

Update on the 2011 MSJC Code and Specification

Richard E. Klingner
SEAOt Conference

San Antonio, Texas

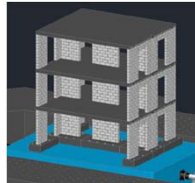
The University of Texas at Austin
September 27, 2012

Update on the 2011 MSJC Masonry Code and Specification



SEAOt Annual Conference
San Antonio, Texas
September 27, 2012

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Objectives

- eye candy
- basic design approach for elements of wall - type buildings, with emphasis on reinforced masonry
- updates to 2011 Masonry Standards Joint Committee (MSJC) provisions
- future evolution of MSJC provisions
- the eye candy again

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full - scale , 3 - story reinforced concrete masonry building under 2.0 MCE



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Essential elements of design for wall - type structures

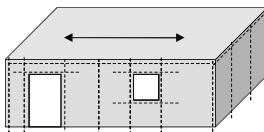
- starting point for design
- design of vertical strips in walls perpendicular to lateral loads
- design of walls parallel to lateral loads
- design of lintels
- simplified analysis for lateral loads
- design of diaphragms
- detailing

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Starting point for wall - type masonry structures

NO BEAMS OR COLUMNS

(example of direction of span)

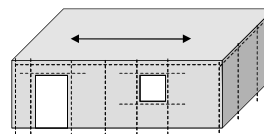


vertical reinforcement of #4 bars at corners, jambs, and about 4 - foot intervals

Horizontal reinforcement of two #4 bars in bond beam at top of wall, and above and below openings (two #5 bars over openings with span > 6 ft)

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Essential function of walls in resisting gravity loads



bearing walls resist axial loads (concentric and eccentric) as vertical strips

non - bearing walls resist concentric axial load as vertical strips

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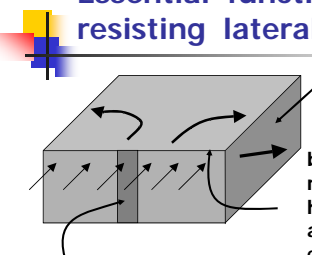
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Essential function of walls in resisting lateral forces



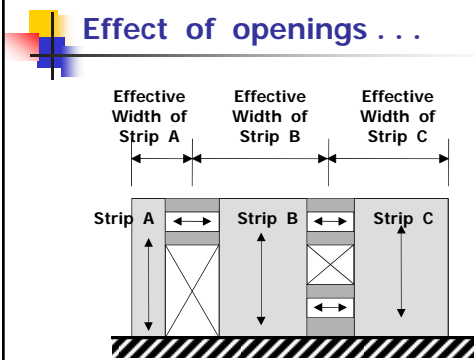
walls parallel to lateral forces act as shear walls

bond beams transfer reactions from walls to horizontal diaphragms, and act as diaphragm chords

vertical strips of walls perpendicular to lateral forces resist combinations of axial load and out-of-plane moments, and transfer their reactions to horizontal diaphragms

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Effect of openings . . .



Effective Width of Strip A Effective Width of Strip B Effective Width of Strip C

Strip A Strip B Strip C

Width A Width B Width C

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. . . Effect of openings

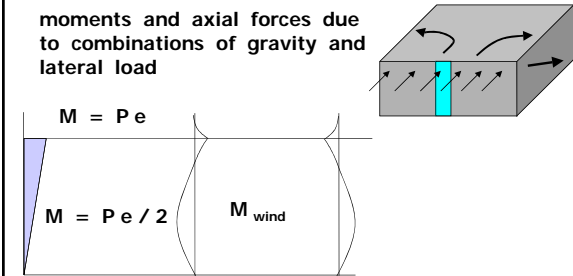
Openings increase original design actions on each strip by a factor equal to the ratio of the effective width of the strip divided by the actual width

$$\text{Actions in Strip B} = \text{Original Actions} \left(\frac{\text{Effective Width B}}{\text{Actual Width B}} \right)$$

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Design of vertical strips in perpendicular walls

moments and axial forces due to combinations of gravity and lateral load



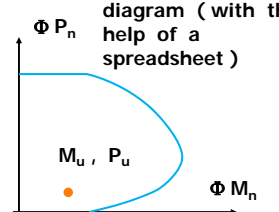
$M = P e$

$M = P e / 2$ M_{wind}

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. . . Design of vertical strips in perpendicular walls

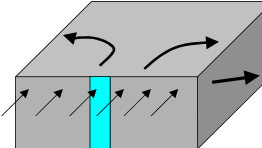
moment - axial force interaction diagram (with the help of a spreadsheet)



