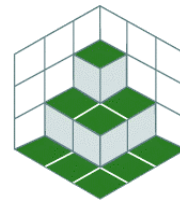


**AUTOCLAVED AERATED  
CONCRETE**

**An Established Structural  
Material New to U.S.  
Practice**

Gregory R. Kingsley Ph.D., P.E.  
Rebecca Faverty, P.E.



***KL&A, Inc.***

Structural Engineers and Builders

# Pros and Cons

## PROS

- Fire resistant
- Acoustic barrier
- Good insulation properties.
- Durable
- Lightweight
- Low embodied energy of production
- Does not off-gas
- Breathable
- Workable on site

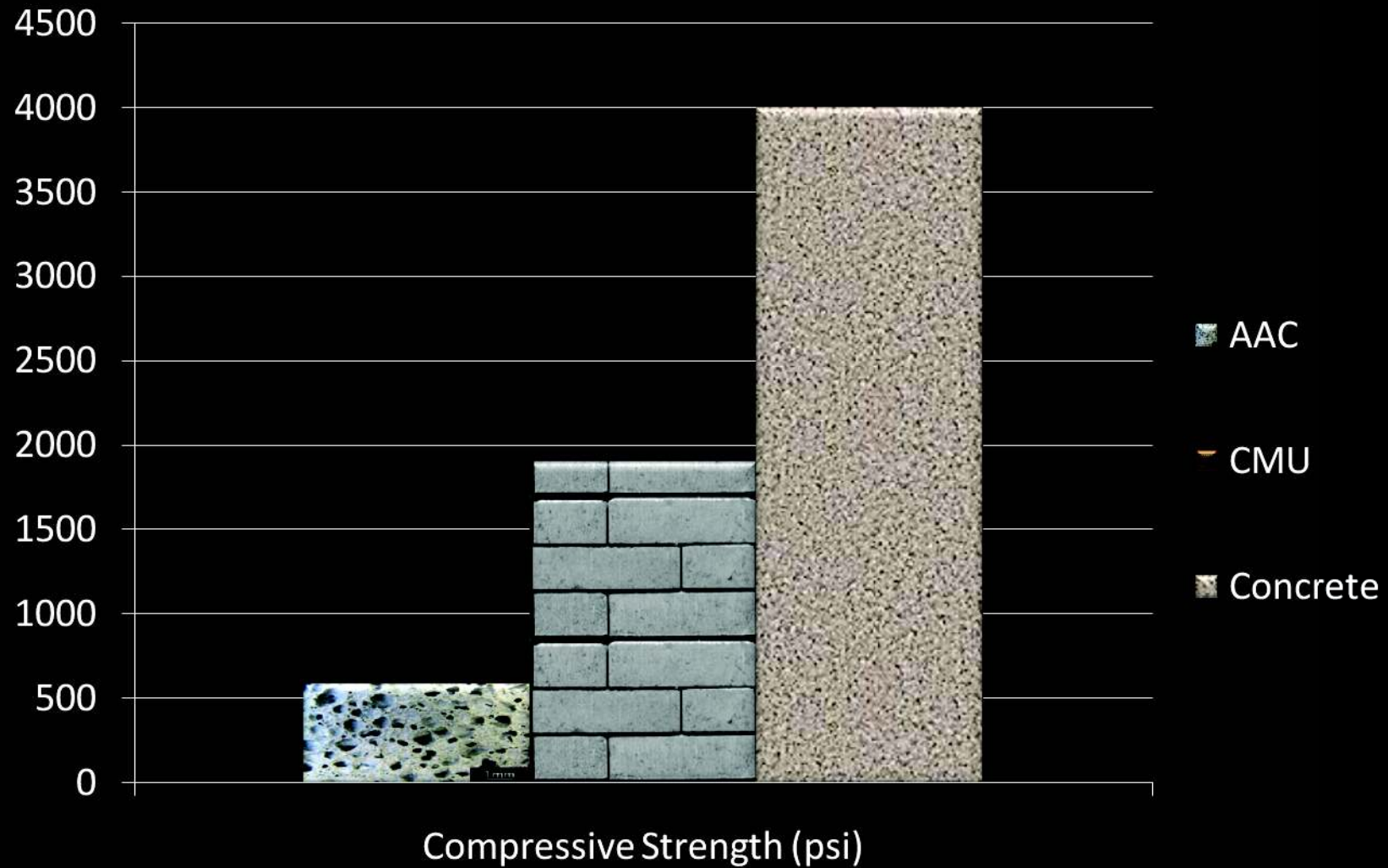
## CONS

- Not so strong
- Not familiar to
  - Code officials
  - Engineers
  - Contractors

# CONS

AAC is not very strong

# Relative Strength of AAC



# Relative Strength of AAC



Low strength is generally not a problem if there are lots of walls, which there are because AAC is filling many needs.

