

Breaking New Ground

The **"ROBUST"** Way

**ROBUST
STRUCTURE™**

ROBUST BUILDING SYSTEM

2015

THE ROBUST BUILDING SYSTEM

The Robust Wall Structure consists of:

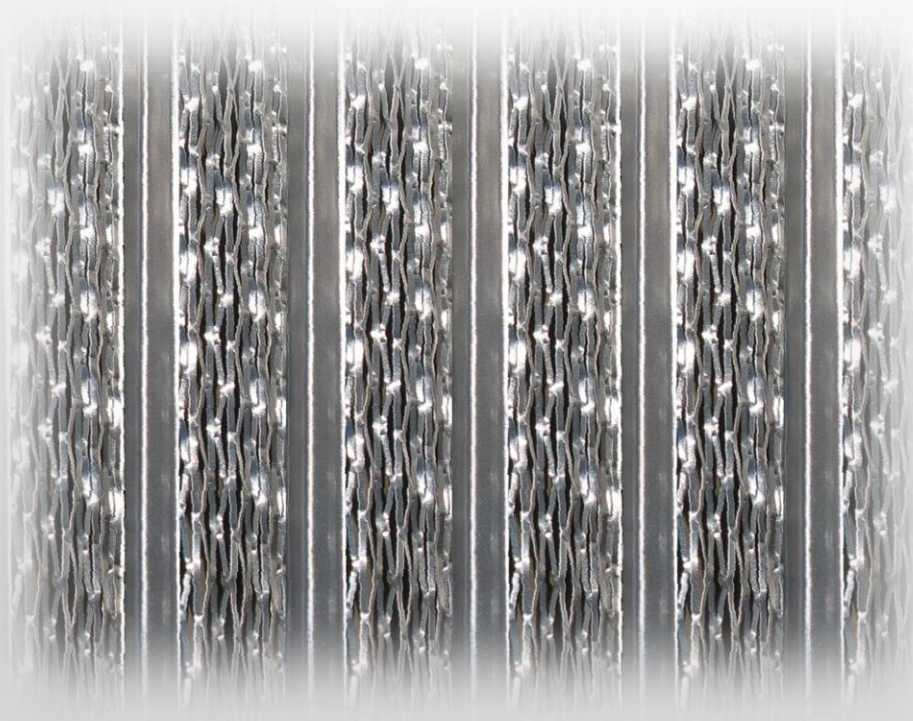
- Factory-produced W profiled expanded metal Core panels
- Top and Bottom C-Tracks
- Horizontally spaced steel reinforcing Y-Bars
- Pre-welded steel mesh
- Mortar
- Plaster

Mortar is applied to the panels mechanically as a wet application by implementing the specially designed Robust Mortar Pump

ROBUST WALL STRUCTURE

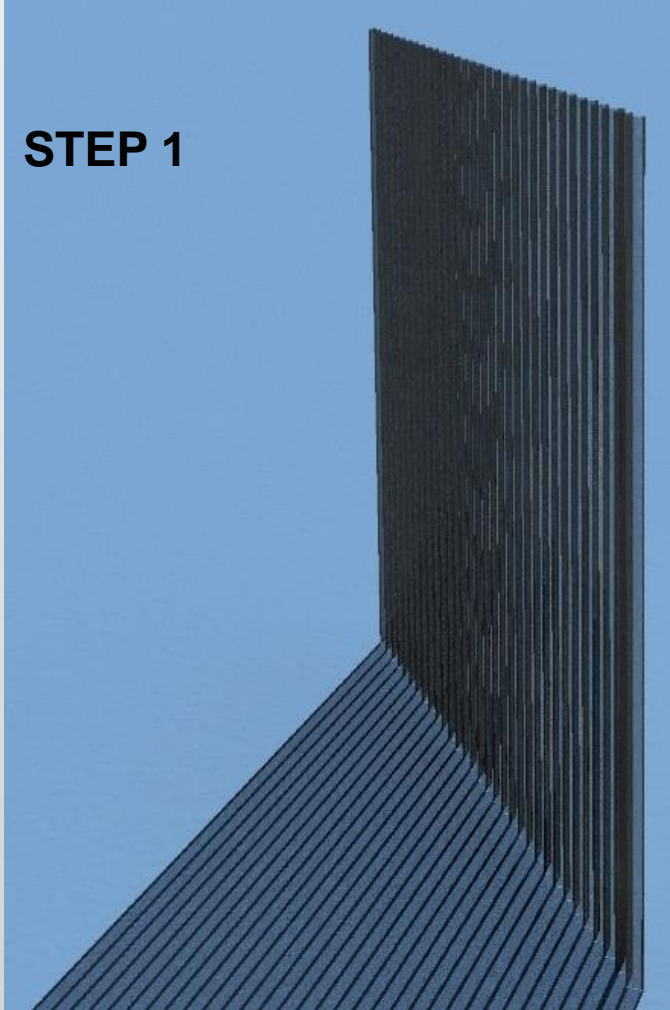
Patented Factory-produced W-profiled Core panels

- Manufactured from Mild Steel Coils
- Panels are manufactured 430mm wide
- Lengths are determined by the heights of walls



ROBUST WALL STRUCTURE

STEP 1

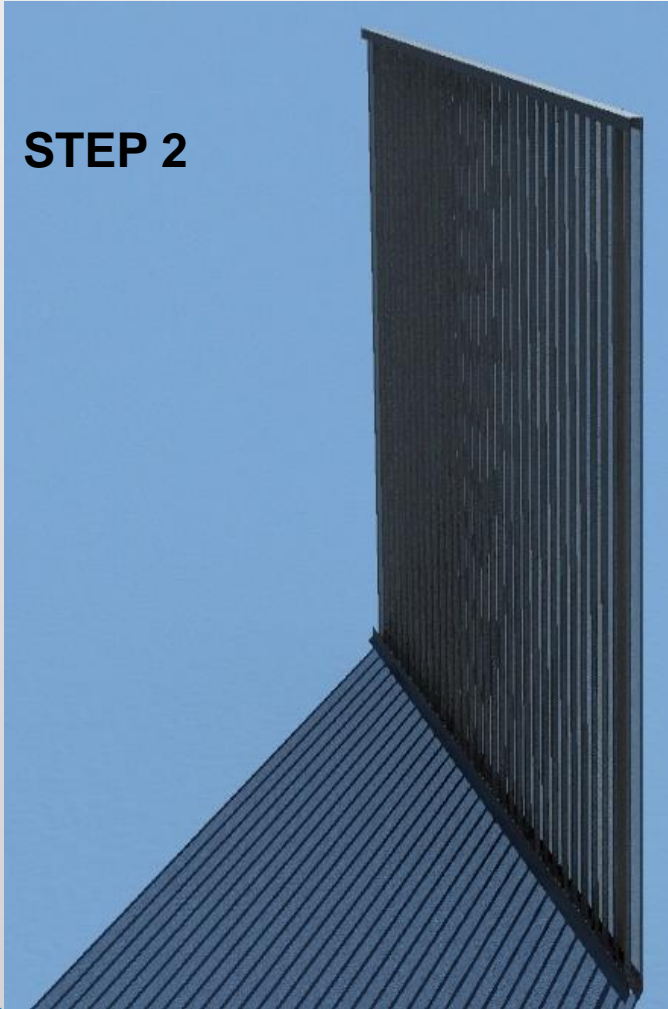


Assembly of Core panels to form a wall Core panel

- 430mm wide Robust Structure™ *core panels are fixed together with the ribs running vertically.*
- *The ribs should be overlapped by at least 20mm.*
- *The core panels are joined together using 13-16mm self tapping screws or 1,6mm non-galvanized binding wire ties at intervals not more than 300mm.*
- *This process is repeated until the required wall width is achieved.*

