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SUSTAINABLE TECHNOLOGICAL SOLUTIONS FOR FASTER AND COST EFFECTIVE CONSTRUCTION OF MASS HOUSING (A CASE STUDY OF RAPID - MONOLITHIC - DISASTER PROOF TECHNOLOGY)

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ABSTRACT

India has been victorious in meeting the food and clothing necessities of its vast population; however the difficulty of providing shelter of all is defying solutions. "While there has been an remarkable growth in the total housing stock from 65 million in 1947 to 187.05 million in 2001, and As estimated that, 26 million homes are mandatory by 2012, to meet the large gap still exists between the demand and supply of housing units.

Key words: Construction, Housing, Housing Industry.

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INTRODUCTION

1.1. Housing scenario in India

Besides, food and clothing, shelter is a basic human need. India has been victorious in meeting the food and clothing necessities of its vast population; however the difficulty of providing shelter of all is defying solutions.

"While there has been an remarkable growth in the total housing stock from 65 million in 1947 to 187.05 million in 2001, and As estimated that, 26 million homes are mandatory by 2012, to meet the large gap still exists between the demand and supply of housing units. The deficiency of housing is extremely felt in urban areas more so in the 35 Indian cities, which according to the 2001 census have a population of more than a million".(Carol., 2005).

2. TRENDS IN HOUSING INDUSTRY

With get better in economy, growth in IT/BT, Retail Business which attract major young unskilled, unemployed youths, shows least interest in construction jobs where one has to sweat very hard to earn his wages. With this, huge shortage of skilled/unskilled labour, construction of quality houses become difficult, lead to abnormal delays in completion of projects with cost overrun. The conventional method of construction in house building, labour availability & labour cost is going to be very critical & challenging for Housing industry in coming days, considering the Welfare Schemes announced by State/Central Govts towards improving the quality life of poor people in India.

Hence, for undertaking mass housing works, it is necessary to have less labour dependency, innovative technologies with mechanization, which are capable of fast rate construction and are able to deliver good quality and durable structure in cost effective manner

3. WHAT IS RMD TECHNOLOGY?

The construction in which, all the elements are cast together with reinforced cement concrete (r c c) by using aluminum form/similar form work, which supports wall, beam, column, roof slab and other elements together for concreting at single go. This ensures absolutely no joints (monolithic) between the elements with great surface finish, hence highly durable & earthquake resistant. This is nothing but strong concrete house.

The construction process which involves minimum number of activities, such activities can be simultaneously carried out with less time, exhibits highest quality and brings most durable, disaster proof, cost effective buildings.

Important Steps in RMD Technology

- Planning, Design & Reinforcement detailing
- Selection of Shuttering
- Selection of Concrete mixes
- Skills to handle shuttering, reinforcement and concreting operations.
- Optimising the cycle time

RMD Technology – A Game Changer?

The R M D Technology - Advantages

- Speed
- Quality
- Consistency
- Superior Structural System
- Durability
- Sustainability
- Economy of scale
- Use of existing labour

Speed

- Post foundation stage - beam, column, brick masonry, mortar, plastering are eliminated
- These processes are replaced by single pour concrete construction
- Construction time is drastically reduced by over 80 %

Quality

- Use of homogeneous material – M 20 Smart Dynamic Concrete (SDC – free flow)
- Thus replacing bricks, mortar & concrete, which are used separately.
- Variations in operations/ skills are avoided

Consistency

- Standardised, system-driven repetitions are used in construction.
- Since single homogenous material is used, better consistency can be achieved in production & placement

Superior Structural System

- Better structural rigidity & ductility due to shear wall design & use of homogeneous RCC
- Moisture resistance is better due to monolithic (joint-free) construction.
- Better resistance to differential thermal stresses due to climatic changes (as compared to conventional construction
- Better resistance to lateral forces – due to Earthquake/ tornado/ flood/ wind forces etc.

Durability

- Durability & superiority of RCC over all other materials is proven.
- Monolithic structure eliminates joints, which cause cracks, moisture penetration and weakening of structure in the long term.

