Creating A Greener Energy Future For the Commonwealth

Stretch Code overview

Ian Finlayson – Manager of Buildings and Climate Programs
Sept 22, 2010 – Cape Cod Regional Forum
Energy Codes have changed

• New MA energy code since July 1 (IECC 2009)
  – Roughly 10% more energy efficient
• Commercial ASHRAE 90.1-2007 option remains
• Towns and Cities can opt into the “Stretch Code” appendix
  – Approx 20% more energy efficient

ASHRAE 90.1 = Energy Standard for Buildings Except Low-Rise Residential Buildings
Stretch Code …what is it?

• Residential – Based on EPA Energy Star Homes
  – Established: over 2,100 ENERGY STAR-units in 2009.
  – Cost effective: all measures tested to ensure $ paybacks
  – Utility incentives: rebates and performance funding

• Commercial – Based on New Buildings Institute (NBI) and ASHRAE / LEED energy modeling
  – Established: Leading national program for commercial
  – Cost effective: NBI based on National lab testing
  – Utility incentives: NBI and LEED have been used since 2005
History of the ‘stretch’ code

• May 2008 - BBRS Requested public comment on Energy Star and LEED as ‘stretch’ codes

• July 2008 - Green communities act passes
  – Includes building lifecycle cost-effective energy efficiency as green community criteria

• May 2009 – BBRS votes to adopt ‘stretch appendix’
Forty-seven municipalities have adopted the new Board of Building Regulations and Standards (BBRS) Stretch Code, as of September 21, 2010.
47 early adopters – more to come

• Effective July 1, 2010:
  – Newton, Cambridge

• Effective Jan 1, 2011: 40 more communities

• Effective July 1, 2011: 5 and counting

• The BBRS has a 6-month transition period before the stretch code becomes the only energy code.
Residential Stretch = Performance Testing
Why Test Performance?

Prescriptive codes don’t guarantee good installation, air and water tightness, or that thermal insulation is effective.

e.g. Small air gaps can reduce insulation R-values by 50% or more
e.g. Insulation

- Performance suffers rapidly when details aren’t followed
- Quality installation is key
- Old energy codes didn’t test this

Photos courtesy Conservation Services Group ©
Tools to Test Performance

IECC 2009 encourages testing, the Stretch code requires it:

• Blower-door test for air leakage
• Duct test for heating & AC
• Optional infra-red camera use to test thermal barrier

Image source: http://www.pixelthermographics.co.uk/images/FrontJoinedIR.jpg
Blower Door Depressurization Test

Calculate Leakage from House Pressure and AirFlow Rate
New Homes – Energy Rating (HERS)

• Energy ‘Performance’ rating (like car MPG)
  – Uses Home Energy Rating System (HERS) Index
  – 70 or less < 3,000 sq ft.
  – 65 or less > 3,000 sq ft.

• Requires a certified HERS rater
  – Review building plans
  – Check insulation installation
  – Blower-door and duct testing
  – Thermal bypass Checklist

Image source: www.lexingtoninfrared.com/hers-ratings.php
HERS rating Process

1. Review Building Plans via Computer Modeling
2. In-process inspections
   – Field inspection
     • Thermal Bypass Checklist
     • Duct tightness test
     • Insulation
   – Final Inspection
     • Blower door test
3. Finalize energy model based on verified performance and equipment
Home Additions – 2 options

• HERS index (same as new construction)

• Prescriptive Path

IECC 2009 plus:

– Energy Star 5.0 Windows, Doors, Skylights
– Tighter ducts for New heating and cooling systems
– Energy Star Thermal Checklist
Home Renovations – 2 options

• Performance Path is easier
  – Easier HERS index requirement (mostly relevant for gut-renovations)
  – 85 or less < 2,000 sq ft.
  – 80 or less > 2,000 sq ft.

• Prescriptive Path
  – Same as for additions
  – Energy Star Windows
  – IECC 2009 envelope & Thermal bypass checklist

Image source: http://www.wilkinsonbuild.co.uk/Portals/5/Renovation/renovation2.jpg
Residential based on ‘Energy Star’

- Proven cost-effective program
  - Over 30% of new construction in MA
- Builder incentives/rebates
  - $1,250/home for HERS 65 (energy star tier 2)
  - Up to $8,000 for HERS <40
  - Rebates on appliances, heating and cooling, lighting, etc.
- Builder training and materials
- Subsidized HERS raters
COMMERCIAL STRETCH CODE
Commercial ‘Stretch’ Appendix

• Based on New Buildings Institute – ‘Core Performance’ Energy Code
Commercial ‘Stretch’ Appendix

