

Intersecting Wall Provisions: What Changed in TMS 402-2022 and Why

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Course Description

Detailing of masonry wall intersections has a significant impact on the flexural and shear behavior of masonry walls as well as their stiffness, whether used as part of the lateral force resisting system or as partition walls. TMS 402/602-22 restructured the intersecting wall provisions to allow greater flexibility in the methods design engineers use to achieve connection between structural intersecting walls.

This presentation will summarize the new provisions and clarify when to use each for your next new building project.

Learning Objectives

1. Learn how to distinguish between the three types of intersecting wall provisions now permitted by TMS 402/602-22
2. Understand the responsibility of the design engineer in detailing wall intersections
3. Summarize the new provisions and when to use each
4. Identify how/when wall intersection detailing differs for walls laid up in stack bond and running bond.

Background

- 2016 Holdover Public comments #69 and #72
 - #69: Conflicting provisions
 - Appendix A, Empirical
 - Chapter 14, Masonry Partition Walls
 - Chapter 5, Structural Elements

TMS 402-16 Appendix A, Empirical

A.8.2 *Intersecting walls*

Masonry walls depending upon one another for lateral support shall be anchored or bonded at locations where they meet or intersect by one of the following methods:

A.8.2.1 Fifty percent of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of not less than 3 in. (76.2 mm) on the unit below.

A.8.2.2 Walls shall be anchored by steel connectors having a minimum section of $\frac{1}{4}$ in. (6.4 mm) by $1\frac{1}{2}$ in. (38.1 mm) with ends bent up at least 2 in. (50.8 mm), or with cross pins to form anchorage. Such anchors shall be at least 24 in. (610 mm) long and the maximum spacing shall be 4 ft (1.22 m).

A.8.2.3 Walls shall be anchored by joint reinforcement spaced at a maximum distance of 8 in. (203 mm). Longitudinal wires of such reinforcement shall be at least wire size W1.7 (MW11) and shall extend at least 30 in. (762 mm) in each direction at the intersection.

A.8.2.4 Other metal ties, joint reinforcement or anchors, if used, shall be spaced to provide equivalent area of anchorage to that required by Sections A.8.2.2 through A.8.2.3.

TMS 402-16 Chapter 14, Partition Walls

14.4.2 *Intersecting masonry partition walls*

Masonry partition walls depending upon one another for lateral support, or upon pilasters within those walls, shall be anchored or bonded at locations where they meet or intersect by one of the following methods:

14.4.2.1 Fifty percent of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of at least 3 in. (76.2 mm) on the unit below.

14.4.2.2 Walls shall be anchored at their intersection at vertical intervals of not more than 16 in. (406 mm) with joint reinforcement or $\frac{1}{4}$ in. (6.4 mm) mesh galvanized hardware cloth.

14.4.2.3 Other metal ties, joint reinforcement or anchors, if used, shall be spaced to provide equivalent area of anchorage to that required by Section 14.4.2.2.

14.4.3 *Anchorage to structural members*

Masonry partition walls depending upon structural masonry walls or structural frame members for lateral support shall be anchored to those members in accordance with Sections 14.4.3.1, 14.4.3.2, and 14.4.3.3.

14.4.3.1 Masonry partition walls shall be anchored so as to transfer out-of-plane lateral load acting on the partition walls to the structural members.

14.4.3.2 Masonry partition walls shall be isolated within their own plane from structural members, except as required for gravity support of the partition walls.

14.4.3.3 Isolation joints and connectors at the interfaces of masonry partition walls and structural members shall be designed to accommodate the vertical and horizontal deformations of the structural members.

TMS 402-16 Chapter 5, Structural Elements

5.1 — Masonry assemblies

5.1.1 *Intersecting walls*

5.1.1.1 Wall intersections shall meet one of the following requirements:

- (a) Design shall conform to the provisions of Section 5.1.1.2.
- (b) Transfer of shear between walls shall be prevented.

5.1.1.2 *Design of wall intersection*

5.1.1.2.1 Masonry shall be in running bond.

5.1.1.2.2 Flanges shall be considered effective in resisting applied loads.

5.1.1.2.3 The width of flange considered effective on each side of the web shall be the smaller of the actual flange on either side of the web wall and the value shown in Table 5.1.1.2.3, based on the state of stress in the flange and whether or not the masonry is reinforced. The effective flange width shall not extend past a movement joint.

