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Session 2: Presentation on –

Integration of Structural Systems & New Generation Concrete Materials Science for Performance

By

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EVOLUTION OF STRUCTURAL SYSTEMS

Session 2: Presentation on –

Integration of Structural Systems & New Generation Concrete Material Science for Performance

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.

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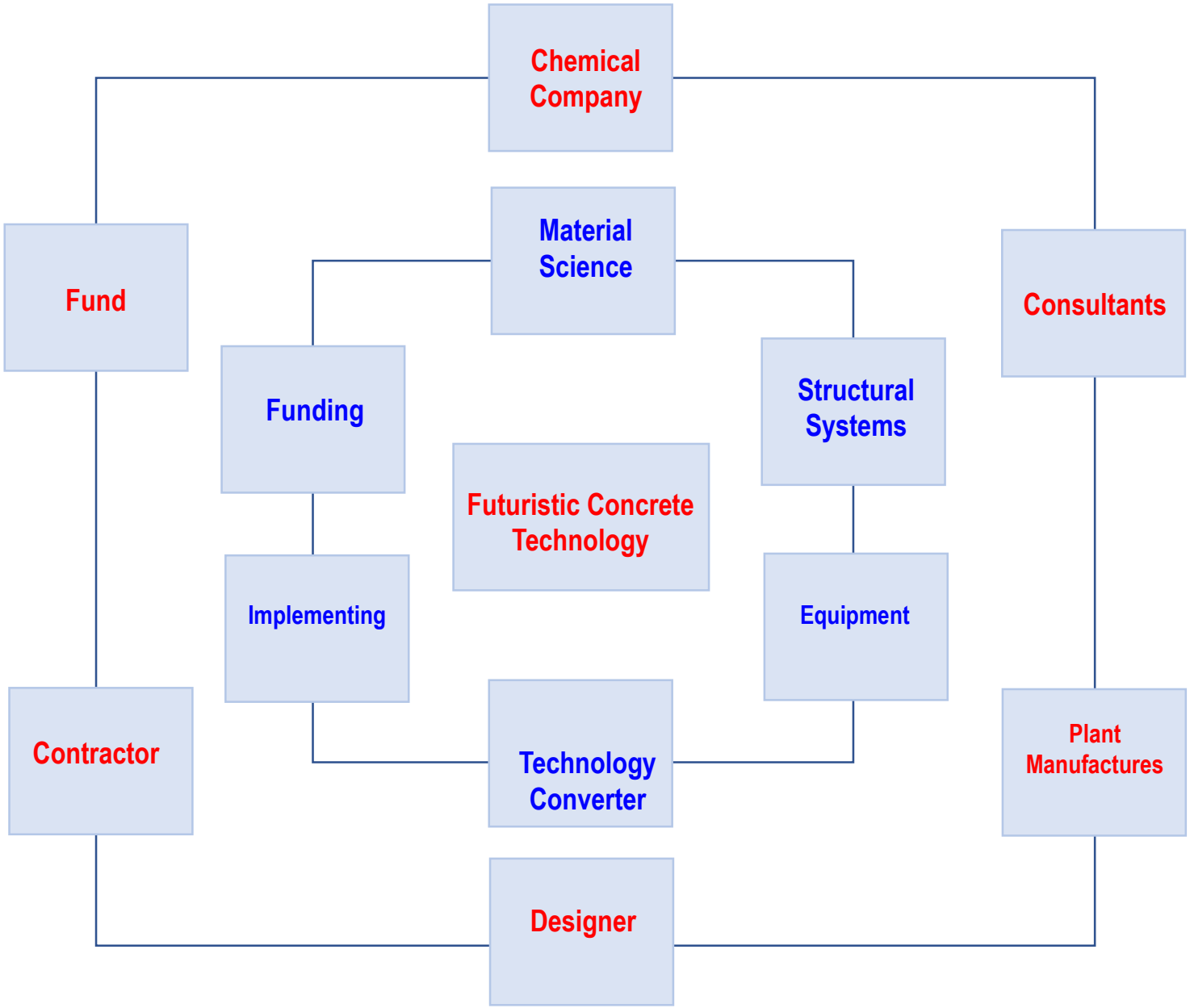
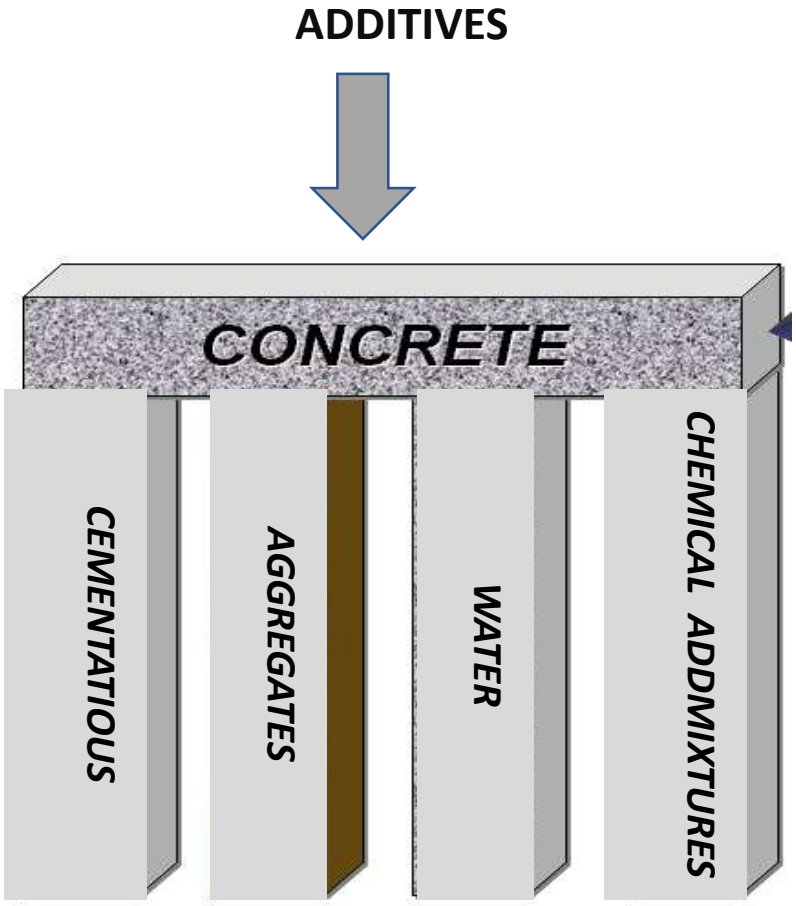


CONCRETE SCIENCE

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	➢Fly ash
➢Diatomaceous earth	➢Ground Granulated Blast furnace Slag (GGBS)
➢Opalinic cherts	➢Silica fume
➢Volcanic tuffs and pumicites	➢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

Cementateous
Fine Aggregate
Coarse Aggregate
Water
Mineral Admixtures
Chemical Admixtures

High Strength Concrete
High Volume GGBS Concrete
Ultra High Performance Concrete
Self Compacting Concrete
Smart Dynamic Concrete
Mass Concrete
Roller Compacted Concrete
Pervious Concrete

