ECO-FRIENDLY TECHNOLOGIES FOR MASS HOUSING

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SL STRUCTUCTURAL CONSORTIUM

www.slstructural.com

Eco-friendly innovation is the way…….

G.SHANKAR NARAYAN

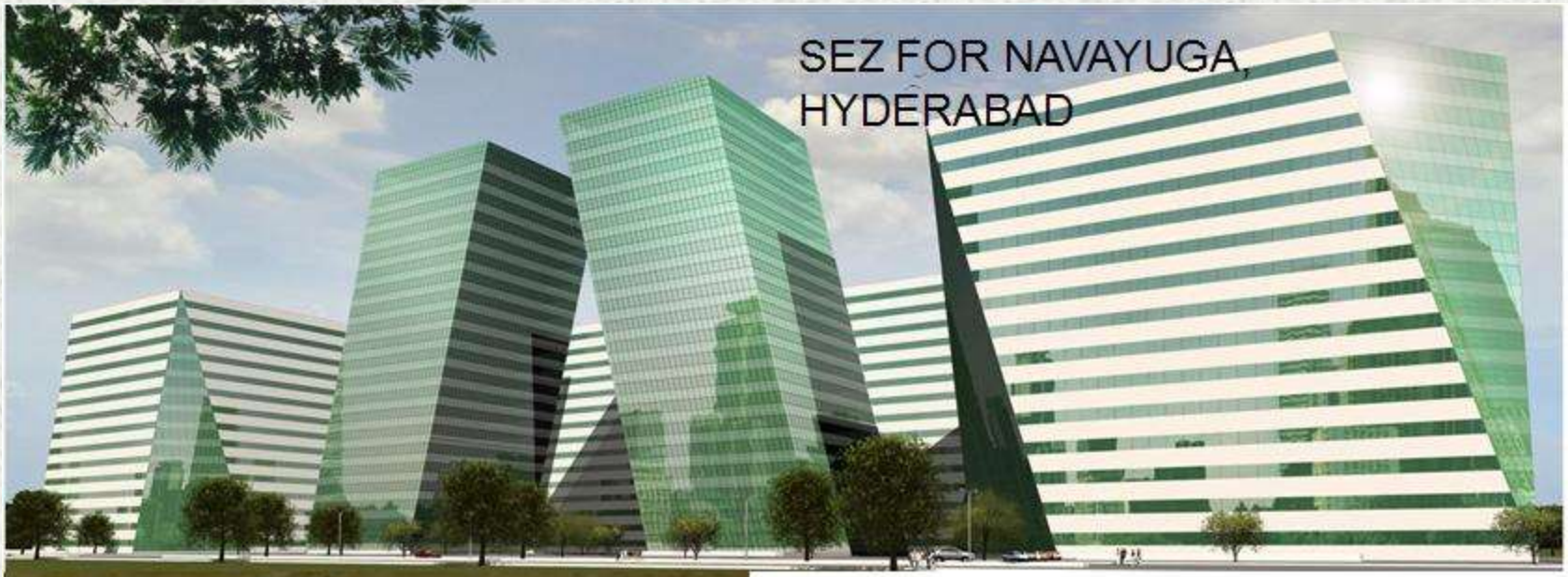
www.shankarch.com

ACKNOWLEDGEMENTS

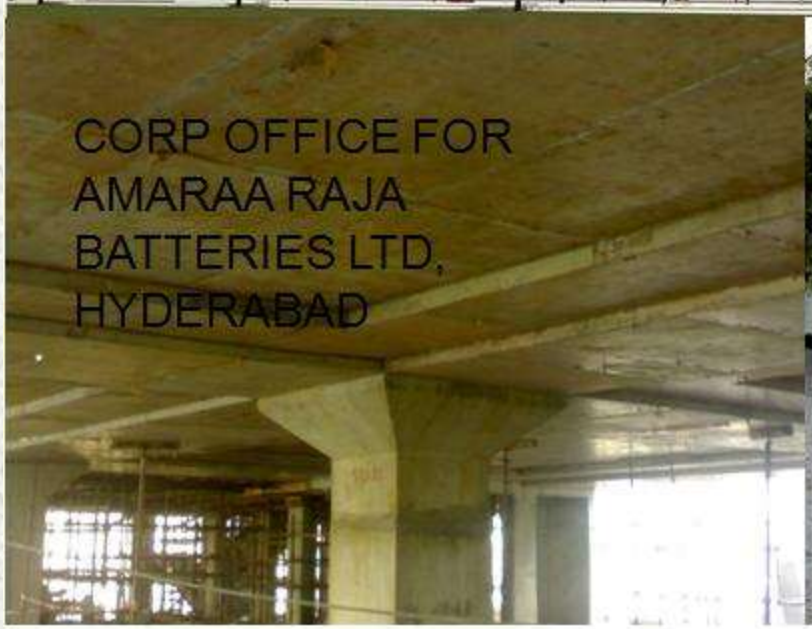
To all those who aspire for sustainable world

To Organisers of PEPSCON , 2018

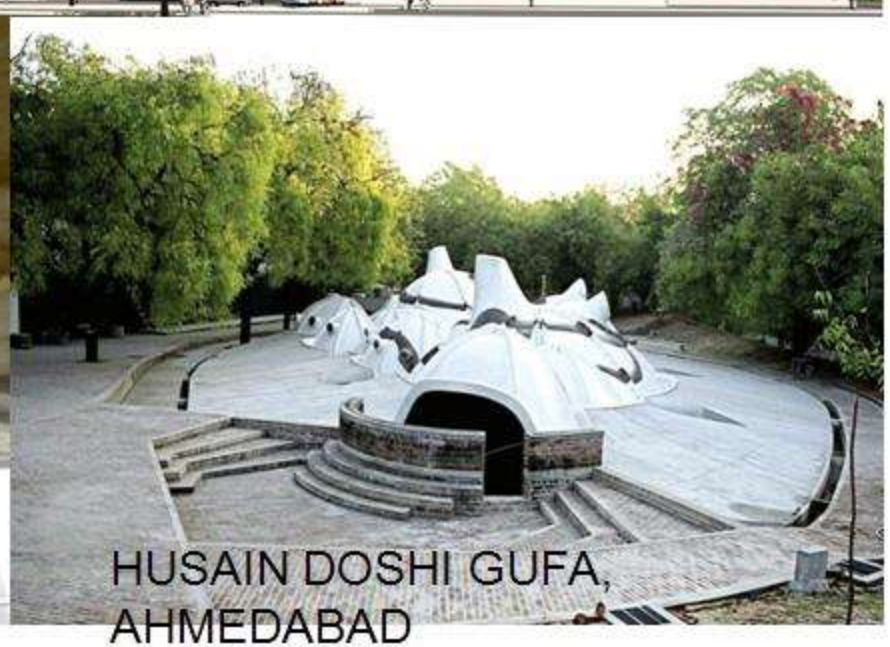
Courtesy Late RK laxman



SEZ FOR NAVAYUGA, HYDERABAD



CORP OFFICE FOR AMARAA RAJA BATTERIES LTD, HYDERABAD



HUSAIN DOSHI GUFA, AHMEDABAD

CHALLENGES & INNOVATIONS

SPAN 15M
THICKNESS : 40MM

LARGE SPAN FERROCEMENT RIBBED SHELL AT AUROVILLE, PONDICHERRY

Work executed without formwork

ECO FRIENDLY INTERIORS OF SLSC'S OFFICE

Concept is evolved using material which otherwise has little or no use in any way. Industrial waste products (packing wood, ACP panels, cut poly carbonate sheets, broken flooring stones, scrap bars to name a few) are potential material to be used for the work.

True to spirit of ideology, either industrial waste or natural material are used.

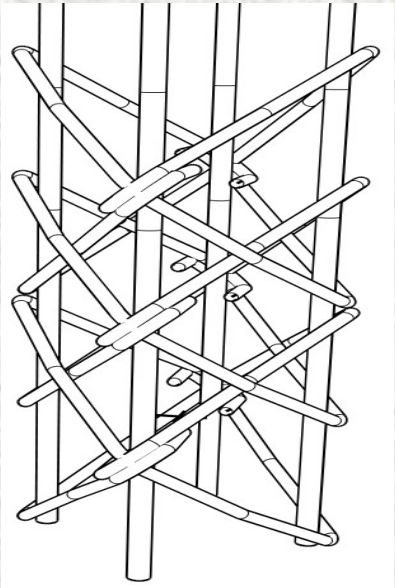
Integrated use to avoid duplication of elements was introduced.

TABLE USING SPACE FRAME & INTEGRATED STORAGE

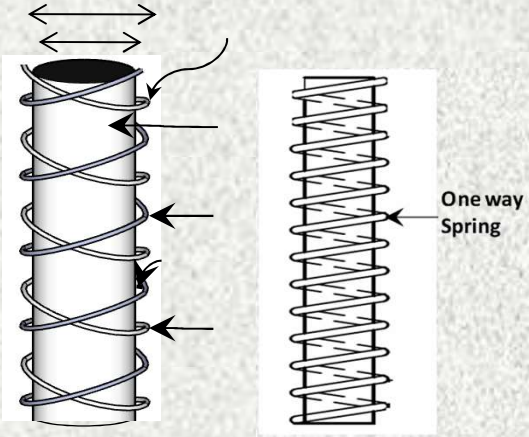
FOCUSSED IN R&D BASED CONSULTANCY

Designed special Structures, Unique structures etc.

