



World Habitat Day

7th October, 2024

Engaging youth to create a better urban future





निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद् आवासन और राहरी कार्य मंत्रालय, भारत सरकार BUILDING MATERIALS & TECHNOLOGY PROMOTION COUNCIL Ministry of Housing & Urban Affairs, Government of India



"Creating Enabling Environment for Affordable Housing for All"





CONTENTS

Engaging Youth in Infrastructure Development for Better Urban Future3Beyond the Stars: Engaging Youth to Drive the Dream of 'Viksit Bharat'4Education for Sustainable Construction12Engaging youth in Creating a better Urban Future15Youth Power: Catalysing Urban Transformation18Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future23Housing the Nation with Young Ideas and Energy27Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development40Expectations of Youth in India: Shaping a Sustainable and Innovative Future42Engaging youth to create a better urban future42Engaging Youth to Create a Better Urban Growth and Development42Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable42Engaging Youth to Create a Better Urban Infrastructure70Imagineering Futuristic Urban Infrastructure70Youth in Urban Emergency and Disaster Management82Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course103Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC112	From the Desk of Executive Director	2
Beyond the Stars: Engaging Youth to Drive the Dream of 'Viksit Bharat'AEducation for Sustainable Construction12Engaging youth in Creating a better Urban Future15Youth Power: Catalysing Urban Transformation18Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future23Housing the Nation with Young Ideas and Energy23Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development40Expectations of Youth in India: Shaping a Sustainable and Innovative Future43Engaging youth to create a better urban future44Engaging youth to create a better urban future44Engaging youth to create a better urban future54Augmenting the Alternative Aggregates Utilisation in Sustainable Construction56Engaging Youth to Create a Better Urban Growth and Development67Volunteering for a Sustainable Tomorrow70Kaplenering Futuristic Urban Infrastructure70Youth in Urban Emergency and Disaster Management70Youth in Urban Emergency and Disaster Management70Paradigm shift in Rental Housing in India100NAVARITIH: Certificate Course100Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC113	Engaging Youth in Infrastructure Development for Better Urban Future	3
Education for Sustainable Construction12Engaging youth in Creating a better Urban Future15Youth Power: Catalysing Urban Transformation18Mission LiFE : A Govt's initiative 	Beyond the Stars: Engaging Youth to Drive the Dream of 'Viksit Bharat'	8
Engaging youth in Creating a better Urban Future15Youth Power: Catalysing Urban Transformation18Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future23Housing the Nation with Young Ideas and Energy23Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development40Expectations of Youth in India: Shaping a Sustainable and Innovative Future43Empowering the Youth to Transform the Urban Landscape Through Systems Thinking43Engaging youth to create a better urban future44Engaging youth to create a better urban future44Engaging Youth to Create a better Urban Growth and Development44Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow44Engaging Youth to Create a Better Urban Infrastructure74Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow74Funder in Better Urban Infrastructure74Funding the Landscape Through Light House Projects74Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course103Paradigm shift in Rental Housing Projects103Performance Appraisal Certification Scheme (PACS)113Publications of BMTPC113Publications of BMTPC114	Education for Sustainable Construction	12
Youth Power: Catalysing Urban Transformation14Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future23Housing the Nation with Young 	Engaging youth in Creating a better Urban Future	15
Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future23Housing the Nation with Young Ideas and Energy23Engaging Youth for an Urban Future: 	Youth Power: Catalysing Urban Transformation	18
Housing the Nation with Young Ideas and Energy27Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development40Expectations of Youth in India: 	Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future	23
Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development44Expectations of Youth in India: Shaping a Sustainable and Innovative Future45Empowering the Youth to Transform the Urban Landscape Through Systems Thinking45Engaging youth to create a better 	Housing the Nation with Young Ideas and Energy	27
Expectations of Youth in India: Shaping a Sustainable and Innovative Future43Shaping a Sustainable and Innovative Future43Empowering the Youth to Transform 	Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development	40
Empowering the Youth to Transform the Urban Landscape Through Systems Thinking49Systems Thinking49Engaging youth to create a better urban future54Augmenting the Alternative Aggregates Utilisation in Sustainable Construction56Engagement of Youth for a better Urban Growth and Development64Engaging Youth to Create a Better 	Expectations of Youth in India: Shaping a Sustainable and Innovative Future	43
Engaging youth to create a better urban future54Augmenting the Alternative Aggregates Utilisation in56Sustainable Construction56Engagement of Youth for a better Urban Growth and Development64Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow76Imagineering Futuristic 	Empowering the Youth to Transform the Urban Landscape Through Systems Thinking	49
Augmenting the Alternative Aggregates Utilisation inSustainable Construction56Engagement of Youth for a better Urban Growth and Development64Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow67Imagineering Futuristic Urban Infrastructure76Youth in Urban Emergency and 	Engaging youth to create a better urban future	54
Engagement of Youth for a better Urban Growth and Development64Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow62Imagineering Futuristic Urban Infrastructure70Exploring the use of Rice Straw Waste Disaster Management70Youth in Urban Emergency and Disaster Management82Technology Transition through Light House Projects102NAVARITIH: Certificate Course102Demonstration Housing Projects102Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC112	Augmenting the Alternative Aggregates Utilisation in Sustainable Construction	56
Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow62Imagineering Futuristic Urban Infrastructure70Exploring the use of Rice Straw Waste76Youth in Urban Emergency and Disaster Management82Technology Transition through Light House Projects102NAVARITIH: Certificate Course106Demonstration Housing Projects102Performance Appraisal Certification 	Engagement of Youth for a better Urban Growth and Development	64
Volunteering for a SustainableTomorrow67Imagineering Futuristic70Urban Infrastructure70Exploring the use of Rice Straw Waste76Youth in Urban Emergency and76Disaster Management82Technology Transition through Light89House Projects89Paradigm shift in Rental Housing102NAVARITIH: Certificate Course106Demonstration Housing Projects108Performance Appraisal Certification5cheme (PACS)Publications of BMTPC115	Engaging Youth to Create a Better Urban Future: The Power of	
Imagineering FuturisticUrban Infrastructure70Exploring the use of Rice Straw Waste76Youth in Urban Emergency and10Disaster Management82Technology Transition through Light82House Projects85Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course106Demonstration Housing Projects108Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC115	Tomorrow	67
Exploring the use of Rice Straw Waste76Youth in Urban Emergency and Disaster Management82Technology Transition through Light House Projects89Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course106Demonstration Housing Projects108Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC115	Urban Infrastructure	70
Youth in Urban Emergency and Disaster Management82Technology Transition through Light House Projects85Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course108Demonstration Housing Projects108Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC115	Exploring the use of Rice Straw Waste	76
Technology Transition through Light House Projects89Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course106Demonstration Housing Projects108Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC115	Youth in Urban Emergency and Disaster Management	82
Paradigm shift in Rental Housing in India102NAVARITIH: Certificate Course106Demonstration Housing Projects108Performance Appraisal Certification Scheme (PACS)112Publications of BMTPC115	Technology Transition through Light House Projects	89
NAVARITIH: Certificate Course106Demonstration Housing Projects108Performance Appraisal Certification112Scheme (PACS)112Publications of BMTPC115	Paradigm shift in Rental Housing in India	102
Demonstration Housing Projects108Performance Appraisal Certification112Scheme (PACS)112Publications of BMTPC115	NAVARITIH: Certificate Course	106
Performance Appraisal CertificationScheme (PACS)112Publications of BMTPC115	Demonstration Housing Projects	108
Publications of BMTPC 115	Performance Appraisal Certification Scheme (PACS)	112
	Publications of BMTPC	115

