High Strength Concrete in Structural System – Design Perspective

By

G.H. BASAVARAJ

Managing Director

Chetana Exponential Technologies Pvt. Ltd.,

Chetana House, #3/1, 10th Cross, Vasanth Nagar, Bangalore – 560 052

Phone: 080-22340405/6/7   Email: basavaraj@chetana.co

chetana
since 1983

www.chetana.co

EVOLUTION OF STRUCTURAL SYSTEMS

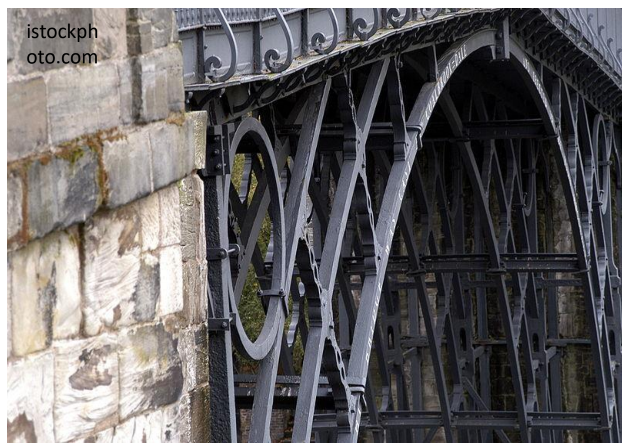
EVOLUTION OF STRUCTURAL SYSTEMS

Caves were last used as habitats around 8000 BC

African Hut at Bana, a small village of Cameroon

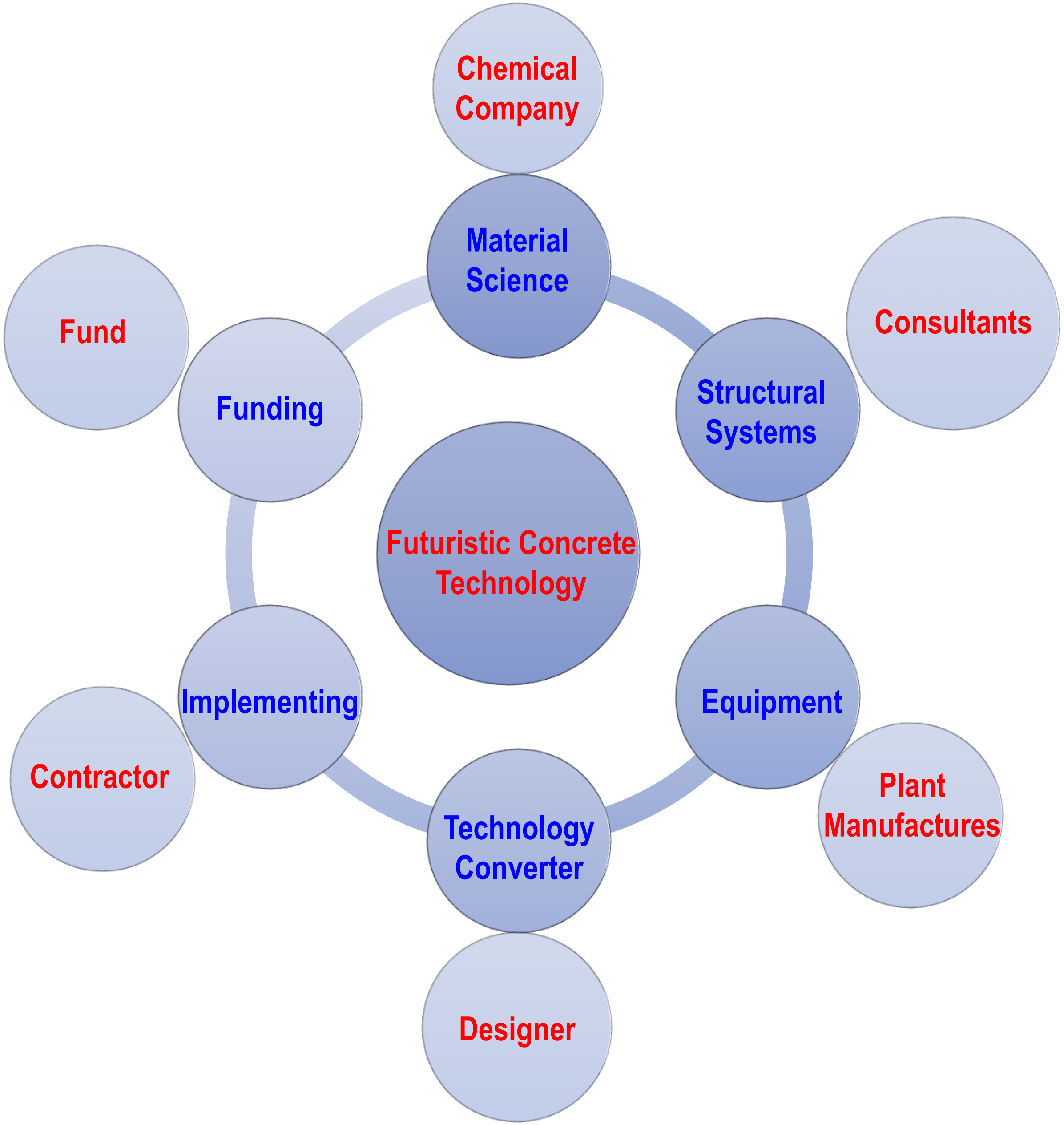
Kukulkan's Pyramid

A Roman bridge crosses the Afrin River in northern Syria and is still in use today.



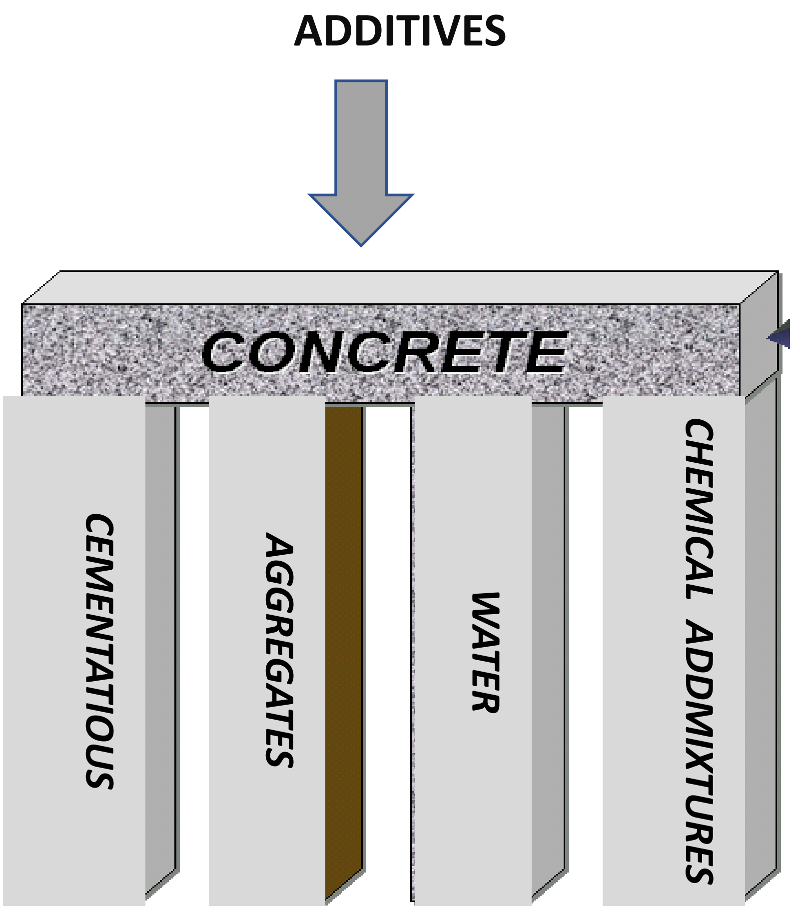
The first arch bridge in the world to be made out of cast iron, a material which was previously far too expensive to use for large structures

The Burj Khalifa (United Arab Emirates) is the tallest man-made structure ever built. It is supported by a reinforced concrete core using a special concrete mix.


Chemical Company
Material Science
Consultants
Structural Systems
Fund
Funding
Futuristic Concrete Technology
Implementing
Equipment
Contractor
Technology Converter
Plant Manufactures
Designer

CONCRETE SCIENCE

Concrete Composition



"Concrete is an **artificial stone** and is produced from a mixture of
Cement,
Mineral Admixture,
Aggregates (Gravel and Sand) and water – usually also with
chemical admixtures

What we want from concrete ?

