HONORABLE MENTION
BEST USE OF WOOD PRODUCTS

A NEW STANDARD

Chris Melander
Ross Smith
RTKL Associates Inc.

Phone: 410.537.6129
Email: cmelander@rtkl.com
Email: drsmith@rtkl.com
Website: www.rtkl.com
A NEW STANDARD

ENTRY #102
The Baltimore rowhouse has been the standard of housing in this colonial city for over 200 years. It is the housing type of the people – bringing social, economic, and ethnic diversity into Baltimore’s neighborhoods. The basic design has stood the test of time and remained relatively unchanged for centuries.

When redesigning Baltimore’s standard housing prototype for the 21st century, we must consider what has changed since the housing type’s inception. While the vast majority of rowhomes in Baltimore have masonry wall construction, we recognize that the use of brick was essential to withstand the threat of fire. But just as real as the threat of fire in the 18th and 19th centuries is the environmental impact created by our homes and cities. As material technology and labor forces have evolved, other materials have emerged to meet the demand of creating buildings that are both sustainable and economically competitive.

Wood is the obvious material of choice when considering environmental sustainability, economic viability, and aesthetics. When harvested from sustainably managed forests, wood has a very low carbon impact and can be recycled for a multitude of uses. In addition, it is locally sourced and preferred for its workability by the construction industry. From an aesthetic point of view, wood creates a warm and inviting experience that is desirable in any home.

We cannot, however, design this new prototype in isolation. The sad truth is that many Baltimore rowhouses are vacant and in disrepair. This new prototype considers these derelict structures and how their materials can be salvaged and used in the construction of new homes. The new design incorporates salvaged brick into precast concrete panels in order to preserve the classic use of brick in the Baltimore streetscape. Reclaimed use of wood beams and wood decking can also be seen throughout the house.

- SITE PLAN
- ELEVATIONS
- FLOOR PLANS
- INTERIOR PERSPECTIVE | KITCHEN
- INTERIOR PERSPECTIVE | LIVING ROOM
- PASSIVE VENTILATION & DAYLIGHTING
- INNOVATIVE MATERIALS
- BUILDING SYSTEMS
- WALL SECTIONS
- ATHENA METRICS
- ATHENA PROJECT ASSEMBLIES
- APPENDIX A - WOOD FIBRE INSULATION
ELEVATIONS

FRONT ELEVATION

REAR ELEVATION

Rainwater Cistern

Atlantic white cedar siding

Operable wood framed window

Brick on precast concrete panels

Concrete Planter

Level One + 2'-0"

Level Two + 11'-0"

Level Three + 20'-0"

Roof + 29'-0"

ENTRY #102
Part of redesigning the prototypical rowhouse for the 21st century is considering how modern living has changed and adapted since the rowhouse was first invented. While once considered service space, the kitchen has become the primary gathering space of the modern home. This new prototype brings the kitchen to the center of the house and puts the living room near the rear entrance, where occupants can experience more privacy and separation from the street.
PASSIVE VENTILATION AND DAYLIGHTING:
To begin the design of a sustainable home, we must first use any passive strategies available to decrease the amount of energy needed. A common challenge in the design of rowhomes is the ability to get light into a long, skinny building. By incorporating a light well, we are able to get light into the center of the house and create a stack effect that allows for natural cross-ventilation of the whole house.
INNOVATIVE MATERIALS

The materials selected for this rowhouse are carefully considered to achieve many goals including sustainability, durability, and aesthetics. This new prototype considers the previous Baltimore rowhomes as a part of its lifecycle, using salvaged materials from disassembled houses. In addition, the home showcases wood as not only a low carbon option, but a material that is both warm and inviting.

