdot p \cdot r^2$		Normalkraft axial force		$N = n \cdot p \cdot r$						
β		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.022	0.004	-0.016	-0.024	-0.020	-0.005	0.021	0.042	0.043	0.025	-0.006	-0.040	-0.074	
	N	-0.117	-0.147	-0.166	-0.174	-0.171	-0.155	-0.129	-0.108	-0.107	-0.126	-0.156	-0.190	-0.224	
30	M	0.026	0.006	-0.027	-0.044	-0.037	-0.008	0.042	0.082	0.084	0.047	-0.013	-0.078	-0.144	
	N	-0.224	-0.266	-0.319	-0.335	-0.329	-0.300	-0.250	-0.210	-0.208	-0.245	-0.304	-0.370	-0.436	
45	M	0.019	0.000	-0.034	-0.056	-0.047	-0.007	0.061	0.117	0.118	0.065	-0.020	-0.112	-0.206	
	N	-0.312	-0.356	-0.432	-0.471	-0.462	-0.422	-0.354	-0.298	-0.297	-0.349	-0.435	-0.527	-0.621	
60	M	0.009	-0.008	-0.041	-0.062	-0.052	-0.005	0.078	0.145	0.145	0.079	-0.026	-0.140	-0.255	
	N	-0.377	-0.421	-0.504	-0.562	-0.563	-0.516	-0.433	-0.366	-0.366	-0.432	-0.537	-0.651	-0.767	
75	M	0.002	-0.015	-0.046	-0.066	-0.054	-0.001	0.090	0.163	0.162	0.087	-0.030	-0.158	-0.287	
	N	-0.416	-0.459	-0.545	-0.611	-0.622	-0.574	-0.483	-0.410	-0.411	-0.485	-0.603	-0.731	-0.860	
90	M	-0.001	-0.017	-0.048	-0.067	-0.054	0.000	0.094	0.169	0.168	0.090	-0.032	-0.165	-0.298	
	N	-0.429	-0.472	-0.559	-0.626	-0.639	-0.593	-0.500	-0.425	-0.426	-0.504	-0.626	-0.758	-0.892	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

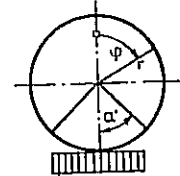
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 2B.12.90

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Eigengewicht
Lastfall | dead weight
load case |
3.8 | Auflagergegendruck rechteckig
-----+ bedding reaction pressure rectangular



α'		Biegemoment bending moment		M = m · s · γ _b · r ²		Normalkraft axial force		N = n · s · γ _b · r							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.489	0.439	0.297	0.086	-0.157	-0.388	-0.560	-0.624	-0.541	-0.286	0.155	0.770	1.127	
	N	0.478	0.394	0.152	-0.218	-0.668	-1.141	-1.571	-1.894	-2.053	-2.004	-1.723	-1.207	-0.478	
30	M	0.459	0.411	0.275	0.074	-0.156	-0.373	-0.529	-0.577	-0.480	-0.211	0.238	0.678	0.840	
	N	0.417	0.335	0.099	-0.261	-0.699	-1.157	-1.571	-1.878	-2.022	-1.961	-1.670	-0.756	-0.417	
45	M	0.419	0.374	0.247	0.059	-0.155	-0.351	-0.485	-0.512	-0.395	-0.109	0.259	0.538	0.642	
	N	0.333	0.254	0.027	-0.320	-0.740	-1.178	-1.571	-1.856	-1.980	-1.902	-1.138	-0.552	-0.333	
60	M	0.381	0.339	0.219	0.045	-0.151	-0.328	-0.440	-0.445	-0.308	-0.051	0.228	0.441	0.520	
	N	0.250	0.174	-0.045	-0.379	-0.782	-1.200	-1.571	-1.835	-1.939	-1.435	-0.862	-0.417	-0.250	
75	M	0.354	0.314	0.201	0.036	-0.147	-0.309	-0.406	-0.395	-0.259	-0.036	0.205	0.390	0.459	
	N	0.189	0.115	-0.098	-0.422	-0.812	-1.215	-1.571	-1.819	-1.627	-1.204	-0.715	-0.333	-0.189	
90	M	0.345	0.305	0.195	0.033	-0.145	-0.302	-0.393	-0.378	-0.247	-0.033	0.198	0.375	0.441	
	N	0.167	0.093	-0.117	-0.438	-0.824	-1.221	-1.571	-1.710	-1.533	-1.133	-0.668	-0.304	-0.167	

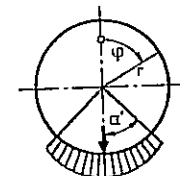
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 3. 8

Schnittkräfte am Kreisring
sectional forces at the circular ring

-----+ Eigengewicht
Lastfall | dead weight
load case |
3.9 | Auflagergegendruck cos-förmig, radial
-----+ bedding reaction pressure cos-shaped, radial



