



Historic Preservation in High Wind Prone Regions: Understanding IEBC-09 and code provisions for work on historic buildings

Presented by
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PRESENTATION OUTLINE

1. General Code Requirements for High Wind
2. IEBC Code requirements for Historic Buildings
3. Case Studies
 - Brewster Meeting House
 - Brooks Academy
4. Questions



CODE REQUIREMENTS FOR STRUCTURES IN HIGH WIND REGIONS

Building in High Wind Prone Areas

Building Codes: Why the Change?

- New Code Requirements
- New Materials and Methods of Construction
- Forensic studies following natural disasters
- Evolving building science and technologies
- Research and test results from full scale models



2012 Hurricane Season Summary

Source: National Hurricane Center



Saffir-Simpson Hurricane Scale

Tropical depression
0–39 mph
0–62 km/h

Tropical storm
39–73 mph
63–117 km/h

Category 1
74–95 mph
119–153 km/h

Category 2
96–110 mph
154–177 km/h

Category 3
111–129 mph
178–208 km/h

Category 4
130–156 mph
209–251 km/h

Category 5
>156 mph
>251 km/h

Increased Hurricane Activity in Recent Years

- 2010- 2012 amongst the most active years in recorded history
- 19 named tropical cyclones, 10 hurricanes and a major hurricane
- 2012 also one of the longest seasons: May 19- Oct 25
- Sandy- Category 2; largest know gale diameter (1100 mi) hurricane
- \$65 Billion estimated damage in US
- At least 253 people killed in seven countries
- Affected 24 states, over 10 million people without power





Extensive Hurricane Damage Photos



Extensive Hurricane Damage Photos

Design Criteria for Buildings in High Wind Regions

- IRC Code
- Design Criteria
- Wind Limitations
- Hurricane Prone Areas
- ASCE 7 Wind Loads

780 CMR 53.00

BUILDING PLANNING FOR SINGLE- AND TWO-FAMILY DWELLINGS

780 CMR 5301 DESIGN CRITERIA

5301.1 Design. Buildings and structures, and all parts thereof, shall be constructed to safely support all loads, including dead loads, live loads, roof loads, flood loads, snow loads, wind loads as prescribed by 780 CMR 51.00 through 99.00. The construction of buildings and structures shall result in a system that provides a complete load path capable of transferring all loads from their point of origin through the load-resisting elements to the foundation.

5301.1.1 Alternative Provisions. An alternative to the requirements in 780 CMR 5301.1 the following standards are permitted subject to the limitations of 780 CMR 51.00 through 99.00 and the limitations therein. In lieu of prescriptive compliance, where engineering design is used in conjunction with these standards the engineered design shall be performed by a Massachusetts-registered professional engineer or architect, employ an appropriate engineering rationale consistent with the standards below and utilize the wind and snow loads set forth in 780 CMR 51.00 through 99.00.

1. American Forest and Paper Association (AF&PA) Wood Frame Construction Manual (WFCM);
2. American Iron and Steel Institute (AISI), Standard for Cold-Formed Steel Framing: Prescriptive Method for One- and Two-family Dwellings (COFS/PM).

Note that seismic design requirements are not applicable to one- and two-family detached dwellings.

5301.1.2 Construction Systems. The requirements of 780 CMR 51.00 through 99.00 are based on platform and balloon-frame construction for light-frame buildings. The requirements for concrete and masonry buildings are based on a balloon framing system. Other framing systems must have equivalent detailing to ensure force transfer, continuity and compatible deformations.

5301.1.3 Engineered Design. When a building of otherwise conventional construction contains structural elements exceeding the limits of 780 CMR 5301 or otherwise, not conforming to 780 CMR 51.00 through 99.00, these elements shall be designed in accordance with accepted engineering practice. The extent of such design need only demonstrate compliance of nonconventional elements with other applicable provisions and shall be compatible with the performance of the conventional framed system. Engineered

design shall be provided by a Massachusetts-registered professional engineer or architect and shall utilize the wind and snow loads set forth in 780 CMR 51.00 through 99.00.

5301.2 Climatic and Geographic Design Criteria. Buildings shall be constructed in accordance with the provisions of 780 CMR 51.00 through 99.00 as limited by the provisions of 780 CMR 5301; also see 780 CMR Table 5301.2 (1).

5301.2.1 Wind Limitations. Buildings and portions thereof shall be limited by wind speed, as defined in 780 CMR Table 5301.2(1), and construction methods in accordance with 780 CMR 51.00 through 99.00. Basic wind speed shall be determined from 780 CMR Table 5301.2(1). Where different construction methods and structural materials are used for various portions of a building, the applicable requirements of 780 CMR 5301 for each portion shall apply. Where loads for windows, skylights and entrance doors are not otherwise specified, the loads listed in 780 CMR Table 5301.2(2) adjusted for height and exposure per 780 CMR Table 5301.2(3), shall be used to determine design load performance requirements for windows and doors.

5301.2.1.1 Design Criteria. Construction in regions where the basic wind speeds from 780 CMR Table 5301.2(4) equal or exceed 110 miles per hour (177.1 km/h) shall be designed in accordance with one of the following:

1. American Forest and Paper Association (AF&PA) Wood Frame Construction Manual for One- and Two-Family Dwellings (WFCM); or
2. Southern Building Code Congress International Standard for Hurricane Resistant Residential Construction (SSR 10); or
3. Minimum Design Loads for Buildings and Other Structures (ASCS-7); or
4. American Iron and Steel Institute (AISI), Standard for Cold-Formed Steel Framing: Prescriptive Method for One- and Two-family Dwellings (COFS/PM);
5. Concrete construction shall be designed in accordance with the provisions of 780 CMR 51.00 through 99.00.

5301.2.1.2 Internal Pressure. Windows in buildings located in wind borne debris regions shall have glazed openings protected from windborne debris or the building shall be designed as a partially enclosed building in

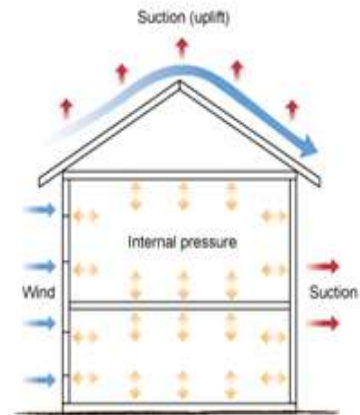


Types of Loads

- Gravity



- Wind



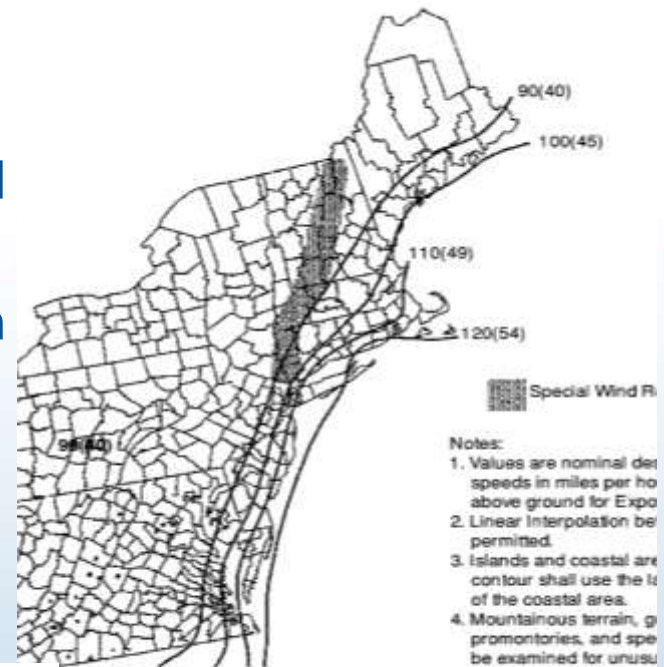
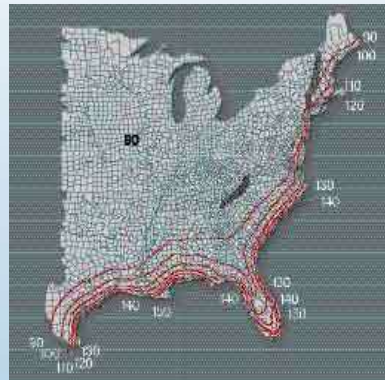
- Flood