• Only New Commercial Buildings

• Only buildings or additions over 5,000 ft$^2$

• 2 Options (depending on size)
  • Performance option - 20% below Code
  • Prescriptive option for most building types
    5,000 - 100,000 ft$^2$
Fidelity Bank
Corporate Office and Branch Case Study
Leominster, MA

Advanced Building Features
- High Efficiency T-5 Pendant Lighting
- Lighting Control Efficiency
- Reduced Lighting Power Density
- Efficient Site Lighting
- Additional Wall Insulation
- High Performance Glazing
- Efficient VAV RTU's, with ECM Motors
- Demand Control Ventilation
- Part Load HVAC Efficiency Enhancements

Funded Utility Services Support
- Early Life Cycle Cost Analysis
- Integrated Design Team Approach
- Commissioning

Project Description
The 47,000 SF Fidelity Bank Corporate Office and Branch was constructed as a design-build project in Leominster, MA. The four-story building will provide office space plus a ground floor branch bank office. This project is acclaimed for its highly successful implementation of the national Advanced Buildings program. The project demonstrates the validity of the Advanced Buildings program assertions. The guideline cost effectively delivered even more than the expected 20% to 30% reduction in annual energy costs compared to a code based design.

Envelope Improvements
- Walls: Added 3-1/2" batt insulation to planned 2" rigid.
- Glazing:
  - Upgrade U value from 0.42 to 0.31
  - Upgrade SHGC from 0.50 to 0.30
- Projected envelope savings: $1,500

Project Team
Owner:
Fidelity Bank
Project Management:
Habitat Advisors Group
High Performance Building Design Uses 31% Less Energy

Savings Projection

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Energy Savings</td>
<td>$27,600</td>
</tr>
<tr>
<td>Additional Cost for Upgrades</td>
<td>$100,622</td>
</tr>
<tr>
<td>Utility Incentives</td>
<td>-$66,500</td>
</tr>
<tr>
<td>Net Owner Costs</td>
<td>$34,035</td>
</tr>
</tbody>
</table>

Payback with Incentives: 1.2 years ROI: 83%
Payback without Incentives: 3.7 years ROI: 27%

31% Improvement Over Code

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC</td>
<td>$18,900</td>
</tr>
<tr>
<td>Lighting</td>
<td>$7,200</td>
</tr>
<tr>
<td>Building Envelope</td>
<td>$1,500</td>
</tr>
</tbody>
</table>

Savings Components ($27,600 annual savings)

Annual Energy Costs

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>$69,150</td>
</tr>
<tr>
<td>Advanced Buildings</td>
<td>$61,550</td>
</tr>
</tbody>
</table>

Lighting Savings Summary

The lighting layout consisted mainly of T-5 pendants in open office areas, and the latest generation of recessed T-5 fixtures in the remaining areas.

Projected Lighting Savings: $7,200

<table>
<thead>
<tr>
<th>Category</th>
<th>Mass Energy Code</th>
<th>Advanced Buildings Criteria</th>
<th>Final Design</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Power Density</td>
<td>1.34 w/SF</td>
<td>0.96 w/SF</td>
<td>0.86 w/SF</td>
<td>36%</td>
</tr>
</tbody>
</table>

Improved lighting quality while using less energy!
Cost of Stretch code

• Cost effective and already proven in the voluntary market
  – Energy star 15% of all MA new residential in 2008
  – Over 30% of all MA new residential in 2009

• Example homes show clear $$ savings
  – Mortgage increase is less than energy bill savings

• 4 Updated case studies on DOER website
  – 4,500 sq ft, 2,700 sq ft, 1,800 sq ft & 3x1,700 sq ft
Residential Stretch Code:
Real World Examples in MA
Small Townhouse Units