Table 5.1.1.2.3 Effective Flange Width

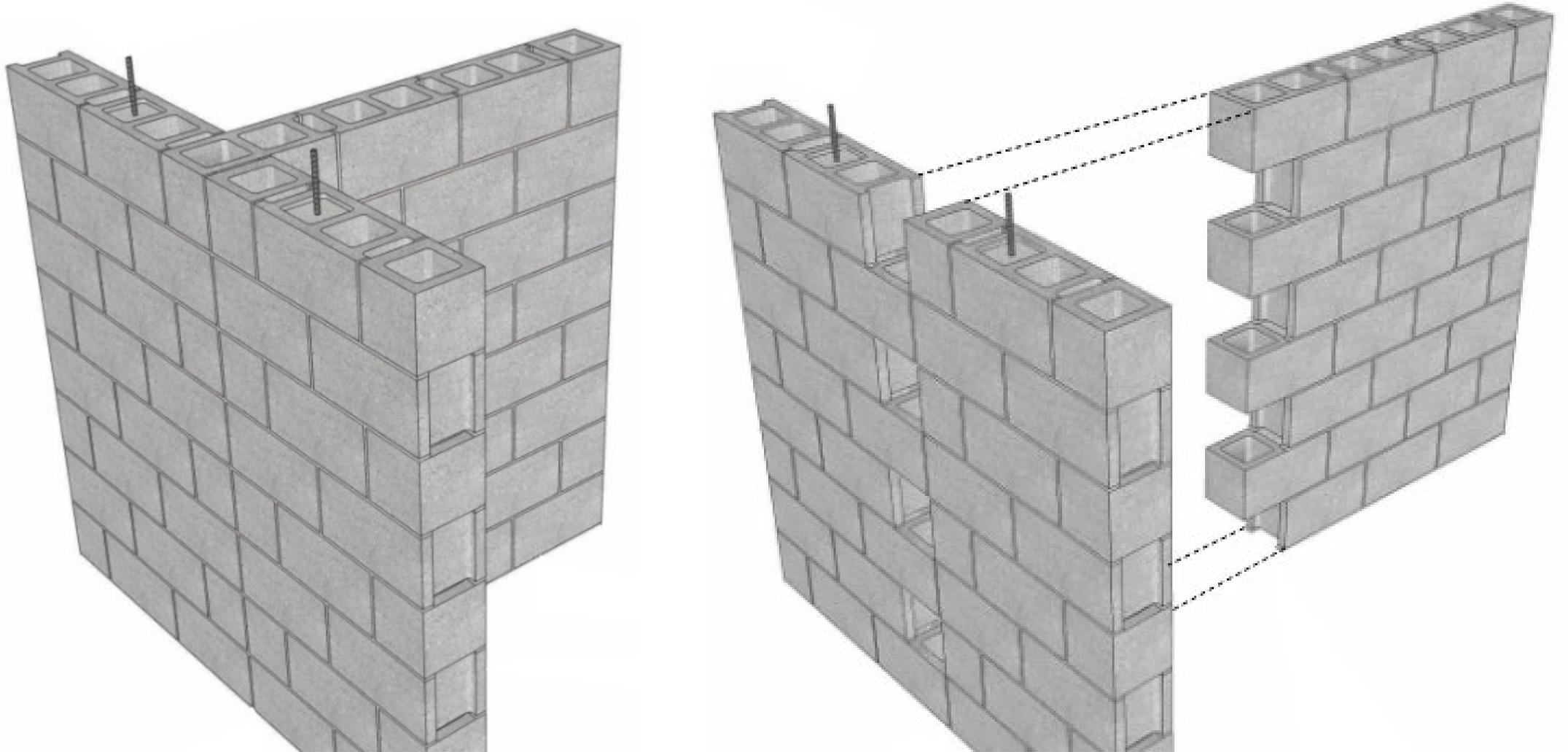
Stress State in Flange	Unreinforced (U) or Reinforced (R) Masonry	Effective Flange Width
Compression	U, R	6 x nominal flange thickness
Tension	U	6 x nominal flange thickness
	R	0.75 x floor-to-floor wall height

5.1.1.2.4 Design for shear, including the transfer of shear at interfaces, shall conform to the requirements of Section 8.2.6; or Section 8.3.5; or Section 9.2.6; or Section 9.3.4.1.2; or Section 10.6; or Section 11.3.4.1.2.

5.1.1.2.5 The connection of intersecting walls shall conform to one of the following requirements:

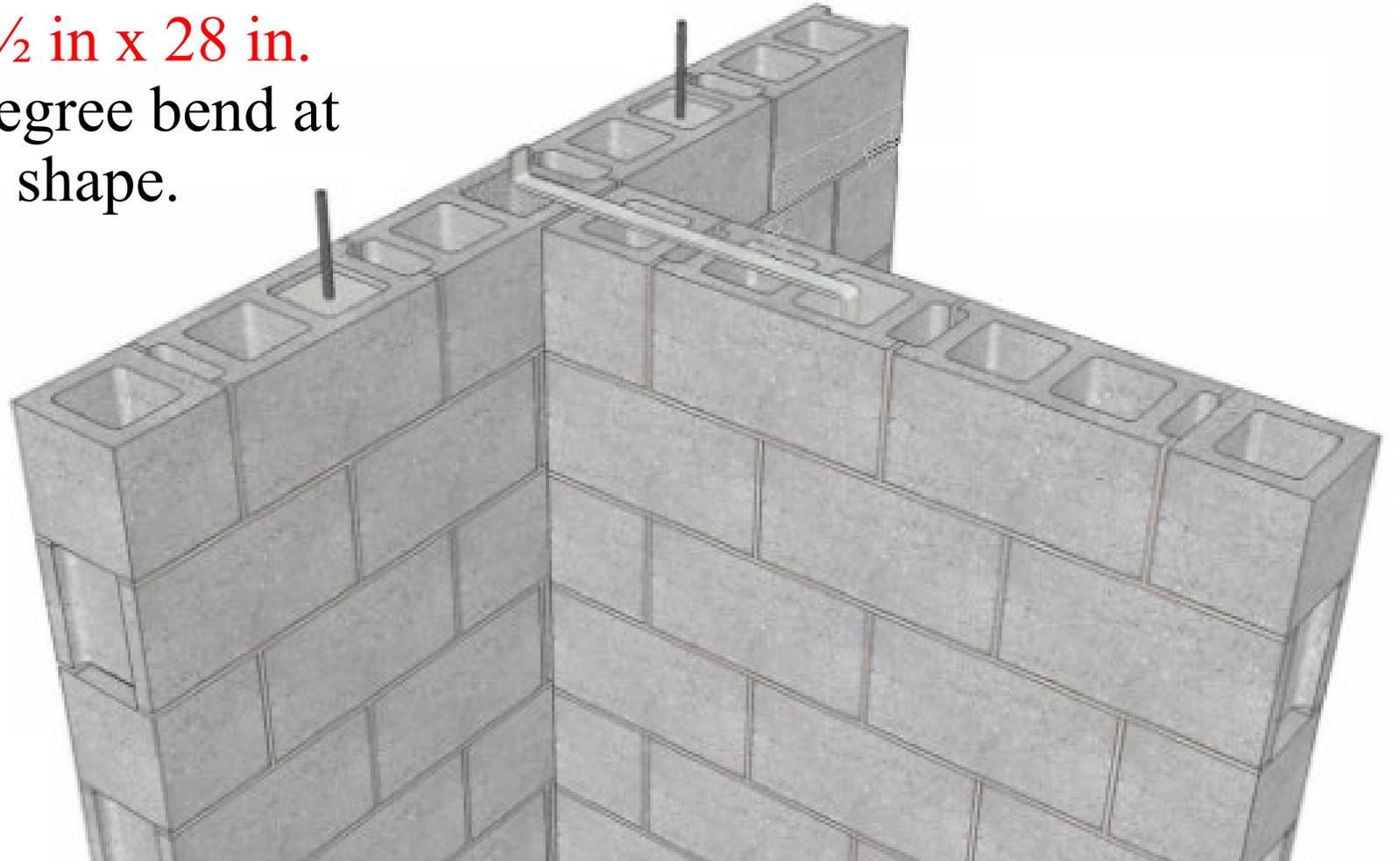
- (a) At least fifty percent of the masonry units at the interface shall interlock.
- (b) Walls shall be anchored by steel connectors grouted into the wall and meeting the following requirements:
 - (1) Minimum size: $\frac{1}{4}$ in. x $1\frac{1}{2}$ in. x 28 in. (6.4 mm x 38.1 mm x 711 mm) including 2-in. (50.8-mm) long, 90-degree bend at each end to form a U or Z shape.
 - (2) Maximum spacing: 48 in. (1219 mm).
- (c) Intersecting reinforced bond beams shall be provided at a maximum spacing of 48 in. (1219 mm) on center. The area of reinforcement in each bond beam shall not be less than 0.1 in.^2 per ft ($211 \text{ mm}^2/\text{m}$) multiplied by the vertical spacing of the bond beams in feet (meters). Reinforcement shall be developed on each side of the intersection.

