Fright to Flight

Sustainable solutions for the industrial world
Project Background

Owner: Trash for Teaching
Type: Educational facility
Site Location: 12901 S. Western Ave Gardena, California
Site area: 157,872 SF
Building area: 50,000 SF
Levels: 2
Operation:
  Monday-Friday    9am-5pm
  Saturday        10am-4pm

Former industrial waste present
Some spills of toxic chemicals into the ground
Owner Expectations

Energy efficiency and recycling focus
Community connectivity
Interactive building
Material display (local industrial waste)
Able to market the property - touring
Classrooms
Community space (garden)
Roof access
Indoor air quality
Integrated Design Approach
Project Logistics

Participant Involvement

Early involvement of owner, architect, contractor & primary subcontractors
More diverse perspective and avoid contingencies

Risk/Reward

Integrated form of agreement
System of shared risk and reward
Contracted Parties

**Three-Way contract – Flexible**
Each party is held accountable to each other as equal partners

Decision Making and Control

**Three Level Collaborative Team**
Integrated Project Field Team
Core Team
Executive Team
Liability

Waive claims except fraud, willful misconduct, gross negligence

Reduces ability for each party to sue each other for issues related to the project

Project Budget and Goal Development

Core Team Development

Core team includes representatives from all parties, including T4T, with an artistic view on project
Roadmap to Efficient Buildings

- Passive Strategies
- Reduce Loads
- Apply Efficient Systems
- Synergies
- Renewable Energy
EE and Recycle Focus
Resource Analysis

<table>
<thead>
<tr>
<th>Design Strategies: January through December</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.9% 1 Comfort (520 hrs)</td>
</tr>
<tr>
<td>9.6% 2 Sun Shading of Windows (843 hrs)</td>
</tr>
<tr>
<td>3. High Thermal Mass (0 hrs)</td>
</tr>
<tr>
<td>4. High Thermal Mass Night Flushed (0 hrs)</td>
</tr>
<tr>
<td>5. Direct Evaporative Cooling (0 hrs)</td>
</tr>
<tr>
<td>6. Two-Stage Evaporative Cooling (0 hrs)</td>
</tr>
<tr>
<td>3.9% 7 Natural Ventilation Cooling (344 hrs)</td>
</tr>
<tr>
<td>3.9% 8 Fan-Forced Ventilation Cooling (339 hrs)</td>
</tr>
<tr>
<td>9. Internal Heat Gain (0 hrs)</td>
</tr>
<tr>
<td>24.1% 10 Passive Solar Direct Gain Low Mass (2110 hrs)</td>
</tr>
<tr>
<td>22.0% 11 Passive Solar Direct Gain High Mass (1930 hrs)</td>
</tr>
<tr>
<td>12. Wind Protection of Outdoor Spaces (0 hrs)</td>
</tr>
<tr>
<td>13. Humidification Only (0 hrs)</td>
</tr>
<tr>
<td>14. Dehumidification Only (0 hrs)</td>
</tr>
<tr>
<td>15. Cooling, add Dehumidification if needed (0 hrs)</td>
</tr>
<tr>
<td>16. Heating, add Humidification if needed (0 hrs)</td>
</tr>
</tbody>
</table>

53.9% Comfortable Hours using Selected Strategies (4726 out of 8760 hrs)
Design Concept
eQUEST Modeling
## Annual Energy Consumption by Enduse

<table>
<thead>
<tr>
<th></th>
<th>Electricity kWh (x000)</th>
<th>Natural Gas MBtu</th>
<th>Steam Btu</th>
<th>Chilled Water Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Cool</td>
<td>48.33</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Heat Reject.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Space Heat</td>
<td>-</td>
<td>15.06</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HP Supp.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hot Water</td>
<td>-</td>
<td>127.01</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vent. Fans</td>
<td>38.73</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pumps &amp; Aux.</td>
<td>0.77</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ext. Usage</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Misc. Equip.</td>
<td>46.67</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Task Lights</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Area Lights</td>
<td>123.56</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>258.06</td>
<td>142.08</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- **Area Lighting**: 48%  
- **Task Lighting**: 19%  
- **Misc. Equipment**: 18%  
- **Exterior Usage**: 15%  
- **Pumps & Aux.**: 11%  
- **Ventilation Fans**: 11%  
- **Water Heating**: 89%  
- **Ht Pump Supp.**: 89%  
- **Space Heating**: 89%  
- **Refrigeration**: 89%  
- **Heat Rejection**: 89%  
- **Space Cooling**: 89%
EE Modeling

Changed R values from low to high for roof and walls
Window glazing from double pane clear single to low E or high performance window
Added exterior shading fins on all windows
Reduce lighting power density by 30%
Adding day lighting
Dim electrical lighting by 30%
Went from regular HVAC to higher efficiency system, Geoexchange
Annual Electric Consumption (kWh)

Selected Runs (see bottom legend)

- Area Lighting
- Task Lighting
- Miscellaneous Equipment
- Exterior Usage
- Pumps & Aux.
- Ventilation Fans
- Water Heating
- Ht Pump Supp.
- Space Heating
- Refrigeration
- Heat Rejection
- Space Cooling

