Smarter Material for Smart Cities

[1]Vivek Mishra [2]Nidhi Gandhi [3]Parth Desani [4]Darshan Mehta
[1,2,3]U.G Student [4]Assistant Professor
[1,2,3,4]Department of Civil Engineering
[1,2,3,4]SSASIT, Surat, Gujarat, India

Abstract

Turkish geophysicist and earthquake scientist Ahmet mete lsikara's famous observation "QUAKES DON'T KILL PEOPLE, BUILDINGS DO" sums up the potential danger of compromised earthquake resistant design that looms over most of us. Poorly designed building contributed most to the recent catastrophe in Nepal. Thus it echoes the need for resilient and earthquake–resistant structural design and building materials. Builders and developers today are giving more focus to the quality of construction materials used in construction and are focusing on disaster resistant architecture that can withstand such natural calamities. For India to realize the prime minister's visionary idea of smart cities, it would require not only safe architecture, but also smarter materials and solutions which make construction process easier and fasters. Steel as structural material provides respite to structural engineers and architects alike since it is ductile and is thus resilient. Buildings using steel structures are lighter than concrete once thereby attracting lesser seismic forces and also allow the flexibility of complex shapes. It is important that whenever comfort mobility, energy resources and respect for the environment are challenged by the situation, smart, eco-friendly and innovative construction solutions to harness the need for a lighter, faster and easier method of construction should be activated and start functioning.

Keyword- Smart Cities, Panther cement, Speed-floors

I. INTRODUCTION

The term smart city is define as "A developed the urban areas that creates sustainable economic development and high quality of life by excelling in multiple key areas; economy, mobility, environment, people, living, and government. There were several scenes in terminator 2 judgment day in which the evil T-1000 was seemingly blown apart, only to pull together and reshape its liquid metal body. The cyborg could even shape shift to become whatever from it chose. Now that's smart material. A scary example, sure but actually not so far off from the types of materials being developed and used by various industries, including construction today. Imagine if we had similar smart provision in the original construction of structures in Nepal and part of India, today the damage would have been so much in control with self-healing smart construction aids to take charge and it is not a fantasy but distinct reality in "smartness parameter" of a smart city. Quality of life is becoming a main issue in modern urban environments and typically in smart cities this issue should be addressed all throughout its life cycle.

A. A List of Smart Materials

1) Speed-floor
2) Welded Mesh
3) Structural insulated panels
4) Fly-ash brick
5) Light weight aggregate
6) Reinforced EPS
7) Photo-catalytic materials
8) Monolithic matrix concrete
9) Global road stabilizers
10) Panther cement
11) TMT bars

1) Speed-Floors: "Cast Floors without Decking Sheet or Props"

The Jindal steel and power company has introduced a revolutionary and innovative technique to eliminate the out dated conventional flooring system with suspended concrete flooring system called Jindal speed-floor. A light-weight technology from New Zealand, it is quick and easy to install that reduces the slab construction cycle from 3 weeks to less than a week, thus ensuring rapid construction. Compatible with steel and concrete frames, speed-floor reduces both the cost and time of slab construction.