α'		Biegemoment bending moment			M = m · s · γ _b · r ²			Normalkraft axial force								N = n · s · γ _b · r			
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180				
15	M	0.489	0.439	0.297	0.086	-0.157	-0.388	-0.559	-0.623	-0.541	-0.285	0.155	0.771	1.123					
	N	0.477	0.393	0.152	-0.218	-0.668	-1.141	-1.571	-1.894	-2.052	-2.004	-1.722	-1.206	-0.888					
30	M	0.456	0.408	0.273	0.073	-0.156	-0.372	-0.525	-0.572	-0.474	-0.204	0.247	0.667	0.814					
	N	0.411	0.329	0.094	-0.265	-0.702	-1.158	-1.571	-1.876	-2.019	-1.956	-1.665	-1.344	-1.232					
45	M	0.406	0.362	0.237	0.054	-0.154	-0.344	-0.471	-0.490	-0.366	-0.075	0.265	0.493	0.573					
	N	0.306	0.227	0.003	-0.339	-0.754	-1.185	-1.571	-1.849	-1.967	-1.882	-1.701	-1.573	-1.528					
60	M	0.347	0.307	0.195	0.033	-0.148	-0.307	-0.401	-0.387	-0.232	0.003	0.211	0.352	0.401					
	N	0.177	0.103	-0.109	-0.430	-0.818	-1.219	-1.571	-1.816	-1.902	-1.874	-1.826	-1.784	-1.769					
75	M	0.295	0.260	0.160	0.016	-0.140	-0.269	-0.332	-0.287	-0.150	0.013	0.162	0.266	0.303					
	N	0.056	-0.013	-0.213	-0.516	-0.879	-1.250	-1.571	-1.785	-1.889	-1.933	-1.943	-1.939	-1.936					
90	M	0.273	0.240	0.145	0.011	-0.134	-0.250	-0.298	-0.250	-0.134	0.011	0.145	0.240	0.273					
	N	0.000	-0.068	-0.262	-0.555	-0.907	-1.264	-1.571	-1.782	-1.907	-1.970	-1.994	-2.000	-2.000					

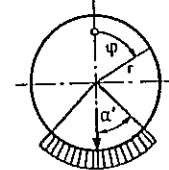
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 3. 9

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall Eigengewicht
load case dead weight
3.10 Auflagergegendruck gleichförmig, radial
 bedding reaction pressure uniform, radial



α'		Biegemoment bending moment			Normalkraft axial force										
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.489	0.439	0.297	0.086	-0.157	-0.388	-0.559	-0.623	-0.541	-0.285	0.155	0.771	1.121	
	N	0.477	0.393	0.151	-0.218	-0.668	-1.141	-1.571	-1.894	-2.052	-2.003	-1.722	-1.206	-0.891	
30	M	0.454	0.407	0.272	0.072	-0.156	-0.371	-0.524	-0.569	-0.470	-0.199	0.252	0.661	0.799	
	N	0.407	0.325	0.091	-0.268	-0.703	-1.159	-1.571	-1.875	-2.017	-1.954	-1.661	-1.352	-1.249	
45	M	0.396	0.353	0.230	0.050	-0.153	-0.339	-0.460	-0.474	-0.346	-0.050	0.269	0.460	0.524	
	N	0.285	0.208	-0.015	-0.354	-0.764	-1.191	-1.571	-1.844	-1.956	-1.868	-1.708	-1.616	-1.587	
60	M	0.314	0.277	0.172	0.021	-0.145	-0.287	-0.362	-0.329	-0.157	0.053	0.190	0.266	0.291	
	N	0.105	0.033	-0.171	-0.481	-0.855	-1.237	-1.571	-1.797	-1.866	-1.864	-1.886	-1.909	-1.918	
75	M	0.206	0.177	0.098	-0.013	-0.126	-0.207	-0.216	-0.118	0.005	0.066	0.089	0.094	0.094	
	N	-0.149	-0.212	-0.391	-0.661	-0.982	-1.303	-1.571	-1.732	-1.850	-1.996	-2.132	-2.227	-2.261	
90	M	0.071	0.054	0.010	-0.045	-0.086	-0.082	0.000	0.082	0.086	0.045	-0.010	-0.054	-0.071	
	N	-0.500	-0.551	-0.695	-0.909	-1.157	-1.394	-1.571	-1.748	-1.985	-2.233	-2.447	-2.591	-2.642	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

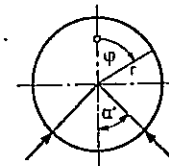
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LF 3.10

Schnittkräfte am Kreisring
sectional forces at the circular ring

für 13 fig 225

Lastfall Eigengewicht
load case dead weight
3.11 Zweiliniengegendruck radial
 two linear support, radial



