

**Worksheet Tool for use with 780 CMR Mass State Building Code**  
**Chapter 34, Existing Building**  
By Richard Croswell, PE, SECB

Projects involving existing buildings now need to comply with the 2009 IEBC (International Existing Building Code) with Massachusetts amendments according to the Eighth Edition of 780 CMR. The IEBC code has three methods of compliance for alterations to existing buildings: Prescriptive, Work Area, and Performance. The selection of an appropriate method is dependent on the complete Project Scope involving all building trades (Architectural, Fire Protection/Prevention, Mechanical and Structural).

Since each compliance method has requirements that impact all members of the design team, consideration has to be given to the impact of each method on the project as a whole to evaluate the best possible solution.

The AEC community has reported that the use of the IEBC with Mass amendments from Chapter 34 is a complicated process. To aid in the selection of the most appropriate Project solution, the Structural Advisory Committee (SAC) to the State Board of Building Regulations and Standards (BBRS) has developed a worksheet that can be used to determine the requirements for each compliance method.

The worksheet is posted on the SEAMASS website ([www.SEAMASS.org](http://www.SEAMASS.org))

The worksheet has been organized so that it can be presented to a client, architect or building official. Using the actual project information, the team can select the compliance method that is appropriate for the project.

SEAMASS representatives continue to work collaboratively through the SAC to assist the BBRS in developing Massachusetts code provisions. While SEAMASS will do its best to keep engineers informed of these changes, the Structural Advisory Committee and SEAMASS recommend that the engineer verify the current code when using the worksheet.

## **Recent work of SEAMASS members on the Structural Advisory Committee regarding Existing Buildings**

By Michael Fillion, PE, SECB

Shortly after the release of the 7<sup>th</sup> Edition of the Massachusetts State Building Code (MSBC) in 2009, the Board of Building Regulations and Standards of the Department of Public Safety for the Commonwealth of Massachusetts decided to pursue the adoption of the International Code Series documents complimented by Massachusetts specific front end amendments. As part of the process, the BBRS formed committees to review the International Codes, including the establishment of a Chapter 34 (Existing Buildings) Task force to examine the adoption of the 2009 International Existing Building Code.

Throughout the Winter and Spring of 2010, members of the select committee, including several members of SEAMASS, met on a regular basis to work out the implementation of Massachusetts amendments along with the Technical Director of BBRS, Michael Guigli. As part of this work, the committee decided to develop Massachusetts amendment 101.10, Masonry Walls, capturing the unique seismic hazard of unreinforced masonry walls present in abundance throughout Massachusetts through Appendix A1 of the IEBC. In August 2010, the 8<sup>th</sup> edition of the MSBC included the 2009 IEBC with the proposed committee amendments.

Since adoption of the 2009 IEBC in Massachusetts, the BBRS has been evaluating the newly promulgated MA amendments, particularly those that added cost over and above the referenced code. Amendment 101.10 (Masonry Walls), requires the use of Appendix A1 in IEBC and unintentionally went beyond the intent of capturing the scope of previous seismic provisions enacted in the Seventh Edition of 780 CMR. These unintentional triggers including in-plane shear evaluation of existing URM walls and an extensive program of in-situ masonry material testing if the code default minimum allowable stress values were exceeded. Because of this, and a desire to move towards a code with as few amendments as possible, the BBRS has decided that MA amendments 101.10, 606.2.1 & 606.3.1 will be deleted in the near future.

In response to the concerns of the BBRS, and the desire to streamline the code, the Structural Advisory Committee (SAC) to the BBRS formed a sub-committee to propose an alternate means to regulate seismic hazards in MA. The sub-committee decided that the proposed regulations should be as consistent as possible with the 2012 IEBC code language.

The sub-committee decided that the best method to affect changes would be to liaise with the National Council of Structural Engineers Association, Existing Building (NCSEA EB) Committee. This method was suggested by NCSEA EB and BASE member David Odeh as being the most direct involvement in the development of a National Code. As part of the code development process, member organizations of NCSEA such as SEAMASS may propose amendments to the nationally sanctioned code development body of NCSEA.

SEAMASS Directors and SAC members Richard Croswell, Mike Fillion and Joe Zona proposed language to alter the 2015 IEBC at the annual NCSEA EB meeting held at the office of Simpson Gumpertz and Heger in Waltham, MA on November 4<sup>th</sup>, 2011 to reflect specific Massachusetts concerns.