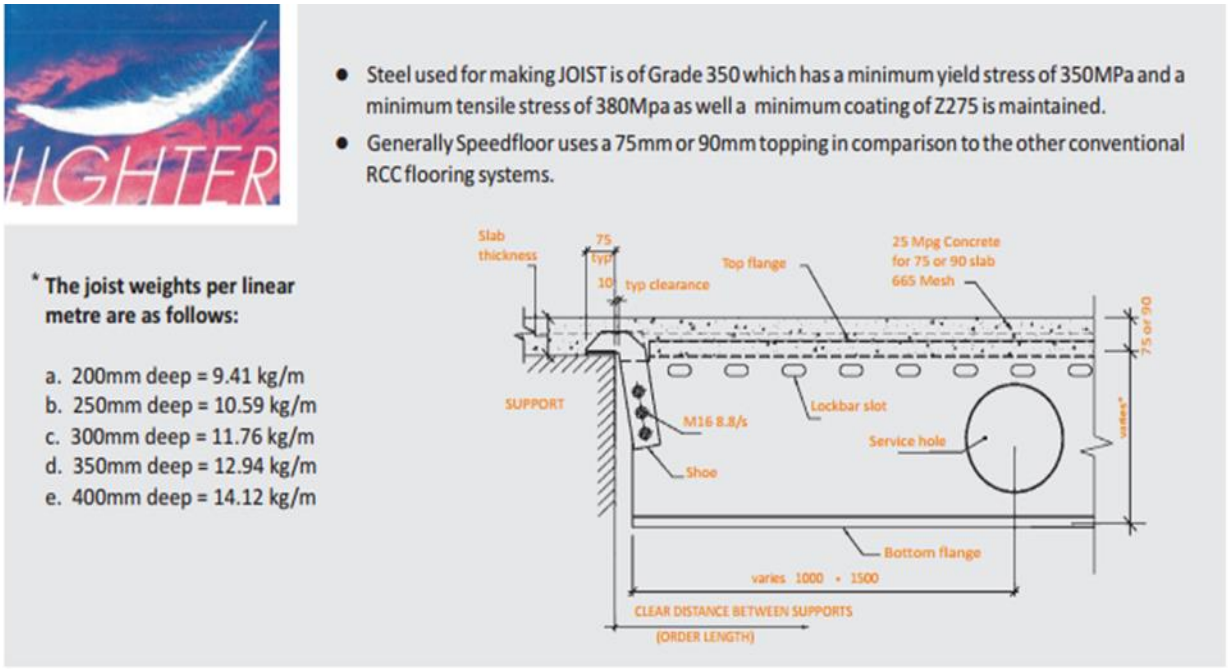


Fig. 1:

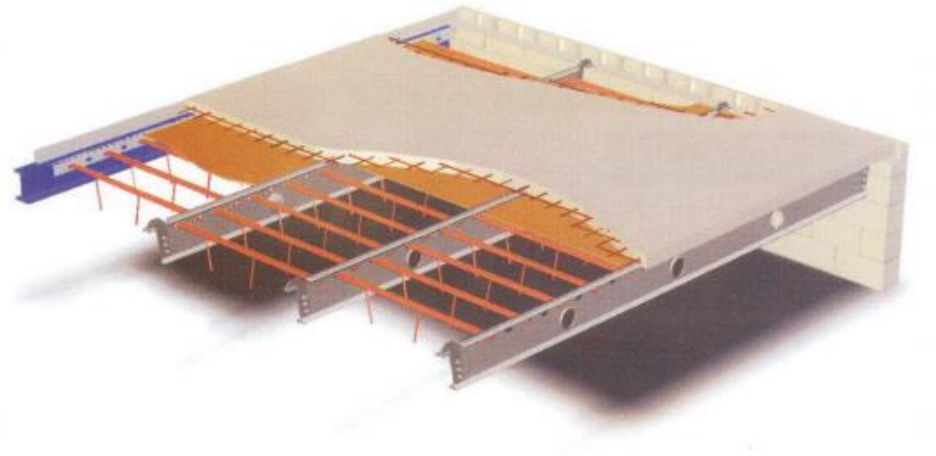


Fig. 2:

At the heart of the system is a roll-framed, galvanized steel joist that offers all the benefits of open-webbed truss system, easy enough to be manually handled into place, reducing crane age costs. This innovative technique has already been implemented in many projects including Medanta hospital, Gurgaon; GD Goneka School, Gurgaon; Philips innovation centre, Banglore; MAX Hypermart, Hyderabad and OP Jindal community college, Raigarh.

