Arch324

STRUCTURES II

Winter 2026
Recitation

FACULTY: Prof. Peter von Bülow
GSI: Hui Zhu huizz@umich.edu

Recitation Guidelines

Homework Problem

Lab

- Please complete the lab sheet during recitation and hand it in before leaving.
- Try to attend all sessions. Unexcused absences will **affect your grade** starting from the second missed class.

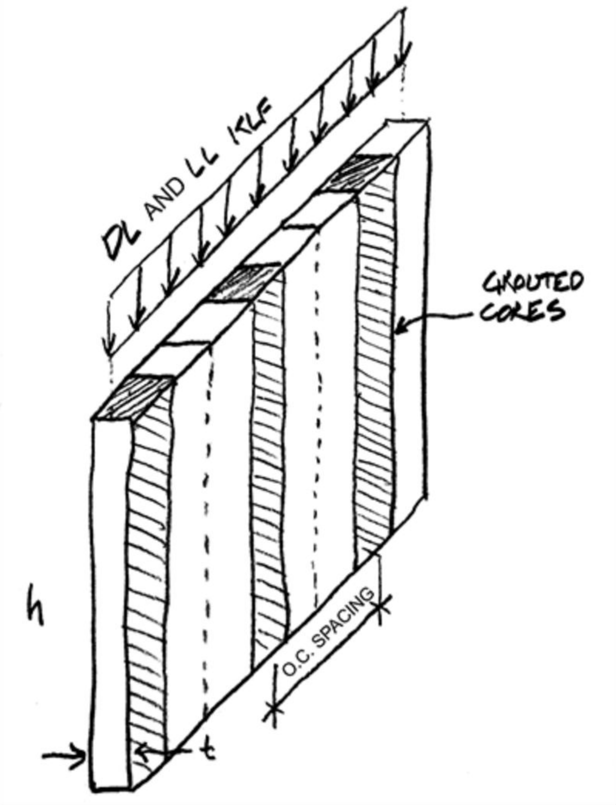
Analysis Example - HW11

11. Masonry Walls

Using the strength method for axial compression (masonry spanning vertically) described in TMS 402, determine the safety of the given concrete masonry wall (pass or fail). Calculate the factored nominal axial strength, phi_Pn and compare it to the required strength, Pu for the given loads. (loads are given without factors)

DATASET: 1 -2- -3-

Height of wall, h	21 FT
Nominal thickness of wall	10 IN
grouted cells o.c. spacing	24 IN
Masonry compressive strength, f'm	1500 PSI
The wall DL	13 KLF
The wall LL	16 KLF



Answer HW11

10 Questions

#	Question	Correct Answer
1	Actual wall thickness, t (see TEK 14-1B)	9.625 IN
2	Net area per foot of wall, An	59.8 IN2
3	Net moment of inertia per foot of wall, In	656.2 IN^4
4	Radius of gyration per foot of wall, r	3.312588738 IN
5	Ratio of h/r	76.07343378
6	Which TMS equation used? (11 or 12)	11
7	Nominal axial strength, Pn	40.457505 KLF
8	Factored nominal axial strength, phi_Pn	36.4117545 KLF
9	Axial strength required by loads, Pu	41.2 KLF
10	Does the wall pass or fail? (1=pass 0=fail)	0

Analysis Example - HW11

Rational Masonry Analysis

Procedure

Strength Design (LRFD) – **non-reinforced**

Rational Approach

for axial compression using TMS 402 (2016)

Given: geometry, material

Find: axial compressive load capacity, Pn

1. Determine the masonry strength, f'm, based on unit strength, fu, and mortar type (table)
2. Find the net area, A_n, and Moment of Inertia, I_n (see NCMA TEK 14-1B with HW problem pdf.)
3. Calculate radius of gyration, $r = \sqrt{I/A}$
4. Calculate h/r
5. Choose the axial strength equation, Pn:
   If $h/r < 99$ use TMS 402 eq.9-11
   If $h/r > 99$ use TMS 402 eq.9-12
6. Calculate øPn where ø for axial force = 0.90
7. Check that øPn is greater than Pu.

(Equation 9-11) for h/r < 99

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

(Equation 9-12) for h/r > 99

$$P_n = 0.80\left[0.80 A_n f'_m\left(\frac{70r}{h}\right)^2\right]$$

Analysis Example - HW11

Q1

Nominal thickness of wall | 10 IN

SECTION PROPERTIES OF CONCRETE MASONRY WALLS

TEK 14-1B
Structural (2007)

Keywords: concrete masonry walls, engineered design, gross area, moment of inertia, net area, radius of gyration, reinforced concrete masonry, reinforced properties, section modulus, section properties, structural properties

INTRODUCTION

Engineered design of concrete masonry uses section properties to determine strength, stiffness and deflection characteristics. These design philosophies are summarized in *Allowable Stress Design of Concrete Masonry*, *Strength Design of Concrete Masonry* and *Post-Tensioned Concrete Masonry Wall Design* (refs. 1, 2, 3).

