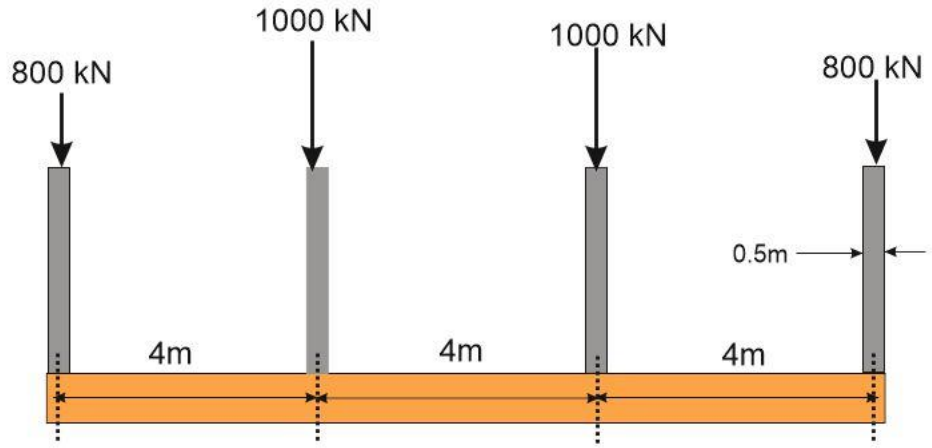
Continuous footing design

A continuous footing imposed by 4 columns a, b, c and d, are loaded with 800 KN, 1000 kN, 1000 kN and 800 kN respectively with 4 m CC. The dimensions of each column are (500mm*500mm). The Allowable B.C is 200 kN/m^2. $f_C = 35\ Mpa, f_y = 450\ Mpa$. A full design is required.



