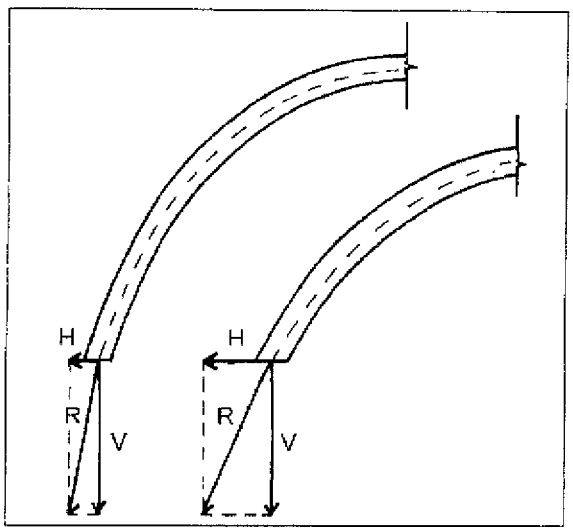
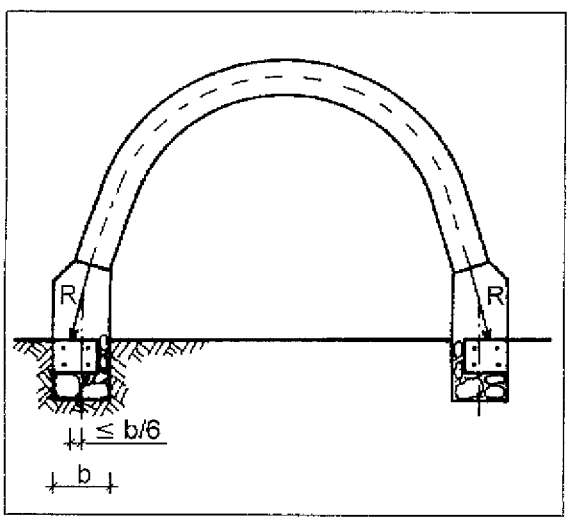


14-1 Resultant forces and their components (Minke 2000)

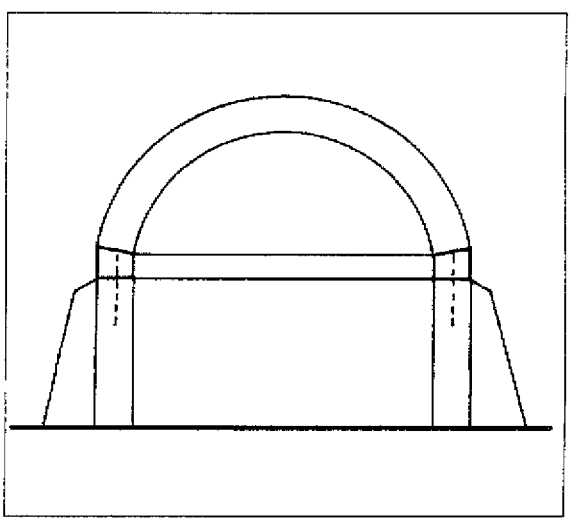
14. Domes

The problem with the structural design of domes is the stress transfer to the foundation. The inclined thrust force can be divided into a horizontal and a vertical component, see Fig. 14-1. The steeper the thrust (resultant), the smaller the horizontal component.