Normally Desired Properties:

Workability	:	Pumpability, Transportability, Reaching Heights, Rheology, Concreting without Vibrator
Compressive strength	:	Moderate to High Compressive Strengths at a cheaper cost.
Flexural strength	:	Moderate Flexural Strengths
Durability	:	Low Shrinkage (No-Shrinkage) Low Creep

Currently Accepted Status of Concrete

Cementitious Materials (CM)

Cement + GGBS + Alccofines + Micro Silica + Fly Ash + other Pozzolans

Pozzolanic materials can be divided into 2 groups

Natural Pozzolans	Artificial Pozzolans
➢ Clay and Shales ➢ Diatomaceous earth ➢ Opalinic cherts ➢ Volcanic tuffs and pumicites	➢ Fly ash ➢ Ground Granulated Blast furnace Slag (GGBS) ➢ Silica fume ➢ Rice husk ash ➢ Surkhi ➢ Metakaoline ➢ Alccofine

Qualities of Concrete made with Cementitious Materials

- Lower the heat of hydration and thermal shrinkage
- Increase the water tightness
- Reduce the alkali-aggregate reaction
- Improve resistance to attack by sulphate soils and sea water
- Improve extensibility
- Improve workability
- Lower susceptibility to dissolution and leaching
- Lower costs

Superiority of Concrete with Cementitious Materials

- Increases the later age strengths by **25 - 40%**
- Reduces the heat of hydration by **35%**
- Reduced pore volume in concrete by **60%**
- Increased water tightness in concrete by **34%**
- Resistance to Sulphate attack in concrete by **60%**
- Resistance to Chloride attack in concrete by **90%**
- Resistance to Alkali-Aggregate reaction in concrete by **86%**

Using Cementitious Materials in Concrete will Enhance the following properties.

- Resistance to the Drying Shrinkage
- Reduction of Creep
- Increases the Flexural Strength
- Increases the Split-Tensile Strength
- Shrinkage reduction

Based on applications and availability of Mineral admixtures following properties of concrete are tested and studied over a period of time

Fresh Concrete	Strength of concrete	Elasticity ,Creep & Shrinkage	Durability of Concrete
Workability	W/C Ratio	Modulus of Elasticity	Permeability test
Segregation	Gel/Space Ratio	Dynamic Modulus of Elasticity	RCPT
Bleeding	Compressive Strength	Plastic Shrinkage	Carbonation Test
Batching	Flexural Strength	Drying Shrinkage	Alkali Aggregate Reactivity
Transporting	Split Tensile Strength	Moisture Movement	Acid attack test
Pumping & Placing	Bond Strength		

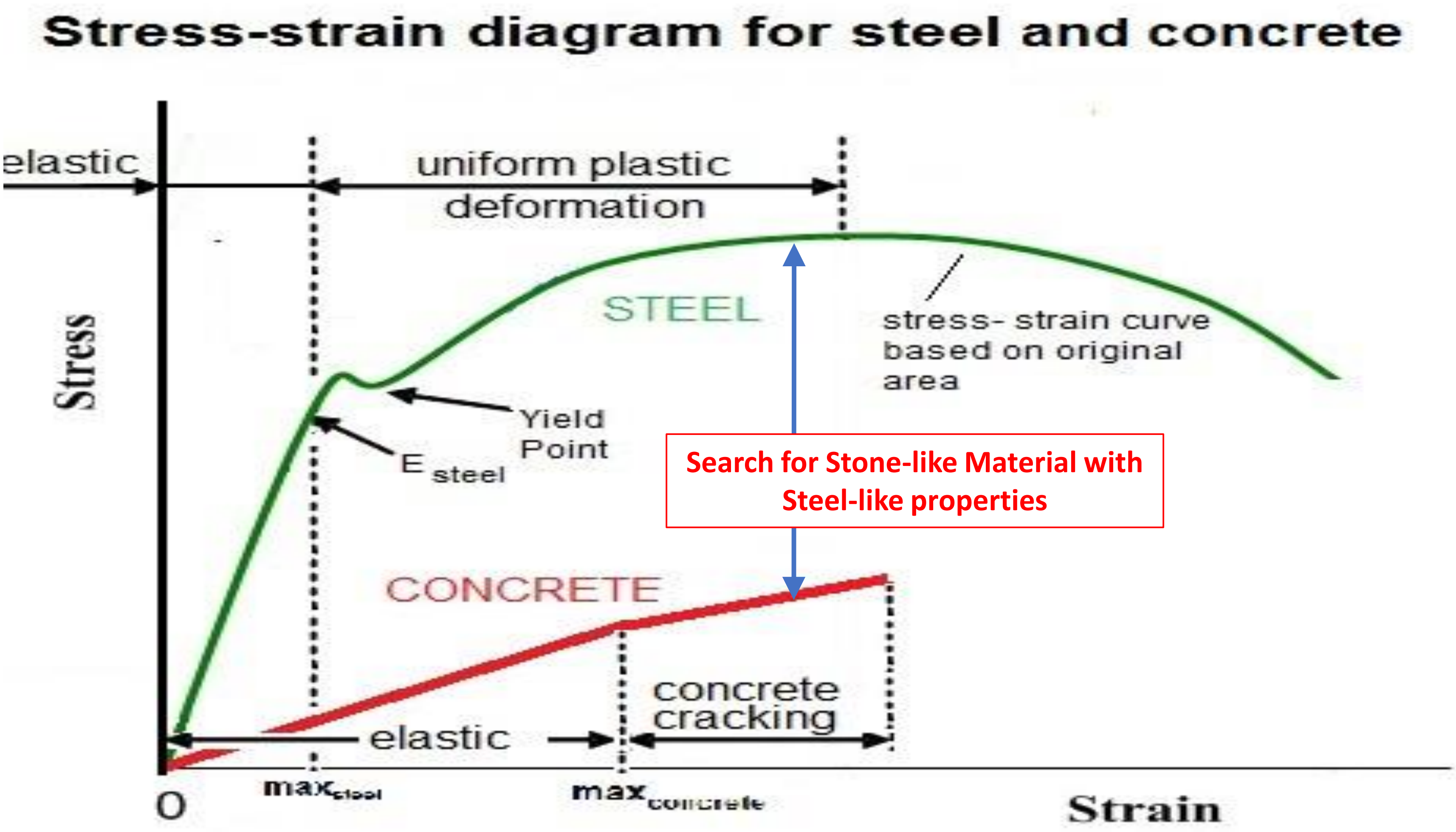
Concrete developed with above minerals and Parameters are

- High Volume Fly-ash /GGBS concrete
- Light weight Concrete
- High-Density Concrete
- Sulphur-Infiltrated Concrete
- Fibre Reinforced concrete
- Polymer Concrete
- Roller compacted concrete
- Self Compacting Concrete
- Smart Dynamic Concrete
- Ultra High performance Concrete

Challenges & Emerging Trends in Research Towards Futuristic Concrete

RESOLVED SOLUTIONS		BARRIER	CHALLENGES
Cementateous	High Strength Concrete		Rheology of Concrete
Fine Aggregate	High Volume GGBS Concrete		Autogeneous shrinkage
Coarse Aggregate	Ultra High Performance Concrete		Internal Curing
Water	Self Compacting Concrete		Self Curing
Mineral Admixtures	Smart Dynamic Concrete		Reduction of Creep
Chemical Admixtures			Toughness Enhancement
	Mass Concrete		Molecular Bonding
	Roller Compacted Concrete		Ductility Enhancement
	Pervious Concrete		Shrinkage Reduction
			Performance Independent of Chemistry, Bendable Concrete
			Mechanical Process
			Micro Structure Tailoring
CONTROL CONCRETE			FUTURISTIC CONCRETE

