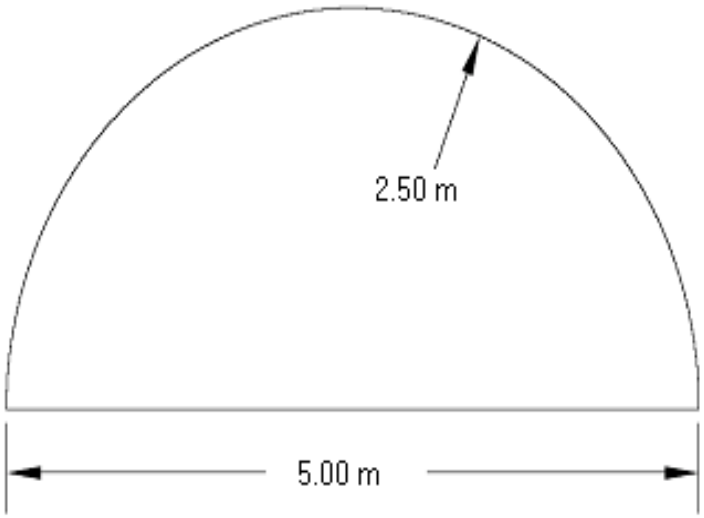
2 - **Semi-circle dome .**

Geometry:

From the drawing given by the architectural engineer we get:
Take thickness t =10cm
R = 2.5 m



Calculation of Loads:

A - Dead load:
Selfweight=0.10×25=2.5KN/m^2
plastering 2cm each side
Plastering=0.04×20=0.8KN/m^2
Dead Load=2.5+0.8=3.3KN/m^2

B - Snow load:
According to the Jordanian code the snow load = 1KN/m^2

Total load W = 3.3 + 1 = 4.3KN/m^2

C - Concentrated load due to the chandelier:
Assume the weight of the chandelier (P_C) = 2.5 KN

Analysis:

calculate the meridian and hoop stresses on the dome:

A - Meridian stresses: $N\varphi=-W\times R\times K_1+\left(\frac{P_C}{R}\right)\times K_3$

B - Hoop stresses: $N\theta=-W\times R\times K_2-\left(\frac{P_C}{R}\right)\times K_3$

Where:

$K_1=\frac{1-\cos\theta}{\sin^2\theta}$, $K_2=\frac{\cos^2\theta+\cos\theta-1}{1+\cos\theta}$, $K_3=\frac{\operatorname{cosec}^2\theta}{2\pi}$

Calculation of K_1 , K_2 , K_3

Angle	K_1	K_2	K_3
0	**0.500**	**0.500**	**---**
10	**0.505**	**0.480**	**5.300**
20	**0.516**	**0.425**	**1.370**
30	**0.537**	**0.330**	**0.640**
40	**0.566**	**0.200**	**0.380**
50	**0.608**	**0.034**	**0.270**
60	**0.667**	**-0.167**	**0.210**
70	**0.747**	**-0.402**	**0.180**
80	**0.838**	**-0.680**	**0.160**
90	**1.000**	**-1.000**	**0.160**

Calculation of the meridian and hoop stresses:

Angle(º)	Meridian stresses NØ(KN/m')	Hoop stresses Nθ (KN/m')
0	**---**	**---**
10	**-0.129**	**-10.46**
20	**-4.177**	**-5.94**
30	**-5.133**	**-4.188**
40	**-5.71**	**-2.53**
50	**-6.27**	**-0.636**
60	**-6.96**	**1.59**
70	**-7.85**	**4.14**
80	**-8.85**	**7.15**
90	**-11.6**	**10.59**

Maximum meridian stress NØ = -11.6 KN/m (compression stress)
Maximum hoop stress Nθ = 10.59 KN/m (tensile stress) at 90^o

$$N\varphi = \frac{-11.6}{t} = \frac{-11.6}{0.10} = -116.0 KN/m^2 = -0.1043 N/mm^2$$

$$N\theta = \frac{10.59}{t} = \frac{10.59}{0.10} = 105.9 KN/m^2 = 0.1059 N/mm^2$$

Check for maximum tensile strength of concrete
$T_c = 10\% \times 0.4 \times f_c^{'} = 0.1 \times 0.4 \times 25 = 1 N/mm^2 > 0.1059 N/mm^2$

Because the maximum tensile strength of concrete is greater than maximum hoop stress, only nominal reinforcement of 0.2% is provided.

Design of steel :
$A_s = 0.2\% \times t \times 1m = 0.002 \times 100 \times 1000 = 200 mm^2/m$
Use Ø8

$$\#\ of\ bars/m = \frac{A_s}{Area\ of\ \varphi 8\ bar} = \frac{200}{50} = 4\ bars/m$$

$$Spacing = \frac{1000mm}{4bar} = 250mm$$

Provide Ø8@250mm c/c (hoop direction)

Provide Ø8@250mm c/c (meridian direction)