Design and Construction Guidelines for Dry-Stack Concrete Masonry

David Biggs, PE, SE

Biggs Consulting Engineering

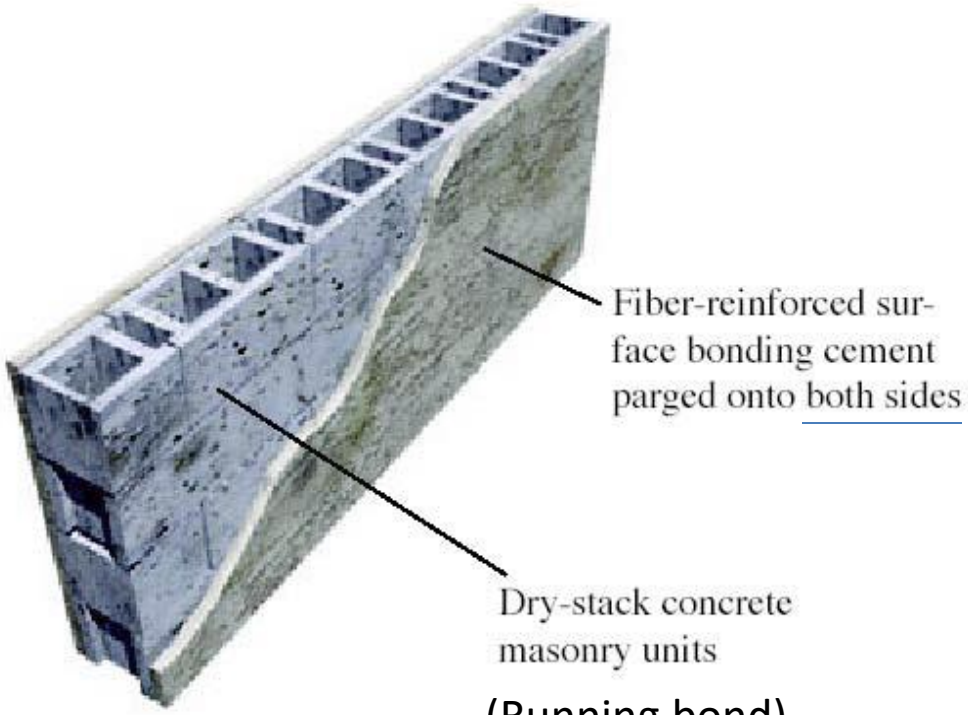
Saratoga Springs, NY

Co-authors: Jason Thompson + Ray Miller

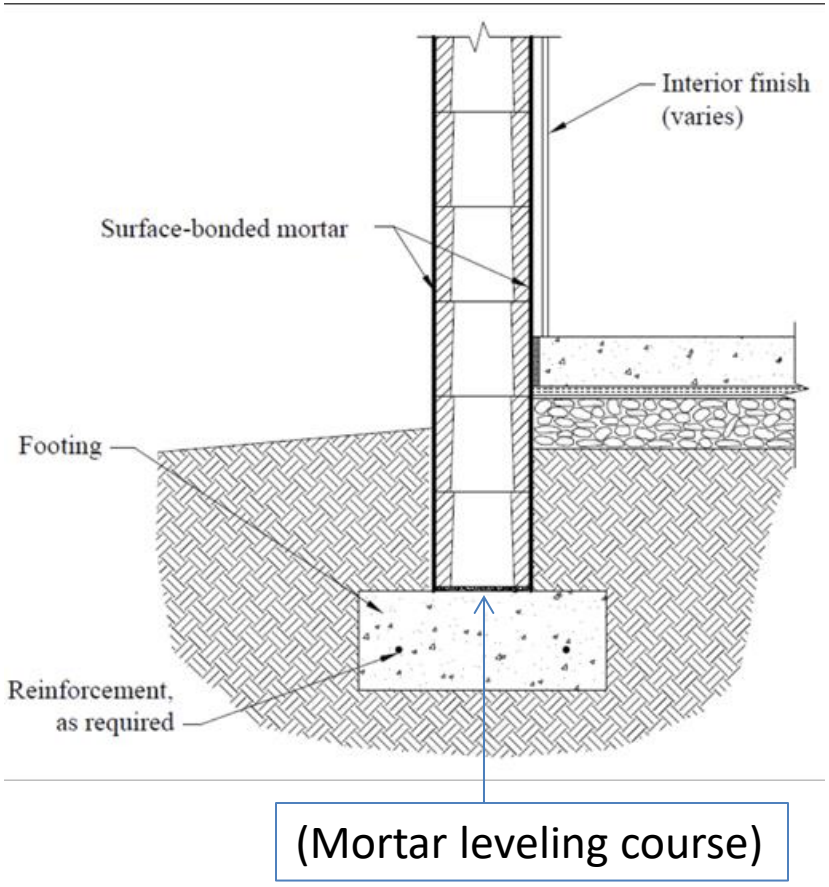
Dry Stack = Mortarless

- Used internationally.
- Uses
  - Buildings
  - Utility structures
  - Retaining walls
  - Residential
  - Storm shelters
- Benefits
  - Speed and ease of installation.
  - Reduced labor expenses.
  - Requires fewer skilled masons directed by experienced masons.

Dry Stack in the IBC



(Running bond)



(Mortar leveling course)

IBC Design Limitations

- Not for essential facilities.
- Not for nominal wind speed V_{asd} > 110 mph
- Empirical design for shear walls for SDC A only
- Empirical design for other walls for SDC A, B and C.

Purpose of Design Guidelines

- Develop a base for future code introduction.
- Address limitations using engineered masonry.

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Table of Contents

Chapter 1 – Introduction

- History and Background.

- Since not code, options for use:
  - ✓ Apply to code official as special structure per *IBC Section 104.10 Modifications* or *IBC Section 104.11 Alternative materials, design and methods of construction and equipment*.
  - ✓ ICC Performance Code for Buildings and Facilities.
  - ✓ Obtain ICC-ES system approval.