# CONS

Code officials are not familiar with AAC

# AAC in U.S. Design Codes

- One of the first, if not the first, “new” materials introduced to U.S. codes.
- Masonry Units covered in MSJC (Masonry Code)
- Factory reinforced panels covered in ACI 523 Guide for Precast Cellular Concrete Floor, Roof, and Wall Units

# AAC in U.S. Masonry Design Codes

- 2002 Masonry Code  
– No AAC

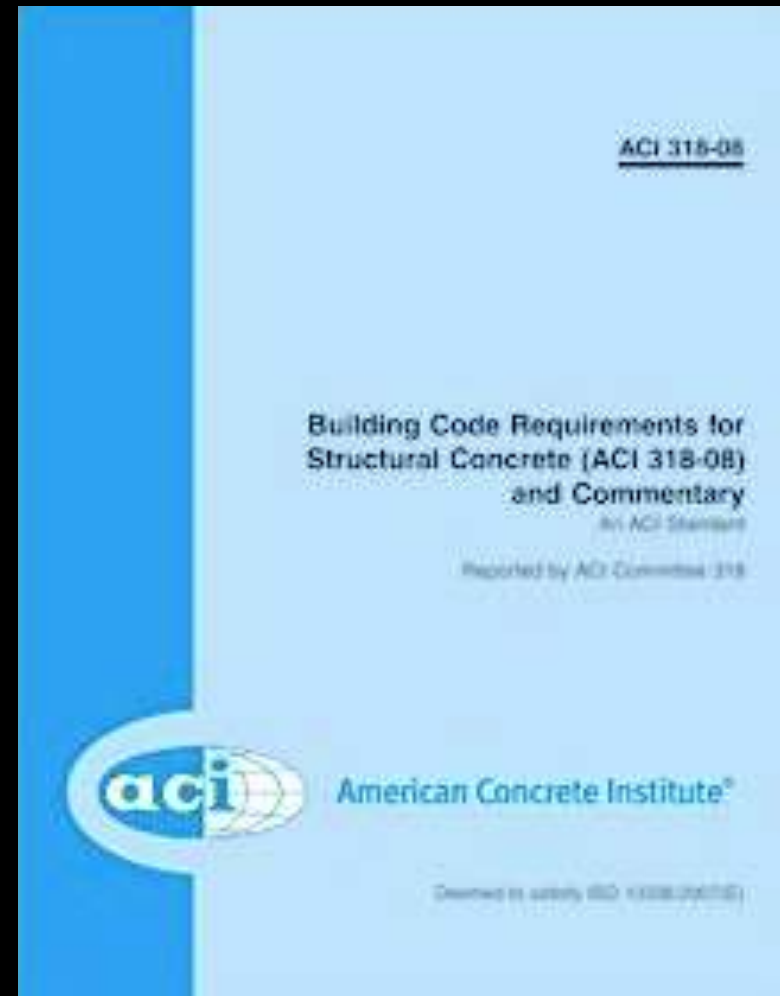
- 2005 and 2008 –  
AAC introduced in  
Appendix A

Strength Design of  
Unreinforced and  
Reinforced AAC



# AAC in U.S. Concrete Design Codes

- ACI is behind, and no provisions are ready for adoption in the concrete code
- Work is ongoing