Sustainability

- Optimisation of construction materials
- Avoidance of wastages at site
- Utilisation of industrial by-products like fly ash, slag
- Recyclability of materials after useful life of the structure (RCA – Recycled Concrete Aggregate)

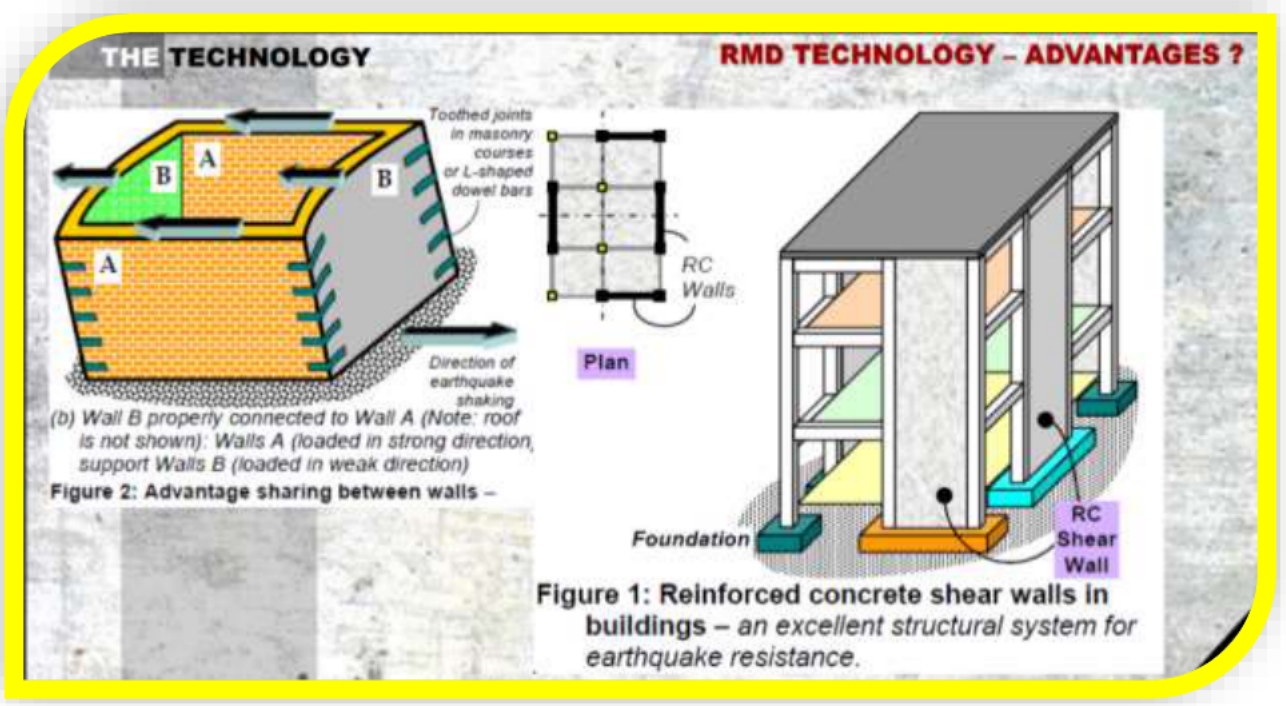
Economy of Scale

- Due to the use of homogenous material, cost of divergent materials (as compared with normal construction) is reduced.
- More number of repetitions bring down the cost of formwork for mass construction.
- Relatively less number of labour hours, by increasing labour productivity
- Due to faster pace of Construction, reduction in Working Capital Cost

Use of Existing Labour

- No special skills / tradesmen are required for this technology.
- Existing labour force can be trained easily within few days of working at site.

Hence, with the above cited reasons, surely the RMD Technology – A Game Changer in the field of Mass Housing Constructions



Challenges

- **Availability of Land** –One of the biggest questions that India needs to answer while going forward is with respect to adequate supply of land for housing purposes
- **Financial and Regulatory Support:** Financial and regulatory constraints have plagued the housing sector in India
- **Appropriate solutions or Technologies** to provide affordable, socio culturally acceptable, environment friendly and faster housing construction continues to be a serious challenge to public as well as private housing providers

RMD Technology – Sustainable

- Mass Housing involves designing and building a home—on the inside and out—to maximize performance and conserve resources.
- A Monolithic home consumes less energy, water and natural resources; creates less waste; and is healthier and more comfortable for the occupants—all qualities that are easily achieved by using time tested material- concrete.