Challenges & Emerging Trends in Research Towards Durable Concrete

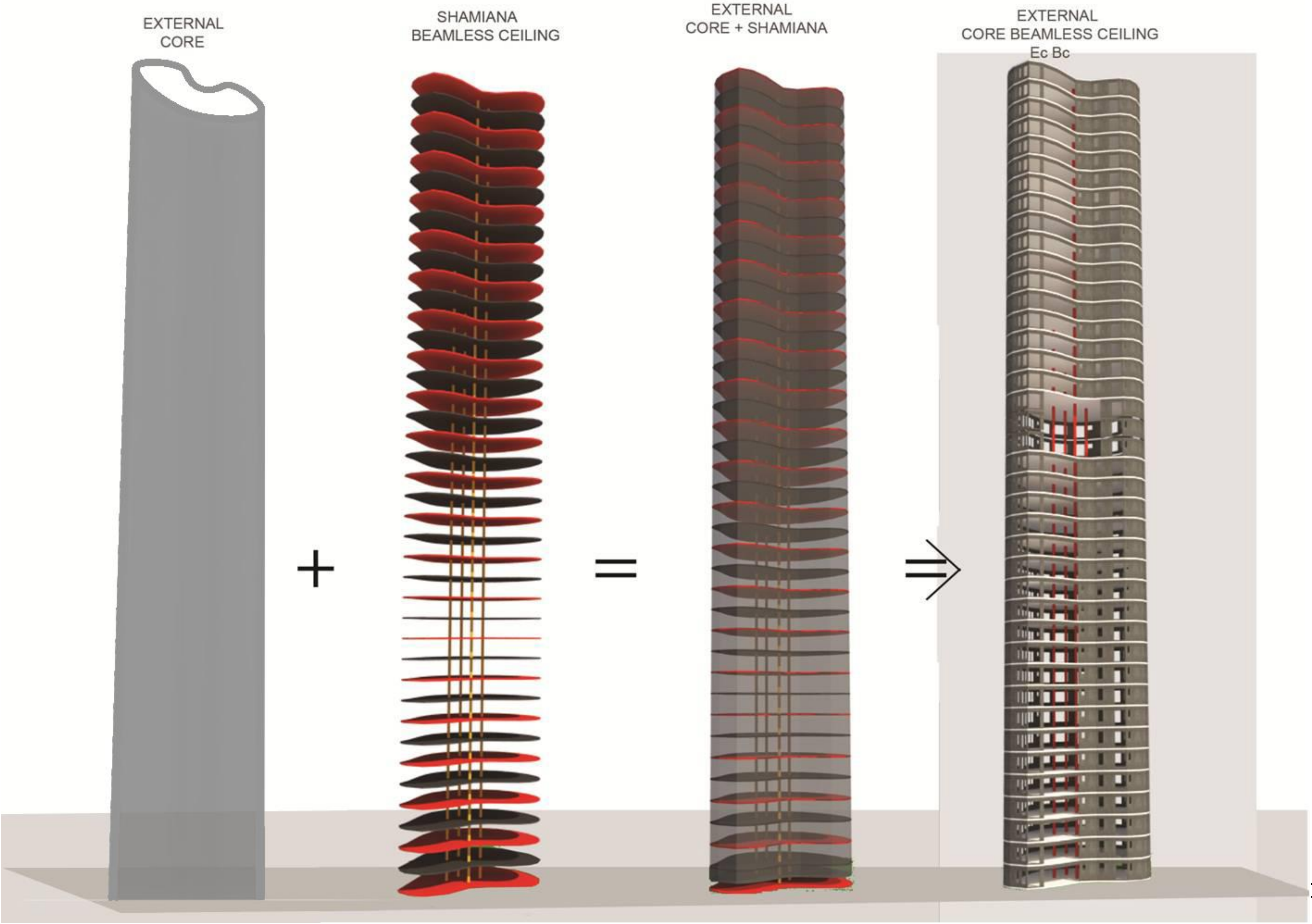


INTEGRATION OF STRUCTURAL SYSTEMS & CONCRETE MATERIAL SCIENCE

SYSTEM-1	SLAB BEAM SYSTEM
SYSTEM-2	MIVAN SYSTEM
SYSTEM-3	Ec Bc Dc™

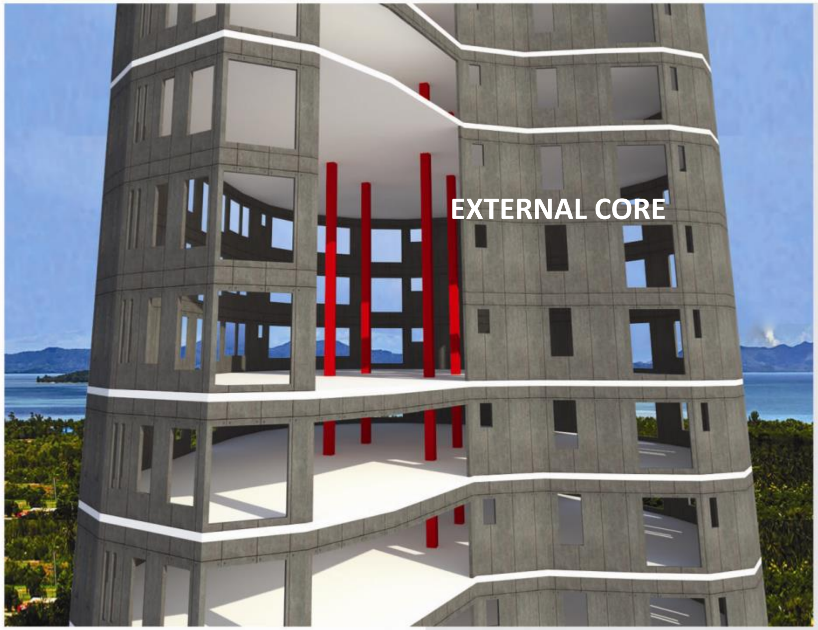
Example Project: **The Presidential Tower, Bangalore**