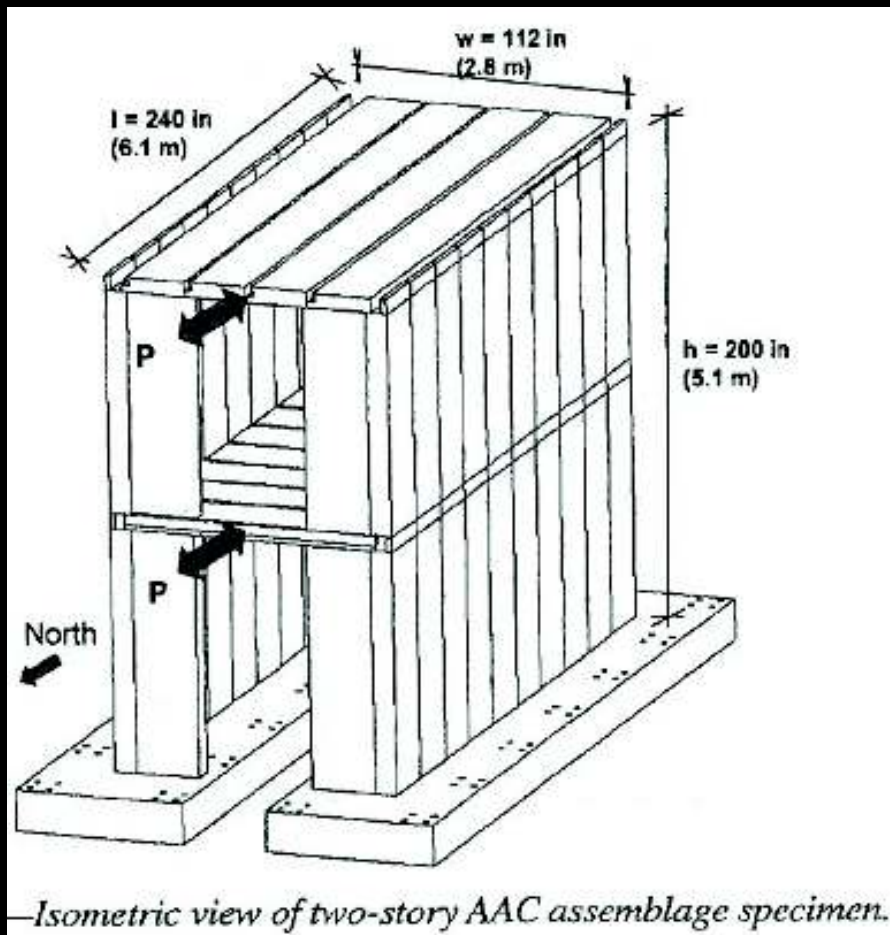
# AAC in U.S. Design Codes

- 2006 IBC:
  - AAC “shall not be used in seismic force resisting system of structures classified in Seismic Design Category B, C, D, E or F”
  - All other MSJC 2005 provisions apply
- 2007 Supplement to 2006 IBC:
  - AAC can be used in SDC A, B, and C, with building heights up to 35 ft