Building

https://theconstructor.org/building/dry-stacked-interlocking-masonry-system-mortarless/9029/

Building

Building

Arizona home

http://www.haenerblock.com/press_new_brick.html

Tanzania home

https://warwick.ac.uk/fac/sci/eng/elith/publications/all_publications/elith-w01.pdf

Highway Sound Barriers

Little mortar! Low maintenance. Control CMU efflorescence!

Interior Storm Shelter

Site Walls

http://www.dereks.com.tr/eng/ecoblock.pdf

Trash Enclosures

Courtesy of Weldcraft Iron Works

Chapter 2 – Materials

- CMU only. (Limited testing available for clay units.)
- Uses standard ASTM CMU. Proprietary possible too.
- Mortar (setting bed), grout, reinforcement same as TMS 602.

- Compressive strength, f'_{dm}
  - ✓ Prism strength
  - ✓ Unit strength

Unit Strength Method

Table 2.6-1. Compressive Strength of Dry-Stack Masonry Assemblies (f'_{dm}) Based on Compressive Strength of Concrete Masonry Units and Interface Condition		
Net Area Compressive Strength of Concrete Masonry Units, psi (MPa)	Net Area Compressive Strength of Concrete Masonry Assembly, f'_{dm}, psi (MPa)	
	Unground Interface	Ground Interface
2,000 (13.8)	1,300 (9.0)	1,300 (9.0)
2,800 (19.3)		1,400 (9.7)
3,150 (21.7)		1,600 (11.0)
3,500 (24.1)		1,800 (12.4)
3,850 (26.5)		2,000 (13.8)

Derived from research at Clemson University

Bed joint interface important

Units ground or unground for bearing.

