- Low cost / High quality housing
- Insulated structure
- Fast and easy installation
PROTEA® is a modular construction system. Standardised components are entirely pre-fabricated in factories, packed in protective containers and delivered on-site, ready to be assembled in 4 days by 4 local people. The PROTEA® building system ensures long term living conditions with respect to safety, insulation, health and comfort.

Newcastle, South Africa
Colours: Sand 4102 for walls, Bordeaux 4802 for roof

Mounting walls

Newcastle, South Africa
Colours: Opale 4936 for walls, Bordeaux 4802 for roof

Internal finishing with plasterboard
Contrisson, France
Colours: Opale 4936

Contrisson, France
Colours: Stone 4703 for walls,
Abyss 4505 for roof

Mounting on a dry steel deck

Mounting walls

Photovoltaic panels

Internal finishing with plasterboard

Dubai, United Arab Emirates
Colours: Opale 4936 for walls,
Bordeau 4802 for roof

Dubai

PROTEA 40m² - 5 projects

These five different projects illustrate
the numerous implementation possibilities and options of PROTEA in terms of:
- Colours
- Floors (concrete slab or steel deck)
- Integration of solar panels
- Doors and windows
- Interior finishing and equipment
Four workers can complete the construction, including doors and windows, in just 4 days.

- Assembly is kept simple by using screw connections only.
- An installation guide is provided, making the installation fast and easy.
- The components, prefabricated in factories, are packed conveniently in protective containers and delivered on site ready to be assembled.
- Three 40m² PROTEA kits can be stored in one 40’ container.

PROTEA Kit delivered to prepared foundation (concrete slab or dry steel deck) and elements are unpacked for assembly.

U-profile elements, which will join the foundation with the wall panels, are fixed on the foundation. First two panels are assembled in the corner.

Mounting of pre-fabricated wall and partition elements is sequenced to build rigid subsets and so ensure stability during construction, especially in case of strong winds.

Wall construction is finalised by the connection of the two last panels at the opposite corner.

U-profile elements to join walls and roof panels are fixed to the top of all the wall panels.

Assembly of the roofing panels including finishing (mono and duo-pitch ridge, edge,...)
Each PROTEA kit comes with complete assembly instructions. Two documents detail all the different steps in the construction process.

1 - Construction manual
In this first document, the following points are covered:

Necessary tools:
Description of the needed equipment.

Nomenclature:
Extensive nomenclature of the kit contents.

Site preparation:
How to prepare the construction site prior to beginning?

Recommendations, preliminary operations:
For example about checking panels verticality.

Layout of the elements
Installation plans giving laying order and position for each element:

Connection details:
How specific connections are treated?

Openings:
How to install and fasten doors and windows?

2 - Fastenings plans
This second document contains a complete range of drawings showing the number and precise position of all the different fastenings.

Safety recommendations
Take extra care of safety on the working site. All workers must wear all necessary safety equipment, which is gloves, safety shoes, helmet, safety glasses.
PROTEA Designs

12 m² shelter

Outside perspective

Top view

Floor plan

20m² cottage

Outside perspective

Top view

Floor plan
PROTEA | Designs

30m² family house

Outside perspective
Top view
Floor plan

Outside perspective

40m² family house

Outside perspective
Top view
Floor plan
PROTEA | Designs

55m² residence

Outside perspective

Top view

Floor plan

71m² residence

Outside perspective

Top view

Floor plan
Internal finishing

Inside the house, PROTEA panels can be covered with a plasterboard to perform:
- Aesthetic finishing
- Fire resistance

Plasterboard are not included in the PROTEA kit, and must be purchased locally.

Plasterboard can be screwed directly onto the steel sheet panels and folded parts. The type and thickness of the plasterboard must be determined according to local regulations.
**Roof panels:**
- Insulated, structural panels
- PUR foam thickness: 40mm (standard)
- Steel sheet thickness:
  - interior: 0.50mm (standard)
  - exterior: 0.63mm (standard)

**Wall panels:**
- Insulated, structural panels
- PUR foam thickness: 60mm (standard)
- Steel sheet thickness:
  - interior: 0.50mm (standard)
  - exterior: 0.63mm (standard)

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**Included in the kit**
- Walls, partitions and roof in sandwich panels with all accessories
- Technical guide for all elements and installation guide
- Technical drawings and Performance Guarantee
- Screws & rivets compatible in shape and colors with wall and roof panels

**Options**
- Dry steel deck
- Doors and windows
- Solar panel system
- Plumbing and electricity
- Supervision training and technical assistance during construction, to be discussed case by case.