Ec Bc Dc™ SYSTEM

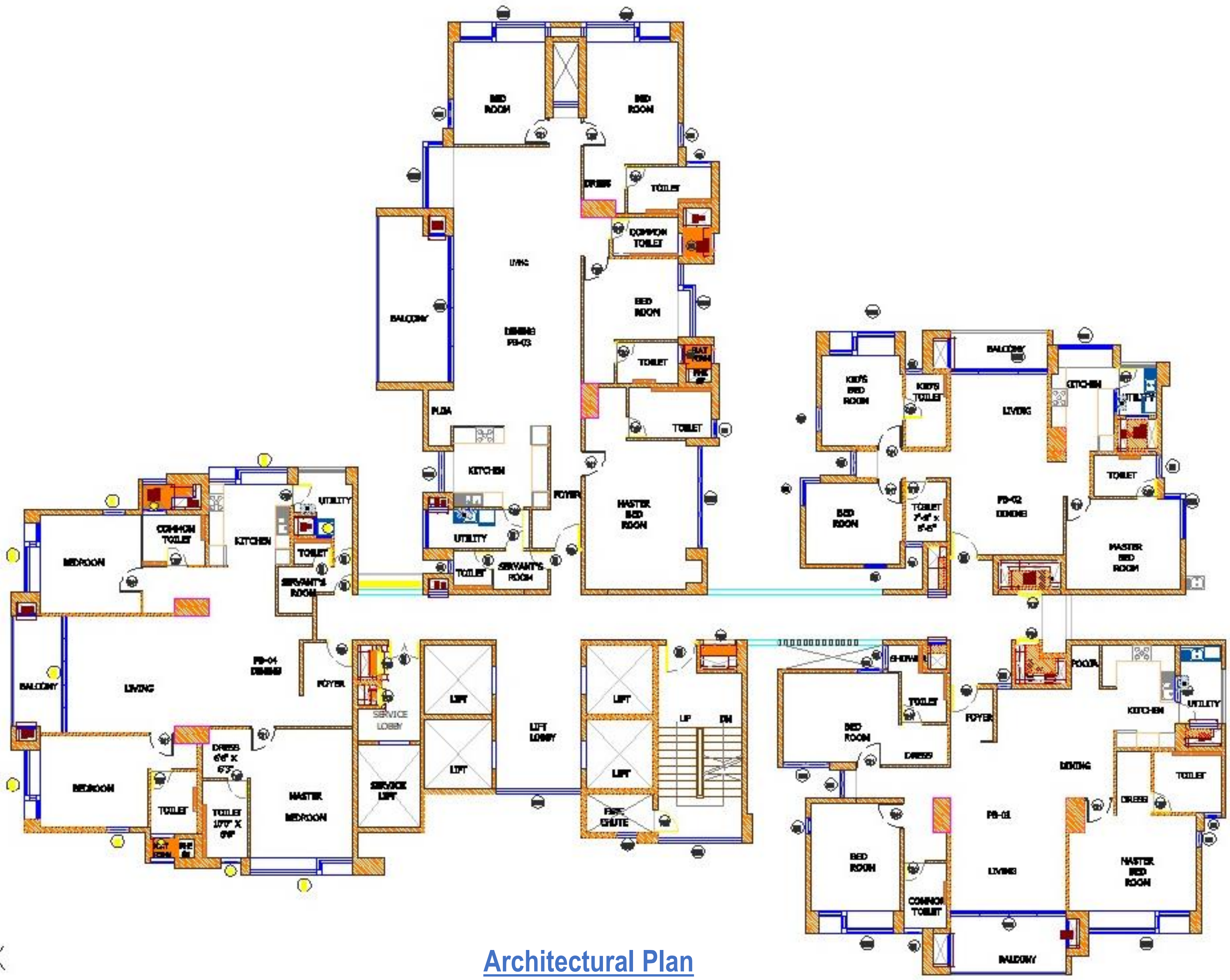


Chetana Exponential Technologies Pvt. Ltd.,

Ec Bc Dc™ SYSTEM

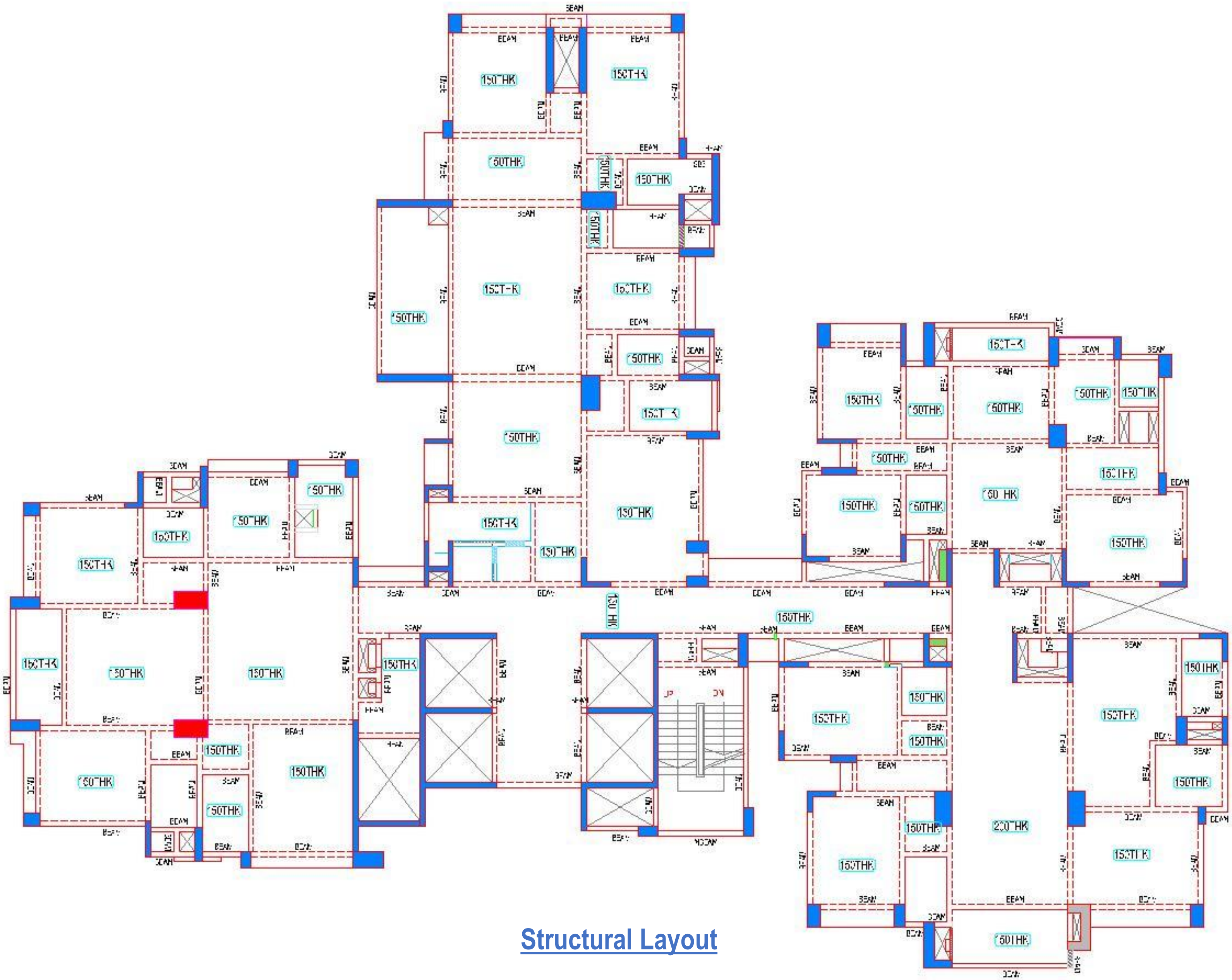


The Presidential Tower



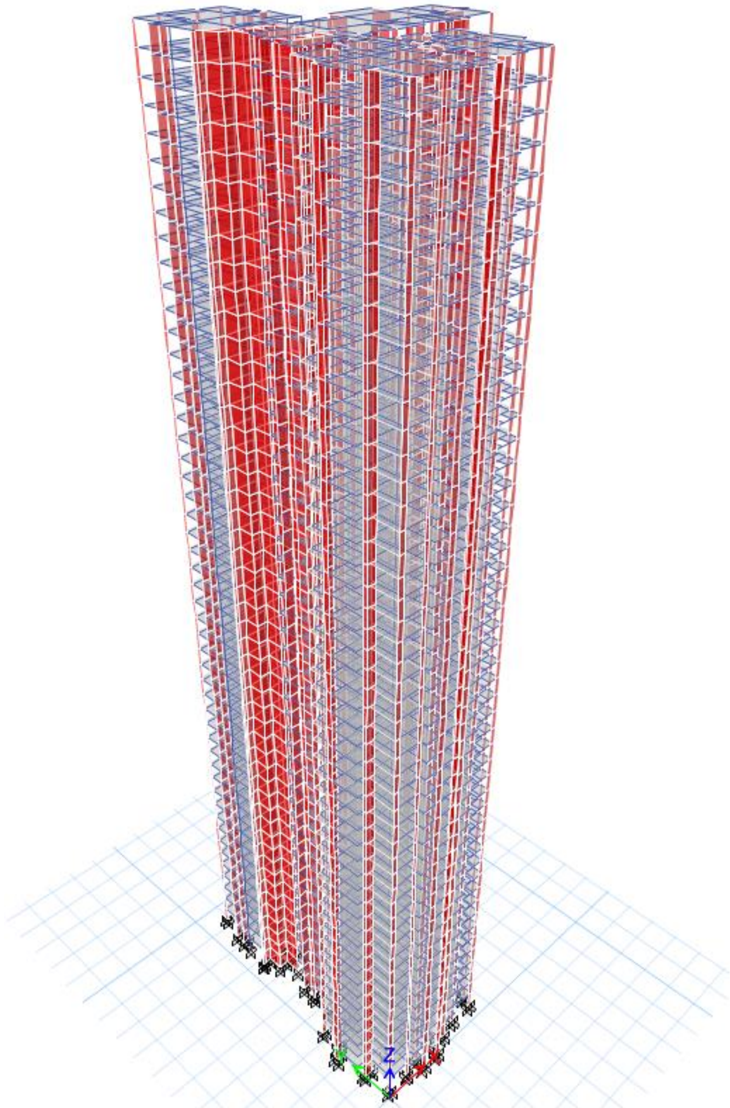
Architectural Plan

CONVENTIONAL SLAB BEAM SYSTEM