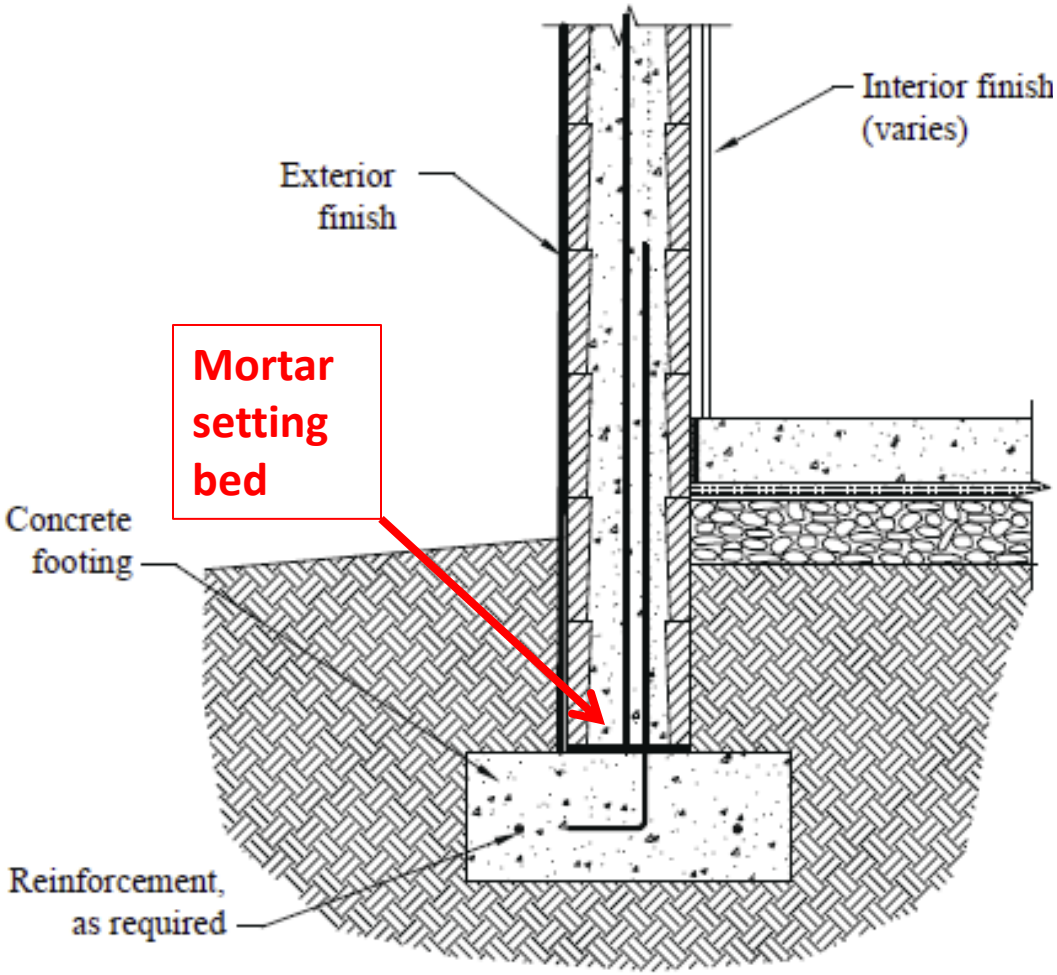
Chapter 3
Dry-Stack Masonry Systems

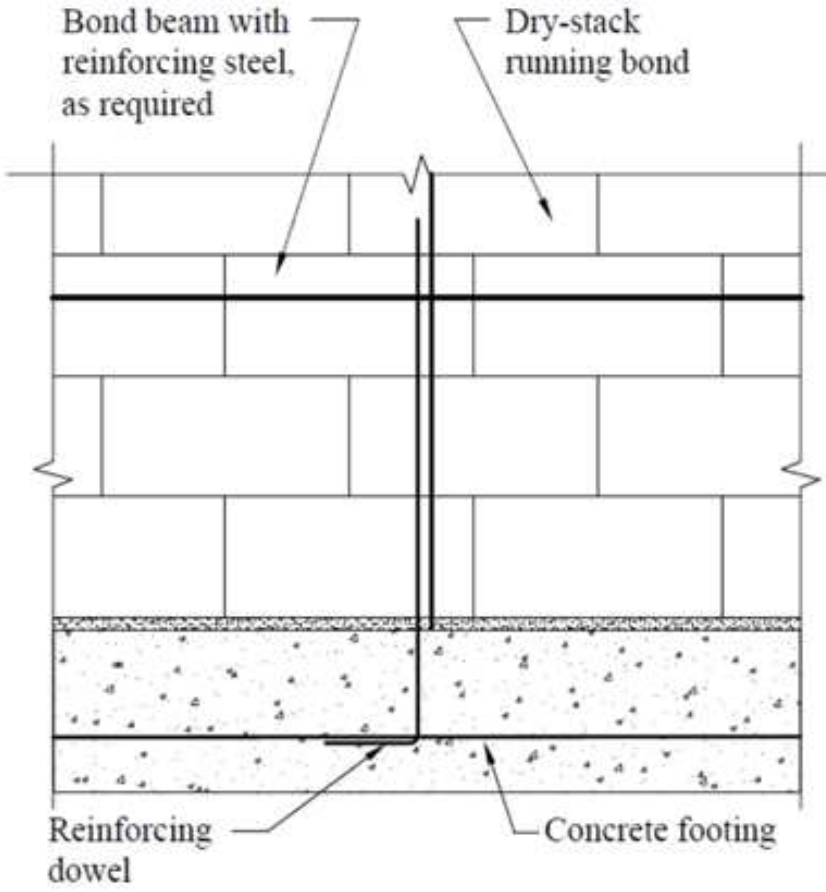
- Two systems:
  - Reinforced …partial or full grouting.
  - Prestressed…..can use surface bonding for shear.

- Single wythe or cavity wall; running bond only.