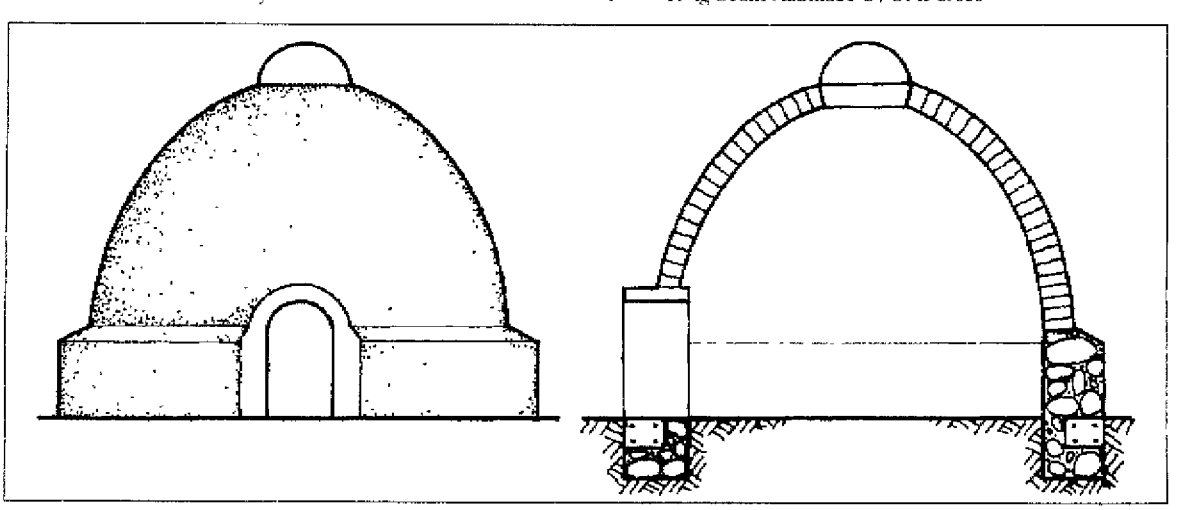
The support of a dome must be a circular horizontal ring of reinforced cement concrete, steel or possibly also timber, and it must be able to take the horizontal forces of the dome. The joint between dome and plinth or foundation must be inclined in order to resist the horizontal seismic movement, see Figs. 14-2 and 14-3. Because of the heavy weight of a dome, high ring beams and walls need to be stabilized by buttresses and the



14-2 Allowable eccentricity



14-3 Ring beam stabilized by buttresses



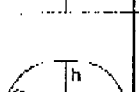
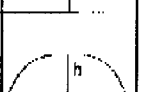
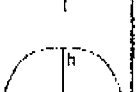
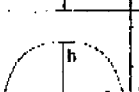
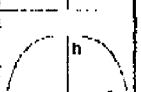
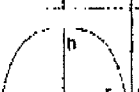
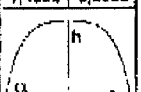
14-4 Stabilization of dome entrance

joint of ring beam and wall must be able to transfer large horizontal forces, see Fig. 14-3.

If the dome rests directly on a low plinth, the structure is much more stable in an earthquake, see Fig. 14-2. In this case the foundation has to act as horizontal ring beam, and is usually built of reinforced cement concrete. It is important to check that the resultant force of the dome stays within the center third of the width of the plinth measured above the ring beam, i.e. the eccentricity must not be more than 1/6 of the base.

If the dome starts above a plinth, it must be taken into account that openings like doors and windows destabilize the dome structure. Therefore the tops of door and windows must be designed as vaults which penetrate the dome and are able to transfer the stresses from the dome to their sides, see Fig. 14-4.

An earthquake-resistant dome must have a certain section, which guarantees that all forces are transferred vertically to the foundation without creating tensile or compressive ring forces. The resultant forces must always be within the center