$\geq 50\%$ of units at interface interlock



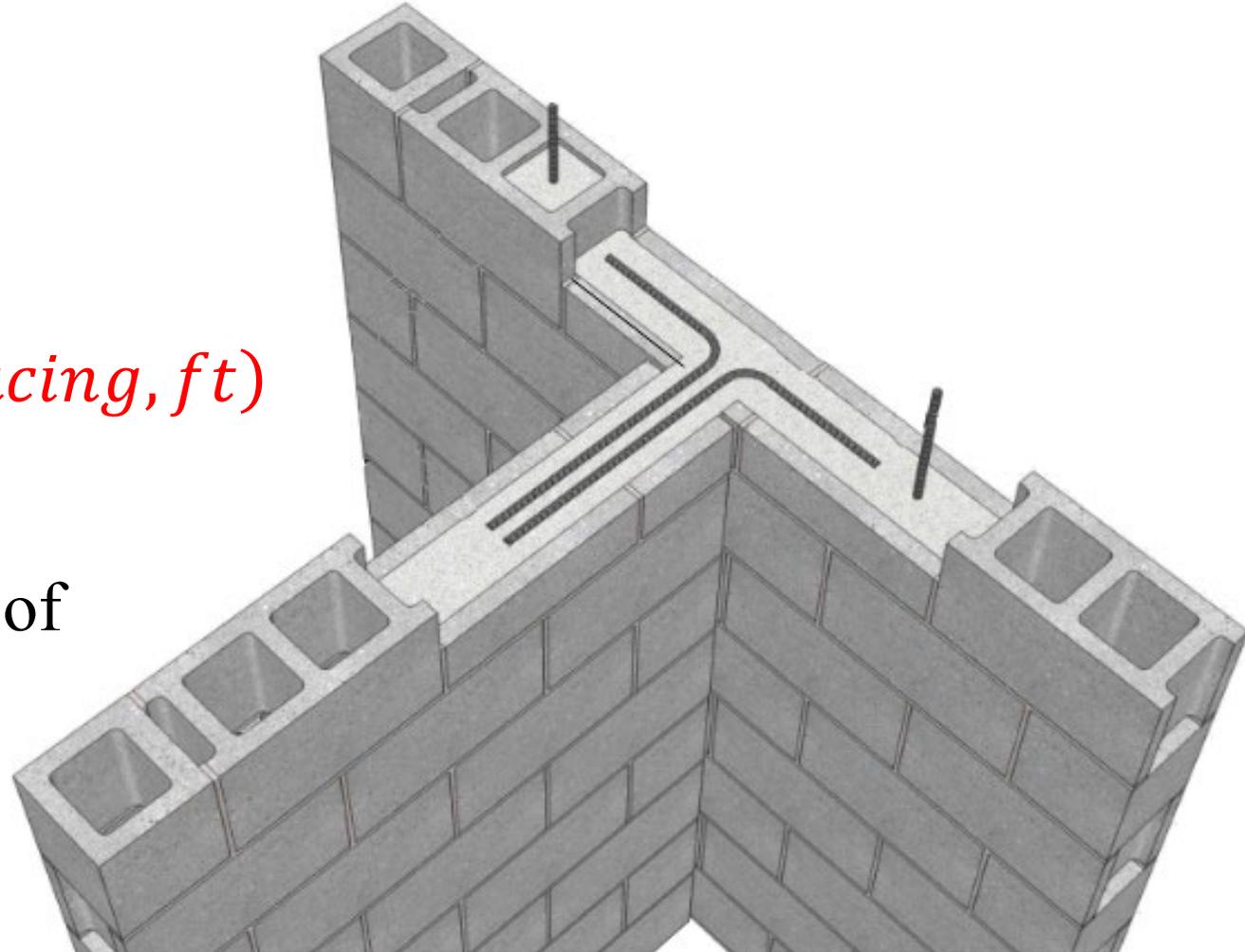
Walls anchored by steel connectors

Minimum size: $\frac{1}{4}$ in. x $1\frac{1}{2}$ in x 28 in.
including 2-in. long, 90-degree bend at
each end to form a U or Z shape.