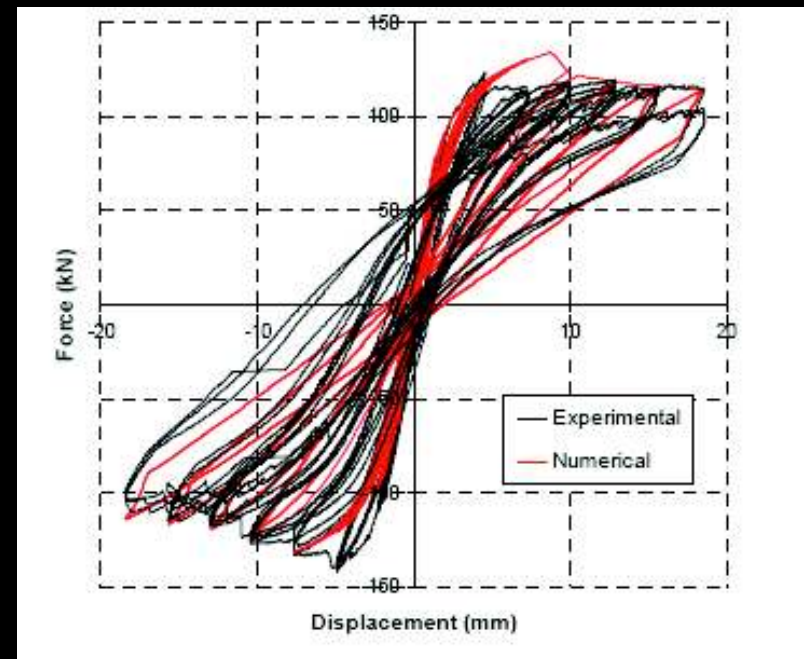
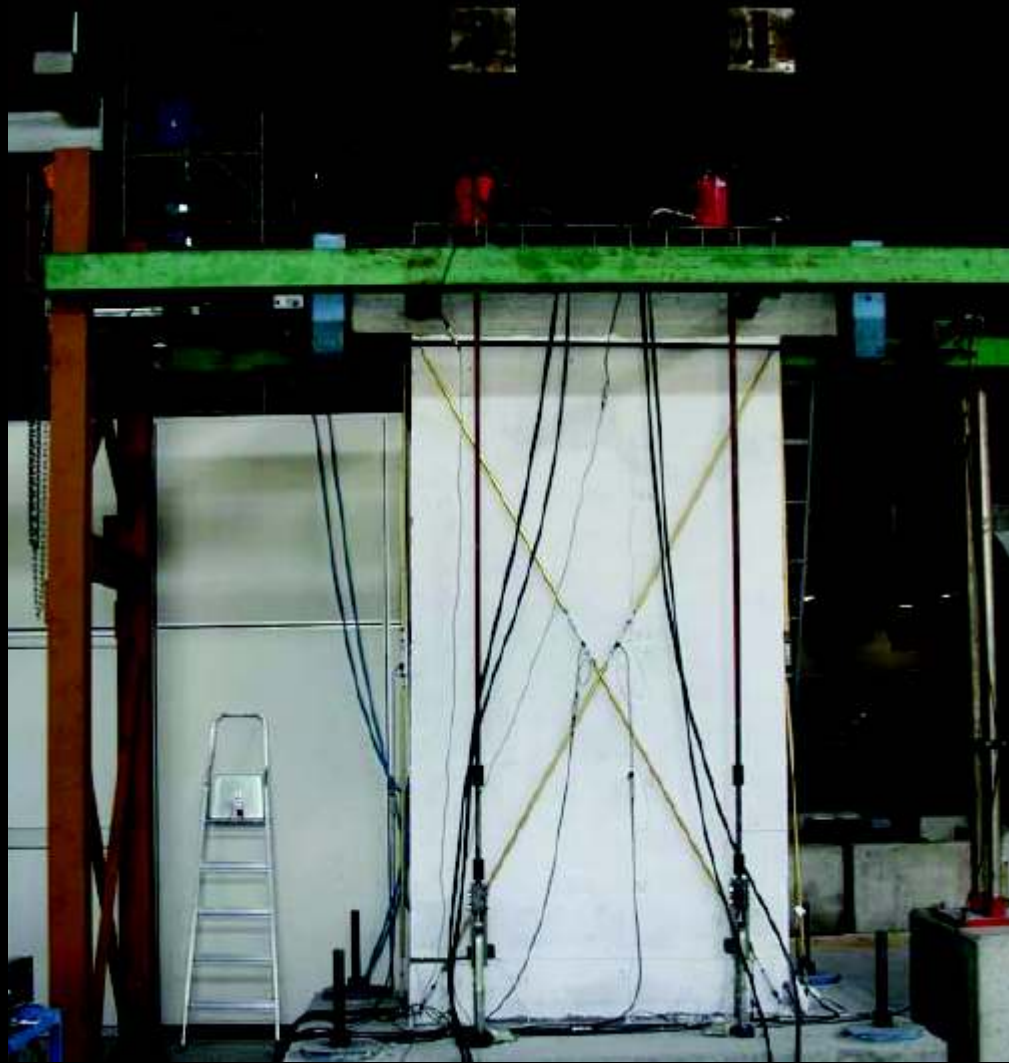
# CONS

Engineers are not familiar  
with AAC

# Experimental testing in U.S. and Europe



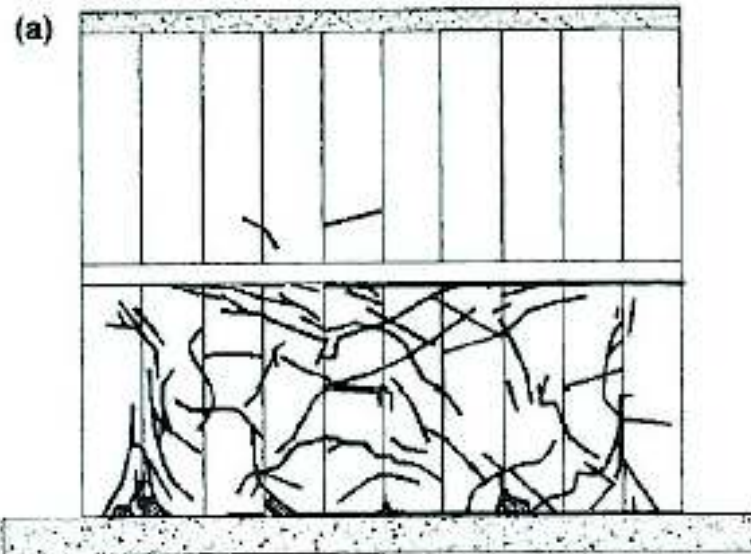
# Experimental testing in U.S. and Europe



# Experimental testing in U.S. and Europe

- Displacement ductility 3.5 – 6
- Maximum drift 0.3% - 0.6%

Shearwall/direction of loading	Displacement ductility	Drift ratio at yield, %	Drift ratio, %
East wall/south	6	0.07	0.42
East wall/north	3.1	0.075	0.24
West wall/south	3.9	0.098	0.37
West wall/north	2.5	0.13	0.24

