Saint-Gobain ISOVER- Multi-Comfort House Students Contest 2016- Brest, Belarus

Croatia 1st prize

University of Zagreb Faculty of Architecture

mislav Barada, Karla Jambrešić

inhabiting treetops

modular sustainable passive housing, Brest, Belarus
**research - context analysis - Belarus**

**Independence from USSR 1991**
- 1994, president Lukashenko - last European dictator, most loyal Russian ally
- All media and most of the land are state owned
- Relatively closed country
- Russian gas pipeline passes through Belarus
- A lot of resources are invested in sport and education

- **Area:** 307,686 km²
- **Mostly lowland country**
- **Temperate continental climate**
- **90% of country covered with greenery**
- **Oak, birch, conifers, pine woods cover 40% of the country**

**Population:** 9,560,000 residents
- 78% Orthodox, 20% Catholics, 7% Greek Catholics
- 30% of the population lives in the countryside, and 70% of the population lives in cities
- 72% speaks primarily Russian, only 11% Belarusian language
- Although it is considered a closed state, residents are very open and liberal
- Residents tend to the European way of life (popularisation of cycling)

**St. Efta cross - Belarus masterpiece**
- Disappeared during WW II
- Never found

**Cherish tradition - open customs**
- Traditional textiles
- Production of straw articles

**The most developed industrial center of USSR - a highly industrialised country**

**Free use of highways**

**Map of Belarus**
- 3 biggest rivers: Nieman, Pripyat, Dnieper
- Good connections by rivers
- Many wetlands
- 11,000 lakes, 20,000 watercourses

**Pitoresque villages slowly decaying, residents move to towns**
- Existing buildings in cities are energy inefficient
- Building materials used: 38% prefabricated concrete components, 35% brick, 25% wood
- 90% of built houses are mass prefabricated buildings
- research - context analysis - Brest

- Name: Brest comes from birch/ bark
- 6th largest town in Belarus
- Capital city of Brest voblast
- 2019: celebrates 1500 years since founding
- Population density: 3,965 residents/km²
- Local materials used in large amounts: granite, sand, clay, limestone, peat
- On the other side of the river, Polish town Terespol
- Dnieper-Bug canal connects Brest harbour with the Black Sea
- On European route E30 Berlin-Moscow
- Important railway center - the last point of the Russian track
- border town between European Union and Commonwealth of Independent States

- Elevation: 280.4 m
- Transitional climate between oceanic and humid continental
- Record low temperature -35 °C, record high +35 °C
- Average winter temperature: -5 °C, summer: +28 °C

- Flat terrain - town in the river valley
- Two rivers flow through the town: Bug and Muhavets
- Muhavets during history caused large floods, 2-3 km wide
- Now dams are built: calm, wide, slow river

- 13th century Heric fortress well known for battles during WW I and WW II - located on island between rivers Muhavets and Bug
- War memorial on site of 1941 battle - largest tourist attraction
- 1st outdoor railway museum
- Architectural site displaying an authentic East Slavic wooden town from 13th century, Brestye

- Strong industry
  - Annual export increase 20%
  - Main industrial partners - Russia, Germany, Poland, Ukraine, Italy
  - High tech agriculture
  - Tractor production - industry and technology
  - Growing meat and dairy products
  - Enterprises use local resources
  - Extraction and processing of minerals

- 40% Brest voblast covered with forest
- Large number of reserves in voblast
- North of Brest national park - habitat of the European bison
- Large number of parks, forests and green areas inside town area
research- surroundings collage with existing forest area
saving existing forest and greenery → rising living area from the ground → inhabiting treetops!
concept- sustainable urban planning strategies

using forest trees as natural shading system together with on-site lakes to prevent overheating and also as natural sound buffer for creating pleasant living environment (+creating unique living-with- nature atmosphere)

reusing excavated earth for creating topography, playgrounds for children and covering car parking (+minimum roads= less CO2); waste recycling points are placed in the ground-covered parking construction

using on-site lakes for water-water heat exchange
creating gardens for urban farming and growing own organic food
creating a strong network of bicycle and pedestrian paths to promote bicycle and pedestrian traffic and destimulate car traffic
general block masterplan
general block masterplan - aerial view
general block masterplan - rowhouse block rooftop plans
Typical rowhouse

reorienting main facade to south (sun)

sloping south side of the roof for maximum sun penetration inside the house

sloping north side of the roof for most efficient collection of solar energy

Roof shape enables maximum efficiency of rainwater collection

Creating multi-benefit buffer space

Enabling higher degree of privacy

Raising from ground— inhabiting treetops
concept: rowhouse modular concept schemes

rowhouse functional zoning

service area  vertical comm.  service area  
horizontal communication

living/sleeping area

module placement scheme

1 or 2  1 or 2  1 or 2  1 or 2

3  4

rowhouse modules can be adapted to fit the family temporary needs and can be changed through the time
concept - rowhouse module types catalog

