



# Textile Reinforced Concrete

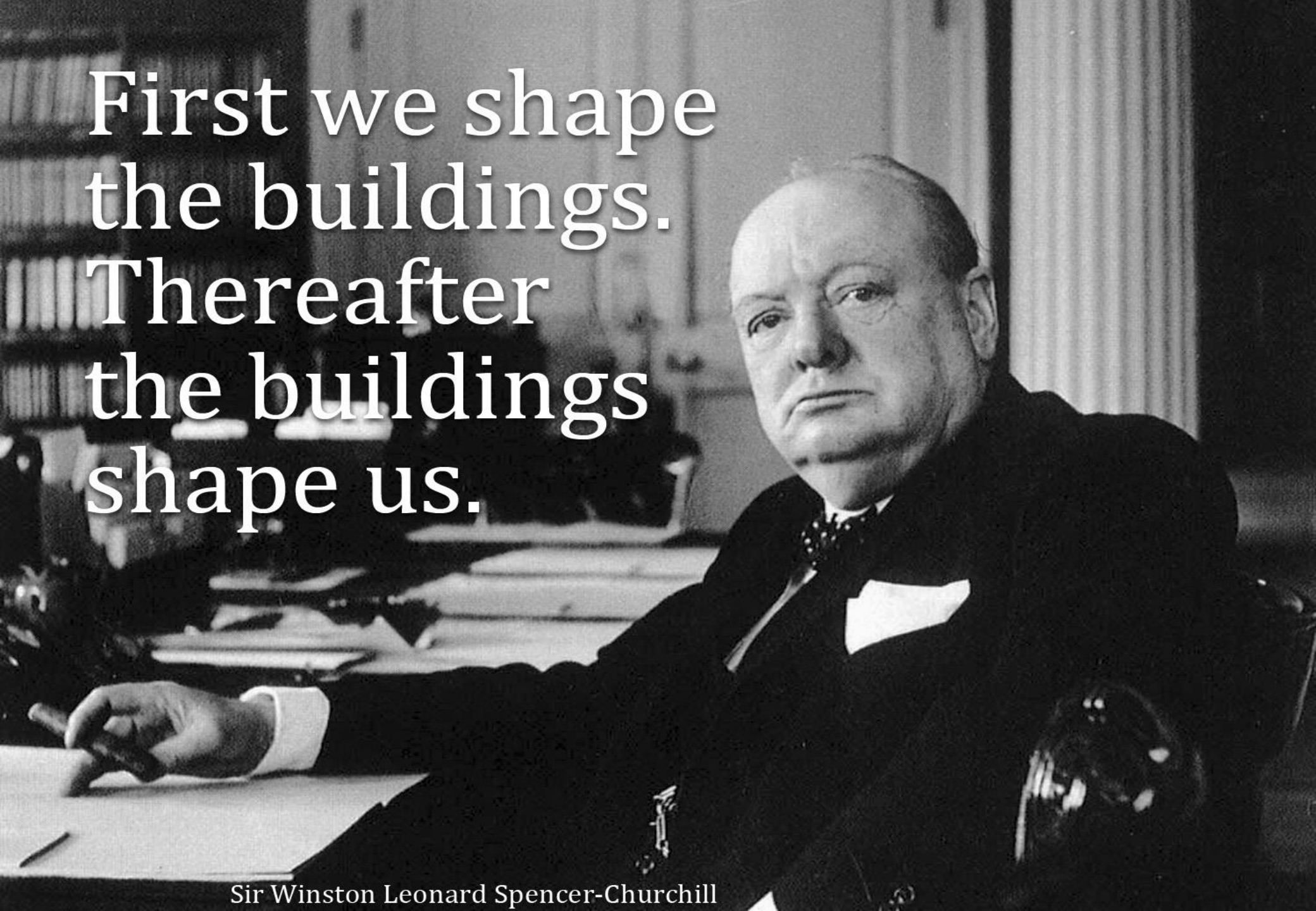
Innovated in Germany, Made in India

**Dr.-Ing. Mohit Raina**  
Managing Director, Raina Industries Private Limited

CONCRETE DAY | 09.10.2017



**Raina Industries**  
**Pvt. Ltd.**

A black and white photograph of Sir Winston Churchill. He is seated at a desk, looking slightly to the right of the camera with a serious expression. He is wearing a dark suit jacket, a white shirt, and a dark tie. His right hand is resting on the desk, holding a cigar. The background shows a bookshelf filled with books and a window with curtains.

First we shape  
the buildings.  
Thereafter  
the buildings  
shape us.

Sir Winston Leonard Spencer-Churchill

# European Research and Innovation

**Project Nr:** LIFE06 ENV/D/000471

**Title:** INSU-SHELL– Environmentally  
Friendly Facade Elements made  
of thermal insulated Textile  
Reinforced Concrete