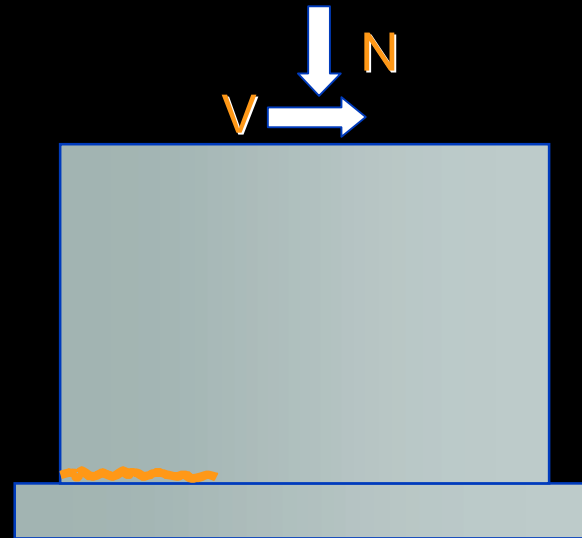


# Equation for Flexural Cracking

## Key factors

modulus of rupture of AAC or  
tensile bond strength

axial force ( N )

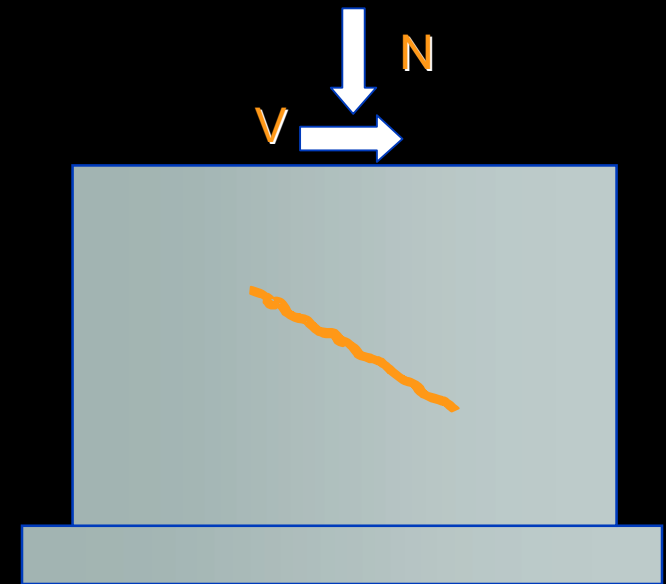


$$V_{cr} = \frac{S}{h} \left( f_{rAAC} + \frac{P}{l_w t} \right)$$

# Equation for shear cracking

## Key factors

- diagonal tensile strength of AAC ( $f_t$ )
- axial force (N)

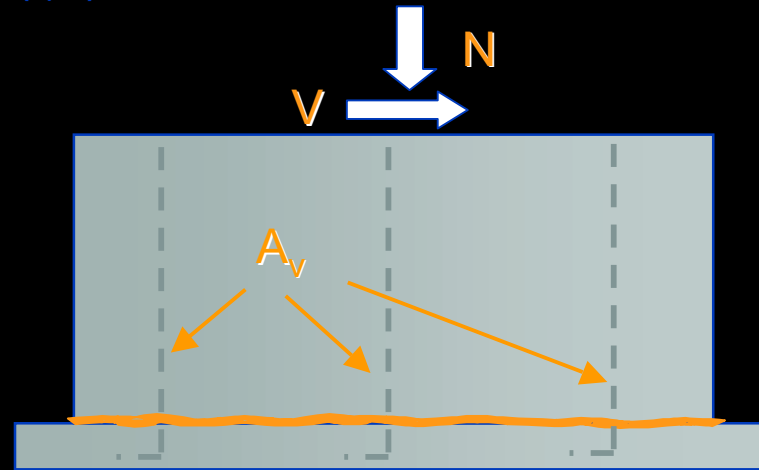


$$V_{AAC} = \ell_w t \sqrt{f'_{AAC}} \sqrt{1 + \frac{P_u}{2.4 \sqrt{f'_{AAC}} \ell_w t}}$$

# Equation for Sliding Shear

## Key factors

dowel action ( $A_v$ ) of vertical bars (monotonic loading only)  
axial force ( $N$ ) and coefficient of friction ( $\mu$ )

