

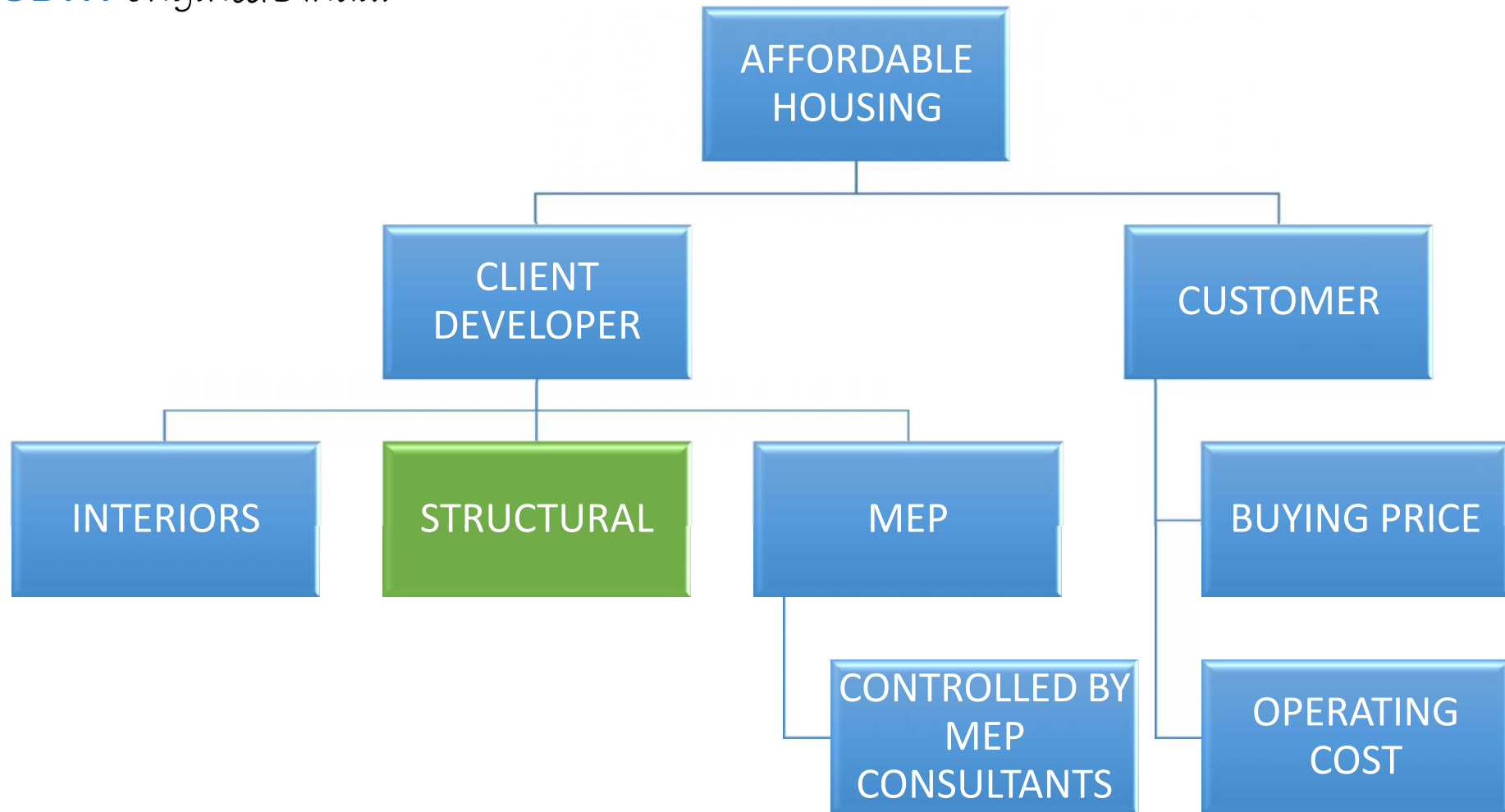
CBM ENGINEERS

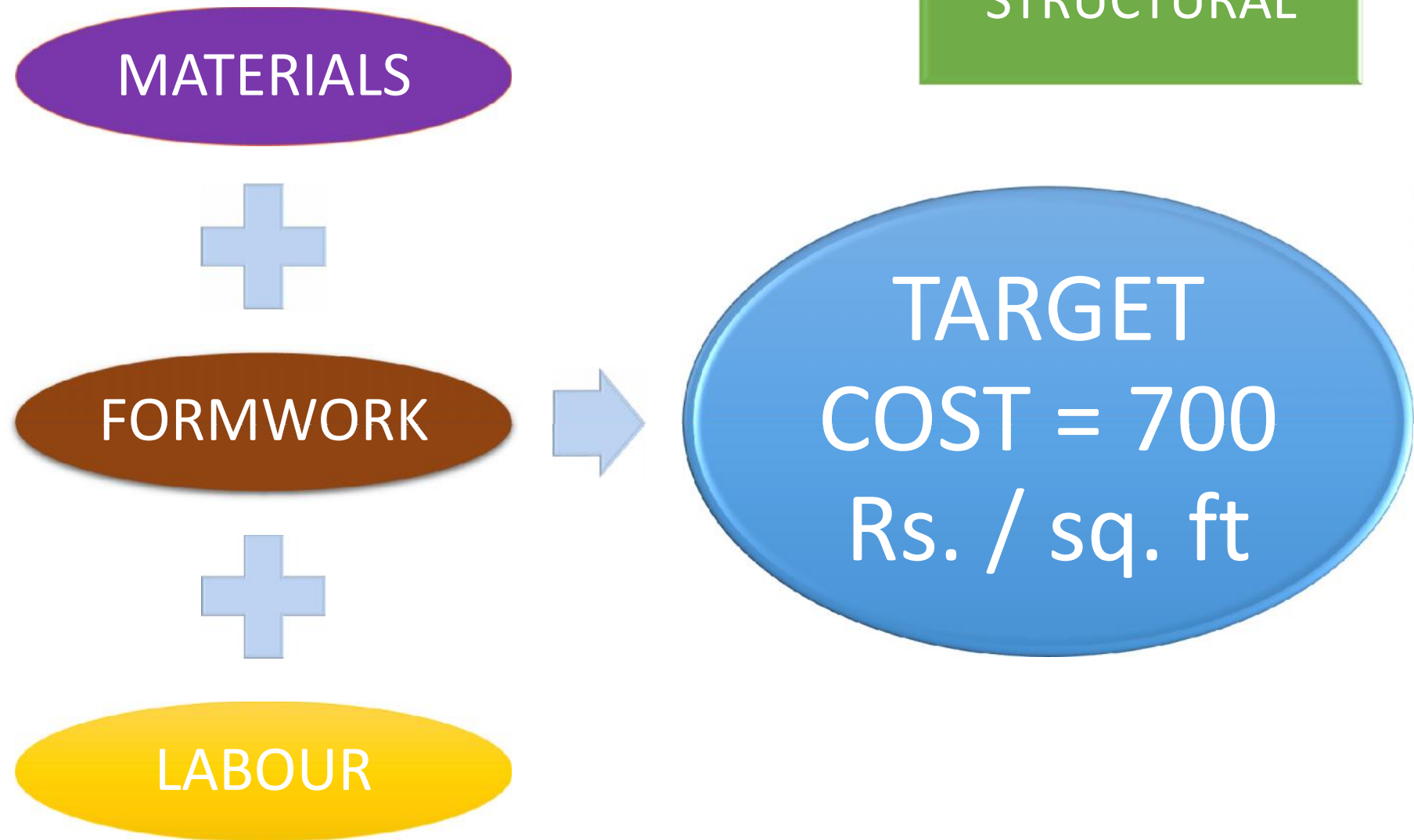


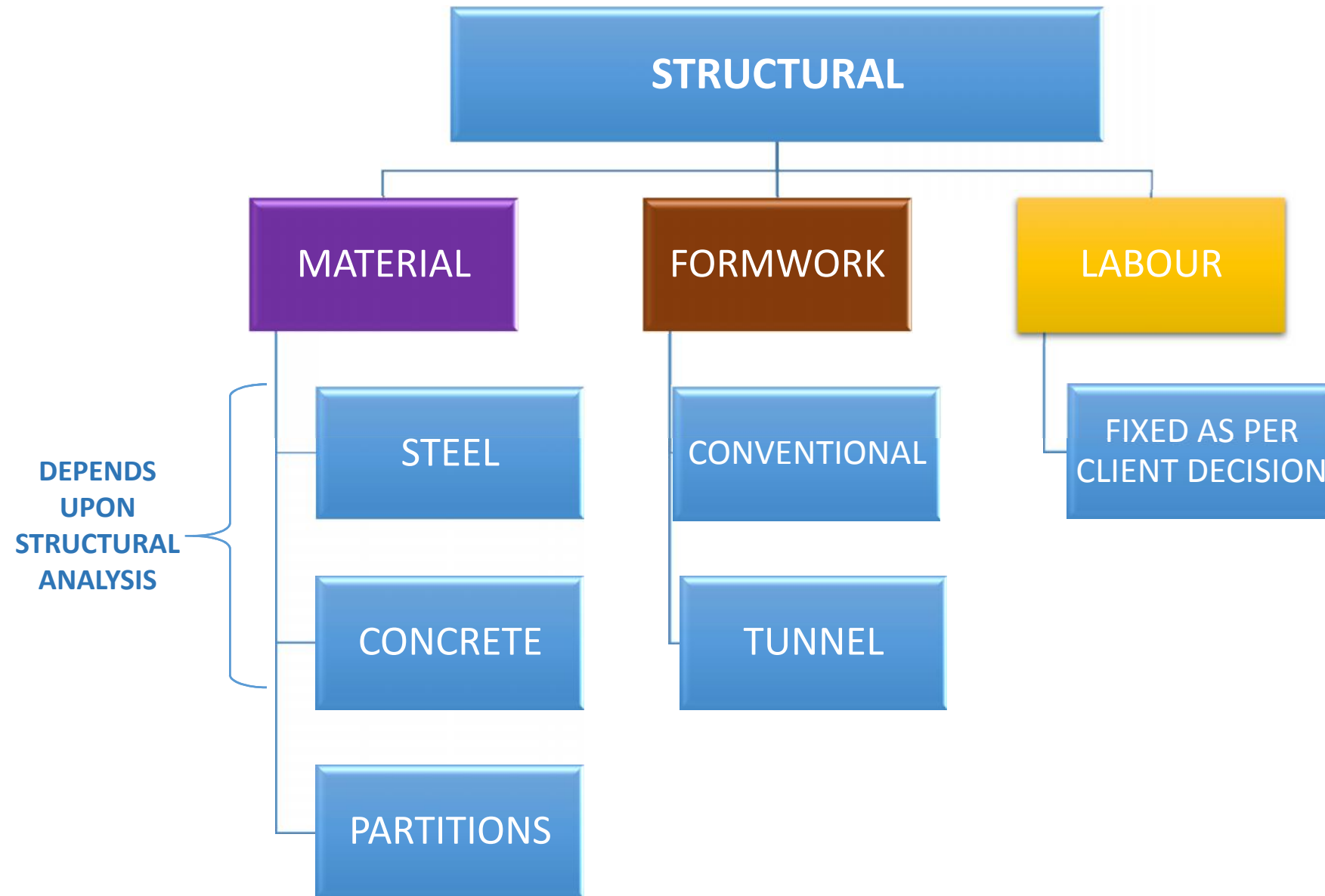
COMPANY PROFILE

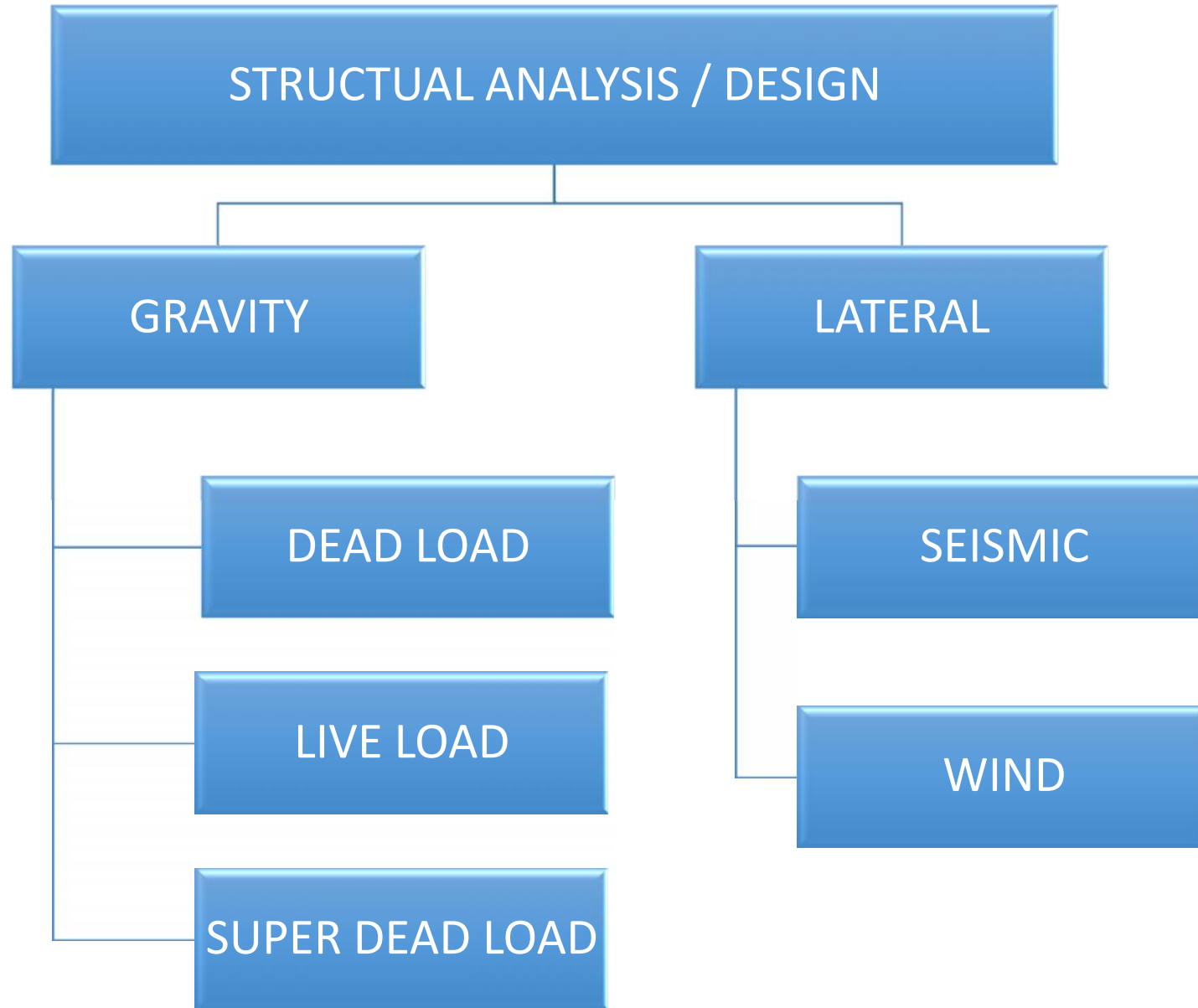
- ☐ Structural Engineering Firm established in 1975 in Houston, Texas - USA
- ☐ Services Offered:
 - ☐ Full Design Built
 - ☐ Value Engineering
 - Peer Review
 - Construction Administration
- ☐ Office Locations:
 - ☐ Houston, Texas, USA (Head quarters – 50 Employees)
 - ☐ Vadodara, India (45 Employees)
 - ☐ Mumbai, India (35 Employees)
 - ☐ Delhi, India (15 Employees)
- ☐ Expertise:
 - ☐ Residential Buildings (High Rise, Medium Rise, Low Rise), Hotels , Commercial Buildings.
 - ☐ Have built more then 500 projects including high rises building across globe (India, USA, Dubai)