		Biegemoment bending moment			Normalkraft axial force			N=n·s·γ _b ·r							
α'		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.465	0.417	0.280	0.077	-0.157	-0.377	-0.536	-0.587	-0.493	-0.228	0.220	0.841	0.764	
	N	0.430	0.347	0.110	-0.251	-0.692	-1.153	-1.571	-1.881	-2.029	-1.970	-1.681	-1.161	-1.272	
17.5	M	0.452	0.405	0.270	0.072	-0.157	-0.370	-0.522	-0.567	-0.467	-0.196	0.256	0.735	0.654	
	N	0.404	0.322	0.088	-0.270	-0.705	-1.160	-1.571	-1.875	-2.016	-1.952	-1.659	-1.279	-1.394	
30	M	0.352	0.312	0.198	0.032	-0.153	-0.317	-0.416	-0.408	-0.258	0.056	0.541	0.245	0.143	
	N	0.198	0.123	-0.091	-0.416	-0.808	-1.213	-1.571	-1.821	-1.913	-1.806	-1.480	-1.875	-2.011	
45	M	0.129	0.105	0.039	-0.050	-0.135	-0.183	-0.157	-0.023	0.243	0.657	0.069	-0.311	-0.442	
	N	-0.285	-0.343	-0.509	-0.757	-1.050	-1.338	-1.571	-1.696	-1.671	-1.464	-2.212	-2.691	-2.856	
60	M	-0.314	-0.303	-0.266	-0.191	-0.064	0.137	0.429	0.829	1.343	0.344	-0.447	-0.953	-1.128	
	N	-1.314	-1.337	-1.400	-1.484	-1.564	-1.604	-1.571	-1.430	-1.157	-2.363	-3.313	-3.919	-4.128	

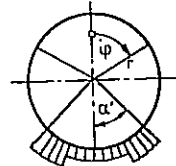
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

4/85

LF 3.11

Schnittkräfte am Kreisring
sectional forces at the circular ring

Lastfall
load case
3.12
 Eigengewicht
dead weight
 Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial



α'	φ	Biegemoment bending moment			Normalkraft axial force			Normalkraft axial force			Normalkraft axial force			Normalkraft axial force			Normalkraft axial force		
		0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255
30	M	0.442	0.395	0.263	0.068	-0.156	-0.365	-0.511	-0.551	-0.445	-0.170	0.286	0.622	0.686					
	N	0.382	0.302	0.069	-0.285	-0.716	-1.165	-1.571	-1.869	-2.005	-1.936	-1.640	-1.404	-1.374					
45	M	0.367	0.326	0.209	0.039	-0.152	-0.323	-0.429	-0.427	-0.284	0.024	0.297	0.355	0.365					
	N	0.225	0.150	-0.067	-0.396	-0.794	-1.206	-1.571	-1.828	-1.926	-1.825	-1.711	-1.753	-1.777					
60	M	0.257	0.224	0.131	0.000	-0.141	-0.253	-0.296	-0.232	-0.030	0.155	0.164	0.106	0.085					
	N	-0.018	-0.085	-0.277	-0.568	-0.916	-1.269	-1.571	-1.765	-1.805	-1.827	-1.977	-2.135	-2.190					
75	M	0.104	0.083	0.027	-0.047	-0.113	-0.138	-0.087	0.071	0.199	0.158	0.000	-0.122	-0.165					
	N	-0.380	-0.435	-0.591	-0.824	-1.097	-1.363	-1.571	-1.672	-1.785	-2.033	-2.350	-2.572	-2.649					
90	M	-0.107	-0.109	-0.110	-0.097	-0.049	0.059	0.252	0.386	0.322	0.097	-0.163	-0.336	-0.396					
	N	-0.930	-0.966	-1.067	-1.213	-1.372	-1.505	-1.571	-1.695	-2.000	-2.432	-2.851	-3.124	-3.219					

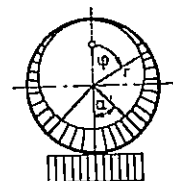
Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
 bending moment + M results in tension on internal pipe surface
 sign
 Normalkraft + N ergibt Zug
 axial force + N results in tension

LF 3.12

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Schnittkräfte am Kreisring
sectional forces at the circular ring

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown
 Lastfall
load case
4.8
 Auflagergegendruck rechteckig
bedding reaction pressure rectangular
 Wasseraußendruck bis Rohrscheitel mit umgekehrtem Vorzeichen
external water pressure up to pipe crown with opposite sign



α'	φ	Biegemoment bending moment			Normalkraft axial force			Normalkraft axial force			Normalkraft axial force			Normalkraft axial force			Normalkraft axial force		
		0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255
15	M	0.244	0.219	0.149	0.043	-0.078	-0.194	-0.280	-0.312	-0.271	-0.143	0.077	0.385	0.563					
	N	0.739	0.714	0.643	0.538	0.416	0.300	0.215	0.183	0.224	0.352	0.572	0.880	1.261					
30	M	0.229	0.206	0.138	0.037	-0.078	-0.187	-0.264	-0.288	-0.240	-0.106	0.119	0.339	0.420					
	N	0.708	0.684	0.617	0.516	0.401	0.292	0.215	0.190	0.239	0.373	0.598	1.105	1.292					
45	M	0.210	0.187	0.123	0.029	-0.077	-0.176	-0.243	-0.256	-0.197	-0.054	0.129	0.269	0.321					
	N	0.667	0.644	0.580	0.487	0.380	0.282	0.215	0.201	0.260	0.403	0.646	1.207	1.333					
60	M	0.190	0.169	0.110	0.023	-0.076	-0.164	-0.220	-0.223	-0.154	-0.025	0.114	0.221	0.260					
	N	0.625	0.604	0.544	0.457	0.359	0.271	0.215	0.212	0.281	0.436	1.002	1.275	1.375					
75	M	0.177	0.157	0.100	0.018	-0.074	-0.155	-0.203	-0.198	-0.130	-0.018	0.103	0.195	0.229					
	N	0.594	0.574	0.518	0.436	0.344	0.263	0.215	0.220	0.437	0.751	1.076	1.317	1.406					
90	M	0.172	0.153	0.097	0.017	-0.073	-0.151	-0.196	-0.189	-0.124	-0.017	0.099	0.187	0.220					
	N	0.583	0.564	0.508	0.428	0.338	0.260	0.215	0.274	0.484	0.787	1.099	1.331	1.417					