Walls anchored by bond beams

- Bond beam spacing: 48" o.c. max
- Bond beam reinforcing:
$$A_s \geq 0.1 \text{ in}^2 / f_t \times (\text{bond beam spacing, ft})$$
- Develop reinforcement on each side of intersection



Background

- 2016 Holdover Public comments #69 and #72
 - #72: Construction danger
 - Sequencing vs final design condition
 - Intersecting walls constructed at different times pose a jobsite hazard



Photo Credit: Richard T. Rickelman, L.M.R. Construction, Inc.



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Intersecting Structural Walls

TMS 402-16

- 5.1 Masonry Assemblies
 - 5.1.1 Intersecting Walls
 - 5.1.1.2 *Design of wall intersection*

TMS 402-22

- 5.2 Walls
 - 5.2.1 Design of Independent Walls
 - 5.2.2 Design of Lateral Supports for Walls, Without Composite Action at the Intersections
 - 5.2.3 Design of Masonry Wall and Pilaster Intersections for Composite Action

Types of Intersecting Structural Walls

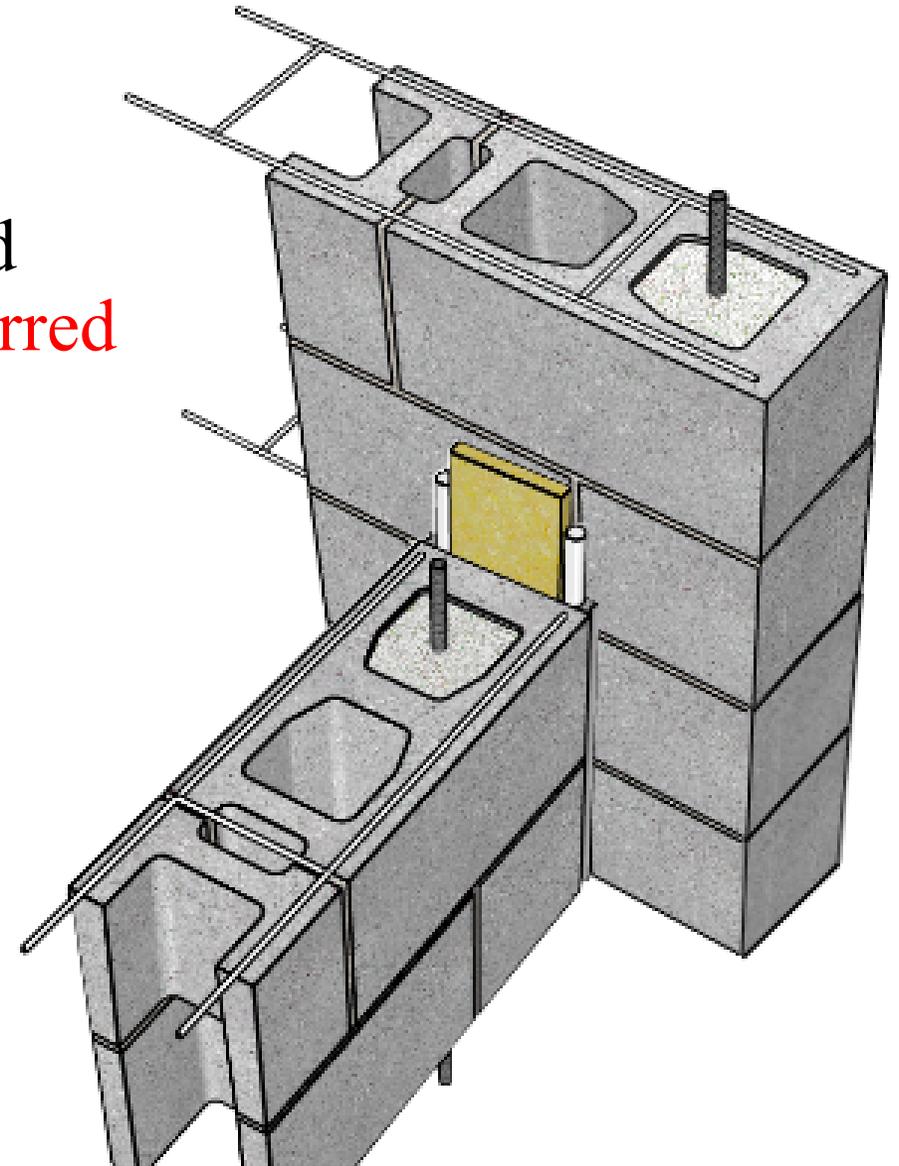
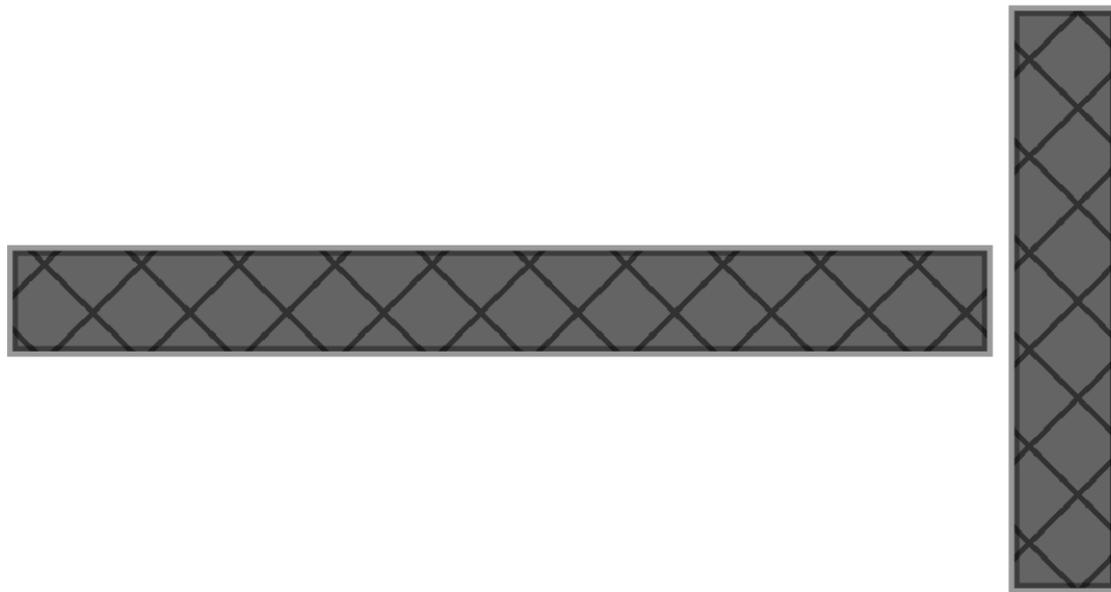
- 5.2.1 Independent
 - “Masonry walls that intersect and do not require lateral support from other walls or pilasters within those walls”