AFFORDABLE HOUSING



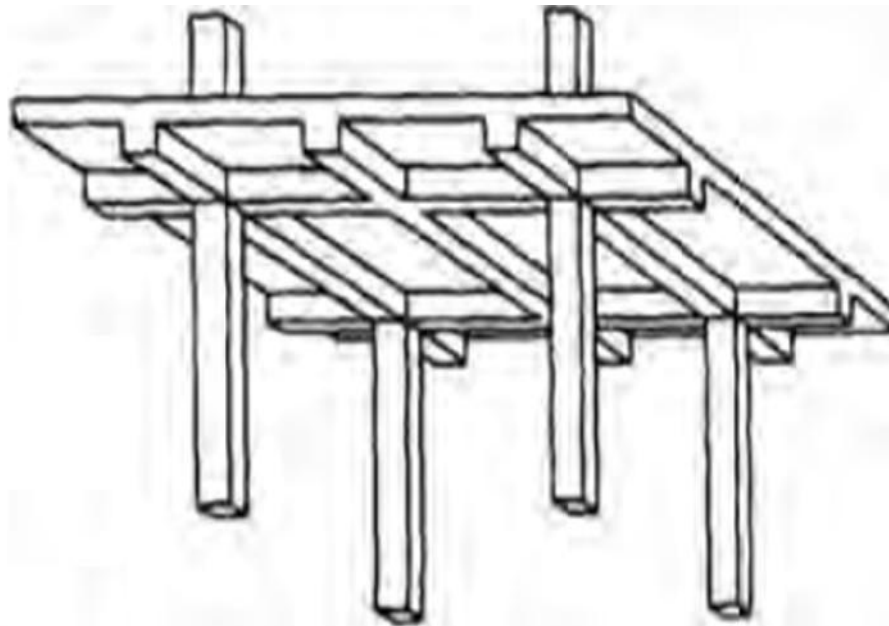




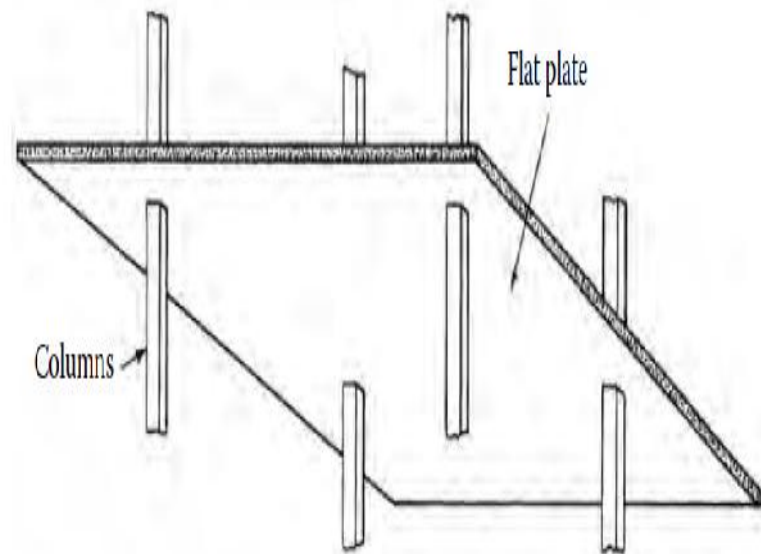


PROPOSED **GRAVITY SYSTEM** FOR AFFORDABLE HOUSING

CONVENTIONAL BEAM SLAB

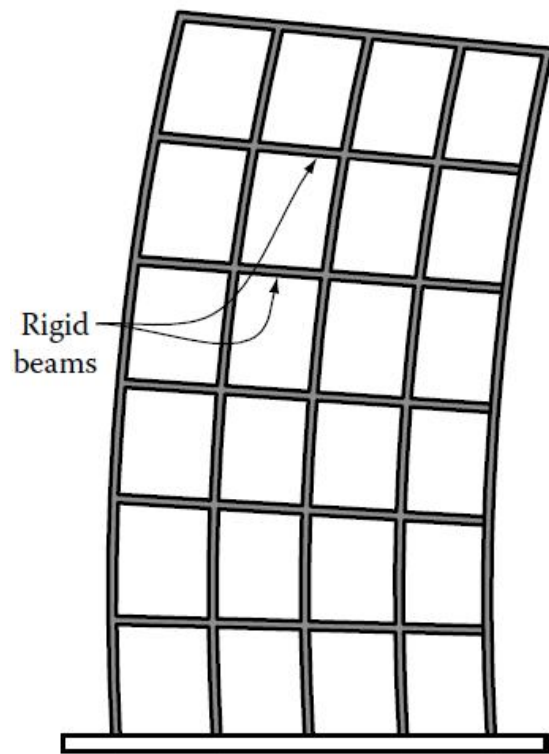


FLAT SLAB

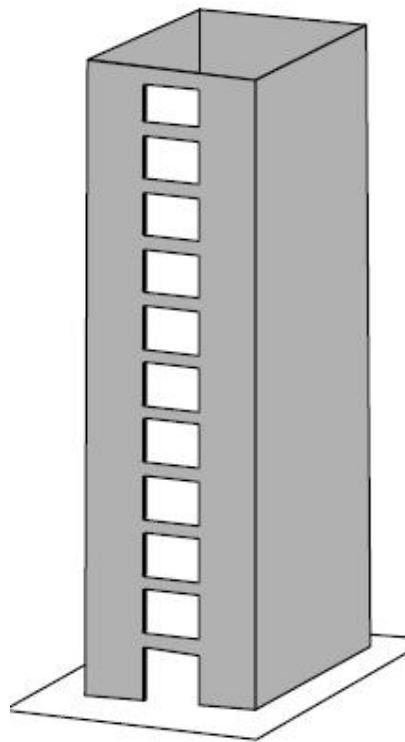


PROPOSED **LATERAL SYSTEM** FOR AFFORDABLE HOUSING

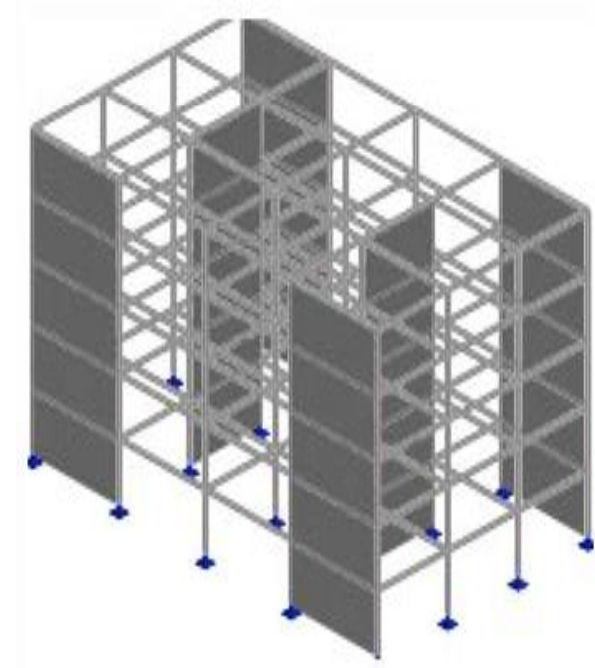
BEAM COLUMNS
FRAMING



WALLS ONLY



COMBINATION OF
BOTH



POSSIBLE STRUCTURAL SYSTEM FOR AFFORDABLE HOUSING

- ☐ Conventional slab – beam with beam – column framing system
- ☐ Flat slab with periphery beam – column and shear wall system
- ☐ Flat slab with shear wall system

- ☐ Conventional Formwork
- ☐ Table Formwork
- ☐ Tunnel Formwork

POINTS OF COMPARISON FOR DIFFERENT STRUCTURAL SYSTEMS

- ☐ Flat Slab over Slab-beam
- ☐ Shear walls over Beam-column
- ☐ Structural drawing set
- ☐ Adopted Formwork system

FLAT SLAB OVER SLAB-BEAM SYSTEM (GRAVITY SYSTEM)

- ❑ **Smaller Slab Spans => Lesser Concrete Consumption:**
 - ❑ Affordable housing will have smaller slab spans.
 - ❑ [Concrete Vol of Flat Slab] << [Concrete vol of Slab-beam]

- ❑ **Beam-less Construction**
 - ❑ No Beam stirrups, no bending of bars
 - ❑ No honeycombing at beams
 - ❑ Faster placing of reinforcement
 - ❑ More Flexibility to relocate internal walls even during construction.

SHEAR WALLS OVER BEAM-COLUMN SYSTEM (LATERAL SYSTEM)

❑ Lateral load carrying capacity:

- ❑ Shear walls are more efficient in carrying lateral loads when compared to beam-column framing systems.
- ❑ Even minimum reinforcement in Shear walls effectively resist lateral loads for a mid rise building.
- ❑ Dead wall places can be converted into shear walls.

❑ Beam-Column Junction Detailing:

- ❑ In absence of beam, complicated beam-column detailing can be avoided.

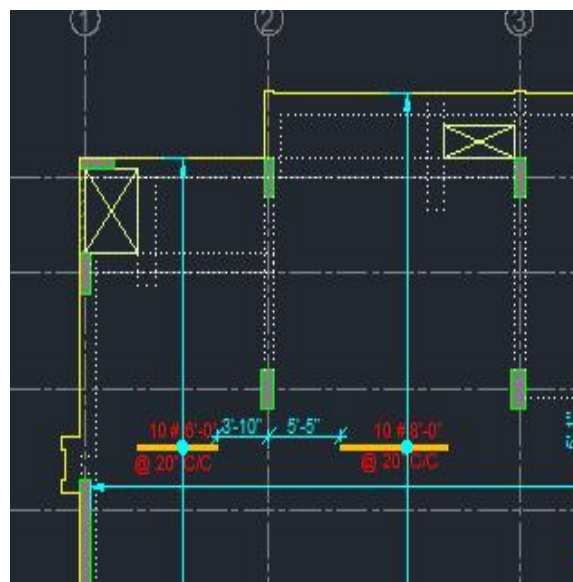
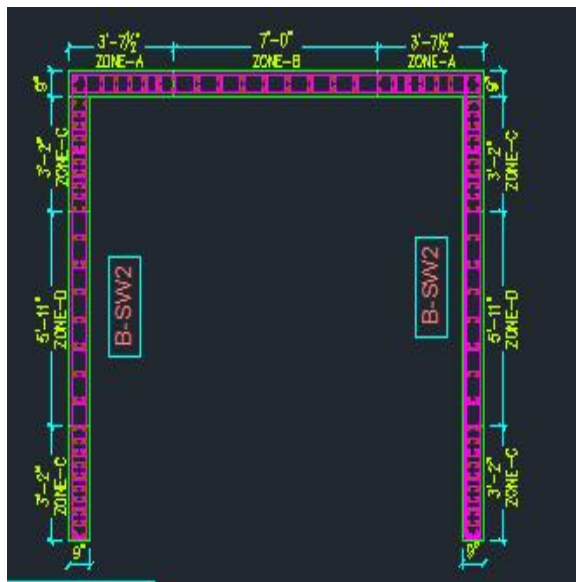