2) Welded Mesh: "Readymade TMT Mesh which saves Time and Cost"

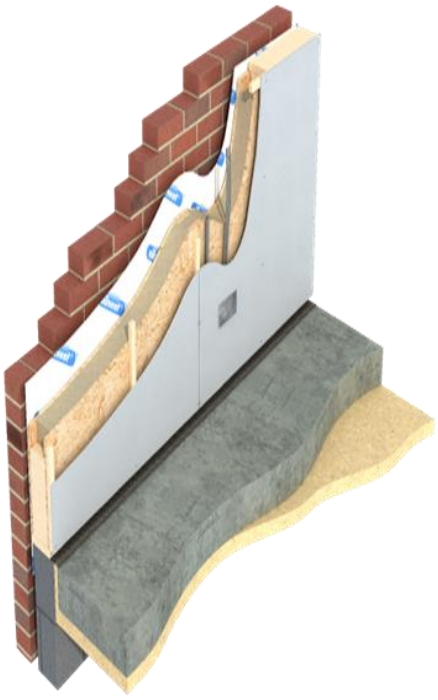
The welded mesh is another highly efficient material that helps in faster's construction. It is processed steel product that consists of re-bars welded together to form a mesh. The use of readymade welded wire mesh at construction has made construction much faster due to elimination of various time-consuming activities such as cutting, marking, and spacing of bars and binding of wires to the bars.

Fig. 3 & 4: Welded Mesh: "Readymade TMT Mesh which saves Time and Cost"

It is a ready to use, cost effective and less labor intensive technique ideal for construction of concrete roads and casting of slabs and retaining walls.

3) Structural Insulated Panels: "Construct Homes without Constructing Them"

This system will spawn a new age in India construction sector with pre-fabricated panels being shipped to site and being erected much faster than any system currently available. Made using technology from US, the components of the system include EPS core, LGS framing and MGO board, making it a complete structural unit in itself. With built-in-insulation and fast construction, these panels are ideal for high altitudes and mass housing.



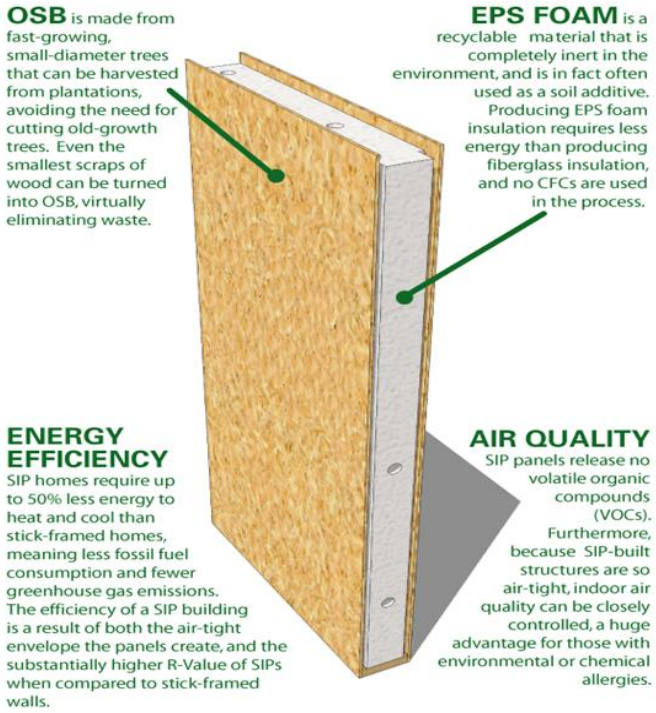


Fig. 5 & 6: Structural insulated panels: "Construct homes without constructing them"

These are an improvement over the current light weight building systems and will prove to be a one shot solutions for pre-fabricated structure needs.

4) Reinforced EPS: "Thermally Efficient Construction"

A renowned building technology from Schell, reinforced EPS is a smart construction technique to stay cool in summer and warm in winters without the need of additional insulation. Light and easy to install, the technology is 50% faster than traditional mode and helps in saving up to 30% electricity consumption through its supreme thermal efficiency. The technology can be used for (up to G+3), external wall cladding, non-load bearing partition walls, floors and roofs. EPS panels are used in construction of Industrial Township and Colonies, Mass Housing, Staff Quarters and Hostels.