BARRIER

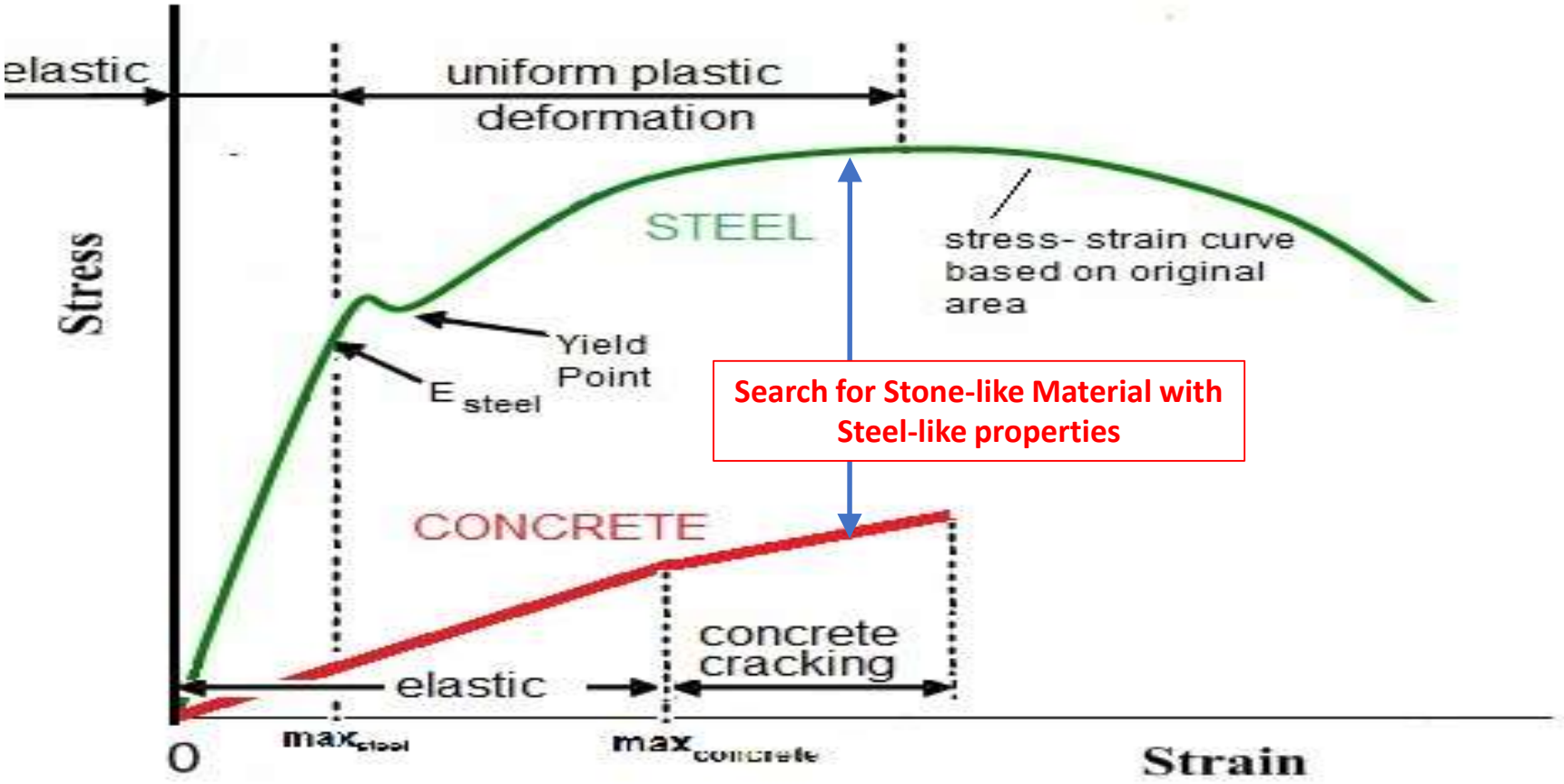
CHALLENGES

Rheology of Concrete
Autogeneous shrinkage
Internal Curing
Self Curing
Reduction of Creep
Toughness Enhancement
Molecular Bonding
Ductility Enhancement
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