ΦP_n

M_u, P_u

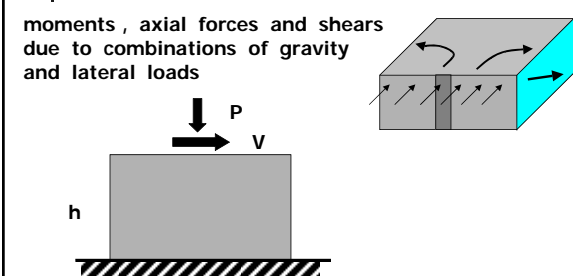
ΦM_n



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Design of parallel walls . . .

moments, axial forces and shears due to combinations of gravity and lateral loads



P

V

h

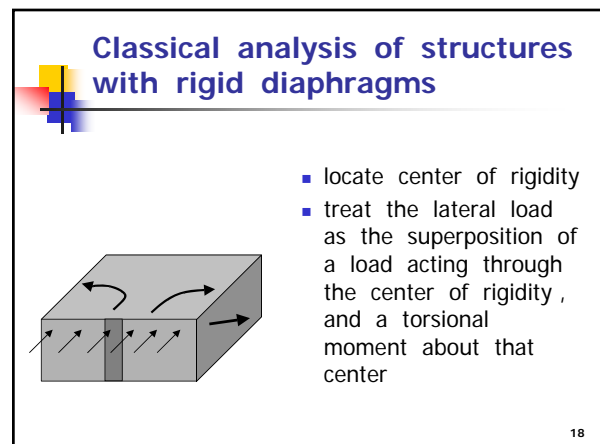
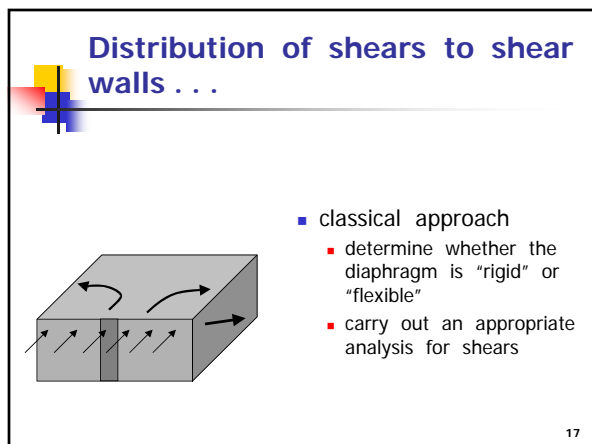
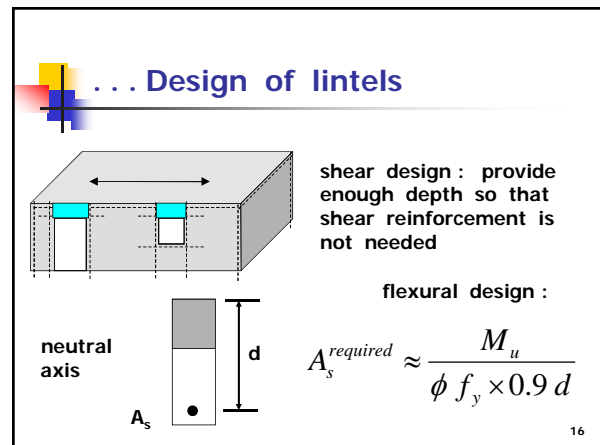
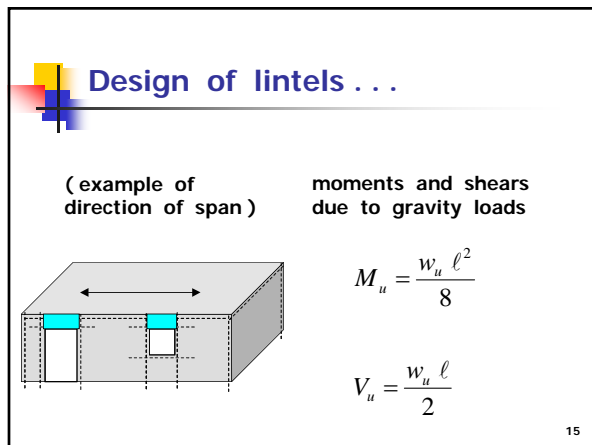
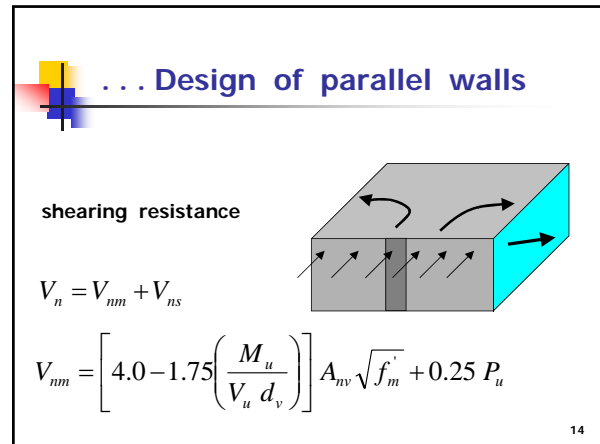
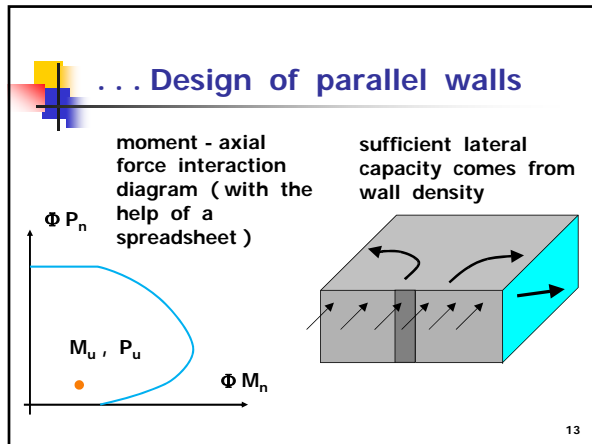
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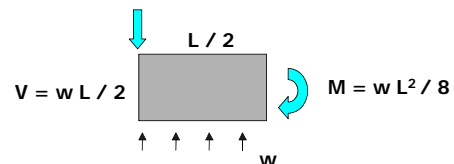
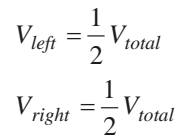
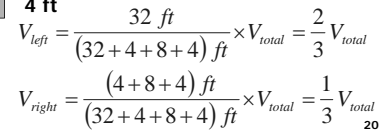
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... Details