- 5.2.2 Laterally Supported, Without Composite Action
 - “Masonry walls depending upon intersecting masonry walls or pilasters for lateral support, without composite action between those members”

- 5.2.3 With Composite Action
 - “Flanges shall be considered effective in resisting applied loads.”

Independent Walls

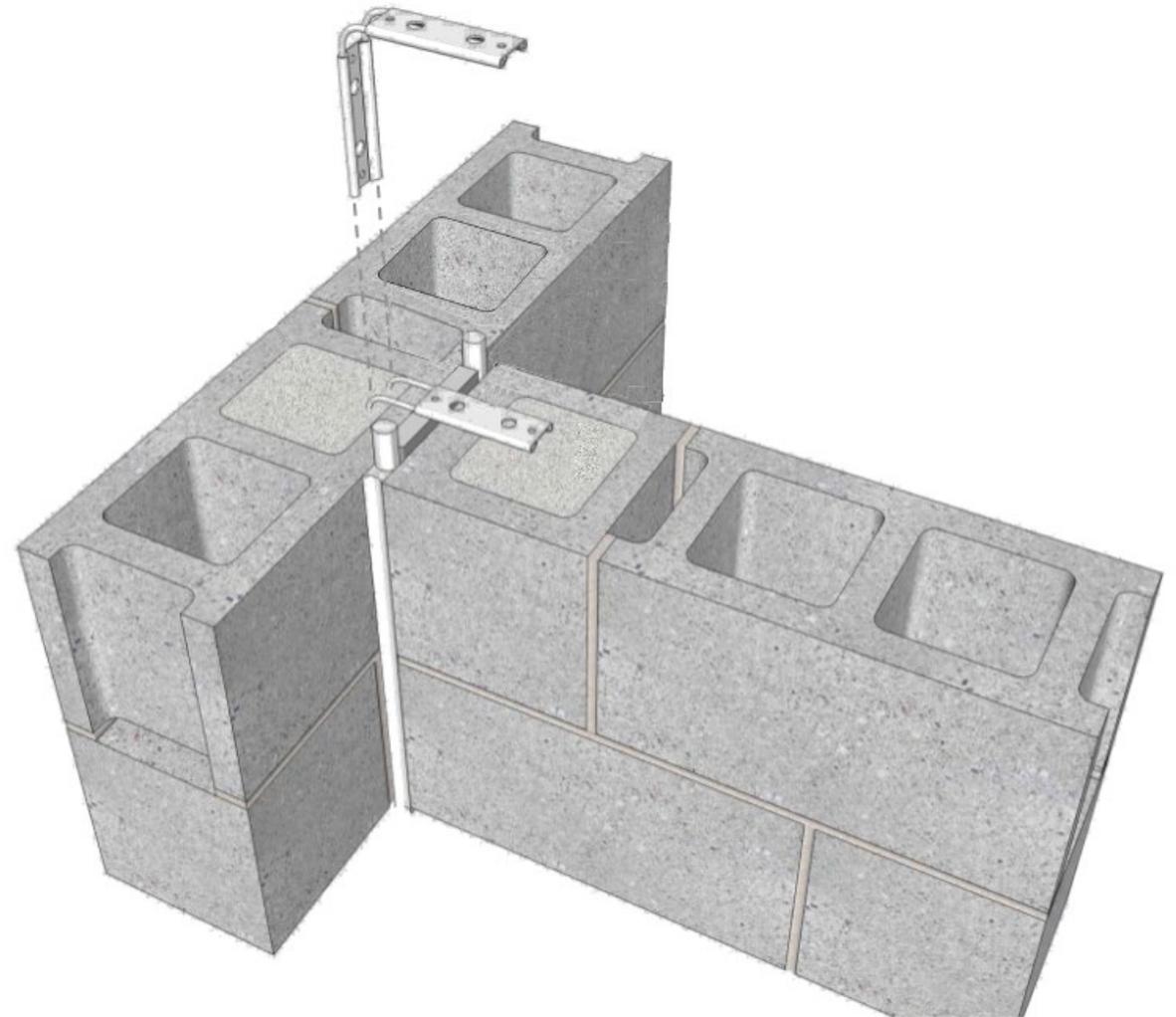
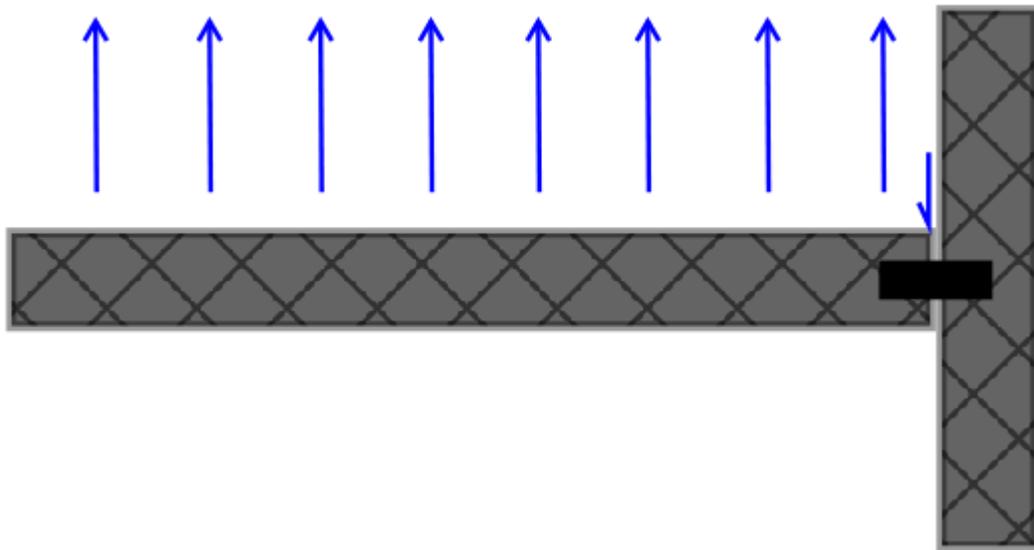
5.2.1.1 Wall Intersections shall be designed and detailed such that **no forces are transferred** between walls.



