DESIGN AND CONSTRUCTION OF THE LYNCH, Dickey & Singleton Dental Clinic

SUSTAINABILITY DELIVERED - LOW ENERGY, MARKET RATE AND FUNCTION

June 17, 2014

Project Summary

Location: Roanoke, Virginia
Client: Drs. Lynch, Dickey and Singleton

The First in the world dental clinic built to Passivhaus Standards

Size: 5500 ft² Gross
4,460 ft² TFA

Final air test: 0.29 ACH₅₀ (Pressurized), 0.25 ACH₅₀ (Depressurized)

Modeled heat demand: 0.86 kBTU/(ft²yr) ~ 3 kWh/(m² yr)

Modeled cooling demand: 8.84 kBTU/(ft²yr) ~ 28 kWh/(m² yr)

Modeled Specific Primary Energy Demand: 67.1 kBTU/(ft²yr) ~ 212 kWh/(m² yr)

The Basics

- Light timber construction
- Simple usage pattern
- Significant thermal comfort requirements
- Mixed humid climate
- Slab – R 18.0
- Wall (Brick) – R 37.3
- Wall (Siding) – R 36.5
- Wall (EIFS) – R 42.4
- Ceiling – R 66.3
- Window Average – R 6.8, SHGC 0.6
- Glass Block Assem. – R 4.9, SHGC 0.66

Virginia?
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THERMAL COMFORT

A consistent area of concern in all clinics is the thermal comfort of the doctor and patient.

Doctors generally complain of being too hot and often patients complain of being too cold.

When one has a dental procedure, one typically has a nervous patient, a working doctor, an assistant and a dental light. When calculating the heat load in the small work area it becomes clear that the heat generated by the people and light is significant.

Three Pronged Strategy:
- Preconditioned fresh air along the ceiling of each operatory space at a very low velocity
- Separate low-velocity forced air conditioning system directed behind the dental chair
- 100 ft\(^2\) passive cooling loops around each dental chair to take radiant heat from the bodies in the space.

Thermal Comfort Results – Intended and Unintended

- The doctors report that the operatory thermal comfort is exceptional
- The doctors report that the fresh air exchange has eliminated the “dental clinic smell”
- The waiting room was overheating in the summer
  - West facing reception room rose as high as 76°F, well above the 72°F set point
  - The 80% reduction solar screens that we designed for the glazing in the waiting room were not being used
  - The doctors said that they did not like the look of the screens
  - Good amount of fresh air supply to this space (60 CFM)
  - The very low velocity the warm air felt stagnant
  - The ceiling in this area is 14 ft. while the balance of the space is 9 ft.
  - A ceiling fan was installed in the waiting room which sufficiently mixed the air to alleviate the problem

Energy

- After first year building energy use is 2.5% below predicted
- Fairly easy building to predict the energy use
- Existing practice and we were able to set up energy monitoring on the existing dental equipment prior to running our models.
- Did not have to depend on the plate rated energy usage of the equipment for our models.
- Very consistent occupant usage

<table>
<thead>
<tr>
<th>kWh/Year</th>
<th>Calculated</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31,4</td>
<td>31,4</td>
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</tbody>
</table>

Energy Code EUI was derived by modeling the as-built design with current code requirements.

CEBECS EUI was extrapolated by averaging data for the following CEBECS data sets:
- Building square footage: 5,000 - 10,000
- Principal building activity: Healthcare – Outpatient
- Principal building activity: Office
- Year constructed: 2000 - 2003
- Census Region and Division: South Atlantic
- Climate Zone: 30
  - Year average: 4,000 - 5,499 HDD
- Number of floors: One

CIBEUS EUI was extrapolated by averaging data for the following CIBEUS data sets:
- Ambulatory Surgical Center
- Medical Office
- Outpatient Rehabilitation/Physical Therapy
- Urgent Care/Clinic/Other Outpatient

<table>
<thead>
<tr>
<th>Difference as Measured Results</th>
<th>Difference as Calculated Results</th>
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</thead>
<tbody>
<tr>
<td>% Difference vs. Calculated EUI</td>
<td>2.5%</td>
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<tr>
<td>Calculated EUI</td>
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<tr>
<td>Measured Results</td>
<td>46.5</td>
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<tr>
<td>Difference vs. Calculated EUI</td>
<td>-2.0%</td>
</tr>
<tr>
<td>Calculated EUI</td>
<td>64.1%</td>
</tr>
<tr>
<td>Measured Results</td>
<td>66.1%</td>
</tr>
<tr>
<td>Difference vs. Calculated EUI</td>
<td>-2.0%</td>
</tr>
</tbody>
</table>

Note: HDD refers to degree heating degree days. The lower the HDD the lower the energy required for heating.

HDD = (65°F - Tavg) x (Days) x 90

Where:
- 65°F = 18°C (uniform room temperature)
- Tavg = average daily temperature over the heating season
- Days = number of days in the heating season
- 90 = the nominal heating degree day factor

6/24/2014
Our experience with dental clinics over the past decade (12 projects) has shown that dental clinics in our region range from $150 to $200 per ft². This clinic was delivered for $155 per ft². Low market rate! Once again proving the cost effectiveness of the Passivhaus methodology!

Saving the Best for Last

A. Recognize and eliminate the inefficiencies we build into our current Design/Construction system
B. Leverage those savings for high performance design and construction
C. Aggressively employ true integrated design
D. The building must be conceptualized as a holistic system
E. Synergies within this system should be identified and maximized
F. Rigorous field quality control implemented (Commissioning is VITAL to success)
G. Operational monitoring to fine tune systems

Questions & Contact

Thank you!

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