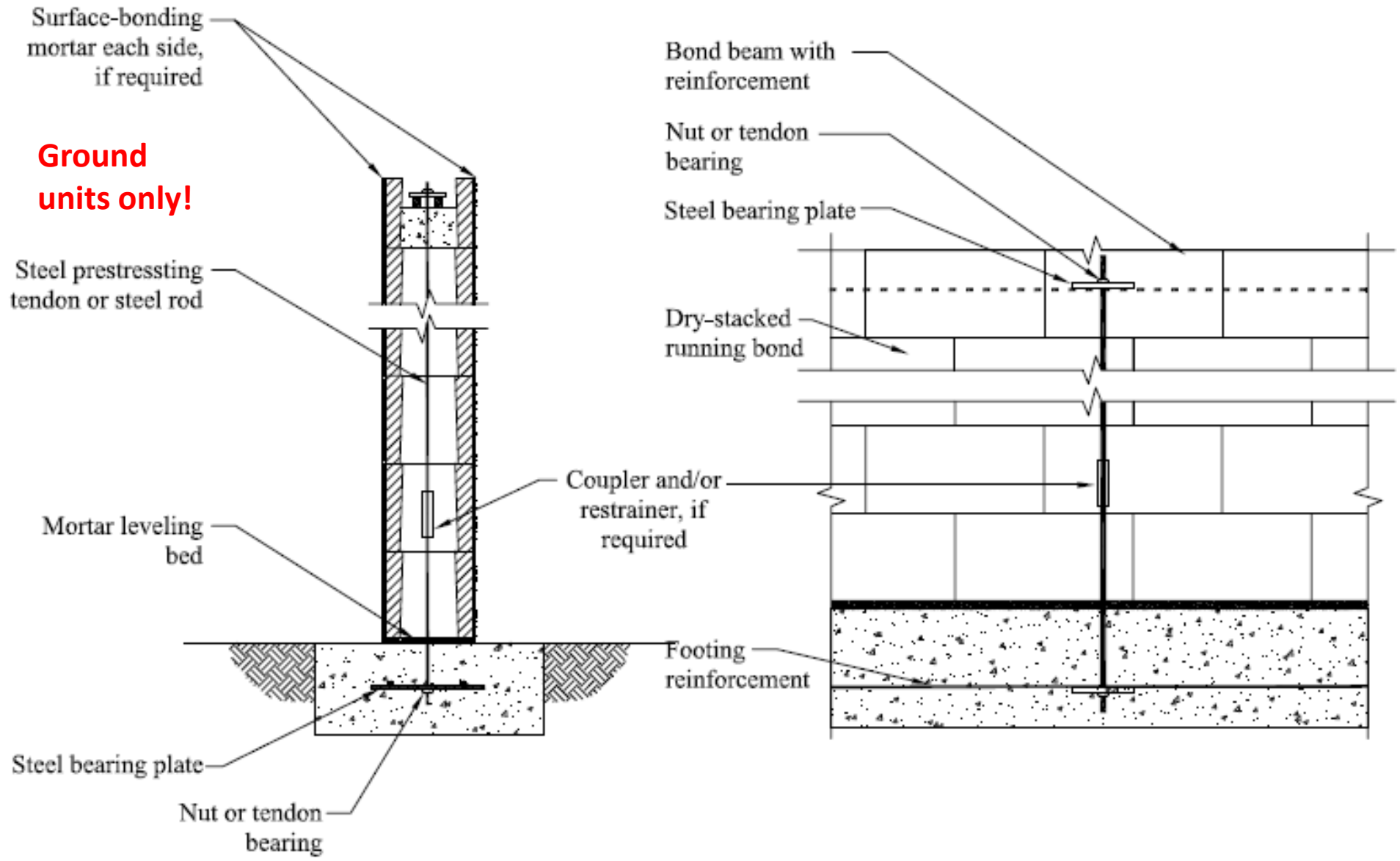
- Does not include: veneers, SRWs or mechanically stabilized walls.