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneinnenseite
 bending moment + M results in tension on internal pipe surface
 sign
 Normalkraft + N ergibt Zug
 axial force + N results in tension

LF 4. 8

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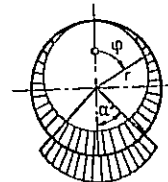
Schnittkräfte am Kreisring
sectional forces at the circular ring

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown

Lastfall
load case
4.9

Auflagergegendruck cos-förmig, radial
bedding reaction pressure cos-shaped, radial

Wasseraußendruck bis Rohrscheitel mit umgekehrtem Vorzeichen
external water pressure up to pipe crown with opposite sign



α'		Biegemoment bending force			Normalkraft axial force			$N = n \cdot \gamma_w \cdot r^2$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.244	0.219	0.148	0.043	-0.078	-0.194	-0.280	-0.312	-0.271	-0.143	0.078	0.385	0.561	
	N	0.739	0.714	0.643	0.538	0.416	0.300	0.215	0.183	0.224	0.352	0.572	0.880	1.056	
30	M	0.228	0.204	0.137	0.037	-0.078	-0.186	-0.263	-0.286	-0.237	-0.102	0.123	0.333	0.407	
	N	0.705	0.681	0.614	0.514	0.399	0.292	0.215	0.191	0.240	0.375	0.601	0.811	0.884	
45	M	0.203	0.181	0.118	0.027	-0.077	-0.172	-0.235	-0.245	-0.183	-0.037	0.133	0.246	0.286	
	N	0.653	0.631	0.568	0.477	0.373	0.278	0.215	0.205	0.267	0.412	0.583	0.696	0.736	
60	M	0.174	0.154	0.098	0.016	-0.074	-0.154	-0.200	-0.193	-0.116	0.002	0.105	0.176	0.201	
	N	0.588	0.569	0.513	0.431	0.341	0.261	0.215	0.221	0.299	0.417	0.520	0.591	0.616	
75	M	0.148	0.130	0.080	0.008	-0.070	-0.135	-0.166	-0.143	-0.075	0.007	0.081	0.133	0.151	
	N	0.528	0.510	0.460	0.389	0.311	0.246	0.215	0.237	0.306	0.387	0.462	0.513	0.532	
90	M	0.137	0.120	0.073	0.005	-0.067	-0.125	-0.149	-0.125	-0.067	0.005	0.073	0.120	0.137	
	N	0.500	0.483	0.436	0.369	0.297	0.238	0.215	0.238	0.297	0.369	0.436	0.483	0.500	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

LF 4.9

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Normalkraft + N ergibt Zug
axial force + N results in tension

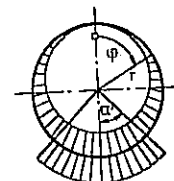
Schnittkräfte am Kreisring
sectional forces at the circular ring

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown

Lastfall
load case
4.10

Auflagergegendruck gleichförmig, radial
bedding reaction pressure uniform, radial

Wasseraußendruck bis Rohrscheitel mit umgekehrtem Vorzeichen
external water pressure up to pipe crown with opposite sign



α'		Biegemoment bending moment			Normalkraft axial force			$N = n \cdot \gamma_w \cdot r^2$							
		φ	0	15	30	45	60	75	90	105	120	135	150	165	180
15	M	0.244	0.219	0.148	0.043	-0.078	-0.194	-0.280	-0.312	-0.270	-0.142	0.078	0.386	0.560	
	N	0.739	0.714	0.643	0.537	0.416	0.300	0.215	0.183	0.224	0.352	0.572	0.880	1.055	
30	M	0.227	0.203	0.136	0.036	-0.078	-0.185	-0.262	-0.285	-0.235	-0.100	0.126	0.330	0.399	
	N	0.703	0.680	0.612	0.513	0.398	0.291	0.215	0.192	0.241	0.377	0.602	0.807	0.876	
45	M	0.198	0.176	0.115	0.025	-0.077	-0.169	-0.230	-0.237	-0.173	-0.025	0.135	0.230	0.262	
	N	0.643	0.621	0.560	0.470	0.368	0.275	0.215	0.207	0.272	0.420	0.579	0.675	0.707	
60	M	0.157	0.138	0.086	0.010	-0.073	-0.143	-0.181	-0.165	-0.078	0.026	0.095	0.133	0.145	
	N	0.552	0.534	0.481	0.406	0.323	0.252	0.215	0.231	0.317	0.422	0.490	0.529	0.541	
75	M	0.103	0.089	0.049	-0.006	-0.063	-0.103	-0.108	-0.059	0.003	0.033	0.044	0.047	0.047	
	N	0.425	0.411	0.371	0.316	0.259	0.219	0.215	0.264	0.325	0.355	0.367	0.369	0.369	
90	M	0.035	0.027	0.005	-0.023	-0.043	-0.041	0.000	0.041	0.043	0.023	-0.005	-0.027	-0.035	
	N	0.250	0.242	0.220	0.192	0.172	0.174	0.215	0.256	0.258	0.237	0.210	0.188	0.179	