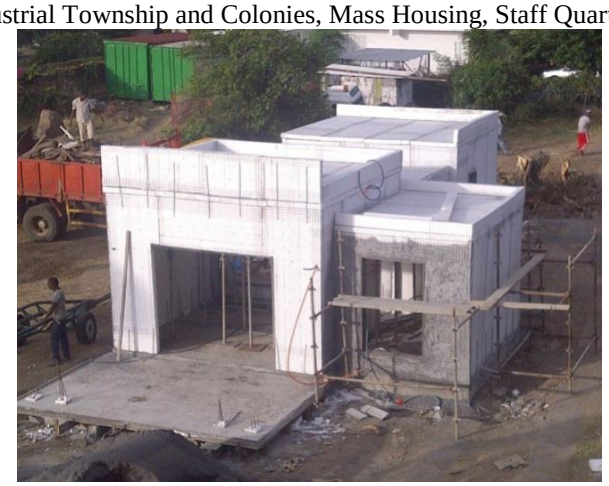



Fig. 7 & 8: Reinforced EPS: "Thermally efficient construction"

5) Fly-Ash Brick: "High on Strength, High on Finish"

The manufacturing of high-strength bricks made of fly-ash, a byproduct of power plants at Raigarh and Angul. With high strength and excellent finish, these bricks can be used in load bearing walls. Their supreme finish helps save construction time and cost in binding mortar and plaster. The company currently produces approximately 3Lakh bricks per day from its plants in Raigarh and Angul.

Fig. 9 & 10: Fly-ash brick: "High on strength, high on finish"

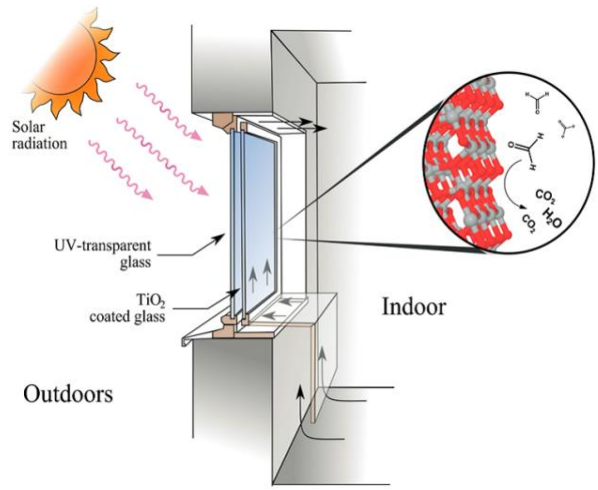
6) Light Weight Aggregate: "Aggregate That Is Clean, Green and Lean"

Another fortifying product being rolled out is light weight aggregate, an eco-friendly aggregate that is up to 50% lighter than conventional aggregate. Lighter aggregate triggers lighter concrete, which in-turn brings down the weight of the building. Made entirely from fly-ash, its high strength combined with low density makes it ideal for use in structural concrete used in bridges and highways.


Fig. 11 & 12: Light weight aggregate: "Aggregate that is clean, green and lean"

7) Photo- Catalytic Materials to Clean The Environment

A photo-catalytic material is mixed in the concrete and whenever normal day light or solar energy falls on this concrete, the air is totally purified and with antiseptically actions the pollutants are oxidized along with its special self-cleansing property. Due to photo-catalytic properties a decomposition of organic dirt particles on the surface will take place and simple water wash apply and result in clean surface and this happens all throughout life of the structure, whenever there is some light falling on the surface.