Stress-strain diagram for steel and concrete



INTEGRATION OF STRUCTURAL SYSTEMS & CONCRETE MATERIAL SCIENCE

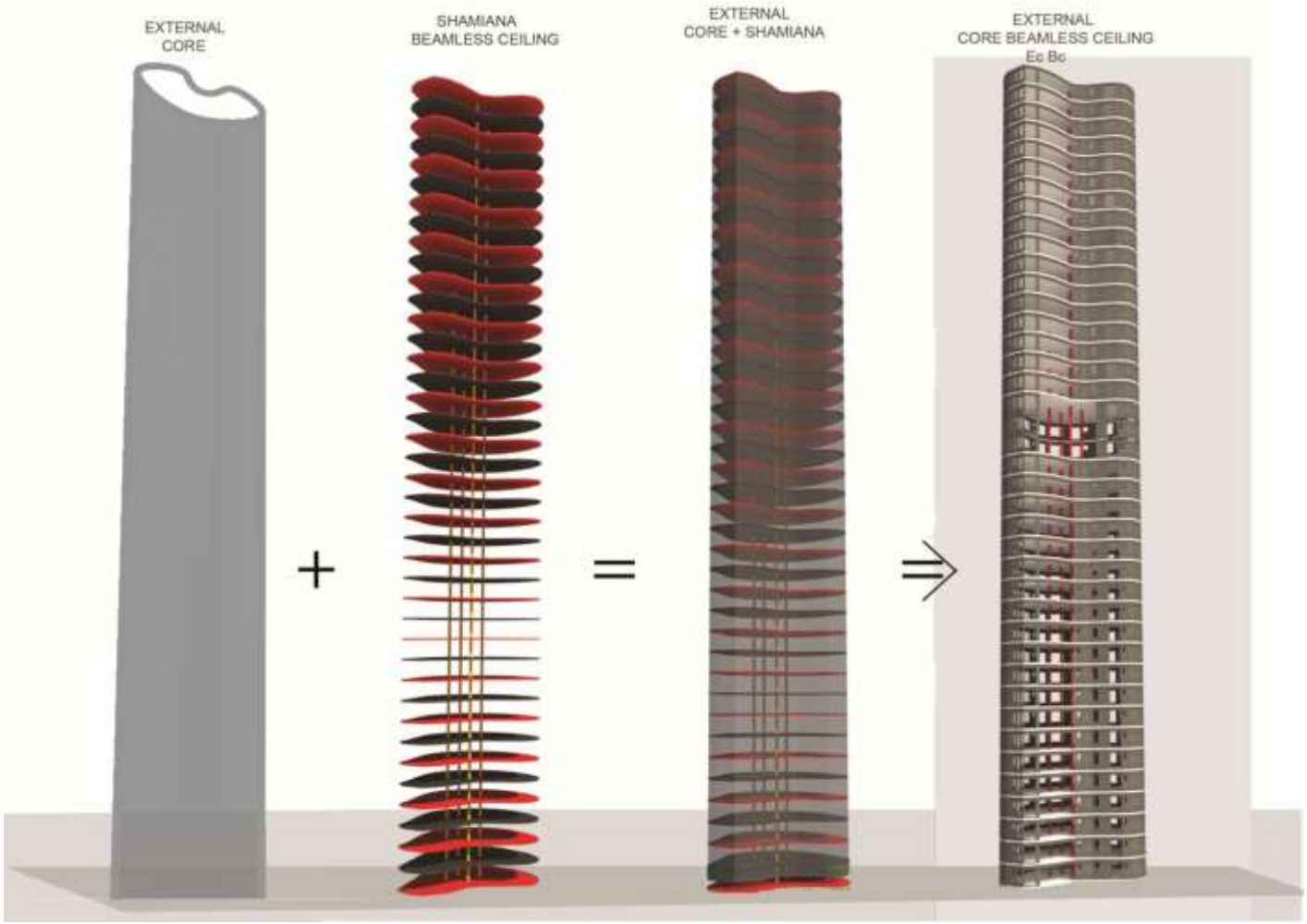
SYSTEM-1 SLAB BEAM SYSTEM

SYSTEM-2 MIVAN SYSTEM

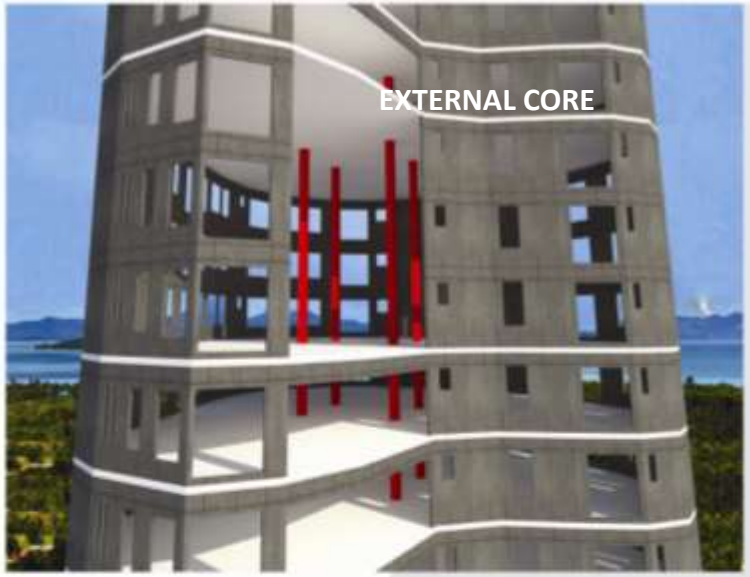
SYSTEM-3 Ec Bc Dc™

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

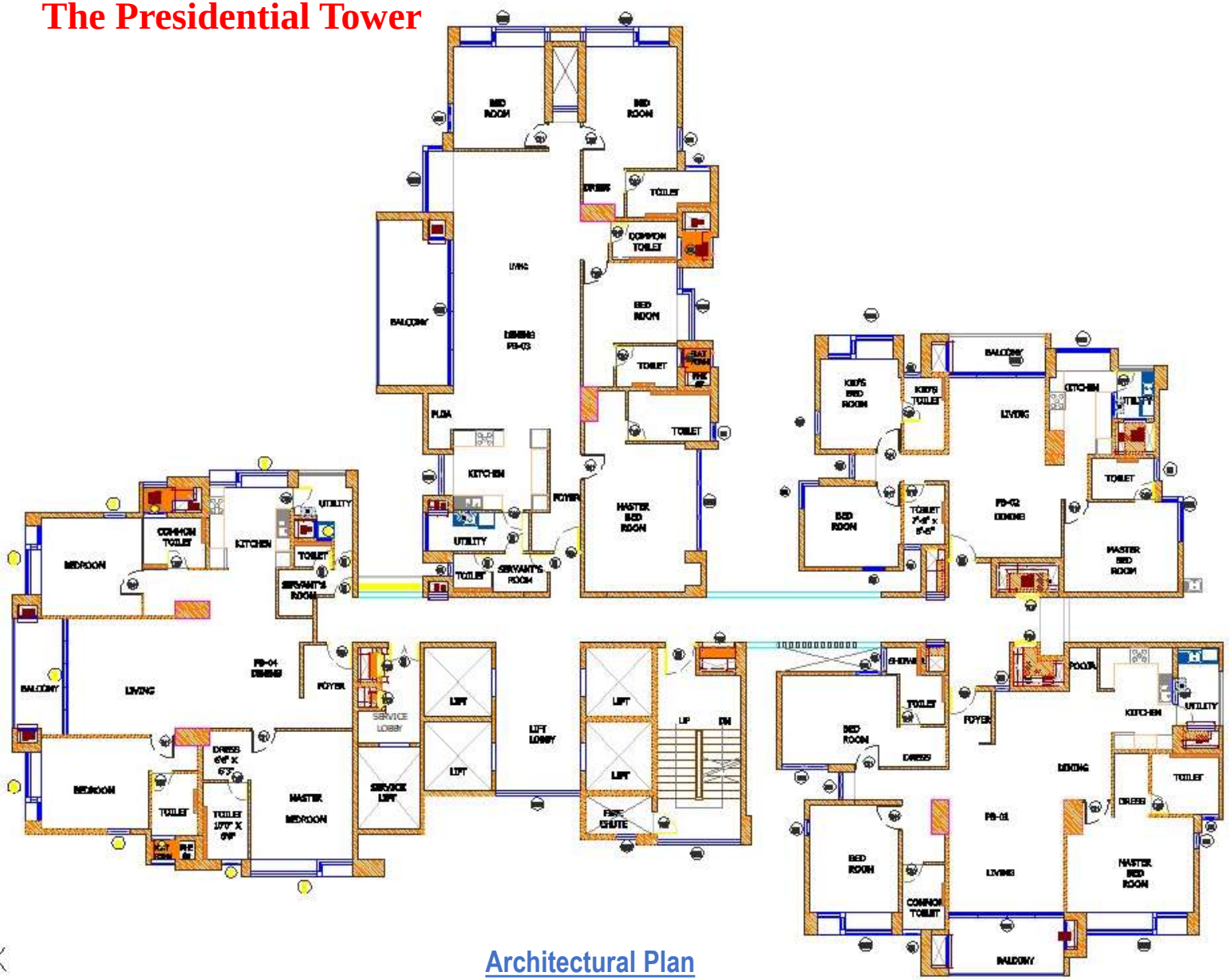
