SILICAWOOD HOUSE FOR A BETTER LIVING CHALLENGE
Sustainable and affordable multi scale housing project in RSA

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Presentation outline

- General introduction
- Introducing Silicawood
- Bbuilding Prefab Construction System
- Case study: Better Living Challenge Project for Cape Town WDC2014
- Case study: redesign for Lynedoch Eco Village Sustainability Institute of Stellenbosch University
- Performance Modelling Results
- Conclusions
Light Weight Structural Construction Material

Silicawood® RAW is a special type of concrete, formed by the ingenious combination of WOOD CHIPS and Silica mixed with cement.

Silicawood® combines the strength of cement & excellent thermal insulation and acoustic properties of WOOD.

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Waste Wood Recycling
Sustainable Development

Pallets-scaffolding

Alien species Eucalyptus Port Jackson

2000-3000 ton/month of SCRAP WOOD

Wood chips treated with an industrial process become:
Silicawood Raw Plant  
(capacity 200 m³/day)

combined heat and power (CHP)

STEP 1
- Scarp wood collection
- Selection of wood
  - Storage of wood
  - Silos and other components of the process
- Primary chipping plant
  - Storage wood chips

STEP 2
- Silicawood Raw Plant
  - Storage of Silicawood raw
  - Wood silos

STEP 3
- Prefab Panel & Block Factory
- Wall panel Prefab Process
  - Lifted vertical after 24 hours
- Self load bearing solid walls dry jointed
Light weight Hollow core slab 1200x6000x150

- Monolithical wall thickness range 18-40 cm
- Silicawood Mix density is 800 kg/m³
- Concrete ready Mix 2400 kg/m³
- Structural self load bearing walls compression strength 3,5 N/mm² (anti-seismic certified)
- Zero condensate risk and very high permeability to steam
- Walls are breathing (diffusion resistance factor u=13)
- Resistance to cyclic frosting and defrosting in severe weather conditions (un plastered walls)
- Thermal insulation (thermal transmittance $U=0,19\ \text{W/m}^2\text{K}$)
- Sound absorption properties (10cm with plaster ‘Rw’ 38 dB)
- Certified fire resistance (10 cm with plaster = REI 180)

Hollow core blocks

<table>
<thead>
<tr>
<th>CONSTRUCTION MATERIAL</th>
<th>Thickness cm.</th>
<th>Transmittance (K)Watt/m² K°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOLLOW BRICKS</td>
<td>30</td>
<td>0,540</td>
</tr>
<tr>
<td>CELLULAR CONCRETE</td>
<td>30</td>
<td>0,530</td>
</tr>
<tr>
<td>TRADITIONAL WALL</td>
<td>12</td>
<td>0,386</td>
</tr>
<tr>
<td>Hollow bricks</td>
<td>6</td>
<td>0,386</td>
</tr>
<tr>
<td>Hollow bricks</td>
<td>12</td>
<td>0,345</td>
</tr>
<tr>
<td>SILICAWOOD® hollow core</td>
<td>30</td>
<td>0,345</td>
</tr>
</tbody>
</table>

Excellent thermal insulation and energy efficiency
A load-bearing SILICAWOOD® wall insulates ca. 6 times more than a brick wall having the same thickness and is 11 times more insulating than cement. High level of energy efficiency is because high insulating power of SILICAWOOD® ($\lambda = 0,09$) versus concrete ($\lambda = 0,8$). SILICAWOOD® has a very small heat dispersion: houses are cool in summer and warm in winter, thus allowing a remarkable energy conservation.
Achievements in EU

Over 130 low rise residential houses in the last 15 years built in Italy, France, Switzerland and Tunis

380 Km of Highway acoustic barriers in across Italian French
**BBuilding House System**

OUTSTANDING ACOUSTIC INSULATION < 53 dB (27 cm)

FAST!!!!! 220 rooms plugged in 30 days

Tiberio Palace Hotel Naples Italy

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**SHOWCASE STRUCTURE FOR AUHF Conference**