MATERIALS FROM DISASSEMBLED ROWHOUSES

Typical Baltimore rowhomes in disrepair can be disassembled and recycled for materials used in new construction.
BUILDING SYSTEMS STRATEGY:
The center core of the rowhouse acts as an integral piece of the building systems strategy. In order to maintain exposed wood decking and ceilings without the need for exposed ductwork, the core becomes a central hub for distributing conditioned air. Optimized variable air volume diffusers with onboard thermostats allow for an automatically adjustable volume of conditioned air at each space. These VAV diffusers throw air from the home’s core towards the exterior walls. The light well at the center of the house allows for the vertical return of air back to the furnace on the third floor.
**Typical Roof Assembly**
- EPDM roof membrane
- 1/4" plywood coverboard
- 12" wood fibre insulation board (R-50)
- 1-1/2" salvaged wood decking
- 2"x8" wood joists @ 24" o.c.

**Typical Floor Assembly**
- 1-1/2" salvaged wood decking
- 3"x8" wood beams @ 24" o.c.

**Typical Party Wall Assembly (2 hr fire rated)**
- 1/2" finished gypsum board
- 2x6 studs w/ 6" wood fibre insulation
- 3/4" airspace
- 2" gypsum shaftwall (shared w/ adj. house)

**Wood Siding Wall Assembly**
- 1/2" atlantic white cedar siding
- 1-1/2" wood battens
- 2" wood fibre insulation board (R-6)
- vapor barrier
- 1/2 plywood sheathing
- 2x6 studs w/ 6" wood fibre batt insul. (R-21)
- 1/2" finished gypsum board

**Brick Precast Wall Assembly**
- 4" precast panel w/ salvaged cut brick
- 1" air space
- 2" wood fibre insulation board (R-6)
- vapor barrier
- 1/2 plywood sheathing
- 2x6 studs w/ 6" wood fibre batt insul. (R-21)
- 1/2" finished gypsum board

**NOTE:** Wood Fibre insulation is a relatively new technology using wood chips from lumber mills to create insulation in both rigid and batt insulation form. Please consult Appendix A for additional information.
**Summary Measure Table By Life Cycle Stages**

**Project:** 102

<table>
<thead>
<tr>
<th>Summary Measures</th>
<th>Manufacturing</th>
<th>Construction</th>
<th>Maintenance</th>
<th>End - Of - Life</th>
<th>Operating Energy</th>
<th>Total Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Material</td>
<td>Transportation</td>
<td>Total</td>
<td>Material</td>
<td>Transportation</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Fossil Fuel Consumption (MJ)</strong></td>
<td>1.50e+05</td>
<td>7.71e+03</td>
<td>1.58e+05</td>
<td>6.93e+03</td>
<td>1.33e+04</td>
<td>2.02e+04</td>
</tr>
<tr>
<td><strong>Global Warming Potential (kg CO2 eq)</strong></td>
<td>1.12e+04</td>
<td>5.52e+02</td>
<td>1.17e+04</td>
<td>6.41e+02</td>
<td>8.32e+02</td>
<td>1.47e+03</td>
</tr>
<tr>
<td><strong>Acidification Potential (moles of H+ eq)</strong></td>
<td>3.73e+03</td>
<td>1.78e+02</td>
<td>3.91e+03</td>
<td>2.89e+02</td>
<td>3.04e+02</td>
<td>5.92e+02</td>
</tr>
<tr>
<td><strong>HH Criteria (kg PM10 eq)</strong></td>
<td>8.69e+01</td>
<td>2.31e-01</td>
<td>8.71e+01</td>
<td>8.05e-01</td>
<td>3.97e-01</td>
<td>1.20e+00</td>
</tr>
<tr>
<td><strong>Eutrophication Potential (kg N eq)</strong></td>
<td>4.32e+00</td>
<td>1.94e-01</td>
<td>4.51e+00</td>
<td>1.47e-01</td>
<td>3.31e-01</td>
<td>4.78e-01</td>
</tr>
<tr>
<td><strong>Ozone Depletion Potential (kg CFC-11 eq)</strong></td>
<td>3.34e-05</td>
<td>2.21e-08</td>
<td>3.35e-05</td>
<td>1.49e-09</td>
<td>3.33e-08</td>
<td>3.48e-08</td>
</tr>
<tr>
<td><strong>Smog Potential (kg O3 eq)</strong></td>
<td>3.78e+02</td>
<td>9.53e+01</td>
<td>4.74e+02</td>
<td>8.21e+01</td>
<td>1.66e+02</td>
<td>2.48e+02</td>
</tr>
</tbody>
</table>

**DESIGN PROVISIONS:**

**Insulation:**
The wood fibre board and batt insulation products utilized in this project have a manufacturing process that with less embodied energy and more recycled content than that of tradition rigid and batt insulation processes. It is for that reason the insulation in this project was calculated as blown cellulose, a product with similar recyclable content and a manufacturing process with lower impact.