Ec Bc Dc™ SYSTEM



Ec Bc Dc™ SYSTEM



The Presidential Tower

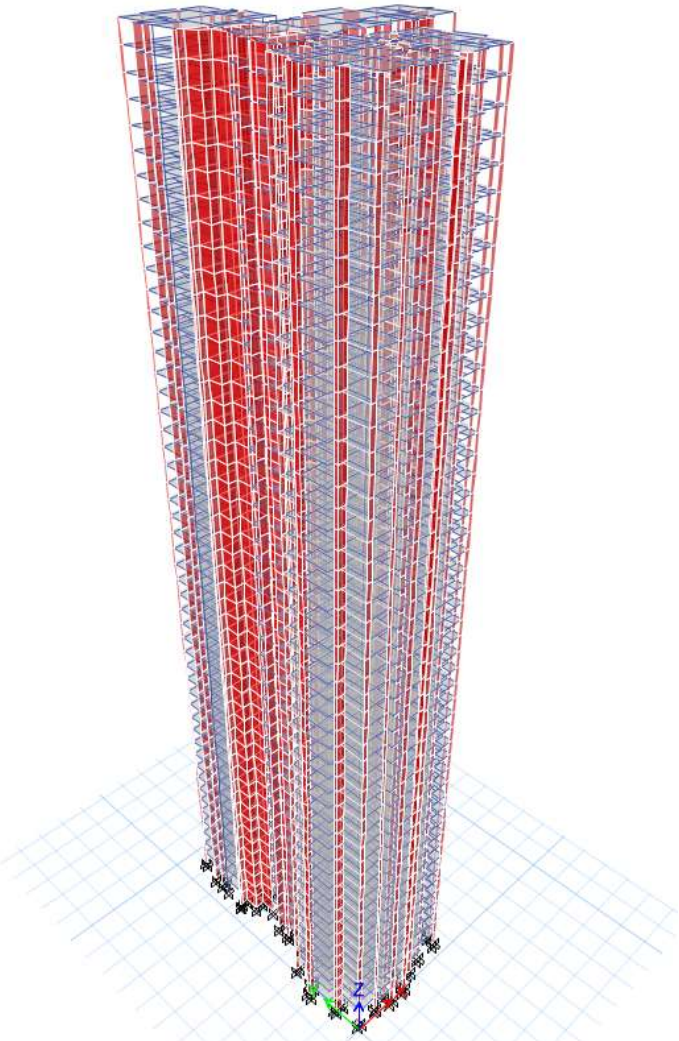


Architectural Plan

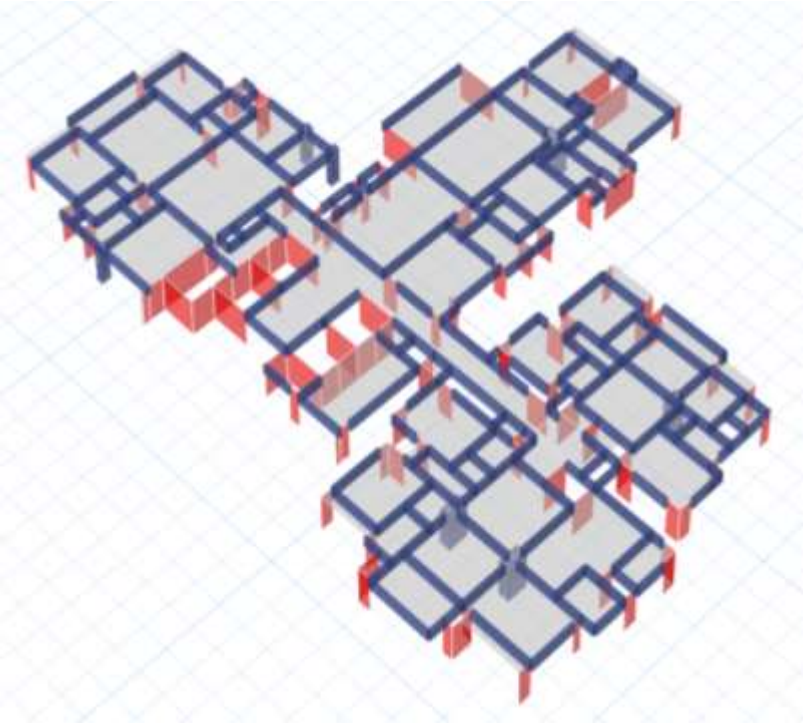
CONVENTIONAL SLAB BEAM SYSTEM

Structural Layout

CONVENTIONAL SLAB BEAM SYSTEM

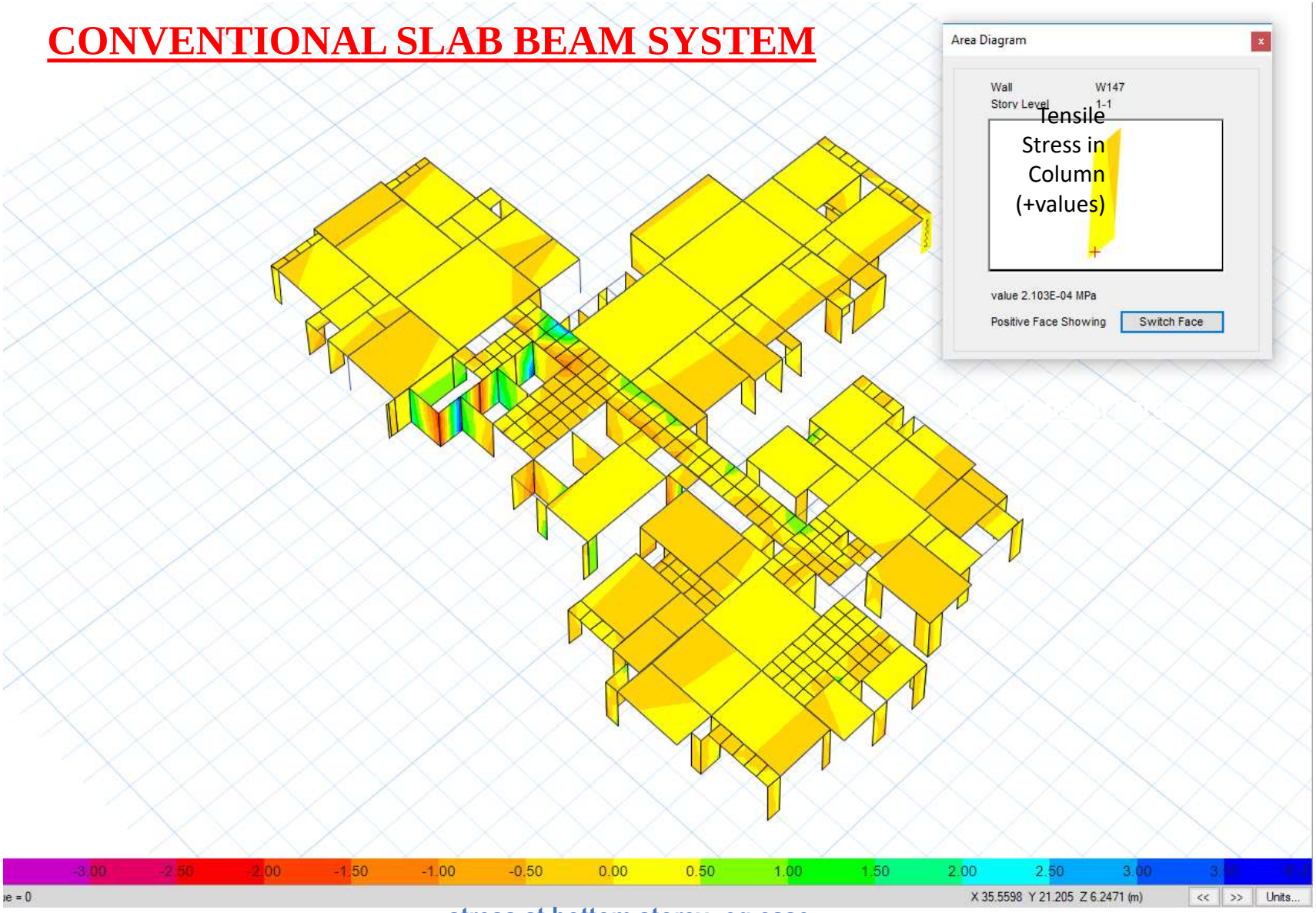


3D Structural Model



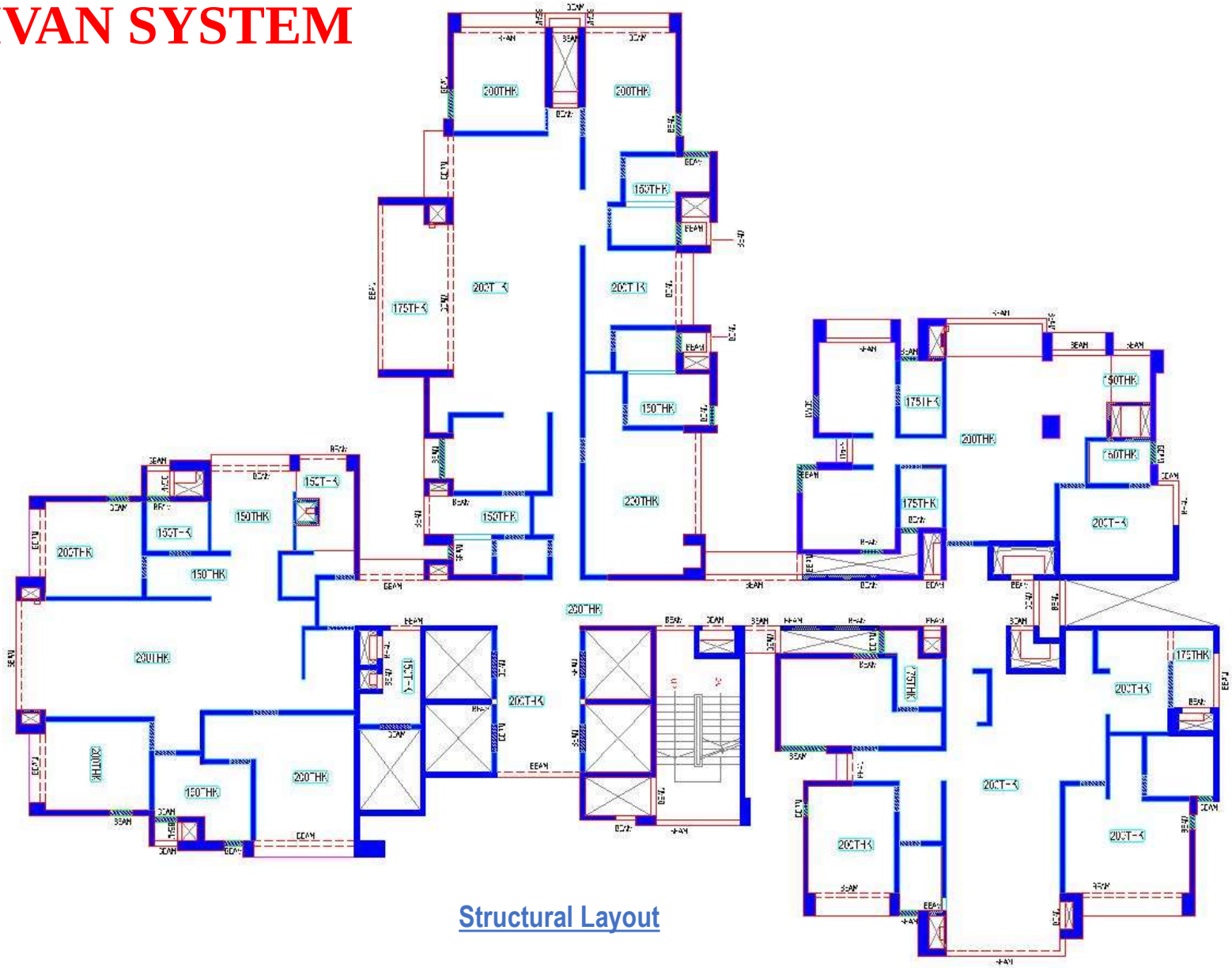