- Other

Wind Load Basics

- Wind Loads based on 100 year recurrence interval for each region based on ASCE Wind Contour Map (ASCE-7)
- Basic Wind Speed used to determine wind pressure on buildings and structures
- Values based on nominal design based on 3 second gust at 33 ft above ground for various Exposure Categories

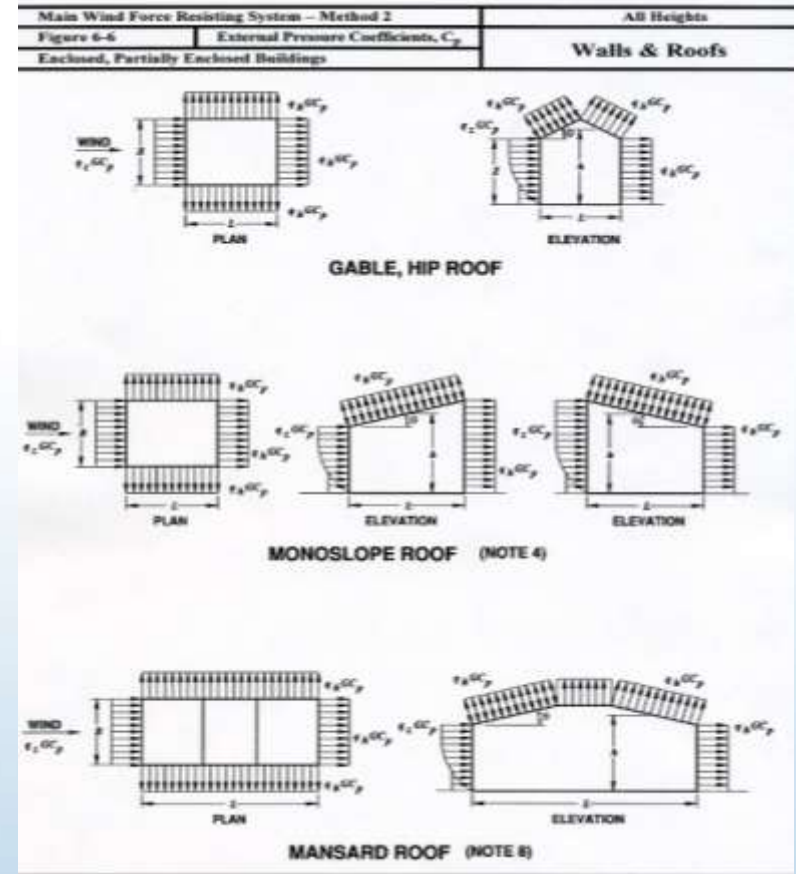


1-1C BASIC WIND SPEED—MD AND NORTHERN ATLANTIC HURRICANE COASTLINE



Main Wind Force Resisting System

- External wind pressure is applied to the building and transmitted into the structural frame
- Wind pressure can either be positive (downward) or negative (uplift) depending on the slope of the roof



ASCE 7-05 Pressure Calculator

ENTER Building Mean Roof Height: **15.00 ft.**

Basic Wind Speed: **140 MPH**

Roof Classification: **Enclosed** Exposure: **C**

Roof Category: **II** Zone: **4**

Roof Type: **Gable** Roof Slope: **18.4 Deg**

Wind Directionality Factor, K_d : **0.85** **1.00**

Opening Size: Height: **48.00"**

Adjusted Area: **10.00 sq.ft.**

Width: **30.00"**

NEGATIVE PRESSURE: -46.34 psf **POSITIVE PRESSURE: 42.72 psf**

WIND LOADING ANALYSIS - Main Wind Force Resisting System

FIG. 6-2.1.1 of Code for Enclosed or Partially Enclosed Buildings Using Method 2, except as Modified in Section 6.5.3 for Low-Rise Buildings

Input Data:

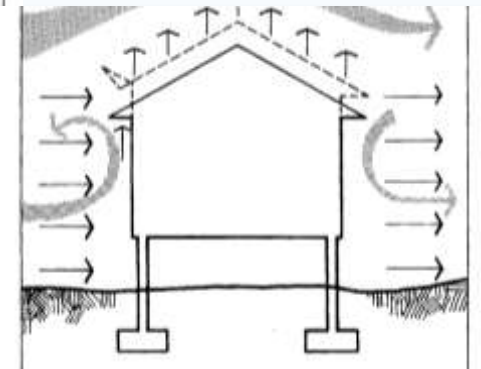
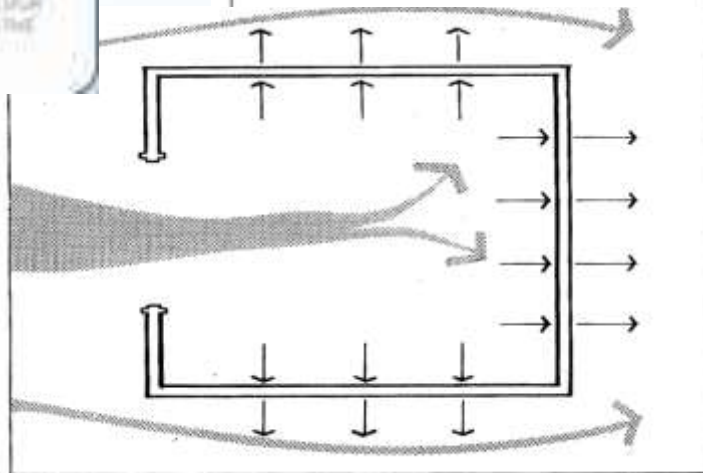
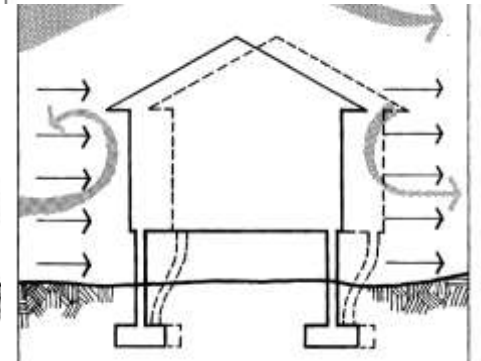
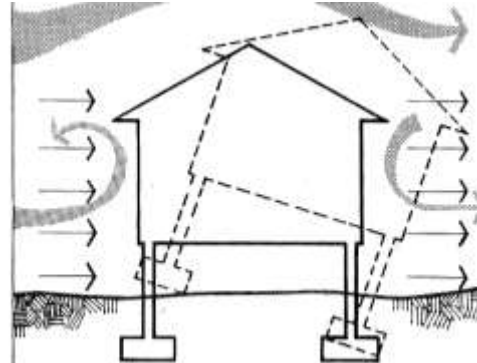
| | | |
|------------------------------|-------|----------------------------|
| Wind Speed, V | 140 | mph (Wind Map, Figure 6-5) |
| Map Classification | C | Exposure 1 (5) |
| Roof Category | II | Roof 1 (5) |
| Roof Slope | 18.4 | Deg (4) |
| Roof Height, h_r | 15.00 | ft (4) |
| Exposure Height, z_e | 15.00 | ft (4) |
| Zone | 4 | (4) |
| Building Height, h | 15.00 | ft (4) |
| Building Length, L | 30.00 | ft (4) |
| Roof Type | Gable | (4) |
| Top Flange, t_f | 1.00 | ft (4) |
| Wind Factor, K_d | 0.85 | (4) |
| Directionality Factor, K_z | 0.85 | (4) |
| Exposure Factor, K_e | 0.85 | (4) |
| Roof Slope Factor, K_{rs} | 0.85 | (4) |

