

# Concrete **Reinforcing** Reinvented

## Game-changing Innovation for **CONCRETE BLOCKS**

### **THE POWER OF REINFORCED BLOCKS**

*FSC Technology provides reinforcement to individual concrete blocks enabling many new applications for block. Construction of Automated Wall Construction for Housing, Effective Shear Walls for the Structural Upgrade of High-Rise Buildings, Explosion Proof Walls, Retaining Walls, Onshore and Offshore Wind Towers, and Marine Structures are among the many new market opportunities.*



- **A COST-EFFECTIVE TECH, WITH FASTER BLOCK INSTALLATION**

No Mortar, No Concrete in the cores, No Steel Reinforcement, for a Dry Assembly System bringing a Cleaner Construction Site.

The system is no longer subject to the adverse effects of steel corrosion and leaves the entire internal cavities to be filled with insulation materials.

**ENABLES THE INDUSTRIALIZATION OF BLOCK WALL CONSTRUCTION** by automatically building Block Wall Panels / Structures either in an offsite factory or on the jobsite. *Installation is taken from Weeks to Hours.*

- **VALID ALTERNATIVE TO 3D PRINTING**

Our Cost-Effective Solution based on *Concrete Blocks, FSC Tech, and Robotics*, is capable to automate the construction process, providing a dramatic increase in Productivity with a system that has lower material costs.

- **DRASTIC REDUCTION OF CO<sub>2</sub> FOOTPRINT**

By eliminating the steel reinforcement and mortar joint construction at the job site the system will have a significantly lower CO<sub>2</sub> footprint.

# The FSC Innovation

The FSC Innovation has two fundamentally new components:

1. THE FLEXURAL STRENGTH OF A SINGLE BLOCK IS GREATLY IMPROVED.
2. BLOCKS ARE CONNECTED TO EACH OTHER IN A NEW WAY.

## RESULTS:

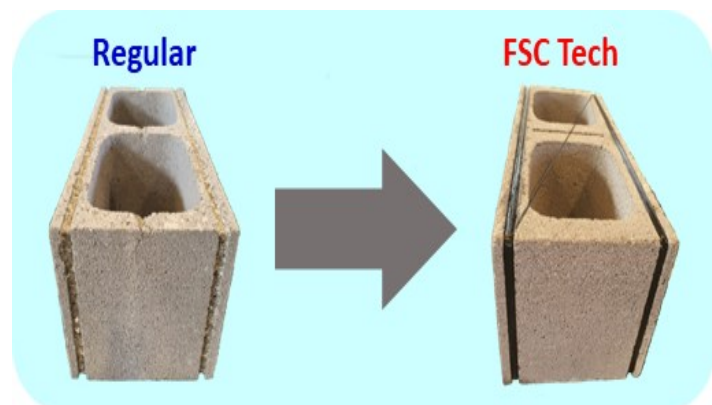
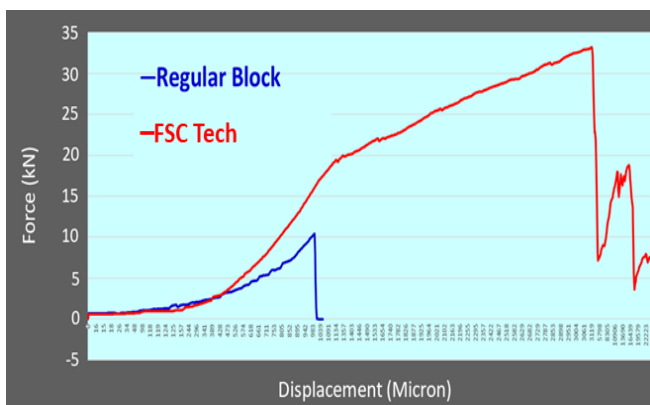
1. A block structure built with this technology, HAS A DUCTILE BEHAVIOR, with Shear Resistance that can exceed the COMPRESSIVE STRENGTH of the Blocks. The structural behavior is very similar to that of a steel structure.
2. The block structure Construction is faster, cheaper, and BECOMES HIGHLY INDUSTRIALIZABLE.
3. A wide field of Structural Applications are now possible, and Concrete Block structures are now a more cost-effective alternative to 3D Printing.

## 1. How the Flexural Strength of a Single Block is Improved

Once cured, Blocks are “wrapped in tension” with FRP (fiber impregnated with resin). This imparts a biaxial post compression, giving the single block a flexural behavior not attainable for current blocks.

This can be done at the production plant as a post-production process, or as a separate activity combined with the second step.

The recesses for the FRP on the block are ground in by the wrapping machine.