**Beneficiary:** Rheinisch-Westfaelische  
Technische Hochschule Aachen

**Website:** <http://www.life-insushell.de>

**Period:** 01-Oct-2006 to 31-Mar-2010



**DFG**



Bundesministerium  
für Bildung  
und Forschung

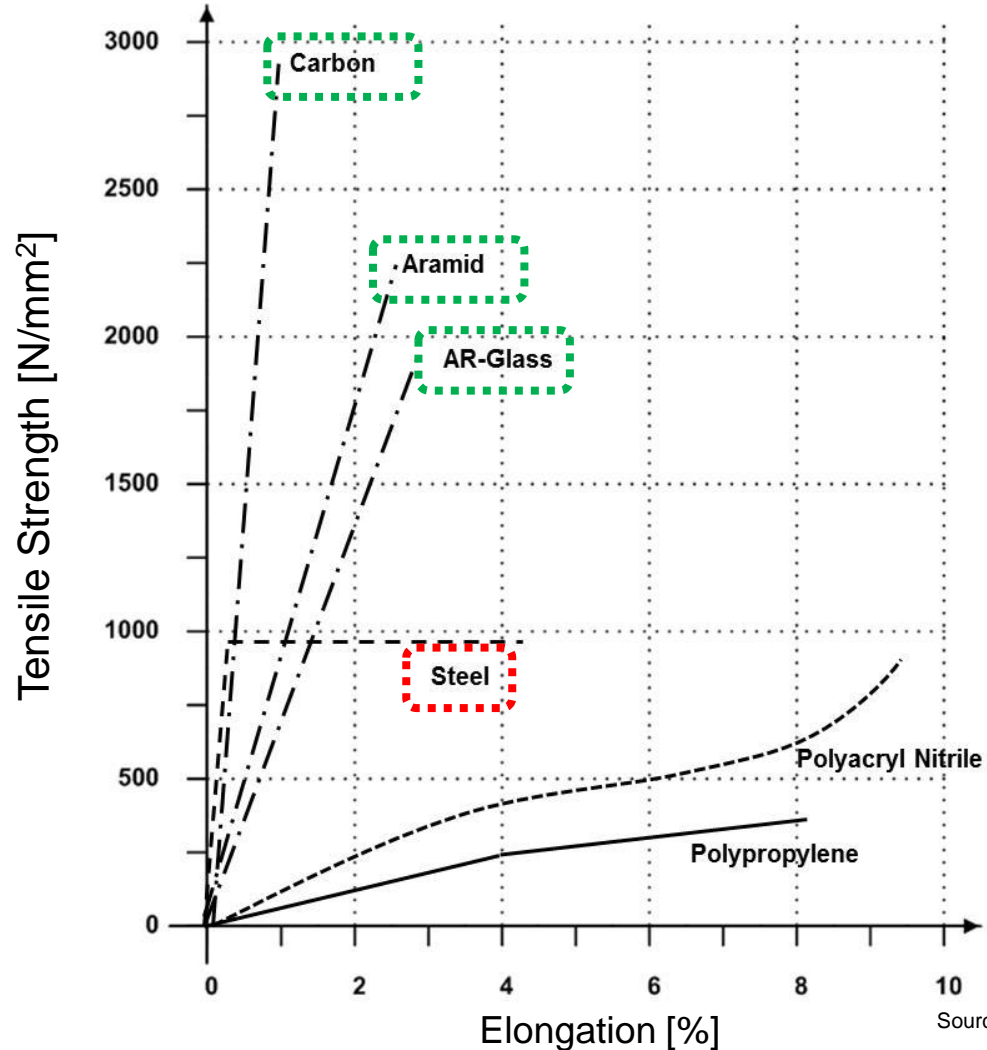


*Ideen eine Zukunft geben*



# Basics of “Textile Reinforced Concrete”

## Why Textile Fibres?

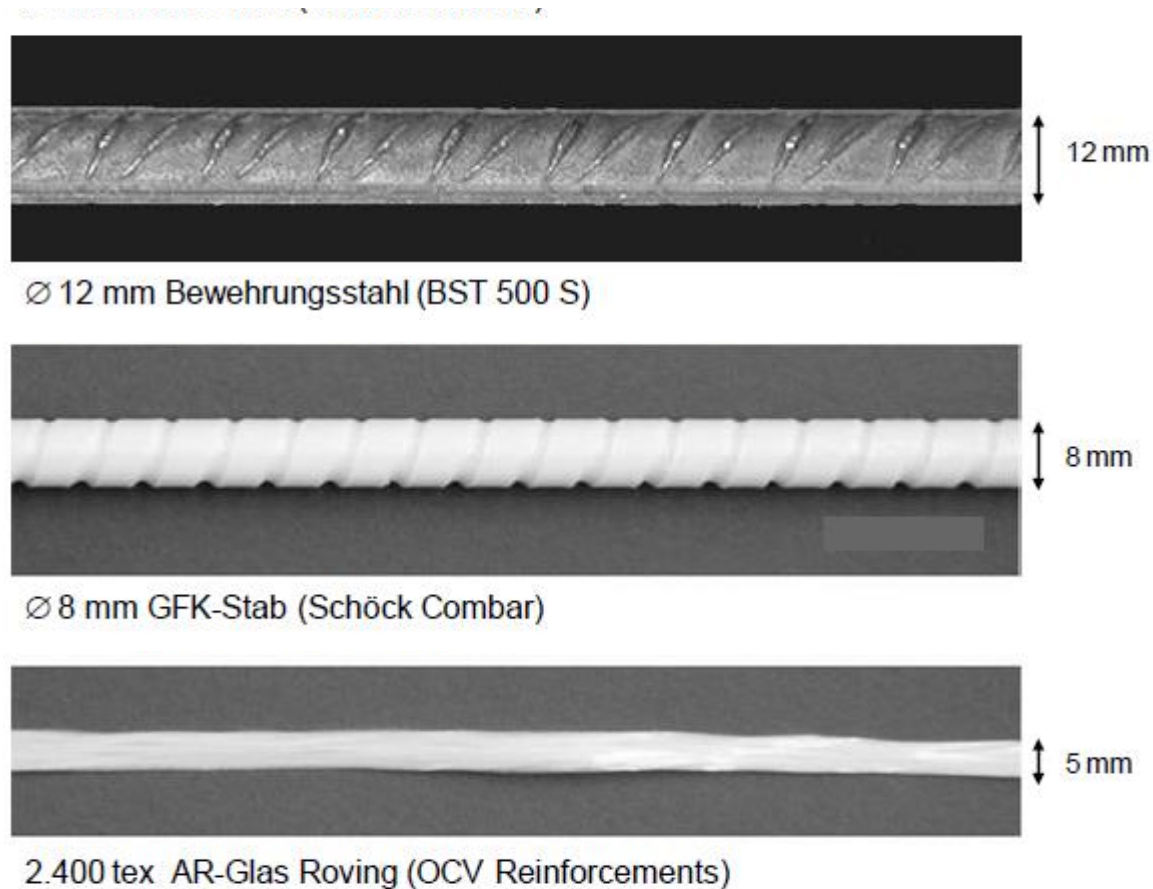