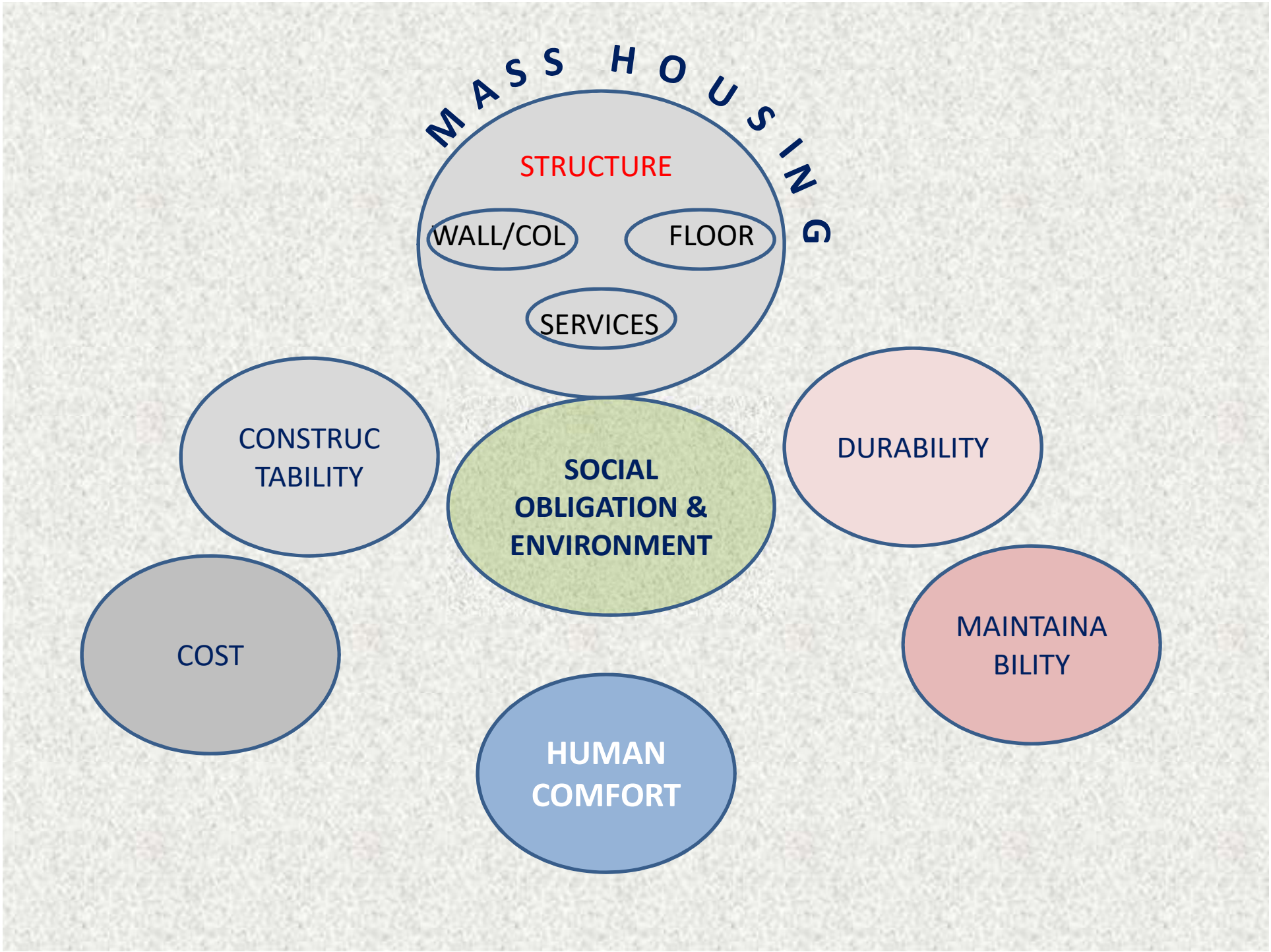
Current Research projects include



New form of Ties for enhancing Ductility for columns and shear walls
Patent Received



BRASR for Buckling enhancement of rebar
Patent under review


MASS HOUSING
STRUCTURE
WALL/COL
FLOOR
SERVICES
CONSTRUC TABILITY
SOCIAL OBLIGATION & ENVIRONMENT
DURABILITY
COST
MAINTAINA BILITY
HUMAN COMFORT

CRITERIA

STRUCTURAL

- Performance (Short term & Long term)
- Executability
- Repeatability
- Skill
- Repairability

ENVIRONMENT

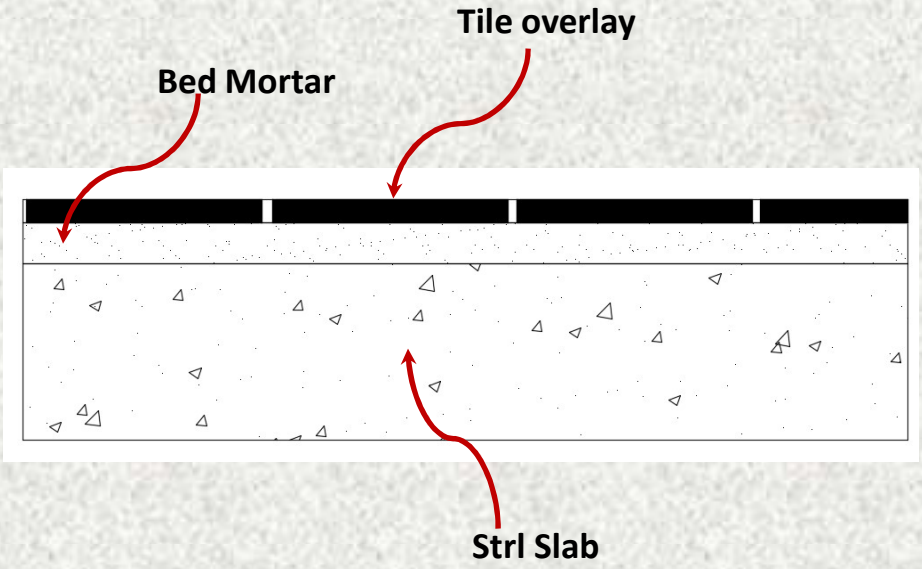
- Material type
- Source
- Energy Costs
- Impact
- Recycling

DURABILITY

- Long term performance
- Response to user and environment
- Hygiene

TYPICAL PROBLEMS IN CONVENTIONAL APPROACHES

Is the Current approach free from problems?



Conventional System

Typically, Tile overlay is superficial with improper mortar grade, fill between joints and Bad workmanship- Good engineering practices are seldom followed in mass housing projects

Persistent Water proofing problem cause concrete spalling and carbonation

Problems with self compacting concrete and normal concrete

Excessive fines cause high shrinkage cracks and such cracks not limited to surface along

High fines change the failure modes of cubes

Such micro cracks are conduits for moisture and eventually cause concrete damage (carbonation, spalling etc.)

Repair methods for concrete walls / slabs are prohibitively expensive

In mass housing projects, such repairs are seldom attended to

Innovations in Precast Construction

ECO-FRIENDLY STONE COMPOSITES FOR SUSTAINABLE WORLD

Traditional Wisdom
Natural Stone slabs
Ecological & environmental compatibility
& Health

Advanced Engineering
& Use of natural & modern materials

Stone slab
+
Ferrocement
+
Precast

Recipient of "ACCE(I) – GAMMON AWARD, 2011

Approved by Indian Institute of Technology, Hyderabad

ECO-FRIENDLY STONE COMPOSITES FOR SUSTAINABLE WORLD (Patent Pending)

STONE & …PERCEPTION…

It is trendy and the " top material of the future " Will be necessarily the top material of the XXIth century if humans want to protect their living conditions on earth by saving the energy necessary for the construction "- *Architect Gilles Perraudin*

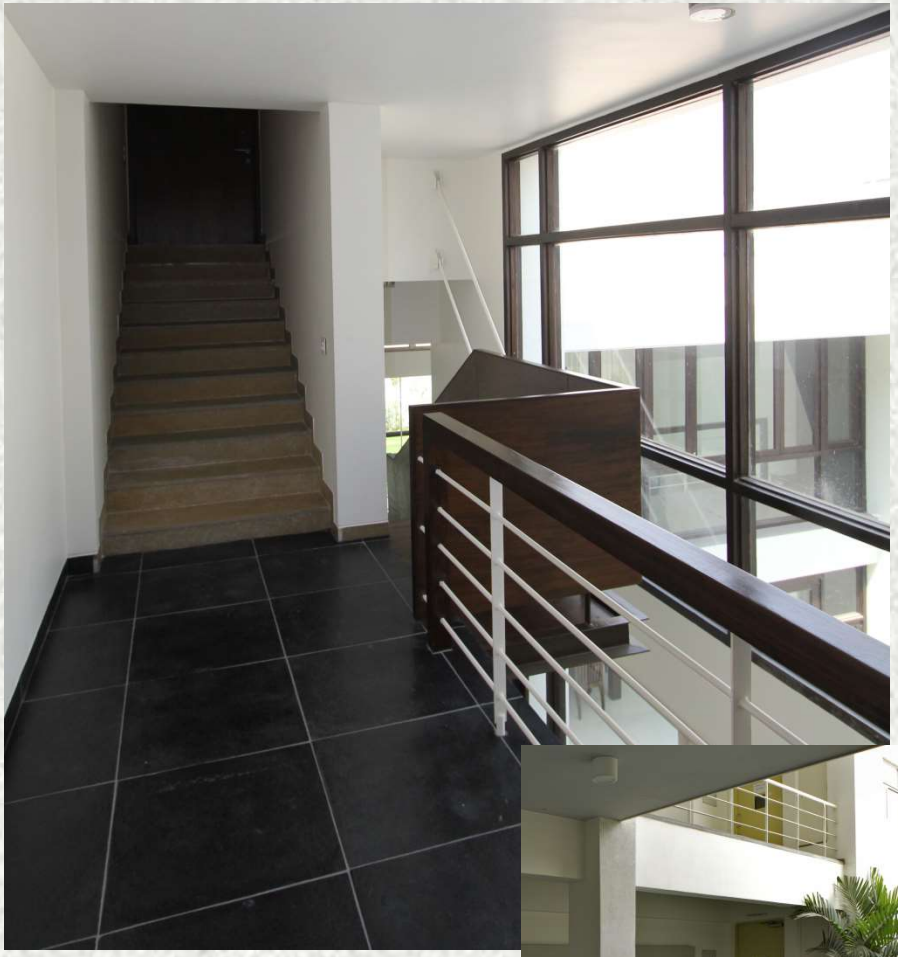
Use of Tandoor stone is having a spiralling growth in rich class.

