Optimizing Energy Performance

The role of doors and hardware in improving building energy efficiency

Program Number:  DSS701
Presented By:

ASSA ABLOY is the global leader in door opening solutions, dedicated to satisfying end-user needs for security, safety and convenience
Energy Efficiency – Why It’s Important

- Two main concerns:
  - Monetary costs
    - Rising fuel prices create desire to reduce energy consumption
    - Structural deficiencies increases cost of achieving and maintaining desired heating/cooling levels
  - Environmental costs
    - Increased fuel usage caused by these deficiencies generates greater amounts of air pollution
Energy Efficiency – Why It’s important

- Canada Green Building Council (CaGBC) created in 2002 to lead and accelerate the transformation to high performing, healthy, green buildings, homes, and communities throughout Canada
  - Establishes Leadership in Energy and Environmental Design Canada (LEED) Green Building Rating System™
- Rating systems also created by local, state and federal government
  - Model National Energy Code for Buildings (MNECB)
  - Natural Resources Canada (NRCA) Office of Energy Efficiency (OEE) administers the ENERGY STAR label.
Energy Efficiency – Why It’s Important

- According to Natural Resources Canada:
  - In Canada alone, buildings in the commercial/institutional sector account for 14% of total secondary energy consumption
  - Almost 60% of this energy is used for space heating and cooling
Energy Efficiency – Why It’s Important

- Approx 40% of all energy leakage comes from the **building envelope**
  - Roof
  - Walls
  - Windows
  - Doors

*The Next Big Energy Savings Frontier: Airtight Building Envelopes" by Tony Woods, 2005
Energy Efficiency – Growing Awareness

- LEED certification
  - CaGBC requires buildings seeking LEED certification to optimize energy performance
    - 1 to 10 points awarded for design energy cost relative to MNECB and ASHRAE 90.1

- EcoENERGY Efficiency Initiative
  - NRCan Validation of New Building Designs
    - 3rd Party confirmation that your design exceeds MNECB minimum requirements by at least 25%.
Energy Efficiency – Types of Energy

- CaGBC divides building energy usage into two categories:
  - Process energy
    - Energy used to power building equipment (computers, elevators, kitchen equipment, laundry equipment)
  - Regulated (non-process) energy
    - Energy used to power lighting and HVAC (space heating and cooling)
Energy Efficiency – Types of Energy

- Regulated (non-process) energy usage can be improved through building design
  - Lighting
    - Extensive use of glazing increases natural lighting
  - HVAC
    - Challenge is to limit exchange of air between building interior and exterior
Energy Efficiency – Design Strategies

- Building design can optimize energy performance
- Stack pressure within a building forces air through any opening, causing the heating/cooling system to work harder
  - Need to create an airtight building envelope
  - Acts as a barrier to lessen heat exchange
Energy Efficiency – Envelope Design

- Doors and hardware play an important role in enhancing building energy efficiency.
- A few basic measures can be taken to improve the thermal integrity of doorways in the building envelope.
Energy Efficiency – Factors to Consider

- Measures can be taken to improve the U-factor or R-factor of an opening

- U-factor
  - The measure of heat transmission from one side of an opening to the other
  - Lower U-value indicates better ability to prevent heat transmission

- R-Factor
  - The measure of a material’s ability to resist heat flow
  - Higher R-value indicates better resistance to heat flow
Energy Efficiency – Converting R to U

- Door manufacturers often display the R-value for their products.
- Energy codes performance guidelines may be expressed in a U-value.
- Following equation converts R-value to U-value:
  \[ U = \frac{1}{R_1 + R_2 + R_3\ldots} \]
Energy Efficiency – Calculated vs. Operable Values

- Manufacturers have traditionally promoted the calculated R and U values for their products
  - Determined by a formula, rather than performance test
  - Calculated core not indicative of real-life performance

- Operable value gives a more realistic estimate of product performance
  - Determined by performance testing
  - ASTM C1363 is the most current test standard, replacing ASTM C236
**Energy Efficiency – Calculated vs. Operable Values**

