Existing Masonry Draft Pre-Standard – What It Says, What It Does Not Say, And How to Use It

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Heather Sustersic, P.E.
Senior Structural Engineer
Colby Company Engineering

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EMG Task Group and EMG Summit

- Nashville TMS meeting 2021
- Currently have:
  - 9 Chapters
  - 1 Appendix
- EMG Summit March 6th-11th, 2024
- 1st EMSC meeting October 16, 2024

	Code	Commentary	Appendix	Total
Page Count	91	126	22	239

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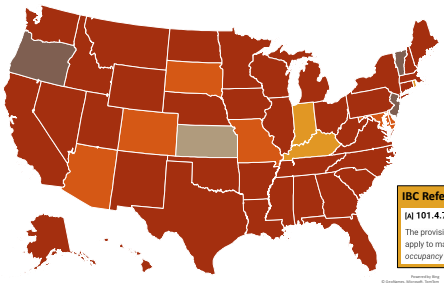
CHAPTER 1 – GENERAL REQUIREMENTS

IEBC Adoption by State



- Statewide
- Limited Localities
- IBC Reference
- State Properties
- None

IBC Reference:

(A) 101.4.7 Existing buildings.

The provisions of the *International Existing Building Code* shall apply to matters governing the *repair*, *alteration*, *change of occupancy* , *addition* to and relocation of *existing buildings* .

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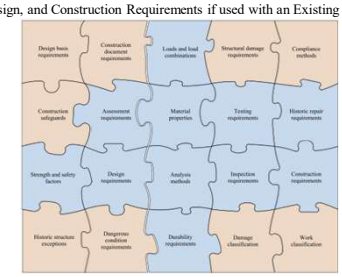
CHAPTER 1 – GENERAL REQUIREMENTS

Existing Building Code Integration

- 1.5 Assessment, Design, and Construction Requirements if used with an Existing Building Code



TMS EMS

IEBC

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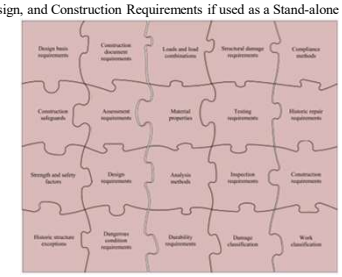
CHAPTER 1 – GENERAL REQUIREMENTS

Stand-Alone Code

- 1.6 Assessment, Design, and Construction Requirements if used as a Stand-alone Building Code



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CHAPTER 2 – NOTATIONS AND DEFINITIONS

Key Terminology

- Alterations
- Assessment
- **Component**
- Connector
- Dangerous
- Design-Basis Code
- Design-Basis Criteria
- Destructive Investigations
- **Evaluation**
- Existing Building Code
- **Functions**
- Historic Fabric or Materials
- **Historic Significance**
- **Intervention**
- Licensed Design Professional
- **Material – New**
- **Material - Existing**
- Mitigation
- Nominal Properties
- Non-destructive investigations
- Original Building Code
- Preservation
- Project
- Re-assessment
- Repair
- **Reinstall**
- Replace
- Retrofit
- **Reversibility**
- Salvage
- Stabilize
- **Systems**
- Tactile Investigation
- Unsafe
- Work Area

R_0 = allowable capacity based on the original building code

R_a = required capacity based on allowable stress design load combinations

R_{a0} = required capacity based on allowable stress design load combinations of the *original building code*

R_{ac} = required capacity based on allowable stress design load combinations of the *current building code*

R_n = nominal capacity

R_{n0} = nominal capacity based on the original building code

R_u = required capacity based on strength design load combinations

R_{u0} = required capacity based on strength design load combinations of the *original building code*

R_{uc} = required capacity based on strength design load combinations of the *current building code*

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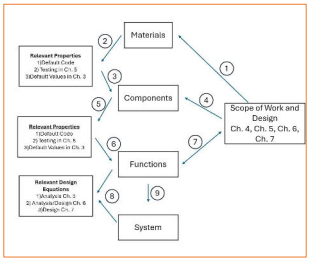
Materials, Components, and Systems

- Changed the title!
- Flowchart
- 3.1.1 Scope, requirements for
  - Existing materials, components, systems
  - New materials, components, systems
- 3.1.1 Scope
  - Supports use of alternate materials and procedures not discussed in the chapter
- 3.1.4 Second-hand materials and components
  - Permitted, must meet material compatibility requirements



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Materials, Components, and Systems