The proposal requested revising the 2015 IEBC to include requiring Seismic Design Categories (SDC) B and C in addition to the proposed SDC D, E and F when mitigating the specific hazards of masonry parapets and wall anchorage and to include these provisions in the prescriptive compliance method. This request was proposed due to two reasons: many buildings in Massachusetts are currently in Soil Site Class D or E which then dictates Seismic Design Category B and C based on current seismic mapping and the concern that the age of the unreinforced masonry building stock and severe weathering in the region results in deteriorated masonry or masonry joints not addressed in the code. By not having these buildings included, it was felt that Massachusetts would not be adequately covered in the event of a seismic event and that buildings renovated under the proposed new code would not perform as well as buildings renovated under previous codes.

As part of the discussion, NCSEA committee members felt that they could not endorse SDC B in the proposal but suggested that a front end amendment to the code specific to Massachusetts could be enacted. The resolution of this meeting is that the 2015 IEBC will include the Massachusetts proposals for unreinforced masonry parapets and wall anchorage for Seismic Design Category C buildings including the prescriptive compliance method. The front end amendment to 780 CMR will include Seismic Design Category B for these specific hazards as presently proposed. The work remains in committee and continues to be discussed.

Many thanks should be given to the SAC committee members involved in the process including Joe Zona, Richard Croswell, Mike Fillion, Jim Balmer, Bill Hagen, Richard Henige, Nick Mariani and Garrett McClean who volunteered many hours in developing the code language.

## **- READ FIRST -**

### ***Instructions for use:***

### ***Code Analysis worksheet for the 2009 International Existing Building Code with Massachusetts Amendments***

The following template was prepared by engineers who are members of the Massachusetts Structural Advisory Committee (SAC) to the State Board of Building Regulations and Standards (BBRS.) This committee includes members of SEAMASS and the Board of Directors has endorsed the work of the SAC on the Massachusetts State Building Code. The authors found this template useful in applying the Existing Building provisions for the Massachusetts State Building Code 8<sup>th</sup> Edition, and want to share this template with the structural engineering community. This is not an official document, and comes with no guarantee of accuracy or completeness. We hope you find it useful in applying the new code provisions.

The first part of the work sheet is a summary sheet has two sections:

- The first describes the scope of the project. Filling this out with as much detail as possible will help in determining various triggers that occur within the code.
- The second part is a summary of the code analysis. This part gets filled out after you have gone through the worksheet and is intended to describe the structural scope of work required for the three compliance sections.

After filling out the scope of the project, the rest of the worksheet goes through the structural portions of the code starting with Chapter 1. The worksheet lists a code section reference, briefly describes the subject of the section and then has a third column for the engineer to input comments regarding the applicability of that section to the project. In some cases, the comments will be specific with a defined scope of work that must be performed. In other cases the comment may be that the section might apply or is not applicable. Following the worksheet to the end will help the engineer walk through the IEBC with MA amendments and develop a good understanding of the required, or potentially required, scope of structural work for each of the three compliance methods.

SEAMASS representatives continue to work collaboratively with the Structural Advisory Committee to assist the BBRS in developing code provisions. While SEAMASS will do its best to keep engineers informed of these changes, the Structural Advisory Committee and SEAMASS recommend that the engineer verify the current code when using the worksheet.

## ***Code Analysis worksheet for the 2009 International Existing Building Code with Massachusetts Amendments***

### **[Project Name]**

#### **Existing:**

- [Describe the existing conditions here. Include all relevant information needed to evaluate the code provisions.]

#### **Planned:**

- [Describe the proposed modifications here. Include all relevant information needed to evaluate the code provisions.]

#### **Summary**

##### Chapter 1 (Applicable to all three compliance methods):

- 

##### Prescriptive Compliance Method:

- 

##### Work Area Compliance Method:

- 

##### Performance Compliance Method:

-

<b>Chapter 1: Scope and Administration</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>101</b>	<b>GENERAL</b>	
<b>101.5.4.0</b>	<b>Mass amendment – Investigation and Evaluation.</b> Subject to Mass amendment 107.6 to the IBC, a written report is required to be submitted to the Building Official.	
<b>101.9</b>	<b>Cumulative effects.</b>	
<b>101.9 Exceptions</b>	<b>Cumulative effects must be considered except when <u>all</u>:</b> <ol style="list-style-type: none"> <li>1. Structural work does not involve more than 2% of the total tributary area of horizontal framing members of any existing framed floor or roof.</li> <li>2. Structural work does not alter shear walls above the foundation.</li> <li>3. Structural work does not alter columns or diagonal braces.</li> <li>4. Structural work does not create an opening in any framed floor or roof that has an area more than 2% of the framed floor or roof.</li> <li>5. Structural work does not alter any floor or roof diaphragm and its connections such that in-plane shear resistance is reduced by more than 5%.</li> <li>6. Structural work does not remove or reconfigure lateral load resisting frames, or foundations supporting them.</li> </ol>	
<b>101.10</b>	<b>Masonry walls.</b>	