- wall - diaphragm connections
- design of lintels for out - of - plane loads between wall - diaphragm connections
- connections between bond beam and walls
- connections between walls and foundation

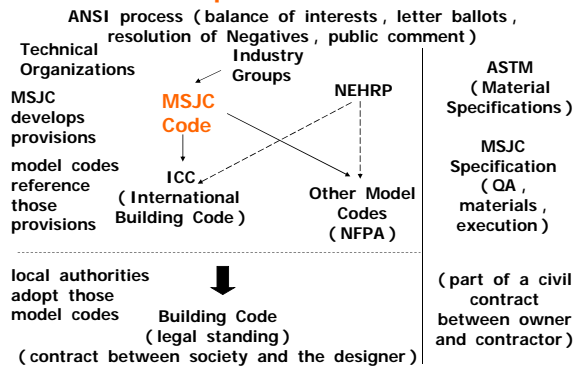
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Code development in the US

- US has no national building code
- code - development process is complex
 - technical organizations develop provisions
 - model codes reference those provisions
 - local authorities legally adopt those model codes

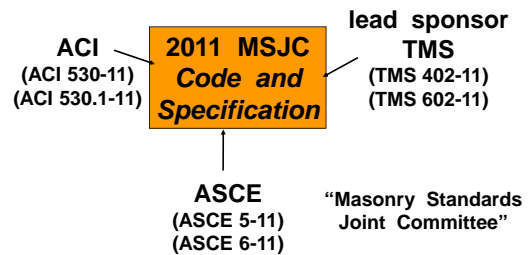
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Code Development in the US



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The MSJC Code and Specification...



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... the MSJC Code and Specification

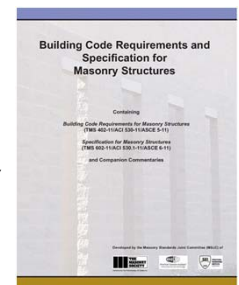
- MSJC began in 1978
- MSJC develops *Code* and *Specification* under ANSI consensus procedures, for reference by model codes such as IBC, NFPA
- New edition of the *Code* and *Specification* every 3 years
 - 2011 edition is referenced by 2012 IBC
 - 2008 edition is referenced by 2009 IBC
 - 2005 edition is referenced by 2006 IBC
 - 2002 edition is referenced by 2003 IBC

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... the MSJC Code and Specification