**Material Reuse:**
By using lumber and brick salvaged from row homes in disrepair, this project extends the lifecycle of those materials. This innovative reuse of materials cannot yet be calculated in the Athena software as most of the calculations are based on creating new materials and not utilizing the existing.

**Wood Decking:**
The typical floor and roof assemblies were calculated without sheathing and the wood decking was itemized in linear board feet and added as an additional material.
### ATHENA PROJECT ASSEMBLIES

#### Project Data

<table>
<thead>
<tr>
<th>Name</th>
<th>Project Location</th>
<th>Building Type</th>
<th>Building Life Expectancy (Years)</th>
<th>Building Height (ft)</th>
<th>Gross Floor Area (ft²)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry #102</td>
<td>Baltimore</td>
<td>Single Family Residential</td>
<td>60</td>
<td>30.8</td>
<td>2,116.0</td>
<td>Imperial</td>
</tr>
</tbody>
</table>

#### Foundations

<table>
<thead>
<tr>
<th>Assembly Type</th>
<th>Assembly Name</th>
<th>Length (ft)</th>
<th>Width (ft)</th>
<th>Thickness (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Footing</td>
<td>Precast Footing</td>
<td>132.75</td>
<td>0.85</td>
<td>6.00</td>
</tr>
</tbody>
</table>

#### Columns and Beams

<table>
<thead>
<tr>
<th>Assembly Type</th>
<th>Assembly Name</th>
<th>Number of Columns</th>
<th>Number of Beams</th>
<th>Supported Area (ft²)</th>
</tr>
</thead>
</table>

#### Walls

<table>
<thead>
<tr>
<th>Concrete Block</th>
<th>Assembly Type</th>
<th>Assembly Name</th>
<th>Length (ft)</th>
<th>Height (ft)</th>
<th>Number of Windows</th>
<th>Total Window Area (ft²)</th>
<th>Number of Doors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Stud Interior Partition</td>
<td>150.50</td>
<td>8.80</td>
<td>0</td>
<td>0.00</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Stud Interior Partition - One Side Gyp</td>
<td>6.80</td>
<td>8.80</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Stud Party Wall</td>
<td>264.75</td>
<td>8.80</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Stud Exterior Wall - Wood Siding</td>
<td>85.00</td>
<td>8.80</td>
<td>8</td>
<td>309.00</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Stud Exterior Wall - Precoat Brick Panels</td>
<td>16.50</td>
<td>8.80</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Tilt Up Precast Foundations</td>
<td>132.75</td>
<td>4.00</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Floors

<table>
<thead>
<tr>
<th>Assembly Type</th>
<th>Assembly Name</th>
<th>Width (ft)</th>
<th>Length (ft)</th>
<th>Floor Area (calculated) (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Joist Wood Beam and Decking</td>
<td>16.00</td>
<td>136.50</td>
<td>2,184.00</td>
<td></td>
</tr>
<tr>
<td>Wood Joist Back Patio</td>
<td>16.00</td>
<td>10.00</td>
<td>160.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>2,344.00</td>
</tr>
</tbody>
</table>

#### Roofs

<table>
<thead>
<tr>
<th>Assembly Type</th>
<th>Assembly Name</th>
<th>Width (ft)</th>
<th>Length (ft)</th>
<th>Floor Area (calculated) (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Joist Main Roof</td>
<td>16.00</td>
<td>38.00</td>
<td>608.00</td>
<td></td>
</tr>
<tr>
<td>Wood Joist Roof Deck</td>
<td>15.00</td>
<td>14.00</td>
<td>210.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>818.00</td>
</tr>
</tbody>
</table>

---

**DESIGN PROVISIONS:**

**Insulation:**

The wood fibre board and batt insulation products utilized in this project have a manufacturing process that with less embodied energy and more recycled content than that of tradition rigid and batt insulation processes. It is for that reason the insulation in this project was calculated as blown cellulose, a product with similar recyclable content and a manufacturing process with lower impact.