Source: Diss. Janetzko



# Basics of “Textile Reinforced Concrete”

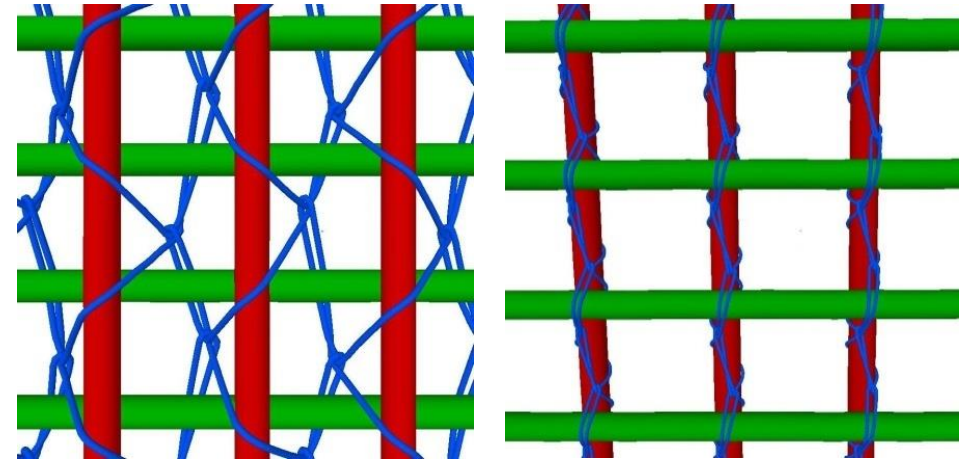
## Comparison to Steel



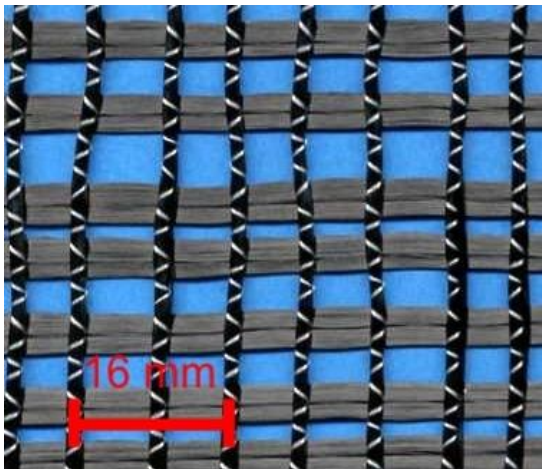
# Textile Reinforced Concrete

## Textiles used

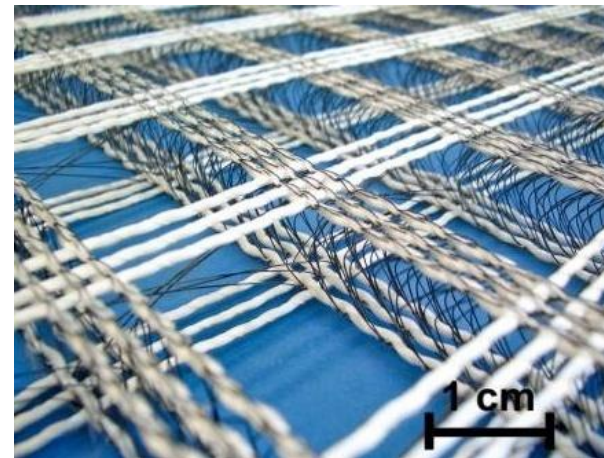
- AR-Glass, Carbon and Basalt conventionally used
- Open Grid Leno woven structures
- 2D and 3D Warp knitted Structures
- Coating of textiles with epoxy