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneenseite
sign bending moment + M results in tension on internal pipe surface

LF 4.10

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Normalkraft + N ergibt Zug
axial force + N results in tension

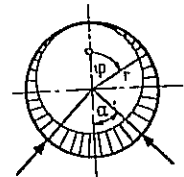
Schnittkräfte am Kreisring
sectional forces at the circular ring

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown

Lastfall
load case
4.11

Auflagergegendruck Zweiliniengegendruck, radial
bedding reaction pressure two linear support, radial

Wasseraußendruck bis Rohrscheitel mit umgekehrtem Vorzeichen
external water pressure up to pipe crown with opposite sign



		Biegemoment bending moment			$M = m \cdot \gamma_w \cdot r^3$		Normalkraft axial force		$N = n \cdot \gamma_w \cdot r^2$							
α'		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
15	M	0.233	0.208	0.140	0.038	-0.078	-0.188	-0.268	-0.294	-0.247	-0.114	0.110	0.420	0.382		
	N	0.715	0.691	0.622	0.521	0.404	0.294	0.215	0.189	0.236	0.369	0.592	0.903	0.864		
17.5	M	0.226	0.202	0.135	0.036	-0.078	-0.185	-0.261	-0.284	-0.234	-0.098	0.128	0.368	0.327		
	N	0.702	0.678	0.611	0.511	0.397	0.291	0.215	0.192	0.242	0.378	0.604	0.843	0.803		
30	M	0.176	0.156	0.099	0.016	-0.077	-0.159	-0.208	-0.204	-0.129	0.028	0.270	0.123	0.072		
	N	0.599	0.579	0.522	0.439	0.346	0.264	0.215	0.219	0.294	0.451	0.693	0.545	0.494		
45	M	0.064	0.052	0.020	-0.025	-0.068	-0.091	-0.078	-0.012	0.122	0.329	0.034	-0.155	-0.221		
	N	0.357	0.345	0.313	0.268	0.225	0.201	0.215	0.281	0.414	0.621	0.327	0.137	0.072		
60	M	-0.157	-0.151	-0.133	-0.096	-0.032	0.068	0.215	0.414	0.672	0.172	-0.223	-0.477	-0.564		
	N	-0.157	-0.151	-0.133	-0.096	-0.032	0.068	0.215	0.414	0.672	0.172	-0.223	-0.477	-0.564		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

LF 4.11

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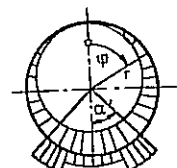
Schnittkräfte am Kreisring
sectional forces at the circular ring

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown

Lastfall
load case
4.12

Auflagergegendruck stufenförmig, radial
bedding reaction pressure gradually shaped, radial

Wasseraußendruck bis Rohrscheitel mit umgekehrtem Vorzeichen
external water pressure up to pipe crown with opposite sign



		Biegemoment bending moment			$M = m \cdot \gamma_w \cdot r^3$		Normalkraft axial force		$N = n \cdot \gamma_w \cdot r^2$							
α'		φ	0	15	30	45	60	75	90	105	120	135	150	165	180	
30	M	0.221	0.198	0.132	0.034	-0.078	-0.182	-0.256	-0.275	-0.223	-0.085	0.143	0.311	0.343		
	N	0.691	0.668	0.602	0.504	0.392	0.288	0.215	0.195	0.247	0.385	0.613	0.781	0.813		
45	M	0.184	0.163	0.105	0.019	-0.076	-0.161	-0.214	-0.214	-0.142	0.012	0.148	0.178	0.182		
	N	0.613	0.592	0.534	0.448	0.353	0.268	0.215	0.215	0.287	0.441	0.577	0.607	0.611		
60	M	0.128	0.112	0.066	0.000	-0.070	-0.126	-0.148	-0.116	-0.015	0.077	0.082	0.053	0.042		
	N	0.491	0.474	0.428	0.362	0.292	0.236	0.215	0.247	0.348	0.440	0.445	0.416	0.405		
75	M	0.052	0.041	0.013	-0.024	-0.057	-0.069	-0.043	0.036	0.099	0.079	0.000	-0.061	-0.082		
	N	0.310	0.299	0.271	0.234	0.201	0.189	0.215	0.294	0.357	0.337	0.258	0.197	0.176		
90	M	-0.054	-0.055	-0.055	-0.049	-0.025	0.029	0.126	0.193	0.161	0.049	-0.081	-0.168	-0.198		
	N	0.035	0.034	0.034	0.040	0.064	0.118	0.215	0.282	0.250	0.137	0.007	-0.079	-0.109		

