

Recitation 12

Masonry Walls

Homework problem

Masonry walls

11. Masonry Walls.

- To determine the safety of the given concrete masonry walls.
- Calculate factored nominal axial strength ($\phi - P_n$)

Height of wall (h) = 21 FT

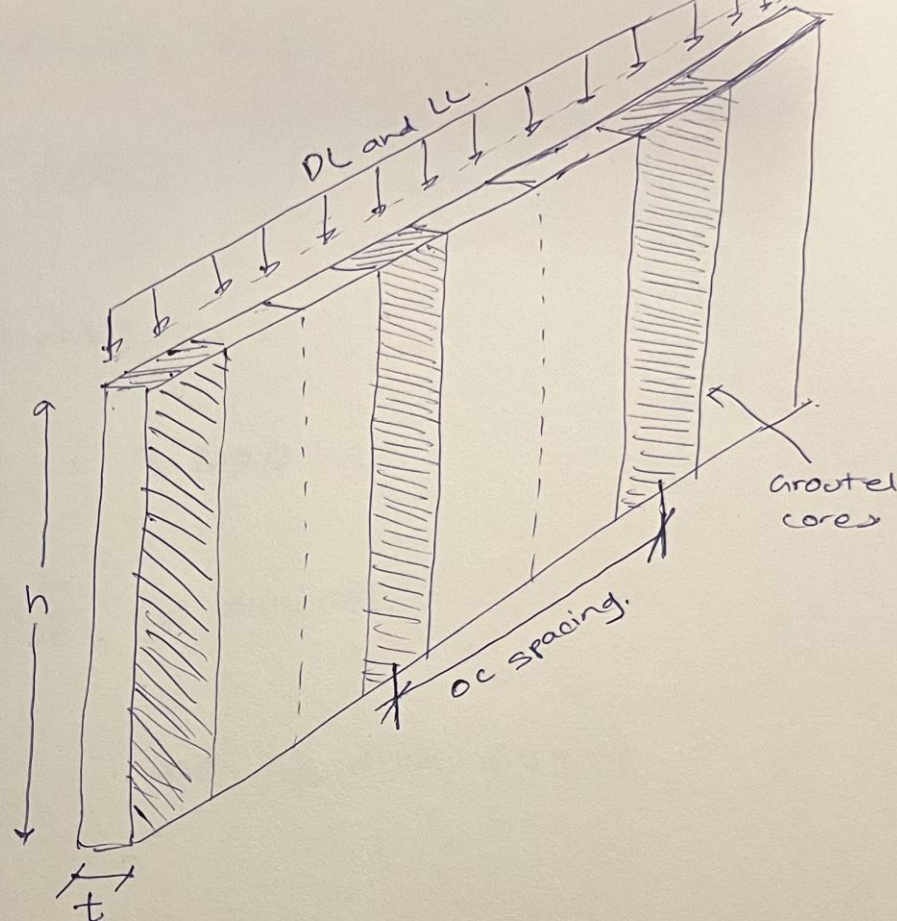
Nominal thickness of wall = 10 IN

Grouted cells @ c spacing = 24 IN

Masonry compressive strength = 1500 PSI (f'_m)