**AUHF 2014**
ANNUAL CONFERENCE CELEBRATING THE 30th ANNIVERSARY OF THE AUHF
Cape Town International Convention Centre, South Africa
THE NEXT FRONTIER IN AFFORDABLE HOUSING: ALTERNATIVE BUILDING TECHNOLOGIES
17 - 19 November 2014
in association with SBS Conferences

Produced in CAPE TOWN 2014
Parameters been considered
- **Material**: Silicawood Mix
- **Construction system**: Modular prefab walls dry jointed
- **Design Process**: Passive Natural Bioclimatic Solar Architecture an Engineering

A – **SW Better Living Challenge House** – Ideal case study for std RDP house
   - A1 – Bioclimatic Building facing north
   - A2 – Multiscale urban design of bio-climatic house neighborhoods

B – **SW Lynerdoch House** - House on plot between existing building s with heliothermic axis oriented (north/est – south/west
   - B1 – House with front facade orientated north
   - B2 - House with solar with solar fins on front
   - B3 – Actual building under construction on finishes in line the eco-village construction guide lines
Solar passive house (48 s.q.m.)

Passive Natural climatization

Optimum orientation facilitates improved thermal performance and comfort
- Solar asymmetry of building facades
- Massive building envelope with thermal and acoustic insulation
- Natural ventilation and lighting
- Sunspaces, porticos, earth integrated systems
- Indoor and outdoor microclimatic quality
- Use of renewable sources

Orientated for:
✓ Protecting from sun in morning and afternoon
✓ Maximising winter sun
✓ Restricting southern exposure
A multi-scale approach to foster smart integrated housing energy efficient settlements

- Shared civic spaces
- Collaborative buildings smart layout
- Self sufficient micro cities settlements
- Micro-cities and towns
A multi-scale approach to foster smart integrated housing clusters to upgrade self-sufficiency and security for the dwellers

Additive process in modern settlements as informal agglomerates

Generative process for ecovillages as organic whole

Various steps in the microcity growth for about 1200 citizens on a land of 120 hectares.
about 1/5 children, 1/5 elders and 3/5 workers:
180 as farmers, 180 as builders, 360 as artisans and services providers.

GENERATIVE PROCESS for Micro cities developments
Row House in a collaborative design

Good ventilation by air flowing through the smaller windows on the south to the larger widows on the north facade.

The court lays in the shadow of the wind diverted by the slop of the pitched roof.

Overhang that allow maximum shading for most sun in the hotter season.

The street is a living room without a ceiling.
Better Living Challenge Energetic Results

<table>
<thead>
<tr>
<th>House</th>
<th>Heating load (GJ)</th>
<th>Cooling load (GJ)</th>
<th>Total load (GJ)</th>
<th>Energy Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidy house</td>
<td>12,29</td>
<td>7,5</td>
<td>19,79</td>
<td></td>
</tr>
<tr>
<td>SW BLC House</td>
<td>8,33</td>
<td>0</td>
<td>8,33</td>
<td>57,9%</td>
</tr>
<tr>
<td>SW Row House</td>
<td>7,67</td>
<td>0</td>
<td>7,67</td>
<td>61,2%</td>
</tr>
</tbody>
</table>

40 sq.m. subsidy house
- 140 mm hollow concrete masonry block
- 75 mm concrete slab
- Steel roof sheet

48 sq.m. Silicawood house

No need for cooling during the summer

decrease of thermal energy requirements in winter for heating of about 32%.

<table>
<thead>
<tr>
<th>Energy Reduction</th>
<th>per house</th>
<th>Nation: assuming Housing backlog 2.2 million units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(heating and cooling)</td>
<td>10,96 GJ</td>
<td>(GJ) 24,112,000 MWh 67million MWh</td>
</tr>
</tbody>
</table>

Case study for Lynedoch Eco Village
Sustainability Institute

CLIMATE 1 - station data
- Station: Cape Town
- Latitude: 33.90°S
- Longitude: 18.53°E
- Altitude a.s.l.: 17 m
- Climate type: Kopperv: Cfb
- Toll: IV, I
Plot 25 @ Lynedoch Eco Village

Conventional House
SW Lynedoch House version 2

North Facade in line with street nearby house

South facade facing the garde
Lynedoch Eco village HBA proposal

SW Lynedoch House version 3

summer solstice 12 a.m.

winter solstice 9 p.m.