<b>Chapter 3: Prescriptive Compliance Method</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>302</b>	<b>ADDITIONS</b>	
<b>302.1</b>	<b>General.</b>	
<b>302.2</b>	<b>Flood hazard area.</b>	
<b>302.3</b>	<b>Existing structural elements carrying gravity loads.</b>	
<b>302.3.1</b>	<b>Design live load</b>	
<b>302.4</b>	<b>Existing structural elements carrying lateral load</b>	
<b>302.4 Exception</b>	Is increase in demand capacity ratio (DCR) of existing lateral load-carrying elements with addition considered $\leq 10\%$ ?	
<b>302.4.1</b>	<b>Seismic</b>	
<b>303</b>	<b>ALTERATIONS</b>	
<b>303.1</b>	<b>General.</b>	
<b>303.2</b>	<b>Flood hazard area.</b>	
<b>303.3</b>	<b>Existing structural elements carrying gravity loads.</b>	

<b>303.3.1</b>	<b>Design live load</b>	
<b>303.4</b>	<b>Existing structural elements carrying lateral load</b> Does the alteration: <ul style="list-style-type: none"> <li>▪ increase design lateral loads? or</li> <li>▪ create a structural irregularity? or</li> <li>▪ decrease the capacity?</li> </ul>	
<b>303.4 Exception</b>	Increase in demand capacity ratio (DCR) of existing lateral load-carrying elements with addition considered $\leq 10\%$ ?	
<b>303.4.1</b>	<b>Seismic</b>	
<b>303.5</b>	<b>Voluntary seismic improvements</b>	
<b>304</b>	<b>REPAIRS</b>	
<b>304.1</b>	<b>General.</b>	
<b>304.2</b>	<b>Substantial structural damage to vertical elements of the lateral-force resisting system.</b>	
<b>304.3</b>	<b>Substantial structural damage to gravity load-carrying components.</b>	
<b>304.4</b>	<b>Less than substantial structural damage.</b>	
<b>304.5</b>	<b>Flood hazard area.</b>	
<b>307</b>	<b>CHANGE OF OCCUPANCY</b>	
<b>307.1</b>	<b>Conformance</b>	
<b>307.4</b>	<b>Structural</b>	
<b>307.4 Exceptions</b>	1. Level of performance and seismic safety equivalent to a new structure? 2. Occupancy category I or II to III and $S_{DS} < 0.33$ ?	
<b>308</b>	<b>HISTORIC BUILDINGS</b>	
<b>308.1</b>	<b>Historic buildings.</b>	
<b>308.2</b>	<b>Flood hazard areas</b>	

<b>Chapter 4: Classification of Work (Work Area Compliance Method)</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>402</b>	<b>REPAIRS</b>	
<b>403</b>	<b>ALTERATIONS—LEVEL 1</b>	
<b>404</b>	<b>ALTERATIONS—LEVEL 2</b>	
<b>405</b>	<b>ALTERATIONS—LEVEL 3</b>	
<b>406</b>	<b>CHANGE OF OCCUPANCY</b>	
<b>407</b>	<b>ADDITIONS</b>	
<b>408</b>	<b>HISTORIC BUILDINGS</b>	
<b>409</b>	<b>RELOCATED BUILDINGS</b>	

<b>Chapter 5: Repairs (Work Area Compliance Method)</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>501</b>	<b>GENERAL</b>	
<b>501.1</b>	<b>Scope</b>	

501.2	Conformance	
501.3	Flood hazard areas	
502	<b>BUILDING ELEMENTS AND MATERIALS</b>	
502.1	Existing building materials	
502.2	New and replacement materials	
506	<b>STRUCTURAL</b>	
506.1	General	
506.2.1	Repairs for less than substantial structural damage (refer to definition of “substantial structural damage” in Chapter 2)	
506.2.2	Repairs for substantial structural damage to vertical elements of the lateral-force-resisting system	
506.2.2.1	Evaluation (determine whether building in predamaged state would comply with the IBC with reduced seismic forces per 101.5.4.2)	
506.2.2.2	Extent of repair for compliant buildings (if predamaged building was compliant with IBC per the evaluation, may repair to the predamaged state)	
506.2.2.3	Extent of repair for noncompliant buildings (specific requirements depending upon reason for damage)	
506.2.3	Substantial structural damage to gravity load-carrying components (repaired gravity components must comply with dead and live load requirements of IBC; snow loads must be considered if snow caused damage; undamaged gravity-load components that receive loads from damaged components must also comply)	
506.2.4	Flood hazard areas	