ROBUST WALL STRUCTURE

STEP 2



Placing Bottom & Top "C" Tracking

- 32x55x32mm cold formed galvanized C-tracking is fixed with 1,6mm *non-galvanized binding wire ties* to bottom and top ends over Robust Structure™ wall panels to straighten the wall panel.
- C-Tracking should overlap at least 200mm where joined together. These "C" Channels are only used where straight and level surfaces are required.

ROBUST WALL STRUCTURE

STEP 3



Reinforcing the Wall structure

- Y-6mm high tensile reinforcing bars are fixed to the Robust Structure™ wall panels with 1,6mm *non-galvanized binding wire ties* horizontally over both surfaces of the Robust Structure™ wall panels at intervals not more than 550mm.
- At this stage the Robust Structure™ wall panels are ready for placement on designated floor slab area.

ROBUST WALL STRUCTURE

STEP 4

Stabilising the Structure

Robust Structure™ wall panels not supported by adjacent structures need to be kept in place and stabilized with Robust Structure™ supporting jigs and roof trusses.

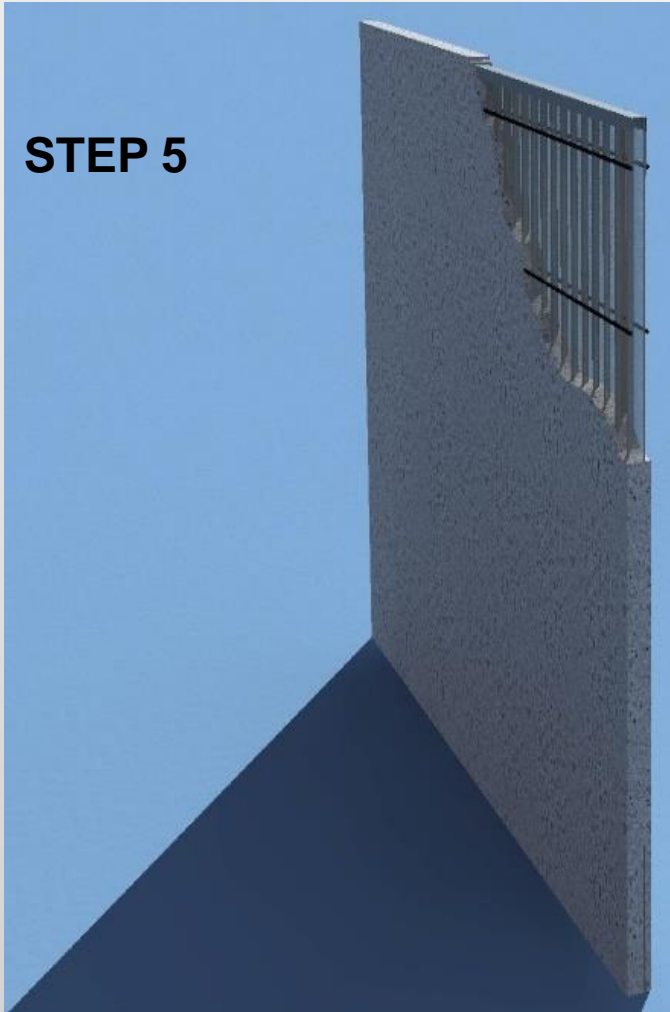
Where C-tracking is used, wall panels are fixed into bottom surface, mechanically nailed with at least 25mm nails through the C-Tracking into the surface bed at maximum intervals of 400mm.

Applications without C-Tracking requires reinforced starter bars.

Welded mesh is placed around all openings and cut-outs on both faces of wall panels to prevent diagonal cracking of mortar.

ROBUST WALL STRUCTURE

STEP 5



Applying Mortar Mechanically

- The minimum mortar strength requirement for a Robust Structure™ wall is 10 Mpa but we recommend a mix design of approximately 15Mpa.
- Mortar mix will consist of:
 - All-purpose Portland cement.
 - River sand or 6mm crusher stone
- Plaster sand. (See downloads for Mix design)

ROBUST WALL STRUCTURE



Plastering of Walls

- The sand ratio will depend on the finish required:

Should walls require a scratch finish, the required sand ratio will be 60% coarse sand and 40% plaster sand.

If the walls are to be plastered smooth as a second application, the mortar will be applied as a first application and the ratio will be 70% coarse sand and 30% plaster sand.

- Second application will be a standard plaster application as required by "NBR".



10 KEY BENEFITS

1. **STRONGER**
2. **MONOLITHIC**
3. **FASTER**
4. **EASIER**
5. **VERSATILE**
6. **AFFORDABLE**
7. **ACCREDITED**
8. **ADDED LIVING SPACE**
9. **STRUCTURAL**
10. **PERMANENT SHUTTERING**

BENEFITS OF ROBUST

The strength of a Robust wall is far superior than conventional walling systems:

1
STRONGER

- It is equivalent to a steel reinforced walling structure.
- The mortar mix design can be adjusted to suit the structural Mpa strength as required by the engineer.
- Far more resistant against structural cracks caused by ground movements as well as forces of nature such as earthquakes, tornados and hurricanes.
- Has a high load bearing strength of 30 tons/lm on a standard 115mm external wall with a 25Mpa mix application therefor eliminating the need of columns in a double storey structure.
- The lateral strength of the Robust wall is by far stronger than that of a single segment walling structure.

BENEFITS OF ROBUST

The Robust walls fit together as a single diaphragm structure without any joints and seams that can cause structural interference.



This adds to:

- A wall that is more difficult to break through.
- A structure that has an unlikelihood to ever have any structural cracks.
- Elimination of structural beams and lintels above all openings.
- A Structural ring beam forming part of wall, lending added lateral strength to walls and allowing greater unsupported suspended floor slab spans.

BENEFITS OF ROBUST

The Robust technology lends itself to be a much faster walling construction method in comparison to that of conventional systems.



- The Robust core panels are light weight and are easily manoeuvrable around the construction site, helping to speed up the construction process.
- Greater throughput with the same amount of labour with 95% of the work force being unskilled.
- The mortar is mechanically applied eliminating the timeous orthodox application by hand.
- No beam filling required eliminating yet another conventional system time delay function.
- No time spent on chasing of services as these services are applied before the mortar application.