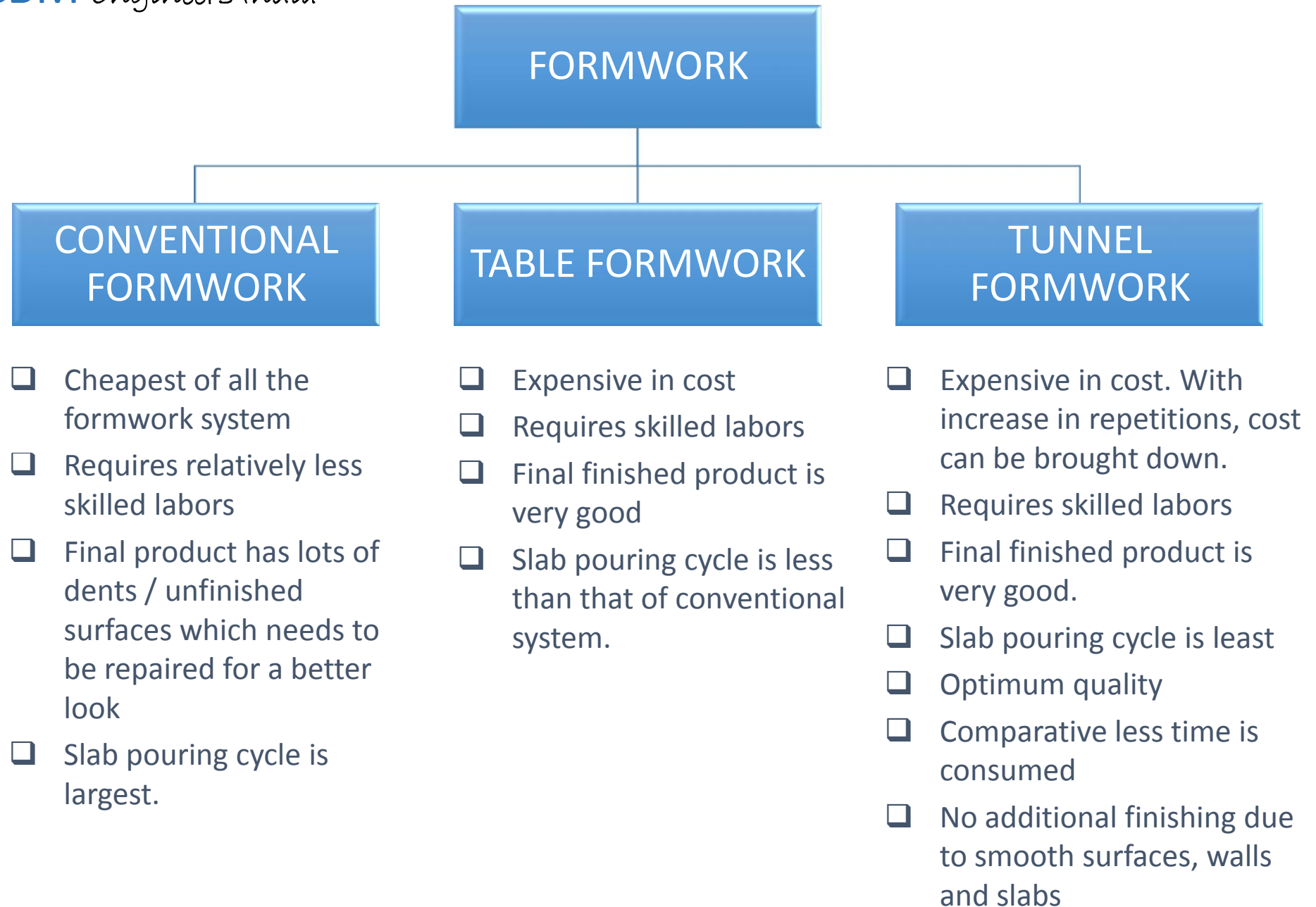
STRUCTURAL DRAWING SET

❑ Structural Drawing Set:

Compared to conventional system, the structural drawing set will only the following drawings;

- ❖ Typical Slab Reinforcement Detail (Grid and few additional reinforcements)
- ❖ Shear Wall reinforcement drawings (mid-rise => Min. reinforcement)





