MOVING THE NEEDLE WITH PASSIVE HOUSE IN PUBLIC PROJECTS: MOUNT VERNON LIBRARY COMMONS
It Takes a Dedicated Village

MVLC A/E Team

HKP Architects (Architecture)
Kriegh Architectural Studio (Sustainability Lead)
WSP (WUFI, WBLCA, and Envelope)
Wil Stubar III, PhD (Materials Scientist, Univ. of Colorado Boulder)
Pacific Survey & Engineering (Survey)
GeoEngineers (Geotechnical)
Swift Company (Landscape)
KPF (Civil and Structural)
FSG (Mechanical)
TFWB (Electrical)
Dark Light Design (Lighting Design)
The Greenbusch Group (Acoustics, AV, and Vertical Transportation)
Studio Pacifica (Accessibility)
Clevenger Associates (Food Service)
BrandQuery (Wayfinding and Graphics)
DCW (Cost Engineering)
Sazan (Commissioning Agent)
Balderston Associates (PHIUS Rater)

Julie Blazek
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HKP Architects
Partner-in-Charge / Design-Lead

Julie Kriegh
Phd, AIA, LEED AP
Kriegh Architectural Studio
Passive House Designer
Sustainability Consultant - Lead

Sarah Buffaloe
AIA, LEED BD+C
WSP
Built Ecology
WBLCA Analysis
Presentation Focus

• Building the Foundation for Decision Making
• Managing Passive House Targets and Compliance
• Managing Carbon Reduction Targets - focus on Concrete
• Strategies for Success Building Passive House into Public Bid Projects
Catalyst and Gateway Project
FIRST FLOOR PLAN

Multi-Use Project
Project Goals and Targets

Overarching Goals

- Library as HUB of community gathering- three uses library, commons, parking/ EV charging
- Climate resilient building:
  » Built to last 75 to 100 years
  » 60% lower operational energy
  » 35% to 40% lower embodied energy
Energy Reduction Target: Early Modeling

WUIF Passive, Therm, and Hygro Modeling

WBLCA for “Hot Spot” Material Analysis

Solar PV Production Analysis
Meeting Criteria - initial recommendations and refinements

- Recommend providing a high efficiency ERV (90% sensible recovery)
- Adding insulation can help reduce heating demand
- Incorporate natural ventilation in the summer to reduce the cooling demand
- Revise ventilation rates to minimize heating and ensure compliance with - ASHRAE 62.1
- Revise equipment using Energy Saving mode operation
- Ensure that the Commercial Kitchen is not considered within the Passive Envelope
- Include PV solar panel renewable energy
Passive House Final WUFI Modeling

WUFI Passive Results

- Air tightness CFM50 per envelope area 0.05
- Renewable generation 114,000 kWh/yr

<table>
<thead>
<tr>
<th>Category</th>
<th>EUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Heating Demand (kBtu/sfyr)</td>
<td>1.41</td>
</tr>
<tr>
<td>Annual Cooling Demand (kBtu/sfyr)</td>
<td>4.66</td>
</tr>
<tr>
<td>Peak Heating Load (kBtu/hr-sf)</td>
<td>4.66</td>
</tr>
<tr>
<td>Peak Cooling Load (kBtu/hr-sf)</td>
<td>1.7</td>
</tr>
<tr>
<td>Source Energy (kBtu/sf)</td>
<td>41.61</td>
</tr>
<tr>
<td>Site Energy (kBtu/sf)</td>
<td>14.86</td>
</tr>
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</table>
Hot spot analysis reveals concrete to be the major contributor in this building by volume and by GWP.

Design team recommended and the structural engineering team agreed to craft specifications that would allow the concrete supplier to use mix designs according to function (PT slab, columns, footings, etc...) with the goal of a 35 to 40% reduction in overall GWP:

- Type 1L cement (15% limestone vs Portland cement)
- SCM (Supplementary Cementitious Materials) (fly ash and/or slag)
- 56-day strength vs 28-day

WBLCA “Hot Spot” Analysis
Decarbonizing Concrete

CONCRETE MIX DESIGN

FINE AGGREGATE (SAND)

CEMENT (PORTLAND CEMENT)

COARSE AGGREGATE (BLUE METAL)

WATER

www.civilplanets.com
<table>
<thead>
<tr>
<th>Strategy</th>
<th>Potential GWP reduction of Cement</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase Supplemental Cementitious Materials (SCM) such as fly ash and slag</td>
<td>20-40% depending on amount of SCMs</td>
<td>Above 20% SCMs will elongate cure time and impact color. Supply of fly ash and slag varies seasonally and may be a local concern</td>
</tr>
<tr>
<td>Increasing cure time from standard 28 day to 56 day</td>
<td>16-18%</td>
<td>May have schedule implications</td>
</tr>
<tr>
<td>Utilizing Type 1 L Cement</td>
<td>15%</td>
<td>Replaces 15% of Portland cement with limestone</td>
</tr>
</tbody>
</table>