BENEFITS OF ROBUST

The Robust Core wall panels weigh 3,5kg/m² and provides for a lighter structure with the following benefits:



- Ease of assembly and erection of panels.
- Highly compacted making transport more cost effective (8,400m² of wall core panels fits on a super link truck, equivalent to 73 BNG houses)
- Youth and women can be employed to work with this light weight structure as it does not put any physical strains on the labour force.
- Easier to transfer skills to unskilled & unschooled communities within a few days.

BENEFITS OF ROBUST

As with other innovative and/or alternative systems, Robust is not limited or restrained to a specific moulding, module or dimension.

5

VERSATILE

- It can be built using any conventional plan requirements and designs.
- Is utilized into any form and shape for example: Curved walls, arched openings and any shape of columns.
- Is not limited to only build houses, but can be implemented to building any walling structure both above and below ground.
- Can be extended and altered to existing conventional brick or block buildings.
- Used as permanent shuttering for applications such as columns, retaining walls and reservoirs eliminating expensive hiring costs.

BENEFITS OF ROBUST

Compared to other innovative and conventional systems, Robust is a far more durable product whilst being affordable:

6

AFFORDABLE

- Robust building costs are comparable to conventional building systems.
- Due to the speed in the delivery of units, property developers, government and the community are all winners.
- Due to its speed of construction there is a reduction in finance costs and overheads.
- Far less rubble to be removed.

BENEFITS OF ROBUST

**The ROBUST system has a proven track record.
The system has been accredited and approved by:**



- Agrément South Africa
- SABS (South African Bureau of Standards)
- NHBRC (National Home Builders Registration Council)
- Miami Dade County, USA



BENEFITS OF ROBUST

The Agrément Certificate



Agrément South Africa is an internationally recognized, independent centre for the assessment certification of innovative, and non-standardised construction systems. As a founding member of the World Federation of Technical Assessment Organisations (WFTAO), Agrément certification is one of the highest standards for non-standardised construction products and is recognised in more than 21 countries around the world. Countries such as: Australia, Brazil, Canada, Czech Republic, Denmark, Finland, France, Hungary, Israel, Italy, Japan, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, South Africa, Spain, United Kingdom and the United States.

Furthermore, Agrément certification incorporates the requirements of:

- The South African Department of Public Works
- Council for Scientific and Industrial Research (CSIR)
- International Council for Building Research, Studies and Documentation
- South African Bureau of Standards (SABS)
- World Federation of Technical Assessment Organisations (WFTAO)
- South African Department of Housing (Human Settlements)
- South African National Home Builder's Registration Council (NHBC)
- Council for the Built Environment (CBE)

BENEFITS OF ROBUST

Due to the thickness of the Robust walls additional internal living space is created.



8

ADDED SPACE

- Robust external walls are 115mm thick (inland) and 130mm if built within 15km of the coast. Internal walls are 90mm thick.
- This compares very favourably with plastered brick walls of 260mm externally and 150mm internally.
- In a 40m² BNG Type dwelling, an additional internal area of 4-5m² is added to the home. This is equivalent to that of an 45m² dwelling built the conventional way.

PERFORMANCE

ASPECTS OF PERFORMANCE

Durability: More durable

Acoustic performance:

46db-49db airborne sound

Fire performance:

Classified Type FR (non-combustible) Fire resistance 60 minutes.

Thermal performance:

Similar to brick.

Energy Usage: Similar to brick

Water penetration:

Better than brick

Condensation: Similar to brick

The Robust building system meets and even surpasses all aspects of performance requirements of the South African National Building Regulations.

By adding an additional 15mm Perlite plaster to the outside face of external walls it will increase all aspects of performance.

GLOBAL MARKET PRESENCE

Zimbabwe

Zambia

Namibia

Malawi

Botswana

Mozambique

South Africa

Honduras

U.S.A.

Angola

STEPS ON HOW IT WORKS

1



Preparation of Raft Foundation

2



Casting of Raft Foundation

3



Demarcation on Slab

4



Assembling Wall Panels

5



Erection of wall panels

6



Fitment of door and window frames

STEPS ON HOW IT WORKS

7



Fitment of in-wall plumbing services

8



Fitment of in-wall electrical services

9



Ref 156 mesh to corners of openings

10



Applying mortar to walls mechanically

11



Plaster finish to mortared walls

APPLICATIONS

Typical Building Applications

Social Housing

Exclusive Housing

Schools

Lodges & Resorts

Multi-Storey Apartments

Office Blocks

Warehouses & Factories

Shopping Centers

Clinics/Hospitals

Community Centers

Correctional facilities (*Prisons*)

Infill walls (*High Rise Buildings*)

Engineered Applications

Structural Load Bearing Walls

Structural Load Bearing Columns

Water Reservoirs

Small Farm Water Reservoirs/dams

Sewage Septic Pits/Tanks

Sewage Treatment Plants

Boundary Walls

Retaining Walls

Silos

Mining applications

Staircases

Swimming pools

Suspended Roof Slabs

STRUCTURAL IMPLEMENTATIONS

Robust can be applied structurally by merely adjusting the wall thickness and steel and mortar requirements.

- Depending on the load or lateral strength requirements, Robust walls can be adjusted to suit the requirements according to engineers specifications.
- Engineers calculations to determine strength specifications will be as per the conventional code of practice.
- Adjustments to the standard Robust wall structure will normally involve the amount of steel required per m² of wall area and the Mpa rating of the mortar applied. Wall thickness will be adjusted in some cases.

STRUCTURAL IMPLEMENTATIONS

Most common structural implementations utilizing the Robust walling system are:

- Load bearing walls.
- Retaining Walls.
- Water Retention/Reservoir walls.
- Structural Columns.