This material is rich in appearance and ever increasing glow

The Myth of Tandoor/ cudapah stone for poor is fast vanishing. In comparison, tiles will loose out to stones

Natural stones are natural healers as most of the natural stones have ingredients of healing stone (such as quartzite etc.)

NOTEWORTHY LOCAL STONE FLOOR PROJECTS



Cudapah Stone flooring
Smt Nilima's Resi, Jubilee Hills, Hyd
Courtesy: Kruthics design, Hyd

Tandoor Stone flooring
Badruka Centenary, Jubilee Hills, Hyd

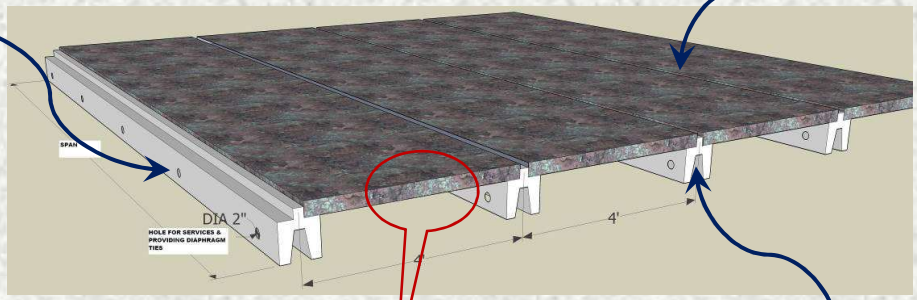


Tandur stone in Rural Andhra Pradesh…

Stone Composite

Stone composite (65-75mm th.)Dual purpose structural system

Provision through joists to improve diaphragm action & take services through



RCC Joist- Optimized, Multifunctional Profile

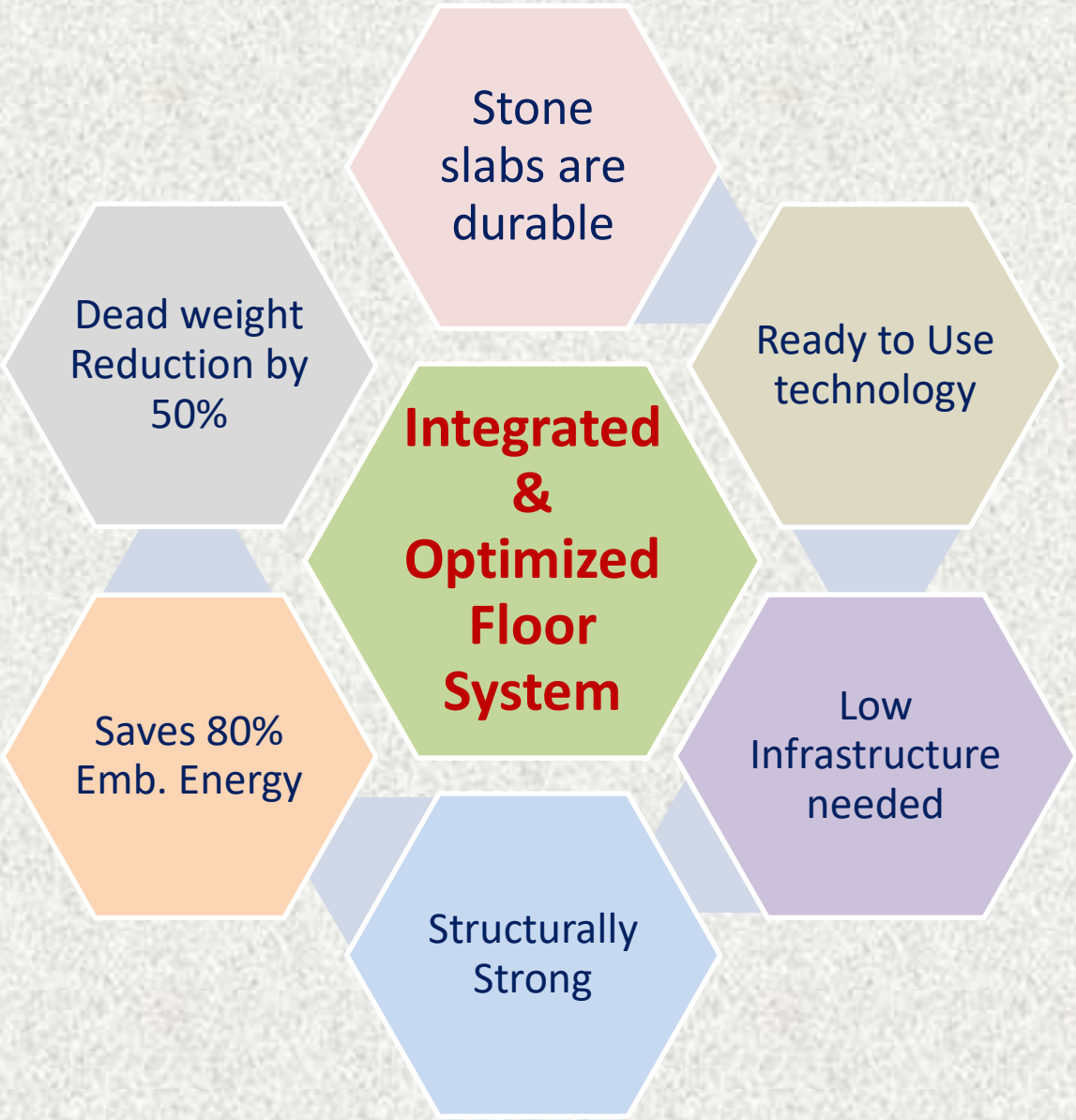
25-30th stone slabs

30-40th Ferrocement/ RC underlay

All elements are structurally integrated to impart monolithic action

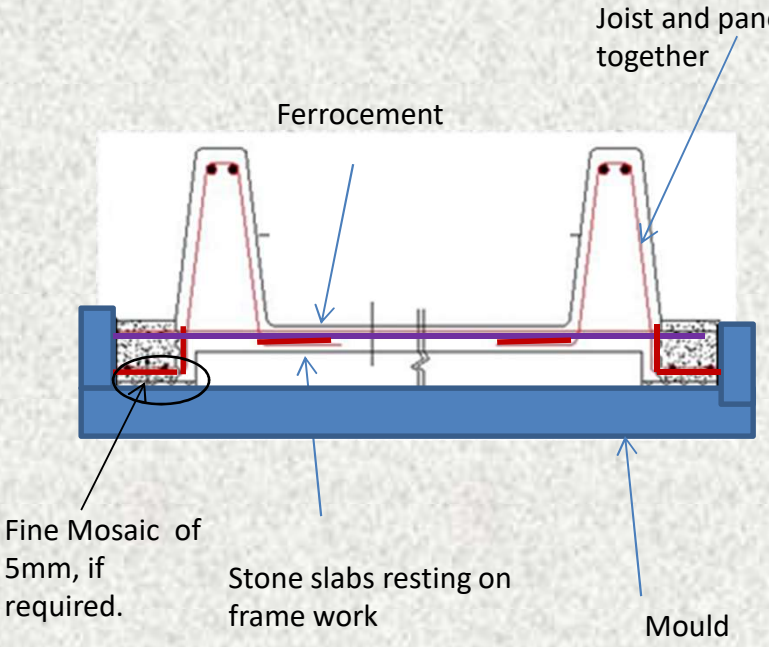
Why Stone Slab Composites ?