*Calportland produces Type IL cement (EPD); should theoretically be cheaper but demand is low (dominated by Caltrans).*

## Can We Meet Our Targets?

### GWP per Concrete Location - Absolute Values

<table>
<thead>
<tr>
<th>Location</th>
<th>Type I/II Cement</th>
<th>Type IIII Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength</strong> (ksi)</td>
<td><strong>Project Volume (m³)</strong></td>
<td><strong>28 day GWP (kg CO₂e per m³)</strong></td>
</tr>
<tr>
<td><strong>Curbs and Pads (plus roof slab)</strong></td>
<td>3,000</td>
<td>37.18</td>
</tr>
<tr>
<td><strong>Retaining Walls, non-structural walls, vehicle barriers</strong></td>
<td>4,000</td>
<td>59.55</td>
</tr>
<tr>
<td><strong>Slab on Grade</strong></td>
<td>4,000</td>
<td>20.56</td>
</tr>
<tr>
<td><strong>Foundations, UNO</strong></td>
<td>4,000</td>
<td>338.00</td>
</tr>
<tr>
<td><strong>Mat Foundations</strong></td>
<td>3,000</td>
<td>1,919.00</td>
</tr>
<tr>
<td><strong>Precast Stairs</strong></td>
<td>5,000</td>
<td>15.17</td>
</tr>
<tr>
<td><strong>Post-Tensioned Slabs and Beams</strong></td>
<td>6,000</td>
<td>2,037.51</td>
</tr>
<tr>
<td><strong>Columns, Shear Walls</strong></td>
<td>6,000</td>
<td>756.72</td>
</tr>
</tbody>
</table>

### Table: GWP and Reductions

<table>
<thead>
<tr>
<th>Location</th>
<th>Strength (ksi)</th>
<th>Project Volume (m³)</th>
<th>28 day GWP (kg CO₂e per m³)</th>
<th>56 day GWP (kg CO₂e per m³)</th>
<th>28 day %Reduction from Baseline lowest of range</th>
<th>56 day %Reduction from Baseline lowest of range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Curbs and Pads (plus roof slab)</strong></td>
<td>3,000</td>
<td>37.18</td>
<td>13,609.37</td>
<td>8,727.84</td>
<td>-29%</td>
<td>-36%</td>
</tr>
<tr>
<td><strong>Retaining Walls, non-structural walls, vehicle barriers</strong></td>
<td>4,000</td>
<td>59.55</td>
<td>26,948.06</td>
<td>17,891.53</td>
<td>-34%</td>
<td>-46%</td>
</tr>
<tr>
<td><strong>Slab on Grade</strong></td>
<td>4,000</td>
<td>20.56</td>
<td>9,303.93</td>
<td>6,177.13</td>
<td>-34%</td>
<td>-46%</td>
</tr>
<tr>
<td><strong>Foundations, UNO</strong></td>
<td>4,000</td>
<td>338.00</td>
<td>152,950.98</td>
<td>98,162.30</td>
<td>-36%</td>
<td>-47%</td>
</tr>
<tr>
<td><strong>Mat Foundations</strong></td>
<td>3,000</td>
<td>1,919.00</td>
<td>385,116.55</td>
<td>290,913.06</td>
<td>-35%</td>
<td>-48%</td>
</tr>
<tr>
<td><strong>Precast Stairs</strong></td>
<td>5,000</td>
<td>15.17</td>
<td>8,412.44</td>
<td>5,956.88</td>
<td>-29%</td>
<td>-42%</td>
</tr>
<tr>
<td><strong>Post-Tensioned Slabs and Beams</strong></td>
<td>6,000</td>
<td>2,037.51</td>
<td>1,190,111.84</td>
<td>658,076.05</td>
<td>-36%</td>
<td>-48%</td>
</tr>
<tr>
<td><strong>Columns, Shear Walls</strong></td>
<td>6,000</td>
<td>756.72</td>
<td>443,169.93</td>
<td>327,228.38</td>
<td>-31%</td>
<td>-40%</td>
</tr>
</tbody>
</table>
Communicating the Goals
41% REDUCTION IN GWP

=1,088.4 metric tons

122,476 GALLONS OF GASOLINE BURNED

2,721,045 miles driven

237 typical passenger cars driven for 1 year

Owner Risk-Reward
Future of Concrete

SCM’S / AGGREGATES / CURE TIMES
- CALCINATED CLAYS
- VOLCANIC GLASS
- SILICA-RICH AGRICULTURAL ASH
- RECYCLED GLASS

FROM CARBON REDUCTION TO CARBON STORING

Where Can This Be Done?