STRUCTURAL IMPLEMENTATIONS

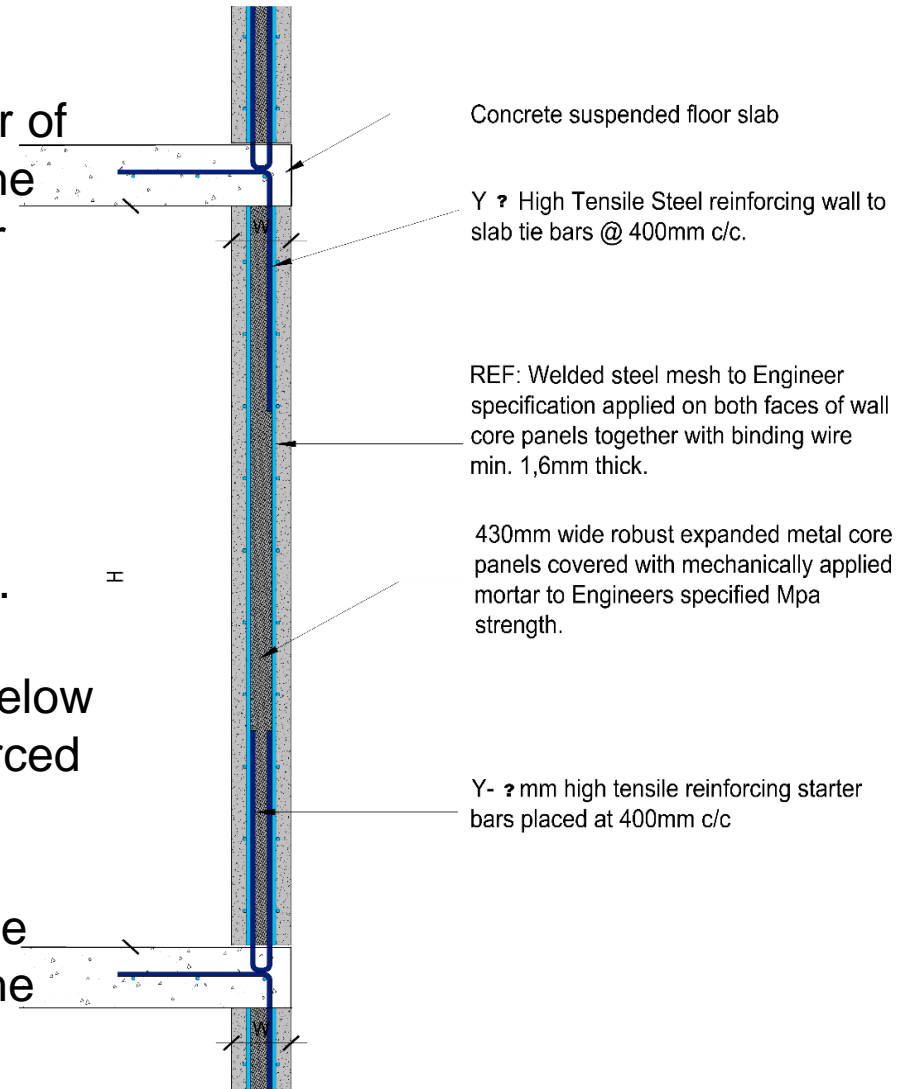
Load Bearing Walls:

Depending on the type of building and the number of floors, Robust load-bearing walls are gauged to the appropriate thickness, amount of steel and mortar strength to carry the weight above them. In most cases all conventional column requirements are eliminated utilizing Robust load-bearing walls.

Load bearing walls are calculated by engineers following the Engineers standard code of practice.

Robust load-bearing walls need to be anchored below with reinforced starter bars and above with reinforced tie bars.

Horizontal and vertical reinforcement is used in the form of Welded Mesh to a Ref. mesh that will fit the weight requirement specified by an engineer.



STRUCTURAL IMPLEMENTATIONS

Soil Retaining Walls:

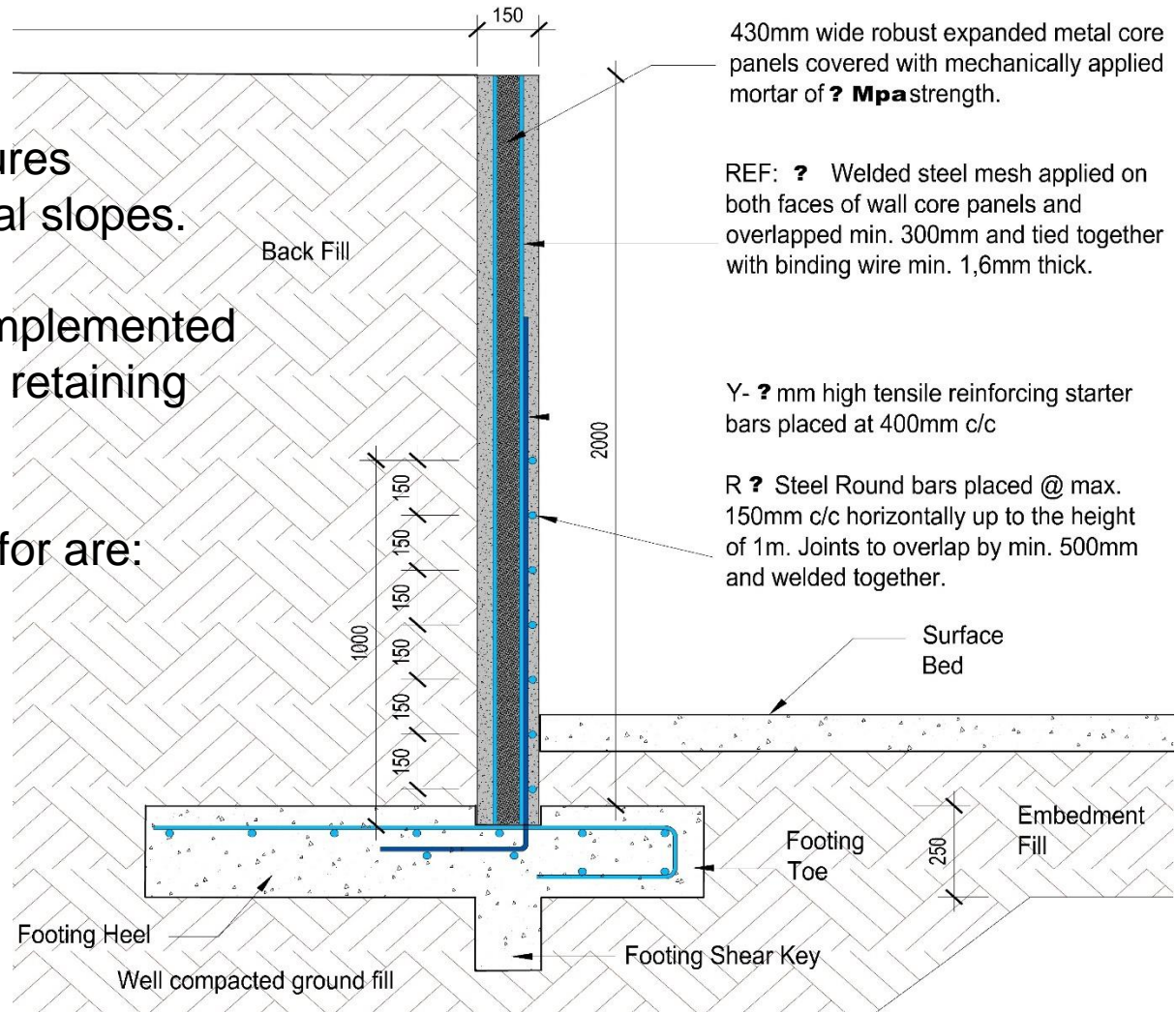
Robust retaining walls are structures designed to restrain soil to unnatural slopes.

The Robust wall structure can be implemented as cantilever, gravity and anchored retaining walls.

Typical applications it can be used for are:

- Basement walls.
- Soil retaining boundary walls.
- Mine shafts.

Engineer calculations will determine wall thickness, steel requirement and mortar mpa strength needed.



