Kevin Roche’s University of Massachusetts-Amherst Fine Arts Center and Brutalism’s Monolithic Concrete Construction Performance Perception Penalty

L Carl Fiocchi, Jr

Available at: https://works.bepress.com/lcarl_fiocchi/8/
Kevin Roche's University of Massachusetts-Amherst Fine Arts Center and Brutalism's Monolithic Concrete Construction Performance Perception Penalty

February 2017
Association for Preservation Technology NorthEast

L. Carl Fiocchi, Ph.D.
Building Construction Technology
Department of Environmental Conservation
University of Massachusetts - Amherst
Southern Façade -1975

Courtesy of KRJDA
Eastern Façade -1975

Courtesy of KRJDA
Out of Two Hundred

KEVIN ROCHE
JOHN DINKELOOG
AND ASSOCIATES
VOL. ONE 1962-1975

Preface by J. Irwin Miller / Introduction by Henry-Russell Hitchcock
Edited and Photographed by Yukio Futagawa

Courtesy of KRJDA
Brutalism’s Perception Problem

The Name

Building Scale

Transparency

Construction Module Scale

Lack of Ornamentation

Maintenance

Concrete

Performance
The Modernist Architects

Personal Life Experiences

Education

Early and Architectural
Three Questions

Did Roche and the rest of the Modernist Masters abruptly jettison their past experiences and education when designing these Brutalist buildings?
Are there any performance enhancing strategies present in the FAC?
And if any are present --- are they effective?

Daylight Maximization
Glare Control
Solar Defense via Self Shading
Siting and Orientation Optimization
Window Direct Solar Gain Defense Strategies
Solar Absorptance Impacts
Thermal Mass Implications
Wind Defense Strategies

What exactly is a monolithic concrete envelope’s impact on performance?
Measuring Energy Performance

Energy Use Intensity

EUI

Commercial Building Energy Consumption Survey

CBECs
DesignBuilder

Revit
Simulation Results

<table>
<thead>
<tr>
<th>Energy/Power Output</th>
<th>Room Electricity (kWh)</th>
<th>Lighting (kWh)</th>
<th>System Fans (kWh)</th>
<th>System Pumps (kWh)</th>
<th>Auxiliary Energy (kWh)</th>
<th>Heating (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 2003</td>
<td>70.47</td>
<td>139.23</td>
<td>140.34</td>
<td>227.20</td>
<td>187.20</td>
<td>62.50</td>
</tr>
<tr>
<td>May 2003</td>
<td>226.24</td>
<td>506.64</td>
<td>373.23</td>
<td>507.65</td>
<td>141.20</td>
<td>62.10</td>
</tr>
<tr>
<td>June 2003</td>
<td>70.47</td>
<td>139.23</td>
<td>140.34</td>
<td>227.20</td>
<td>187.20</td>
<td>62.50</td>
</tr>
</tbody>
</table>

The table above shows the energy consumption for different categories such as room electricity, lighting, system fans, system pumps, auxiliary energy, and heating for the months of April, May, and June 2003. The data indicates a consistent pattern across these months, with small variations for each category.
# FAC EUI vs CBECS 2012

<table>
<thead>
<tr>
<th>For Buildings in the Northeast</th>
<th>FAC Model EUI (KBtu/sq.ft.)</th>
<th>FAC’s % Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Buildings</td>
<td>93.9 (296.08)</td>
<td>+16.55</td>
</tr>
<tr>
<td>Building Floor Space: 200,001 – 500,000 sq.ft.</td>
<td>109.7 (345.83)</td>
<td>-0.24</td>
</tr>
<tr>
<td>Principal Building Activity: Education</td>
<td>82.1 (258.82)</td>
<td>+33.30</td>
</tr>
<tr>
<td>Year constructed: 1970-1979</td>
<td>134.9 (425.27)</td>
<td>-18.87</td>
</tr>
<tr>
<td>Northeast Climate Region: Mixed-Humid</td>
<td>104.7 (330.06)</td>
<td>+4.53</td>
</tr>
<tr>
<td>Government Owned: State</td>
<td>153.4 (483.59)</td>
<td>-28.66</td>
</tr>
<tr>
<td>Predominant Exterior Wall: Material Concrete</td>
<td>101.6 (320.29)</td>
<td>+7.72</td>
</tr>
<tr>
<td>Predominant Roof Material: Built-up</td>
<td>113.4 (357.48)</td>
<td>-3.49</td>
</tr>
<tr>
<td>Roof Characteristic: Flat</td>
<td>105.4 (332.27)</td>
<td>+3.83</td>
</tr>
<tr>
<td>Energy Source: District Heat</td>
<td>143.5 (452.38)</td>
<td>-23.74</td>
</tr>
</tbody>
</table>

**FAC EUI 33.30% Worse than 2012 CBECS**
## FAC EUI vs CBECS 2003

<table>
<thead>
<tr>
<th>For Buildings in the Northeast</th>
<th>EUI KBtu/sq.ft.</th>
<th>FAC’s % Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAC Model</strong></td>
<td><strong>109.44 (345.01)</strong></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td><strong>All Buildings</strong></td>
<td><strong>98.5 (310.72)</strong></td>
<td><strong>+10.00</strong></td>
</tr>
<tr>
<td><strong>Building Floor Space:</strong></td>
<td><strong>106.3 (335.33)</strong></td>
<td><strong>+2.87</strong></td>
</tr>
<tr>
<td>200,001 – 500,000 sq.ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Principal Building Activity:</strong></td>
<td><strong>101.6 (320.51)</strong></td>
<td><strong>+7.17</strong></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FAC EUI 7.17% Worse than 2003 CBECS**
FAC with 1970 Brick Wall Assembly

FAC EUI: CBECS 2012 From 33.30% Worse 7.18% Better

CBECS 2003 25.00% Better
Contemporary Intervention

Change R-value
1.7023 ft²-F⁰-hr/Btu  to  12.35 ft²-F⁰-hr/Btu)

Compared to 2012 CBECS

Walls Only (excluding Performance Spaces)
FAC EUI: 33.30% Worse  ➔  0.4% Worse

Ceilings and Walls (excluding Performance Spaces)
FAC EUI: 33.30% Worse  ➔  28.86% Better
Architecture 2030 Challenge Goals

FAC EUI with Ceiling and Wall Intervention
58.4 KBtu/sq.ft.

The 2030 Challenge Targets for U.S. National Medians for College/University Campus Level Buildings.

<table>
<thead>
<tr>
<th>Year of Compliance</th>
<th>Reduction Percentage</th>
<th>Expected EUI KBtu/sq.ft. (KWh/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>50</td>
<td>52 (163.93)</td>
</tr>
<tr>
<td>2010</td>
<td>60</td>
<td>41.6 (131.14)</td>
</tr>
<tr>
<td>2015</td>
<td>70</td>
<td>31.2 (98.36)</td>
</tr>
<tr>
<td>2020</td>
<td>80</td>
<td>20.8 (65.57)</td>
</tr>
<tr>
<td>2025</td>
<td>90</td>
<td>10.4 (32.79)</td>
</tr>
<tr>
<td>2030</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Inference

There are strategies, concealed within the FAC, consistent with good performance.

It is their operation and existence, which contributes to the FAC’s respectable EUI,

once

the large negative of the thermal envelope’s conductivity is eliminated from the discussion.
Contributions

Architecture’s Brutalist Scholars, Preservationists, and Stakeholders

Brutalist Critics

Performance Improving Intervention