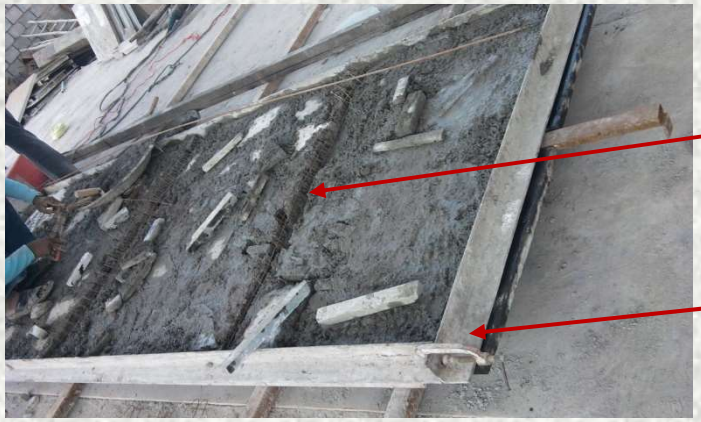
Stones are a locally available resource



Step 1: Cut stone slabs to correct size

Step 2: Grooves





On the stones, weld mesh is laid)both over the surface as well through joints

Joists are laid with projecting reinforcement facing downward

Ferrocement/ RC is done to get complete panel

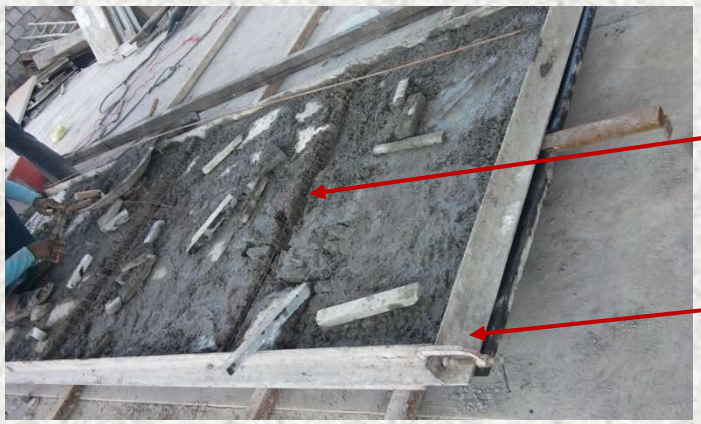
Reinforcement spread over stone blocks

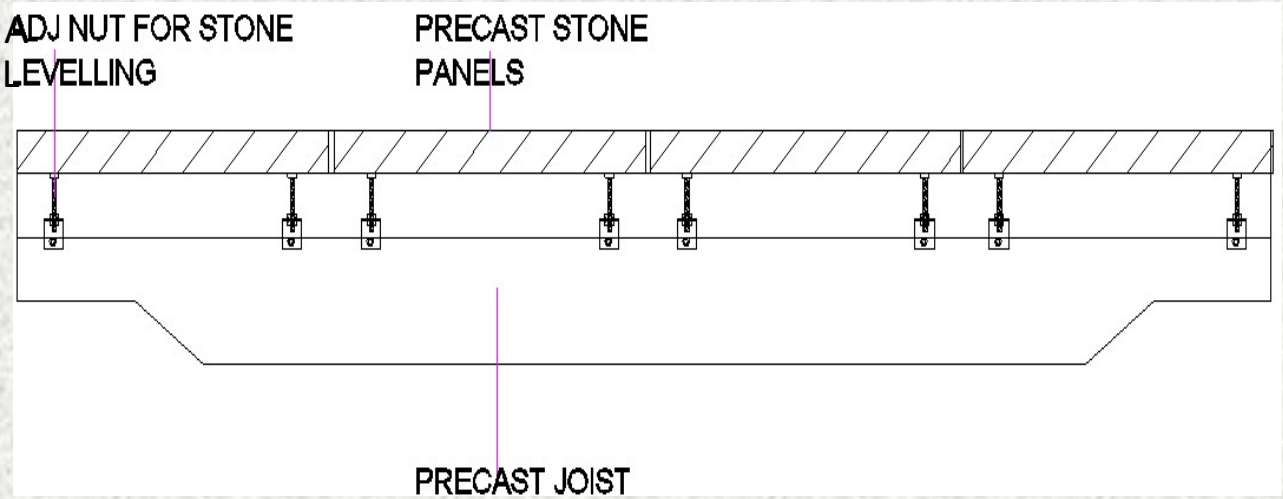
Reinforcement coming from precast joists

MOSAIC PANEL SYSTEM

STEP 1 : Place assorted size stone pieces in temporary frame work. Gap between shall be min 25mm

STEP 2 : Place assorted size of weld mesh pieces at some locations in stone gaps and project upwards





Temporary cleats are provided to beam t with adjustable nut arrangement

Stone panels rest on bolt heads and also centrally supported

Check nuts are adjusted to level stone slabs

APMAS

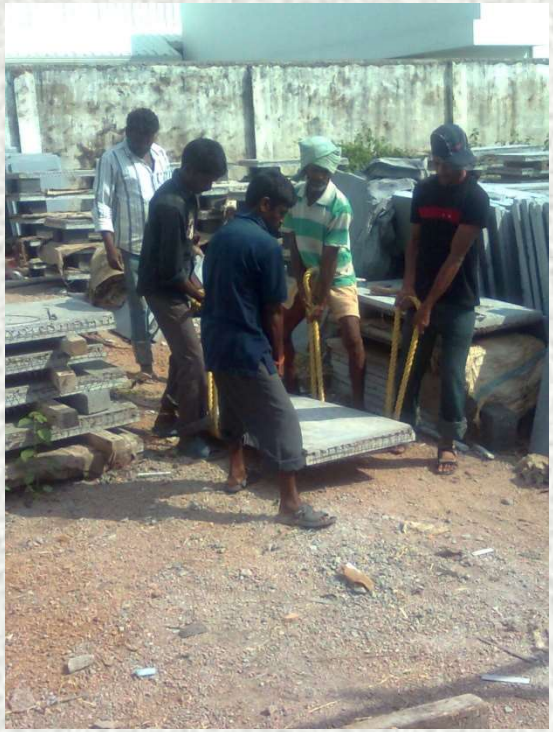
APMAS

COMPONENT ASSEMBLY SYSTEM

JOISTS ARE CAST SEPARATELY

STONE PANELS ARE CAST SEPARATELY

ASSEMBLY IS DONE AT SLAB LVL



TESTING

- Flexural testing on Full panels on MTS till failure
- Flexural testing on Full panels in filed for sustained Loading
- Digital Image Correlation for point strains
- UPV to ensure the composite is intact
- Drop Load Test
- Vibration Analysis Test
- Delamination Test

Flexural Test for Sustsianed Load

Full Performance Flexural test on MTS, IIT, Hyderabad

Load Test

DROP LOAD TEST

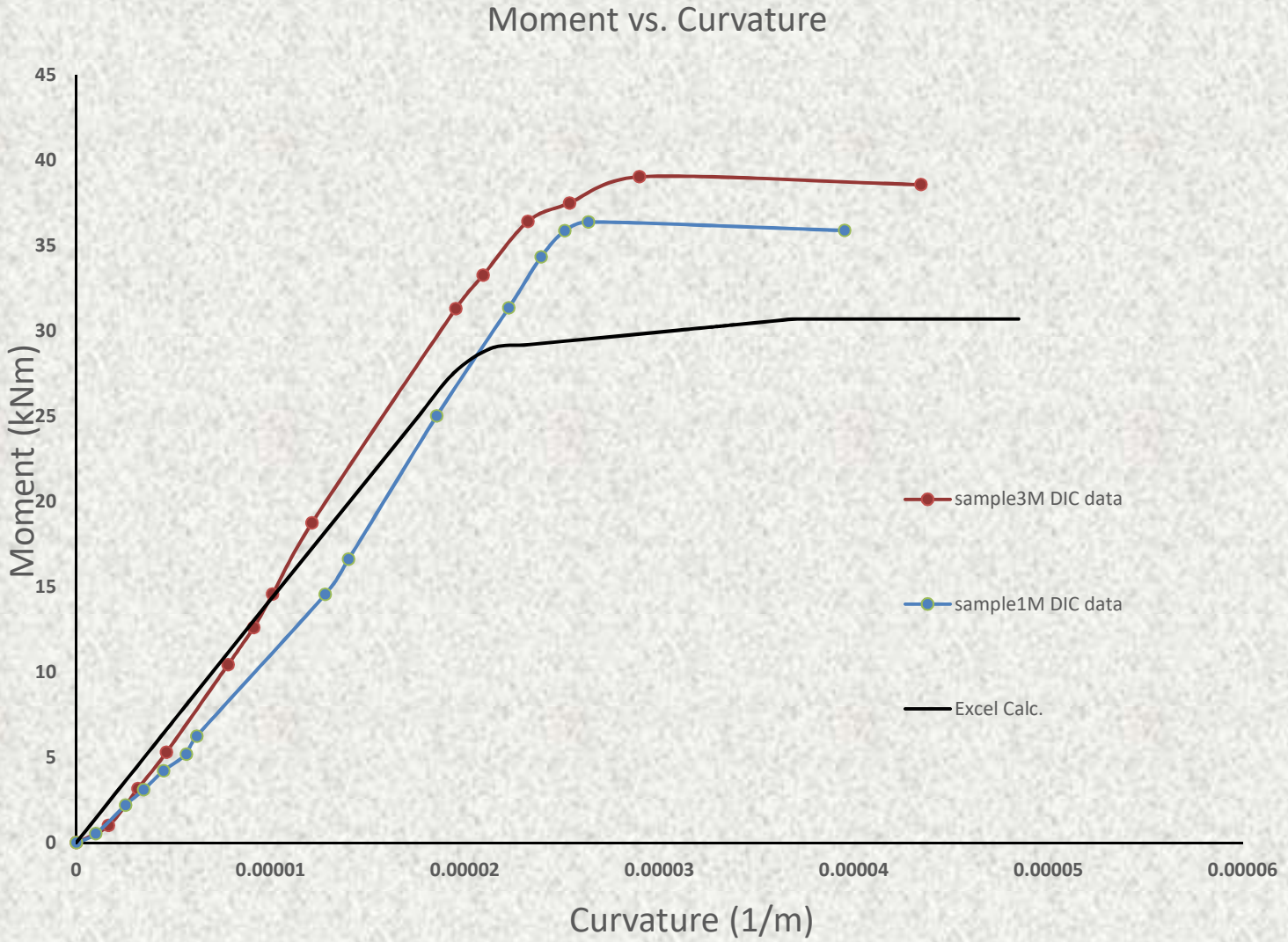
Normal stone broke instantaneously

Marking to drop Load

Load of 15 kg being dropped

Surface after impact (completely intact after 3 drops)

STRUCTURAL PERFORMANCE



High ductile behaviour & Consistent Performance

Composite action till end of the test

Self weight of the panel is not included

HYGIENE TOILETS

Natural stone slabs are used
Erected in 6 hours
No maintenance

Field Tested

Seamless Construction Systems with Innovative Confined Shear Wall (CSW)

CONFINED SHEAR WALL FOR FAST AND DURABLE CONSTRUCTIONS

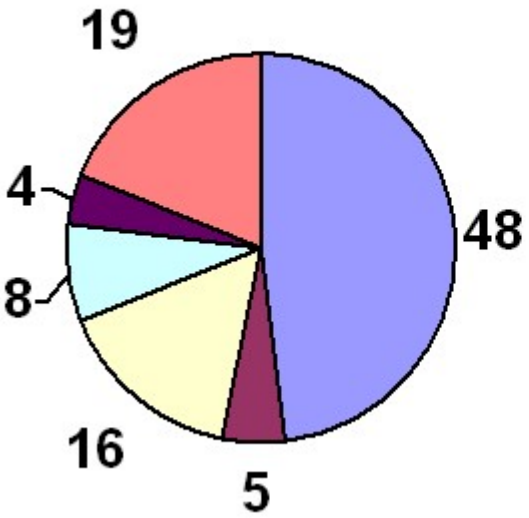
GFRC Panels Developed by IIT - It is a multiwall panel and concrete is poured inside