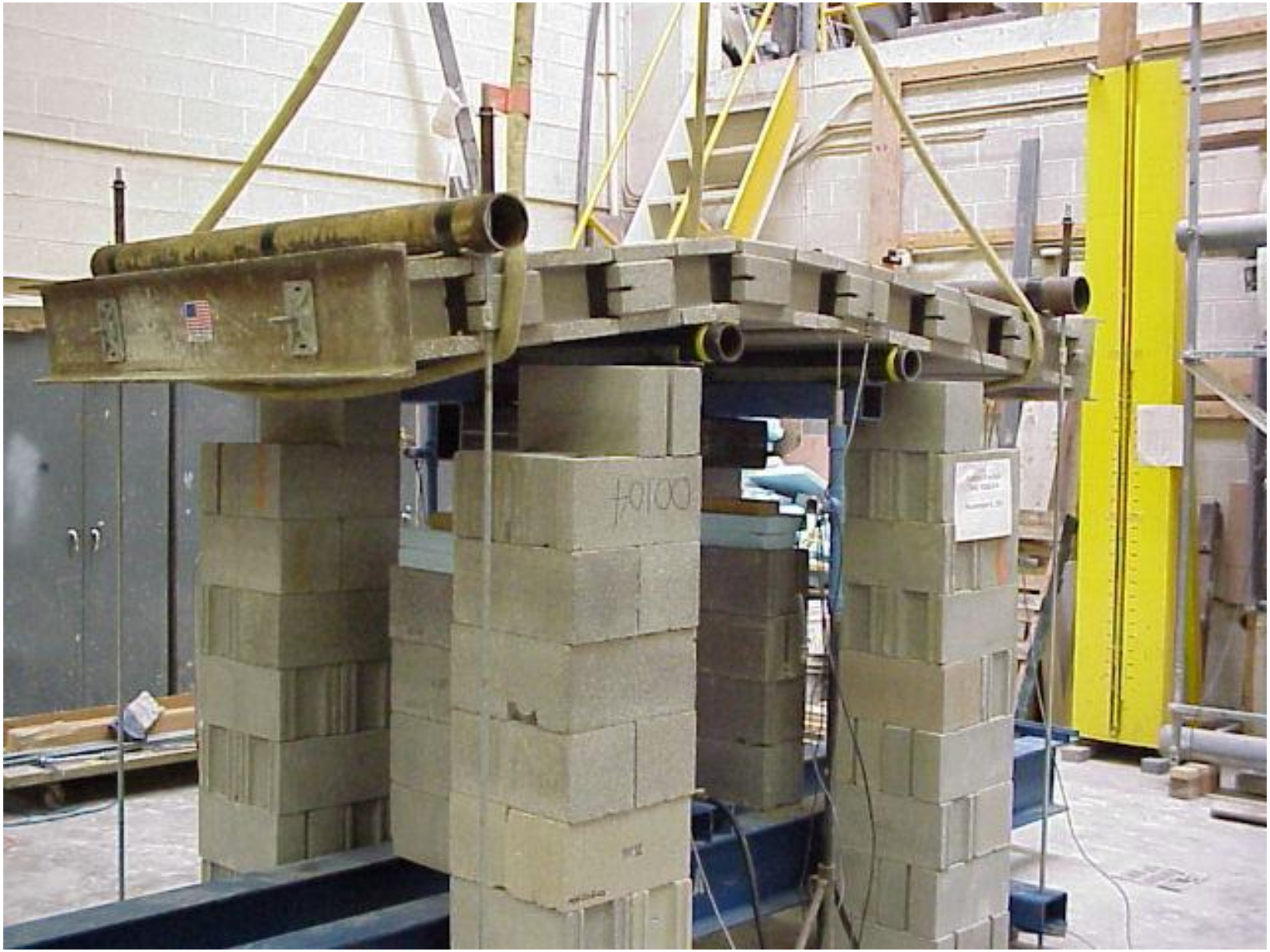
Reinforced Dry Stack (partial or full grouting)





Prestressed Dry Stack





Dry Stack Buildings with Cavity Walls

- Reinforced or Prestress CMU back-up
- Low seismic.
- Air and moisture barriers.
- Anchor veneer to units rather than joint reinforcement.

Single Wythe Buildings

- Might require proprietary systems that are more resistant to water penetration.
- Fully grouted mass barrier wall.
- No mortar, but possibly an adhesive.