Solution

$$A = \frac{Q}{q_{all}} = \frac{Q_1+Q_2+Q_3+Q_4}{q_{all}}$$

$$A = \frac{800+1000+1000+800}{200} = 18\ m^2$$

$$18 = B * 12.5$$

B = 1.44 m

Let $L = 12 + 0.25 + 0.25 = 12.5m$

$$B = \frac{A}{L} = \frac{18}{12.5} = 1.44\ m,$$

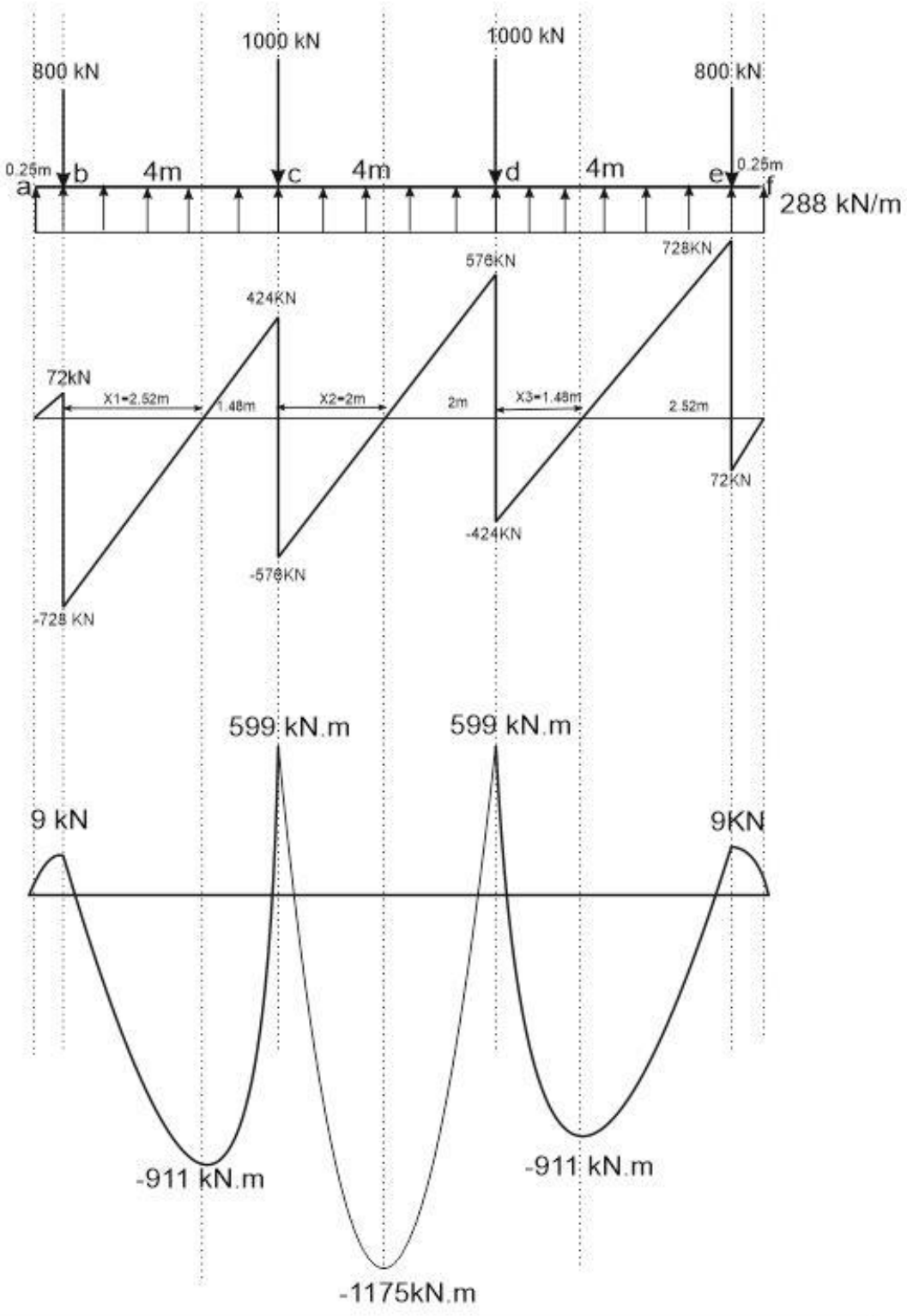
Soil reaction check

Since the resultant is acting at the center of the footing, we can normally estimate the soil reaction as follows:-

$$q = \frac{3600}{12.5*1.44} = 200\ kN/m2$$ **o.k**

$$q = 200kN/m2\ * 1.44\text{m} = 288\ kN/m$$

Estimation of Shear and bending moment diagrams



$M_{0-0.25}$

$M_b = 288\frac{x^2}{2} = 288\frac{0.25^2}{2} = 9KN.m$

$M_{0.25-4.25}$

$$M_{at\ zero\ shear} = 288\frac{x^2}{2} - 800(x - 0.25)$$

$$M_{at\ zero\ shear} = 288\frac{(2.52+0.25)^2}{2} - 800(0.25 + 2.52 - 0.25) = -911.1kN.m$$

$$M_C = 288\frac{x^2}{2} - 800(x - 0.25) = 288\frac{4.25^2}{2} - 800 * (4.25 - 0.25) = -599\ kn.m$$

$M_{4.25-8.25}$

$$M_{at\ zero\ shear} = 288\frac{x^2}{2} - 800(x - 0.25) - 1000(x - 4.25)$$

$$M_{at\ zero\ shear} = 288\frac{(6.25)^2}{2} - 800(6.26 - 0.25) - 1000(6.25 - 4.25) = -1175kN.m$$

Determination of footing Thickness

$$U = b_o d\emptyset(0.34) * 1000\sqrt{f'_C}$$

$$1000 = 4(0.5 + d)d * 0.85 * (0.34) * 1000\sqrt{35}$$

$0.5848 = (0.5 + d)d$, d = 0.55 m,

Punching check

$$V_{max\ punching} = 0.33\sqrt{fc} = 0.33\sqrt{35} = 1.93\ Mpa$$

$$V_{punching} = \frac{U}{b_o d} = \frac{1000/1000}{4(0.5+0.55)0.55} = 0.43\ Mpa \qquad O.K$$

Shear check

$$V_{max\ shear} = 0.17\sqrt{fc} = 0.17\sqrt{35} = 1\ Mpa$$

$$V_C = \frac{v}{Bd} = \frac{728/1000}{1.44*0.55} = 0.919\ Mpa$$ O. K

$$H = d + cover = 0.55 + .075 + 0.05 = 0.675m \quad say\ H = 0.7m$$

Dnet= 0.7-0.075-0.05= 0.575 m

Negative Reinforcement design

$$Mu = \emptyset\rho bd^2 f_y(1 - \frac{\rho f_y}{1.7f_C})$$

$$1.7 * 1175 = 0.85\rho\ (1.44)(0.575)^2 * 1000 * 450(1 - \frac{\rho 450}{1.7*35})$$

$0.010968 = \rho\,(1 - 7.56\rho)\,, \quad \rho = 0.012, \quad A_S = \rho Bd = 0.012 * 1.44 * 0.575 = 0.009936\ mm^2$