A Case Study

- Project: Cluster of EWS Houses – 350 Nos
- Client: Karnataka Housing Board Govt of Karnataka.
- Project Implementing Agency: Rajiv Gandhi Housing Corporation/Karnataka Habitat Centre
- Technology Support: UltraTech Cement Limited, Unit -UltraTech Concrete

Specifications

- E W S House – for Urban Poor

- Area of Plinth – 285 sft. – Single storey, 1 Hall, 1 Kitchen, 1 Bed room & 1 Bath cum toilet
- Cost of a House – Rs 2 lacs
- Technology – RMD Technology adopted
- Grade of Concrete – M20 Dynamic grade for wall & M20 for Roof & Foundation Shuttering – Aluminium shuttering (Mivan or equivalent)

The increase in carpet area in the above case is about 22.35 sft of the total 285 sft. Hence, increase in carpet area will be 7.8%

The above calculation does not includes the additional cost-benefits such early occupational cost (4-5 months), and saving in interest cost, resources holding charges (4-5months)etc.. as in case of conventional construction. The wastage of materials at site not accounted (3-5%). Also not considered the scrap value of Aluminium forms after 100 repetition (generally scrap value is higher compared to steel). Considering above all cost aspects, by adopting RMD Technology, about 15-20% of overall cost shall be saved

RMD Technology as sustainable

Mass Housing involves designing and building a home—on the inside and out—to maximize performance and conserve resources. A Concrete home consumes less energy, water and natural resources; creates less waste; and is healthier and more comfortable for the occupants—all qualities that are easily achieved by using concrete.

Case Study: Execution Model House: Location Bankapura – Shigao – Dharawd Dist.

Day 1: Marking of foundation, Earth work excavation by JCB at 4.00 pm
Day 2: Sand Piling and Sand Bed filling, Steel fabrication for Foundation & Plinth Beam, Concreting of Foundation & Plinth Beam, fabrication of reinforcement of steel for wall & roof
Day 3: Erection of shuttering with reinforcement for wall & roof and Concreting for wall &roof
Day 4: De -shuttering of wall & roof, curing compound application, filling the holes **Day 5:** Doors & Windows fitting, Sanitary & electrical fittings, Whitewashing/ colouring, flooring, finishing
Day 6: Ready for Opening

4. SEQUENCING OF CONSTRUCTION OF MASS HOUSES UNDER RMD TECHNOLOGY

Day 1- Marking of foundation, Earth work excavation by Back Hoe Excavator

Day 2: Sand Piling and Sand Bed filling, Steel fabrication for Foundation & Plinth Beam, Concreting of Foundation & Plinth Beam, fabrication of steel for wall & roof

Day 3: Erection of shuttering with reinforcement for wall & roof and Concreting for wall &roof

Day 4: De -shuttering of wall & roof, curing compound application, filling the holes

Day 5: Doors & Windows fitting, Sanitary & electrical fittings, Whitewashing /colouring, flooring, finishing

Day 6: Ready for Opening

5. TAKE AWAY

Perception Change (Reputation): The perception on quality in mass housing among the public is very poor. With adaptation of RMD Technology, it has been proven that the perception has been totally changed. The RMD Technology brings pride & appreciation to the designer, owner, contractor, agencies who associated with the project by the end users.

On Speed –At site, 3 day/ 4 day cycle can be easily achievable and can complete the entire house in a week time. The Foundation, Wall & Roof components has to be designed, based on the soil & structural considerations. All the details of Electrical & Plumbing has to be precise and shall be placed in position before concreting. The RMD Technology is widely acceptable, and the fastest technology available at present, however, the precast technology is yet to mature enough to replace RMD Technology in terms of cost, assembly of elements at site, issues associated with Joints & its sealants etc..

On Quality- The de-shuttering shall be done for wall & roof after 24 hours of concreting, by leaving adequate props to support roof concrete. Hence quality houses are built at one go. The RMD Technology is the only technology which can deliver the quality parameters as designed & targeted without much deviation.

On Labour – The requirement of Labour and Skills are very minimum and hence, the less quality issues, speedier construction.

On Technology – The RMD Technology delivers the strong houses which are more durable & sustainable against tornado's, earthquakes etc,, compare to any other methods of construction

On Cost – The RMD Technology for Mass Housing is comparable and economical for Mass Housing Projects or the similar projects are repeated across many locations /site

Limitations

- Generally, used in mass housing project with same plan and the multi-storey structures having same plan area at all floors.
- Huge initial investment for formwork procurement