NUFORM walls - It is a multiwall polymer panel developed in Canada which act as "Stay in Form" and durable protection to concrete

As per Canadaian reports, material is fire rated for 2 hrs

Design development as per Indian codes is by SLSC and Testing & Approval is done in association with IIT , Hyderabad

COMPOSITE STONE SLAB TECHNOLGY



WHAT STONE COMPOSITE OFFER

REINF.COR — COMPLETELY AVOIDED

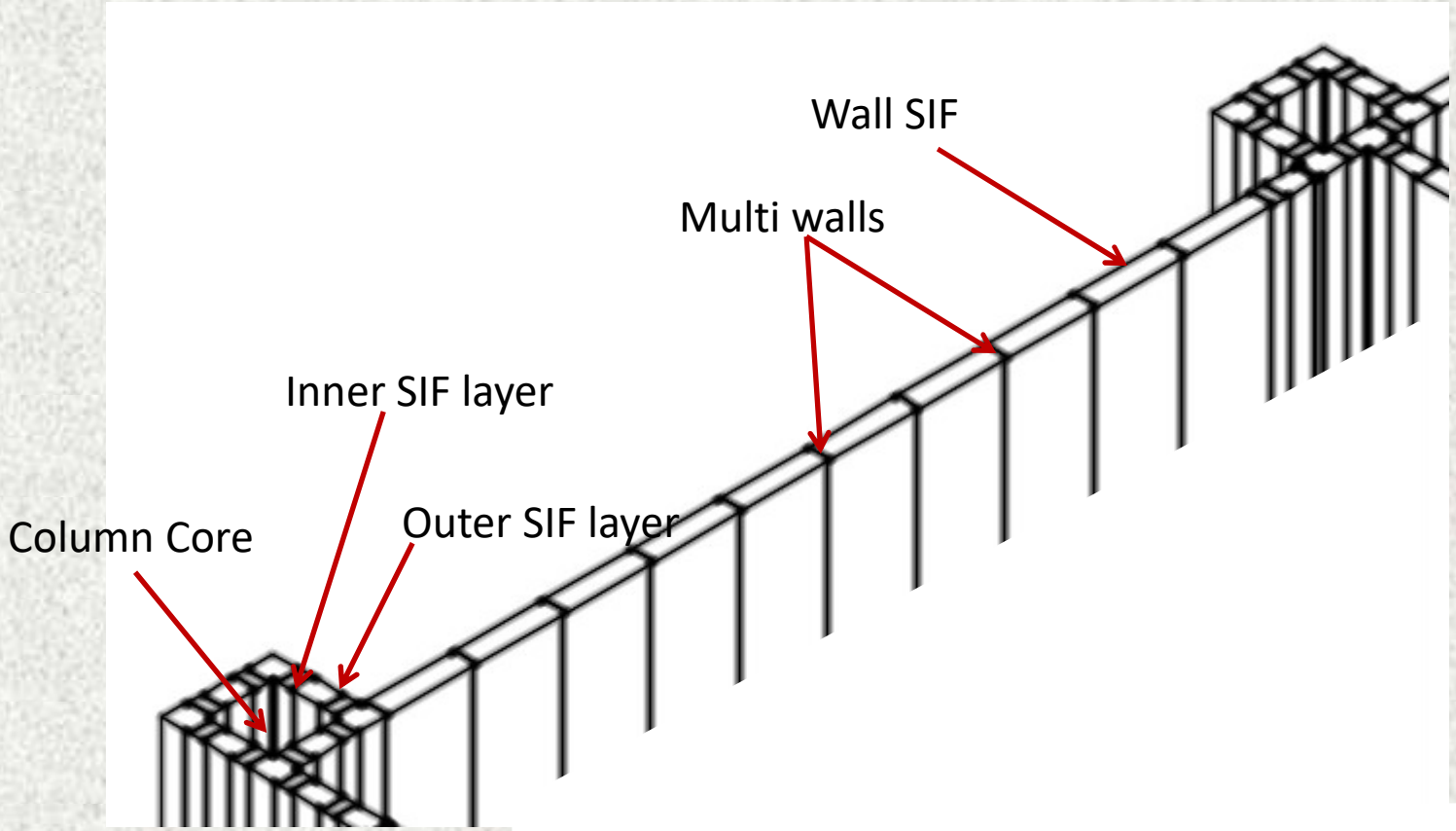
ACC.LOAD — IT IS A DESIGN ISSUE

FIRE — STONE IS FIRE RESISTANT

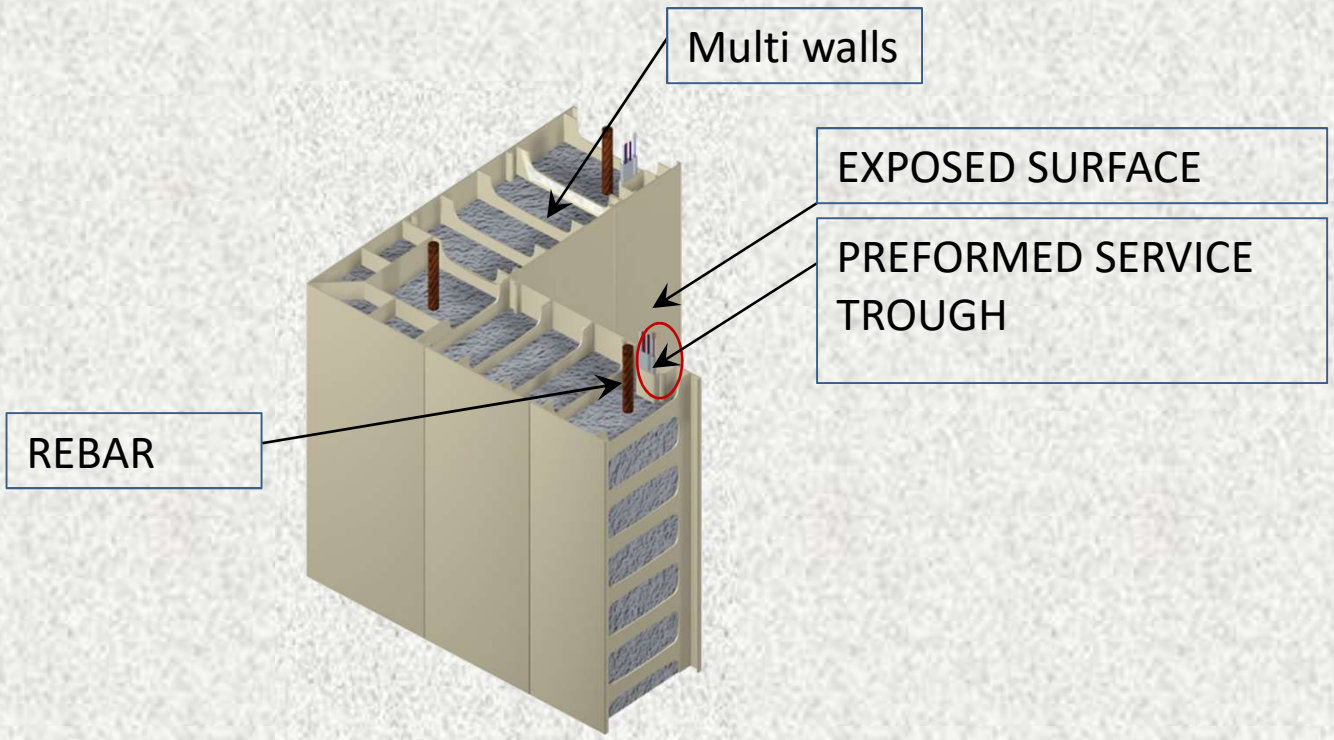
ASR — COMPLETELY AVOIDED

STR. — IT IS A DESIGN ISSUE

CHEMICAL — COMPLETELY AVOIDED

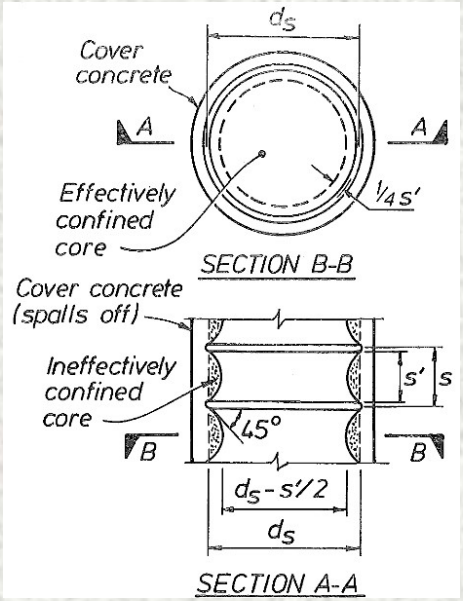


TYPICAL WALL VIEW

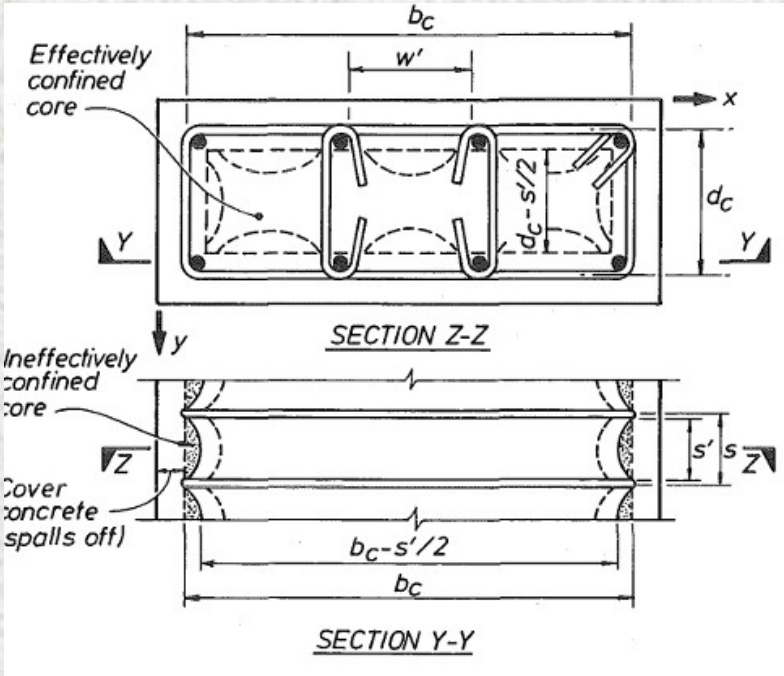


TYPICAL WALL VIEW