- Example of differences in calculated and operable R and U values

<table>
<thead>
<tr>
<th>Door Series / Core</th>
<th>Test Method: ASTM C518 Calculated</th>
<th>Test Method: ASTM C1363* Operable</th>
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</thead>
<tbody>
<tr>
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<td>U - Factor</td>
<td>R - Value</td>
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<tr>
<td>Imperial / Polyurethane</td>
<td>0.09</td>
<td>11.0</td>
</tr>
<tr>
<td>Trio / Polyurethane &amp; Steel Stiffened</td>
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<td>11.0</td>
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<td>Legion / Polystyrene</td>
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<tr>
<td>Regent / Honeycomb</td>
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<tr>
<td>Medallion / Steel Stiffened</td>
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<td>1.6</td>
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</table>
Energy Efficiency – Components of an Energy Efficient Opening

- Opening components must be pieced together to create a weatherized opening
  - Thermal break frames
  - Insulated doors
  - Gasketing (also known as weatherstripping)
  - Kerf frames
  - Hardware (closing and latching)
  - Revolving doors
Energy Efficiency – Thermal Break Frames

- Thermal break frames can improve an opening’s U-factor
  - Since door frames are made of metal, a thermal break consisting of an insulated material is needed to stop heat transmission
    - Reduce heat loss
    - Prevent frost/condensation
    - Provides a positive thermal break within the frame profile
    - Delivers maximum protection against cold penetration
    - Ideal for openings exposed to extreme cold
Energy Efficiency – Insulated Doors

- Insulated doors boost the R-factor of an opening
- Hollow metal doors commonly used in building envelope
  - Constructed from sheet metal in 20, 18, 16 and 14-gauge thickness
  - Core or interior space can be filled with insulated material
    - Polystyrene
    - Polyurethane

*Polyurethane Core*
Energy Efficiency – Insulated doors

- **Door cores**
  - **Polystyrene**
    - Features an R-factor of roughly 6.4
  - **Polyurethane**
    - R-factor of about 11 creates an effective thermal barrier
Energy Efficiency – Sealing the gaps

- All openings have small gaps and creases
- Left untouched, these gaps allow free passage of air and are a significant source of energy loss
- Gasketing needed to fill these creases
- ASTM E283 provides guidelines for air infiltration performance
Energy Efficiency – Sealing the Gaps

- What is air infiltration?
  - Air infiltration: A measurement of the air leakage around the perimeter of a door opening
  - CFM = Cubic Feet per Minute
- Example of air infiltration test results:

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<tr>
<td></td>
<td>CFM / SQ FT</td>
</tr>
<tr>
<td>Imperial / Polyurethane</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Energy Efficiency - Gasketing

- Gasketing should be used to fill seams around the jambs and door head
- A bottom seal and threshold can eliminate the gap under the door
- Openings with a pair of doors also require gasketing to seal the meeting stile
Energy Efficiency - Gasketing

- Gasketing available in several materials
  - Silicone
  - Neoprene
  - Vinyl
  - Polypropylene

- Materials are flexible
  - Do not impede door operation

- Available in varying Grades to meet conditions of different climate zones

- Look for products that meet or exceed ANSI 156.22 Door Gasketing and Edge Seal Systems standards
Energy Efficiency – Gasketing Installation

- Kerf frames
  - Specially designed frames feature a groove along the frame section that comes in contact with the door edge
  - Simplifies installation of weatherstripping
  - Serves as a convenient channel to install weatherstripping without using additional fasteners
Energy Efficiency – Door Closers

- Mechanical closers used on majority of doorways
- Door closer operates in five cycles
  1. Opening cycle
  2. Back-check cycle
  3. Delayed-action cycle
  4. Closing cycle
  5. Latching cycle
Energy Efficiency – Door Closers

- Overcoming stack pressure
  - Stack pressure created by differences between inside and outside air pressure
    - Can create a strong rush of air to flow out that overpowers the closing cycle of the door closer
    - Door may stay open longer than intended or fail to properly latch closed
    - Properly sized closer needed to overcome stack pressure
Energy Efficiency – Door Closers