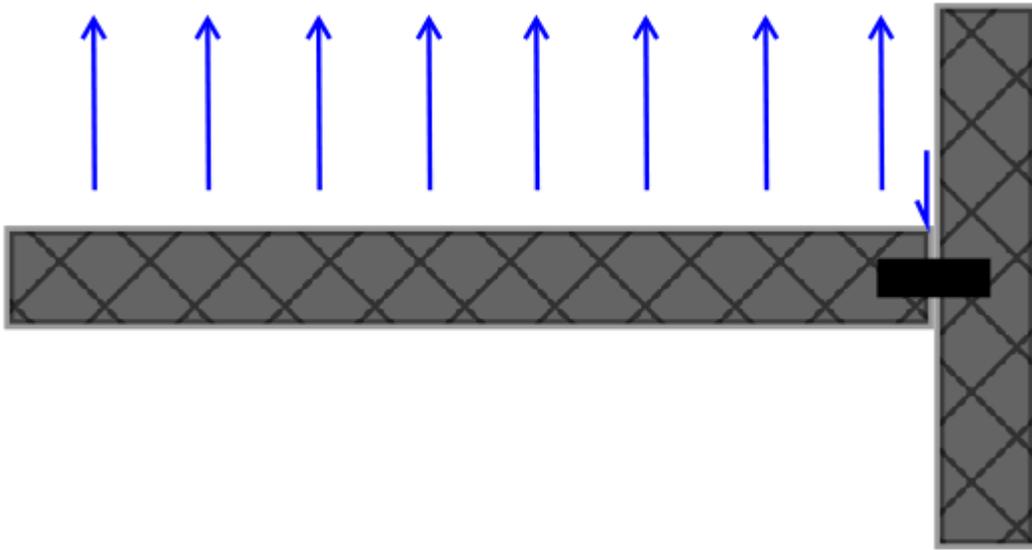
Laterally Supported, No Composite Action

- **5.2.2.1** The supported masonry wall or pilasters shall be anchored so as to **transfer no forces other than out-of-plane lateral load** acting on the supported wall to the supporting wall.
- **5.2.2.2** The supported wall or pilasters and the supporting wall shall be **permitted to share a common footing** or other gravity load support at the base of the wall.
- **5.2.2.3** The joint and the connectors shall be **designed and detailed to accommodate the vertical and horizontal deformations** of the supporting wall or pilasters.