TYPICAL FOUNDATIONS
MAT FOUNDATIONS
SLAB ON GRADE
POST TENSIONED SLABS AND BEAMS
NON-STRUCTURAL CONCRETE WALLS
COLUMNS AND SHEAR WALLS
CURBS AND PADS

CONCRETE

CONCRETE WORK SHALL CONFORM TO ALL REQUIREMENTS OF IBC CHAPTER 19.

CONCRETE MIXTURES

CONCRETE MIXTURES SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:

<table>
<thead>
<tr>
<th>F'c (PSI)</th>
<th>TEST AGE (DAYS)</th>
<th>EXPOSURE CLASS</th>
<th>MAX W/C RATIO</th>
<th>USE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,500</td>
<td>56</td>
<td>F1 S0 W0 C1</td>
<td>-</td>
<td>CURBS AND PADS</td>
<td>3</td>
</tr>
<tr>
<td>4,000</td>
<td>56</td>
<td>F0 S1 W0 C1</td>
<td>-</td>
<td>FOUNDATIONS, UNO</td>
<td>5</td>
</tr>
<tr>
<td>4,000</td>
<td>56</td>
<td>F0 S1 W0 C1</td>
<td>0.45</td>
<td>WALLS (UNO), VEHICLE BARRIERS</td>
<td>4</td>
</tr>
<tr>
<td>4,000</td>
<td>56</td>
<td>F0 S1 W1 C1</td>
<td>0.45</td>
<td>INTERIOR SLAB-ON-GRADE, ELEVATOR PIT WALLS</td>
<td>2</td>
</tr>
<tr>
<td>4,000</td>
<td>56</td>
<td>F1 S1 W1 C1</td>
<td>0.45</td>
<td>EXTERIOR SLAB-ON-GRADE</td>
<td>4</td>
</tr>
<tr>
<td>5,000</td>
<td>56</td>
<td>F0 S1 W0 C1</td>
<td>-</td>
<td>MAT FOUNDATIONS</td>
<td>5</td>
</tr>
<tr>
<td>5,000</td>
<td>56</td>
<td>F0 S1 W0 C1</td>
<td>-</td>
<td>PRECAST STAIRS</td>
<td>-</td>
</tr>
<tr>
<td>6,000</td>
<td>56</td>
<td>S0 W0 C1</td>
<td>0.40</td>
<td>ELEVATED SLABS AND BEAMS, UNO</td>
<td>1, 2</td>
</tr>
<tr>
<td>6,000</td>
<td>56</td>
<td>S0 W1 C1</td>
<td>0.45</td>
<td>ELEVATED SLABS AND BEAMS AT TOP LEVEL, TOP RAMP</td>
<td>1, 2</td>
</tr>
<tr>
<td>6,000</td>
<td>56</td>
<td>F0 S0 W0 C1</td>
<td>-</td>
<td>COLUMNS, SHEAR WALLS</td>
<td>2</td>
</tr>
</tbody>
</table>

1. FOR POST-TENSIONED SLABS AND BEAMS, CONCRETE SHRINKAGE SHALL BE A MAXIMUM OF 0.035 PERCENT, OR A MAXIMUM ALLOWABLE WATER CONTENT OF 25% LC/FCY.
2. PROVIDE A MINIMUM OF 10% SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM).
3. PROVIDE A MINIMUM OF 20% SUPPLEMENTARY CEMENTITIOUS MATERIALS.
4. PROVIDE A MINIMUM OF 25% SUPPLEMENTARY CEMENTITIOUS MATERIALS.
5. PROVIDE A MINIMUM OF 30% SUPPLEMENTARY CEMENTITIOUS MATERIALS.
Public Bid Process and Strategies
1.4 PASSIVE HOUSE CERTIFICATION REQUIREMENTS

A. Project shall meet all of the requirements for Passive House Certification. Contractor shall endeavor to install the construction materials as shown to achieve certification.

B. Contractor Training: Contractor is required to assign a single Passive House lead coordinator for the project. Lead Coordinator shall either have Passive House for Builder training or certifications or shall complete a training course equivalent to the Passive House Network’s On-Demand “Introduction to Passive House Trades”.

C. Pre-Installation Conferences: Refer to Section 01 31 19 Project Meetings.

D. PHIUS Review: The project Documents have been reviewed by PHIUS for compliance with Passive House requirements. Details shall not be changed and installations shall not be modified without consent of the Architect and approval from PHIUS.

E. PHIUS Rater: A Third-Party PHIUS Rater has reviewed the project Documents and is required to inspect installations throughout construction. Contractor shall coordinate with the Third-Party PHIUS Rater to provide mock-ups, testing, Pre-Installation Conferences, and detail review in an effort to successfully pass inspections and testing.