<b>Chapter 6: Alterations—Level 1 (Work Area Compliance Method)</b>		
Section	Title	N/A and comments
601	<b>GENERAL</b>	
601.3	Flood hazard areas	
606	<b>STRUCTURAL</b>	
606.1	General	
606.2	Addition or replacement of roofing or replacement of equipment	
606.2 Exceptions	1. Dead load increase $\leq 5\%$ ? 2. Conventional light-frame construction and dead load increase $\leq 5\%$ ? 3. Second layer of roofing $\leq 3$ psf?	
606.2.1	Wall anchors for concrete and masonry buildings	
606.3	Additional requirements for reroof permits	
606.3.1	Bracing for unreinforced masonry bearing	



	<b>wall parapets</b>	
<b>606.3.2</b>	<b>Roof diaphragms resisting wind loads in high-wind regions</b> <ol style="list-style-type: none"> <li>1. Basic wind speed greater than 90 mph and occupancy category type III or IV</li> <li>2. Basic wind speed is greater than or equal to 105 mph</li> </ol>	

<b>Chapter 7: Alterations—Level 2 (Work Area Compliance Method)</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>701</b>	<b>GENERAL</b>	
<b>701.2</b>	<b>Alteration Level 1 compliance</b> (all Level 2 work must also comply with Level 1 requirements)	
<b>701.3</b>	<b>Compliance</b> (all new construction must comply with IBC)	
<b>707</b>	<b>STRUCTURAL</b>	
<b>707.2</b>	<b>New structural members</b>	
<b>707.3</b>	<b>Minimum design loads</b>	
<b>707.4</b>	<b>Existing structural elements carrying gravity load</b>	
<b>707.4 Exceptions</b>	<ol style="list-style-type: none"> <li>1. Stress increase <math>\leq 5\%</math>?</li> <li>2. Group R? Less than 6 units? And conventional light-frame construction?</li> </ol>	
<b>707.5</b>	<b>Existing structural elements resisting lateral load</b>	
<b>707.5.1</b>	<b>Irregularities</b>	
<b>707.6</b>	<b>Voluntary lateral-force-resisting system alterations</b>	

<b>Chapter 8: Alterations—Level 3 (Work Area Compliance Method)</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>801</b>	<b>GENERAL</b>	
<b>801.2</b>	<b>Compliance</b> (all Level 3 work must also comply with Levels 1 and 2 requirements)	
<b>807</b>	<b>STRUCTURAL</b>	
<b>807.1</b>	<b>General</b>	
<b>807.2</b>	<b>New structural elements</b>	
<b>807.3</b>	<b>Existing structural elements carrying gravity load</b>	
<b>807.4</b>	<b>Structural alterations</b>	
<b>807.4 Exceptions</b>	<ol style="list-style-type: none"> <li>1. Group R? Less than 6 units? And conventional light-frame construction?</li> <li>2. Alterations on lowest story only? And no change of occupancy?</li> </ol>	
<b>807.4.1</b>	<b>Evaluation and analysis</b>	
<b>807.4.2</b>	<b>Substantial structural alterations</b>	
<b>807.4.3</b>	<b>Limited structural alteration</b>	

<b>Chapter 9: Change of Occupancy (Work Area Compliance Method)</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>902</b>	<b>SPECIAL USE AND OCCUPANCY</b>	
<b>902.1</b>	<b>Compliance with the building code</b> (changes to certain occupancies require full compliance with the IBC)	
<b>902.2</b>	<b>Underground buildings</b>	
<b>907</b>	<b>STRUCTURAL</b>	
<b>907.1</b>	<b>Gravity loads</b>	
<b>907.1 Exception</b>	Stress increase $\leq 5\%$ ?	
<b>907.2</b>	<b>Snow or wind loads</b>	
<b>907.2 Exception</b>	Is new occupancy with higher importance factor $\leq 10\%$ of the total floor area?	
<b>907.3</b>	<b>Seismic loads</b>	
<b>907.3.1</b>	<b>Compliance with the IBC level seismic forces</b>	
<b>907.3.1 Exceptions</b>	<ol style="list-style-type: none"> <li>1. Group M building to start with and is <math>&lt; 6</math> stories and in Seismic Design Category A, B, or C?</li> <li>2. Equivalent level of performance and seismic safety approved by the building official?</li> <li>3. Is occupancy with the higher hazard category <math>\leq 10\%</math> of total building floor area and not classified as Occupancy Category IV?</li> <li>4. Unreinforced masonry in Occupancy Category III and in Seismic Design Category A or B? If so may use Appendix A1.</li> </ol>	
<b>907.3.2</b>	<b>Access to Occupancy Category IV</b>	