Code and Code Commentary

Specification and Specification Commentary



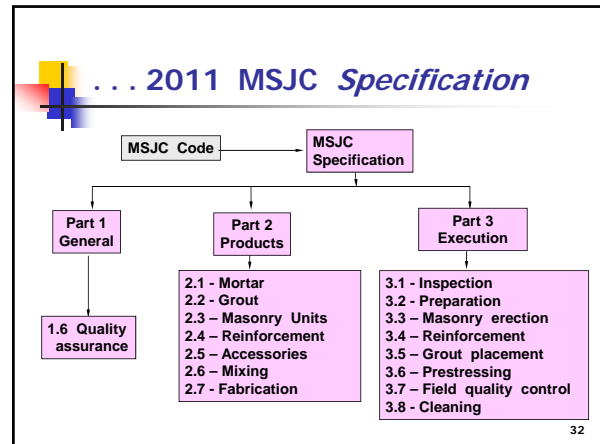
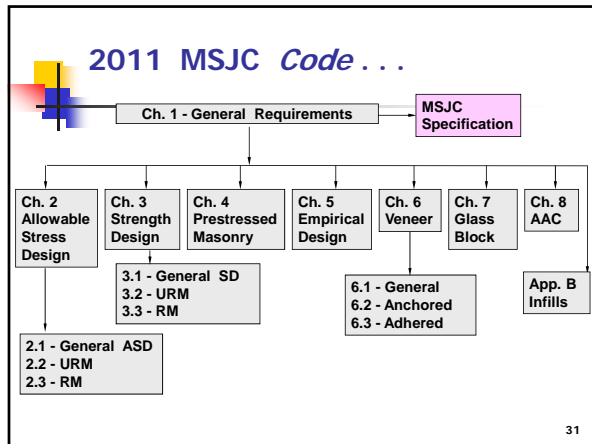
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Updates from the 2008 to the 2011 MSJC Code ...

- side - by - side format
 - Code and Code Commentary
 - Specification and Specification Commentary

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... Updates from the 2008 to the 2011 MSJC Code

- updated to ASCE 7 - 10
 - wind loads in ASCE 7 were recalibrated to strength levels
 - load factors changed (SD from 1.6 to 1.0)
 - wind triggers changed for empirical design , veneer , and glass unit masonry

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... Updates from the 2008 to the 2011 MSJC Code

- new Appendix B for masonry infills
 - unreinforced CMU and clay units (work on AAC infill for 2013 edition)
 - participating and non - participating infill
 - prescriptive reinforcement required

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... Updates from the 2008 to the 2011 MSJC Code

- Recalibration of stresses
 - remove 1/3 stress increase option that was formerly permitted for Allowable Stress Design (ASD) for loading combinations including wind or seismic loads
 - harmonize ASD and SD shear provisions
 - increase some allowable stresses , compensating for effect of removing 1/3 stress increase
 - eliminate conflict between MSJC ASD provisions permitting the 1/3 stress increase and the ASCE 7 provision prohibiting the increase

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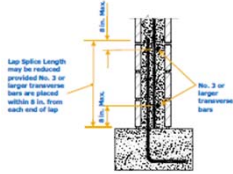
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New in the 2011 MSJC Code...

- lap splices are permitted to be reduced when transverse reinforcement is placed within 8 in. of the end of the splice and fully developed in grouted masonry



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...New in the 2011 MSJC Code

- the beneficial effect of larger cover for computation of required development length has been changed from $5 d_b$ to $9 d_b$
- provisions have been added for deep beams
 - effective ratio of span to depth less than 3 for continuous spans or 2 for simple spans
 - require additional analysis, and minimum flexural and shear reinforcement (Code 1.13.2)

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...New in the 2011 MSJC Code

- installation requirements for anchor bolts have been revised
- references to "stack bond" or other bond patterns have been changed to "running bond" or "not in running bond"
- revised equation for walls with unbonded prestressing tendons

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...New in the 2011 MSJC Code

- empirical design is prohibited for structures assigned to Risk Category IV (Essential Structures)
- provisions have been added for adhered dimension stone
- single - pintle ties are permitted for anchored veneer
- clarification that drips are prohibited in wire anchors, joint - reinforcement cross - wires, and tabs

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...New in the 2011 MSJC Code

- provisions for nominal sliding shear capacity at the interface of AAC and thin - bed mortar
- expanded and clarified QA requirements for AAC masonry

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...New in the 2011 MSJC Code

- MSJC QA tables include specific references to applicable code and specification requirements, because similar references were removed from the IBC in 2012.

Inspection Task	Frequency ^a		Reference for Criteria	
	Continuous	Periodic	TMS 402/ACI 530/ASCE 5	TMS 602/ACI 530.1/ASCE 6
4. Verify during construction:				
a. Size and location of structural elements		X		Art. 3.3 F
b. Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction		X	Sec. 1.16.4.3, 1.17.1	

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... New in the 2011 MSJC Code

- grout lift height is changed to 5 ft - 4 in. to accommodate modular construction
- provisions are added for testing prisms cut from existing construction

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future evolution of the MSJC Code and Specification (personal opinion only)

- empirical design will eventually be replaced by engineered design
- allowable stress design, almost completely harmonized with strength design, will eventually be replaced by strength design
- we will have new options for seismic design
 - limit design, permitting a plastic distribution of ASCE 7 forces, and appropriate detailing of reinforcement
 - eventually, displacement-based design

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full - scale , 3 - story reinforced concrete masonry building under 2.0 MCE



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For more information

- MSJC = www.masonrystandards.org
- TMS = www.masonrysociety.org
- BIA = www.bia.org
- NCMA = www.ncma.org

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Objectives

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