Vorzeichen: Biegemoment + M ergibt Zug auf Rohrinneuseite
sign bending moment + M results in tension on internal pipe surface

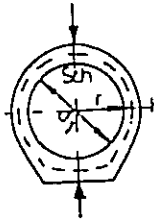
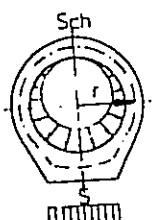
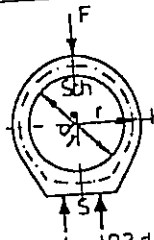
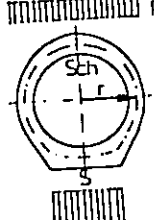
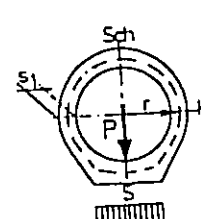
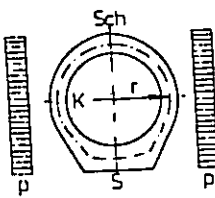
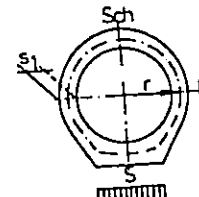
Normalkraft + N ergibt Zug
axial force + N results in tension

LF 4.12

4/85

Zusammenstellung:
Auswertung Biegemomente und Normalkräfte für kreisförmige Rohre mit Fuß, wandverstärkt, nach DIN 4032 KFW

Compilation:
Evaluation of bending moments and axial forces for circular pipes with base, wall strengthened according to DIN 4032 KFW

<p>Lastfall load case</p> <p>1</p>  <p>284</p>	<p>Lastfall load case</p> <p>5</p>  <p>Wasserfüllung water filling</p> <p>285</p>
<p>2</p>  <p>284</p>	<p>6</p>  <p>285</p>
<p>3</p>  <p>284</p>	<p>7</p>  <p>285</p>
<p>4</p>  <p>Eigengewicht dead weight</p> <p>284</p>	

Schnittkräfte am wandverstärkten Rohr mit Fuß DIN 4032 KFW
sectional forces at wall-thickened pipe with base DIN 4032 KFW

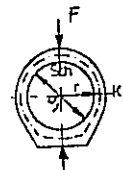
Lastfall
load case
1

Zweilinienbelastung
two linear loads

Biegemoment
bending moment $M = m \cdot F \cdot r$

Normalkraft
axial force $N = n \cdot F$

	Scheitel crown	Kämpfer springing line	Sohle invert
m \nearrow	0,30	- 0,13	0,46
n \nearrow	0,00	- 0,50	0,00



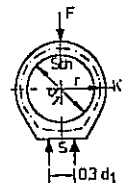
Lastfall
load case
2

Dreilinienbelastung
three linear loads

Biegemoment
bending moment $M = m \cdot F \cdot r$

Normalkraft
axial force $N = n \cdot F$

	Scheitel crown	Kämpfer springing line	Sohle invert
m \nearrow	0,30	- 0,13	0,29
n \nearrow	~ 0,00	- 0,50	~ 0,00



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am wandverstärkten Rohr mit Fuß DIN 4032 KFW
sectional forces at wall-thickened pipe with base DIN 4032 KFW

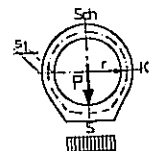
Lastfall
load case
3

Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Biegemoment
bending moment $M = m \cdot F \cdot r$

Normalkraft
axial force $N = n \cdot F$

	Scheitel crown	Kämpfer springing line	Sohle invert
m \nearrow	- 0,006	0,005	- 0,140
n \nearrow	0,00	0,00	0,00



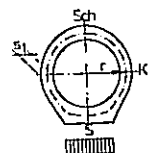
Lastfall
load case
4

Eigengewicht / Auflagergegendruck rechteckig
dead weight / bedding reaction pressure rectangular

Biegemoment
bending moment $M = m \cdot s_1 \cdot \gamma_b \cdot r^2$

Normalkraft
axial force $N = n \cdot s_1 \cdot \gamma_b \cdot r$

	Scheitel crown	Kämpfer springing line	Sohle invert
m \nearrow	0,39	- 0,40	1,24
n \nearrow	0,17	- 1,51	- 0,20



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am wandverstärkten Rohr mit Fuß DIN 4032 KFW
sectional forces at wall-thickened pipe with base DIN 4032 KFW

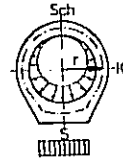
Lastfall
load case
5

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Biegemoment
bending moment $M = m \cdot \gamma_w \cdot r^3$

Normalkraft
axial force $N = n \cdot \gamma_w \cdot r^2$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	0,20	- 0,20	0,66
n N	0,61	0,23	1,49



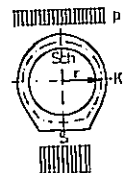
Lastfall
load case
6

Rechteckig verteilte Auflast /
rectangularly distributed surcharge / Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	0,25	- 0,21	0,56
n N	~ 0,00	- 1,00	~ 0,00



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am wandverstärkten Rohr mit Fuß DIN 4032 KFW
sectional forces at wall-thickened pipe with base DIN 4032 KFW