Textile Structures



2D-Textile

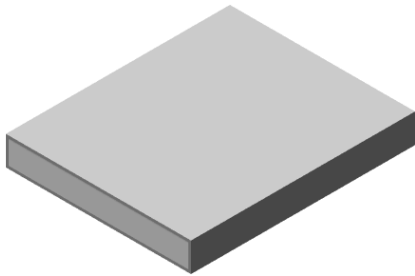


Spacer Fabrics



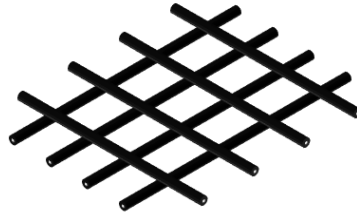
# Textile Reinforced Concrete

**Fine Concrete**



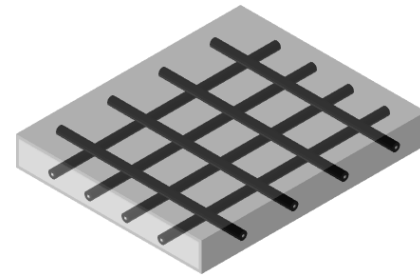
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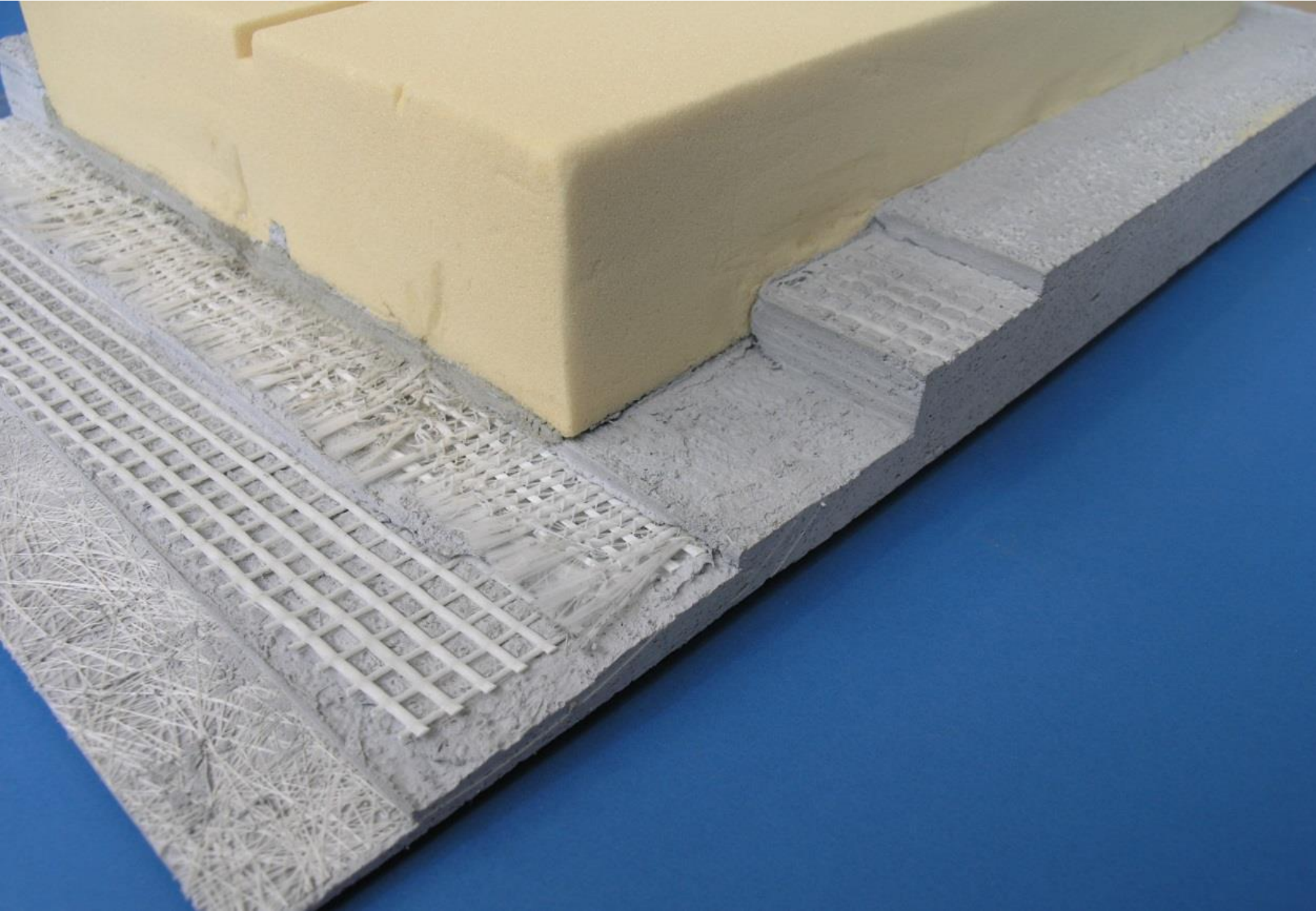
**Textile  
Reinforcement**



=

**Textile  
Reinforced Concrete  
(TRC)**







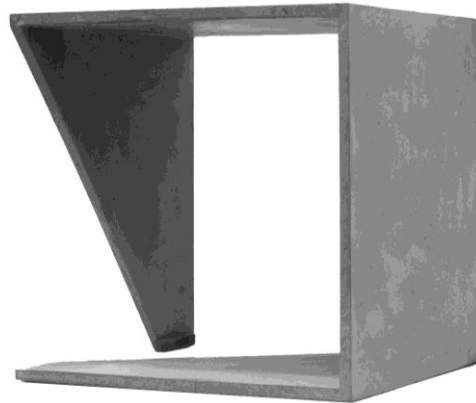
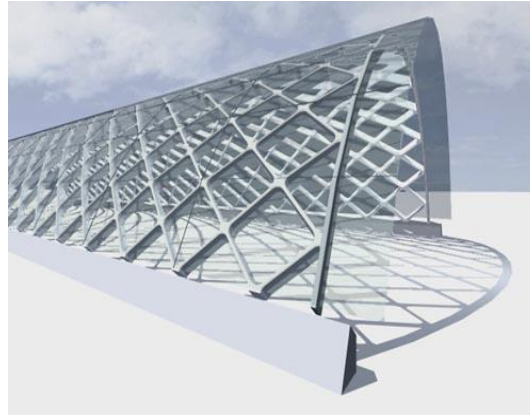
# Properties