STRUCTURAL IMPLEMENTATIONS

Water Retaining Walls:

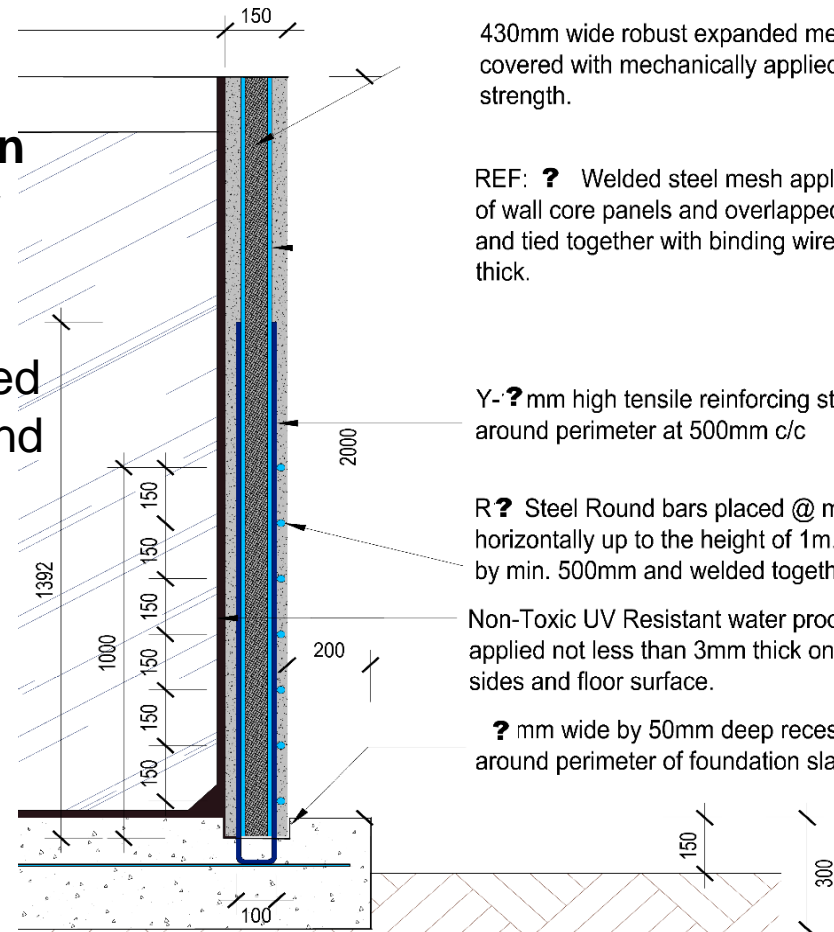
Similar to soil retaining walls, **water retention walls** are structures designed to retain water within a confined space.

The Robust wall structure can be implemented as water retaining walls both aboveground and underground.

Typical applications it can be used for are:

- Farm type reservoirs.
- Sewage treatment plants.
- Septic tanks.
- Channelling of water such as storm water.

Engineer calculations will determine wall thickness, steel requirement and mortar mpa strength needed.



430mm wide robust expanded metal core panels covered with mechanically applied mortar of ?mpa strength.

REF: ? Welded steel mesh applied on both faces of wall core panels and overlapped min. 300mm and tied together with binding wire min. 1,6mm thick.

Y-? mm high tensile reinforcing starter bars placed around perimeter at 500mm c/c

R? Steel Round bars placed @ max. 150mm c/c horizontally up to the height of 1m. Joints to overlap by min. 500mm and welded together.

Non-Toxic UV Resistant water proofing membrane applied not less than 3mm thick on internal wall sides and floor surface.

? mm wide by 50mm deep recess provided for around perimeter of foundation slab

? mm thick x ? Mpa concrete surface bed with REF: ? welded mesh reinforcing laid on top of a well compacted ground filling in layers of 150mm

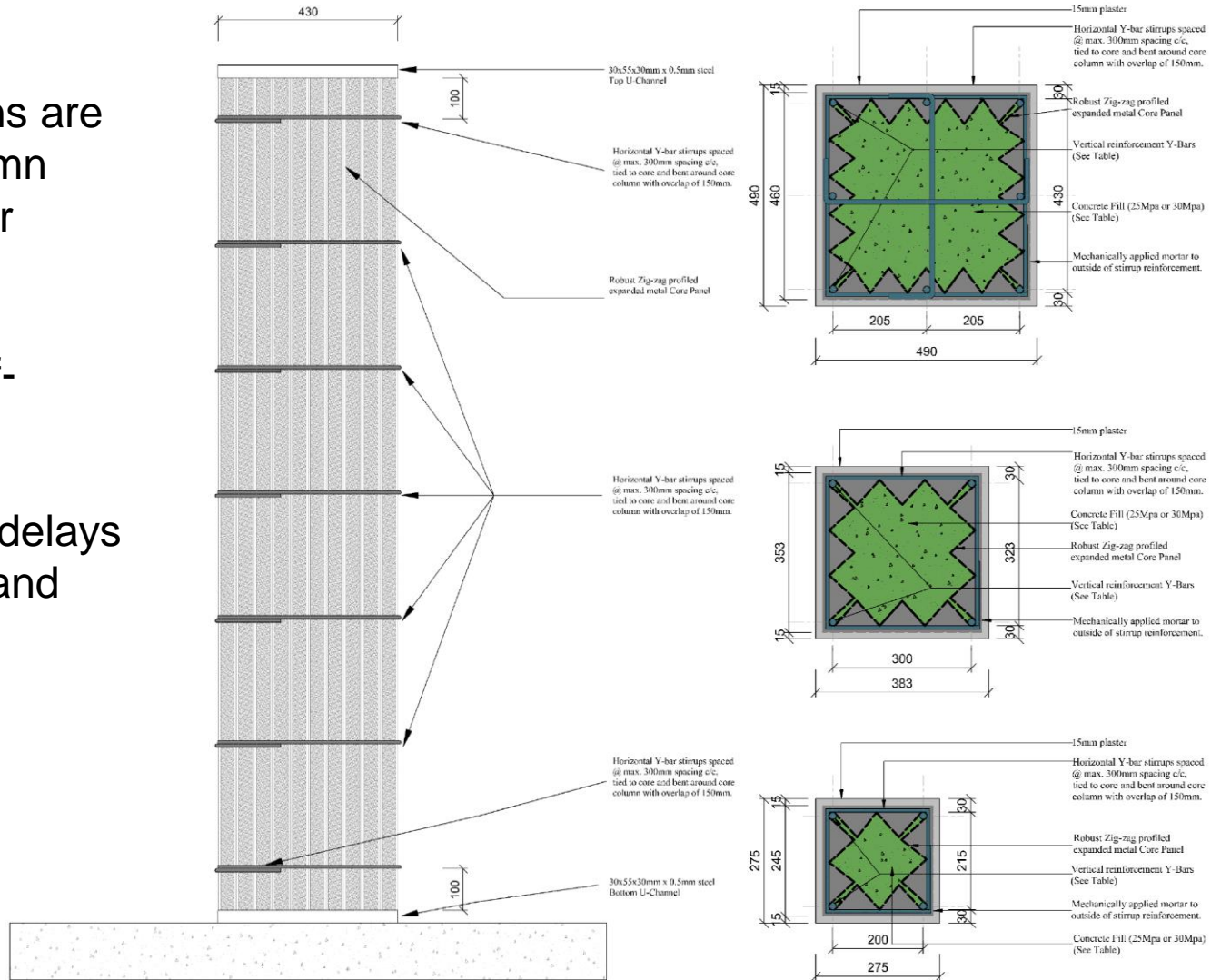
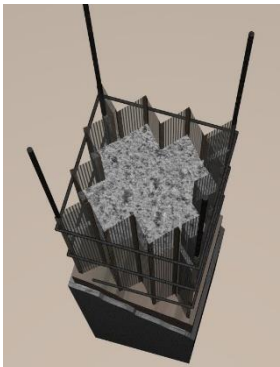
STRUCTURAL IMPLEMENTATIONS