Wall DL = 13 KLF

Wall LL = 16 KLF



Q1) Actual wall thickness, (t):-

$$\text{Wall thickness} = 9 \frac{5}{8} = 9.625 \text{ in}$$

Q2) Net Area per foot of wall, A_n :-

$$A_n = 59.8 \text{ in}^2/\text{ft.}$$

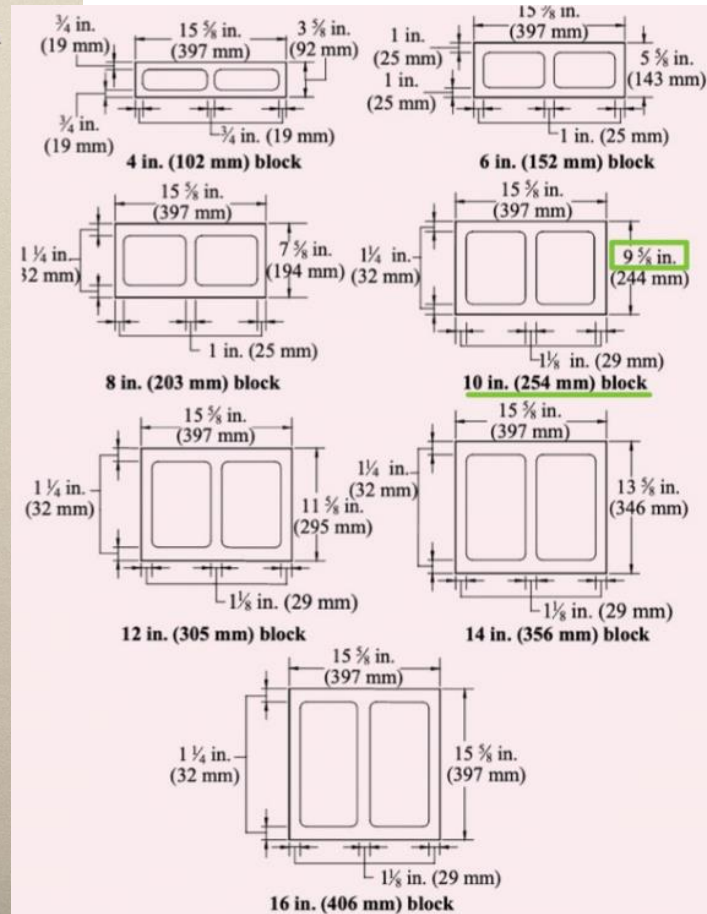


Figure 1—Specified Block Dimensions and Minimum Face Shell and Web Thicknesses (ref. 4)

Table 4—10-inch (254-mm) Single Wythe Walls, 1¼ in. (32 mm) Face Shells (standard)

| 4a: Horizontal Section Properties (Masonry Spanning Vertically) | | | | | | | | | |
|---|---------------------|----------------|---|------------------------------|------------------------------|---|----------------------------------|----------------------------------|-----------------|
| Unit | Grout spacing (in.) | Mortar bedding | Net cross-sectional properties ^A | | | Average cross-sectional properties ^B | | | |
| | | | A_n (in. ² /ft) | I_n (in. ⁴ /ft) | S_n (in. ³ /ft) | A_{avg} (in. ² /ft) | I_{avg} (in. ⁴ /ft) | S_{avg} (in. ³ /ft) | r_{avg} (in.) |
| Hollow | No grout | Face shell | 30.0 | 530.0 | 110.1 | 48.0 | 606.3 | 126.0 | 3.55 |
| Hollow | No grout | Full | 48.0 | 606.3 | 126.0 | 48.0 | 606.3 | 126.0 | 3.55 |
| 100% solid/solidly grouted | | Full | 115.5 | 891.7 | 185.3 | 115.5 | 891.7 | 185.3 | 2.78 |
| Hollow | 16 | Face shell | 74.8 | 719.3 | 149.5 | 80.8 | 744.7 | 154.7 | 3.04 |
| Hollow | 24 | Face shell | 59.8 | 656.2 | 136.3 | 69.9 | 698.6 | 145.2 | 3.16 |
| Hollow | 32 | Face shell | 52.4 | 624.6 | 129.8 | 64.4 | 675.5 | 140.4 | 3.24 |
| Hollow | 40 | Face shell | 47.9 | 605.7 | 125.9 | 61.1 | 661.6 | 137.5 | 3.29 |
| Hollow | 48 | Face shell | 44.9 | 593.1 | 123.2 | 58.9 | 652.4 | 135.6 | 3.33 |
| Hollow | 72 | Face shell | 39.9 | 572.0 | 118.9 | 55.3 | 637.0 | 132.4 | 3.39 |
| Hollow | 96 | Face shell | 37.5 | 561.5 | 116.7 | 53.5 | 629.3 | 130.8 | 3.43 |
| Hollow | 120 | Face shell | 36.0 | 555.2 | 115.4 | 52.4 | 624.7 | 129.8 | 3.45 |
| 4b: Vertical Section Properties (Masonry Spanning Horizontally) | | | | | | | | | |
| Hollow | No grout | Face shell | 30.0 | 530.0 | 110.1 | 46.3 | 597.4 | 124.1 | 3.59 |
| Hollow | No grout | Full | 30.0 | 530.0 | 110.1 | 48.0 | 606.3 | 126.0 | 3.55 |
| 100% solid/solidly grouted | | Full | 115.5 | 891.7 | 185.3 | 115.5 | 891.7 | 185.3 | 2.78 |
| Hollow | 16 | Face shell | 72.8 | 710.8 | 147.7 | 89.1 | 778.3 | 161.7 | 2.96 |
| Hollow | 24 | Face shell | 58.5 | 650.5 | 135.2 | 74.8 | 718.0 | 149.2 | 3.10 |
| Hollow | 32 | Face shell | 51.4 | 620.4 | 128.9 | 67.7 | 687.9 | 142.9 | 3.19 |
| Hollow | 40 | Face shell | 47.1 | 602.3 | 125.2 | 63.4 | 669.8 | 139.2 | 3.25 |
| Hollow | 48 | Face shell | 44.3 | 590.2 | 122.6 | 60.6 | 657.7 | 136.7 | 3.29 |
| Hollow | 96 | Face shell | 37.1 | 560.1 | 116.4 | 53.5 | 627.6 | 130.4 | 3.43 |
| Hollow | 120 | Face shell | 35.7 | 554.1 | 115.1 | 52.0 | 621.6 | 129.2 | 3.46 |