(1,200 square feet)
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls</td>
<td>R-19</td>
</tr>
<tr>
<td>Ceiling</td>
<td>R-41</td>
</tr>
<tr>
<td>Slab (Perim./Under)</td>
<td>R10/R10</td>
</tr>
<tr>
<td>Heating</td>
<td>Hydro-Air, 92%</td>
</tr>
<tr>
<td>Cooling</td>
<td>14 SEER</td>
</tr>
<tr>
<td>DHW</td>
<td>Integrated, 0.86 EF</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>5 ACH@50</td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>6% of floor area</td>
</tr>
<tr>
<td>HERS Index</td>
<td>63</td>
</tr>
</tbody>
</table>
Single Family
(2,600 square feet)
<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls (cavity)</td>
<td>R-19</td>
</tr>
<tr>
<td>Ceiling (cavity)</td>
<td>R-37</td>
</tr>
<tr>
<td>Floor (cavity)</td>
<td>R-30</td>
</tr>
<tr>
<td>Foundation</td>
<td>N/A</td>
</tr>
<tr>
<td>Slab (Perim./Under)</td>
<td>R5/R10</td>
</tr>
<tr>
<td>Heating</td>
<td>Oil Boiler, 86%</td>
</tr>
<tr>
<td>Cooling</td>
<td>13 SEER</td>
</tr>
<tr>
<td>DHW</td>
<td>Integrated, 0.79 EF</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>5 ACH@50</td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>6% of floor area</td>
</tr>
<tr>
<td>HERS Index</td>
<td>66</td>
</tr>
</tbody>
</table>
Another Single Family
(2,600 square feet)
<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls (cavity)</td>
<td>R-25</td>
</tr>
<tr>
<td>Ceiling (cavity)</td>
<td>R-59</td>
</tr>
<tr>
<td>Floor (cavity)</td>
<td>R-39</td>
</tr>
<tr>
<td>Foundation</td>
<td>R-0</td>
</tr>
<tr>
<td>Slab (Perim./Under)</td>
<td>N/A</td>
</tr>
<tr>
<td>Heating</td>
<td>Furnace 80%</td>
</tr>
<tr>
<td>Cooling</td>
<td>13 SEER</td>
</tr>
<tr>
<td>DHW</td>
<td>Stand Alone Tank EF - 0.55</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>2.5 ACH@50</td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>0% of floor area</td>
</tr>
<tr>
<td>HERS Index</td>
<td>68</td>
</tr>
</tbody>
</table>
Medium-Large Single Family
(4,200 square feet)
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls (cavity)</td>
<td>R-15</td>
</tr>
<tr>
<td>Ceiling (cavity)</td>
<td>R-34</td>
</tr>
<tr>
<td>Foundation</td>
<td>R-22</td>
</tr>
<tr>
<td>Slab (Perim./Under)</td>
<td>R10/R10</td>
</tr>
<tr>
<td>Heating</td>
<td>Hydro-Air, 92%</td>
</tr>
<tr>
<td>Cooling</td>
<td>14 SEER</td>
</tr>
<tr>
<td>DHW</td>
<td>Integrated .85 EF</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>5 ACH@50</td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>6% of floor area</td>
</tr>
<tr>
<td>HERS Index</td>
<td>63</td>
</tr>
</tbody>
</table>
Training on new energy codes

• Covering both the IECC 2009 & Stretch code
• Provided free to all Code Officials
  – Includes IECC code book and Stretch appendix
• Provided at cost to building professionals
• Register online: www.cetonline.org/Events/events.php
  – Separate Commercial and Residential sessions
• Energy star homes training available for free: www.energystarhomes.com/
• Utilities offer commercial ‘Core Performance’ energy training
Energy Conservation 'Appendix 120 AA' Approved

A code change proposal relating to energy conservation was approved by the BBRS at the May 12, 2009 meeting and will become an appendix to the MA State Building Code (780 CMR) on or about August 1, 2009. It is based on the International Energy Conservation Code (IECC) 2009 and can be viewed by following the 1st link below. The 2nd link will take you to a two-page overview of this new appendix.

This appendix may be adopted by any municipality in the commonwealth, by decision of its governing body. In a city a Plan D or Plan C charter the governing body shall be the city manager and the city council, and in any other city the mayor and city council. In towns the governing body shall be the board of selectmen. In order to be adopted, the appendix must be considered at an appropriate municipal public hearing, subject to the municipality's existing public notice provisions. If adopted by a municipality this appendix rather than 780 CMR 13, 34, 61, or 93, as applicable, shall govern.

Also at the May 12 meeting a concurrency period and a training policy were approved. Concurrency period is a period when either the new code or the existing code can be used but not combined. The BBRS approved a concurrency period of 6 months to a maximum of 12 months, with such period to begin on either January 1 or July 1 of any year. In addition a town or city which adopts the appendix must provide training to the building official. If you have comment or questions on this subject please forward them to mike.quigley@state.ma.us

Appendix 120 AA July 9, 2009 Final

Stretch Code Overview June 5, 2009
Building Energy Codes

Energy Efficiency Provisions of the State Building Code (780 CMR)

The Massachusetts Board of Building Regulations and Standards (BBRS) recently upgraded the "base" building energy code, 780 CMR, to be consistent with the 2009 International Energy Conservation Code (IECC). This upgrade is in accordance with the Green Communities Act of 2008 (GCA), which requires Massachusetts to update its building code every three years to be consistent with the most recent version of the IECC. Effective July 1, 2010, residential construction must comply with the IECC 2009 residential provisions and commercial construction must comply with the IECC commercial provisions or ASHRAE 90.1 2007.

