<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PMF-System</td>
<td>3</td>
</tr>
<tr>
<td>Modular Structure</td>
<td>5</td>
</tr>
<tr>
<td>Building Configuration</td>
<td>6</td>
</tr>
<tr>
<td>Building Properties</td>
<td>7</td>
</tr>
<tr>
<td>Indoor climate</td>
<td>8</td>
</tr>
<tr>
<td>Interiors</td>
<td>9</td>
</tr>
<tr>
<td>Ecological Footprint / Life Cycle Assessment</td>
<td>10</td>
</tr>
<tr>
<td>Layout Variety</td>
<td>11</td>
</tr>
<tr>
<td>Specialty Markets</td>
<td>12</td>
</tr>
<tr>
<td>Value Chain</td>
<td>13</td>
</tr>
<tr>
<td>Cost Comparison</td>
<td>14</td>
</tr>
<tr>
<td>Contact Information</td>
<td>15</td>
</tr>
<tr>
<td>Appendix</td>
<td>16</td>
</tr>
</tbody>
</table>
Innovation for the construction industry

PMFHousing offers an innovative modular building system, which significantly reduces complexity and costs of the building shell and provides increased flexibility for the client, whilst substantially reducing construction time.

The PMF-System is based on standardized wall and roof modules with integrated insulation. These modules are combined to form a robust and highly insulating building envelope.

The PMF-System allows architects to design a wide range of buildings that vary greatly in size, shape and functionality: From individual holiday homes or single-family homes to kindergartens and schools.
Advantages compared to the classic prefabricated house

- Flexible modular construction for walls and roofs
- Wide range of possible building types and styles
- Short construction time (e.g. approx. 5 days for a single-family house shell and roof)
- Up to 30% less shell construction costs than comparable prefabricated houses
- Insulation layer firmly “foamed” into the wall
- Excellent insulation properties
- Pleasant indoor climate
- Great stability with little material input
- Very good ecological footprint
The basic structure of the wall module consists of a stable timber frame with cross braces and separate compartments. The individual compartments are lined with a three-dimensional special fabric that sets the shape for the foam filling. The thickness of the wall can be adjusted depending on the insulation required.

Each compartment is then separately filled with components mixed under high pressure, which react together to form rigid polyurethane foam. This makes the wall modules extremely strong, with excellent insulation. No further layers of insulation are needed. This construction method is applied to wall, roof and floor elements.
Building Configuration

**Roof Shapes**
- Flat, mono-pitched, or saddle roof

**Layout**
- Almost unlimited number of possible variations, based on standardized wall modules
- Construction Time: 5 Days

**Foundation**
- Cellar/basement level, concrete foundation slab, point foundation, screw foundation
- Cellar with top sided insulation
- Concrete foundation slab with top sided insulation
- PMF-Floor on point foundation
Building Properties

The PMF-House: Energy-efficient, safe and cost-effective

Insulation

Insulation integrated into the wall: The shell (roof & outer wall) thus consists of only one layer, resulting in low cost of materials and low weight.

Efficient, airtight insulation according to EnEV 2016 / GEG 2020 (Germany): no sealing membranes required; low energy consumption.

Low permeability for water vapor, therefore no vapor barriers and no back-ventilation required.

Cost-efficient design

Safety

Snow load: up to 4m; Roof also supports PV systems, greenery and heavy roofing.

Fire protection: all materials meet the standards of fire class B2 or higher; Fire class F30 & F60 can be achieved through appropriate cladding.

Storm: designed for the highest German wind class 4.

Earthquake: very high safety level due to high elasticity and effective vibration damping; another property of the rigid foam filling.

Foundation

Top-sided insulation without thermal bridges; suitable for underfloor heating; space for installations.
Building with PMF: healthy and ecological

The highly insulating PMFHousing building envelope effectively protects against heat, cold, noise and fire.

The wooden modules are made from natural material and the foamed-in insulation makes the structure airtight and almost impermeable to water vapor.

Therefore, additional layers, such as vapor barriers, tightness membranes or façade ventilation become obsolete. The insulation contains no rotting components.