## Surface quality



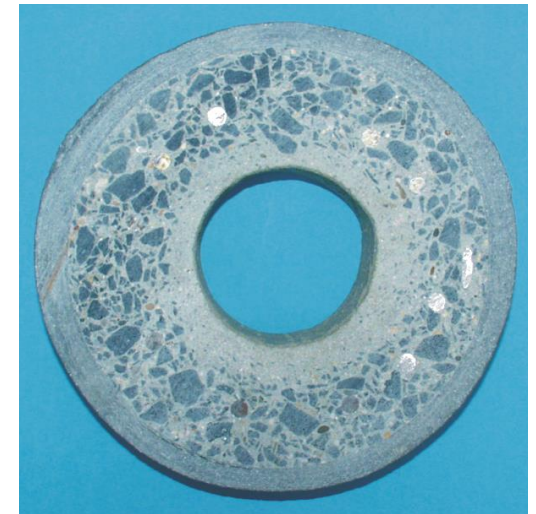
Outer Facades  
Germany

## Freedom in design



Pavilions and Furniture  
Germany

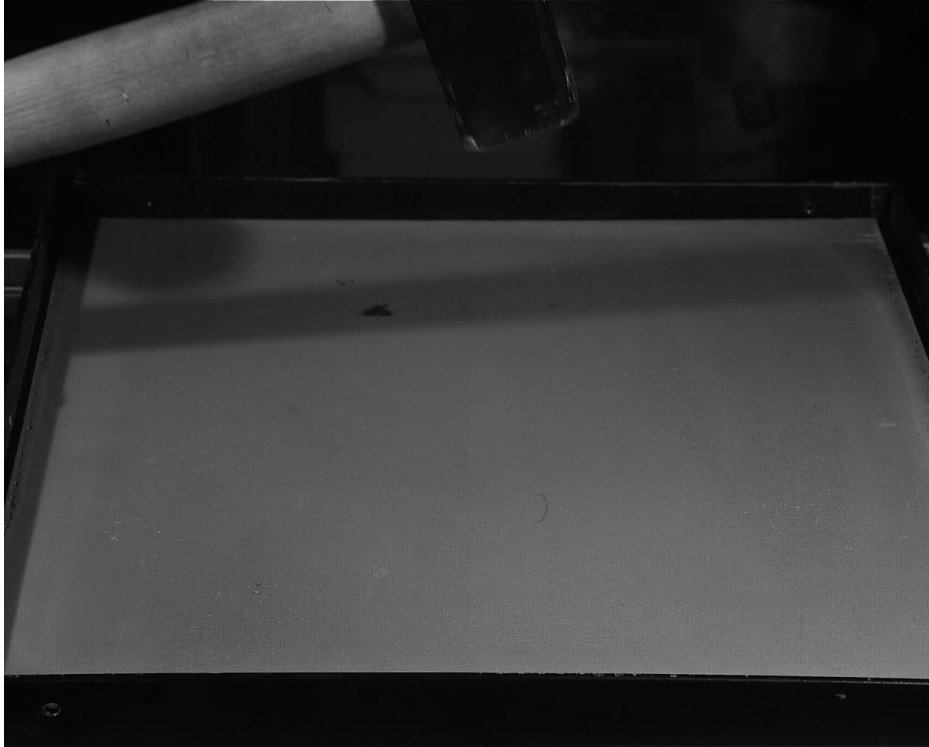
## Thin walled elements



Internal Walls  
Germany



# The Power of Textiles....



Concrete Plate Reinforced with Fibres



Concrete Plate Reinforced with Textiles

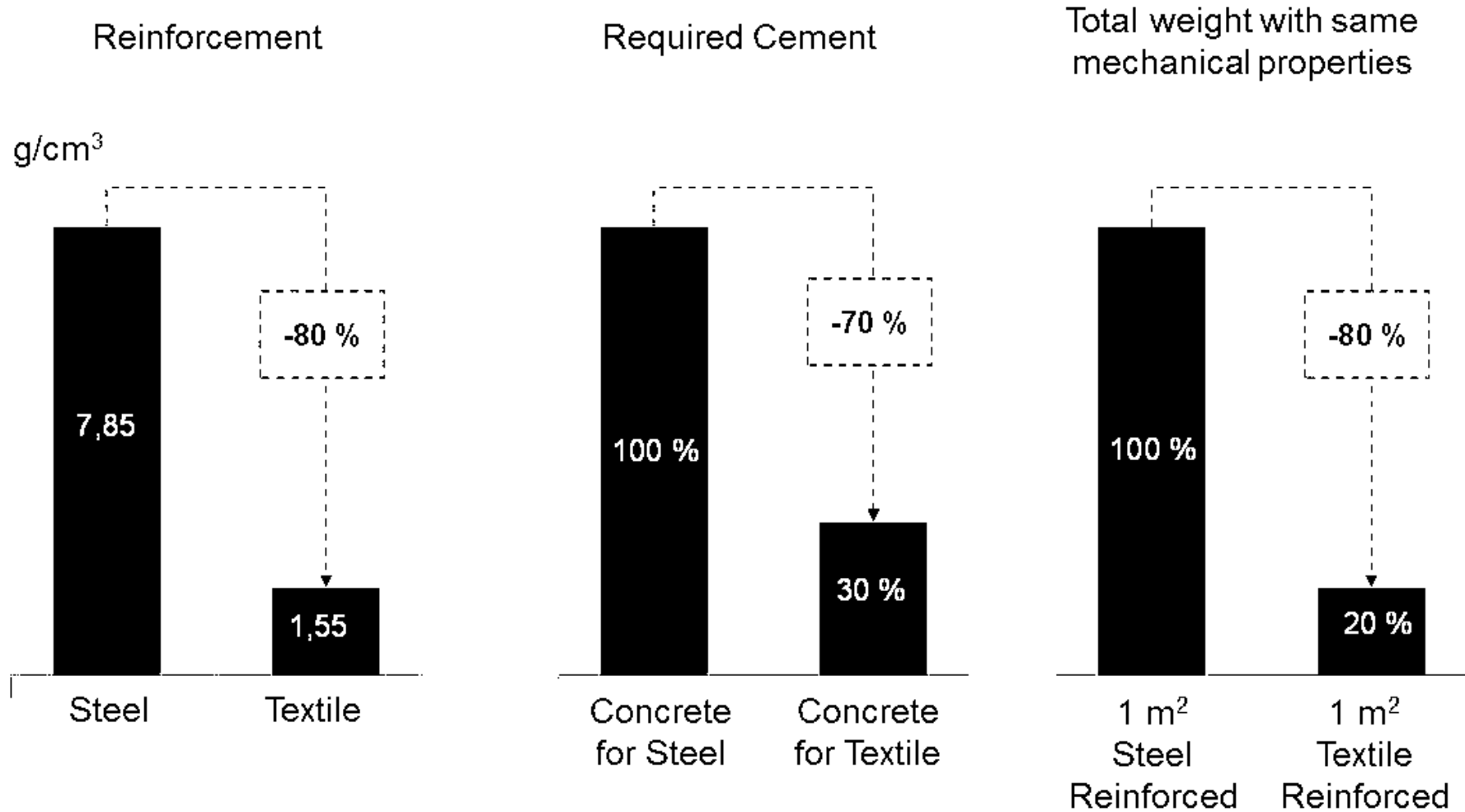




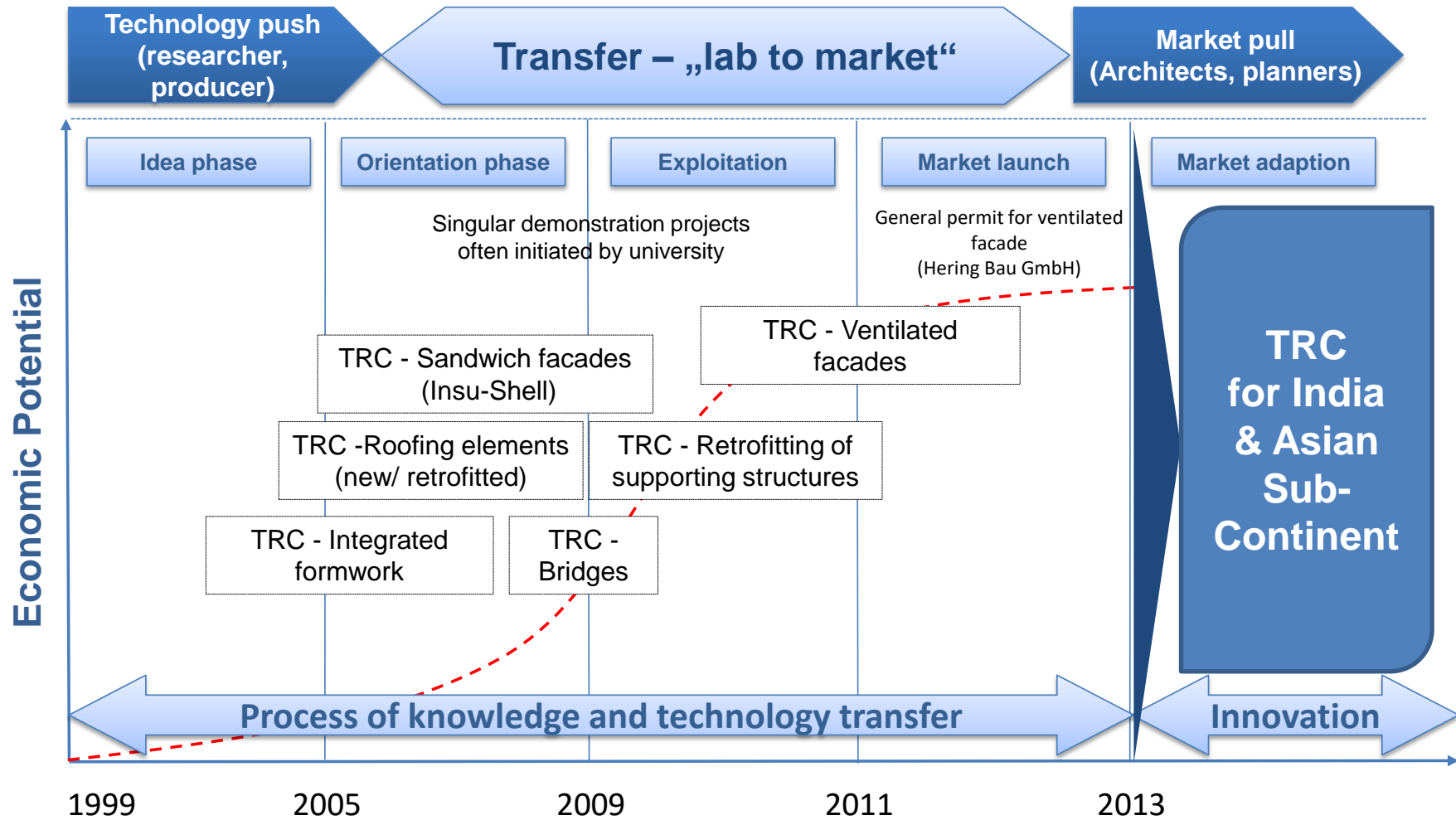
## Awarded the “Best of the Best” LIFE Environment project 2011



# Textile Reinforced Concrete



# History of TRC



# Indian Construction Industry

## The Market Size

- Market Volume: 35.64 Bil. €
- Share of GDP: 11 %
- Growth of the industry: 10 %
- Usage of Cement: 159.43 Mil. Tons
- Industrial Construction: 28 Bil. €
- Construction Area: 9.44 Mil. sq.ft.
- Margins: 5-7 %
- People employed: 31 Million
- Population: 1.29 Billion





## 1.29 Billion Souls to Care

- Technology existing with possibilities of great impact on the building industry
- Magnanomus Indian building and construction market
- Challenge of getting the technology to the market
- **Birth of Raina Industries Private Limited in November 2014**



# Technology Transfer



RWTH AACHEN  
UNIVERSITY



**Raina Industries  
Pvt. Ltd.**

## Green building lab opens at ATIRA

TIMES NEWS NETWORK

Ahmedabad: The first-ever innovative and green building laboratory in India, IGB Lab, was inaugurated at Ahmedabad Textile Industry's Research Association (ATIRA) campus on Friday. The laboratory will be used for testing as well as display of Textile Reinforcement Concrete (TRC).