<b>Chapter 10: Additions (Work Area Compliance Method)</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>1001</b>	<b>GENERAL</b>	
<b>1001.1</b>	<b>Scope</b> (additions to comply with IBC; only that portion of existing building impacted by addition needs to comply with IEBC unless otherwise specified in IEBC)	
<b>1003</b>	<b>STRUCTURAL</b>	
<b>1003.1</b>	<b>Compliance with the IBC</b>	
<b>1003.2</b>	<b>Additional gravity loads</b>	
<b>1003.2 Exceptions</b>	<ol style="list-style-type: none"> <li>1. Stress increase <math>\leq 5\%</math>?</li> <li>2. Group R? Less than 6 units? And conventional light-frame construction?</li> </ol>	
<b>1003.3</b>	<b>Lateral force-resisting system.</b>	

<b>1003.3 Exceptions</b>	1. Group R? Less than 6 units? And conventional light-frame construction? 2. Lateral-force story shear increase in any story $\leq 10\%$ cumulative	
<b>1003.3.1</b>	<b>Vertical additions</b>	
<b>1003.3.2</b>	<b>Horizontal additions</b>	
<b>1003.3.3</b>	<b>Voluntary addition of structural elements to improve the lateral-force-resisting system</b>	
<b>1003.3.4</b>	<b>Irregularities</b>	
<b>1003.4</b>	<b>Snow drift loads</b>	
<b>1003.4 Exceptions</b>	1. Element stress increase $\leq 5\%$ ? 2. Group R? Less than 6 units? And conventional light-frame construction?	

### **Chapter 11: Historic Buildings (Work Area Compliance Method)**

<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>1101</b>	<b>GENERAL</b>	
<b>1101.2</b>	<b>Report</b> (report to building official required if necessary in the opinion of the code official)	
<b>1101.4</b>	<b>Flood hazard areas</b> (historical buildings are exempt)	
<b>1102</b>	<b>REPAIRS</b>	
<b>1102.1</b>	<b>General</b> (repairs may be made with original or like materials subject to provisions of Ch. 11)	
<b>1106</b>	<b>STRUCTURAL</b>	
<b>1106.1</b>	<b>General</b> (must satisfy requirements for non-historical buildings, except code official may accept operational controls that limit live loads on floors that do not meet IBC LL requirements)	

### **Chapter 12: Relocated or Moved Buildings (Work Area Compliance Method)**

<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>1201</b>	<b>GENERAL</b>	
<b>1201.2</b>	<b>Conformance</b> (Any repair, alteration, change of occupancy, field-fabricated items?)	
<b>1202</b>	<b>REQUIREMENTS</b>	
<b>1202.2</b>	<b>Foundation</b> (foundations and building connections to foundations must comply with IBC or IRC.)	
<b>1202.3</b>	<b>Wind loads</b> (comply with IBC or IRC except for exceptions.)	
<b>1202.4</b>	<b>Seismic loads</b> (comply with IBC or IRC except for exceptions.)	
<b>1202.5</b>	<b>Snow loads</b> (comply with IBC or IRC except for exceptions.)	
<b>1202.6</b>	<b>Flood hazard areas</b>	
<b>1202.7</b>	<b>Required inspection and repairs</b>	

<b>Chapter 13: Performance Compliance Method</b>		
<b>Section</b>	<b>Title</b>	<b>N/A and comments</b>
<b>1301</b>	<b>GENERAL</b>	
<b>1301.1</b>	<b>Scope</b> Maintain or Increase the current degree of public safety without requiring full compliance w/ Chapter 3 or Chapters 4-12	
<b>1301.3.4</b>	<b>Peer review</b>	
<b>1301.4</b>	<b>Investigation and evaluation</b>	
<b>1301.4.1</b>	<b>Structural Analysis</b> Analysis of existing building and proposed alteration shall comply with IBC Chapter 16	
<b>1301.4.2</b>	<b>Submittal</b> Structural investigation and evaluation submitted to code official for review and approval	