Hence, PMFHousing creates a pleasant room climate - providing ideal conditions for healthy living.
Ecological Footprint

Use of Materials

The combination of insulation and reinforcement saves material – without reducing stability. A PMF house requires only around two thirds of the wood required to build conventional wooden house and a wall module weighs 80% less than a brick wall of the same size. This does not only protect forests, but also saves transport costs which also reduces CO₂ emissions.

Energy Consumption

Thanks to its excellent insulation properties, the PMF house requires little energy for heating and cooling. It meets the requirements of the low energy standard (up to KfW 55 - 40) and thus makes an important contribution to climate protection. In addition, the PMF home helps tenants and homeowners to reduce operating costs.

Recyclability

The materials used are recyclable. At the same time, the components of the modules can themselves be obtained from recycled materials, thus contributing to the circular economy.
Installations

Electricity/heating/water/gas: all cables or pipes can be easily installed directly into the floor and walls - no additional installation level is necessary.

The heating is installed at basement level or in a technical cabinet. Floor modules are suitable for underfloor heating.

The installation of heating, wiring and fittings is carried out by partner companies on-site.

Surface Paneling

The walls and floors of the PMF house are suitable for all common paneling and flooring.

Walls:
- Plasterboard
- Plaster
- Wood
- Ceramics

Floors:
- Wood
- Laminate
- Tiling
- Carpet

The thickness and material of the cladding can further improve fire and noise protection. Walls can support even heavy wall cabinets.

Kitchen & Plumbing

Manufacturer and products freely selectable; Sampling, planning and selection by a local architect’s office or specialized supplier. Installation by local craftsmen.
<table>
<thead>
<tr>
<th>Size</th>
<th>Floors</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 - 80 m²</td>
<td>1 - 2</td>
<td>Small Building e.g. Vacation Home, Garden Cottage</td>
</tr>
<tr>
<td>270 – 900 ft²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 - 300 m²</td>
<td>1</td>
<td>Single Floor Family Home</td>
</tr>
<tr>
<td>900- 3200 ft²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 - 400 m²</td>
<td>2</td>
<td>Two-Storey Residential Building</td>
</tr>
<tr>
<td>1500- 4300 ft²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 - 1200 m²</td>
<td>1 - 2</td>
<td>Large building e.g. Medical Centre, Community Centre or School</td>
</tr>
<tr>
<td>1500- 13000 ft²</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Specialty Markets

Resilience to the forces of nature
Adapted to locations with special requirements in terms of statics and safety.

Permafrost Soil

In arctic regions, larger buildings are usually built on concrete piles and these are anchored deep in the permafrost ground. Due to climate change, 30% of these buildings are now considered unstable*. PMF offers an efficient alternative: thanks to their low weight and the good insulation of the self-supporting floor, PMF houses can be placed directly on the permafrost ground and do not sink even when the ground becomes boggy.

Seismic Zones

Low weight, the framework principle and vibration damping are properties that make a building earthquake-resistant. The PMF House fulfils all three criteria. The decisive component is the foam core of the walls which efficiently absorbs the horizontal forces of an earthquake and dampens vibrations. The ease of transport and quick assembly also allow the PMF house to be used as emergency solution in earthquake areas.

Storm Zones

The risk of severe cyclones is highest in climate zones where the regional architecture relies primarily on lightweight construction: from the equator to the Southern United States, the damage to the building stock by climate-change-related extreme weather events is increasing. PMF-Housing offers a solution for this by combining lightweight construction and storm resistance. The poured-in foam core keeps the walls impervious even in case of extreme storms and provides strong protection against flying debris. Solid anchoring prevents the house from being lifted off the ground.

Flooding

As a result of climate change, building damage caused by flooding is increasing worldwide. However, the severity of the damage strongly depends on the type of construction.

Here, the PMF design has a decisive advantage: Unlike other insulation materials, the water does not soak through the polyurethane-core. During clean-up after flooding therefore, only the wall cladding needs to be removed; the walls themselves remain impermeable and stable. Oftentimes, inhabitants can continue living in the house during repair.

* Source: https://www.bpb.de/internationales/europa/russland/analysen/317723/analyse-urbane-infrastruktur-und-permafrost
Cooperation with Local Partners

In order to keep construction logistics simple and transport routes short, PMFHousing aims to cooperate with timber construction companies in the individual target markets. They will produce the modules under license based on the approved components supplied by PMFHousing, construct the building shell or supply the contracted construction companies on-site.