Textile-reinforced concrete is a type of reinforced concrete in which the usual steel reinforcing bars are replaced by textile materials. Instead of using a metal cage inside the concrete, this technique uses a fabric cage inside the same.

According to experts, TRC is 80% lighter than fiber-reinforced composite (FRC) and stronger. This lab is an attempt to make the builders aware about this green building technology.



'Textile-reinforced concrete is the future'

The lab has been established with international partners like Institut für Textiltechnik-RWTH Aachen (ITA), Aachen Germany and German House for Research and Innovation, along with a Mumbai-based company and CSIR-Structural Engineering Research Centre, Chennai.

### Seminar on new tech

In order to create awareness and motivate entrepreneurs to go for new investment in BuildTech, a class of technical textiles that are increasingly being used in construction replacing traditional material like steel, a seminar was also organised by the ATIRA jointly with office of the textile commissioner, Mumbai, and the Union ministry of textiles, on Friday. TNN

"We want to bring TRC to India. This lab will help us convince the architects and builders about the feasibility of TRC. FRC is being used for constructing green buildings," said Mohit Raina, Indian coordinator for German partners in IGB lab.





# Creating an Eco-System

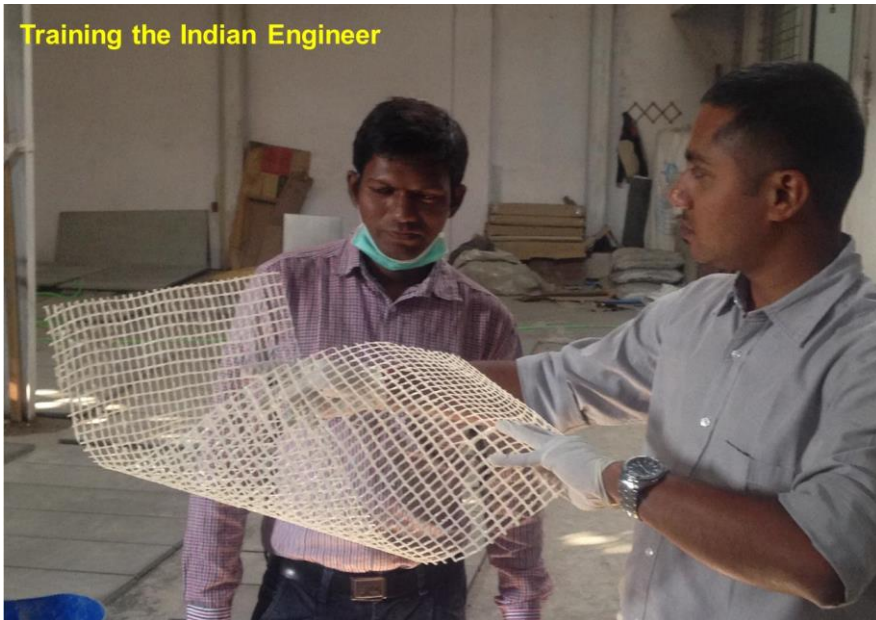


Involving European Stakeholders– Aachen Building Experts



Involving Indian Stakeholders

Training the Indian Engineer



Producing the first building components



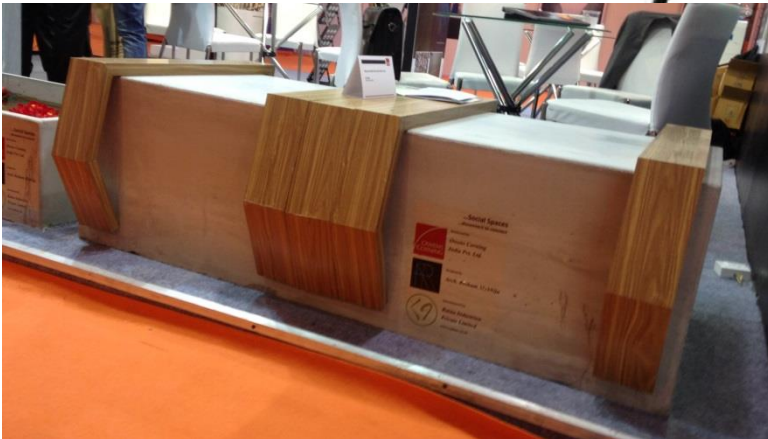
# Creating an Eco-System



# Aesthetic Application

## Structural

- Thin-walled lightweight structures
- No corrosion problems
- Flexibility in design



## Ecological

- Reduction of CO<sup>2</sup> and energy usage in
  - production
  - transport
  - implementation
  - use



# Aesthetic Application



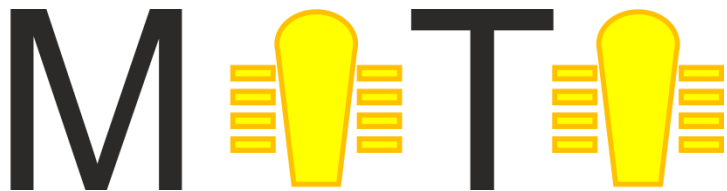
© Lehrstuhl Baukonstruktion, RWTH Aachen



# Mass Application



TRC Plate



## Addressing Sanitation in India

- **Project** – Mo-To Sanitation Units
- **Details**
  - Clean India Mission intend to make India defecation free
  - Modular Toilets made out of TRC
  - Basic unit is a Mo-To TRC Plate
  - Dimensions – 1219 mm x 335 mm x 25 mm
  - Primary Reinforcement – Textile Grid with mesh of 16 mm E-Glass/ Basalt epoxy resin coated
  - Secondary Reinforcement – Anticrack Fibres CemFil
  - Concrete M60 Grade concrete