**Material Reuse:**

By using lumber and brick salvaged from row homes in disrepair, this project extends the lifecycle of those materials. This innovative reuse of materials cannot yet be calculated in the Athena software as most of the calculations are based on creating new materials and not utilizing the existing.

**Wood Decking:**

The typical floor and roof assemblies were calculated without sheathing and the wood decking was itemized in linear board feet and added as an additional material.
Plants for wood fiber insulation boards

01 I 2010

DIEFFENBACHER
Advantages of wood fiber insulation boards

- Renewable raw material - green product
- Environmentally compatible building material (e.g. natureplus® certificate)
- Recyclable
- Low energy consumption of the production
- Excellent thermal properties
- Suitable cover against cold in winter and heat in summer – phase displacement
- Superior dehumidification - breathable
- Good sound insulation
- Uncomplicated and safe handling for roofers/craftsmen
## Properties of rigid wood fiber insulation boards with different densities

<table>
<thead>
<tr>
<th>Properties</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>35 kg/m³</td>
</tr>
<tr>
<td>Tensile strength vertical to the mat surface [kN/m²] (EN 1607)</td>
<td>2</td>
</tr>
<tr>
<td>Compression load with 10 % deformation [kN/m²] (EN 826)</td>
<td>-</td>
</tr>
<tr>
<td>Water absorption [kg/m²] (with hydrophobising agent, EN 1609)</td>
<td>-</td>
</tr>
<tr>
<td>Heat conductivity [W/mK] (EN 13171)</td>
<td>0.034</td>
</tr>
</tbody>
</table>
Ingredients of wood fiber insulation boards

- Wood fibers
- Bonding agent:
  - MDI 3 - 6 %, or
  - MDI with additive, ~ 6 % each for rigid panels with low density (< 90 kg/m³), or
  - Plastic fibers 5 - 10 %
- Hydrophobising agent: Depending on the desired board properties 0 - 5%. Typically 1 - 2%.
- Fire retardant agent: Depending on the desired board properties 0 - 8%.

Moisture content of the insulation board 7 - 10 %.
Functional areas

Chipping and Refining
- The production of wood fibers is done with the same machines and the same process as for the production of MDF boards. The logs are debarked and cut to chips and then refined to fibers.

Drying
- The fibers are dried in a one stage tube dryer with hot air or exhaust gas to approx 6 % moisture content.

Blending
- Fire retardant and hydrophobising agent are added in the blowline before the drier. The blending of the wood fibers with plastic fibers or MDI is done in two different mechanical blending systems.
Functional areas

Forming
- The forming process is the same as for the production for MDF panels. By using special bin discharge rolls, the fibers are dissolved before spreading to the mat. The main compression of the formed mat is done in the pre-press.

Continuous steaming system – CSS
- The mat is compressed to the required thickness and afterwards heated under steam conduction within a few seconds. By using a simultaneous steam discharge at the upper and lower surface a symmetric density profile of the board is obtained. For a total glue hardening the mat remains in the CSS heating zone for a specific period of time.

Board handling
- After the CSS the „endless“ mat is trimmed on the edges and cut with a diagonal saw to the desired length. On-line tongue and groove shaping and stacking on pallets can also be realized.
Plant specifications

- Board thickness: 20 - 250 mm
- Board width: 1,2 - 1,3 m
- Fiber throughput: 1 - 6,5 t/h
- Production speed: 15 - 140 mm/s
- Board density: 35 - 250 kg/m³

Installed electrical power:
- From 3.000 - 4.900 kW depending on the plant equipment

Energy demand (~ 6,5 t/h fiber throughput)
- Steam demand of the refiner and CSS 5 t/h ~ 4 MW
- Dryer ~ 6,8 MW