**Not included**
- Concrete slab
- Plasterboard
- Floor finishing
- External finishing

These elements should be subcontracted to local companies.

**Steel characteristics**
- Steel grade: S350GD
- Hot dip galvanised Z275
- 25μm prepainted steel coating (standard)
- A dedicated coating will be selected in regions with aggressive climatic conditions (sea shore...)

**Adaptability**
Any specific design can be investigated on a case by case basis by the ArcelorMittal Construction Design & Engineering team.
**Colours**

Type of coating: thermosetting polyester resin.
- Good corrosion resistance
- Good colour and appearance stability
- Good external sustainability
- Good metal forming suitability

<table>
<thead>
<tr>
<th>Walls</th>
<th>Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand 4102</td>
<td>Bordeaux 4802</td>
</tr>
<tr>
<td>Ral 1002</td>
<td>Ral 8012</td>
</tr>
<tr>
<td>Stone 4703</td>
<td>Abyss 4505</td>
</tr>
<tr>
<td>Ral 7032</td>
<td>Ral 5008</td>
</tr>
<tr>
<td>Opale 4936</td>
<td></td>
</tr>
<tr>
<td>Ral 9010</td>
<td></td>
</tr>
</tbody>
</table>

*Other colours can be investigated case by case by ArcelorMittal*

**Doors and windows (option)**

A kit comprising doors and windows can be provided. Exterior doors are insulated, and windows feature double glazing. All doors and windows are made of PVC, except for the exterior doors frames, which are made of aluminium.

For protection, all windows can be equipped with anti-intrusion bars.

**Steel deck (option)**

A steel deck can be provided for each type of house (12, 20, 30, 40, 55, 71 and 100m²). It is delivered ready to be assembled, with all fastenings and connection parts, including connections between the structure and the concrete pads.

Depending on the house type, the number of concrete pads will vary.

This solution allows a good evenness of the floor, even on an uneven soil, and is a must in terms of protection in case of torrential rains.
A system of rails able to support various types of photovoltaic modules can be provided. Concerning the photovoltaic panels, a study can be done to match your specific needs.

Extension kit (option)

A 15m² extension kit is available, for the following house types: 20m², 30m² and 40m².

A gutter system allowing the harvesting of rainwater can be provided. The system includes gutters, gutter stops, down pipe connections and down pipes, elbows, junctions and brackets.

Rainwater system (option)

A gutter system allowing the harvesting of rainwater can be provided. The system includes gutters, gutter stops, down pipe connections and down pipes, elbows, junctions and brackets.

Photovoltaic panels (option)

A system of rails able to support various types of photovoltaic modules can be provided.

Detail of the mechanical testing of the rail

Roof example with 7 rails and 6 solar modules:

Concerning the photovoltaic panels, a study can be done to match your specific needs.
Technical agreement:
ArcelorMittal complies with local construction regulations in countries where PROTEA is erected.

Fire performance:
The CSIR* in South Africa performed a fire resistance test on the 60mm wall panel, with a 15mm Firestop plasterboard on the exposed side. The complex achieved a Fire Resistance Rating (FRR) of 30 minutes.

*Council for Scientific and Industrial Research

Fire test in South Africa

Structural performance:
The PROTEA structural performance has been assessed. The house structure is essentially ensured by self bearing panels.

Wind forces:
The calculation shows that the PROTEA house is able to resist to winds up to 36m/s (130km/h) with peaks up to 50m/s (180km/h).

Simulation of wind action (confirmed the calculation model)

Seismic forces:
Moreover, steel is known to behave well in an earthquake. Global failures and huge numbers of casualties are mostly associated with structures made from other materials.

This is mainly due to three major qualities of steel:
- Light weight:
  Steel structures are generally lighter than those using other materials. Some steel structures are sufficiently light so that seismic design is not critical.
- Flexibility:
  Steel structures are generally more flexible than other types of structure. Constraints in the structure and its foundations are therefore lower.
- Ductility:
  Unlike other materials, steel's failure mode is ductile; this means that when submitted to strong forces, steel doesn't break but dissipates energy by plastic deformation.