Chapter 4
Seismic Design Recommendations

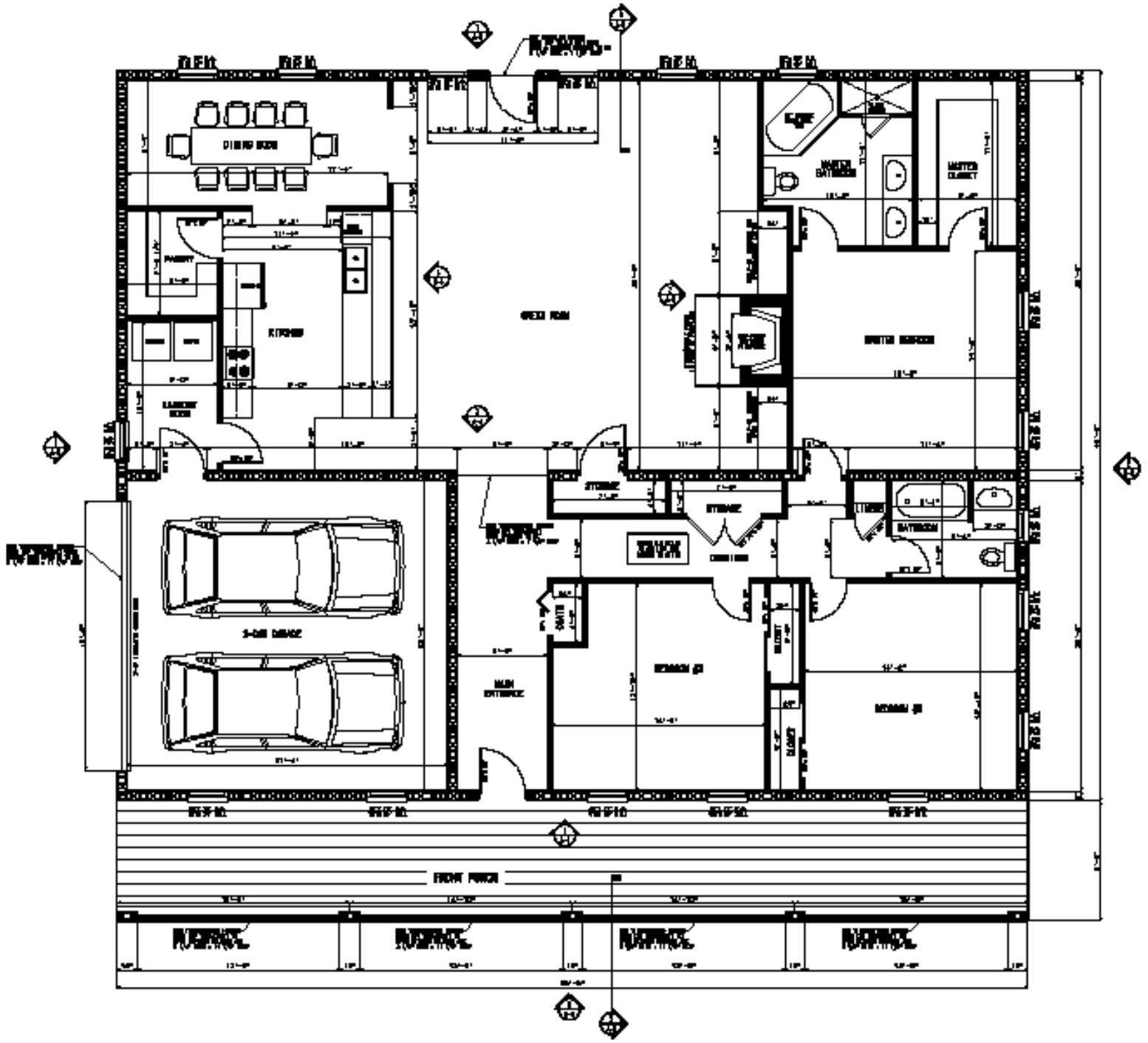
- Use TMS 402 prescriptive detailing for shear walls.
- If ground units, use R & C_d for mortared systems.
- If unground units, reduce one level.