Q5) Net moment of inertia per foot of wall, I_n :-

$$I_n = 656.2 \text{ in}^4 / \text{ft.}$$

Q4) Radius of gyration per foot of wall :-

$$\text{from } r = \sqrt{\frac{I_n}{A_n}} = \sqrt{\frac{656.2}{59.8}} = 3.3126 \text{ in}$$

Q5) Ratio $\frac{h}{r}$:- $\frac{h}{r} = \frac{214 \text{ ft}}{3.3126 \text{ in}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 76.07$

Q6) which equation used? :- $\boxed{76.07 < 99}$ \therefore use equation (9-11).

Q7) Nominal axis strength, P_n :-

from :- (Equation 9-11)

for $h/r < 99$

$$P_n = 0.80 \left[0.80 A_n f_m \left[1 - \left(\frac{h}{140r} \right)^2 \right] \right]$$

$$f'_m = 1500 \frac{\text{lb}}{\text{in}^2} \times \frac{1\text{k}}{1000\text{lb}} = 1.5 \text{ k/in}^2$$

$$P_n = 0.80 \times 0.80 \times A_n \times f'_m \left[1 - \left(\frac{h}{140r} \right)^2 \right]$$
$$= 0.80 \times 0.80 \times 59.8 \times 1.5 \left[1 - \left(\frac{76.07}{140} \right)^2 \right]$$

$$\therefore P_n = 40.459 \text{ k/ft}$$

$$\phi P_n = 0.9 (40.459) = 36.413 \text{ k/ft}$$

Q.9) Axial strength required by loads, (P_u):-

$$P_u = 1.2 \text{ DL} + 1.6 \text{ LL}$$

$$= 1.2 (13 \text{ k/ft}) + 1.6 (16 \text{ k/ft})$$

$$P_u = 41.2 \text{ k/ft}$$

Q.10) Does the wall pass or fail?

$$(P_u = 41.2 \text{ k/ft}) > (\phi P_n = 36.413 \text{ k/ft})$$

\therefore fail

Thankyou !!!