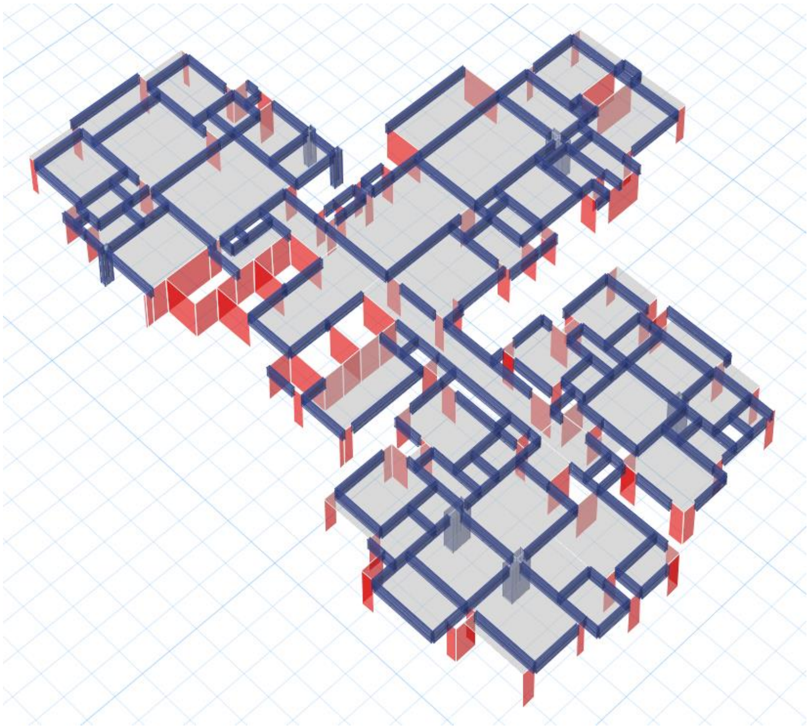


Structural Layout

CONVENTIONAL SLAB BEAM SYSTEM



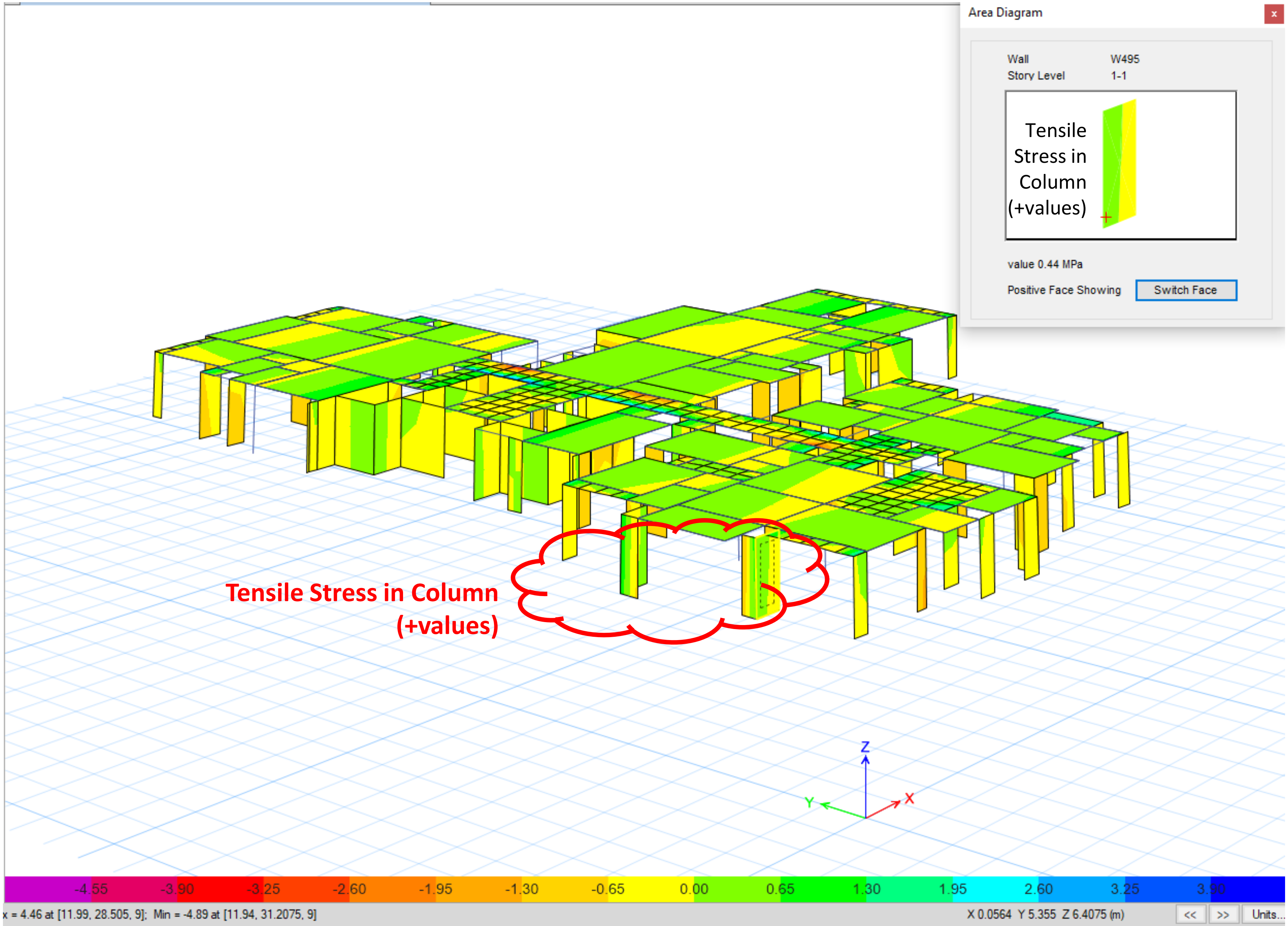
3D Structural Model



floor plan-beam slab system

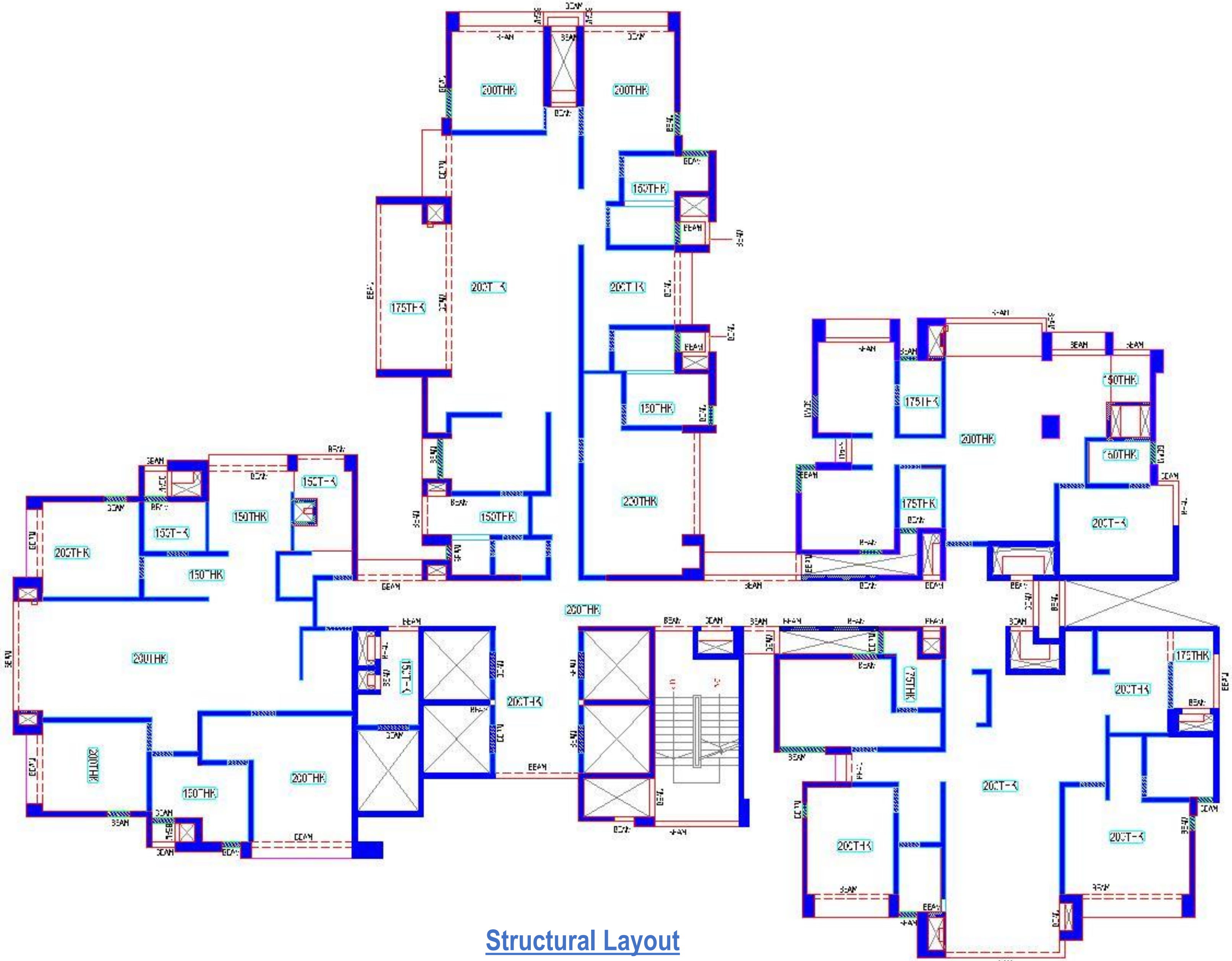
Chetana Exponential Technologies Pvt. Ltd.,

