PASSIVE HOUSE OBJECT DOCUMENTATION

Iga Passive House – ID 6319

Detached single family house in Iga, Mie, Japan

Client / Building Services :        Hideaki Mori                Moridaikenchisan
Architect :                      Yutaka Iizuka                i + i architects
Energy consultant :              Kota Aoyama               Ingerosec Corporation

This is a model house proposed by a construction company based in Iga, focusing on domestic building materials in order to realize an affordable and simple passive house. The owner is the president of the construction company. The building is two levels with wood-frame.

U-Value exterior wall = 0.167 W/m2K        PHPP annual heating demand = 8.56 kWh/m2a
U-Value floor        = 0.265 W/m2K          PHPP Primary energy demand = 98 kWh/m2a
U-Value roof         = 0.125 W/m2K          Pressure test n50 = 0.30/h
U-Value windows      = 1.18 W/m2K

Heat recovery efficiency = 86%
1. **Description of the construction task**

This is a model house proposed by a construction company based in Iga (known as Ninja village), focusing on domestic building materials in order to realize an affordable and simple passive house. The owner is the president of the construction company.

Iga is a basin with a climate that is hot in summer and cold in winter, and is one of the coldest areas in Mie prefecture. He, the owner and president of the construction company, thought that a passive house would be suitable for such a harsh climate and would be the standard for homes that locals want.

The building faces south and the roof is gabled. Most of the south surface is an opening, and the south side of the first floor is set back, so that the solar shading/acquisition in the summer and winter will work effectively. The light taken in from the south reaches the entire house by the central atrium. Therefore, electricity for lighting in the daytime is almost unnecessary. From the window on the west side of the second floor, residents can see the mountains of Iga and feel a sense of unity with nature.

There are two air conditioners, an underfloor air conditioner on the 1st floor and a wall-mounted air conditioner on the 2nd floor, and these two units are used according to the season. Focus200 is used for the ventilation system, and an indoor circulation type range hood is used because the kitchen is IH.

Insulation of walls and roof is composed of Urethane foam with $\lambda$-value: 0.021(W/mK) and Phenolic foam with $\lambda$-value: 0.020(W/mK), and around the foundation is composed of concrete with XPS with $\lambda$-value: 0.028(W/mK).

The windows are PVC windows (triple glazing) made by a Japanese manufacturer (YKK AP), and used solar acquisition type glazing and solar shielding type glazing properly on the south side and other sides.

And solar collector backed up by a gas boiler is used for hot water supply.
2. Exterior photos
3. Interior photos

1F Living & Dining

1F Living & Dining

Double Height
2F Free Space

2F Bridge
4. Cross section
5. Floor plans

1st floor plan

2nd floor plan
6. Thermal envelope area
7. **Construction details**

7.1 **External wall build-up against the ground**

<table>
<thead>
<tr>
<th>External wall 1</th>
<th>U= 0.167 W/m²K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plaster board (t=12.5)</td>
<td>Air cavity (t=30, timber 16.5%)</td>
</tr>
<tr>
<td>Urethane foam (λ=0.031)</td>
<td>Timber 16.5%</td>
</tr>
<tr>
<td>Structural plywood (t=12)</td>
<td>Phenolic foam (λ=0.020)</td>
</tr>
<tr>
<td>Timber (t=50)</td>
<td>Timber (3.2%)</td>
</tr>
</tbody>
</table>

**Foundation wall ambient**

<table>
<thead>
<tr>
<th>XPS (λ=0.036)</th>
<th>R=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced concrete</td>
<td>R=150</td>
</tr>
<tr>
<td>XPS (λ=0.036)</td>
<td>R=50</td>
</tr>
</tbody>
</table>

7.2 **Roof build-up / Ceiling build-up**

**Roof**

<table>
<thead>
<tr>
<th>U= 0.125 W/m²K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cypress board (t=12)</td>
</tr>
<tr>
<td>Urethane foam (λ=0.031)</td>
</tr>
<tr>
<td>Structural plywood (t=12)</td>
</tr>
</tbody>
</table>

**Floor slab**

<table>
<thead>
<tr>
<th>U= 0.265 W/m²K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced concrete (t=150)</td>
</tr>
<tr>
<td>XPS (λ=0.036)</td>
</tr>
</tbody>
</table>

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7.3 Ceiling build-up

7.4 Window installation
The windows are PVC window developed by YKK AP in Japan. The “APW430” series with triple glass is used in this building. Uf is 1.25-2.20 W/m2K. Ug and g-value are as follows.