Equinox - Mar & sept 12 a.m.

winter 12 am

winter 2 p.m.

100% solar radiation enters the rooms

50% solar radiation enters the rooms, 50% stored up in massive walls

No solar radiation enters the rooms

0% solar radiation enters the rooms

All radiation is stored up in massive walls
**BIOCLIMATIC STRATEGIES FOR DECREASING THE ENERGY REQUIREMENTS IN SUMMER AND WINTER, AND THE EMISSIONS OF CO₂**

<table>
<thead>
<tr>
<th>Isolated house</th>
<th>Row houses</th>
<th>Solar contribution</th>
<th>Total annual thermal load (GJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Isolated house" /></td>
<td><img src="image" alt="Row houses" /></td>
<td><img src="image" alt="Solar contribution" /></td>
<td>Bioclimatic isolated house: 10.60 GJ&lt;br&gt;Row house: 9.75 GJ&lt;br&gt;20% solar contribution in summer and shaded in winter: 8.21 GJ</td>
</tr>
<tr>
<td><img src="image" alt="Isolated house" /></td>
<td><img src="image" alt="Row houses" /></td>
<td><img src="image" alt="Solar contribution" /></td>
<td>Bioclimatic Isolated house: 8.33 GJ&lt;br&gt;15% solar contribution in summer shaded in winter: 8.69 GJ</td>
</tr>
<tr>
<td><img src="image" alt="Isolated house" /></td>
<td><img src="image" alt="Row houses" /></td>
<td><img src="image" alt="Solar contribution" /></td>
<td>Bioclimatic row house building: 13.50 GJ&lt;br&gt;25% east and west modulated solar contribution: 8.00 GJ</td>
</tr>
<tr>
<td><img src="image" alt="Isolated house" /></td>
<td><img src="image" alt="Row houses" /></td>
<td><img src="image" alt="Solar contribution" /></td>
<td>Bioclimatic house: 13.500&lt;br&gt;18% solar contribution in summer: 8.47 GJ</td>
</tr>
</tbody>
</table>

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**Silicawood buildings highlights**

**QUALITY**
- **Robustness and safety** 4 story building is resistant to earthquakes
- **Acoustic Insulation** - Very high -35 dB 53dB
- **Fire Resistance** doesn’t burn
- **Wellness of living** far superior inside the house (especially in hot climates)

**ENERGY SAVING**

- **Silicawood® blocks** contribute to a saving 35% of energy for cooling
- **Bbuilding Bio-Climatic Engineering** can produce up to 60% ~ 80% saving of the electrical power (kWh) for running the house

**ECO COMPATIBILITY**
- **Waste & Scrap wood recycling**
  - CO₂ emission reduction and credits saving
  - 80% of volume of walls are made with scrap wood !!!
  - 1 m² (33 cm wall) stores permanently 270 m³ CO₂
**Summary Building**

- **AFFORDABLE** (scrap wood costs less than sand and aggregates)
- **SUSTAINABLE** (energy saving and self upgrading urban systems)
- **DURABLE** (house is solid and quality and appreciates value in time)
- **FAST** (relief of social tensions for housing – the builder is the owner right)
- **LOCAL DESIGN** (nice-comfortable and living wellness)
- **ECOLOGICAL** (large scale wood recycling is appreciable - Furthering ecological developments to reduce environmental impact)

and

**MULTI SCALE BIO-CLIMATIC ARCHITECTURE**
- induces large scale efficiencies
- enhancement of collaborative self sufficient live habits, and improved life styles both in the shared public open spaces and in the interiors and privacy of each single house

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**Assessment Checklist**
- Does it improve quality of life?
- Does it reduce demand on municipal services?
- Does it reduce raw material consumption?
- Does it create a technology platform, or is it just another walling system?
- Does the technology empower the owner, or does it lock the owner into a specific system?
- Does it facilitate later expansion without diminishing the structural integrity of the building?
- Does it facilitate job creation?
- Does it reduce construction time?
- Is it cost effective?
- Does it result in improve construction quality?
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