CONVENTIONAL SLAB BEAM SYSTEM



Chetana Exponential Technologies Pvt. Ltd.,

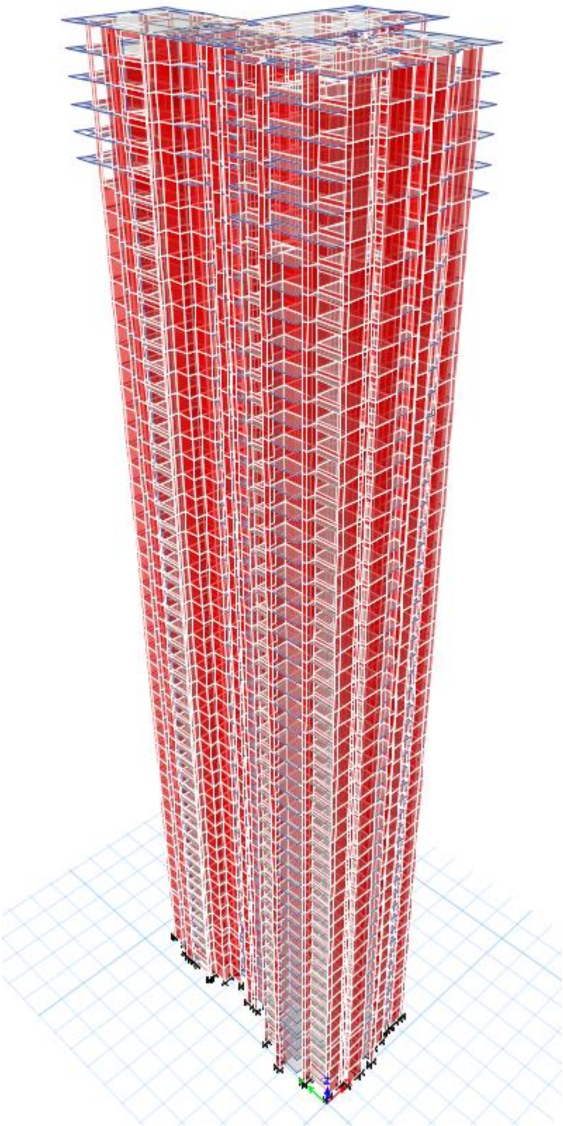
MIVAN SYSTEM



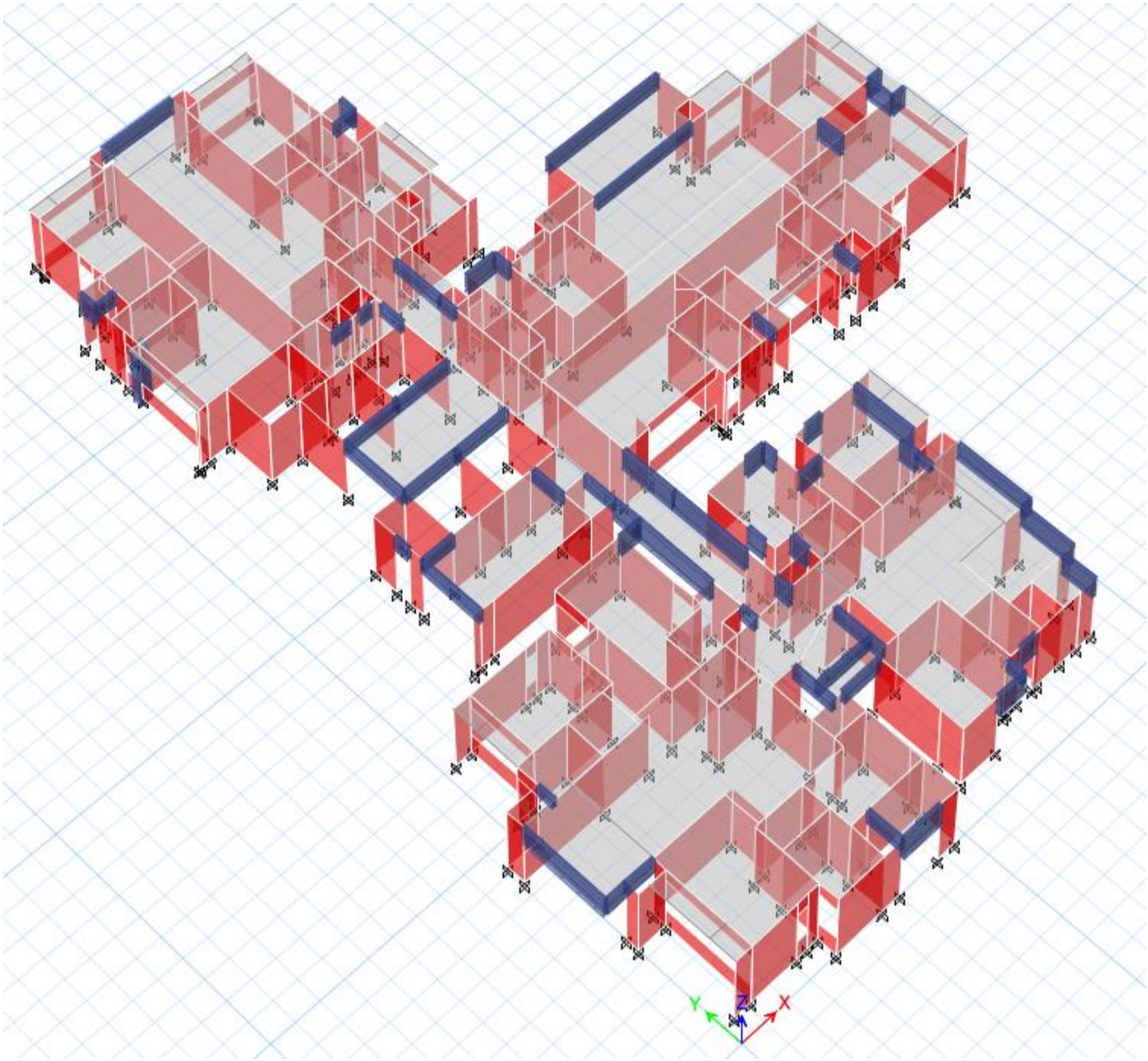
Structural Layout

Chetana Exponential Technologies Pvt. Ltd.,

MIVAN SYSTEM

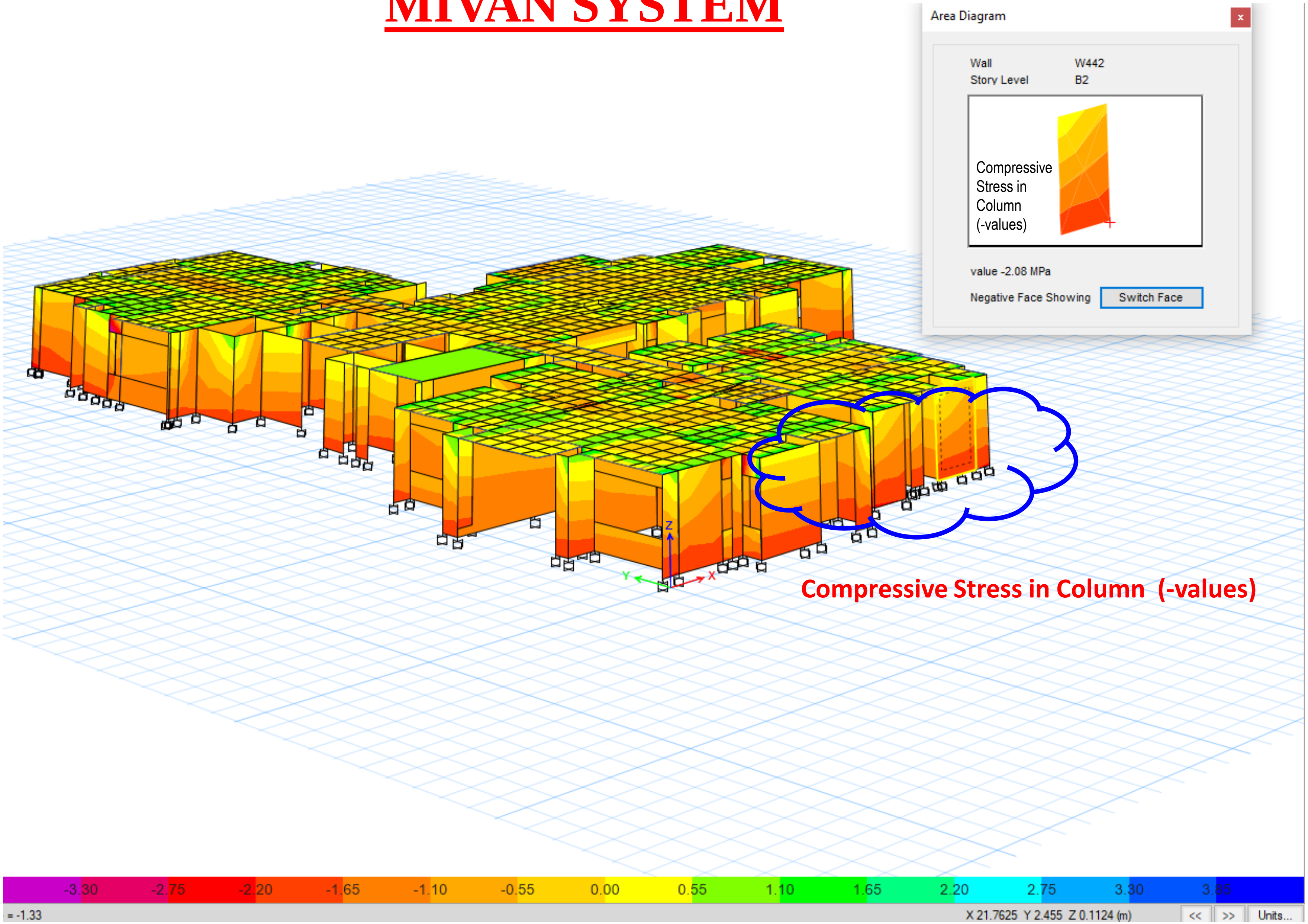


3D frame mivan system



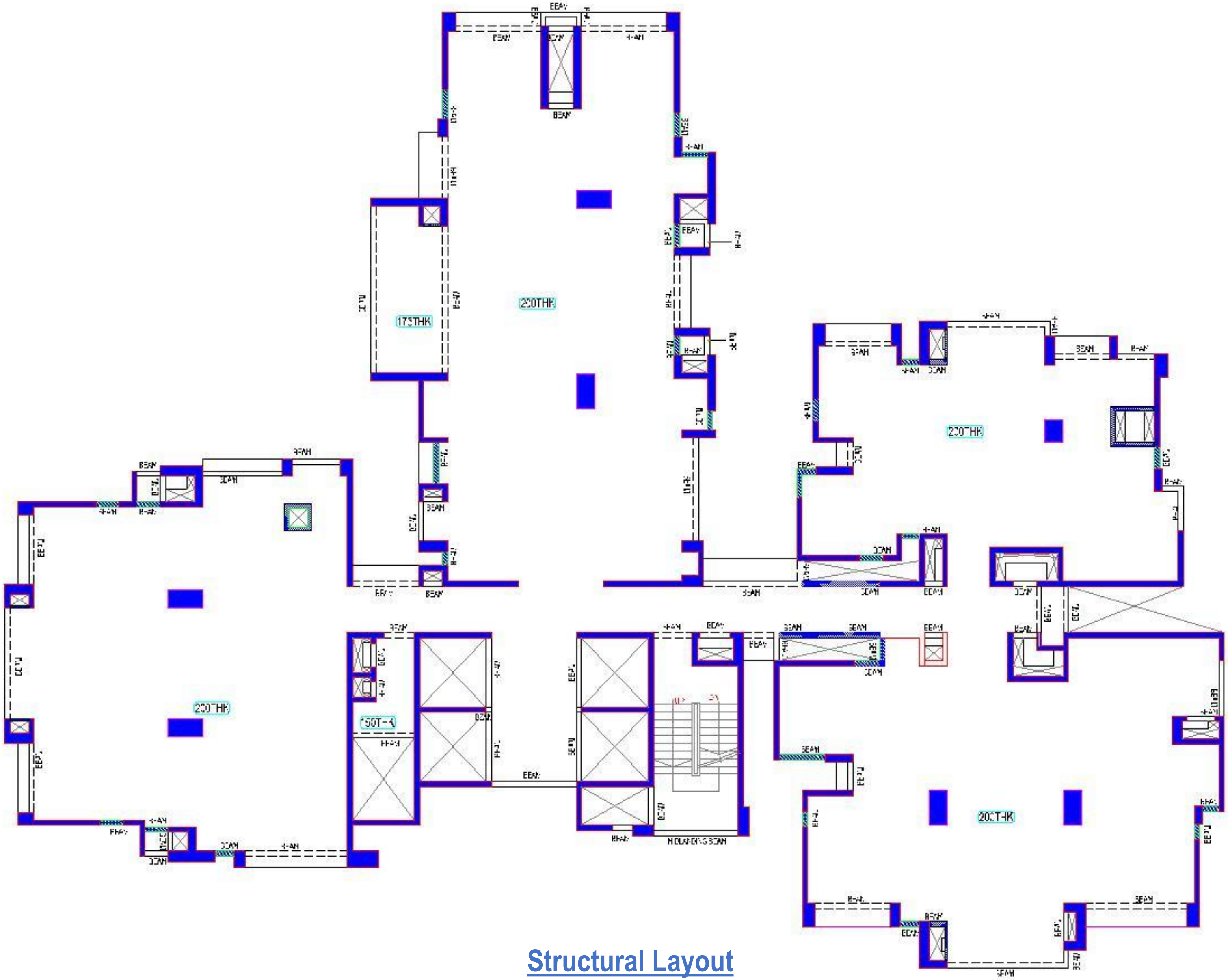
Floor plan - Mivan System

MIVAN SYSTEM



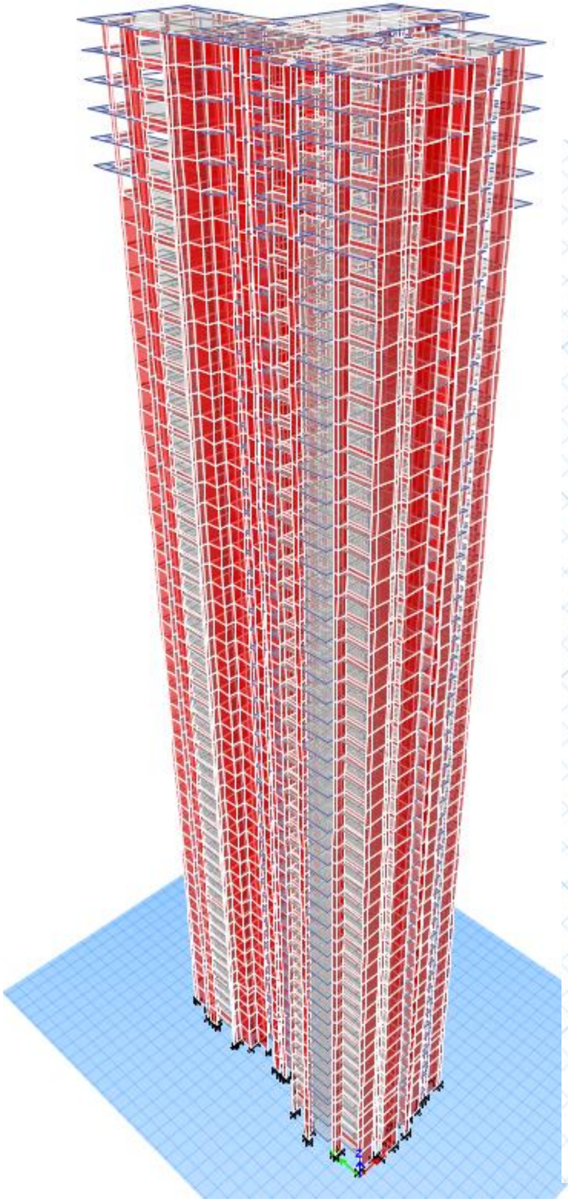
wall stress in mivan system

Ec Bc Dc™ SYSTEM

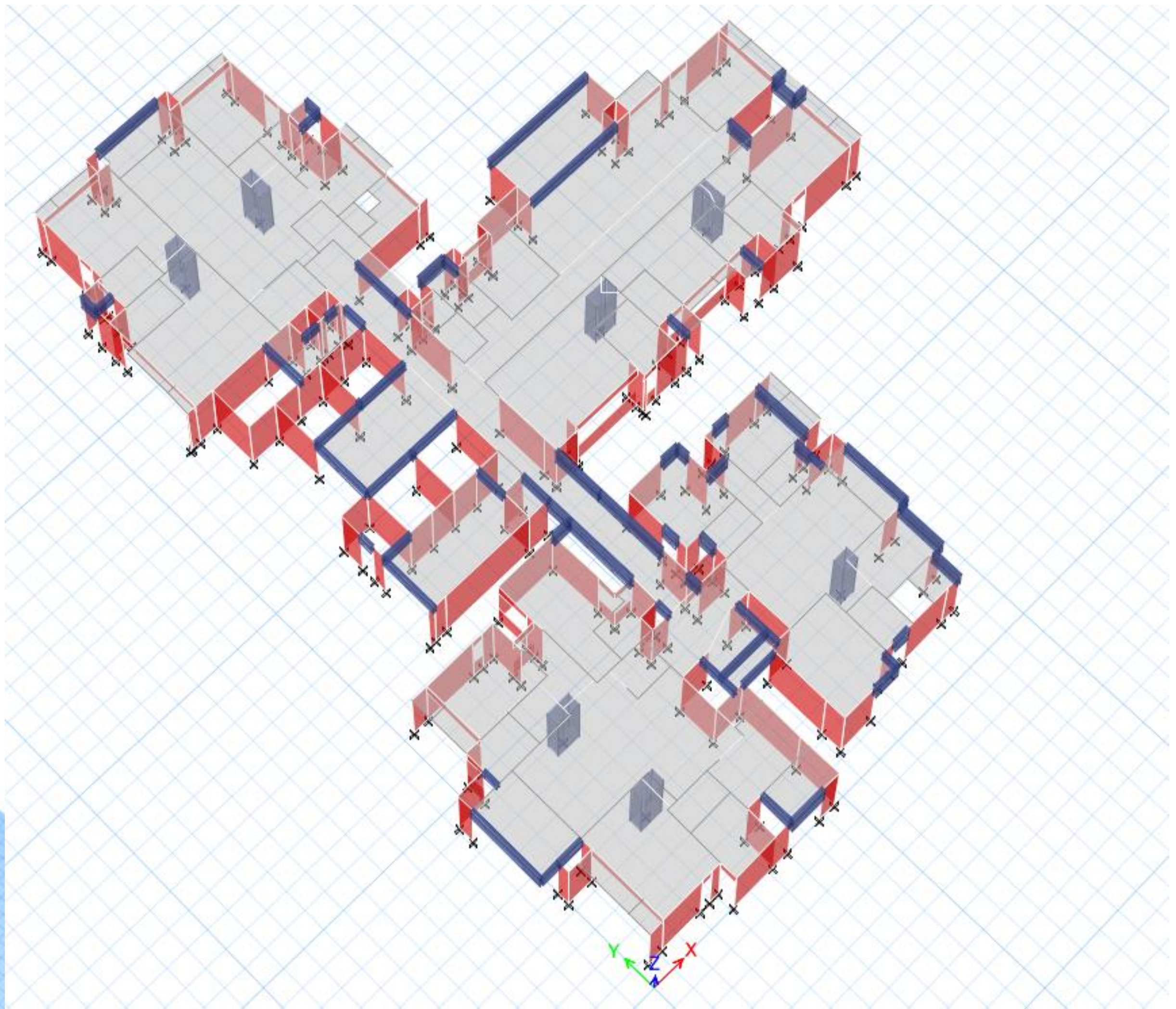


Structural Layout

Ec Bc Dc™ SYSTEM

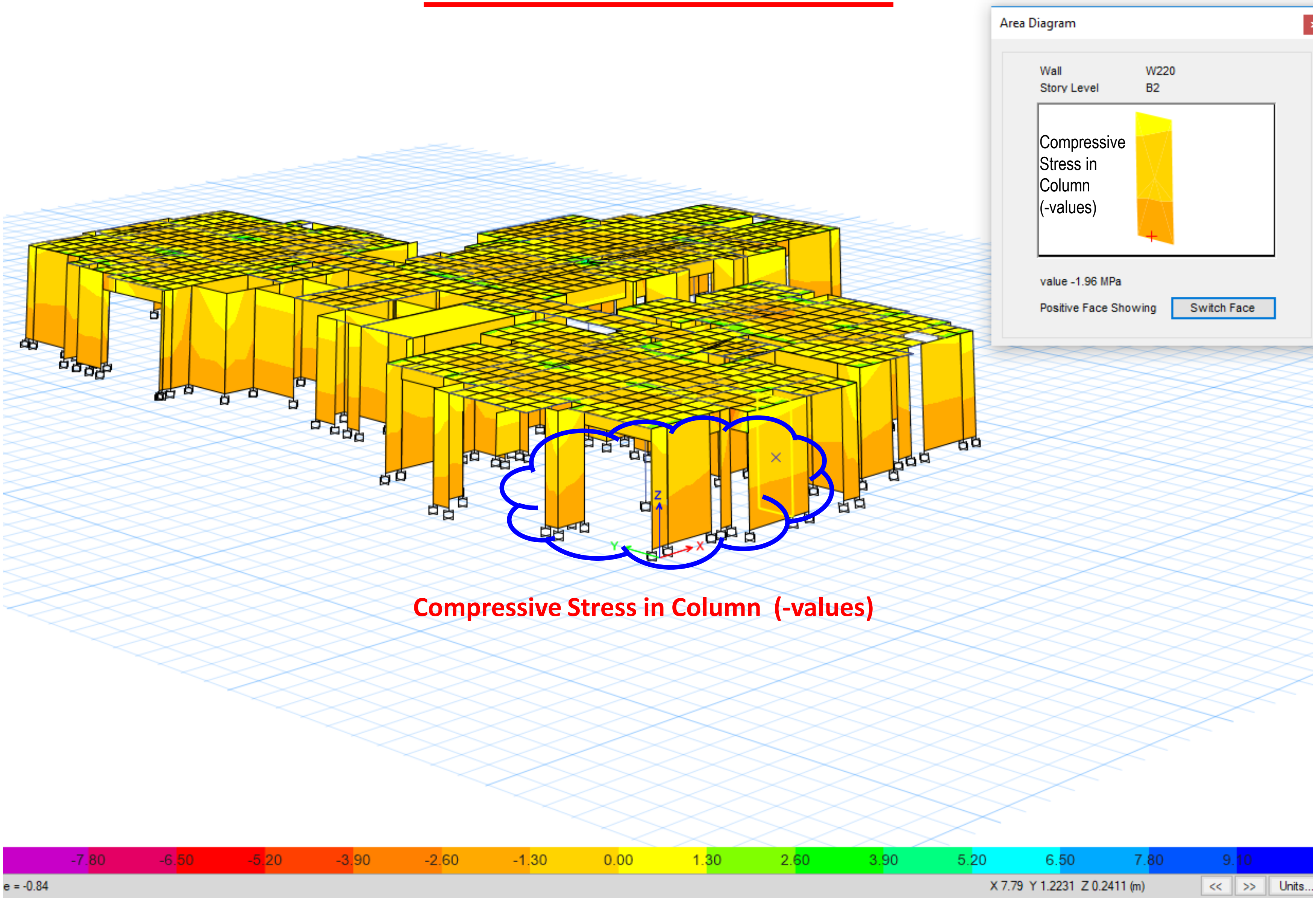