Nr.	y	x	y	x	y	x	y	x	y	x	y	x	y	x
1	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000
2	0,0452	0,9854	0,0454	0,9875	0,0479	0,9885	0,0470	0,9902	0,0472	0,9912	0,0494	0,9918	0,0499	0,9929
3	0,0973	0,9674	0,0982	0,9720	0,1013	0,9750	0,1007	0,9783	0,1016	0,9807	0,1036	0,9823	0,1013	0,9844
4	0,1469	0,9483	0,1508	0,9586	0,1544	0,9608	0,1543	0,9658	0,1555	0,9696	0,1578	0,9724	0,1556	0,9755
5	0,2001	0,9279	0,2030	0,9381	0,2073	0,9456	0,2077	0,9520	0,2093	0,9579	0,2118	0,9620	0,2098	0,9662
6	0,2506	0,9061	0,2548	0,9105	0,2600	0,9295	0,2610	0,9380	0,2629	0,9456	0,2657	0,9511	0,2640	0,9565
7	0,3005	0,8827	0,3061	0,8998	0,3123	0,9124	0,3139	0,9237	0,3164	0,9328	0,3196	0,9396	0,3180	0,9462
8	0,3495	0,8575	0,3569	0,8782	0,3642	0,8940	0,3667	0,9079	0,3697	0,9188	0,3732	0,9274	0,3720	0,9354
9	0,3974	0,8303	0,4069	0,8552	0,4158	0,8744	0,4191	0,8911	0,4227	0,9041	0,4267	0,9145	0,4258	0,9241
10	0,4441	0,8011	0,4562	0,8305	0,4666	0,8533	0,4711	0,8730	0,4755	0,8885	0,4800	0,9008	0,4795	0,9121
11	0,4893	0,7695	0,5043	0,8038	0,5167	0,8306	0,5226	0,8536	0,5280	0,8718	0,5331	0,8863	0,5331	0,8993
12	0,5327	0,7355	0,5513	0,7749	0,5660	0,8060	0,5736	0,8328	0,5800	0,8540	0,5859	0,8708	0,5864	0,8856
13	0,5738	0,6987	0,5967	0,7436	0,6143	0,7795	0,6239	0,8103	0,6316	0,8347	0,6384	0,8542	0,6396	0,8714
14	0,6124	0,6592	0,6402	0,7097	0,6613	0,7507	0,6733	0,7860	0,6827	0,8140	0,6905	0,8364	0,6924	0,8551
15	0,6479	0,6170	0,6815	0,6731	0,7067	0,7194	0,7217	0,7590	0,7330	0,7917	0,7422	0,8173	0,7450	0,8397
16	0,6799	0,5721	0,7200	0,6337	0,7502	0,6865	0,7688	0,7309	0,7825	0,7674	0,7932	0,7966	0,7971	0,8220
17	0,7081	0,5246	0,7554	0,5913	0,7913	0,6407	0,8143	0,6998	0,8309	0,7411	0,8436	0,7743	0,8468	0,8030
18	0,7322	0,4750	0,7872	0,5462	0,8296	0,8090	0,8578	0,6658	0,8790	0,7124	0,8930	0,7500	0,8999	0,7825
19	0,7522	0,4235	0,8149	0,4984	0,8646	0,5663	0,8988	0,6290	0,9234	0,6811	0,9414	0,7235	0,9503	0,7602
20	0,7680	0,3707	0,8384	0,4485	0,8957	0,5207	0,9369	0,5891	0,9687	0,6470	0,9883	0,6947	0,9998	0,7360
21	0,7801	0,3166	0,8576	0,3967	0,9227	0,4725	0,9716	0,5461	1,0076	0,6089	1,0330	0,6632	1,0482	0,7096
22	0,7887	0,2624	0,8725	0,3436	0,9452	0,4221	1,0023	0,5002	1,0403	0,5696	1,0767	0,6287	1,0951	0,6807
23	0,7944	0,2076	0,8836	0,2896	0,9633	0,3700	1,0286	0,4517	1,0705	0,5282	1,1172	0,5912	1,1403	0,6491
24	0,7978	0,1526	0,8912	0,2350	0,9771	0,3165	1,0504	0,4009	1,1005	0,4789	1,1544	0,5505	1,1830	0,6145
25	0,7994	0,0975	0,8961	0,1801	0,9870	0,2623	1,0675	0,3485	1,1350	0,4309	1,1879	0,5065	1,2236	0,5768
26	0,8000	0,0425	0,8987	0,1251	0,9936	0,2075	1,0804	0,2948	1,1557	0,3798	1,2170	0,4586	1,2606	0,5358
27	0,8000	0,0000	0,8998	0,0700	0,9974	0,1526	1,0894	0,2404	1,1719	0,3270	1,2415	0,4101	1,2933	0,4915
28			0,9000	0,0000	0,9993	0,0975	1,0951	0,1856	1,1836	0,2731	1,2611	0,3585	1,3222	0,4443
29					0,9999	0,0425	1,0983	0,1306	1,1916	0,2185	1,2761	0,3064	1,3459	0,3944
30					1,0000	0,0000	1,0997	0,0755	1,1965	0,1638	1,2867	0,2513	1,3648	0,3425
31							1,1000	0,0205	1,1990	0,1086	1,2936	0,1966	1,3789	0,2882
32							1,1000	0,0000	1,1999	0,0535	1,2978	0,1416	1,3887	0,2349
33									1,2000	0,0000	1,2995	0,0865	1,3949	0,1801
34											1,3000	0,0315	1,3993	0,1251
35											1,3000	0,0000	1,3997	0,0700
36													1,4000	0,0150
37													1,4000	0,0000
														
	h = 0,8 r		h = 0,9 r		h = 1,0 r		h = 1,1 r		h = 1,2 r		h = 1,3 r		h = 1,4 r	
α	72,6	Grad	75,0	Grad	76,9	Grad	78,5	Grad	79,7	Grad	00,7	Grad	81,6	Grad
A	5,3374	r²	5,7789	r²	6,2195	r²	6,6941	r²	7,1685	r²	7,6426	r²	8,1514	r²
V	16,1064	r³	18,7911	r³	20,4262	r³	22,8921	r³	24,9307	r³	27,1455	r³	29,5145	r³

14-7
Dome coordinates for 7 different proportions (Minke 2000)