Resulting External Pressure Coefficients:

Roof Slope $\theta = 18.4$ deg
 Mean Roof Slope $\theta_m = 18.4$ deg (if $\theta > 15$ deg)

Check Codes for a valid Building: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Wind Forces on Buildings

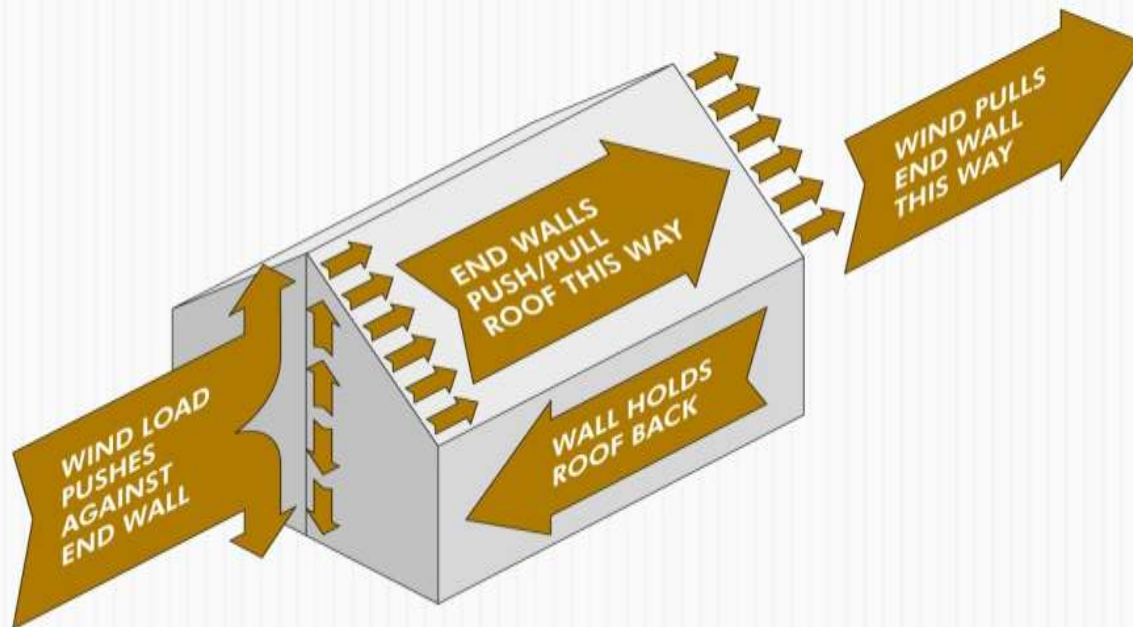


Wind Forces on Structures
Source FEMA -55 Coastal Construction Manual

Wind Force Distribution

FIGURE 5

WIND FORCES ACTING ON AREA



Load Path

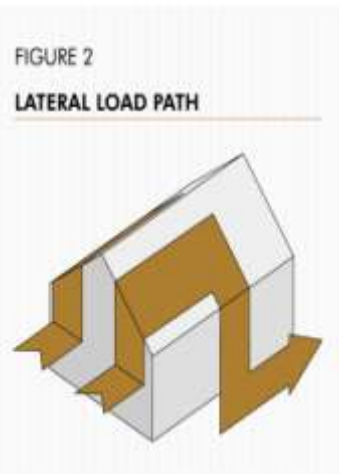
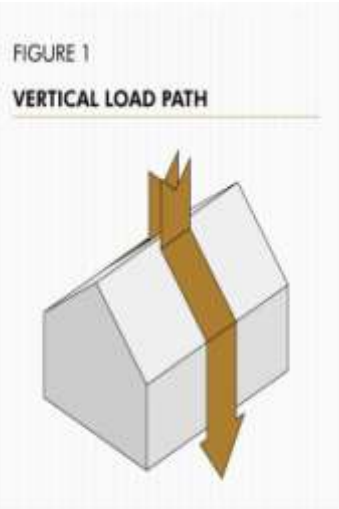
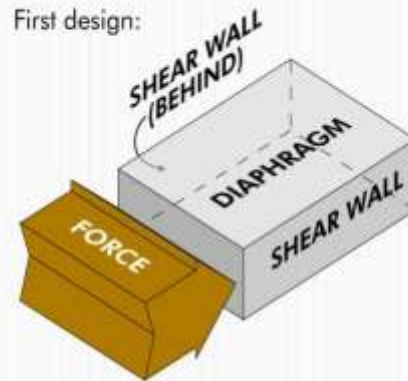


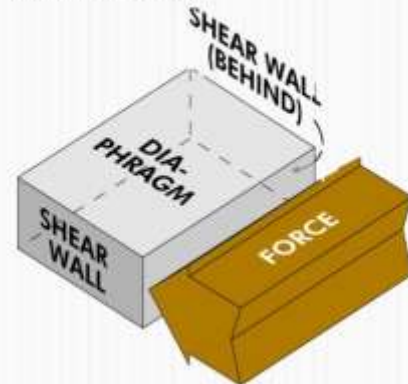
FIGURE 3

LATERAL LOAD ANALYSIS MUST BE CONDUCTED ALONG BOTH AXES OF STRUCTURE

First design:



and then design:



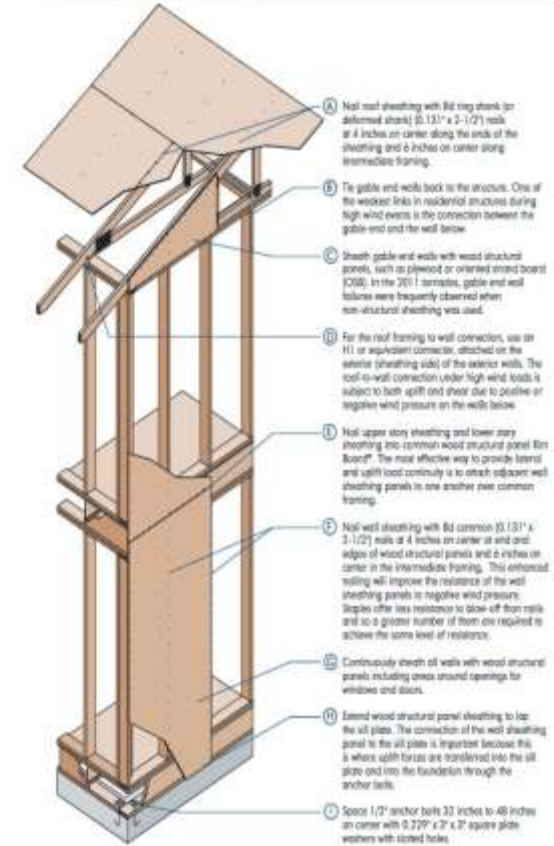
Tips for Improving Wind Resistance

Ref: APA Design Guide Building for High Wind Resistance

- Well Nailed Roof Sheathing
- Gable end wall bracing
- Continuous gable wall sheathing
- Upper story wall sheathing
- Well nailed shear walls
- Continuous wall sheathing
- Foundation anchorage