Laterally Supported, No Composite Action

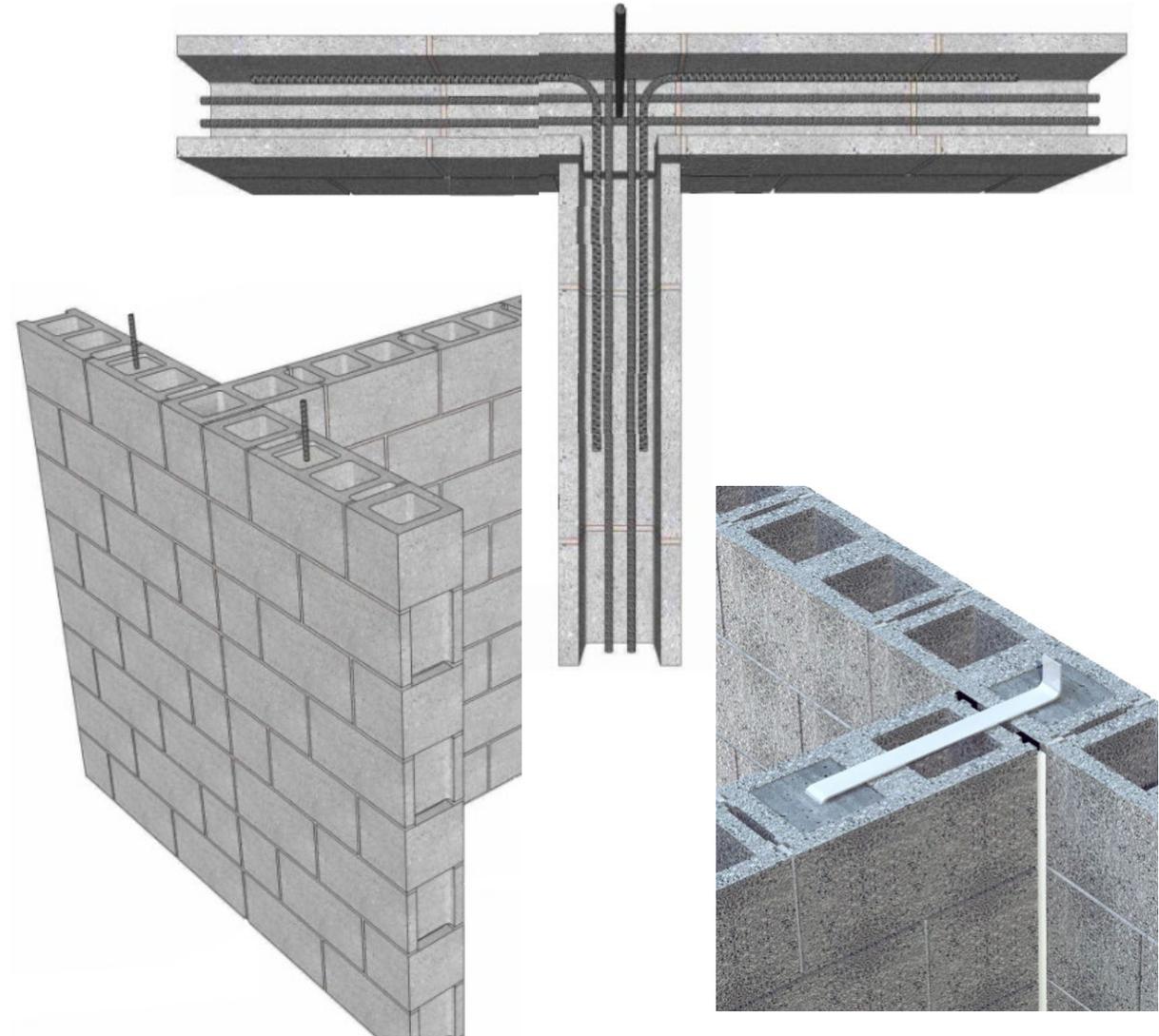
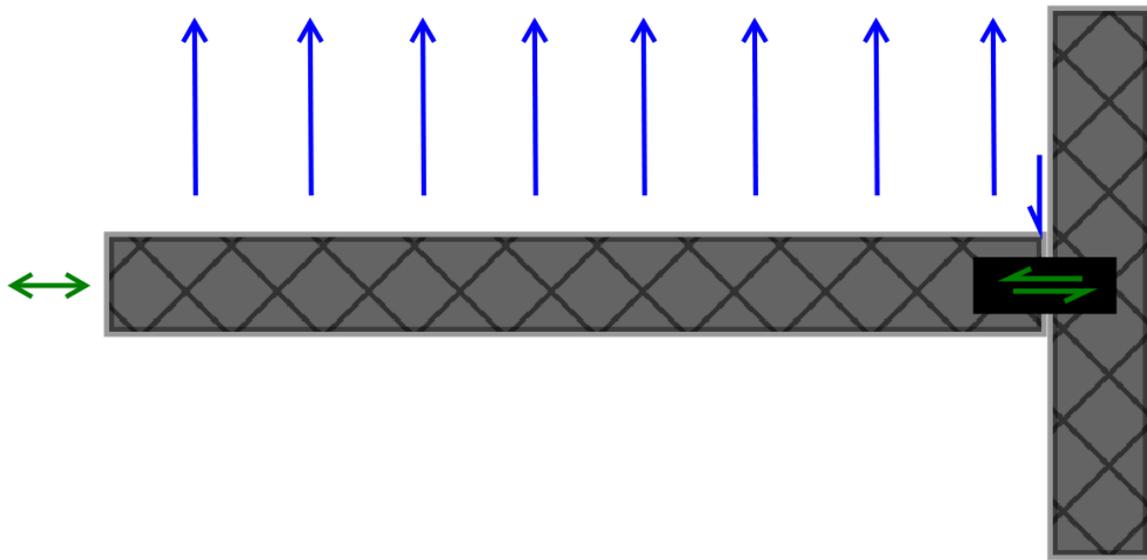


Laterally Supported, No Composite Action



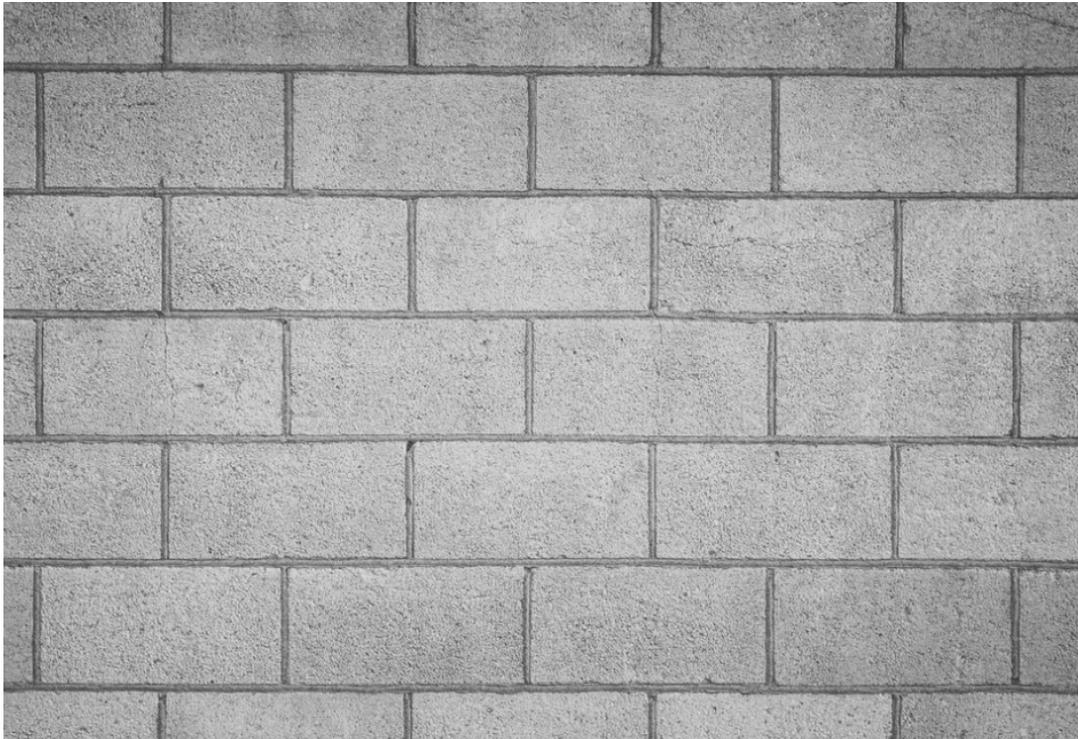
Wall Intersections with Composite Action