3d view EcBcDc system



floor plan EcBcDc system

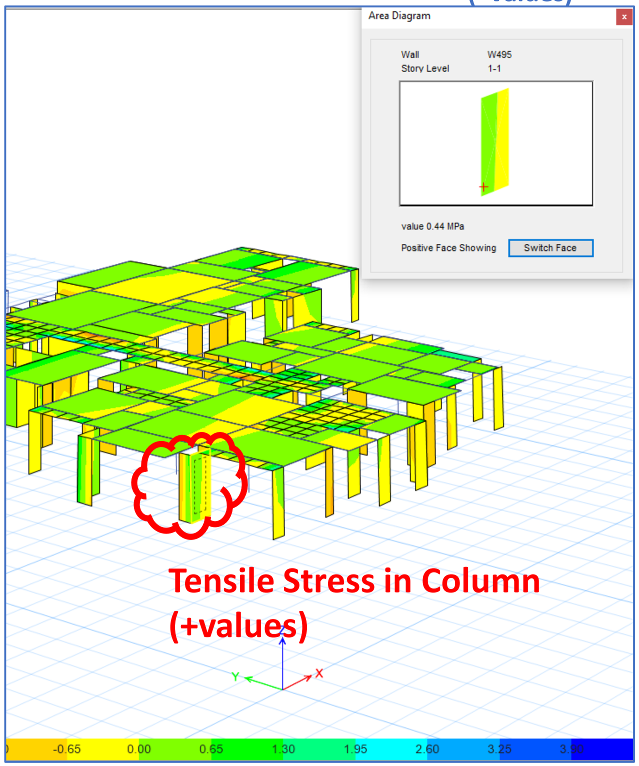
Ec Bc Dc™ SYSTEM



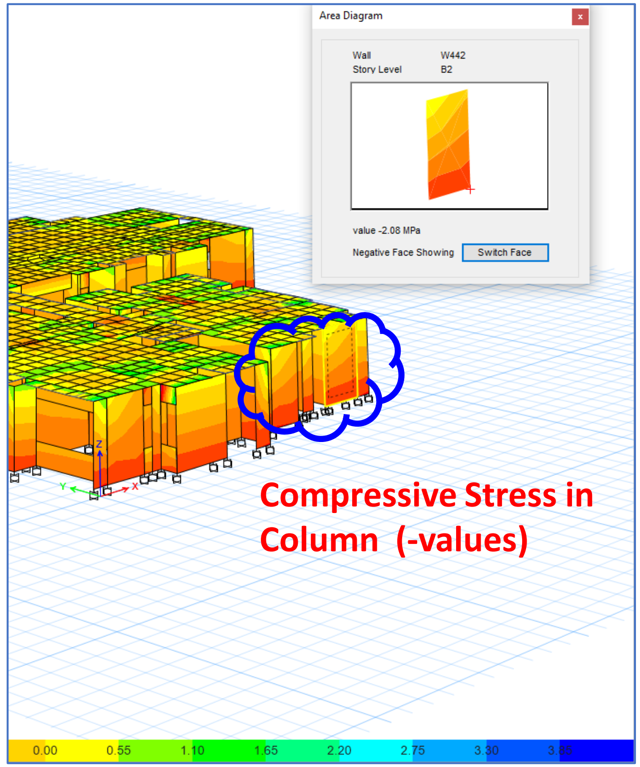
Wall stresses

Comparison of Performance

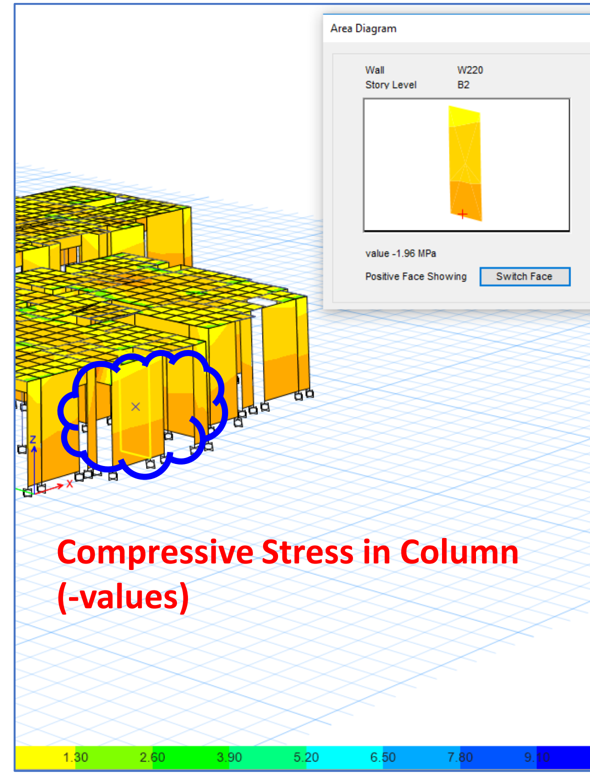
Tensile Stress in Column (+values)



Compressive Stress in Column (-values)



Compressive Stress in Column (-values)



SLAB BEAM SYSTEM	MIVAN SYSTEM	Ec Bc Dc™ System
Tensile Stress in Column (+values)	Compressive Stress in Column (-values)	Compressive Stress in Column (-values)

- Axial tension stress observed in vertical elements for beam slab system where as other two system shows axial compressive stresses.

Conclusions:

- Axial tension stress observed in vertical elements for beam slab system where as other two system shows axial compressive stresses.
- There is an impact of structural system for material science demand.
- Depending on structural system, material science can be varied.
- Due to compressive stress in wall system, the High strength concrete demand can be varied.
- High strength concrete will add advantages in high rise buildings structural systems.
- By choosing efficient structural systems, we can achieve good performance using moderate grade concretes.

Thank you….