Structural Columns:

Robust column specifications are similar to conventional column requirements with one major additional advantage.

The Robust column is a self-shuttering system.

It eliminates timeous costly delays of implementing shuttering and waiting for concrete to set.



STRUCTURAL IMPLEMENTATIONS

Structural Columns:

This illustration is of a Typical Robust 4 panel column. Columns can however be designed to any size and load bearing requirement.

ULTIMATE COLUMN LOAD CHART - 4 Panel Column

$U_w =$ 25 Mpa

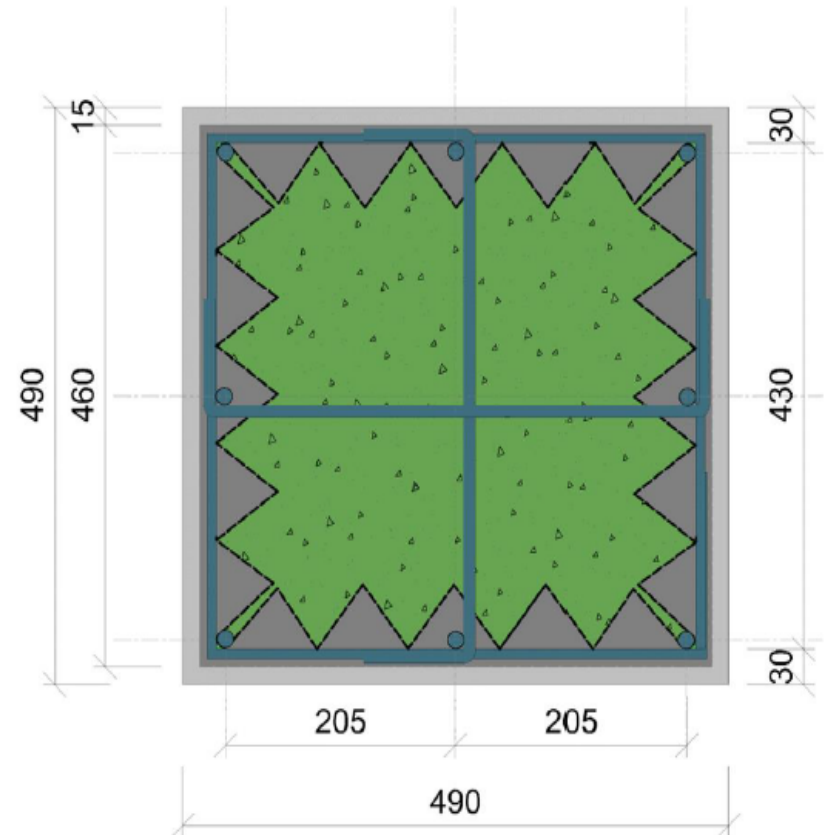
$f_y =$ 450 Mpa

COL SIZE (mm)	HEIGHT (mm)	DESIGN SIZE (mm)	REINFORCEMENT (bar diam)	ULTIMATE LOAD P_u (kN)
490x490	2700	375x375	4Y16+4Y12	1600
"	"	"	4Y20+4Y12	1800
"	3100	"	4Y16+4Y12	1600
"	"	"	4Y20+4Y12	1800
"	3600	"	4Y16+4Y12	1600
"	"	"	4Y20+4Y12	1800
"	4000	"	4Y16+4Y12	1600
"	"	"	4Y20+4Y12	1800

** 12mm bars to avoid spacing between bars bigger than 300mm*

NOTES:

- 1) Columns designed as supporting axial loads only
- 2) Allowance for excentricity as per the Code
- 3) Columns designed as partially fixed at both ends
- 4) Effective length factors in both directions 0.85
- 5) Columns considered braced in both directions



ROBUST TOOLING

Robust supplies a range of tooling equipment to assist in the ease of erection

- Mortar Pump.
- Vertical Binding Jig.
- Stabilising Support Arm Jig.

ROBUST TOOLING

The Robust Mortar Pump



The pump delivers a wet mortar application @ $3\text{m}^3/\text{hour}$.

The pump consists of a peristaltic pump, generator, compressor and a road going trailer.

ROBUST TOOLING

Vertical Binding Jig

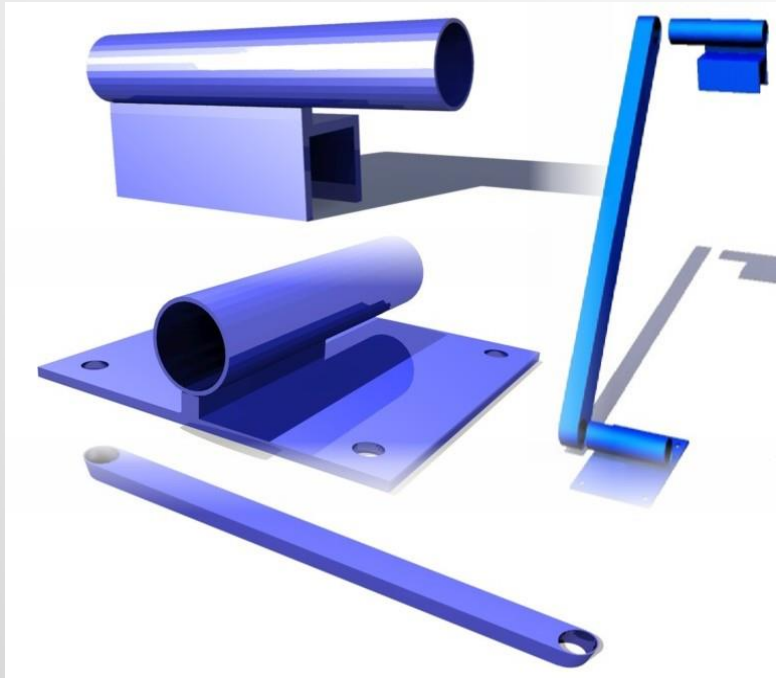


The vertical binding jig allows for wall panels up to 3,2m high and 6m wide.