CBM PROPOSED SYSTEM FOR AFFORDABLE HOUSING

FLAT SLAB WITH SHEAR WALLS USING TUNNEL FORMWORK SYSTEM

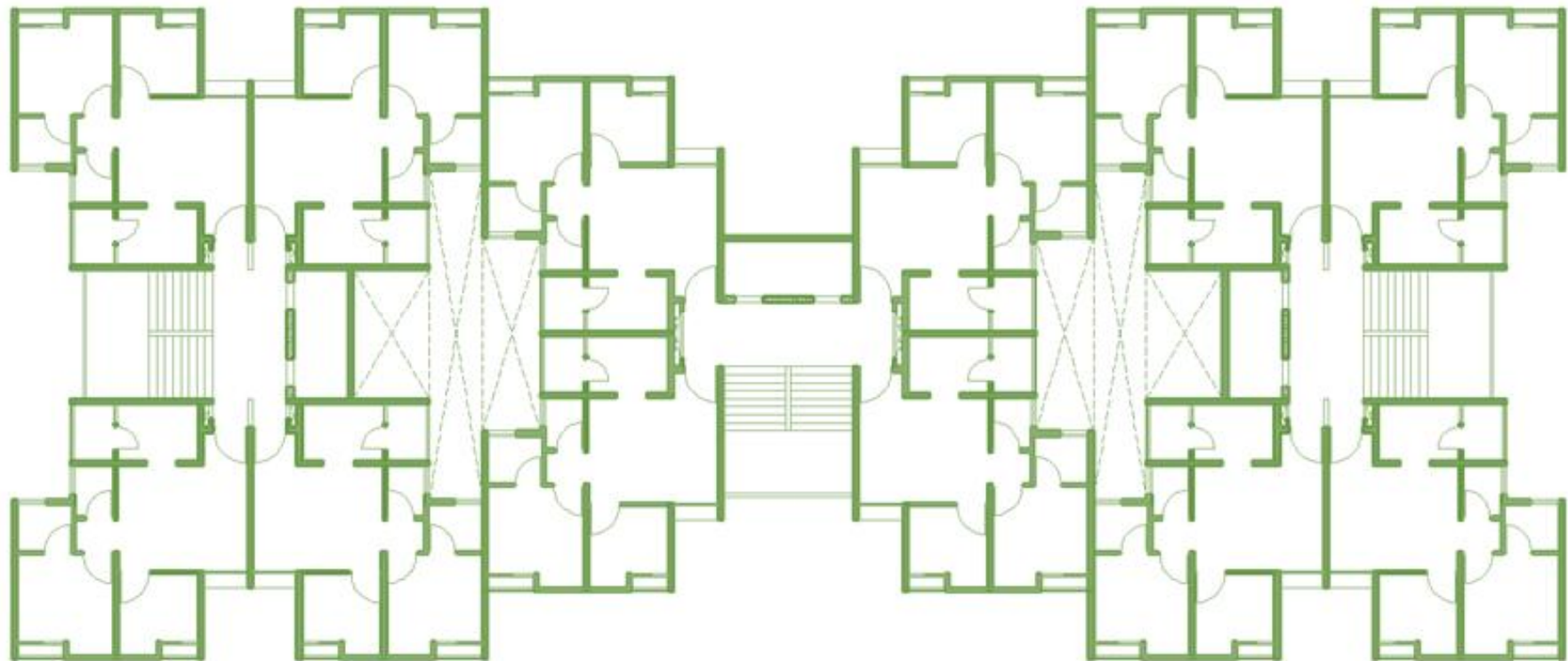
CASE STUDY

GODREJ GARDEN CITY, AHMEDABAD

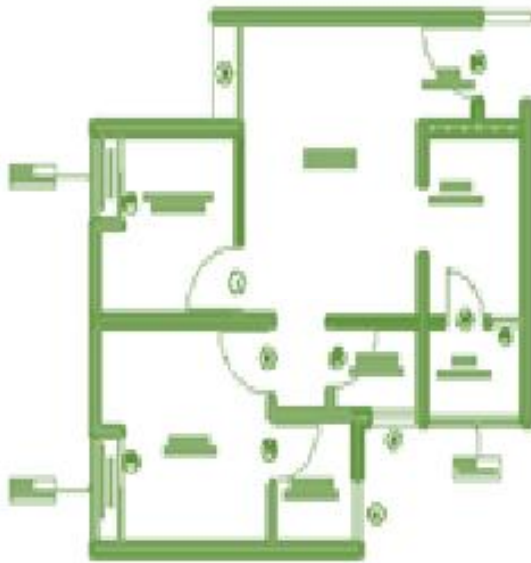
GODREJ GARDEN CITY, AHMEDABAD

- ❑ CONFIGURATION : Basement + Ground + 14 Typical Floor + Terrace
- ❑ TOTAL HEIGHT FROM GROUND FLOOR TO TERRACE : 43.50 MT.
- ❑ SEISMIC ZONE : Zone III – 0.16 (Ahmadabad) Ductility shear walls.
- ❑ WIND : Wind speed – 39 m/sec
 - Terrain category - 3
 - Class of building - B