- Solar acquisition 3+Ar16+3+Ar16+low-E3 : Ug = 0.97 W/m2K, g-value = 0.57
- Solar shielding Low-E3+Ar16+3+Ar16+low-E3 : Ug = 0.60 W/m2K, g-value = 0.31
7.5 Construction Site Photos

Thermal insulation work for basement
XPS: t=50mm x 2
(Inside and Outside)

Thermal insulation work for wall
Urethanform: t=90mm

Thermal insulation work for wall
Urethanform: t=150mm
7.6 Thermal Bridges
### 7.7 Airtightness

**Under Pressure**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Under Pressure</th>
<th>Over Pressure</th>
<th>Vapor Barrier</th>
<th>Breather Membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Air Volume</td>
<td>263.9 m³</td>
<td>263.9 m³</td>
<td>263.9 m³</td>
<td>263.9 m³</td>
</tr>
<tr>
<td>Under Pressure Test</td>
<td>0.246 / h at 50Pa</td>
<td>0.360 / h at 50Pa</td>
<td>0.30 / h at 50Pa</td>
<td></td>
</tr>
</tbody>
</table>

**Average Air Change Rate:**

\[
\frac{(0.246 + 0.360)}{2} = 0.3032 \text{ / h at 50Pa}
\]

Net Air Volume for Airtightness test:

\[ V_t = 263.9 \text{ m}^3 \]

The result of Pressurization test:

- **Under Pressure** 0.246 / h at 50Pa
- **Over Pressure** 0.360 / h at 50Pa

Average Air change rate:

\[ 0.30 / \text{h at 50Pa} \]
7.8 Ventilation

Effective heat recovery: 91%
Electrical efficiency: 0.31 Wh/m³
7.9 Heating and Cooling

1st floor plan

Air-conditioner partly installed in crawl space
(Mainly for Heating)

2nd floor plan

Wall mounted Air-conditioner
(Mainly for Cooling)
7.10 DHW (Domestic Hot Water)

Solar collector: 2.27 m²
Tank: 195 L
8. PHPP results

### Passive House Verification

- **Building:** 6th Passive House
  - **Street:** 1280 Masukishi, Iga
  - **Postcode/City:** 518-5454, Mie
  - **Province/Country:** Mie, JP-Japan
  - **Building type:** Detached timber house (single family)
  - **Climate data set:** ud-48-JP010101-Kyoto
  - **Climate zone:** 4: Warm-temperate
  - **Height of building:** 305.3 m
  - **Home owner / Client:** Hideki Mori, Morioka Kairincho
  - **Postcode/City:** 1280 Masukishi, Iga
  - **Province/Country:** Mie, JP-Japan
  - **Mechanical engineer:** Morioka Kairincho
  - **Street:** 3-21-18, Ohashi, Kanagawa
  - **Postcode/City:** 228-0007, Kanagawa
  - **Province/Country:** Kanagawa, JP-Japan

#### Specific building characteristics with reference to the insulated floor area

<table>
<thead>
<tr>
<th>Space heating</th>
<th>Furnace heating demand kWh/m²</th>
<th>Heating load kWh/m²</th>
<th>Criteria</th>
<th>Alternatives</th>
<th>Fulfilled</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>8.56</td>
<td>10.34</td>
<td>≤ 15</td>
<td>22</td>
<td>yes</td>
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<tr>
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<td>21.20</td>
<td>14.50</td>
<td>≤ 21</td>
<td>21</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>0.30</td>
<td>0.6</td>
<td>≤ 10</td>
<td>10</td>
<td>yes</td>
</tr>
</tbody>
</table>

#### Primary Energy

- **Primary Energy:**
  - **PER demand kWh/m²:** 65
  - **Generation of renewable energy (in relation to net-metered kWh/m²):** ~
  - **Specific capacity (kWh/m²):** 84
  - **Specific heating capacity (kWh/m²):** 26.9
  - **Specific cooling capacity (kWh/m²):** 26.9
  - **Mechanical cooling:** ~

9. Year of Construction and Costs

**Year:** 2017 – 2018

**Costs:** Information not available
10. Further Information

Client and Construction company:
Moridaikenchisan Corporation
https://www.mori-dai.com/event/passivehouse/

Architect:
i + i architects
https://iplusi.info/

Movie with the interview:
https://youtu.be/urKjeYTwCvl