It consists of 16 items that can easily be assembled and disassembled for ease of transport.

ROBUST TOOLING

Support Arm Jig



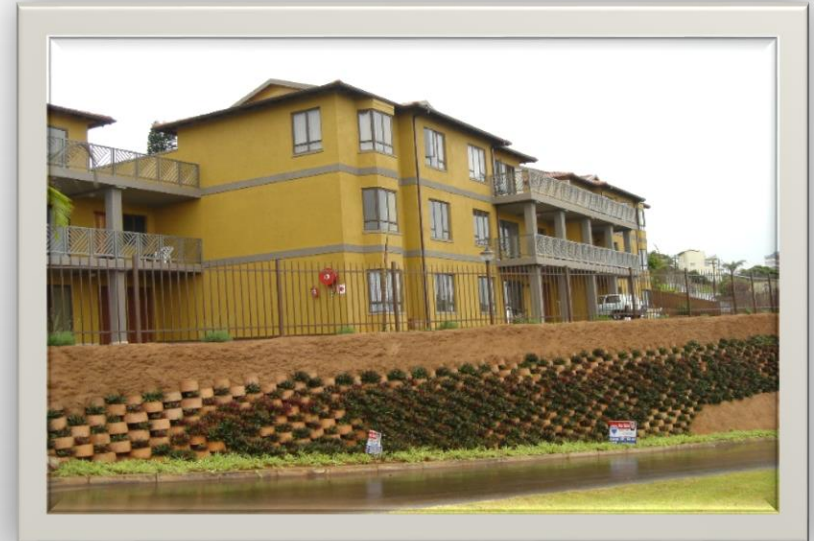
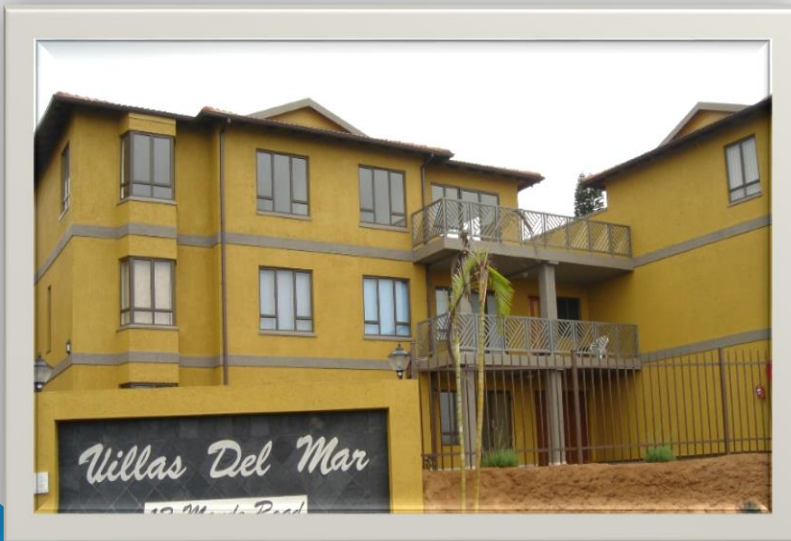
The support arm are to secure and keep wall panels in place during the erection process.

It consists of 3 pieces - Top arm cap, support arm and floor securing bracket.