1. Project 4 - Baseline Design (06/22/12 @ 13:42)
2. Project 4 - Window Glass Type EEM (06/22/12 @ 13:43)
3. Project 4 - Window Ext Shading EEM (06/22/12 @ 13:43)
4. Project 4 - Lighting Power EEM (06/22/12 @ 13:43)
5. Project 4 - Equipment Power EEM (06/22/12 @ 13:43)
6. Project 4 - Daylighting EEM (06/22/12 @ 13:43)
7. Project 4 - Pkg HVAC Eff EEM (06/22/12 @ 13:43)
SPOT Light Modeling
40% Energy Savings Achieved

<table>
<thead>
<tr>
<th>Cumulative SAVINGS (MWh)</th>
<th>(values (and % savings) are relative to the Base Case, negative entries indicate increased use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 0 - Window Glass Type EE</td>
<td>0.00 (0%) 0.00 (0%) 0.12 (13%) 0.34 (16%) 0.00 (0%) 1.34 (16%) -- 9.56 (4%)</td>
</tr>
<tr>
<td>2 1 - Window Ext Shading EE</td>
<td>0.00 (0%) 0.00 (0%) -0.96 (-43%) 14.48 (22%) 0.00 (0%) 2.34 (29%) -- 15.85 (7%)</td>
</tr>
<tr>
<td>3 2 - Lighting Power EEM</td>
<td>37.42 (30%) 0.00 (0%) 2.68 (-128%) 19.42 (30%) 0.00 (0%) 3.12 (38%) -- 57.12 (24%)</td>
</tr>
<tr>
<td>4 3 - Equipment Power EEM</td>
<td>37.42 (30%) 9.88 (24%) 3.70 (-167%) 20.63 (31%) 0.00 (0%) 3.29 (40%) -- 67.51 (28%)</td>
</tr>
<tr>
<td>5 3 - Daylighting EEM</td>
<td>63.18 (51%) 0.00 (0%) 5.06 (-228%) 22.61 (35%) 0.00 (0%) 3.54 (43%) -- 84.28 (35%)</td>
</tr>
<tr>
<td>6 5 - Pkg HVAC EEM</td>
<td>63.18 (51%) 0.00 (0%) 5.06 (-228%) 39.17 (60%) 0.00 (0%) 3.54 (43%) -- 100.84 (42%)</td>
</tr>
</tbody>
</table>
Heating and Cooling – Geoexchange

Ground Loop Heat Exchanger

Heat Pump Cooling Cycle

- Compressor
- Gas condenses into a liquid
- Expansion Valve
- Outdoor Coils
- Fan
- Liquid evaporates into gas
- Indoor Coils

Heat Pump Heating Cycle

Solar Panels - Installation
PV Summary

### Payback

- Initial Cost ($/Wdc): 4.59
- Initial Cost ($): 80508.59
- Rebates ($): 0
- Tax Credits ($): 24152.58
- After Incentives ($): 56300
- Payback (years): 24.62

### System Outputs

This table shows the amount of electricity (kWh) generated by this system each month, and the dollar amount that those values translate into.

<table>
<thead>
<tr>
<th>Month</th>
<th>Output (kWh)</th>
<th>Value* ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1609</td>
<td>144.81</td>
</tr>
<tr>
<td>February</td>
<td>1560</td>
<td>140.40</td>
</tr>
<tr>
<td>March</td>
<td>2058</td>
<td>185.22</td>
</tr>
<tr>
<td>April</td>
<td>2612</td>
<td>235.08</td>
</tr>
<tr>
<td>May</td>
<td>2334</td>
<td>210.06</td>
</tr>
<tr>
<td>June</td>
<td>2282</td>
<td>205.38</td>
</tr>
<tr>
<td>July</td>
<td>2435</td>
<td>219.15</td>
</tr>
<tr>
<td>August</td>
<td>2470</td>
<td>222.30</td>
</tr>
<tr>
<td>Sept</td>
<td>2304</td>
<td>207.36</td>
</tr>
<tr>
<td>October</td>
<td>1869</td>
<td>168.21</td>
</tr>
<tr>
<td>Nov</td>
<td>1875</td>
<td>168.75</td>
</tr>
<tr>
<td>Dec</td>
<td>1595</td>
<td>143.55</td>
</tr>
</tbody>
</table>

*Value based on electricity rate of $0.09/kWh

### Load

Now compare your estimated electricity production with your electricity consumption.

**Step 1. Select a load profile.**

You may select a residential sample profile or upload your own custom load profile. The residential load profile is based on a 4kW system.

**Sample Profile:**

- OR

**Upload a load profile.**

Click the Upload File button below. Then browse to locate your load profile document. For help click [here](#).
Recycled Building Materials
Thank you!

• Bogdan Rusu - brusu@uci.edu
• Andrea Nunez - andreanunez33@gmail.com
• Brandon Kaysen – kaysenpoint@gmail.com
• Mrinalini Manandhar – mrinalini.manandhar@gmail.com