Value Chain

PMFHousing
- Module design
- Licensing
- 3-D-Fabric
- Polyurethane components
- Optional:
  - Module manufacturing
  - Delivery to Construction site

Timber Construction Company
- Consulting by PMFHousing
- Optional:
  - Local module manufacturing
  - Delivery to construction site

Construction Site
Construction of the house by timber construction company or local contractor.
Interior work

Architect / Local Contractors
- Planning
- Ordering
- Building Supervision
- Contractor management
- Exterior and interior design
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>Brick Wall</th>
<th>Prefabricated House</th>
<th>PMFHousing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Time</strong></td>
<td>several Weeks</td>
<td>1 Week</td>
<td>1 Week</td>
</tr>
<tr>
<td><strong>Cost/m² (indexed)</strong></td>
<td>100</td>
<td>80</td>
<td>65</td>
</tr>
<tr>
<td><strong>Insulation</strong></td>
<td>Separate exterior Insulation required</td>
<td>Insulation filled into wall cavities</td>
<td>Integrated Insulation</td>
</tr>
<tr>
<td><strong>Layers</strong></td>
<td>approx. 6 layers including facade and interior work</td>
<td>Up to 10 layers for insulation, vapour and wind barriers and installation layer</td>
<td>5 layers, including exterior cladding and interior work</td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>Truck, crane, concrete mixer</td>
<td>Truck, large crane</td>
<td>Truck, small crane</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>approx. 450kg/m²</td>
<td>approx. 45kg/m²</td>
<td>approx. 35kg/m²</td>
</tr>
<tr>
<td><strong>Ecological footprint</strong> (indexed)**</td>
<td>100</td>
<td>80-90</td>
<td>60-70</td>
</tr>
</tbody>
</table>

* including insulation, without exterior cladding; brick wall with Index 100; based on raw material prices March 2021

** non-renewable primary energy consumption

Source: ÖKOBAUDAT-data, brick wall with Index 100
Andreas Mohr  
Managing Director  
PMFHousing GmbH  
Am Flugfeld 7  
40489 Düsseldorf  
Germany  
E-mail: andreas.mohr@pmfhousing.eu  
Mobile: +49 152 014 665 88
Appendix

Technical Details
### Industrial Norms (extract)

<table>
<thead>
<tr>
<th>Norm</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dibt – I 71-1.10.9-832/1</td>
<td>Approval by the „Deutsches Institut für Bautechnik“ in Berlin</td>
</tr>
<tr>
<td>Bauordnung NRW *</td>
<td>Regional Building Requirements North Rhine Westphalia</td>
</tr>
<tr>
<td>Eurocode / DIN EN 19990</td>
<td>Basics of Structural Design</td>
</tr>
<tr>
<td>Eurocode 1 / DIN EN 1991-1-1</td>
<td>Impact on Structures Part 1-1</td>
</tr>
<tr>
<td>Eurocode 1 / DIN EN 1991-1-4</td>
<td>Impact on Structures</td>
</tr>
<tr>
<td>Eurocode 5 / DIN EN 1995-1-1</td>
<td>Dimensioning &amp; design of timber structures I</td>
</tr>
<tr>
<td>Eurocode 5 / DIN EN 1995-1-2</td>
<td>Dimensioning &amp; design of timber structures II</td>
</tr>
<tr>
<td>DIN EN 14592</td>
<td>Timber structures: Fasteners</td>
</tr>
<tr>
<td>DIN 4102</td>
<td>Fire protection</td>
</tr>
<tr>
<td>DIN 4108</td>
<td>Thermal insulation</td>
</tr>
<tr>
<td>DIN 4109</td>
<td>Soundproofing</td>
</tr>
<tr>
<td>DIN 4149</td>
<td>Earthquake protection</td>
</tr>
<tr>
<td>DIN 68800</td>
<td>Wood protection</td>
</tr>
<tr>
<td>DIN 18040</td>
<td>Planning principles for accessibility</td>
</tr>
<tr>
<td>DIN 18065</td>
<td>Stairs in buildings</td>
</tr>
</tbody>
</table>

* Depending on the location of the building, other regional requirements may apply