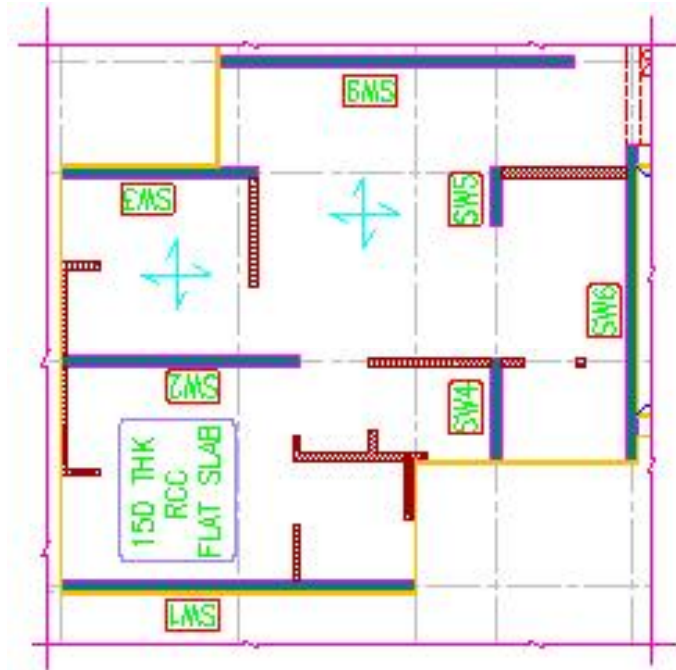
ARCHITECTURAL LAYOUT



UNIT FLAT LAYOUT

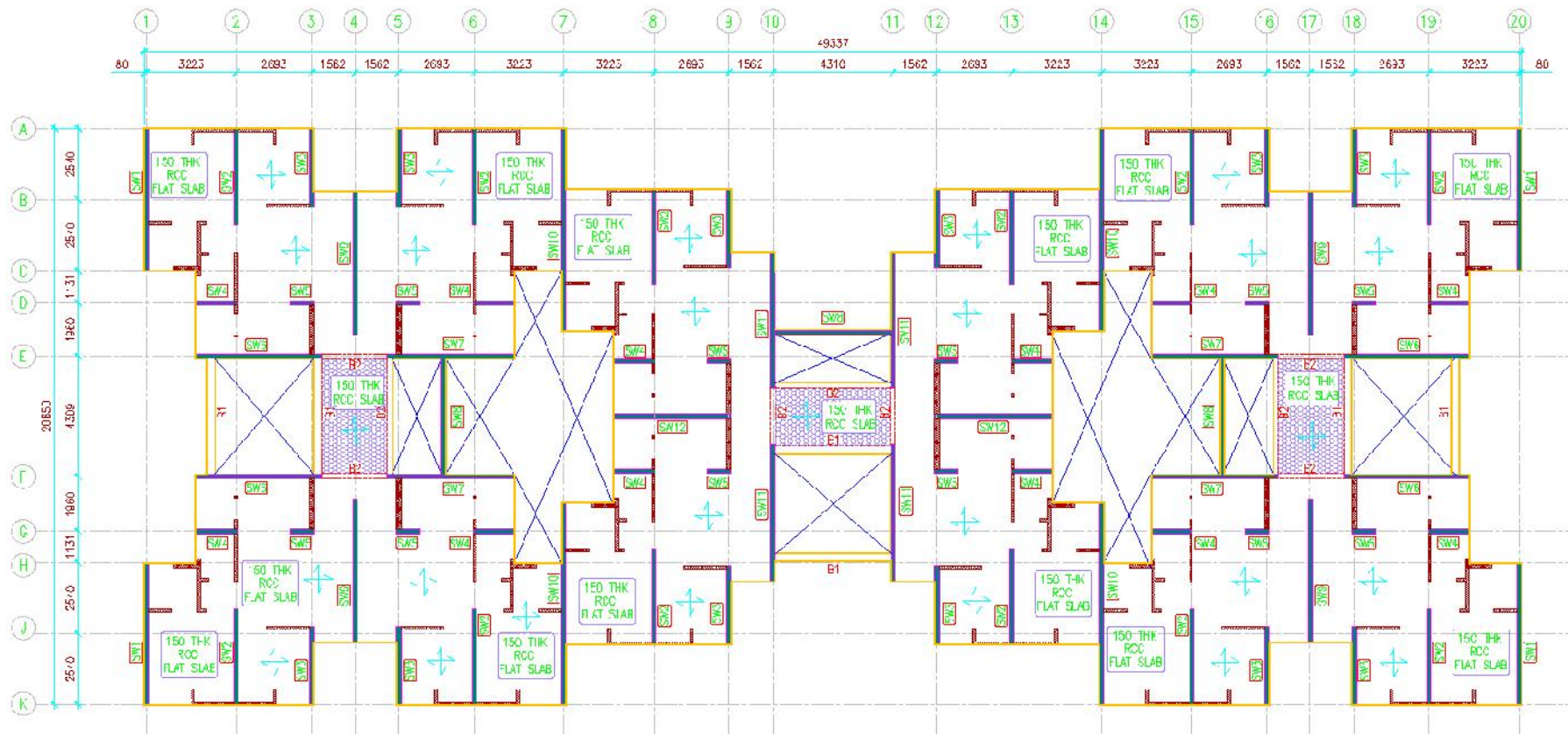


**ARCHITECTURAL
LAYOUT**

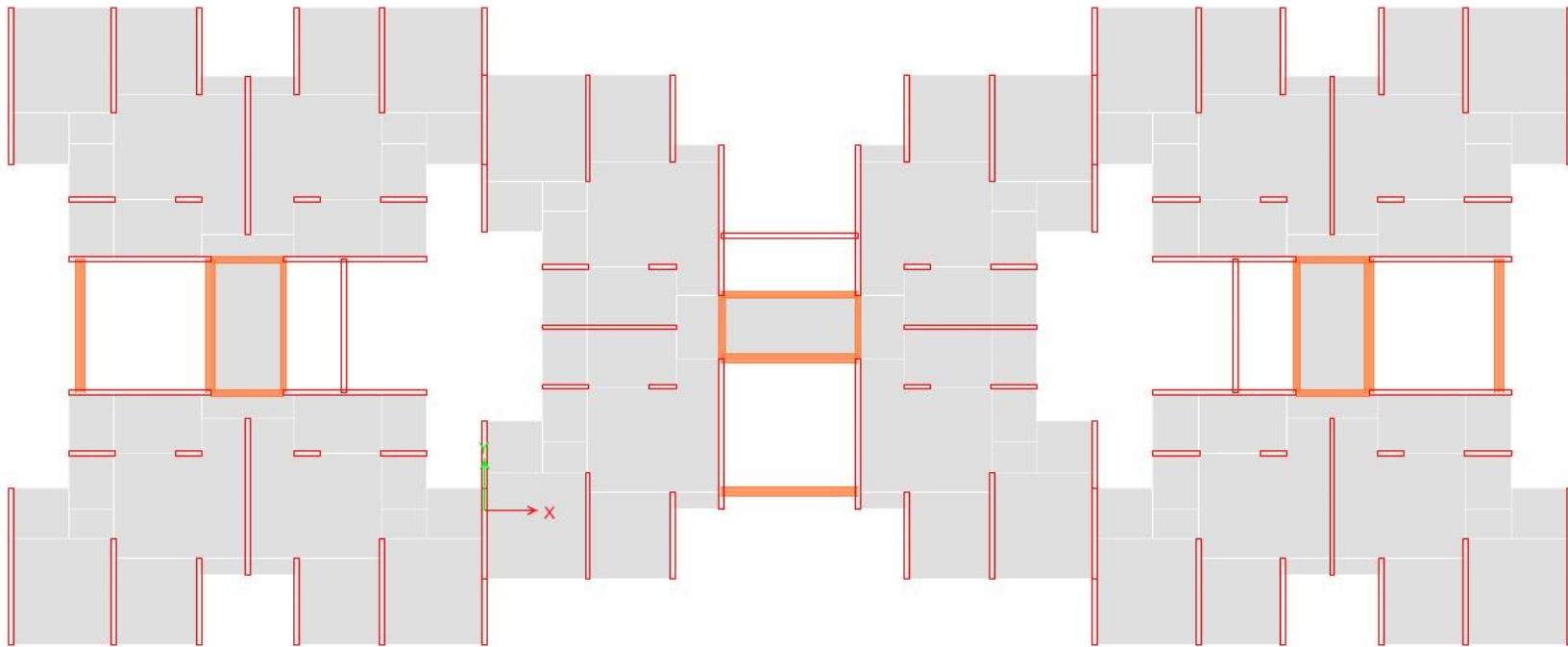


STRUCTURAL LAYOUT

PROPOSED STRUCTURAL SYSTEM

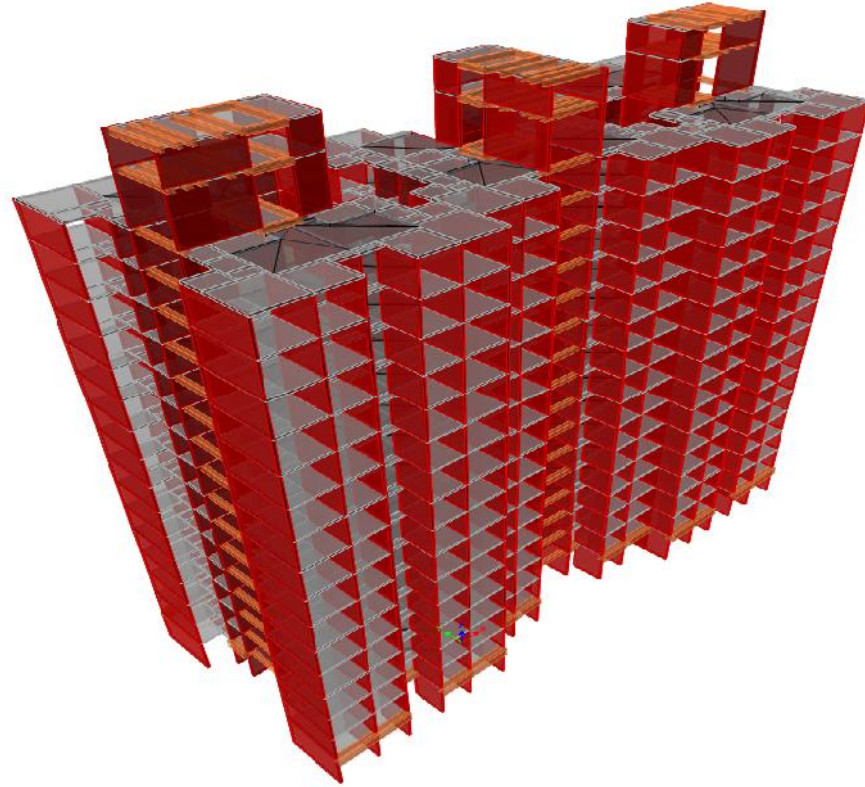


STRUCTURAL ANALYSIS / DESIGN



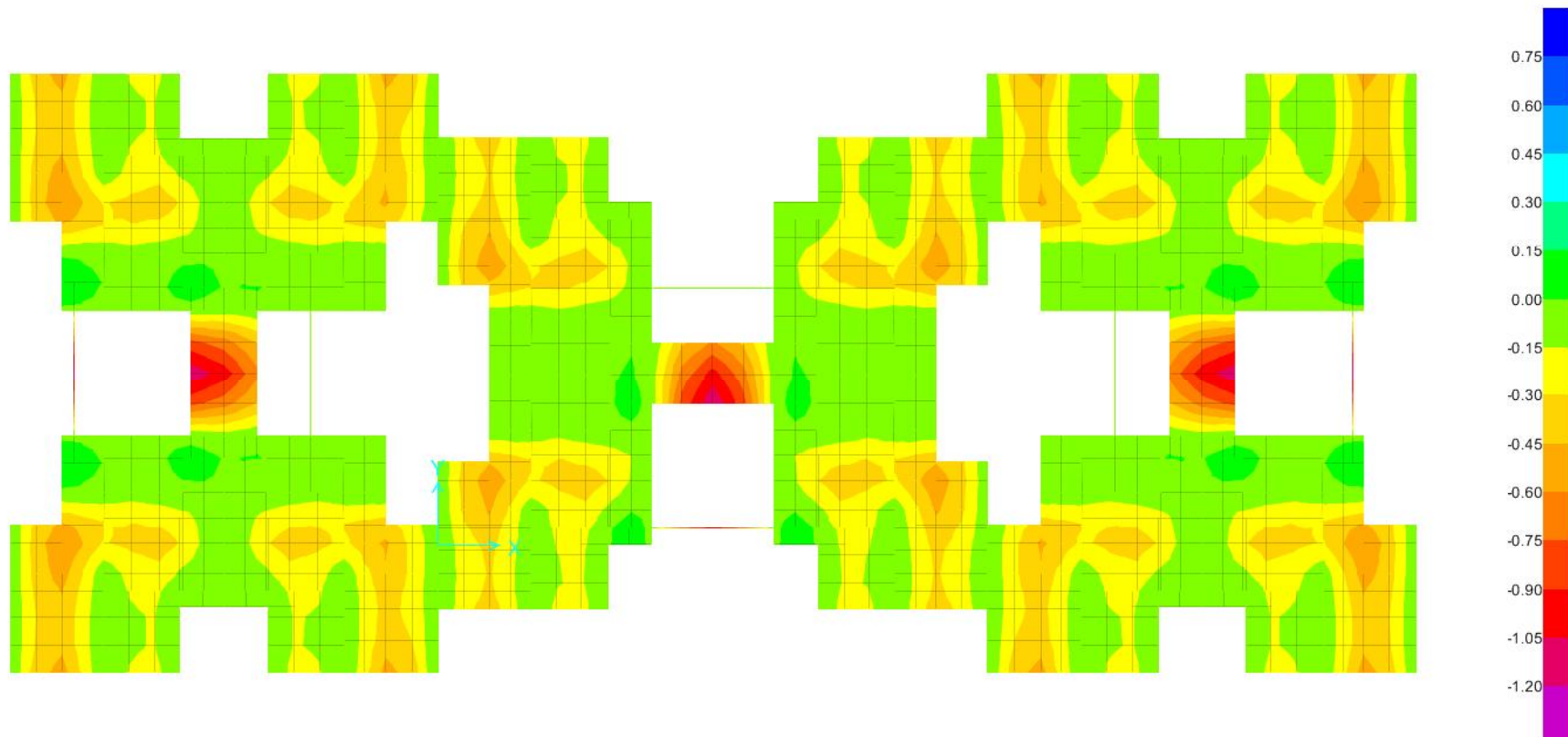
ETABS FEM ANALYSIS

STRUCTURAL ANALYSIS / DESIGN



ETABS FEM ANALYSIS

STRUCTURAL ANALYSIS / SLAB DESIGN



SAFE FEM ANALYSIS

MATERIAL CONSUMPTION

GODREJ GARDEN CITY AT AHMEDABAD				
TOWER	ELEMENT	Ratio (Steel / Concrete)	Ratio (Steel / Area)	Ratio (Concrete / Area)
		(Kg / m3)	(Kg / Sq.Ft.)	(Kg / Sq.Ft.)
1.50 and 2.0 BHK				
	RC WALL (160 mm)	120.00	1.85	0.0155
	RC BEAM	235.00	0.20	0.00085
	FLAT SLAB (150 mm Thk.) (RCC Slab in Tower Area Including Passage)	55.00	0.78	0.0145
	STAIRCASE	105.00	0.15	0.0014
	TOTAL	515.00	2.98	0.0323
	RAFT FOUNDATION	150.00	0.95	0.0065
	RC TANK (OHT)	75.00	0.030	0.00035
	TOTAL	225.00	0.98	0.00685

COST ANALYSIS FOR 1.50 BHK

MATERIAL CONSUMPTION FOR 1.50 BHK					
Layout : 1 Basement + 1 Ground Floor + 14 Residential Floors + Terrace					
Floor Plate = 7746 Sq.Ft.			Total BUA = 123936 Sq.Ft.		