**The flexural strength of Concrete Blocks is dramatically improved.**

## 2. The NEW Connection System between Blocks

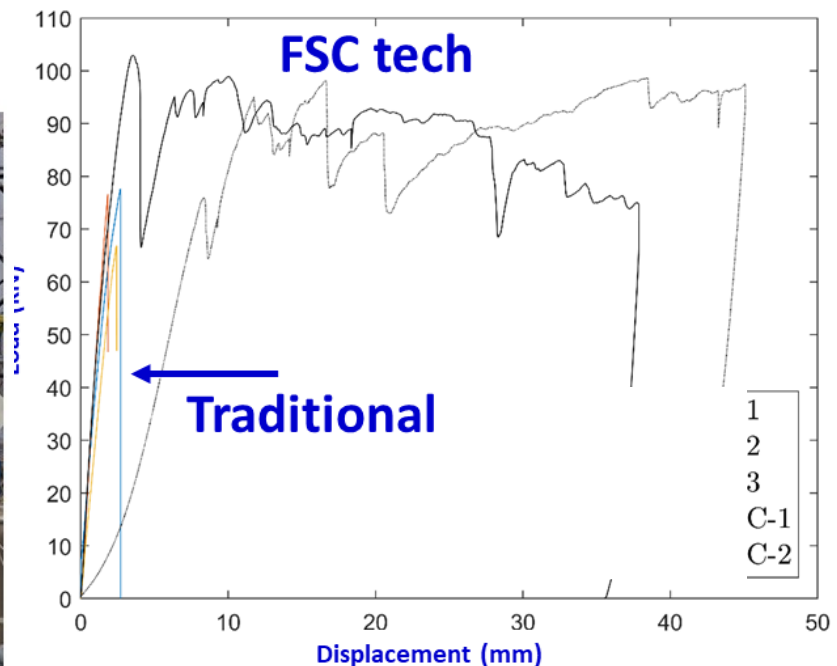
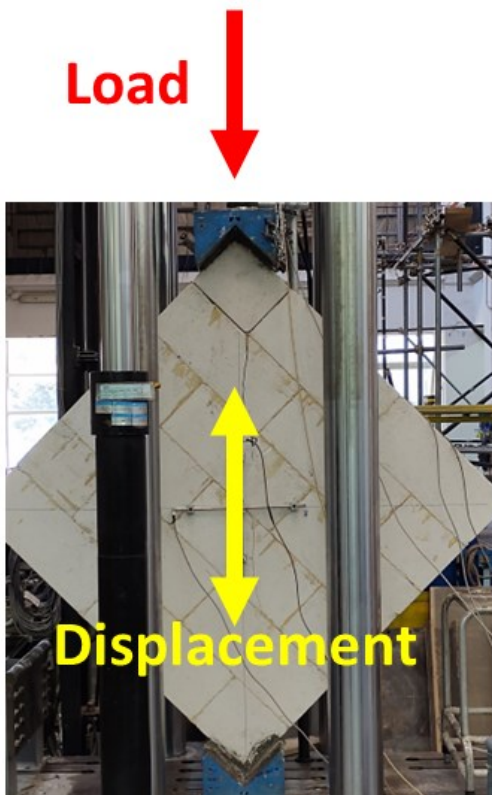
The blocks are connected together by **GLUING THE TENSIONED FIBERS**, using polyurethane, epoxy, or other resin-based glues.

- In this way, the connection between Blocks is no longer limited by THE TENSILE/SHEAR STRENGTH OF THE CONCRETE/MORTAR.
- EACH CONCRETE BLOCK BECOMES THE “FRAME” OF THE FIBER WRAPPING.
- THE CONNECTION BETWEEN BLOCKS IS BASED ON FIBER / GLUE ADHESION and this completely changes the structural behavior of the wall.



## THE RESULTS: BLOCK WALL SYSTEM DUCTILE BEHAVIOR

The block wall shows a behavior very similar to that of a corresponding steel structure, and eliminates mortar joints, steel rebars, and poured concrete in the block cavities.