TIPS FOR IMPROVING TORNADO OR HURRICANE RESISTANCE OF LIGHT-FRAME WOOD CONSTRUCTION





CODE REQUIREMENTS FOR HISTORIC STRUCTURES



Code Requirements for Historic Structures: Based on 2009 IEBC Amended by MA State Building Code Amendments 780 CMR

MA Building Code based on 2009 International Existing Building Code amended by MA State Building Code Amendments 780 CMR

Section Outline:

- Summary of IEBC Requirements
- Summary of General MA Amendments to IEBC-09
- Summary of General Structural MA Amendments to IEBC-09
- Summary of IEBC-09 Chapter 11- Historic Buildings



Background



Development of Existing Building Codes and the IEBC

- Codification required to regulate work on existing buildings in order to:
 - Allow for the continued use of existing buildings without compromising public life-safety protections
 - Allow for the adaptive re-use of existing structures
 - Provide for a logical approach to obsolete technical methodologies or archaic construction techniques
 - Provide standards to preserve historic and cultural assets, protect property values and assets and allow for sustainable growth

Code Principles and Philosophy



- Regulate work on existing buildings without penalty for non-conformance
- Allow work on an existing building without requiring full compliance with current code requirements
- Adopt code provisions that ensure:
 - **Do No Harm**- any work on an existing building will not compromise the integrity of the historical building fabric
 - **New work** needs to meet **new code** requirements so long as there is a logical methodology to separate structural elements
 - **Existing structure** is generally **acceptable**- with clear to determine it and how to proceed when it isn't.

Code Attributes



- **Recognize:** Existing buildings are different
 - although originally built in a specific time period, building use and occupants change because they are not fixed in time
- **Code Provisions:** are written as conditional
 - not as instructions or prohibitions
 - not retroactive
- **Respect the philosophy,** but still be a code:
 - allow for flexibility in interpretation for unique conditions
 - aid applicants and code officials implementing policy
- **Intent:** provide flexibility to permit use of alternative approaches to achieve compliance with minimum requirements to safeguard public health, safety and welfare

Common vs. Code Terminology

- Rehabilitation
- Retrofit
- Upgrade
- Renovation
- Reconstruction
- Adaptive Reuse
- Restoration
- Replacement
- Preservation
- Maintenance
- Alteration
- Addition
- Repair
- Change of Occupancy
- Relocation



Code Trigger Points

- Code Provisions apply only if triggered by work thresholds
- Code Provisions have three basic parts:
 - **Trigger Point**- the intended works exceeds some limit
 - **Scope**- what part of the building is effected by proposed work
 - **Criteria**- design loads, materials and acceptability rules
 - **Exceptions**- there are always exceptions



Typical Provisions

Chapter 34: Typical provisions

| Topic | Trigger | Scope | Criteria |
|--------------------|--|---|--|
| Flood hazard areas | “Substantial” work, > 50% replacement cost | Whole building shall comply | Section 1612 |
| Gravity | Load increase > 5%, capacity decrease, or damage | Check triggered gravity-carrying elements | D+L as if new, but approved LL may be used |
| Lateral | Load increase, capacity decrease, substantial structural damage, new risk category | Whole building, elements with DCR increase < 10% exempt | 1609 for wind, 1613 for seismic, with allowances |



David Bonowitz, S.E.

Summary of IEBC Requirements

- Prescriptive Compliance Method
- Work Area Method
 - Repairs
 - Alterations
 - Level 1
 - Level 2
 - Level 3
 - Change of Occupancy
 - Historic Buildings
 - Relocated or Moved Buildings
- Performance Compliance Method



Three Compliance Methods

Work Area Method may/will have some dependency between chapters.

The method is the choice of the owner. The three methods are independent.



| Chapters | Subjects |
|----------|--|
| 1-2 | Administrative Requirement and Definitions |
| 3 | Prescriptive Compliance Method |
| 4-12 | Work Area Compliance Method |
| 4 | Classification of Work |
| 5 | Repairs |
| 6 | Alterations: Level 1 |
| 7 | Alterations: Level 2 |
| 8 | Alterations: Level 3 |
| 9 | Change of Occupancy |
| 10 | Additions |
| 11 | Historic Buildings |
| 12 | Moved or Relocated Buildings |
| 13 | Performance Compliance Method |

Summary of General MA Amendments to IEBC-09

- MA Code amends general code administration requirements for building permit applications with special recognitions for historic structures
- Specific criteria for historic buildings
- Life-Safety Code requirements for Fire Protection Systems, CO detectors, Egress, Fire Escapes, Lighting /Ventilation, and buildings in flood hazard areas
- IEBC supersedes previous “Chapter 34” requirements
- Requires an investigation and evaluation report as a condition to the issuance of the building permit

Compliance Alternatives

- Section 101.5 MA Amendments allows for “**compliance alternatives**” for when full compliance with code is not feasible or “impractical”
- **May** be approved by the building official
- Must be itemized with permit application
- Reference archaic building materials and fire ratings found in Appendix A of IEBC or in previous code Editions



Summary



Structural MA Amendments to IEBC-09

- Structural alterations, additions or changes in occupancy requires compliance with code requirements for new construction
- **New work= New code**
- Conditions assessment **report required** to identify any deficiencies
- **Cumulative Effects** of previous work needs to be considered
- Existing structure may remain if new work impacts meet all the following:
 - floor framing alteration $< 2\%$
 - structural walls and columns are not changed
 - floor and roof openings $< 2\%$
 - lateral load resisting frames are not changed or altered

Summary of IEBC-09 Chapter 11- Historic Buildings

- Road Map of the “Work Area” Method
 - Section 1101- Scope/Conformance
 - Section 1102- Repairs
 - Section 1103- Fire Safety
 - Section 1104- Alterations
 - Section 1105- Change of Occupancy
 - Section 1106- Structural



IEBC-09 Chapter 11 Overview

- Definition of “Historic Building”
- Scope of Work: Repair, Alteration or Change of Use
- Requirement for Written Evaluation Report
- Occupancy and Use Categories
- Fire Safety Requirements
- Accessibility
- Structural Provisions



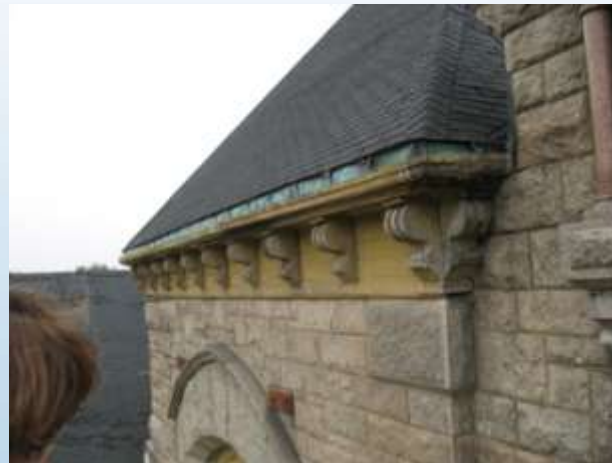
Section 1101.2- Evaluation Report

- **Intent** of the Chapter 11 is to provide for the **Preservation** of Historic Buildings
- Code allows for the repair, alteration or change of use of Historic Buildings, provided **minimum** code requirements for protection of life and building safety are met
- If the building is intended to meet the requirements of Chapter 11, a **written report** (subject to the opinion of the code official) must be prepared and filed by a registered design professional



