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STRAWTEC MADE IN RWANDA



Affordable · Fast · Sustainable

STRAWTEC Production Facility



STRAWTEC's production facility in Kigali

Designed by FBW Group and constructed by ROKO Construction, the STRAWTEC production facility was completed in Q3 2015 and is situated in Phase II of the Kigali Special Economic Zone.

A 30 meter free-span steel structure accommodates the strawboard production equipment, offices, staff facilities, storage rooms and a pre-fabrication area.

A covered roadway conceals the drop-off area designated for delivery and storage of raw materials and loading of finished goods.

Designed by



Constructed by



Dedicated Pre-Fabrication Area

STRAWTEC Production Technology

International demand for flexible and affordable construction requires an entirely new intellectual approach and highly-efficient building technologies. Connected with this is a need to apply and maintain these technologies as simply as possible; only then do they have the potential to function all over the world.

STRAWTEC technology combines heat and compression in a dry extrusion process that allows the natural adhesives contained within agricultural fibers to bind the fibers to form a continuous high-quality strawboard panel. High strength recycled paper is used to seal the strawboard panels and to give a finish-ready surface.

The manufacturing process produces zero toxic waste, is completely nonhazardous and requires very low energy input. No water or gas is needed. Although wheat straw is the preferred primary raw material, the STRAWTEC panel has been successfully manufactured from a variety of cereal straws and grasses in a wide range of climates throughout the world. These agricultural waste fibers are typically burned for disposal, a process that releases harmful pollutants into the atmosphere.

Sustainable

STRAWTEC has a negative Carbon footprint, is 100% recyclable and biodegradable.

STRAWTEC already fulfills the future requirements for sustainable, energy-efficient, healthy building materials.



Tests and standards



STRAWTEC panels have been tested extensively and meet the following Standards:

- ▶ UK: British Standard BS 4046 (recognised by the Rwanda Standards Board)
- ▶ Germany: DIN 4103
- ▶ France: CSTB
- ▶ USA: ASTM

High Performance

STRAWTEC panels are extremely robust and have an impressive combination of physical properties including

- ▶ a very high strength to weight ratio
- ▶ excellent thermal insulation and heat storage capacity
- ▶ excellent sound insulation and acoustic properties
- ▶ superior fire resistance up to 90 minutes
- ▶ high resistance to mould and pest infestation
- ▶ load-bearing capacity up to 80kg per screw



High performance STRAWTEC panels

Economic Benefits for Rwanda



STRAWTEC has created a local value chain from raw material supply to turnkey housing units leading to the following economic benefits:

Income generation

1,000,000 USD p.a. to local straw supply chain
 600,000 USD p.a. to factory staff
 3,000,000 USD p.a. to construction workers

Positive impact on balance of trade

Import substitution (i.e. cement, gypsum board)
 Export of construction material and design/construction skills

Reduction in affordable housing shortage

One production line delivers enough panels to build 2,000 dwelling units of 50 sqm each year
 Turnkey construction costs well below 400 USD/sqm can be achieved

Skills development

1,000 TVET graduates and craftsmen to be trained
 1,200 farmers have been trained

Job creation

5,000 farming jobs to supply straw
 Transport jobs to transport raw material and finished products
 100 production staff
 Specialized architects and engineers
 1,000 specialized construction jobs

Rwanda - Positive Investment Environment

STRAWTEC has a unique concept to establish local, self-sufficient manufacturing facilities to produce robust strawboard panels, which then serve as the primary building material for mass-housing and commercial construction projects. The innovative and easy-to-manage production technology employs local labour and locally grown, renewable resources.

STRAWTEC has identified Rwanda as the ideal entry point into the African market due to the sound leadership and effective economic reforms that have resulted in a positive investment environment, and the Government's commitment to meeting future housing and construction demands.

- ▶ Rwanda is ranked third in Africa and 46nd in the world, in the World Bank's "Ease of Doing Business" indicator
- ▶ Rwanda demonstrates political and economic stability
- ▶ The East African Community as a regional export market has a population of 145 million
- ▶ Implementation of the Green Growth and Climate Resilience Strategy
- ▶ Government support for Alternative Building Technologies (ABT's)
- ▶ The Rwandan Development Board guides and supports investors



The President of Rwanda Paul Kagame and the Foreign Minister of Germany Frank Walter Steinmeier discussing the economic impact with Strawtec Chairman Eckardt Dauck (right to left)

The establishment of STRAWTEC will ensure that Rwanda is at the forefront in Africa for construction using locally manufactured, sustainable, green building solutions.

STRAWTEC Partitioning Solutions



STRAWTEC Panels

STRAWTEC's The WALL is a self-supporting wall system delivering an exceptional combination of high performance properties, fast and flexible construction, low weight and green credentials. STRAWTEC offers complete partitioning solutions for residential, office and commercial buildings, using custom-made STRAWTEC panels as the primary component.