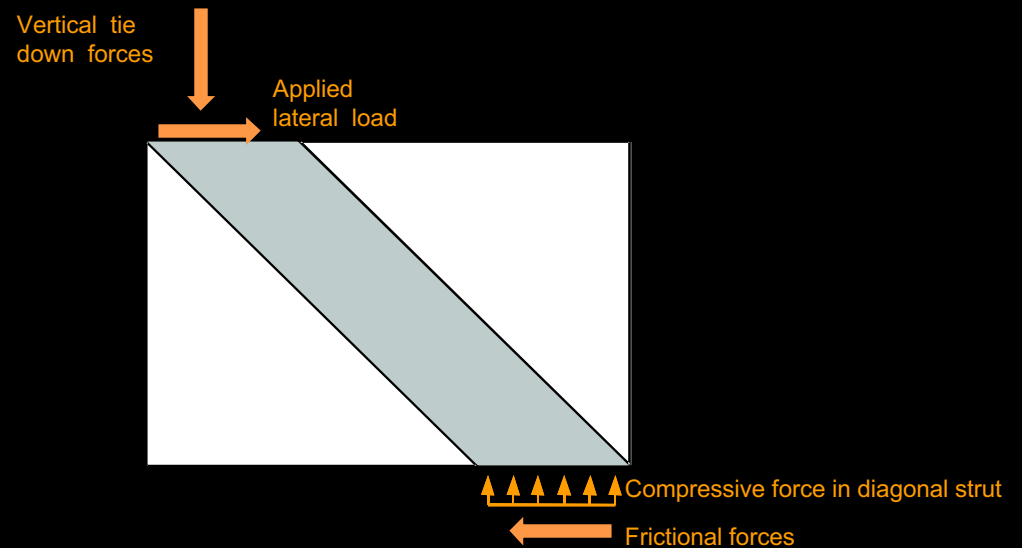


$$V_{ss} = \mu P_u$$

# Equation for crushing of diagonal strut

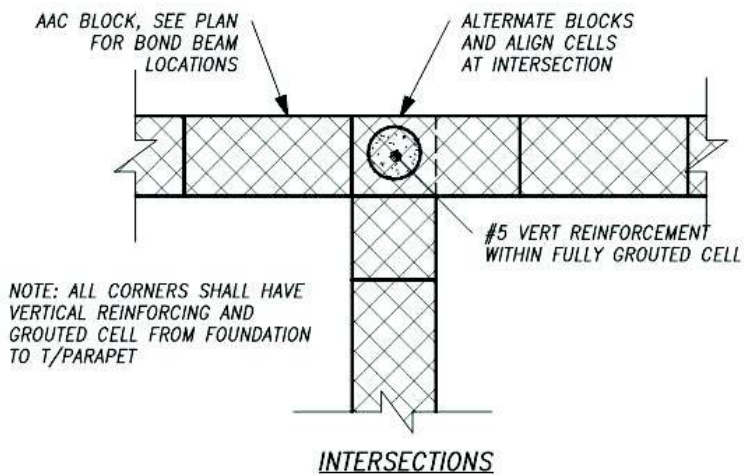
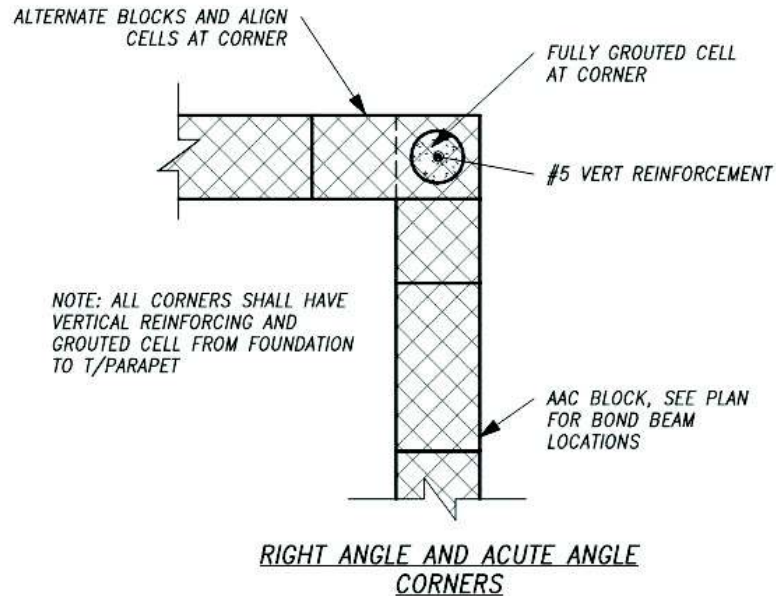
## Key factors

- axial load
- compressive strength



$$V_{ds} = 0.9 \cdot f_{AAC} \cdot t \cdot w_{strut} \left[ \frac{h \cdot \left(\frac{3}{4} l_w\right)}{h^2 + \left(\frac{3}{4} l_w\right)^2} \right]$$