Material	ELEMENT	Concrete (Cu.m.)	Steel (Kg)	Ratio (Cu.m./Sq. Ft.)	Ratio (Kg/Sq. Ft.)
	RC WALL (160 mm)	1985	198300	0.0160	1.60
	RC BEAM	105	24800	0.00085	0.20
	FLAT SLAB	1800	99200	0.0145	0.80
	STAIRCASE	175	18600	0.0014	0.15
	RAFT FOUNDATION	810	117800	0.0065	0.95
	TC TANK (OHT)	43	3750	0.00035	0.03
	TOTAL	4918	462450	0.0397	3.73

Material Cost	Type	Price	Area (Approx.)	Total Cost (Rs.)
	AAC Block Partiton Wall	6000 Rs/Cu.m.	1100 Cu.m.	6600000
	6 mm Plater (Putty)	182 Rs/Sq.m.	17000 Sq.m.	3094000
	Steel Cost	68 Rs/Kg	462450 Kg	31446600
	Concrete Cost	7000 Rs/Cu.m.	4918 Cu.m.	34426000
	Total Cost	=	610	Rs/ Sq.Ft.

Tunnel Formwork with labour Cost	Repetitions Assumed	=	348	Nos.
	Form work Cost (Tunnel)	=	83	Rs/ Sq.m.
	Tower Crane Cost	=	31	Rs/ Sq.m.
	Crane Operating Cost	=	80	Rs/ Sq.m.
	Labour Cost	=	300	Rs/ Sq.m.
	Total Cost	=	494	Rs/ Sq.m.
		=	45.92	Rs/ Sq.Ft.

Total Cost (Including Concrete, Steel, Partitions, Tunnel Formwork with labour)	=	656	Rs/ Sq.Ft.
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COST ANALYSIS FOR 2.0 BHK

MATERIAL CONSUMPTION FOR 2.0 BHK					
Layout : 1 Basement + 1 Ground Floor + 14 Residential Floors + Terrace					