floor plan-beam slab system

CONVENTIONAL SLAB BEAM SYSTEM



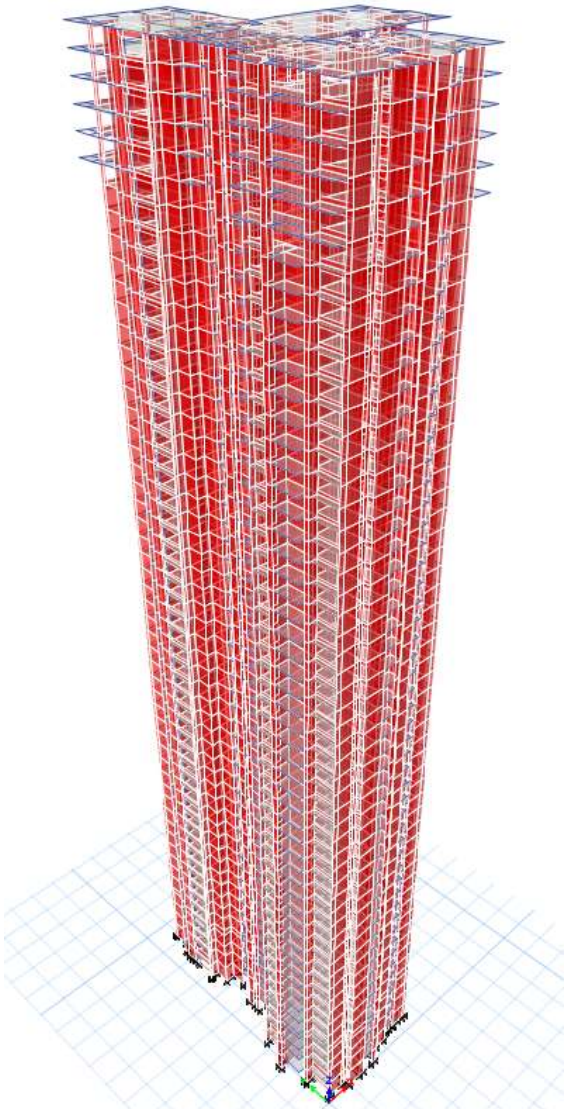
stress at bottom storey- eq case

MIVAN SYSTEM

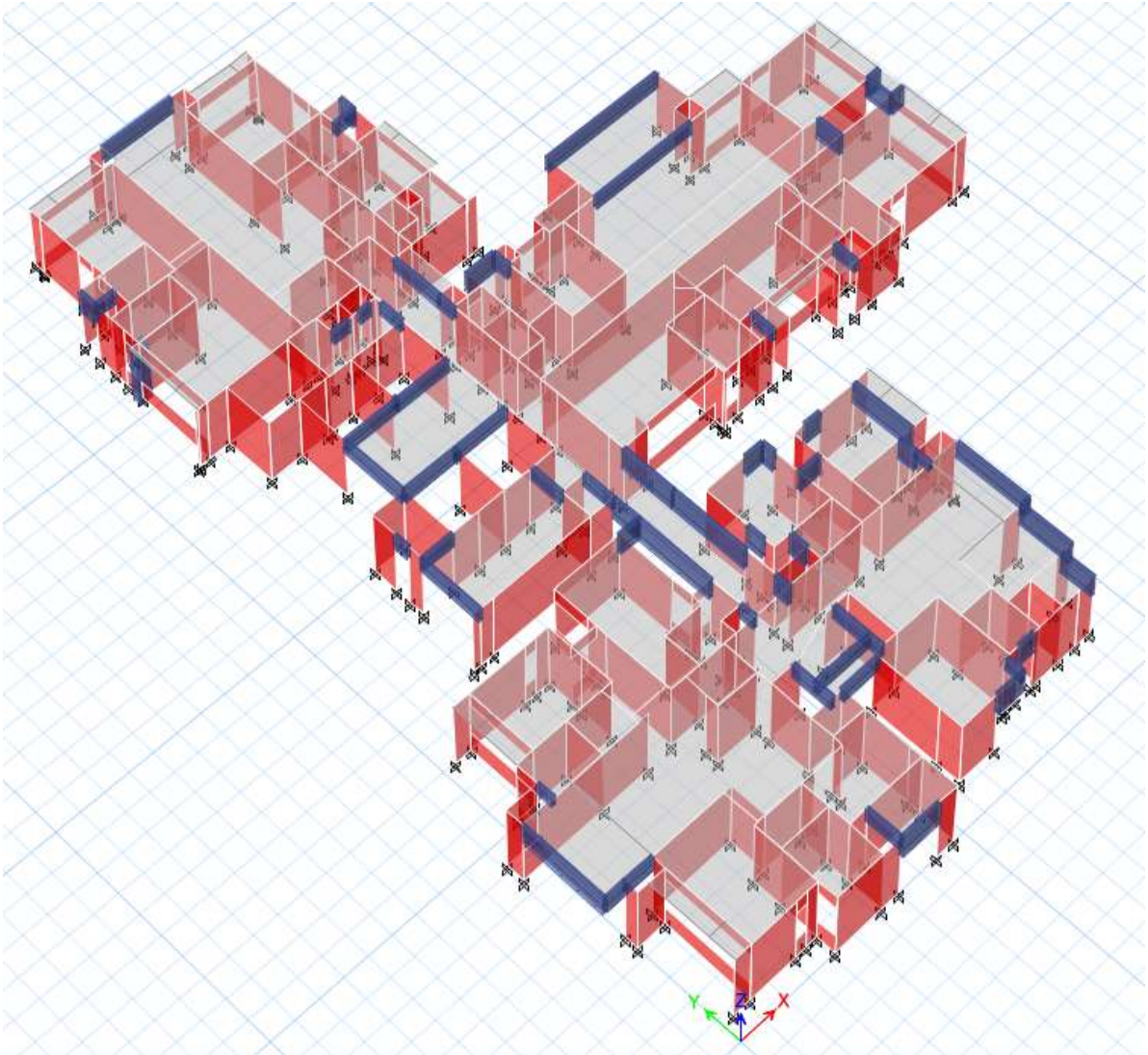


Structural Layout

MIVAN SYSTEM

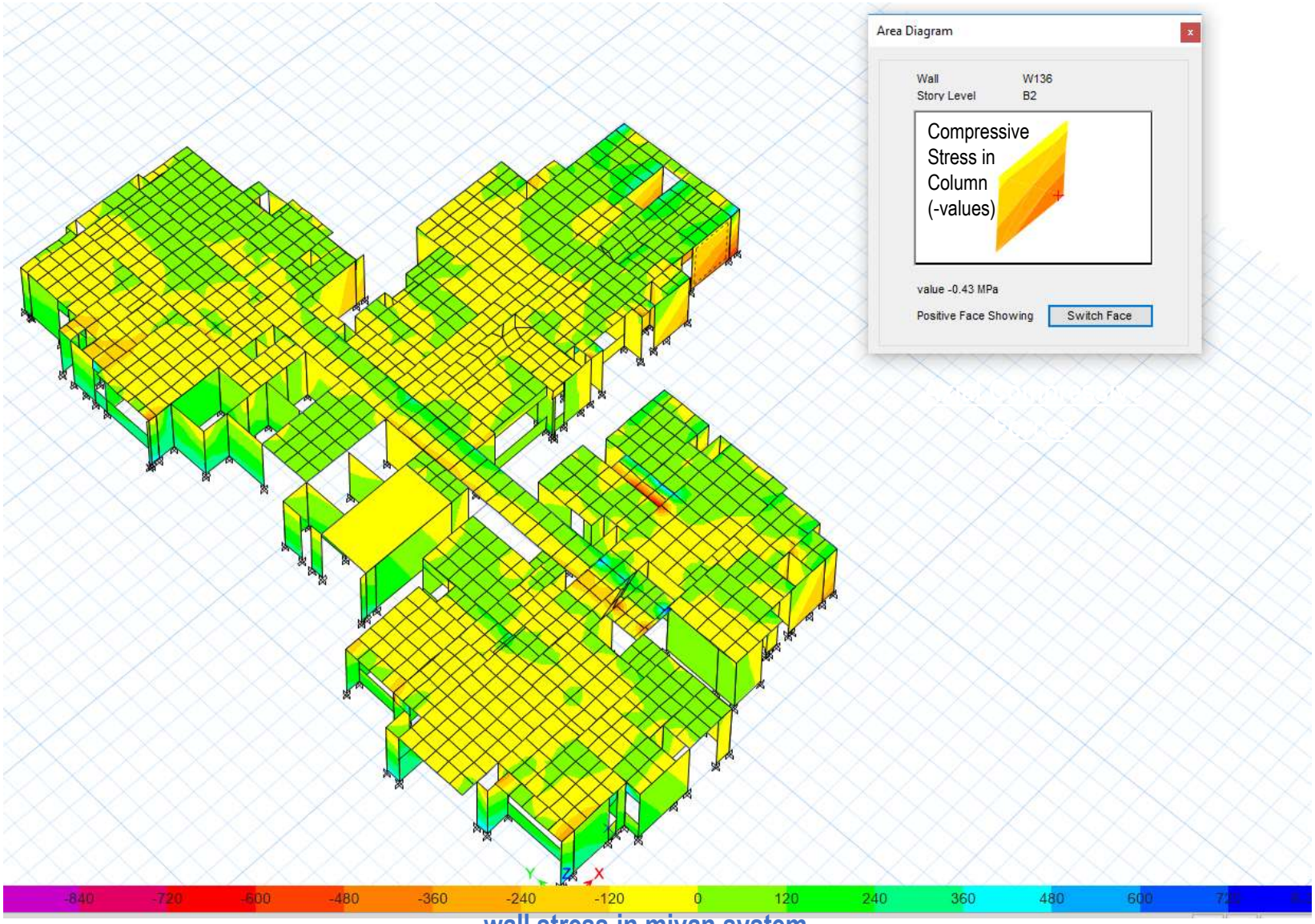


3D frame mivan system



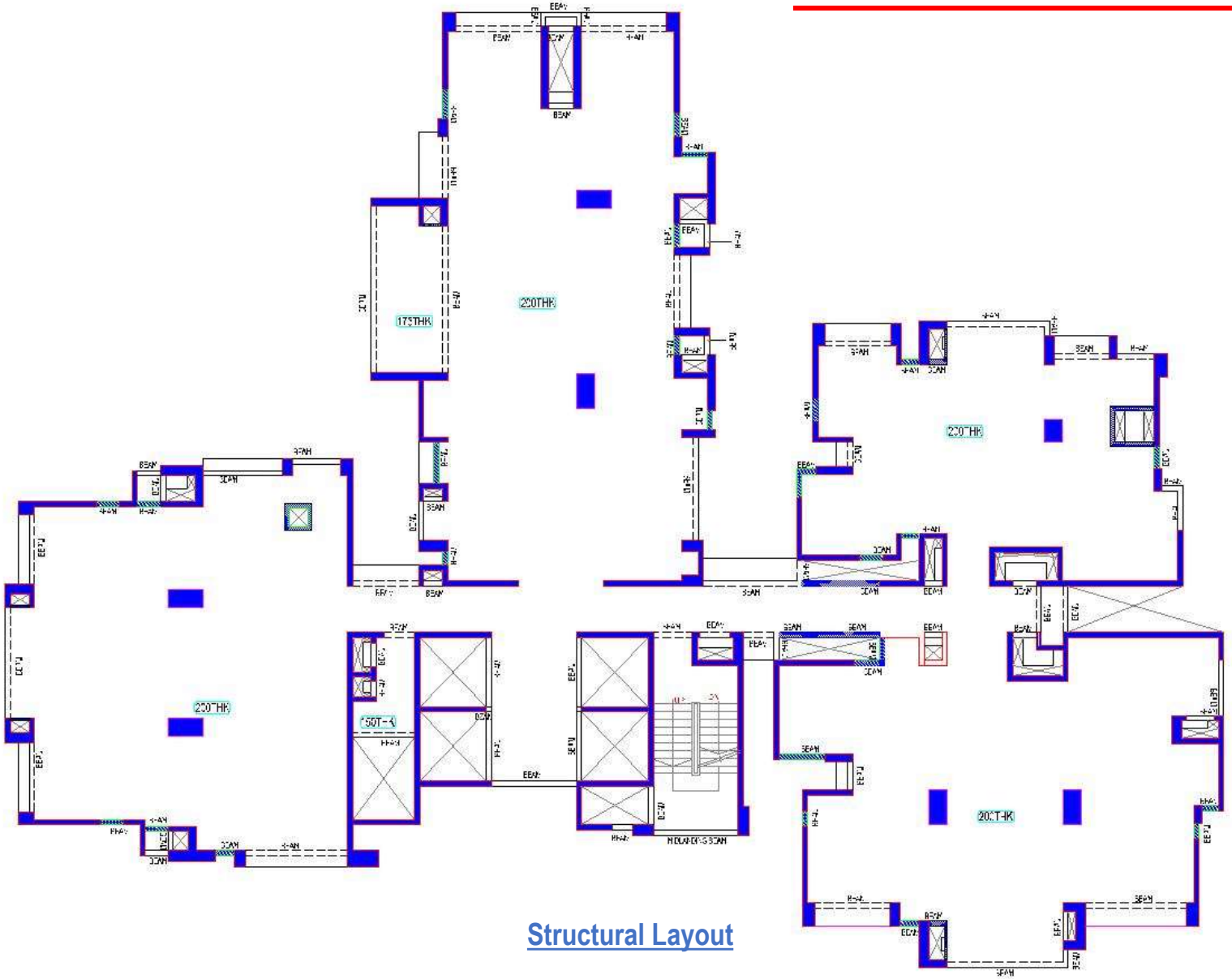
Floor plan - Mivan System