- 3.1.2 Properties of existing materials, components, and systems
  - 3.1.2.3 Nominal properties
  - 3.1.2.4 Unspecified properties
    - Ch. 5, Assessment and Evaluation
      or
    - 3.2, 3.3 Default properties (materials, components)

Masonry type	Year range	Physical property, unit	Default Conservative property	Typical property	Upper-bound
Fully grouted CMU	19XX-present	Compressive strength, psi			
		Modulus of rupture, psi			
		Modulus of elasticity, psi			
		Modulus of rigidity, psi			

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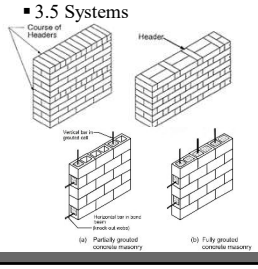
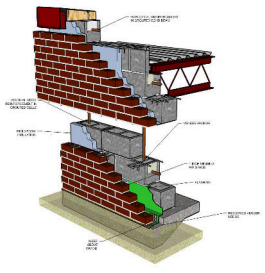
Materials, Components, and Systems

- 3.4 Functions
- 3.5 Systems





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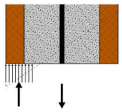
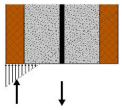
Structural Requirements

Member Demands
- Loads & Load Combinations

Member Capacities
- Strength Design



- Allowable Stress Design



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Member Capacities

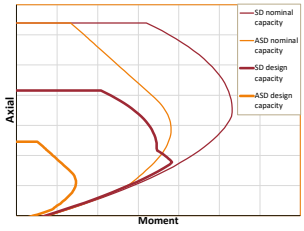
- SD-ASD Harmonization

$$R_u \leq \phi R_n$$

$$R_a \leq \frac{R_n}{\Omega}$$

- Verified Material Strengths

$$\phi_{ver} \;\&\; \Omega_{ver}$$



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Assessment and Evaluation

- Provides procedures, techniques, means, and methods
- Scope varies based on *Project Objectives*
- Informs the Intervention (Chapter 7) to meet the Objective
- Commentary-heavy
- Chapter 5 DOES NOT include (but will direct the user for)
  - Disaster response
  - Rapid safety assessment
  - Intervention
  - Design
  - Seismic requirements
  - Additional requirements for heritage structures and items of historical significance

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Assessment

- Level of assessment
  - LDP responsible to define
- Required vs optional assessment
  - Establishes minimum standard of care
- Reporting requirements
  - Minimum expected documentation
- Archival, visual, tactile, nondestructive, destructive investigations
- Types of nondestructive and destructive tests for units, mortars, grouts, metals
  - A la carte listing of measurement types with Commentary for each
  - Tables of test type, sample size, standard reference
- As-Built properties
  - Geometric, material, physical, chemical
- Sampling requirements, types, constraints, locations

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Evaluation

- Reporting requirements
- When is Immediate Intervention needed?
  - Dangerous or unsafe conditions
  - Items of historic significance
- Parameters that need to be *identified*
  - Functions, Systems ← required
  - Materials, Components ← as needed
- Damage classification
  - Type, severity, extent
- In-Place material properties
- Test data interpretation, variation, confidence
- Analysis requirements
  - Equilibrium, Stability, Load Path, Components Functions
- Evaluation methods and limitations
  - Graphical (geometry), Empirical (experience), Analytical (mechanical), Computational (advanced modeling)

5.3.5.1. Test Data Interpretation

If the design uses the Strength Design approach, characteristic capacity (F_c) shall be determined using the 5% fractile value, based on a confidence level of 90%, in accordance with Eq. (5.3.5.1a). If the design uses the ASD approach, the safety factor Ω shall be assigned to the test capacity in accordance with Eq. (5.3.5.1b).

$$F_c = F_m(1 - Kv) \quad (5.3.5.1a)$$

$$F_{ASD} = F_m/\Omega \quad (5.3.5.1b)$$

where

F_m = Mean value of tested results
K = Statistical factor determined in accordance with Table 3.2.5.2.2 (unitless)
v = Coefficient of variation (unitless)
Ω = Safety Factor for ASD, Determined with Section 4.3.2

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Durability

Objective: Educate professionals and promote thinking about and consideration for durability in designing for repair and restoration projects

1. Understand the building/structure and materials

Photo courtesy of Jordan Dick

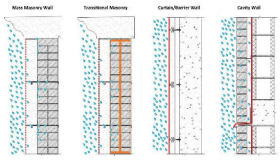

Image courtesy of Amy Lamb Woods

Heavy on Commentary; light on Code

Chapter Outline:

