FacadeRetrofit.org: an Online Database-driven Resource for Facade Renovation of Existing Buildings

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FacadeRetrofit.org is a collaborative development between the University of Southern California School of Architecture and the Advanced Technology Studio of Enclos, a leading façade design and engineering contractor. The project received the prestigious 2014 Council on Tall Buildings and Urban Habitat (CTBUH) International Seed-funding sponsored by the East China Architectural Design & Research Institute (ECADI).
Façade Retrofit

*Intervention of the building envelope through the fitting, addition, or substitution of new or modernized materials, components, or systems to an existing construct.*

There is need to make data about energy retrofits more widely available, especially data about façade retrofits.
Outline

- Methodology of the research
- Identification stage
- Database / Website
- Typology
- Data demographics
- What is next?
Methodology

- **Online Survey 1** – General
- **Online Survey 2** – Specific
- **Website** facaderetrofit.org
Identification

- **Online Survey 1**
  300+ respondents (63% planning + implementation stages)

- **Online Survey 2**
  200+ respondents (65% planning + implementation stages)
Identification

- **Online Survey 1**
  - 300+ respondents
  - 200+ building names
  - 32 countries

- **Online Survey 2**
  - 200+ respondents
  - 110 buildings
  - 16 countries

Building projects by country

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Identification

- **Online Survey 1**
  - 300+ respondents
  - 200 building names
  - 32 countries
  - Re-clad

- **Online Survey 2**
  - 200+ respondents
  - 110 buildings
  - 16 countries
  - Re-clad + Over-clad

### Scope of facade retrofits

<table>
<thead>
<tr>
<th>Change in Facade</th>
<th>Survey 1</th>
<th>Survey 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repairs in facade</td>
<td>27%</td>
<td>3%</td>
</tr>
<tr>
<td>Film on windows was...</td>
<td>0%</td>
<td>68%</td>
</tr>
<tr>
<td>Insulation was added</td>
<td>37%</td>
<td>30%</td>
</tr>
<tr>
<td>Sunshades were added</td>
<td>39%</td>
<td>44%</td>
</tr>
<tr>
<td>New cladding material(s) was added</td>
<td>33%</td>
<td>18%</td>
</tr>
<tr>
<td>Glass infill panels were replaced</td>
<td>18%</td>
<td>14%</td>
</tr>
<tr>
<td>Opaque infill panels were replaced</td>
<td>44%</td>
<td>33%</td>
</tr>
<tr>
<td>The whole existing facade was...</td>
<td>14%</td>
<td>18%</td>
</tr>
<tr>
<td>Double skin</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>22%</td>
<td>5%</td>
</tr>
</tbody>
</table>

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FacadeRetrofit.org

The main elements of this online resource are the large commercial and multifamily buildings that have undergone or are undergoing building façade retrofits.

Oriented to the architectural, engineering and construction community, servicing designers to academic researchers.
Data forms

Project Database

- Data gathered from an open submission process.
- The website allows either the collection of new cases and/or update of existing project profiles.
- Minimum number of required fields.
Case studies

- A team review each project submission and gather additional information as required.
- Case studies provide added depth to this web resource.
Resources

Research Catalog

This ongoing research will collectively identify and catalog:
- Drivers of façade retrofits
- Taxonomy for retrofit classification, scope, and scale of intervention
- Materials, technologies, system designs, and constructability considerations employed in building façade retrofit projects
- Pre and post building façade retrofit analysis, including energy performance, indoor environmental quality (IEQ), building occupancy

Additionally, a glossary of main concepts and a list of related databases efforts are provided.
Typology

- renovation/restoration
  - refit
  - retrofit
    - re-clad
    - over-clad
    - selective replacement
    - selective enhancement
Re-clad
Over-clad

 renovation/restoration

 refit

 retrofit

 re-clad

 over-clad

 selective replacement

 selective enhancement

 OVER-CLAD

<table>
<thead>
<tr>
<th>Building</th>
<th>Location</th>
<th>Function</th>
<th>Stories</th>
<th>Year Built</th>
<th>Year Retrofit</th>
<th>Façade</th>
<th>Overclad Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS Tower</td>
<td>Manchester, United Kingdom</td>
<td>Commercial Office</td>
<td>25</td>
<td>1962</td>
<td>2006</td>
<td>Curtainwall</td>
<td>Overclad using PV panels</td>
</tr>
<tr>
<td>Columbus Circle</td>
<td>New York, NY, US</td>
<td>Commercial Office</td>
<td>26</td>
<td>1964</td>
<td>2013</td>
<td>Terracotta-glass / Glass Curtainwall</td>
<td>Overclad with glazed double-skin</td>
</tr>
<tr>
<td>608 Silver Spur</td>
<td>Los Angeles, California, US</td>
<td>Commercial Office</td>
<td>3</td>
<td>1960</td>
<td>2005</td>
<td>Window-wall</td>
<td>Overclad with Sunscreen</td>
</tr>
<tr>
<td>Celebreze Federal Building</td>
<td>Cleveland, Ohio, US</td>
<td>Government Office</td>
<td>32</td>
<td>1961</td>
<td>2014</td>
<td>double skin</td>
<td>Overclad with highly glazed double skin</td>
</tr>
</tbody>
</table>