Massachusetts Stretch Code

In 2009, Massachusetts became the first state to adopt an above-code appendix to the "base" building energy code—the "Stretch Code" (780 CMR Appendix 120.AA). The Stretch Code, which emphasizes energy performance, as opposed to prescriptive requirements, is designed to result in cost-effective construction that is at least 20% more energy efficient than that built to the "base" energy code.

Massachusetts Municipalities Adopt Stretch Code

Municipalities may choose to adopt the Stretch Code in lieu of the base building energy code. Stretch code adoption is mandatory for designation as a "Green Community" under the GCA. As of August 5, 2010, 45 municipalities have adopted the Stretch Code, with more expected in the fall of 2010. Building code officials have received free code training since January 2010; more training will be conducted in October 2010.
Questions?

Contacts:
Dept. of Public Safety
Mike Guigli (617) 826-5215
mike.guigli@state.ma.us

Dept. of Energy Resources
Ian Finlayson (617) 626-4910
ian.finlayson@state.ma.us

Energy & Environment (EOEEA)
Marc Breslow (617) 626-1105
marc.breslow@state.ma.us

Image source: Manulife building, Fort Point Associates, Inc.
http://www.fpa-inc.com/HTML%20Files/Projects_Com.htm
The Stretch Code ...what is it?

- The stretch appendix replaces IECC 2009 chapter 4 (Residential) with a HERS rating and performance testing.
- and rewrites chapter 5 (Commercial) to be more energy efficient, or allows LEED style modeling.
- Stretch code uses real-world testing to ensure residential energy savings,
  and energy modeling to ensure commercial energy savings.

  Performance based, not prescriptive.
Ducts are now tested under both Base & Stretch code.

- If all ducts are inside the insulated space – no test required, only test when ducts can leak to the outside.
Commercial ‘Stretch’ Appendix

• Performance option
  – 20% below Code (ASHRAE 90.1-2007 appendix G)
  – all buildings over 100,000 ft²
  – Labs, Supermarkets, over 40,000 ft²

• Prescriptive option for most building types
  – 5,000 - 100,000 ft²

• Exemptions (comply with base code)
  – Special cases smaller than 40,000 ft²
Commercial ‘Stretch’ & LEED(v.3)

• LEED and Commercial ‘Stretch’ code are fully compatible
  – Both use ASHRAE 90.1-2007 app. G as the energy modeling baseline.
• LEED energy model = Stretch code model ASHRAE 90.1-2007 – 20% = 5 LEED energy points
• LEED also has non-energy requirements
Code Compliance & Inspections

- Essentially the same as base code
- Code Official has the same authority
  - Same building inspections
  - Approves building documents, Energy Star and HERS rating or ASHRAE modeling as documentation of energy
- Certificate is required
## Example of Benefit-Cost: 3-bedroom 2,672 sq ft

<table>
<thead>
<tr>
<th>HERS Index Modeled in REM/Rate</th>
<th>IECC 2009 Code</th>
<th>Stretch Code</th>
<th>Stretch Code - with ENERGY STAR(^4,5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement Costs</td>
<td>$2,049</td>
<td>$2,155</td>
<td></td>
</tr>
<tr>
<td>HERS Rater Fee(^1)</td>
<td>$900</td>
<td>$900</td>
<td></td>
</tr>
<tr>
<td>HERS Rater reimbursement(^2)</td>
<td>-</td>
<td>$(650)</td>
<td></td>
</tr>
<tr>
<td>ENERGY STAR Incentive(^3)</td>
<td>-</td>
<td>$(650)</td>
<td></td>
</tr>
<tr>
<td>Total Improvement Costs</td>
<td>$2,949</td>
<td>$1,755</td>
<td></td>
</tr>
<tr>
<td>Mortgage Interest Rate</td>
<td>6%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Loan Term (Years)</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Annual Incremental Mortgage Payment</td>
<td>$214</td>
<td>$127</td>
<td></td>
</tr>
<tr>
<td>Annual Energy Costs(^6)</td>
<td>$3,970</td>
<td>$3,463</td>
<td>$3,454</td>
</tr>
<tr>
<td>Annual Energy Savings from Baseline</td>
<td>$507</td>
<td>$516</td>
<td></td>
</tr>
<tr>
<td><strong>Annual Cash Flow</strong></td>
<td><strong>$ -</strong></td>
<td><strong>$ 293</strong></td>
<td><strong>$ 389</strong></td>
</tr>
</tbody>
</table>