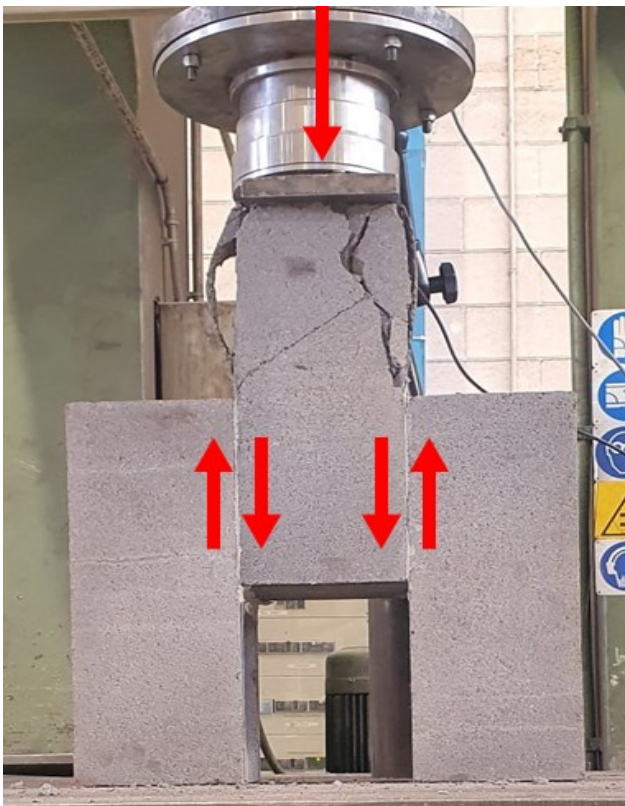
## SHEAR CAPACITY OF THE SYSTEM

In the test, 3 Blocks were post-compressed by “wrapping in tension” of FRP, then glued together with a resin-based adhesive.

The set of 3 Blocks was then subjected to a load to verify the Shear Strength of the FSC System.

**THE CENTRAL BLOCK HAS COLLAPSED BY COMPRESSION, FOR A LOAD OF 134.5 KN.  
NOTHING HAS HAPPENED TO THE GLUE CONNECTION BETWEEN BLOCKS.**

**IT MEANS THAT THE CONNECTION BETWEEN BLOCKS HAS SHEAR STRENGTH HIGHER THAN THE  
COMPRESSIVE STRENGTH OF THE SINGLE BLOCK!**



## RAW MATERIALS USED FOR THE TEST

CONCRETE BLOCKS 200 (8”) x 200 (8”) x 500 (20”) mm, weight 17.5 Kg (38.5 lb) each.

WRAPPING: For each block, about 35 grams (1.3 oz) of Basalt Fiber Roving 1200 Tex were used, and about 5 grams (0.2 oz) of epoxy resin. The Blocks have 9 wraps on 2 sides. Cost of the Wrapping/Reinforcing is about \$ 0.11 USD.

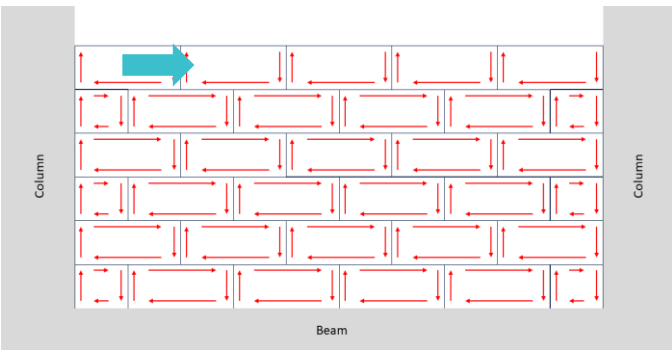


# EXAMPLE Structural Engineering Applications



## AUTOMATED WALL CONSTRUCTION FOR HOUSING

The block walls can be automatically pre-assembled, and then shipped to the construction site. The wall assemblies will be glued together at the site making for a fast erection of a building while eliminating a lot of labor and site waste.. Result is a drastic reduction of Manpower, both for assembling and installation.

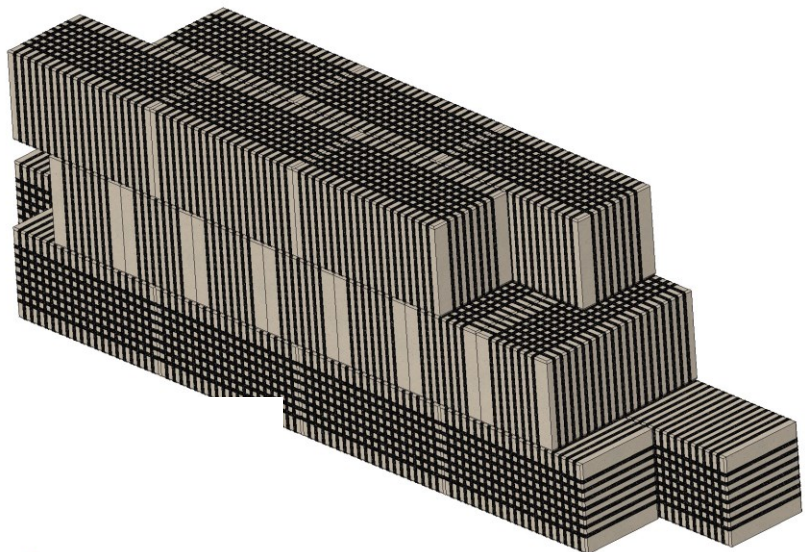


## SHEAR WALLS

It becomes easy and effective to build Shear Walls, for example for the Structural Upgrade of High-Rise Buildings.