SECTION PROPERTIES

Tables 1 through 13 summarize section properties of grouted and ungrouted 4-, 6-, 8-, 10-, 12-, 14- and 16-in. (102-, 152-, 203-, 254-, 305-, 356- and 406-mm) wide concrete masonry walls, based on:

- standard unit dimensions are based on the minimum face shell and web thickness requirements of *Standard Specification for Loadbearing Concrete Masonry Units*, ASTM C 90-06 (ref. 4) as shown in Figure 1, except as noted in Tables 8 through 13. Note that prior to ASTM C 90-06, two minimum face shell thicknesses for units 10-in. (254-mm) and wider were specified. With the introduction of ASTM C 90-06, the two face shell thicknesses were replaced with one minimum thickness requirement ($1^1/_4$ in. (32 mm)). See Reference 5 for further information. Tables 10 through 13 can be used for section properties of units complying with previous

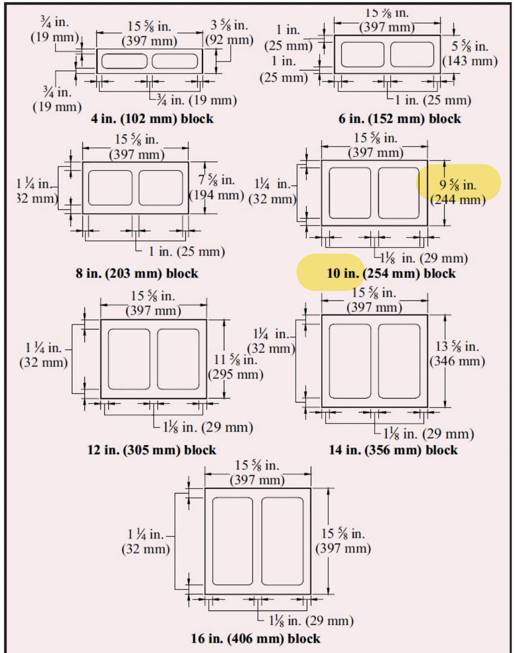


Figure 1—Specified Block Dimensions and Minimum Face Shell and Web Thicknesses (ref. 4)

TEK 14-1B

t=9.625 in Q1

Analysis Example - HW11

Q2-3

Nominal thickness of wall	10 IN
grouted cells o.c. spacing	24 IN

Table 4—10-inch (254-mm) Single Wythe Walls, 1¹/₄ in. (32 mm) Face Shells (standard)

Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties[A] A_n (in.²/ft)	I_n (in.⁴/ft)	S_n (in.³/ft)	Average cross-sectional properties[B] A_{avg} (in.²/ft)	I_{avg} (in.⁴/ft)	S_{avg} (in.³/ft)	r_{avg} (in.)
4a: Horizontal Section Properties (Masonry Spanning Vertically)									
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

An=59.8 in²/ft Q2

In=656.2 in⁴/ft Q3

Analysis Example - HW11

Q4-10

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(Equation 9-12) for h/r > 99

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Q4 $r = \sqrt{\frac{I}{A}} = \sqrt{\frac{656.2}{59.8}} = 3.313''$

Q5 $\frac{h}{r} = \frac{21 \times 12}{3.313} = 76.06$ ← transfer to inch

Q6 $76.06 < 99 \rightarrow$ use TMS 402. eq. 9-11

Q7 $P_n = 0.8\left\{0.8 A_n f'_m \left[1-\left(\frac{h}{140r}\right)^2\right]\right\}$

$= 0.8\left\{0.8(59.8)(1.5)\left[1-\left(\frac{21 \times 12}{140(3.313)}\right)^2\right]\right\}$ ← transfer to inch; KSI (f'm/1000)

$= 40.46$ KLF

Q8 $\varphi P_n = 0.9 \times 40.46 = 36.414$ KLF

Q9 $P_u = 1.2 DL + 1.6 LL = 1.2 \times 13 + 1.6 \times 16 = 15.6 + 25.6 = 41.2$ KLF

Q10 $P_u = 41.2$ KLF $> \varphi P_n = 36.414$ KLF $\rightarrow$ Fail