Occupancy and Use Categories

- Definitions of Occupancy and Use Categories per Chapter 3
- **Historic R-3** (Residential) Structures, that are less than **3000** square feet in area, used for A, B or M (Assembly, Business or Mercantile) may be classified as Occupancy Use Classification **Group “B”**
- Change in Use of Historic Buildings must conform to Chpt 9 and Section 1105 requirements/modifiers



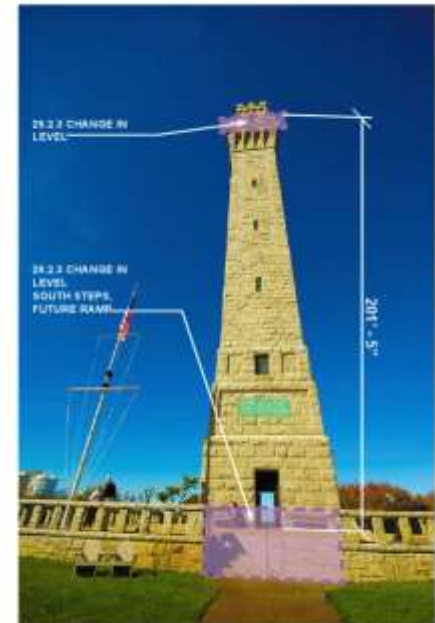
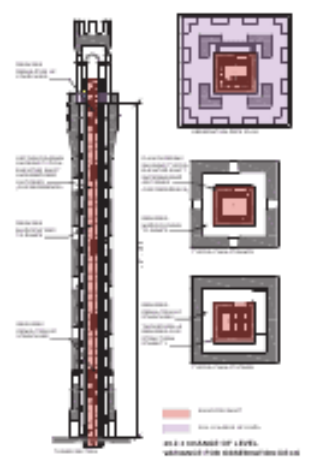
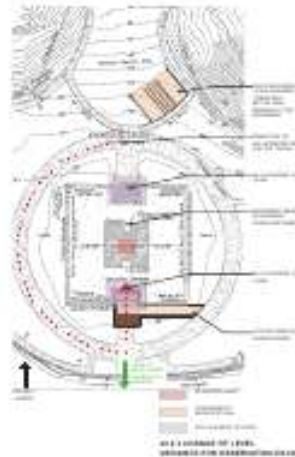
Fire Safety Requirements for Historic Buildings

- **Fire safety** of Historic Buildings includes consideration of fire sprinklers, means of egress, materials used for interior finishes, glazing and fire ratings of building assemblies
- Section 1103.12- Automatic Fire-extinguishing system:
 - *“If an historic building is provided with an approved automatic fire suppression system in accordance with Chapter 9 of IBC, then the building would be deemed compliant with all of the construction requirements specified within the IBC”*



Accessibility Requirements of Historic Buildings

- Accessibility to Historic Buildings required per 521 CMR
- Thresholds and trigger points the same as for any existing building, determined based on:
 - Scope of Work
 - Value of Work
 - Assessed Value of Existing Building
 - Variance process



IEBC-09 Chapter 11 Structural Provisions

- Limited but must address unsafe conditions
- When a change in occupancy results in the structure being reclassified to a higher occupancy category, the seismic requirements for new construction apply to the existing structure
- Exemption: Requirement may be waived by the building official if the change of occupancy does not constitute a distinct life safety hazard
- All MOVED structures are required to meet ALL of the requirements for new construction (which is why the other compliance methods are useful!)
- Structural repairs permitted, but must be distinguished between “repair” and “substantial structural damage”
 - Repairs are allowed to restore the building to “pre-damaged” state
 - Structure needs to comply with code if damage is substantial (defined as greater than 20% strength reduction in load carrying capacity)



Key Definitions in IEBC 09 / MA Amendment:

- Addition- An extension or increase in floor area, number of stories or height of a building or structure
- Alteration- Any construction or renovations to an existing structure other than a repair of addition. Alterations are further classified as Level 1, Level 2 and Level 3
- Change of Occupancy- A change in the purpose or level of activity within a building that involves a change in application of the requirements of this code



- Repair- The restoration to good or sound condition of any part of an existing building for the purpose of maintenance
- Dangerous- Has collapsed or is at significant risk or collapse, detachment or dislodgment of any part of the structure under service loads
- Substantial Structural Damage-
 1. Greater than 20 % reduction in lateral load carrying capacity of as a result of damage to any vertical elements of the lateral force resisting system
 2. Less than 75% load carrying capacity of any gravity load carrying system.



IEBC places great **emphasis** on building *Structural Conditions*- life safety issue covering basic structural systems including:

- Gravity load carrying components
- Lateral force resisting systems
- Code specific requirements for structural provisions not subject to compliance alternative provisions
- Life safety requirements must be met

IEBC-CHPT 3- PRESCRIPTIVE METHOD

Prescriptive Method-General

- Structural Evaluation Report is required
- New Additions and new structural elements must comply with new Code requirements
- Alterations must generally comply with new Code
- Portions of the building not related or affected by the proposed work are not required to comply with IBC for new construction
- Existing structural elements with very limited load increase or no increase are allowed as is
- Existing structural elements experience identified load increases must be sized to meet new Code
- Dangerous conditions must be corrected
- Change in Use of Occupancy to greater hazard index will trigger conformance with new Code



Additions or Alterations to Existing Structure

- Where additions or alterations increase the gravity load in any existing structural element by more than 5%, the structural element must be augmented or replaced to carry the increase load as required for new construction
- Any addition to an existing building must be analyzed for lateral loads due to current code requirements for seismic and wind loads.



Repairs

- Repairs are differentiated from alterations- clarified as routine maintenance
- Dangerous situations warrant improvements to the structural system for purposes of increasing safety
- RDP required to establish whether “substantial structural damage” has occurred to a structure
- For non-substantial structural damage, repairs using materials and strengths that existed prior to the damage are allowed to restore the building to its pre-damaged state (304.4)
- New structural members and connections must comply with detailing provisions for new buildings



Change in Occupancy

- A change in occupancy to an existing building requires the building to meet the requirements of the IBC for the new occupancy (307.1)
- When the change of occupancy results in the structure being classified to a higher occupancy category, the seismic requirements for new construction shall apply to the existing structures



Historic Buildings

- Proposed work that does not constitute a distinct life safety hazard may be approved by the code official without mandatory compliance for new code requirements (308.1)
- Includes *repairs, alterations, additions, restoration, movement of structures and change of use*
- *Substantial Improvement* to Buildings located in flood zones must comply with IBC flood code, except buildings that are:
 - Listed on the National Register
 - Determined by the US Dept. of Interior as being in a historic district
 - Designated as historic under state or local preservation program



IEBC-CHPT 4- WORK AREA METHOD

Work Area Method-General

- Structural Evaluation Report is required
- New Additions and new structural elements must comply with new Code requirements
- Alterations must generally comply with new Code
- Portions of the building not altered or affected by the proposed work are not required to comply with IBC for new construction
- Existing structural elements with very limited load increase or no increase are allowed as is
- Existing structural elements experience identified load increases must be sized to meet new Code
- Dangerous conditions must be corrected
- Change in Use of Occupancy to greater hazard index will trigger conformance with new Code

Repairs – Chapter 5



Repairs: Covers the patching or restoration or replacement of damaged materials, elements, equipment or fixtures for the purpose of maintaining such components in good or sound conditions with respect to existing loads or performance requirements.