## EXPLOSION PROOF WALLS

Bunkers/shelters built with our technology enable to create very strong but flexible buildings that will have the mass of a concrete structure - very important for absorbing energy waves - but showing a pseudo ductile behavior closer to metallic structures.



## ONSHORE / OFFSHORE WIND TOWERS

The wrapped blocks are shipped to the construction site / harbor.

The towers are built in segments at the installation site / barge by gluing together blocks using a robotic system.

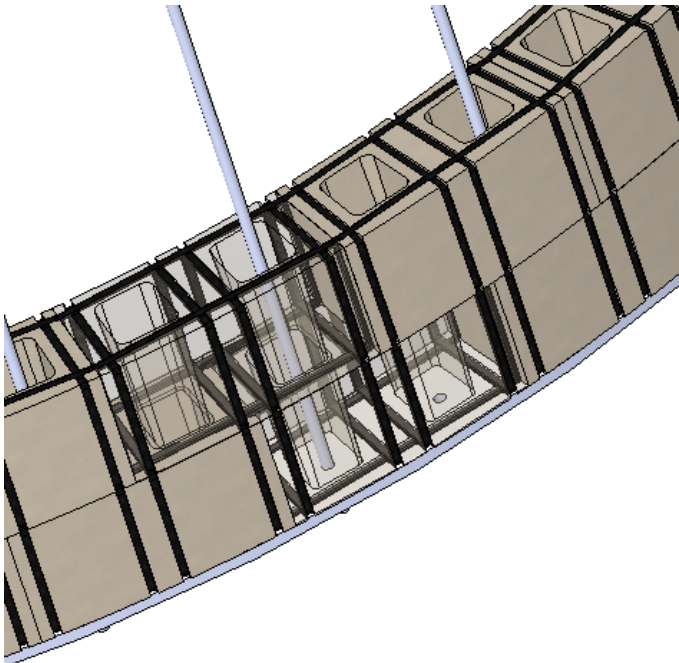
Given that the installation is done on site, the diameter of the Towers is not limited by the transportation rules.



The blocks can be milled to give the tower the desired conical shape.

Additional Structural Fiber Strips will be glued externally.

Post tensioned rods can be added if needed, since the blocks can be hollow.





## A Cost-Effective Tech with Faster Block Installation

The System makes construction much faster as it is much easier to glue the "wrapped" blocks together. It is no longer necessary to insert the reinforcing bars and filling the cores with concrete.

Furthermore, the structure thus created is structurally much more efficient, with less risk of cracking due to settling.

### FURTHER BENEFITS OF THIS SYSTEM are:

- Not subject to adverse effects of steel corrosion and leaves the internal cavity to be filled with insulation materials.
- Gluing resin produces a very fast building erection even in cold climates.
- Easy for areas with difficult access.
- Applicable also for light weight blocks.
- Significant reduction in costs.

### THE INDUSTRIALIZATION OF BLOCK WALL CONSTRUCTION IS ENABLED

By automatically building Block Wall Panels / Structures either in an offsite factory or on the jobsite.

### INSTALLATION IS TAKEN FROM WEEKS TO HOURS



# A Valid Alternative to 3D Printing

IN THIS SECTION WE CAN SEE WHY THE FSC SOLUTION  
IS SUPERIOR TO 3D PRINTING

## 3D PRINTING

3D Printing applied to the Construction Industry has the purpose to automate the construction process by casting / modeling the structure on site with robotic systems.

## THE LIMITS OF 3D PRINTING

3D Printing has at least 2 limits:

### 1. CONCRETE IS EXPENSIVE DUE TO THE HIGH RATIO OF BINDER

The concrete / mortar needed has a high ratio of binder, so that it is quite expensive and has higher CO2 footprint.

Concrete Blocks binder percentage is 7% while in 3D printing it is more than 30%

### 2. MECHANICAL/STRUCTURAL STRENGTH

The mechanical / structural strength relies only on the chemical adhesion between the casted layers. Also, adding fibers in the mix does not help because the orientation of the fibers does not significantly support the connection between layers.



## WHY THIS SOLUTION IS BETTER THAN 3D PRINTING?

Because based on **3 key factors: the Concrete Blocks, the FSC Tech, and Robotics**, that when put together are capable to provide a dramatic increase in Productivity for the Construction Industry:

- **CONCRETE BLOCKS** are a very successful, readily available, and cost-effective material. It is widely available everywhere, manufactured in full automated plants, so unit cost is very low. Also, the production process based on dry cast concrete requires a low percentage of binder which is beneficial to the CO2 footprint and the cost structure.
- **The FSC Tech** makes possible to provide blocks a cost effective and disruptive structural behavior.
- **ROBOTICS** makes the Construction process fast and highly automated by gluing together the blocks into the required wall system.