# Mass Application

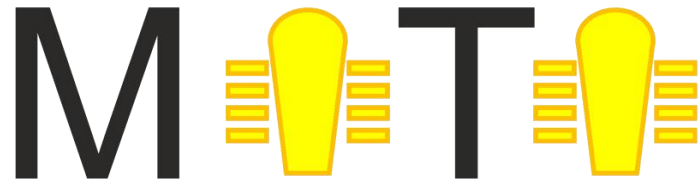


Installation



Installed





Raina Industries Pvt. Ltd.  
Mumbai, India

*Creating Impact with Creative Innovation*



# Engineered Application

## Façades

- Project Name – Club Priva Façade
- Façade Material – TRC + GFRC
- Façade Size – 6m x 2m
- Total Area Covered – 4600 sq. ft.
- Facade Thickness – 75mm
- Details
  - The size and the infills of the facade posed a challenge
  - Reinforcement using textile structures
  - Warp Knitted Textile Structures used





# Engineered Application

## Lattice Truss

- Lattice shell with diamond shape
- Dimension 1000x600x160mm
- Dimensions: 10 m X 3 m
- Thickness: 25 mm



# Engineered Application

## Hyperbola Paraboloid

- Length x Breadth: 7 x 7 m
- Periphery thickness: 60 mm



# Engineered Application

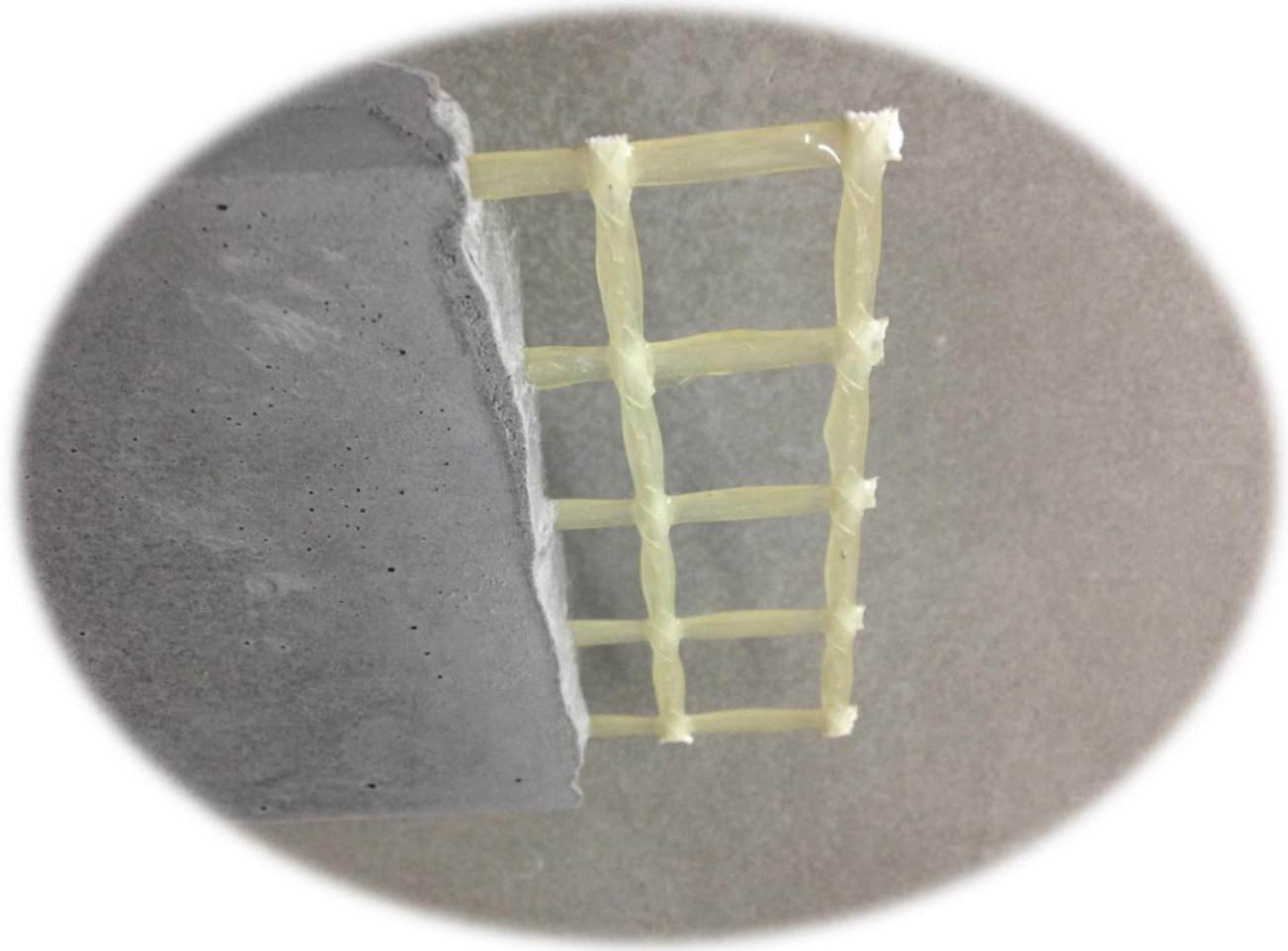
## Façades

- Project Name – Walking Gallery
- Façade Material – TRC + GFRC
- Façade Size – 3.6m x 3m
- Total Area Covered – 8000 sq. ft.
- Facade Thickness – 25mm
- Details
  - The boundary of the floral design difficult to demould
  - Reinforcement using textile structures to support demoulding process
  - Textile also to support the delicate structure during transportation



**The Future  
Is Here**





**RWTH**AACHEN  
UNIVERSITY

Thank you for your  
attention

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**Raina Industries  
Pvt. Ltd.**