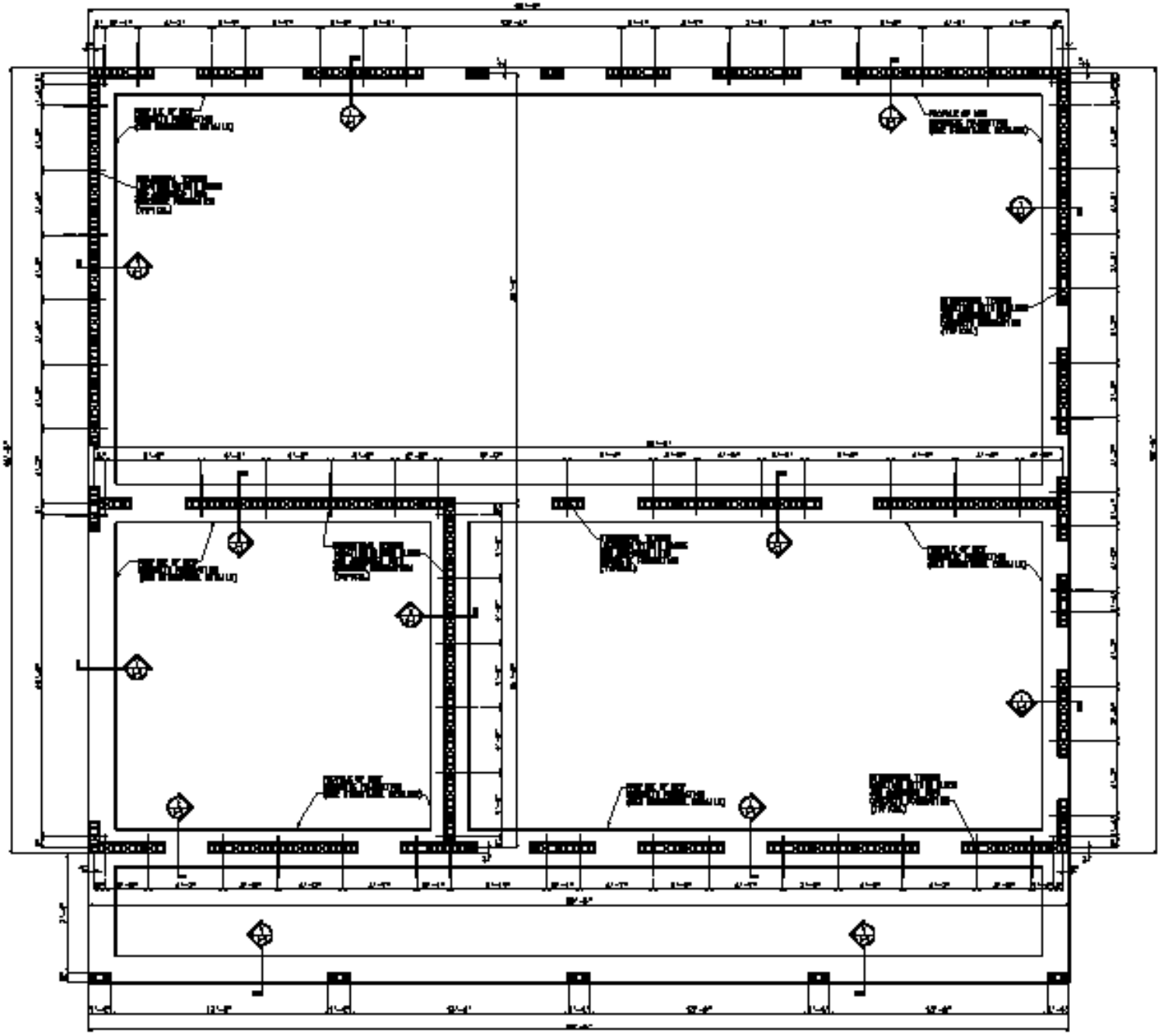
Chapter 5
Performance and Serviceability

- Fire Resistance
- Air and Water Penetration Resistance
- Sound
- Aesthetics
- Drift and Deflection
- Movement Joints

Residence
Texas

Masonry Shell | Construction | Cost Analysis | Drawings


DINING ROOM
KITCHEN
LIVING ROOM
MASTER BEDROOM
MASTER BATHROOM
MASTER CLOSET
LAUNDRY ROOM
STORAGE
STORAGE
STORAGE
LINEN
BATHROOM
3-CAR GARAGE
MAIN ENTRANCE
BEDROOM #3
BEDROOM #2
CLOSET
CLOSET
FRONT PORCH



First Course Alignment

Drill Tendon Locations

Set Anchor

Stress Anchor

Mortar Set First Course

First Course Level

Remaining Courses Dry Stack

Completed Walls Before Tensioning

Prior to Surface Bonding for weathertightness and shear value.

Completed

- Surface bonded exterior
- Trussed roof
- Anchored stone veneer

Thank you!