- Large number of repetitions makes this technology cost –effective. About 70-80% of form work elements shall be useful for new project (new plan)after first project, rest shall be suitably designed and procured for next projects
- Initial setting of formwork at site (as demo), as per drawing dimension, may take more time The training of labour to handle designed formworks at site- however, this would overcome with support of formwork suppliers
- All the utilities, has to lay & embedded in concrete walls/slabs, hence relocation, repair of these will be very difficult
- Since, structure is monolithic and wall thickness is less, these houses are little warmer than the conventional during summer/ sunny days. However, this problem can overcome by using Light weight concrete(Foam Concrete) or thermal insulated paint for external wall or by adopting simple thermal insulation techniques or growing creepers & plants around the external walls

6. CONCLUSIONS

Population explosion has always been a bottleneck to the development for Indian society especially providing housing for economically weaker sections(EWS) and low income groups is both gigantic and a complex problem. India desperately needs a lot of rapid dwelling units. Mass housing projects with RMDC technique is one of the solutions to the overgrowing problem. The speed & quality construction drives this technology;

- Cost effective – average 15% cost saving for load bearing wall over conventional timber/plywood shuttering
- Increased Carpet area/Usable floor space of (5 – 8%) over Conventional Design
- Speedy construction – 1/4th – 1/6th of time required to complete construction against the conventional
- Easy to use, since it's simplified design
- Monolithic construction-box type strong structures with minimum/ no joints
- Structures are better earth quake and wind resistant
- Highly durable structures – required least maintenance
- Smooth finish of wall/roof/floor- ready to take the paint
- Block/Brick masonry eliminated thus Internal & External Plaster eliminated
- Environmental friendly – no wood/timber used
- Form work -Lightweight section are used –hence easy to lift and used
- Only hammer required to erect – joining by simple pins & wedges and horizontal ties
- Aluminium shuttering material has higher scrap value compared to plywood/steel

R.M.D.C. VS CONVENTIONAL CONSTRUCTION


FINISHES
CONVENTIONAL
R.M.D.C.
VS
• Plastered walls lead to problems like plaster cracks.
•Non Uniform finish
•More of joints.
• Less Weather resistant
• Plaster work not required.
• Durable walls
• Minimum decoration, repair and refurbishment costs.
•Uniform finishes.


SERVICES
CONVENTIONAL
R.M.D.C.
VS
• Improper conduiting for services leads to leakage and seepage
• Dampness
• Less fire-resistant as compared to shear wall.
• The window and door frames, electrical conduits and sockets, water pipes and sewer ducts are pre engineered
•Eliminating the need for chiseling, drilling, boring and excavation work.
• Use of Pre engineered drawings

Residential Complex for Police Personnel at 15 Bnindore

Client: Madhya Pradesh Police Housing Ltd

Location: 15 Bn, Indore (Madhya Pradesh)

Dwelling Unit: 1652 units

Type of building: Residential/Group housing

Built-up area: 160244 Sq.m

Residential Complex for Police Personnel at 1st Bnindore

Client: Madhya Pradesh Police Housing Ltd

Location: 1st Bn, Indore (Madhya Pradesh)

Dwelling Unit: 2242 units

Type of building: Residential/Group housing

Built-up area: 106986 Sq.m

Residential Complex For Police Personnel At Pipliyana Indore
Client: Madhya Pradesh Police Housing Ltd
Location: Piplihana, Indore (Madhya Pradesh)
Dwelling Unit: 944 units
Type of building: Residential/Group housing
Built-up area: 80551 Sq.m

CRPF Residential Quarters & Barracks, Gurgaon, Haryana
Client: CPWD
Location: Kadarpur, Gurgaon
Dwelling Unit: 973 units
Type of building: Residential/Group housing
Built-up area: 105723 Sq.m

Parijat Apartments, Lucknow

Client: Lucknow Development Authority, Location:Lucknow
Type of buildings: Residential/Group housing
Dwelling Units: 406
Estimated Cost: 150 Cr.
Built-up area: 66397.66 Sq.m.

Sargam Apartments, Lucknow

Client : Lucknow Development Authority
Location: Sector –J (ext.) Jankipuram, Lucknow
Type of building: Residential/Group housing
Dwelling Units: 720
Estimated Cost: 186.99 Cr.
Built-up area: 93700.01 Sq.m

Low Cost Housing For Urban Poor /Slum Rehabilitation, Delhi

Client: Delhi State Industrial & Infrastructure Development Corporation

Location: Tikri Kalan Delhi

Type of building: Residential/Group housing

Dwelling Unit: 8420

Estimated Cost: 485 cr.

Site area: 61.89 acre

Built-up area: 305239.96 Sq.m

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