- Determine if substantial structural damage as defined by code has occurred
 - Evaluate Vertical gravity load carrying components and extent of damage with threshold limits of anything greater than 20% of pre-damage condition and 75% of new code requirements
 - Evaluate affects of damage on lateral load resisting elements



- Repairs for less than substantial structural damage:
 - Repairs are allowed that restore the building to its pre-damaged state
 - New structural members and connection used shall comply with the detailing provisions of the current IBC
- Structure Evaluation require per 506.2.2.1



Alterations to Existing Structures – Chapter 6

Alterations Level 1-Chpt 6: includes the removal and replacement or the covering of existing materials, elements equipment, or fixtures using new materials that serve the same purpose.

- Level 1 Alterations must not lessen the safety to the existing building
- All new work must comply with new code
- No more than 5% increased dead load is permitted on re-roofing projects
- New roofing requires insulation
- Wall anchors are required to tie the roof to the walls for new roofing projects > 25%
- Bracing required for unreinforced masonry bearing wall parapets
- Roof diaphragms must be designed to resist wind transfer and uplift loads



Alterations Level 2- Chpt 6 & 7: includes the reconfiguration of space, the addition or elimination of any door or window, the reconfiguration of any system, or the installation of any additional equipment

- Same as for Level 1 as summarized above
- Threshold for work areas greater than 50% of the floor area
- Structural requirements similar to earlier chapters
- Updated components need to satisfy MA amended IECC
- Additions or alterations need to comply with current code requirements of IBC
- The demand capacity ratio of an existing lateral load resisting element can not exceed 10% of the existing unaltered structure
- Existing lateral force resisting system may be voluntarily upgraded



Alterations Level 3- Chpt 6, 7, & 8-: applies where the work area exceeds 50% of the aggregate area of the building or 50% of the floor area

- Same as above, with exceptions as noted in chapter 8
- Level 3 is used when work area exceeds 50% of building area. If the work area exceeds 30% of the total floor and roof area, then the wind loading shall be evaluated based on IBC and seismic on allowed reduced IBC requirements
- When the demand capacity ration of an existing lateral load resisting element exceeds 10% of the existing, the requirements of Level 3 shall apply

IEBC CHPT 9 - CHANGE IN OCCUPANCY

Change in Occupancy: General

- Change in Occupancy- Chpt 9-apply where the activity is classified as a change in occupancy or use. There are three basic types of change in occupancy:
 1. The occupancy classification changes to a different group
 2. The occupancy classification changes within a group
 3. The occupancy classifications stays the same, but the level of activity changes
- Triggers are predicated on a change of occupancy to a higher hazard classification and a change in occupancy classification
- A change in use of a historic building must comply with Section 1105
- Gravity loads must comply with current code requirements, provided the stress is not increased by more than 5%
- Wind and Seismic Loads must be evaluated for effects of new change in use and importance factors

IEBC CHPT 10 - ADDITIONS

Aditions-General

- Additions-Chpt 10 – for new work as defined as an increase in floor area, number of stories or height of a building or structure
- The addition must not create or extend a Code non conformity
- Either addition is structurally independent or not
- Additional gravity loads must comply with the requirements of the IBC unless the stress is not increased by greater than 5%

Vertical Additions

- Meet lateral load requirement for wind and seismic requirements of IBC as specified in Section 101.5.4.1
- Any element not meeting those provisions must be replaced, reinforced or augmented to meet load resistance requirements



Horizontal Additions

- Isolated additions are designed to meet current code requirements as self supporting structure with no impact on the existing building
- Where building addition is not isolated, portions of the existing lateral force resisting system affected by the addition are required to meet two specific lateral load requirements:
 1. Wind load requirements of IBC as amended
 2. IBC level seismic provisions as specified in Section 101.5.4.1

IEBC CHPT 11- HISTORIC BUILDINGS

Historic Buildings- General

- The code section is intended to provide a means for the preservation of historic buildings
- Historic buildings are as listed or determined to be eligible for listing on National Register of Historic Places, or as otherwise designated as historic under state or local historic preservation program
- Written report required for any repair, alteration or change in use

Repairs

- Historic buildings undergoing repairs shall comply with all the applicable requirements of Chapter 5, except as specifically exempt for historic structures

Secretary of Interior Standards for Historic Buildings

The Standards offer four distinct approaches to the treatment of historic properties—preservation, rehabilitation, restoration, and reconstruction with Guidelines for each.

The Standards for the Treatment of Historic Properties are regulatory for all grant-in-aid projects assisted through the national Historic Preservation Fund.

The Standards for Rehabilitation, codified in 36 CFR 67, are regulatory for the review of rehabilitation work in the Historic Preservation Tax Incentives program.

The Guidelines are advisory, not regulatory.





Historic Building-Structural Requirement Summary

- Depending on the classification of work or methodology, must comply with other sections of the code for work on historic structures
- Code official may allow existing floors to remain and approve operational controls that limit the occupancy live load on any such floor
- Localized unsafe conditions may be repaired without triggering systematic upgrades to the entire structure

Impact Resistant Windows

BBRS Official Interpretation No. 2012_09

Date: January 8, 2013

Subject: 8th Edition 780 CMR, Base Volume, Requirements for replacement windows.

Background/Discussion:

When code guidance is sought for replacement windows there are at least four code sections in the Base Volume that deal with this topic:

- *International Building Code (IBC), Section 2401.2 Glazing Replacement, which reads, 'The installation of replacement glass shall be as required for new installation.'*
- *International Existing Building Code (IEBC), Alteration – Level 1 Section 403.1 Scope, which reads, 'Level 1 alterations include the removal and replacement or the covering of existing materials, elements, equipment, or fixtures using new materials, elements equipment of fixtures that serve the same purpose.'* and Section 306 Glass Replacement, which reads, 'The installation or replacement of glass shall be as required for new installations.'
- *International Energy Conservation Code (IECC), Section 101.4.3 Additions, alterations, renovations or repairs, which in part reads, 'Additions, alterations, renovations or repairs to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction...'*

This official interpretation is provided to address the apparent overlap of these requirements and considers the absence of evidence that hurricanes cause widespread damage of building fenestration in MA.

Replacement Windows

Replacing windows is a typical existing building project so the code that applies is the IEBC and not Chapter 24 of the IBC. This is considered a Level 1 alteration, which is defined as *'the removal and replacement or covering of existing materials, elements, equipment, or fixtures using new materials, elements, equipment, or fixtures that serve the same purpose (emphasis added here)'*. So, for example compliance to the IECC, section 101.4.3 would dictate energy conservation requirements, since a 'purpose' of the original windows was energy conservation. The original windows had other functions as well but in general, the replacement windows need not comply with the wind borne debris requirements since this was not likely a 'purpose' of the original windows.