Floor Plate = 9279 Sq.Ft.			Total BUA = 148464 Sq.Ft.		
Material	ELEMENT	Concrete (Cu.m.)	Steel (Kg)	Ratio (Cu.m./Sq. Ft.)	Ratio (Kg/Sq. Ft.)
	RC WALL (160 mm)	2380	237600	0.0160	1.60
	RC BEAM	126	29700	0.00085	0.20
	FLAT SLAB	2160	118800	0.0145	0.80
	STAIRCASE	215	22300	0.0014	0.15
	RAFT FOUNDATION	970	141100	0.0065	0.95
	TC TANK (OHT)	54	4500	0.00036	0.03
	TOTAL	5905	554000	0.0398	3.73

Material Cost	Type	Price	Area (Approx.)	Total Cost (Rs.)
	AAC Block Partiton Wall	6000 Rs/Cu.m.	1400 Cu.m.	8400000
	6 mm Plater (Putty)	182 Rs/Sq.m.	22500 Sq.m.	4095000
	Steel Cost	68 Rs/Kg	554000 Kg	37672000
	Concrete Cost	7000 Rs/Cu.m.	5905 Cu.m.	41335000
	Total Cost	=	616	Rs/ Sq.Ft.

Tunnel Formwork with labour Cost	Repetitions Assumed	=	406	Nos.
	Form work Cost (Tunnel)	=	67	Rs/ Sq.m.
	Tower Crane Cost	=	22	Rs/ Sq.m.
	Crane Operating Cost	=	57	Rs/ Sq.m.
	Labour Cost	=	300	Rs/ Sq.m.
	Total Cost	=	446	Rs/ Sq.m.
		=	41.46	Rs/ Sq.Ft.

Total Cost (Including Concrete, Steel, Partitions, Tunnel Formwork with labour)	=	658	Rs/ Sq.Ft.
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QUESTIONS

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