Thermal performance calculation:
The PROTEA thermal performance has been assessed by thermal calculation.

As a result, this calculation shows that the PROTEA house provides better summer comfort compared to a traditional brick and mortar house (up to 5 °C cooler).

Thermal performance measurement:
A thermography measurement was performed on a prototype, showing good thermal insulation and air tightness.
The advantages of steel are numerous and make it an ideal building material.

**Steel, a material coming from nature:**
Iron ore, its raw material, is one of earth’s most abundant elements.

**Steel is clean; its manufacturing process as well:**
Steelworks have cut steel manufacturing’s energy consumption and CO₂ emissions by half compared with 1960 levels.

**Steel reduces building site noise pollution and makes for clean and safe construction:**
Prefabricated materials are delivered, minimising waste and on-site storage and making building sites safe, dry and dust-free.

**Steel is sustainable, durable and solid:**
Today, steel can be effectively protected against corrosion, particularly through the galvanisation process.

**Steel is recyclable and recycled**
Steel is indefinitely and 100% recyclable. More than 40% of the world steel production comes from recycled steel.

**Steel is earthquake-resistant:**
Steel increases building longevity in earthquake-prone areas and preserves human life through its resistance.

**Cooperation between «Habitat for Humanity» Haïti and ArcelorMittal Construction Dominicana (steel roof sheets)**

**Sandwich panels recycling process:**
Different studies show that technical solutions to recover steel in buildings and to transform it in high quality scrap exist.

The goal is to separate steel from polyurethane foam in such a way that each component will be pure enough to be easily recycled in its own process. Two different tools exist: a shredder commonly used to process end of life vehicles or household appliances, and a rotary shear commonly used to shred steel packaging.

However, reusing the sandwich panels at the end of the house life could be a much simpler and cheaper solution of recycling.

For more information:
http://www.arcelormittal.com
PROTEA | Benefits

Low cost
Cheaper than traditional materials with higher performances

Industrial power
Industrialised system available in very large quantities

Training for local contractors
Supervision training and technical assistance during construction

Environmentally friendly
- Steel is indefinitely and 100% recyclable
- Steel is sustainable, durable and solid

Thermal insulation
\[ U_{\text{wall}} = 0.29 \text{ to } 0.47 \text{ W/m}^2 \text{K (100-60 mm)}, \]
\[ U_{\text{roof}} = 0.28 \text{ to } 0.58 \text{ W/m}^2 \text{K (100-40 mm)} \]

Fast installation
- 4 days
- 4 workers

Easy installation kit
Easy to assemble, construction guide provided

Dry and clean construction site
No water nor concrete needed

National certificates
ArcelorMittal Construction respects the national construction regulations

Sound insulation
Walls (60mm): \( R_w \text{ (C; Ctr): 25(-1;-3) dB} \)
Roof (40mm): \( R_w \text{ (C; Ctr): 25(-1;-3) dB} \)

Environmentally friendly
- Steel is indefinitely and 100% recyclable
- Steel is sustainable, durable and solid

Training for local contractors
Supervision training and technical assistance during construction

Environmentally friendly
- Steel is indefinitely and 100% recyclable
- Steel is sustainable, durable and solid

Corrosion resistance
Validated by salt spray test and humidity resistance

UV resistance
- \( \Delta \varepsilon \leq 3 \)
- Gloss retention \( \geq 60\% \)

Wind load
Up to 50 m/s (180km/h)

Seismic resistance
Up to 10m/s²

Reaction to fire
SBI test with 10mm plasterboard: B s1 d0 (EU norms)
PROTEA | Fast and easy installation

- Low cost, high quality housing
- Dry and clean construction site
- Watertight structure completed in just 4 days

Day 1
- Products reception and site preparation
- Chalk line tracing
- Preparing and installing the floor rails on the slab

Day 2
- Installing the walls and partitions

Day 3 & 4
- Installing the top rails
- Installing the roof
- Installing wall to roof junctions and finishing

Excellent technical performance of:
- Thermal insulation
- Resistance to fire (with plasterboard)

Resistance to:
- Earthquakes
- Strong winds
- UV rays

Steel characteristics:
- High Strength Steel: S350GD
- Hot Dip Galvanised
- Pre-painted Organic Coating

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