MIVAN SYSTEM



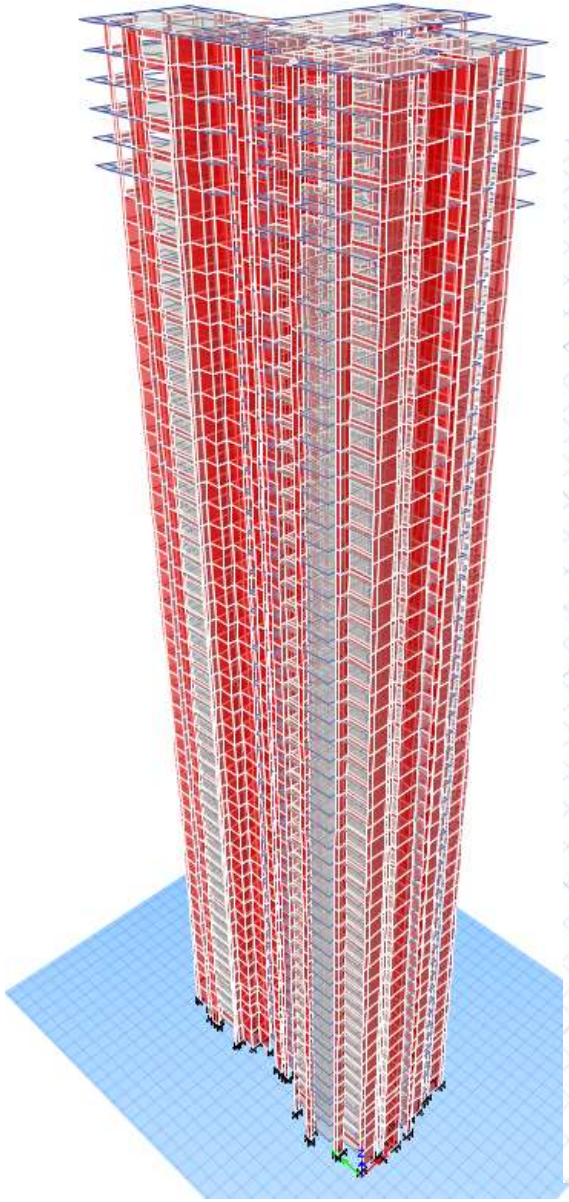
wall stress in mivan system

Ec Bc Dc™ SYSTEM

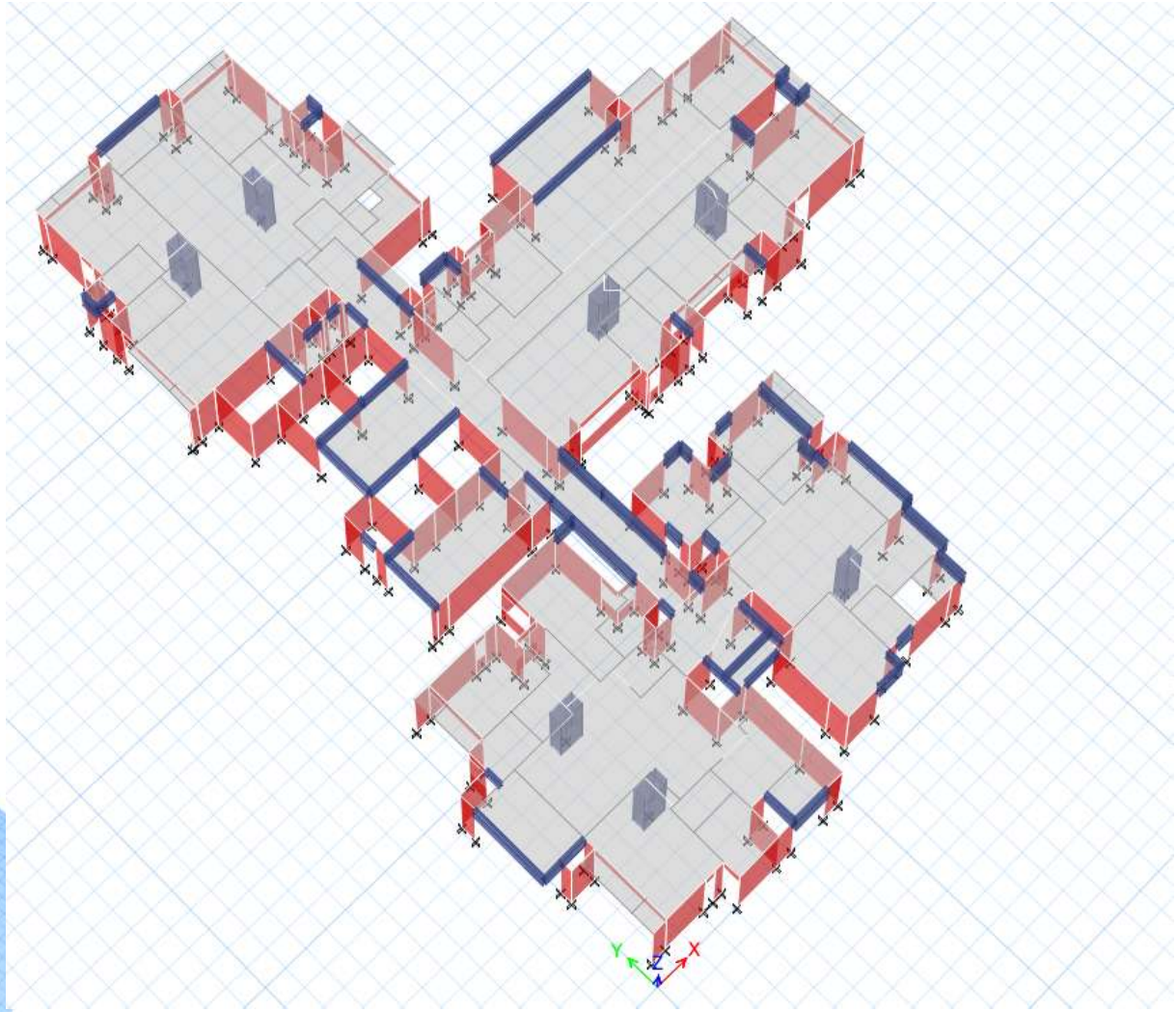


Structural Layout

Ec Bc Dc™ SYSTEM

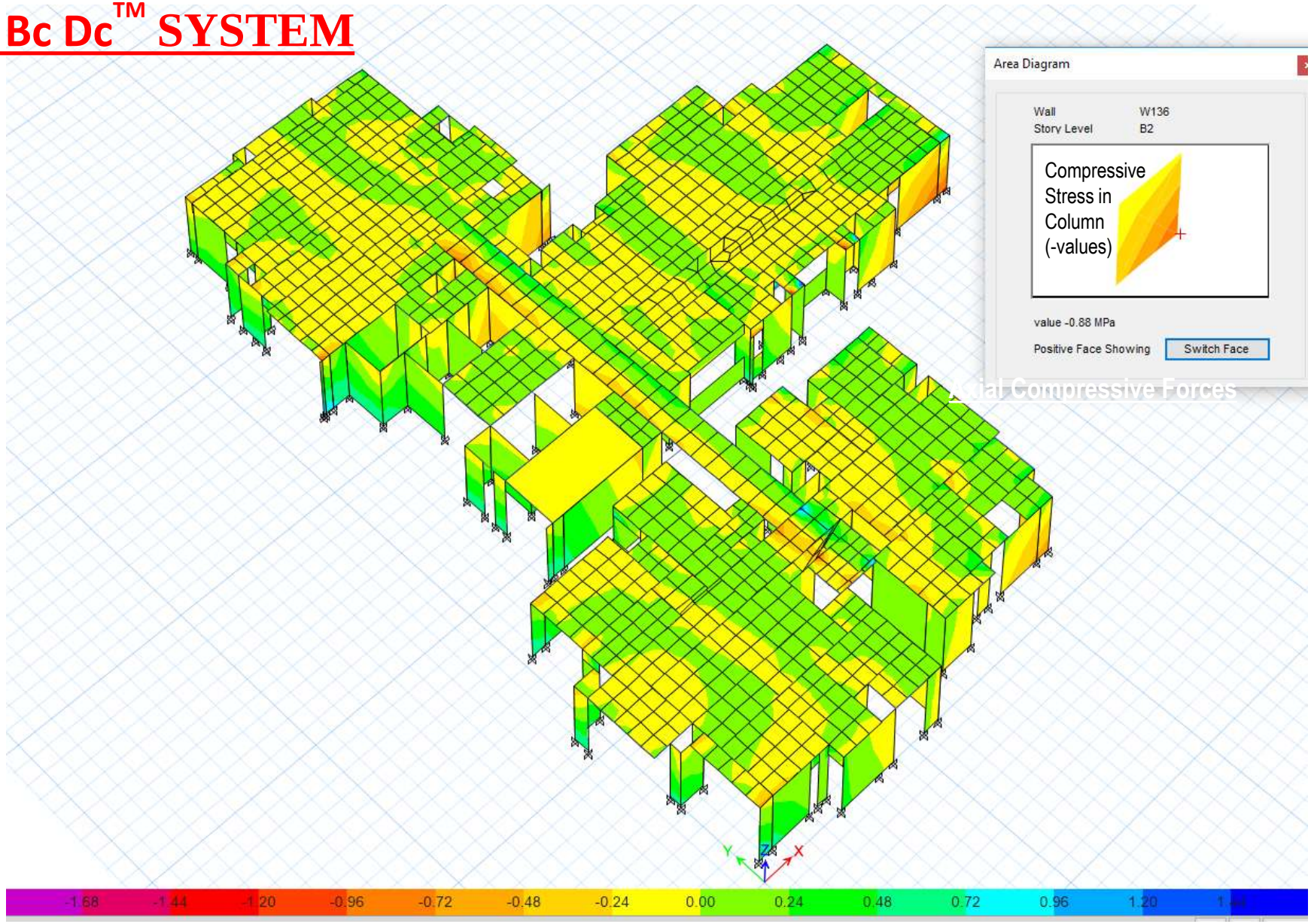


3d view EcBcDc system



floor plan EcBcDc system

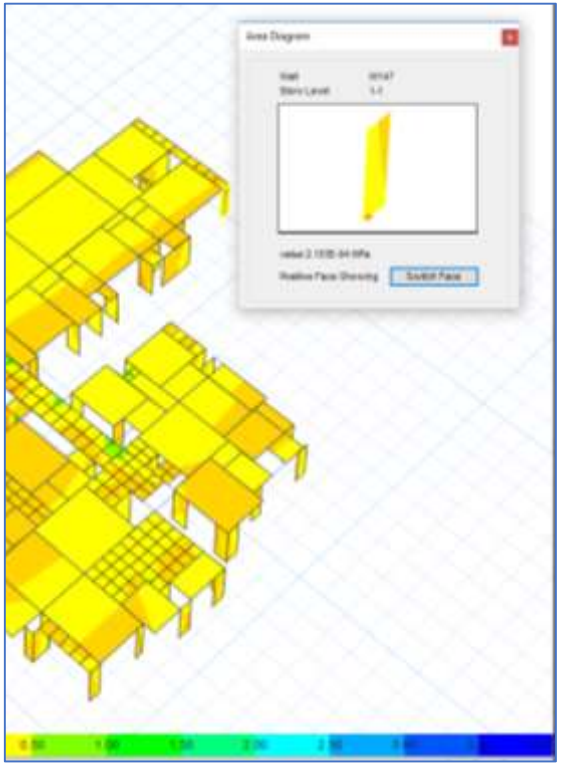
Ec Bc Dc™ SYSTEM



Wall stresses