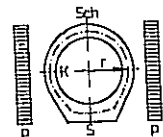
Lastfall
load case
7

Seitlicher Erddruck rechteckig
lateral earth pressure rectangular

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	- 0,25	0,20	- 0,45
n N	- 0,94	0,00	- 1,12



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Zusammenstellung:
Auswertung Biegemomente und Normalkräfte für eiförmige Rohre nach DIN 4042

Compilation:
Evaluation of bending moments and axial forces for oval pipes according to DIN 4042

<p>Lastfall load case</p> <p>1</p> <p>287</p>	<p>Lastfall load case</p> <p>7</p> <p>Eigengewicht dead weight</p> <p>288</p>	<p>Lastfall load case</p> <p>13</p> <p>Wasserinnen- druck internal water pressure</p> <p>290</p>
<p>2</p> <p>287</p>	<p>8</p> <p>Wasserfüllung water filling</p> <p>288</p>	<p>14</p> <p>290</p>
<p>3</p> <p>287</p>	<p>9</p> <p>Wasseraußen- druck external water pressure</p> <p>289</p>	<p>15</p> <p>290</p>
<p>4</p> <p>287</p>	<p>10</p> <p>Wasseraußen- druck external water pressure</p> <p>289</p>	<p>16</p> <p>290</p>
<p>5</p> <p>Eigengewicht dead weight</p> <p>288</p>	<p>11</p> <p>Wasserfüllung water filling</p> <p>289</p>	<p>17</p> <p>291</p>
<p>6</p> <p>Eigengewicht dead weight</p> <p>288</p>	<p>12</p> <p>Wasseraußen- druck external water pressure</p> <p>289</p>	

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

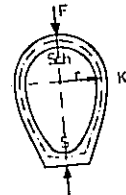
Lastfall
load case
1

Zweilinielenbelastung
two linear loads

Biegemoment $M = m \cdot F \cdot r$
bending moment

Scheitel
crown
0,36
- 0,02

Normalkraft $N = n \cdot F$
axial force
Kämpfer
springing line
- 0,12
- 0,50
Sohle
invert
0,42
0,02



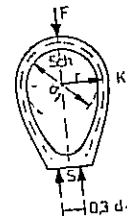
Lastfall
load case
2

Dreilinielenbelastung
three linear loads

Biegemoment $M = m \cdot F \cdot r$
bending moment

Scheitel
crown
0,36
- 0,03

Normalkraft $N = n \cdot F$
axial force
Kämpfer
springing line
- 0,12
- 0,50
Sohle
invert
0,25
0,03



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

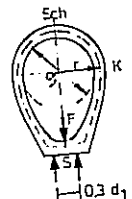
Lastfall
load case
3

Zweiliniengegendruck
two linear support

Biegemoment $M = m \cdot F \cdot r$
bending moment

Scheitel
crown
- 0,01
- 0,01

Normalkraft $N = n \cdot F$
axial force
Kämpfer
springing line
0,00
0,00
Sohle
invert
- 0,18
- 0,01



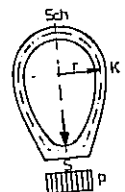
Lastfall
load case
4

Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Biegemoment $M = m \cdot p \cdot r^2$
bending moment

Scheitel
crown
- 0,003
- 0,005

Normalkraft $N = n \cdot p \cdot r$
axial force
Kämpfer
springing line
0,000
0,000
Sohle
invert
- 0,127
0,005



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

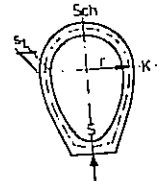
Lastfall
load case
5

Eigengewicht
dead weight
Linienlagerung
linear support

Biegemoment $M = m \cdot \gamma_b \cdot s_1 \cdot r^2$
bending moment

		Scheitel crown	Kämpfer springing line	Normalkraft axial force
m	M	0,64	- 0,34	Sohle invert 2,78
n	N	0,29	- 1,67	- 0,29

Normalkraft $N = n \cdot \gamma_b \cdot s_1 \cdot r$
axial force



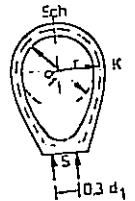
Lastfall
load case
6

Eigengewicht
dead weight
Zweiliniengegendruck
two linear support

Biegemoment $M = m \cdot s_1 \cdot \gamma_b \cdot r^2$
bending moment

		Scheitel crown	Kämpfer springing line	Normalkraft axial force
m	M	0,59	- 0,32	Sohle invert 1,07
n	N	0,22	- 1,67	- 0,22

Normalkraft $N = n \cdot s_1 \cdot \gamma_b \cdot r$
axial force



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

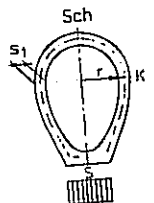
Lastfall
load case
7

Eigengewicht
dead weight
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Biegemoment $M = m \cdot \gamma_b \cdot s_1 \cdot r^2$
bending moment

		Scheitel crown	Kämpfer springing line	Normalkraft axial force
m	M	0,62	- 0,34	Sohle invert 1,66
n	N	0,24	- 1,67	- 0,24