- Same as in 2016
 - (except...)



Effect of Bond Pattern

Running Bond



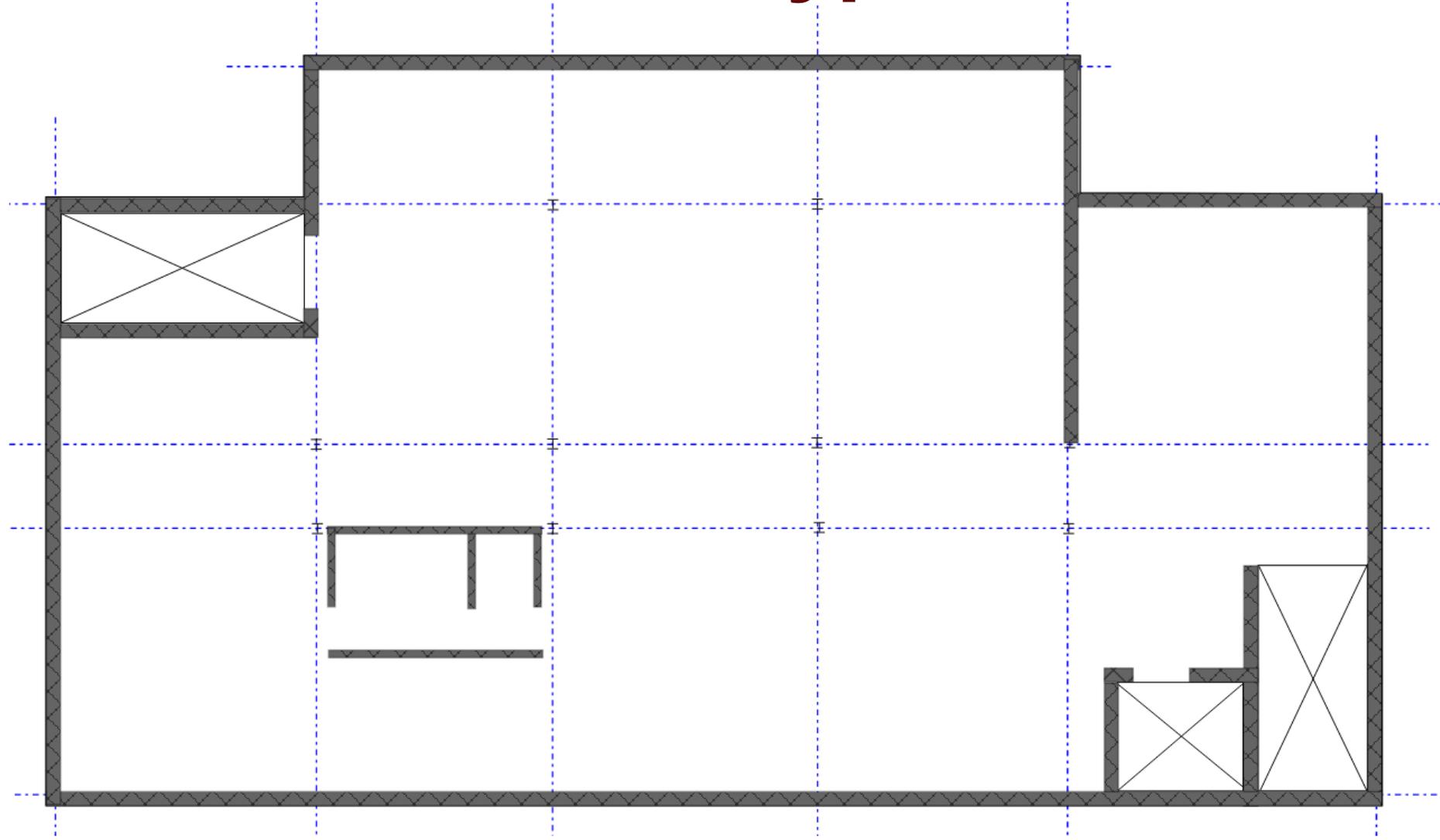
Other than Running Bond



EOR's Responsibility

- Determine force transfer required at intersection
 - Bearing/non-bearing
 - Shear wall
 - Partition
 - Control joint spacing
- Anchorage detailing must match intended wall behavior
 - $\sum F_{x,y,z} = 0$; $\sum M_{x,y,z} = 0$
- Deformation compatibility
- Consider construction sequencing

What Intersection Type Do I Use?



Conclusions

- TMS 402-22 introduces a new option for engineers to detail laterally supported structural walls, enabling the use of alternate connectors.
- Engineer must detail wall intersections for force and deformation compatibility consistent with intended behavior and bond pattern
- Consider construction sequencing and worker safety in detailing wall intersections

Acknowledgements

- TMS 402-16 Structural Members Subcommittee and Main Committee
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This concludes The American Institute of Architects Continuing Education Systems Course

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