Comparison of Performance

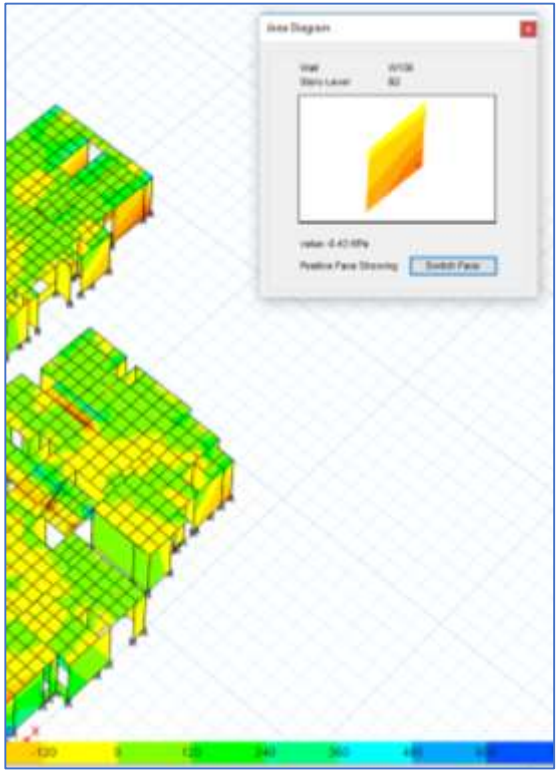
Tensile Stress in Column (+values)



SLAB BEAM SYSTEM

Tensile Stress in Column (+values)

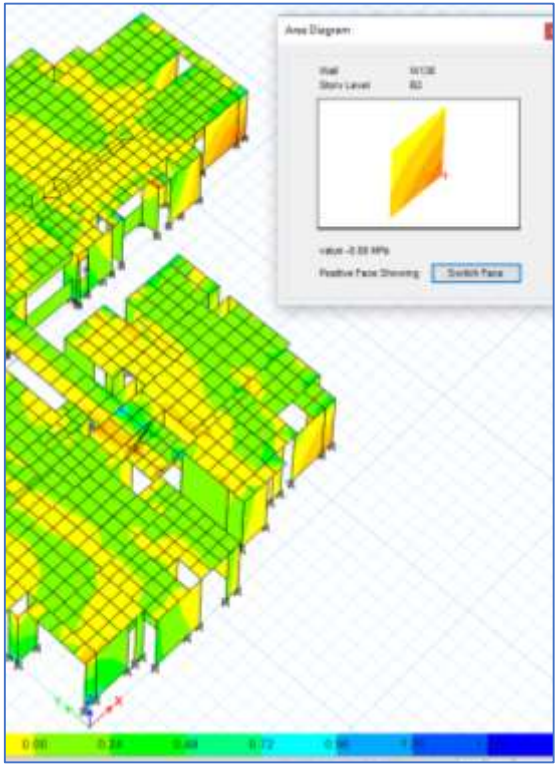
Compressive Stress in Column (-values)



MIVAN SYSTEM

Compressive Stress in Column (-values)

Compressive Stress in Column (-values)



Ec Bc Dc™ System

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.
- 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.
- Requirement of High Strength concrete for High Rise buildings depends on structural systems.

by **G.H. BASAVARAJ**
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Thank you....

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