Track Record

Multi Level Buildings



Exclusive Housing



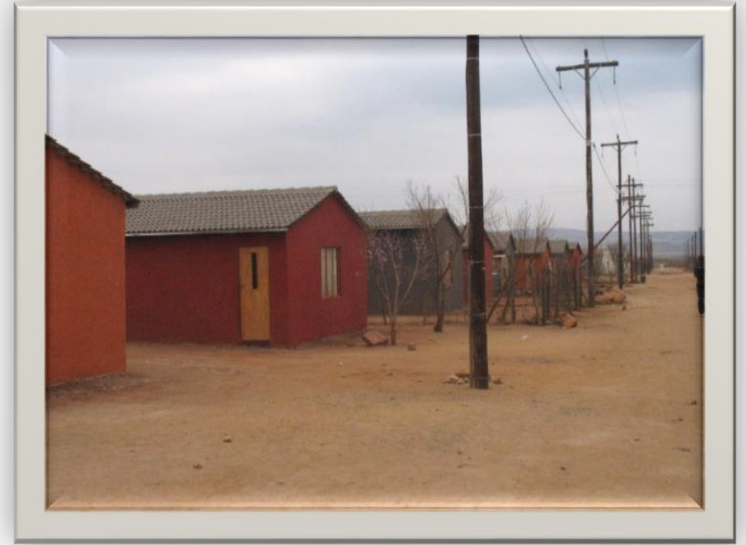
Exclusive Housing



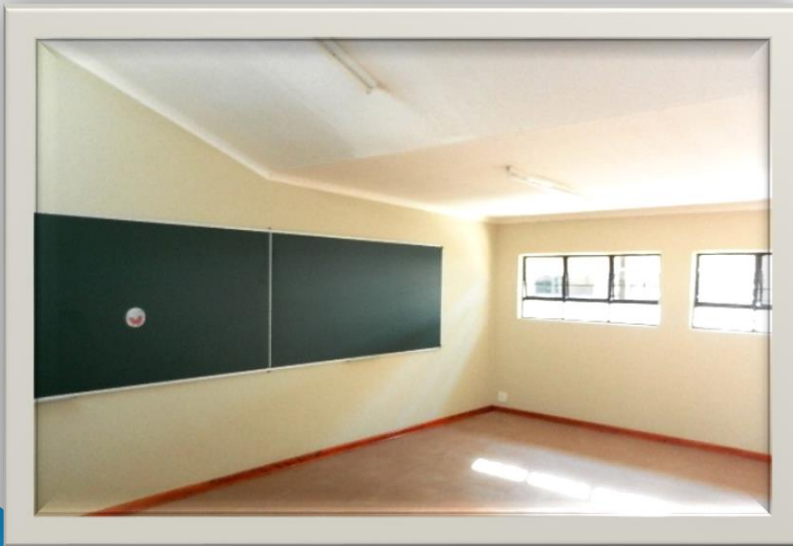
Social Housing



Social Housing



Schools



Lodges & Conference Venues



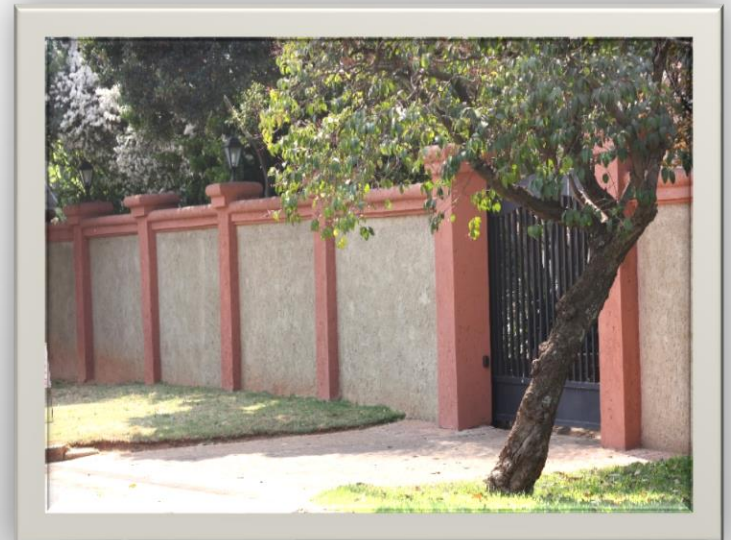
Military Applications



Mine Applications



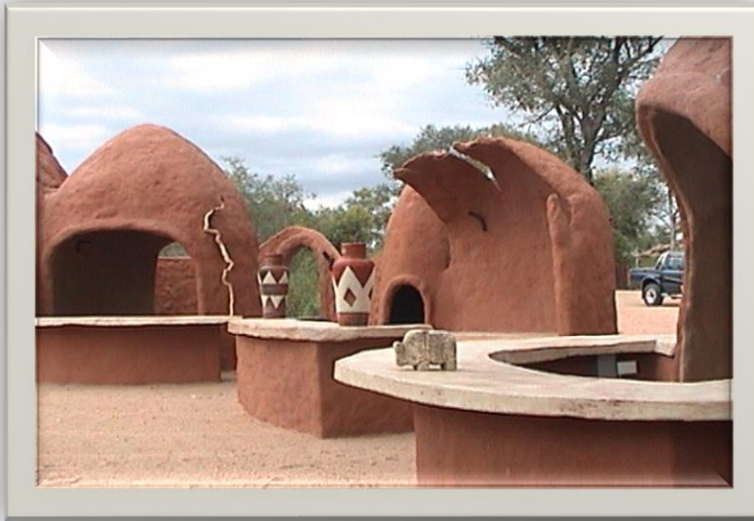
Boundary Walls

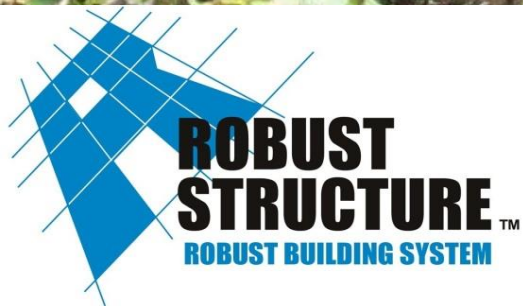


Other Applications



Other Applications





Robust Structures (Pty) Ltd

Reg. No. 2005/043961/07

30 London Road, Apex Industrial Sites

Benoni 1540, South Africa

P.O.Box 634, Benoni, 1500, South Africa

Tel:+27 11 420 1470 Fax:+27 11 420 1463

email: info@robuststructure.com

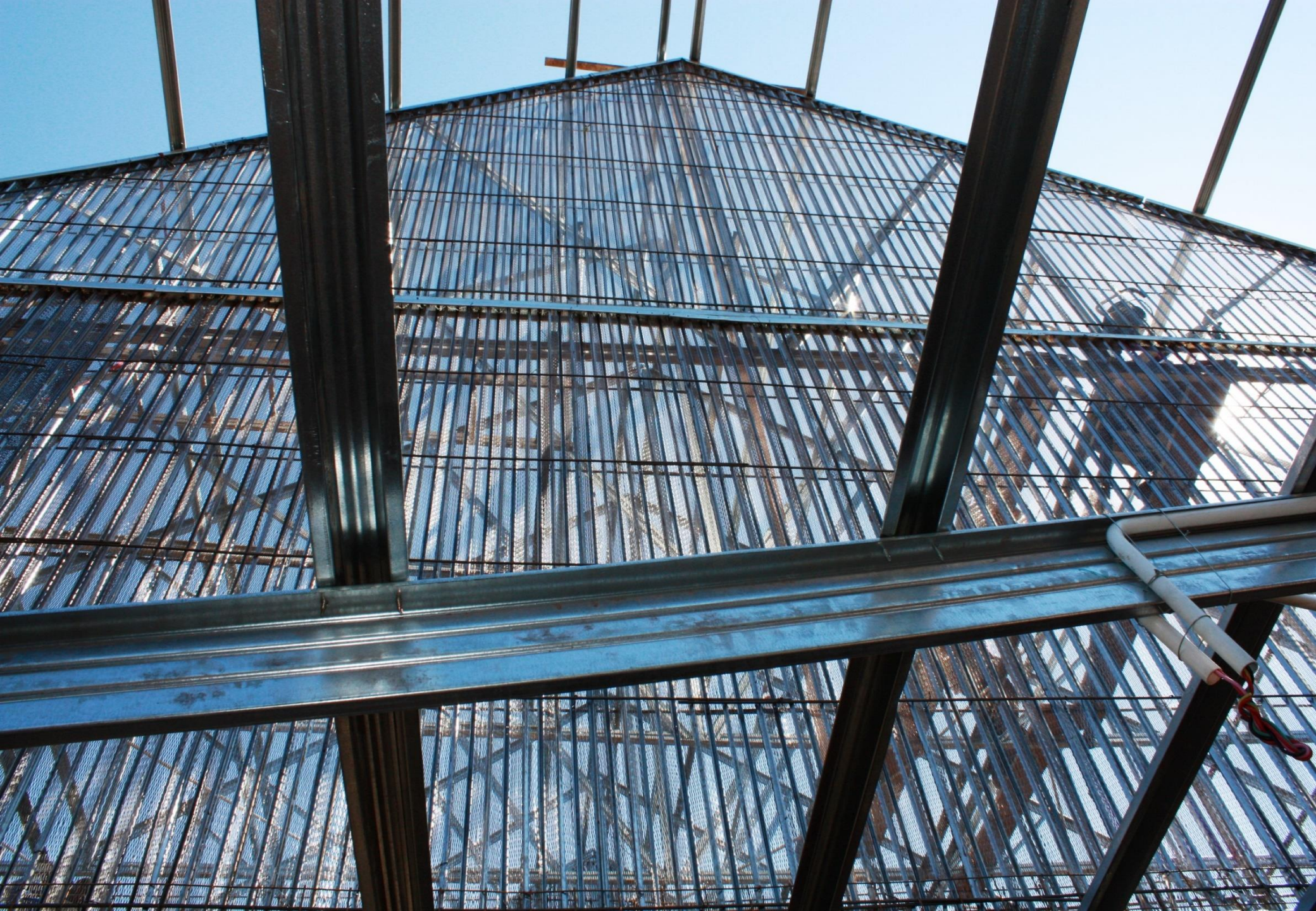
website: www.robuststructure.com

ROBUST BUILDING SYSTEM























ROBUST

STRUCTURE TM

ROBUST BUILDING SYSTEM