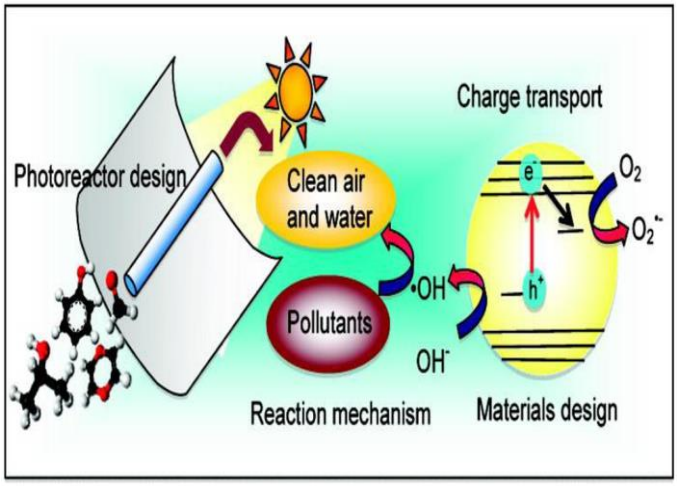


Fig. 13 & 14: Photo- catalytic materials to clean the environment

In places like Antwerp separate parking lanes are made with photo-catalytic pavement blocks which continuously keep on purifying pollutants in the air.

8) Global Road Stabilizers: "For Roads That Are 'Hard' To Beat"

In line with govt. of India's fast-tracking of road construction in India, JSPL has introduced a cutting-edge, eco-friendly soil stabilization technology called JGRS, which helps in increasing the bearing capacity of in-situ soil by stabilization. This technology helps in reduction of thickness of road layers and uses locally available material thus eliminating the need for transporting stone aggregate for large distance.

Fig. 15 & 16: Global road stabilizers: "For roads that are 'Hard' to beat"

JGRS reduces the cost by 20 to 30% and leads to 40 to 45% faster construction over conventional roads. The roads constructed using JGRS are durable and maintenance free. It can be used for construction of Highways, High-altitude roads, Airstrips and railway embankments.

9) Panther Cement

A panther cement has unmatched strength, is highly durable and corrosion resistant to meet the growing complex construction requirement of contractors, architects and owners looking for steady and durable concrete. Panther cement is made using slag from our processes which ensure excellent quality. Panther cement is being produced at JSPL's Raigarh facility with a production capacity of 0.7 MTPA, and the company plans to ramp up the capacity to 3 MTPA.

Fig. 17 & 18: Panther cement

II. CONCLUSION

Within our definition of smart materials, there are a host of candidate materials and systems which have been described in the public domain, some of which have already begun to find their way into real applications in the construction sector. It is not particularly useful here to make generic recommendations comparing individual technologies, since their eventual uptake will be application specific, even within a particular market sector, and based on a trade-off of performance parameters including cost. However, major issues that will (in addition to cost) influence the commercial exploitation of any of the candidate technologies in this sector include structural integration and lifetime performance (in some cases over many decades of use). Further work is required on these aspects in particular

Today, the most promising technologies for lifetime efficiency and improved reliability include the use of smart materials and structures. Understanding and controlling the composition and microstructure of any new materials are the ultimate objectives of research in this field, and is crucial to the production of good smart materials. The insights gained by gathering data on the behavior of a material's crystal inner structure as it heats and cools, deforms and changes, will speed the development of new materials for use in different applications. Structural ceramics, superconducting wires and nanostructure materials are good examples of the complex materials that will fashion nanotechnology. New or advanced materials to reduce weight, eliminate sound, reflect more light, and dampen vibration and handle more heat will lead to smart structures and systems which will definitively enhance our quality of life.

ACKNOWLEDGMENT

"We have taken efforts in this research paper. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

We are highly indebted to Prof. Darshan J. Meheta & Prof. Mehul J. Bhavsar, for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project. They taught us how to work, guided us on every step and all because of them we UG students are able to publish Research Papers, Thank you sir for the trust you have shown in us. However we grow we will never forget that you were the one who planted the seeds. The current work is in this format is all because of them.

Our thanks and appreciations also go to my colleagues Parth Desani, Kajol Mevawala & Liza Hirpara in developing the project and people who have willingly helped me out with their abilities."

REFERENCES

[1] The International Organization for Standards (ISO) is also working towards developing indices for smart cities as a part of Smart City standardization.
[2] http://www.smart-cities.eu/download/smart_cities_final_report.pdf
[3] http://niti.gov.in/mgov_file/CSTEP%20Report%20Smart%20Cities%20Framework.pdf