# Design Challenges



AAC is not the same as CMU, but it is close

# CONS

Contractors are not  
familiar with AAC

# Construction Method



- AAC is laid up using a polymer-modified, thin-bed mortar applied with a special toothed trowel

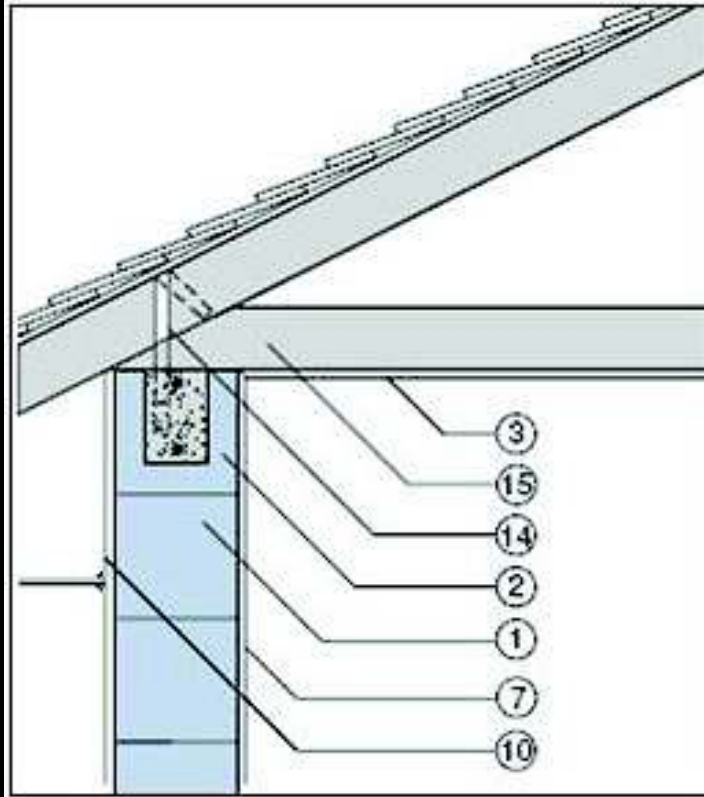
# Construction Methods

- AAC can be grouted and reinforced just like conventional concrete masonry

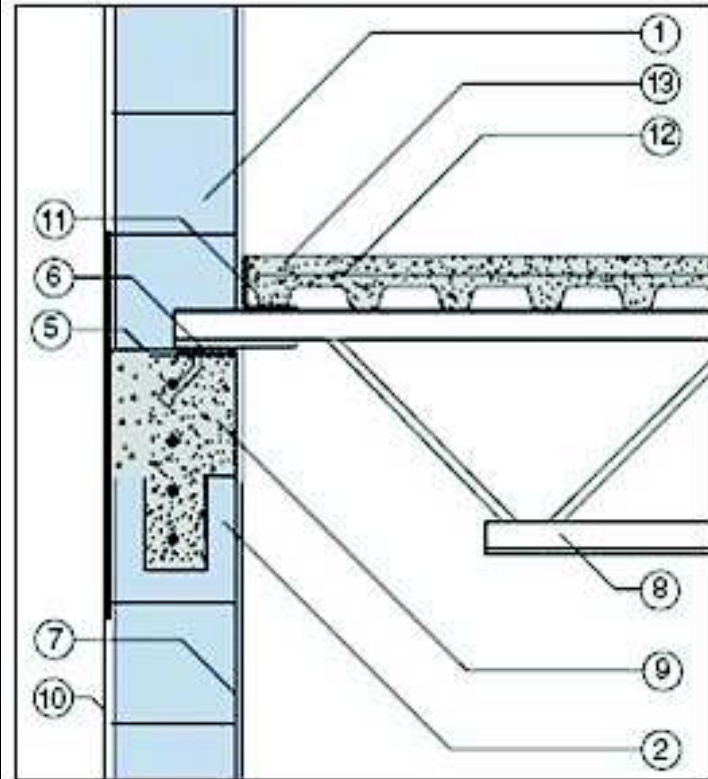


# Construction Method

Bond Beam Detail

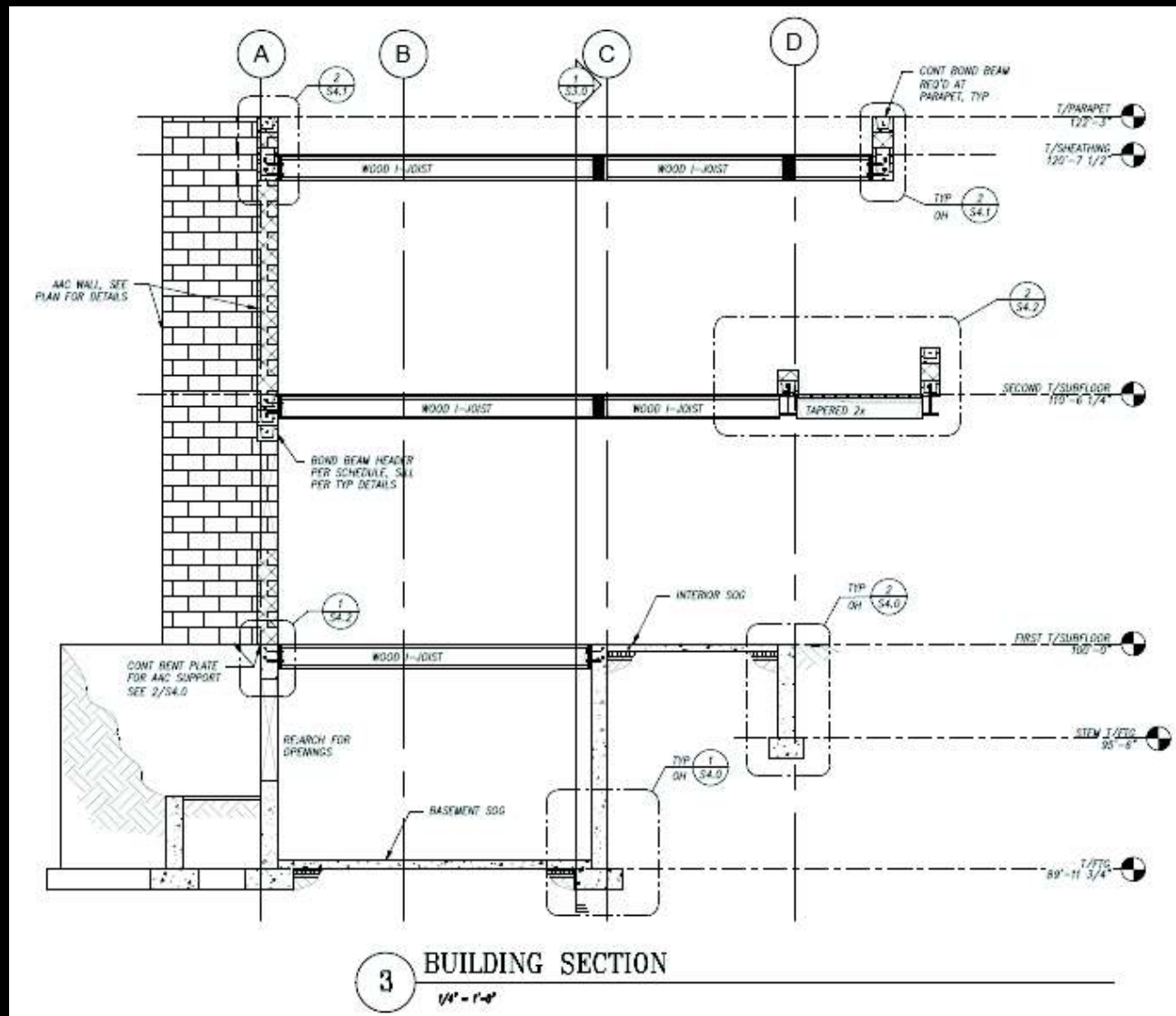


Joist Bearing Detail



- Details similar to conventional reinforced masonry

# Construction Details



# Construction Method



- AAC can be easily modified on site

# Construction Method



- AAC can adapt to a variety of forms

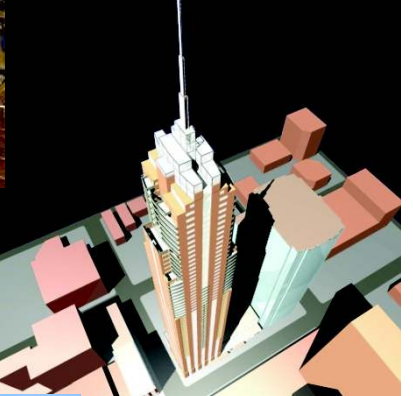
# Challenges - Construction

Additional inspections may be necessary to verify that unfamiliar details are understood correctly



# Conclusion

- There are enormous advantages to AAC
- It is still new to many, but the knowledge gap is not hard to close
- Codes are in place and improving rapidly



*KL&A*

Structural Engineers and Builders