- Innovations
  - A new generation of mechanical closers have self-adjusting features
    - Eliminates the need to determine closer size
    - Automatically adjusts any time there is a change in stack pressure
    - One size fits all
    - Simplifies code compliance
Energy Efficiency – Automatic Operators

- Automatic or power-assisted doors used on heavily-accessed entrances
Energy Efficiency – Other Opening Options

- Alternatives to swinging/sliding doors
  - Revolving doors
Energy Efficiency – Revolving Doors

- Swinging/sliding doors allow air to rush out of the building
- Revolving doors stop the free flow of air
  - Revolving door is never open
  - Seals remain in contact with walls of the doors at all times
  - Only air transferred is in the chamber with the person using the door
Energy Efficiency – Revolving Doors

- MIT 2006 study
  - Swinging doors allow eight times as much air exchange as revolving doors’
  - Study estimated that limiting ingress and egress to revolving doors would save school $7,500 a year for a single building
  - Accompanying reduction in emissions would total about 15 tons of carbon dioxide annually per building
Energy Efficiency – Revolving Doors

- Overcoming habits
  - MIT study found most people entering the building bypassed the revolving door in favor of the nearby swinging door
    - Building codes require a swinging door to be placed in close proximity to revolving doors
  - Revolving door traffic increased after a sign was posted indicating the potential energy savings
Energy Efficiency – Revolving Doors

- Improving manual revolving door efficiency
  - Efficiency can be improved by including a speed control enhancement that moves the door to the X position (return-to-quarter-point)
  - When door rests in X position, all four door wings seal the door unit to the outside curved wall
  - Keeps the door in rest position until activated by a user
Energy Efficiency – A Sealed Building

- Optimizing thermal performance requires attention to the entire building envelope.
- Steps should be taken to create a sealed barrier that prevents air infiltration and heat transfer.
- Each opening component should be carefully selected:
  - Insulated doors
  - Thermal break frames and kerf frames
  - Door closers
  - Gasketing
  - Revolving doors
- Following this strategy, doorways can be used to create a more energy efficient building.
Keep In Mind – Fire Safety

- MUST be Self or Positive Latching
  - Latching device must conform to door manufacturing labeling service
- MUST be Self or Automatic Closing
  - Door closer must be used and cannot have a mechanical means of holding open
- Hinges or Pivots MUST be Steel Material Ball Bearing
  - Spring hinges must be “Labeled”
- MUST be Free Swinging
  - Nothing blocking or prohibiting the door from swinging freely
- 2007 – ANNUAL Inspection of Fire Door Assemblies
Keep In Mind – Life Safety

- Doors MUST Swing in Direction of Egress
- Hardware MUST be Operated Without “Special Knowledge,” without a key or other tool.
- Hardware MUST Operate with One Motion
- In an Assembly Area of 50 or more people, Panic/Fire Exit Devices MUST be used
  - Local Codes May Differ
- Doors MUST meet Fire Codes where applicable
- Inactive Leaf of a pair of doors may NOT have any Operating Trim, Pull, or Dummy Trim
Keep In Mind - Specifications

SECTION 08 14 16
1.01 SUMMARY

C. RELATED SECTIONS

08 06 71 Door Hardware Schedule
08 11 13 Metal Doors and Frames
08 14 23 Clad Wood Doors
08 14 33 Stile & Rail Wood Doors
08 17 00 Integrated Door Opening Assemblies
08 71 00 Door Hardware
08 74 00 Access Control Hardware

Always be sure to include the proper related sections, names and dates of the appropriate codes and standards documents in your specifications.
How To Get More Information?

- **Codes:**
  - National Fire Protection Association: www.nfpa.org
  - International Code Council (ICC): www.iccsafe.org

- **Institutes:**
  - Construction Specifications Canada: www.csc-dcc.ca
  - Window & Door Manufacturers Assoc: www.wdma.com
  - Architectural Woodwork Institute: www.awinet.org
  - Door and Hardware Institute: www.dhi.org
  - Canada Green Building Council: www.cagbc.org