When compared to traditional construction materials used in Rwanda, STRAWTEC's The WALL provides a significantly faster and more cost-effective solution.



Fast installation



STRAWTEC partitioning at CSS Bank

Space Saving

With a width of just 58mm, installation of The WALL allows developers and investors to optimize the available floor space for their project. Put into context, installation of the Wall as an alternative to cement blocks will add up to 5% in usable floor space by reducing the thickness of the partitioning walls.

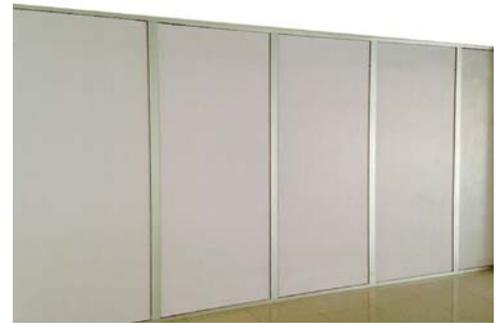
Finishings

The paint-ready surface of STRAWTEC panels ensures easy application of standard finishings such as primer (for waterproofing), paint, plaster and tiles, resulting in a good quality, durable internal finish to The WALL.

For ultimate flexibility, STRAWTEC offers ready-laminated panels fitted with aluminium profiles for partitioning in offices and shopping centres, combining extremely fast construction, a high-quality finish and a wall that can be easily demounted and re-positioned.

Customized Solutions

STRAWTEC also offers customized solutions for enhanced sound-, fire and bullet-proofing, typically used for hotels and commercial buildings.



STRAWTEC Laminated Partitioning at CHIC Commercial Complex, Kigali

STRAWTEC Slab Solutions



STRAWTEC Slab being fitted to a metal frame, Kigali

The key differentiators when comparing the STRAWTEC slab system versus traditional reinforced concrete slabs are ease and speed of construction. STRAWTEC slabs can be fitted directly on to a concrete or lightweight metal skeleton base.

STRAWTEC Slab

One team of STRAWTEC fitters can typically lay 30m² of flooring per hour. Internal fit-out of the building can commence just one day after the slab is fitted.

Reinforced Concrete Slab

On average, 4-6 weeks per floor is required to prepare the site, fix the steel braces, pour the concrete slab and allow to dry, before internal fit-out of the building can commence.

Put into context, the application of STRAWTEC slab flooring on a 6-storey building would save approximately 6 months construction time when compared to a reinforced concrete slab.

Strawtec Modular Pre-Fabricated Housing Units

The Strawtec manufacturing facility has an initial production capacity of 2,000 pre-fabricated, modular housing units per annum. Strawtec offers contractors and developers pre-fabricated units for all typologies, including single and row houses as well as apartments.

A specialized, trained workforce and pre-fabrication techniques ensure the following advantages

- ▶ a controlled production environment leading to a reduced project risk and a consistent high quality output
- ▶ ease of assembly at the construction site due to a systemized approach
- ▶ optional pre-wiring of electrical systems

ZEROCARBON DESIGNS — Designed by Zero Carbon Designs Ltd, these housing solutions are optimized for the Strawtec modular system and made to meet local requirements and tastes.

STRAWTEC also offers turnkey delivery of housing units with a variety of finishing packages according to the target budget.

Incremental building is a solution when it comes to the construction of affordable housing. Our design typically allows to add-on rooms when required using Strawtec's pre-designed extension kits.

Single Family Homes



Single and double storey single-family homes offer flexible, adaptable living space.

Assembling a Strawtec pre-fabricated house on an existing foundation takes approximately 10 days. The subsequent time for fit-out and finishes depends on the standard selected.

The cost of a turnkey Strawtec family house starts at 15,000,000 RWF, which is less than 400 USD per sqm.

A model house has been erected and can be viewed at the Strawtec factory in the Kigali Special Economic Zone.

Row Houses

Strawtec row houses are the ideal solution to meet higher density requirements, while at the same time allowing individual ownership of the plot with a private garden.

A three-storey row house development can achieve a similar density as a three-storey apartment development, whilst maintaining individual plots for the owners.



Apartments

To achieve a high density development, apartments blocks are the only choice.

Strawtec's fast and cost effective multi-storey pre-fabricated apartment solution is based on a light-weight metal structure in combination with Strawtec floor slabs, partitions and facades infill.

This solution reduces project costs and project risk considerably due to reductions in

- ▶ construction time
- ▶ dimensions of the loadbearing structure including foundations
- ▶ financing costs
- ▶ time to market
- ▶ supply chain risk due to local production



All Strawtec modules and the light-weight metal structures are pre-fabricated in Kigali and meet high quality standards.

Using Strawtec in the context of a more traditional reinforced concrete skeleton also leads to an overall cost, construction time and project risk reduction.