- General
- Masonry Wall Systems
- Structural Intervention
- Water Management Improvement
- Thermal and Differential Movement of Materials
- Corrosion Mitigation of Embedded Steel
- Fire Damage Considerations
- Repair Material Quality
- Masonry Unit Material Compatibility
- Supplemental and Replacement Connectors
- Mortar Selection
- Cleaning
- Coatings
- Interior Insulation
- Implementation of Repair Work

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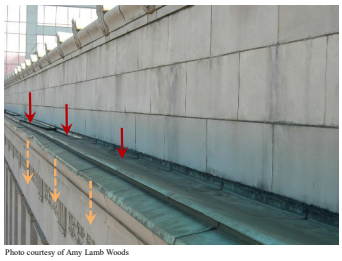
CHAPTER 6 – DURABILITY

Address root cause of damage

2. Address the root cause of the damage (e.g. water infiltration, stabilization)

Photo courtesy of John Cooke



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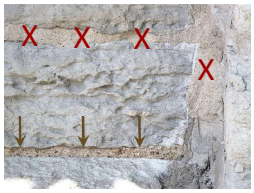
CHAPTER 6 – DURABILITY

Compatible materials

3. Select repair and replacement materials that are compatible and/or appropriate



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CHAPTER 6 – DURABILITY

Implementation of repair work

4. Conduct quality control for mockups and implementation of repair work

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Rehabilitation Design

Photos courtesy of Craig Bennett

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Rehabilitation Design

- Minimal Intervention Concept
  - Based on evaluation ensure global and local stability
  - Principles of historic preservation shall be considered
- Design Approaches – Choice of Design Professional
  - *Original Design Basis (I)*
    - Local repair of masonry components shall be designed to bring the structure to a performance level consistent with the original design.
  - *Alteration Design Basis (II)*
    - Alterations of designed to allow the masonry systems to comply with the original design. New components designed in accordance with the current building code.

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Rehabilitation Design

- Design Approaches – Choice of Design Professional
  - *Improved Performance Design Basis (III)*
    - Repairs or alterations shall be designed to improve the performance of masonry components or systems thereby increasing the level of safety of the structure.
  - *Current Code Design Basis - Complete Retrofit (IV)*
    - Rehabilitation of masonry systems and components shall be designed to achieve compliance with current building codes.
- The remaining sections and commentary describe how to do this
- Does NOT address seismic retrofit

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Construction & Quality Assurance

- Construction
  - Closely matches ACI 562 *Chapter 9 - Construction* with a few additions specific to masonry construction.
  - Contractor Responsibilities shall be indicated in the construction documents for:
    - Protecting the Safety of individuals involved in construction
    - Maintaining stability of the existing structure
    - Ensuring the quality of work
- Quality Assurance
  - Combines the provisions of TMS 402 3.1 *Quality Assurance Program* and ACI 562 *Chapter 10 - Quality Assurance*
  - A Quality Assurance program must be implemented by the Contractor
  - Construction documents must include requirements for minimum Special Inspections, testing and field observations

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Construction & Quality Assurance

- Commentary
  - Includes construction techniques specific to masonry repair with recommendations to ensure quality workmanship.
  - Contains a template for "Minimum Quality Assurance Requirements" (similar to "Minimum Special Inspection Requirements of TMS 602")
    - Includes Submittal Reviews, Material Testing and Construction Observations
    - Tasks and frequencies shall be edited by the LDP based on scope and complexity
- ACI 562 *Chapter 10* stresses the importance of **reporting unanticipated conditions** revealed during construction.
  - The Provisions and Commentary of Chapter 8 attempt to reinforce this important concept!

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THE MASONRY SOCIETY

Heather Sustersic, P.E.
Colby Company Engineering
47A York Street
Portland, Maine 04101
hsustersic@colbycoengineering.com

Initial Team
- Chapter 1 - **Patrick Dillon**, Larry Kahn
- Chapter 3 - **Mike Schuller**, Bennett Banting, Kenton McBride
- Chapter 4 - **Patrick Dillon**, Larry Kahn, Peter Babaian
- Chapter 5 - **Heather Sustersic**, Can Simsir, Daniele Malomo, Meera Ramesh
- Chapter 6 - **Amy Lamb Woods**, Jordan Dick, John Cooke
- Chapter 7 - Sara Ganzerli, Craig Bennett, Mike Brown, **Mark McGinley**
- Chapter 8 - Lisa Burnett, **Tom Elliot**, Brad Crumb

Reviewing Team
- Randall Bernhardt
- David Biggs
- Ron Hunsicker

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