COLUMNS WITH CONVENTIONAL TIES



Circular Columns



Rectangular Columns

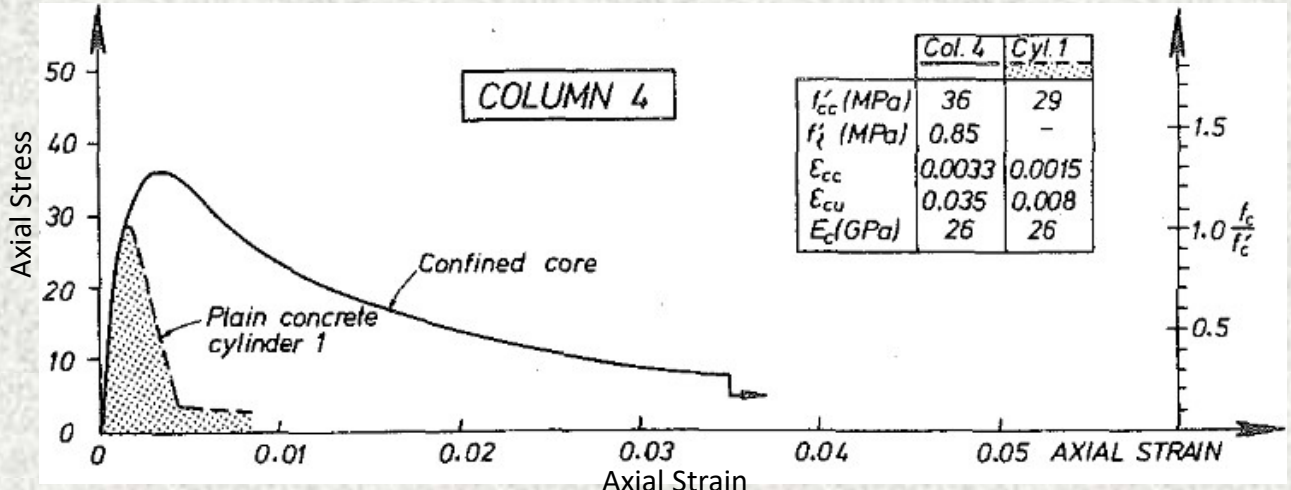
Effectively confined core

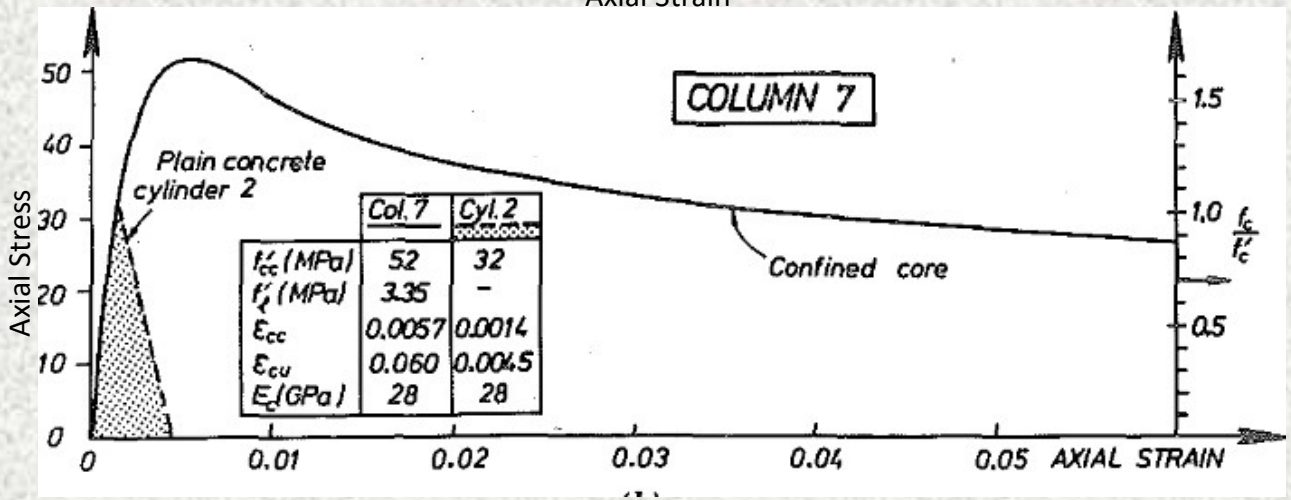
- Configuration for lateral reinforcement in the form of a tie does not provide for optimal use of material since the

  a) Confinement is limited in the plane of ties
  b) Steel is not oriented perpendicular to the shear crack.

Mander et al. 1988

RESPONSE OF CIRCULAR COLUMNS UNDER AXIAL LOADS

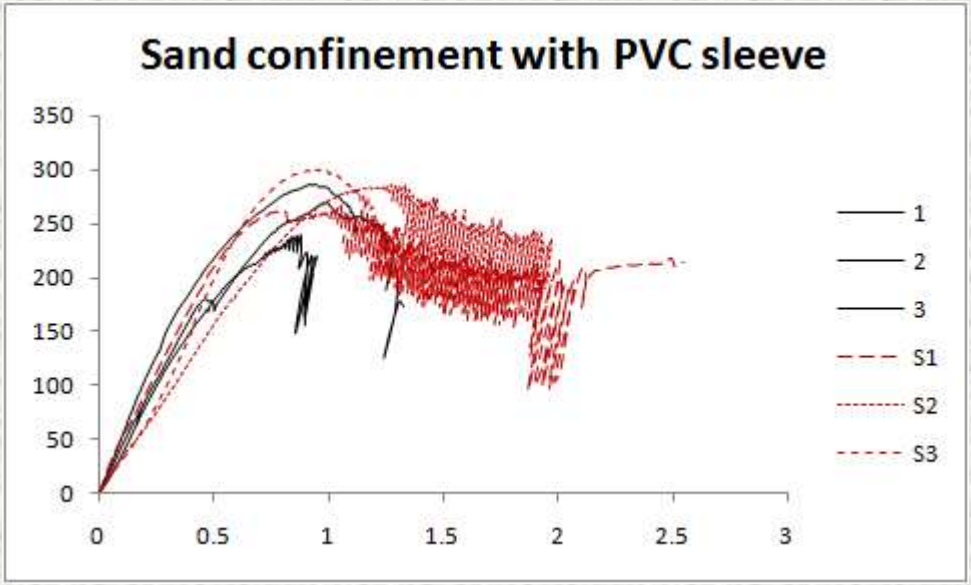




- Increase in volume of transverse steel improves ductility with increased deformability

Mander et al. 1988

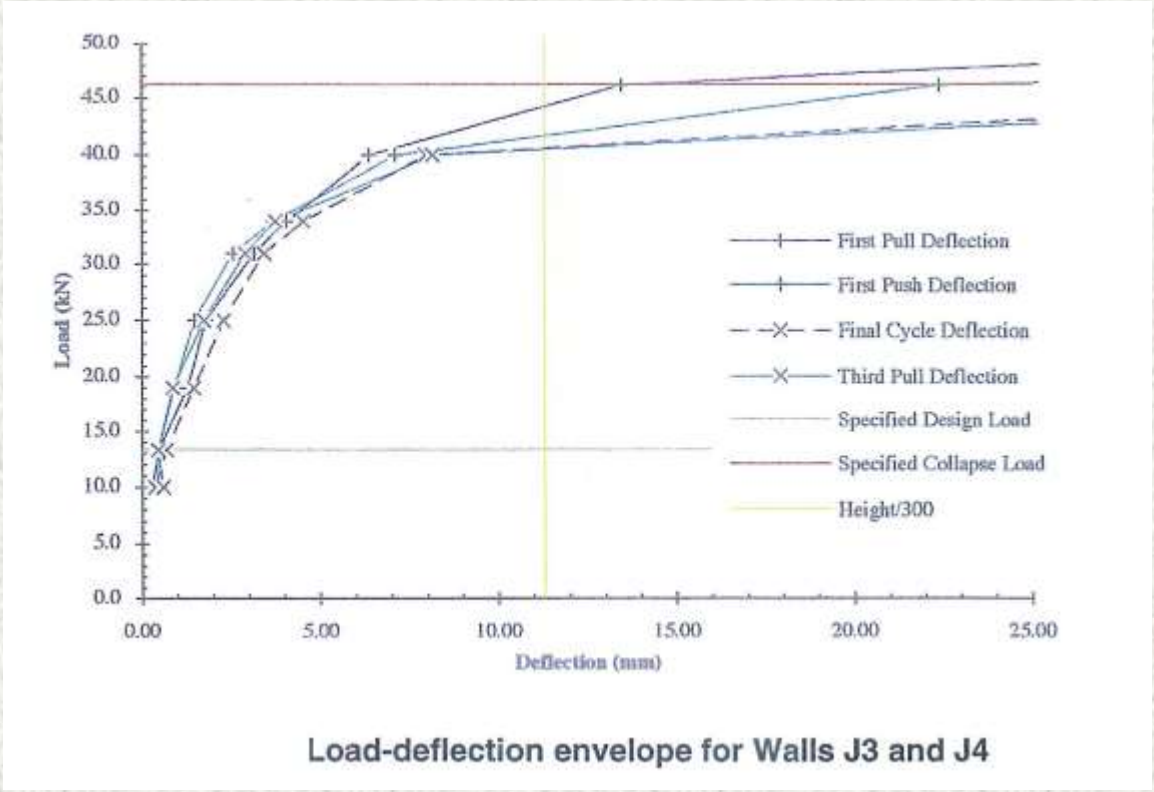
Influence of PVC sleeve confinement on Conventional Concrete