STRAWTEC partitions, slab and ceiling

Research and Development Project, Ethiopia

STRAWTEC participated in the research project 'Welcome to Africa' in partnership with the Bauhaus University Weimar and the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) at the University of Addis Ababa, Ethiopia.

The initial focus was to investigate and test STRAWTEC panels as an innovative and low-weight construction material for emerging cities in Ethiopia, followed by the construction of a prototype building - the Sustainable Emerging City Unit (SECU).

The SECU building design is a STRAWTEC panel double-storey loadbearing wall structure, thus eliminating the need for cost-intensive frames, and follows the need for urban density with a design that can be aggregated in various patterns (single, double, row and courtyards). The SECU was constructed in 2012 on the university campus in Addis Ababa and now serves as a university guesthouse.



SECU Construction 2012



SECU 2014



EiABC

Bauhaus-Universität Weimar



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Research and Demonstration Project, Rwanda

STRAWTEC is one of the project partners working with Zero Carbon Designs Ltd in a National Climate Change and Environment Fund (FONERWA) Innovation Grant funded project which started in August 2015.



Prototype Demonstration Units



ZERO CARBON
DESIGNS



Flexible Living Space

The specific objectives of the project are,

- ▶ to develop low-carbon, affordable dwelling units that will be acceptable to the target markets and that can be mass-produced via prefabrication in Rwanda
- ▶ to demonstrate and evaluate the units through the construction of a prototype building
- ▶ to engage with potential end-users and other stakeholders to explore the potential for adaptation to lower-income sectors through the use of incremental construction, co-housing 'sweat equity' participation and other methodologies
- ▶ to commission a detailed Life Cycle analysis in order to verify the anticipated reduction in carbon emissions

It should be noted that an initial quantification based on the construction of 1500 dwelling units of 50sqm built using Strawtec panels to replace conventional construction, indicates that the potential annual reduction in carbon emissions will be 9,750 tonnes. Put into context, this is more than the total Co2 emissions avoided target per annum for Fonerwa, as detailed in the Monitoring and Evaluation Framework.

Skills Development and Vocational Training

STRAWTEC is committed to support skills development and vocational training in Rwanda and has partnered with the Workforce Development Authority (WDA), Ministry of Education (MINEDUC) and Gesellschaft für Internationale Zusammenarbeit (GIZ).

STRAWTEC and GIZ launched a development partnership in 2014, with the primary objectives to improve capacities in the Rwandan construction sector, to develop sustainable construction systems using STRAWTEC's low carbon building panels and to promote green building materials within Rwanda and neighbouring countries.

The immense housing programs planned by the Rwandan Government depend on a broad approach to capacity building, for which an approved standard is a prerequisite. The new development partnership addresses this challenge head-on by developing a qualified workforce that is competent to work with STRAWTEC in the delivery of affordable housing.



Construction with STRAWTEC

In conjunction with GIZ and WDA, the first training programme 'Construction with STRAWTEC' was successfully delivered in July 2015 at the STRAWTEC TRAINING CENTER within the Nyanza Technical Secondary School (NTSS).



Valens Uwiringiyimana cuts a STRAWTEC Panel under the close supervision of Master Trainer Richard Becker



Minister of State in charge of TVET Albert Nsengiyumva

With a focus on knowledge transfer and skills development, ten TVET graduates and three TVET trainers received theoretical and practical instructions from STRAWTEC's Master Trainer. The course content included training in the safe use of tools, cutting and sealing Strawtec panels and the construction of STRAWTEC walls.

In close cooperation with WDA, Rwandan contracting companies and the Institution of Engineers, further training modules will be developed and delivered to graduates and professional craftsmen to meet the anticipated demand for construction workers that are qualified in STRAWTEC construction.

The course was concluded with an official Award Ceremony presided over by Minister of State in charge of TVET Albert Nsengiyumva as Guest of Honour. All ten graduates are now working for STRAWTEC, demonstrating the true meaning of Vocational Training.



Planned STRAWTEC TVET school prototype at the Nyanza Technical School

Industrial attachment program

The STRAWTEC TVET school prototype has been designed by Zero Carbon Designs Ltd with the support of WDA planners and it is planned to start construction in 2016.

TVET students will gain hands-on experience when building this 2,600 m² school under the supervision of the STRAWTEC construction team.

Straw Handling, Baling and Storage

Capacity building of local farmers and operators of baling machines is key to maintaining a secure supply chain of raw materials to STRAWTEC's manufacturing facility. During the summer harvest in 2014, STRAWTEC's resident agronomist trained over 1,000 farmers in straw harvesting and storage techniques.

Following the introduction of mechanised balers later that year by STRAWTEC and the Ministry of Agriculture and Animal Resources (MINAGRI), STRAWTEC facilitated the training of mechanisation centre staff in straw baling and handling techniques.



Training of Baler Operators 2014



Musanze farmers receive training 2014



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