F. Air-Tightness Quality Control: Contractor shall install Passive House envelope to meet the air-tightness criteria.
Penetration Schedule and Details
PRE-BID WALK-THROUGH AGENDA

Date: August 3, 2022
Project: Mount Vernon Library Commons
Held By: Christine Baldwin, HKP Architects

Project Sustainability Goals (Julie)
  i.  EV Charging
  ii.  Passive House
  iii.  Carbon Reduction
  iv.  LEED Silver Targets
**Date Issued:** 03.10.2023  
**Customer:** Lydig Construction  
**Project:** MV Library Commons  
**Mix I.D.:** 1240AF  
**Slump:** 5” max  
**Design Fc:** 3500 psi

<table>
<thead>
<tr>
<th>Absorption</th>
<th>Specific Gravity</th>
<th>Material</th>
<th>Batch weight SSD (lbs)</th>
<th>Material Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.15</td>
<td>2.65</td>
<td>ASTM C-33 #57</td>
<td>1,550 lbs.</td>
<td>9.23</td>
</tr>
<tr>
<td>1.25</td>
<td>2.66</td>
<td>ASTM C-33 #85</td>
<td>950 lbs.</td>
<td>2.03</td>
</tr>
<tr>
<td>2.14</td>
<td>2.69</td>
<td>ASTM C-33 Sand</td>
<td>1,280 lbs.</td>
<td>7.74</td>
</tr>
<tr>
<td>3.15</td>
<td>3.05</td>
<td>ASTM C-595 Type II (Cement)</td>
<td>451 lbs.</td>
<td>2.29</td>
</tr>
<tr>
<td>2.75</td>
<td>2.85</td>
<td>ASTM C-1897 SCM</td>
<td>115 lbs.</td>
<td>0.66</td>
</tr>
<tr>
<td>1.00</td>
<td></td>
<td>ASTM C-1602 Water</td>
<td>237.0 lbs.</td>
<td>3.80</td>
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<tr>
<td>~1.00</td>
<td></td>
<td>MasterAir AE-90 (Air Int.)</td>
<td>5.00%</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MasterGlencor 7500 (High Range WRA)</td>
<td>11 - 80 oz.</td>
<td></td>
</tr>
</tbody>
</table>

**W/C Ratio:** 0.42  
**Density:** 146.5  
**Design Volume:** 27.17  

**Notes:**  
* ASTM C-94 (5.8) “The purchaser shall ensure that the manufacturer is provided copies of all reports of tests performed on concrete samples taken to determine compliance with specification requirements. Reports shall be provided on a timely basis.”  
* Miles S&G does not acknowledge test lab data that does not conform completely to ASTM standards.  
* Point of placement, or mix conformance, is at the end of the discharge chute of the mixer.  
* Miles S&G is not responsible for changes in the mix due to placement methods.  
* Concrete placed that exceeds the maximum design slump, is placed at the risk of the contractor and owner.  
* When NOT delivered MILES MILES agrees to batch concrete based on Customer’s order. The performance of the concrete becomes the sole responsibility of the Customer at the time of batching. Customer understands that MILES provides no representations or warranties, either express or implied, of merchantability, fitness for a specific purpose, or otherwise with regards to any concrete provided hereunder. Customer hereby knowingly and intentionally releases, indemnifies, and holds MILES harmless from and against any and all claims, actions, liabilities, and costs for performance, personal injury or property damage resulting from concrete provided hereunder.

**Remarks:** 3500 PSI 20% SCM Replacement Air Entrained

Application: Curbs and Pads

**Construction: Collaboration**
Construction: Awareness and Engagement
### Construction: Modifications and Support

#### Krypton Gas Window Unit Substitution - War in Ukraine

<table>
<thead>
<tr>
<th>Glazing Type</th>
<th>Type of Glazing</th>
<th>NFRC Certified Product #</th>
<th>Spec.</th>
<th>Med.</th>
<th>Mat.</th>
<th>Gap Fill</th>
<th>U-Value</th>
<th>SHGC</th>
<th>VLT</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed - with Triple-Pane Glazing</td>
<td>Advanced Low-E IG</td>
<td>PEL-N 257-00117-000601</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>argon</td>
<td>1.16</td>
<td>0.29</td>
<td>0.54</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Advanced Low-E IG</td>
<td>PEL-N 257-00117-000602</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>argon</td>
<td>1.16</td>
<td>0.29</td>
<td>0.54</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Advanced Low-E IG</td>
<td>PEL-N 257-00117-000603</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>argon</td>
<td>1.16</td>
<td>0.29</td>
<td>0.54</td>
<td>73</td>
</tr>
</tbody>
</table>

*Note: The above table provides specifications for different types of glazing used in construction projects.*
Insulation decrease in localized areas due to mechanical conflicts
Construction: Modifications and Support

Insulation Substitutions Related to Strike

Specified, Approved

Substitution 1, Approved

Substitution 2, Approved
70% Complete; Opening in Spring 2024