$A_S min = 0.0018Bd$

$A_S min = 0.0018 * 1.44 * 0.575 = 0.0014904m2$ o.k

No of Bars = $\frac{9936}{490} = 21$, use $21\emptyset 25mm$/1.44m

Positive Reinforcement design

$Mu = \emptyset\rho bd^2 f_y(1 - \frac{\rho f_y}{1.7f_C})$

$1.7 * 599 = 0.85\rho\,(1.44)(0.575)^2 * 1000 * 450(1 - \frac{\rho 450}{1.7*35})$

$0.00559 = \rho\,(1 - 7.56\rho)\,, \quad \rho = 0.006,$
$A_S = \rho bd = 0.006 * 1.44 * 0.575 * 10^6 = 0.004968\ mm^2$

No of Bars = $\frac{4968}{490} = 10.13$, use $11\emptyset 25mm$

Reinforcement in B direction

SFD & BMD

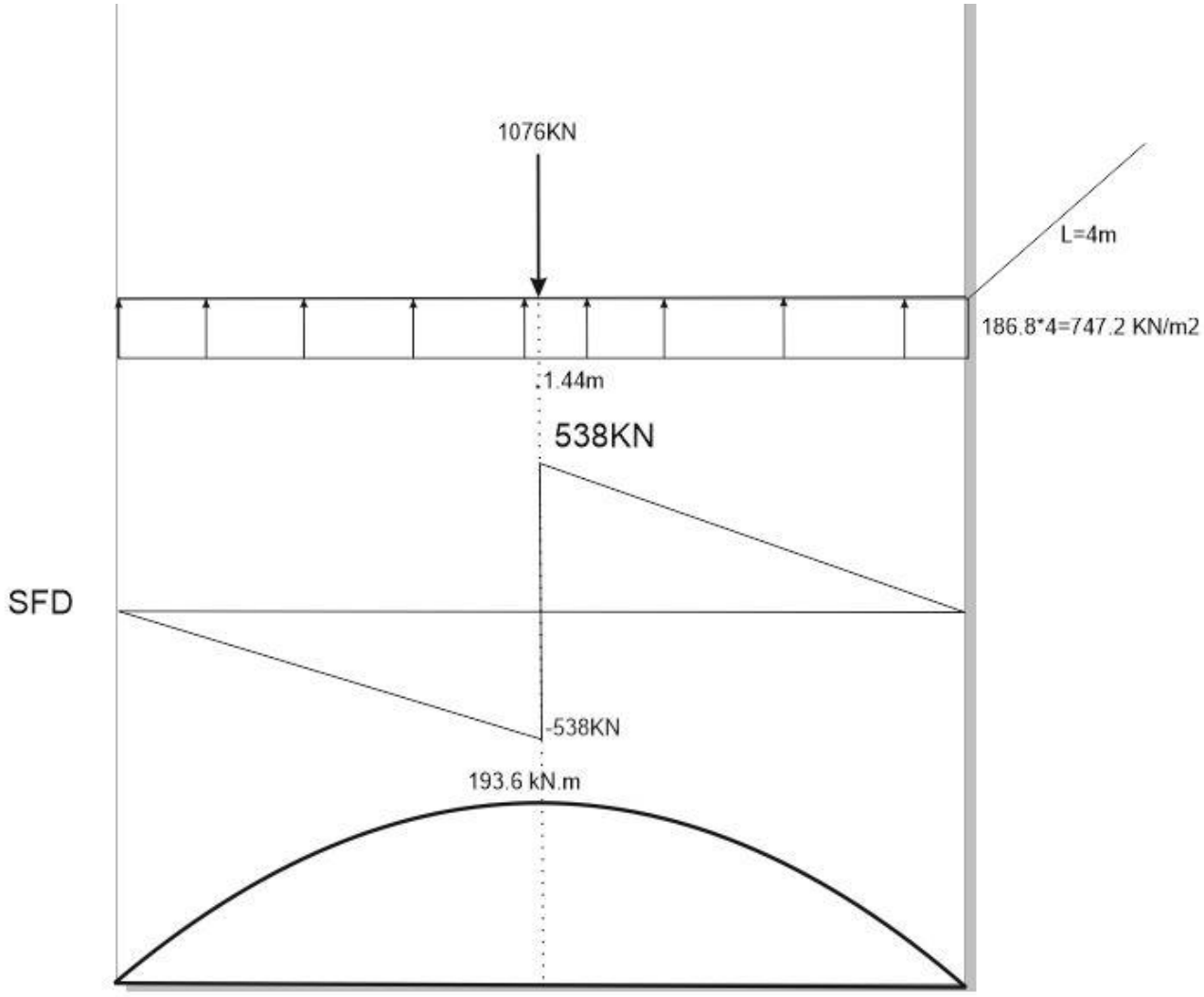
Factorization

Footing pressure = $1000\ kN$, Soil reaction = 200*1.44*4=1152 KN/m2

Average = $\frac{1000+1152}{2} = 1076$ KN