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Selective Enhancements

- renovation/restoration
  - refit
  - retrofit
    - re-clad
    - over-clad
    - selective replacement
    - selective enhancement

SELECTIVE ENHANCEMENTS

- Herbert C. Hoover Building
  - Washington DC, United States
  - Function: Government Office
  - Stories: 7
  - Year Built: 1932
  - Year Retrofit: 2021
  - Façade: Masonry punched windows
  - Repairs
  - Insulation

- A Maceo Smith Federal Building
  - Austin, TX, United States
  - Function: Government Office
  - Stories: 12
  - Year Built: 1972
  - Year Retrofit: 2011
  - Façade: Curtainwall
  - Repairs

- Henry M. Jackson Federal Building
  - Seattle, WA, United States
  - Function: Government Office
  - Stories: 37
  - Year Built: 1974
  - Year Retrofit: 2007
  - Façade: Precast concrete
  - Repairs

- AT&T Tower
  - Los Angeles, CA, United States
  - Function: Commercial Office
  - Stories: 32
  - Year Built: 1965
  - Year Retrofit: 2008
  - Façade: Curtainwall
  - Repairs
  - Addition of painted metal panels
  - Sunshade modification

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Building projects

Statistics

- Location: 60% USA, 8% UK
- Function: office (62%)

Percent is calculated within all data.
Building projects

Statistics

- Location: 60% USA, 8% UK
- Function: office (62%)
- Size: 400,000 sf (median)
- Height: 15 stories (median)
- 1961 median
- 73% curtainwall façade
- Small number with green certification was identified
FR types

- Re-clad/ Window Replacement

Percent is calculated within all data.
FR types

- Re-clad/ Window Replacement
- Complementary systems

Other systems included in the retrofit plan

- HVAC upgraded or replaced: 92%
- Lighting systems upgraded or replaced: 33%
- Occupancy sensors: 21%
- Daylighting controls: 24%
- On-site energy generation: 24%
- A building management system: 33%
- Other: 12%
FR types

- Re-clad/ Window Replacement
- Complementary systems

Percent is calculated within all data.
Construction vs Retrofit

Façade Retrofits
- Implemented almost 50 yrs. after construction

<table>
<thead>
<tr>
<th>Variable</th>
<th>Year_Built</th>
<th>Year Renovated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1958</td>
<td>2006</td>
</tr>
<tr>
<td>StDev</td>
<td>24.97</td>
<td>7.563</td>
</tr>
<tr>
<td>N</td>
<td>372</td>
<td>372</td>
</tr>
</tbody>
</table>

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Tall Buildings

**Function**

- 64% offices
- 17% residential
- 1970 (median)
- 26 stories (median)

Post-Retrofit Building Function

Percent is calculated within all data.
Tall Buildings

Function

- 64% offices
- 17% residential
- 1970 (median)
- 26 stories (median)
Tall Buildings

Function

- 64% offices
- 17% residential
- 1970 (median)
- 26 stories (median)

Mean 29.48
StDev 14.44
N 201
Tall Buildings

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Tall Buildings

- Selective Replacement
- Selective Enhancement
- Re-Clad
- Over-Clad

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Tall Buildings

YEAR OF ORIGINAL CONSTRUCTION AND YEAR OF RETROFIT

Variable
- Year Constructed
- Year Completed

<table>
<thead>
<tr>
<th>Year Constructed</th>
<th>StDev</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>2170</td>
<td>195</td>
</tr>
<tr>
<td>2007</td>
<td>9092</td>
<td>195</td>
</tr>
</tbody>
</table>
What’s next?

• The design of facade systems that anticipate the need for future retrofit (zero net energy-ready facade systems)
• Life Cycle Analysis (LCA) for comparative analysis of various facade retrofit strategies
• The potential of using evidence-based research in facade retrofit to improve energy efficiency in the commercial building sector
• The assessment of facade retrofit opportunity in targeted urban sectors
• Studying the ravages of time and weather on a façade.
• The development of software tools, guidelines, and best practices that facilitate various aspects of facade retrofit as an integrated, holistic practice.
Thanks.