Normalkraft $N = n \cdot \gamma_b \cdot s_1 \cdot r$
axial force



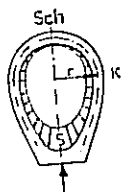
Wasserfüllung bis Rohrscheitel
water filling up to pipe crown

Lastfall
load case
8

Biegemoment $M = m \cdot \gamma_w \cdot r^3$
bending moment

		Scheitel crown	Kämpfer springing line	Normalkraft axial force
m	M	0,62	- 0,33	Sohle invert 2,54
n	N	1,15	0,25	3,26

Normalkraft $N = n \cdot \gamma_w \cdot r^2$
axial force



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

Lastfall
load case
9

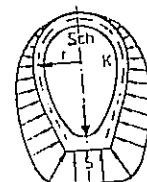
Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

Wasseraußendruck bis Rohrscheitel (Stützung an der Sohle)
external water pressure up to pipe crown (bedding invert)

Biegemoment
bending moment $M = m \cdot \gamma_w \cdot r^3$

Normalkraft
axial force $N = n \cdot \gamma_w \cdot r^2$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	- 0,62	0,33	- 2,54
n N	- 1,15	- 0,25	- 3,26



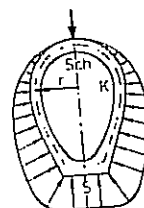
Lastfall
load case
10

Wasseraußendruck bis Rohrscheitel (Stützung im Scheitel)
external water pressure up to pipe crown (bedding on top)

Biegemoment
bending moment $M = m \cdot \gamma_w \cdot r^3$

Normalkraft
axial force $N = n \cdot \gamma_w \cdot r^2$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	0,64	- 0,21	- 0,61
n N	- 1,25	- 2,54	- 3,17



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Lastfall
load case
11

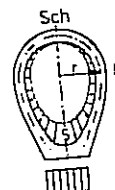
Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

Wasserfüllung bis Rohrscheitel
water filling up to pipe crown
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Biegemoment
bending moment $M = m \cdot \gamma_w \cdot r^3$

Normalkraft
axial force $N = n \cdot \gamma_w \cdot r^2$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	0,61	- 0,33	2,00
n N	1,13	0,25	3,28



Wasseraußendruck bis Rohrscheitel (Stützung in der Sohle)
external water pressure up to pipe crown (bedding invert)

Biegemoment
bending moment $M = m \cdot \gamma_w \cdot r^3$

Normalkraft
axial force $N = n \cdot \gamma_w \cdot r^2$

	Scheitel crown	Kämpfer springing line	Sohle invert
m M	- 0,61	0,33	- 2,00
n N	- 1,13	- 0,25	- 3,28



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

Wasserinnendruck

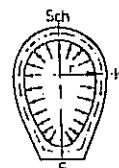
internal water pressure

Lastfall
load case
13

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

		Scheitel crown	Kämpfer springing line	Sohle invert
m	M	0,23	- 0,12	0,68
n	N	1,34	1,01	1,64



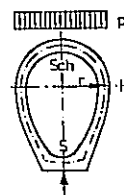
Rechteckig verteilte Auflast
rectangularly distributed surcharge

Lastfall
load case
14

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

		Scheitel crown	Kämpfer springing line	Sohle invert
m	M	0,34	- 0,18	0,77
n	N	0,02	- 0,99	- 0,02



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

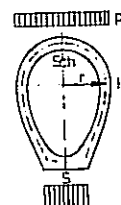
Rechteckig verteilte Auflast
rectangularly distributed surcharge
Auflagergegendruck rechteckig
bedding reaction pressure rectangular

Lastfall
load case
15

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

		Scheitel crown	Kämpfer springing line	Sohle invert
m	M	0,34	- 0,18	0,54
n	N	0,02	- 0,99	- 0,02



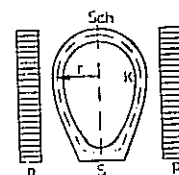
Seitlicher Erddruck rechteckig
lateral earth pressure rectangular

Lastfall
load case
16

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

		Scheitel crown	Kämpfer springing line	Sohle invert
m	M	- 0,54	0,31	- 1,05
n	N	- 1,32	- 0,01	- 1,65



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface
Normalkraft + N ergibt Zug
axial force + N results in tension

Schnittkräfte am eiförmigen Rohr DIN 4032 EF
sectional forces at egg-shaped pipe DIN 4032 EF

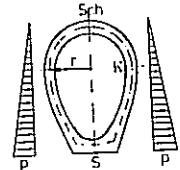
Seitlicher Erddruck dreieckförmig
lateral earth pressure triangular

Lastfall
load case
17

Biegemoment
bending moment $M = m \cdot p \cdot r^2$

Normalkraft
axial force $N = n \cdot p \cdot r$

		Scheitel crown	Kämpfer springing line	Sohle invert
m	M	- 0,19	0,11	- 0,56
n	N	- 0,35	- 0,01	- 1,06



Vorzeichen: Biegemoment + M ergibt Zug auf Rohrrinnenseite
sign bending moment + M results in tension on internal pipe surface

Normalkraft + N ergibt Zug
axial force + N results in tension