Soil pressure = $200 * \frac{1076}{1152} = 186.8$

Factored load= $1000 * \frac{1076}{1000} = 1076$ = KN



Reinforcement design

$$Mu = \emptyset\rho bd^2 f_y\left(1 - \frac{\rho f_y}{1.7 f_c}\right)$$

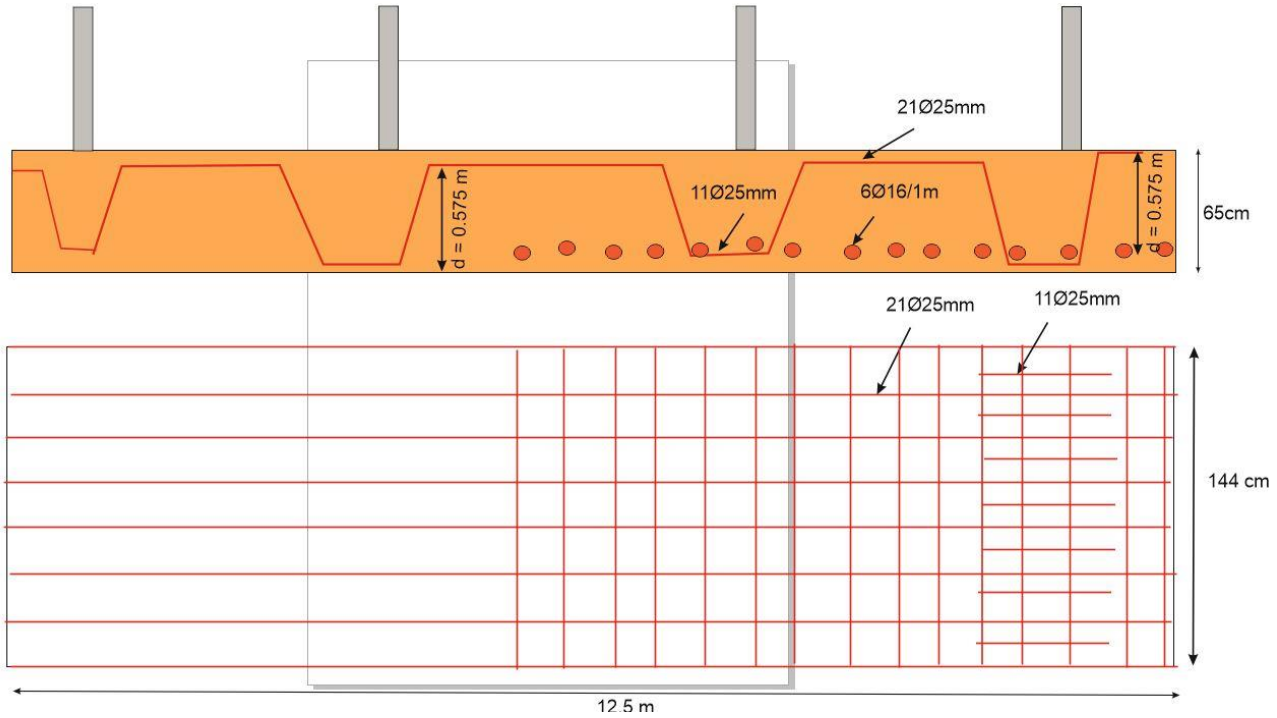
$$1.7 * 193.6 = 0.85\rho\,(4)(0.575)^2 * 1000 * 450\left(1 - \frac{\rho 450}{1.7*35}\right)$$

$$0.00065 = \rho\,(1 - 7.56\rho)\,, \quad \rho = 0.0007, \quad A_S = \rho bd = 0.0007 * 4 * 0.575 * 10^6 = 1610\ mm^2$$

$$A_S min = 0.0018Bd$$

$$A_S min = 0.0018 * 4 * 0.575 = 0.00414\ m2 > 0.001610\ m2$$

No of Bars = $\frac{4140}{201} = 20.597$, use $6\emptyset 16mm/1m$


21Ø25mm
11Ø25mm
6Ø16/1m
d = 0.575 m
d = 0.575 m
65cm
21Ø25mm
11Ø25mm
144 cm
12.5 m