Courtesy : Innovative Confinement to improve ductility –
V V Rangarao, KVL Subramaniam & Suriya P, IIT-Hyderabad

The benefits of polymer as confining material is expected

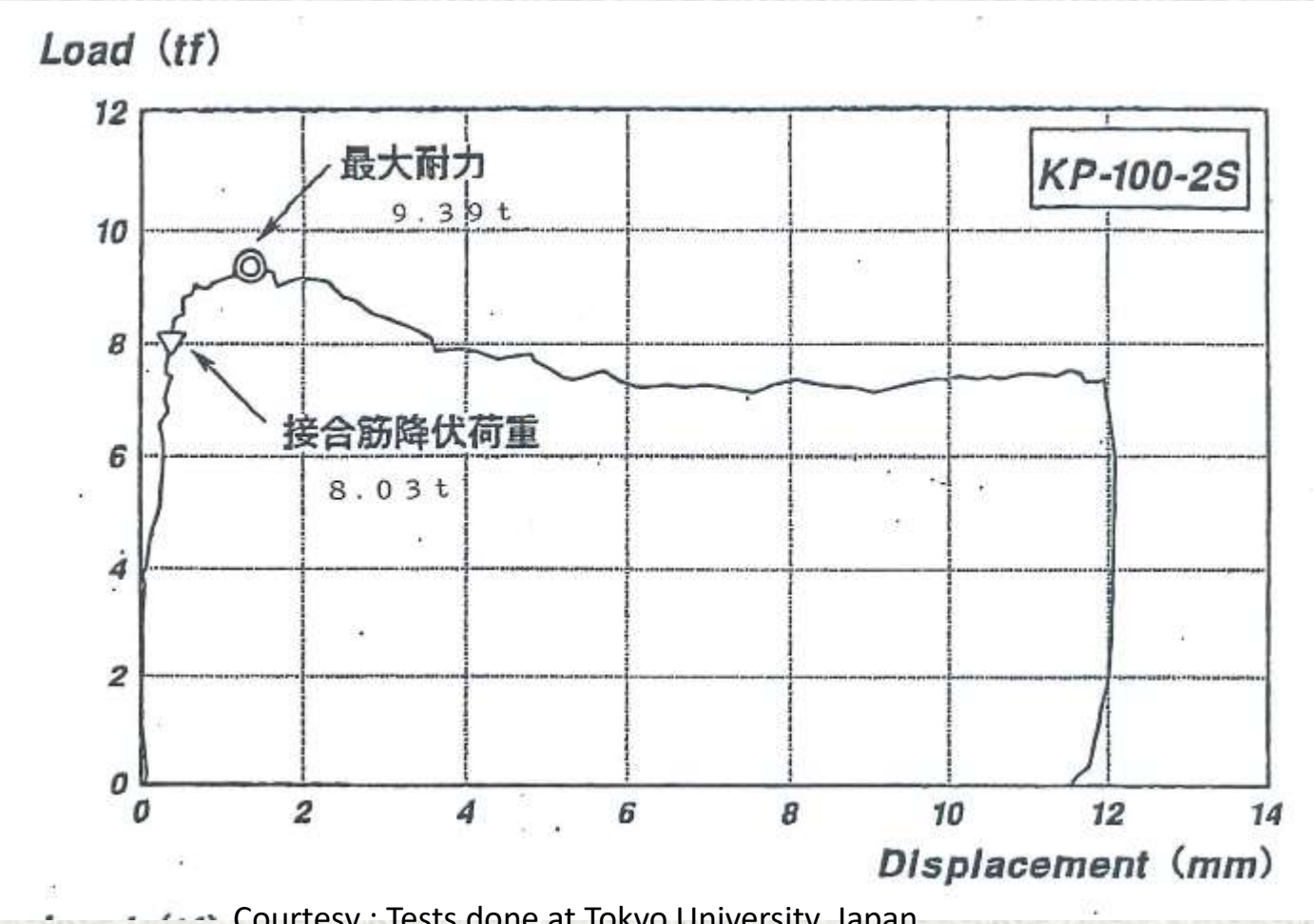
TYPICAL RESPONSE OF NOVEL WALL



Load-deflection envelope for Walls J3 and J4

Tests done in USA

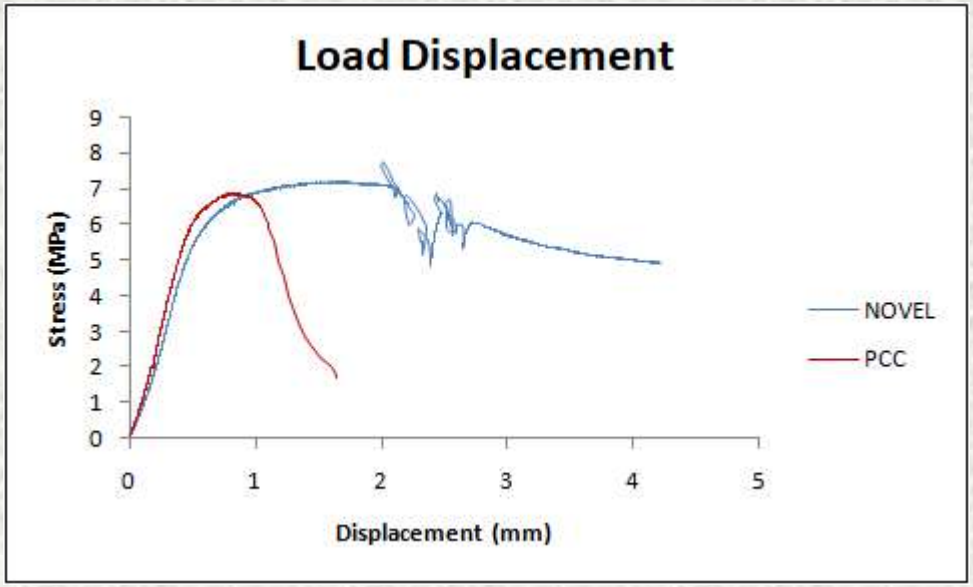
Performance of Polymer confined walls under lateral Loads-