If an existing building project is 'significant' whereby it is essentially considered 'new' construction which will likely include an analysis of the structure of the building, then the IBC applies and not the IEBC. So, it may be reasonable for the building official to invoke wind borne debris protection of openings. In this case, an analysis of the structure of the building, using an assumption of either a 'closed', 'open', or 'partially enclosed' building per ASCE-7, will help the owner decide if adding opening protection is a cost effective option.

This official interpretation only applies to the energy conservation and opening protection requirements for the replacement of exterior windows. If other systems which contain glass (like interior doors or rail guards) are being replaced then the code for new construction likely applies to those items.

Replacement Windows Question

* QUESTION 1

For buildings in wind borne debris regions do replacement windows need to comply with both wind borne debris protection and energy conservation requirements?

* ANSWER 1

When the project involves mainly removal and replacement of the existing windows, that is a Level 1 Alteration;

- Wind borne debris protection: No
- Energy conservation: Yes



CASE STUDIES



CASE STUDY: BREWSTER MEETING HOUSE

Scope of Work

- a. Foundation Underpinning & Excavation
- b. Structural Floor Framing Augmentation
- c. Roof Truss Repairs/Reinforcement
- d. Building Envelope Repairs
- e. Structural Steel Framing
- f. New exterior sheathing, siding and roofing
- g. Window restoration
- h. Interior finishes

















Case Study: Brooks Academy



Restoration Project



A look back to 2004...

Scope of Work

Structural repairs and building reconstruction following recommendations found in Architectural Conservation Assessment Report by Phillip C. Marshall, dated November 1988.

Scope of Work

1. Crawl Space
2. Floor Structure Reinforcement
3. Portico Structure Stabilization
4. Foundation Underpinning
5. Attic – Cleanup & Insulation
6. Column Restoration
7. Cornice and Architrave Restoration





(1 c)

(1 a)

(1 b)

Construction Bid Documents

1. Crawl Space - #007:

- a. Install soil with 6-mil polyethylene vapor barrier.
- b. Remove and dispose of debris.
- c. Existing masonry remnant foundation to remain.

2. Floor Structure - #009:

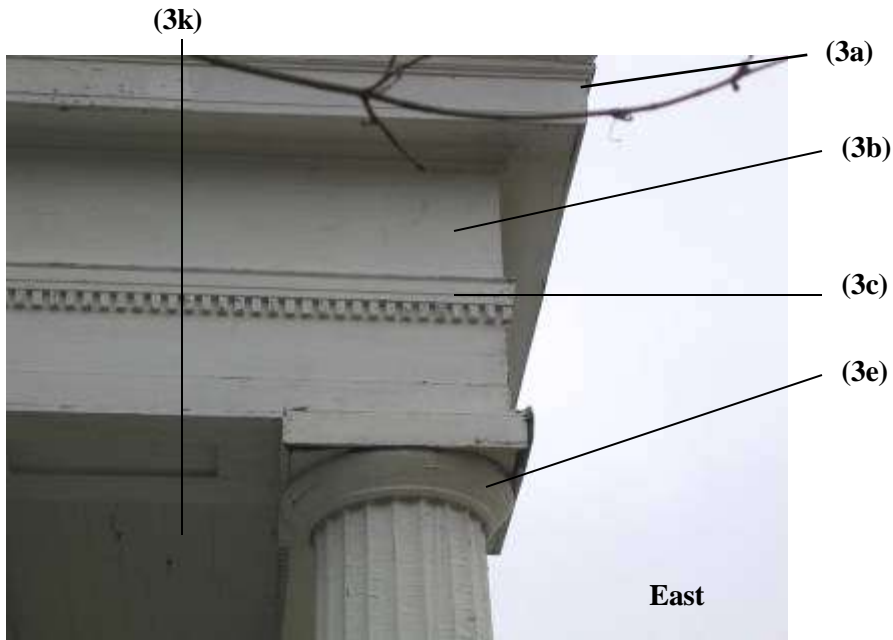
- a. Structural stabilization of first floor framing of rooms #201-#203 (1844 section) and rooms #204-#206 (1909 section).

(1)



(2)





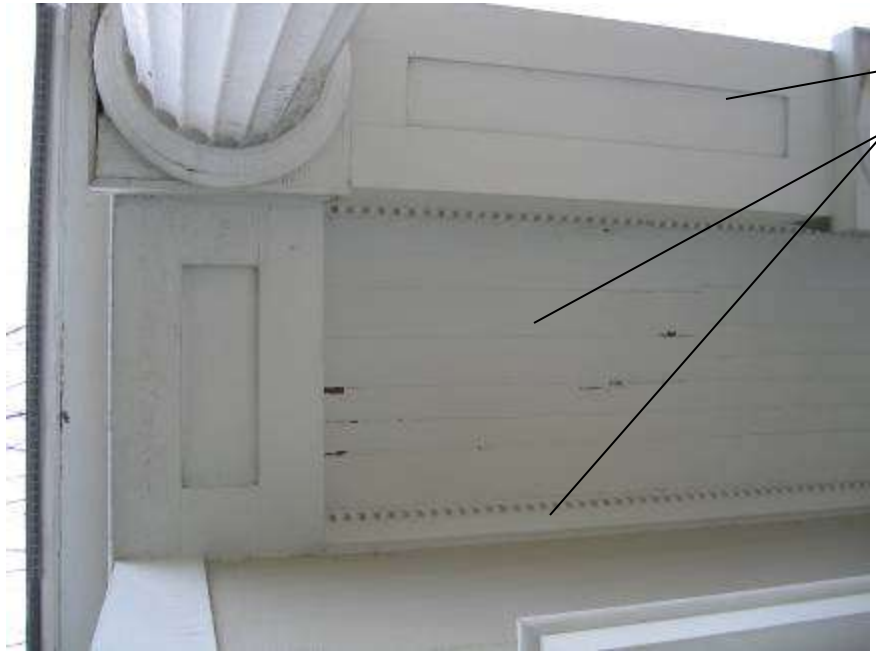
3. Portico - #001: Repair and reconstruction of all Portico components including:

- Entablature - pediment cornice (3a), frieze (3b), architrave (3c), architrave (3l), and column capital (3e).
- North façade - flush board siding of pediment (3f) and entry area, doors & door trim, door hardware (3g), and corner boards (3h).
- Portico ceiling - flush board ceiling and perimeter trim (3i).
- Pediment cornice (3j) - Repair and install new lead coated copper cap.
- Architrave soffit (3k).
- Architrave dentel (3l).