module

<table>
<thead>
<tr>
<th>module</th>
<th>area</th>
<th>module types</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,00 m²</td>
<td>1a- staircase  1b- elevator  1c- bathroom  1d- toilet</td>
</tr>
<tr>
<td>2</td>
<td>5,20 m²</td>
<td>2a- bathroom  2b- bathroom  2c- utility room  2d- utility room  2e- walk in closet</td>
</tr>
<tr>
<td>3</td>
<td>12,80 m²</td>
<td>3a- dining room  3b- bedroom  3c- bedroom  3d- children’s bedroom</td>
</tr>
<tr>
<td>4</td>
<td>19,50 m²</td>
<td>4a- living room  4b- living room + dining room  4c- bedroom  4d- children’s bedrooms</td>
</tr>
</tbody>
</table>
Rowhouse layers - loadbearing construction

- Loadbearing reinforced concrete structure: very low carbon footprint (0.13)
- Roof slab: 18 cm
- Walls: 18 cm
- Foundation slab: 10 cm
- Foundation grid: 65 x 90 cm

Thermal break element:
- Allows thermally insulated connections between wood and concrete
- Enables high level of prefabrication
- Reduces thermal bridges, CO2 emissions and conserves natural energy resources

Loadbearing laminated wood structure:
- For every m² of wood used instead of other material, approx. 1 tonne of CO2 is saved
- Creates healthier environment
- Is a recyclable material
- Roof beam: 9/24 cm; spacing: 96 cm
- Beam: 8/24 cm
- Steel wire tie: Ø = 28 mm
- Wood column: 8/20 cm
- Beam: 8/24 cm; spacing: 69 cm
rowhouse layers - summer kitchen/ multipurpose storage/ garden tools storage

- folding bed
  - flexible and moving element
  - easy folding/unfolding
  - maximizes use of groundfloor deck

- additional storage
  - used by personal temporary needs
  - can be used for storing deck chairs

- summer kitchen
  - used for outdoor cooking
  - maximizes use of groundfloor deck
  - enables spending more time in nature

- garden tools storage
  - for storing tools used in own urban gardens: shovel, fork, rakes, hose, axe, lawnmower...
  - promotes growing own plants and organic food
rowhouse layers - facade and roof PV panels

PV panels:
- Using renewable energy resources
- Collecting electricity

Tin covered pitched roof:
- Enables rainwater collection and reuse

Passive house standard triple glazing windows:
- Thermally insulated frames
- Large south and small north, east and west windows

Smooth plaster facade

Wood cladding facade:
- Creates living-in-nature feeling
- Local material
- With ISOVER passive house standard insulation and low U values

Wooden deck flooring:
- Natural material - natural and warm atmosphere
- Creates healthier environment
- Is a recyclable material
rowhouse layers - multi-benefit buffer space

- passive house standard triple glazing sliding doors
  - thermally insulated frames
  - internal and external facade

- multi-benefit buffer space
  - enables natural ventilation
  - enables temperature regulation
  - protects from external noise

- external sun protection
  - prevents interior overheating
  - protects from direct sun rays
possible scenarios - cross sections
possible scenarios - rowhouse north and south facades
PV panels, roof shape and daylight:
- PV panels placed on the northern roof slope enable the most efficient collection of solar energy which is stored in accumulators at the ground floor.
- Big openings and roof shape on south facade (15°) enable penetration of daylight in all rooms in the house.
passive energy and sustainability diagrams - benefits

Rainwater collection:
- Roof shape enables maximum efficiency of rainwater collection
- Water is filtered and stored in the underground tank
- Collected water is used as sanitary water and for external use
passive energy and sustainability diagrams - benefits

natural ventilation
- efficient natural ventilation is enabled by placement of the windows on two opposite sides of the house.
- the interspace can be naturally ventilated through openings on the bottom and the top of the construction.
temperature regulation
-during hot days interior facade is closed but interspace is ventilated which prevents house interior from overheating
temperature regulation
- during cold days interspace is closed so air in interspace is warmer than outside air
- inside space can be naturally ventilated with warmer air through the interspace
wind and noise protection
- load-bearing northern walls protect the inside from cool winds
- interspace on south protects the inside from outside noise
rowhouse - energy demand calculations

Heat Demand Calculations

- Transmission Heat Losses: 4534.44 kWh/a
- Ventilation Heat Losses: 870.41 kWh/a
- Total Heat Losses: 5404.86 kWh/a
- Internal Heat Gains: 1397.57 kWh/a
- Available Solar Heat Gains: 2556.53 kWh/a
- Total Heat Gains: 3721.98 kWh/a
- Annual Heat Demand: 1882.88 kWh/a
- Specific Annual Heat Demand: 12.80 kWh/(m²a)
rowhouse - summer exterior 3d - south facade
rowhouse- winter exterior 3d- south facade
rowhouse - autumn exterior 3d - north facade
general block masterplan - residential building block rooftop plans
residential building segment typical cross section

residential building segment typical floorplan

residential building segment typical facade
residential building - **summer exterior 3d** - south facade

thank you for your attention!