Courtesy : Tests done at Tokyo University, Japan

Published report from Tokyo University

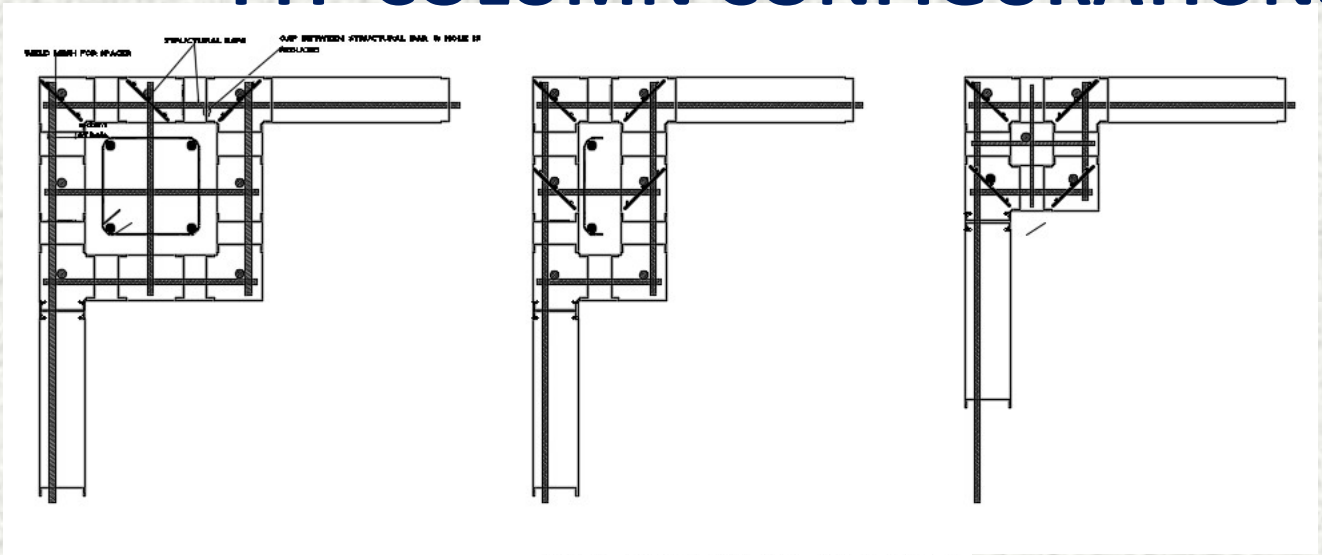
RECENT TESTS AT IIT-H

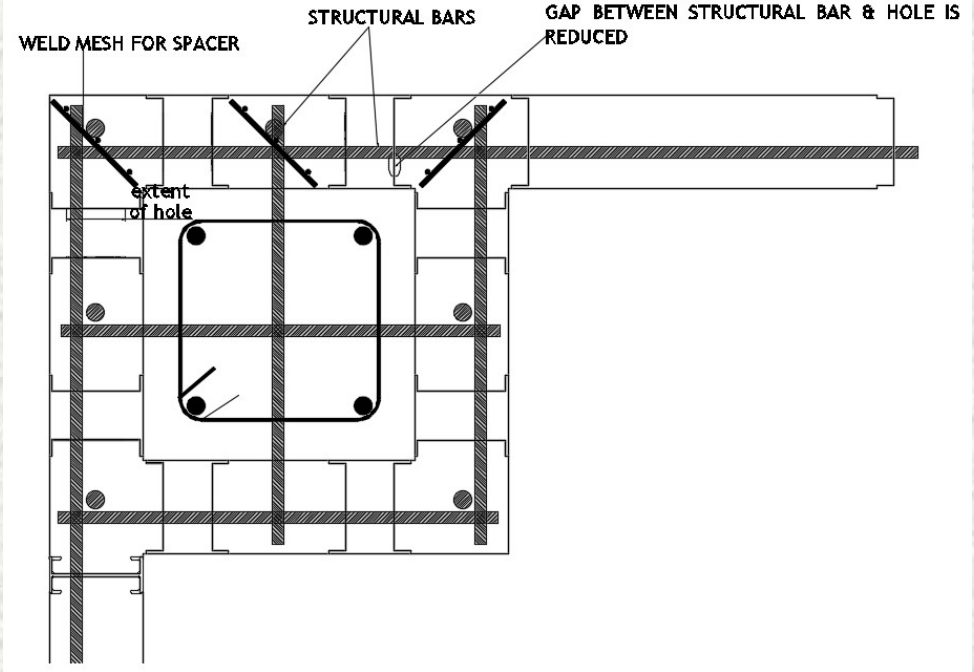


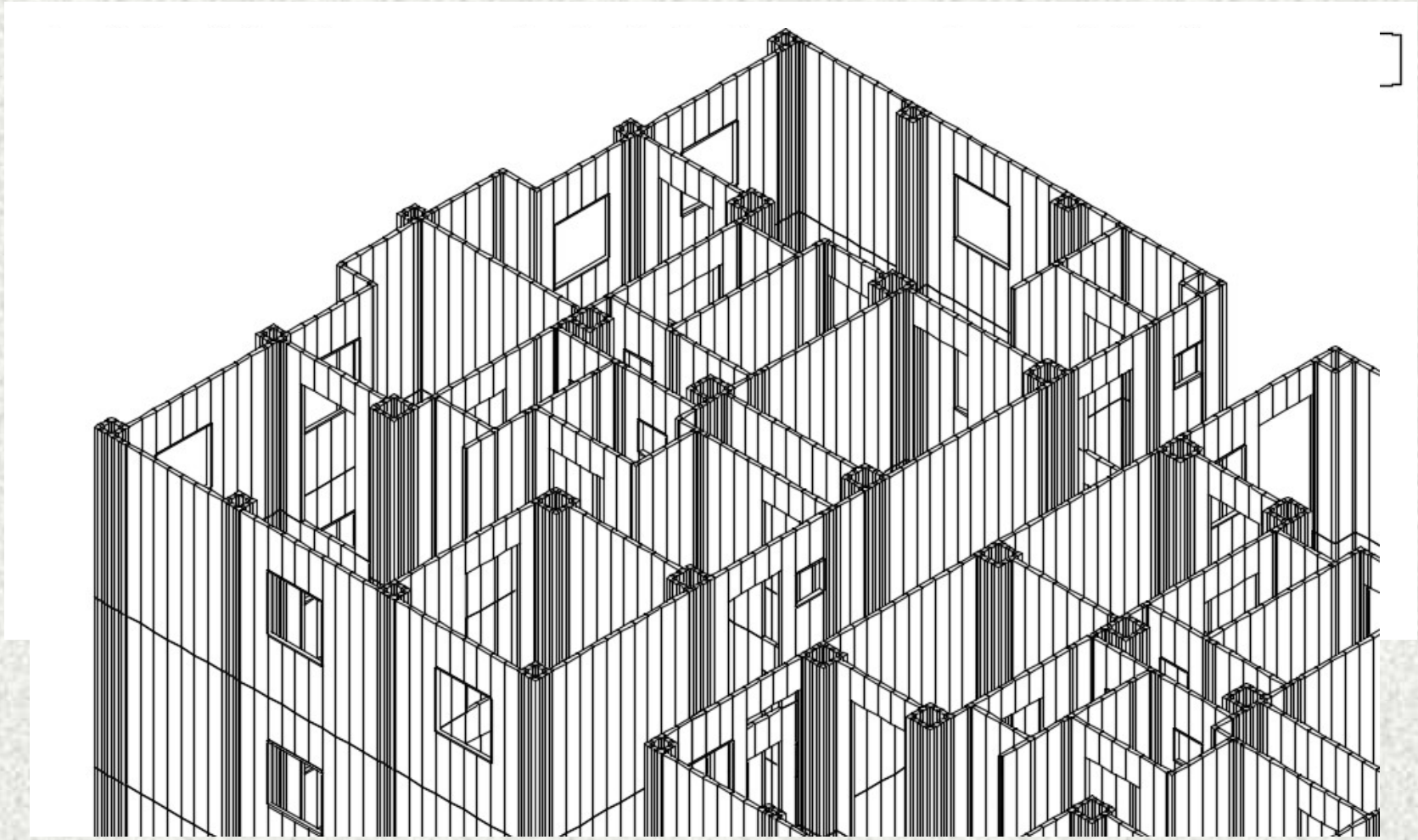
250 X 64 X 300MM High

PCC specimens are cast in forms

TYP COLUMN CONFIGURATIONS







“CSF” WALL SYSTEM

- ✓ Installation and Alignment
- ✓ Rebar placement
- ✓ Concreting
- ✓ No of workers – not more than 3-4 workers/ day

Max 2-3 days time per floor

“No Curing Required”

CONVENTIONAL SHEAR WALL

- ✓ Rebar placement
- ✓ Shuttering Installation & alignment
- ✓ Rebar cleaning
- ✓ Concreting
- ✓ Curing
- ✓ De-erection & shuttering cleaning
- ✓ Surface preparation & Plastering
- ✓Painting

Min 7-10 days for walls & 21 days or more for other operations. Demands large number of skilled work force & tools

OTHER R & D PROJECTS OF SLSC FOR MASS HOSUING

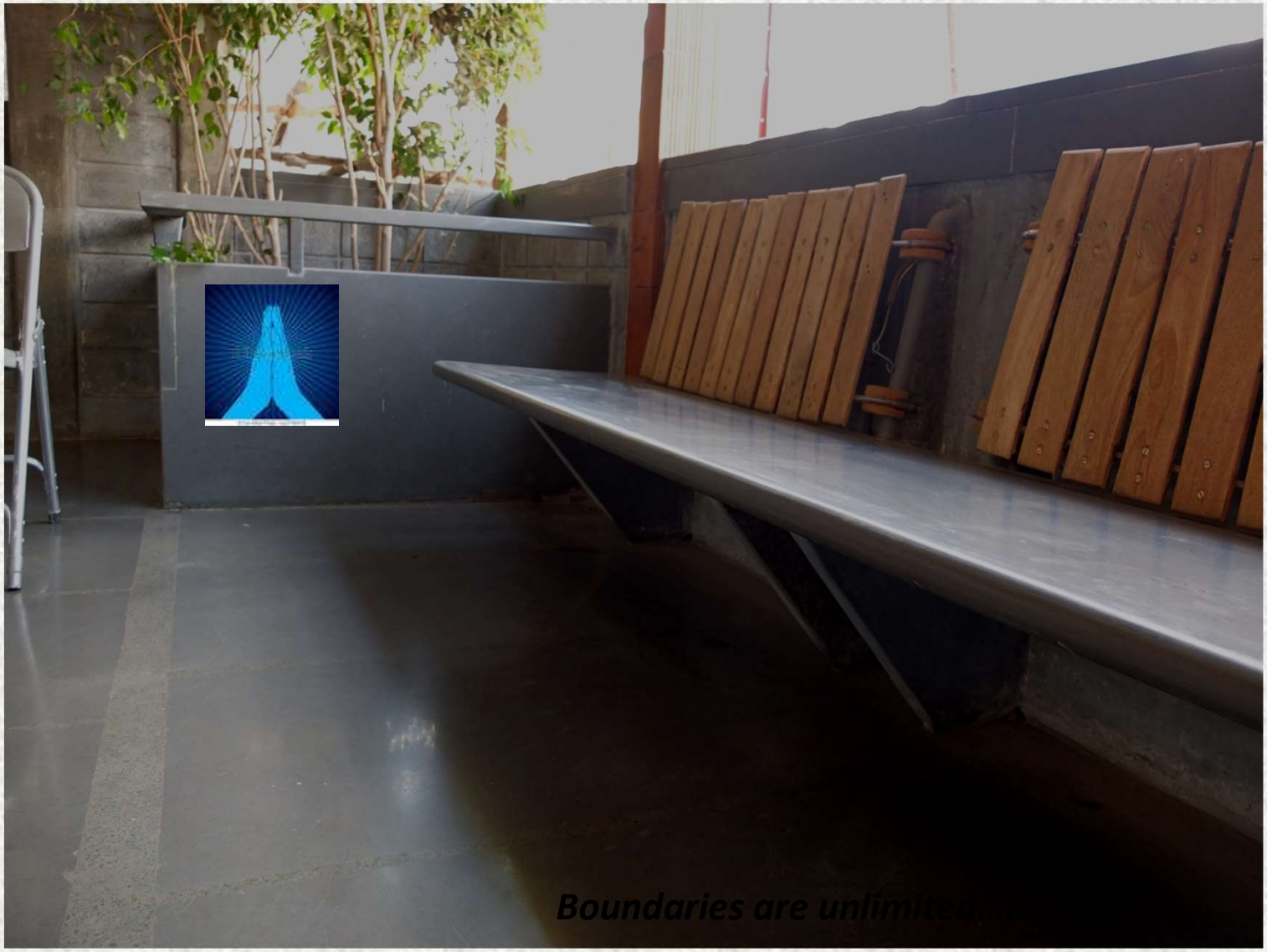
1. Sandwich panels for walls and Floor- Strength Enhancement mechanisms over and above the current Practices- Project supported by M/S BEARDSELL Ltd

2. Use of Paper Tubes for structures – Project supported by JAICA and designed by Shigerban Associates, Japan

3. Ferrocement Modular Assembly – Anupama Kundoo, Queensland Unversity, Australia

4. Origamy for Emergency Shelters - Anupama Kundoo, Queensland Unversity, Australia

5. Confined Shear wall – Novel Buildtec (P) Ltd, Mumabi & Canada


Boundaries are unlimited