(3f)



(3k)

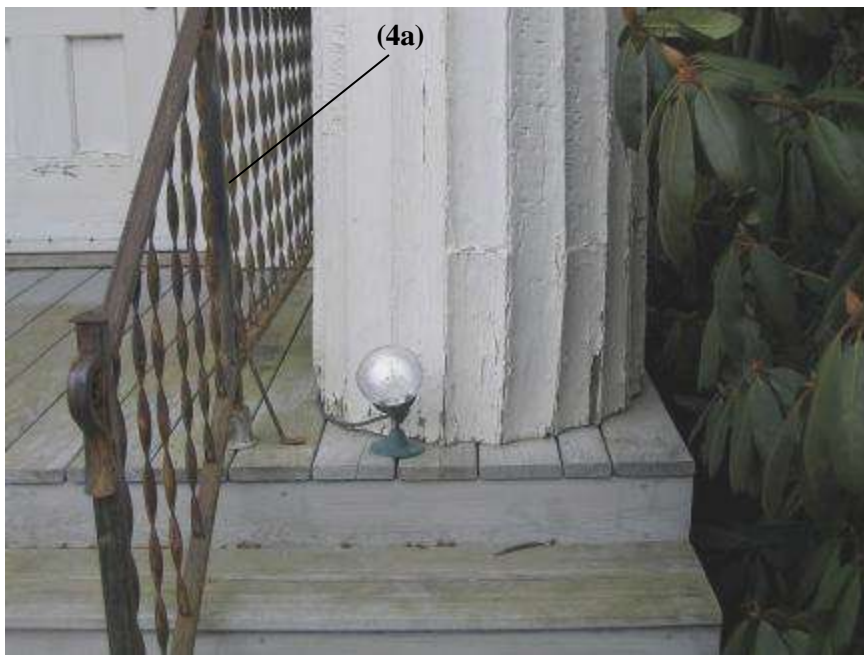
(3i)



(3h)



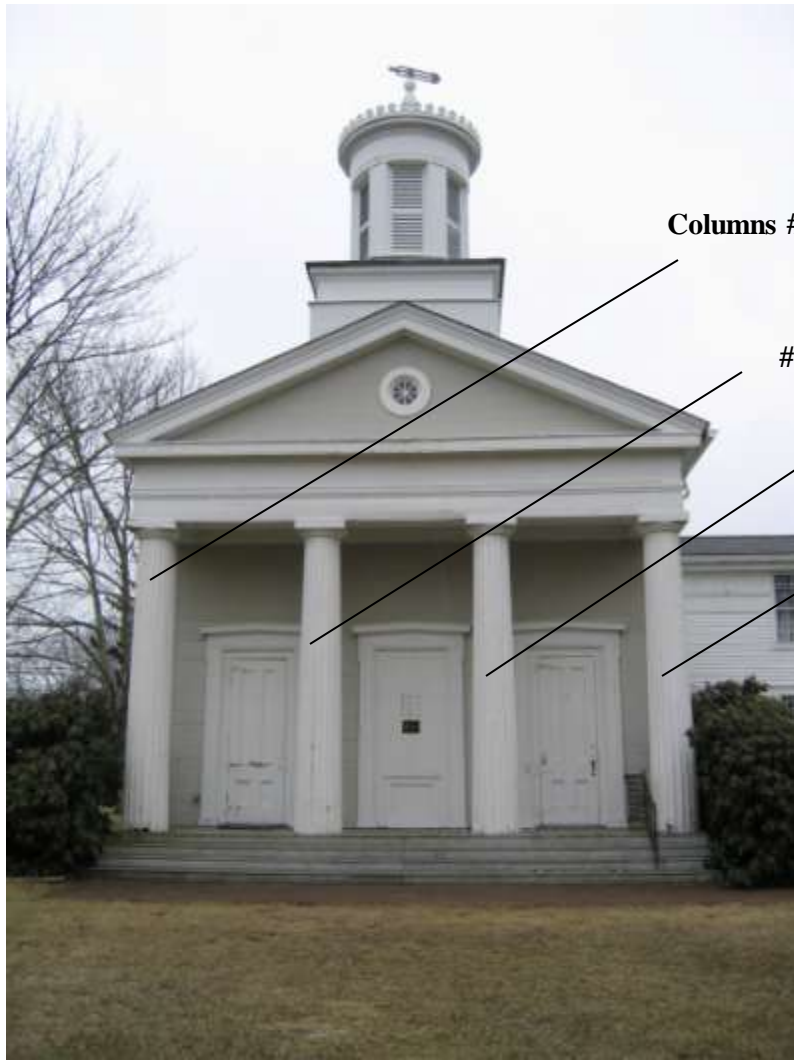
(3g)



4. Railings - #012: Remove existing iron railings.



5. Attic - #019: Remove all debris, insulate with new layer of 6" fiberglass batt and install new 4' wide plywood access walkway down center of attic space.



6. Columns - #023: Complete restoration of all four columns to include:

- a. Repair all deteriorated wood with epoxy consolidant and wood filler. Saturate end grain of column base with epoxy consolidant (6a).
- b. Remove and replace deteriorated stave using “Dutchman” repair techniques with Spanish cedar wood cut to match existing stave profiles.
- c. Strip and remove existing paint coatings.
- d. Reinforce column shafts with new timber compression rings installed inside the hollow column section.
- e. Secure wood staves to new compression ring using stainless steel screws, counter and sealed using a wood plug and urethane-based adhesive.
- f. Caulk and seal all joints between staves with polysulfide sealant.
- g. Prime and paint.
- h. Install new mahogany bases to be mounted on concrete piers and set flush with new wood decking.



(6a)

- a. Saturate end grain of column base with epoxy consolidant (6a).



(6a)



(6a)



(7)

7. **Portico Deck** - #023: Install new deck framing and decking.
 - a. New decking to consist of 2x6 Douglas Fir, tongue and groove fastened to pressure treated framing with stainless steel trim head screws through tongue and concealed by the next board. Edge of deck to get a “breadboard” finish and bullnose profile (stair tread similar). Deck to be pitched away from building at a 1:50 slope.
 - b. Install new stair stringers, treads, and risers (risers to be painted white pine).



(8)

- = CORNICE
- = FRIEZE
- = ARCHITRAVE
- = CAPITAL
- = COLUMN SHAFT

Foundation and Structural Framing Repairs



October 2, 2006

2006



October 12, 2006

2006



October 18, 2006

2006



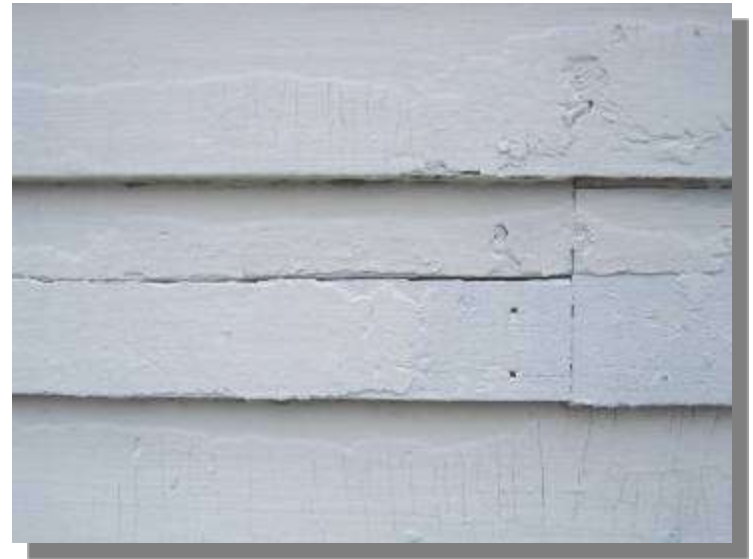
October 18, 2006



October 25, 2006



October 25, 2006



December 29, 2006



January 12, 2007



January 14, 2007



References

- Massachusetts State Building Code 780 CMR
- National Design Standard for Wood Construction, NDS-05
- ASCE 7-05 Minimum Design Loads for Buildings and Structures
- International Existing Building Code IEBC-09
- Sect of Interior Standards for Treatment of Historic Properties
- Click into the following web sites for additional information on wood frame construction guidelines:
 - *APA - The Engineered Wood Association:* www.apawood.org
 - The American Wood Council: www.awc.org
 - Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings <http://www.nps.gov/hps/tps/standguide/>

National Park Service
U.S. Department of the Interior





QUESTIONS?

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