From the Desk of Executive Director

n the wake of global warming & extreme weather events, the countries world over are committed to put climate change mitigation strategies in place. The situation is further aggravated by the fast-paced urbanization & opulent life styles. The targets with regard to greenhouse gas emissions, energy consumption, power generation through renewable resources, clean & green technologies are being set forth. All these efforts remind us to leave a legacy for our future generations to nurture sustainable growth & ensure quality living. The concerted & sincere efforts are being made at the policy & governmental level, nevertheless, it could only be achieved only when it becomes people-centric people's movement in which young generation will play the decisive role. Therefore, this year's theme of World Habitat Day **Engaging Youth to Create a Better Urban Future** is a welcome step by UN Habitat which will nudge the world specially youth to take care of planet earth in sync with nature.

Being part of Housing for All (PMAY-U) mission of Ministry of Housing & Urban Affairs, Govt. of India to provide all-weather houses to the urban poor, we have successfully completed sanctioning 11.8 million houses, out of which 8.7 million have been completed & handed over to beneficiaries since the inception of scheme in 2015. The roaring success has led Govt. of India to launch PMAY-U 2.0 though which another 10 million houses to be constructed in next five years. The construction of houses at such a large scale is unprecedented & unheard world over & to facilitate resource-efficient, climate-responsive, eco-friendly, energy-efficient & disaster-resilient technologies & materials, Technology Sub-Mission has been introduced. The sub-mission underscores sustainable development using innovative materials & passive design strategies for thermally comfortable houses with proper sunlight & ventilation. The momentous breakthrough of submission has been Global Housing Technology Challenge-India (GHTC-I) through which 54 best available, time-tested & proven construction systems from all around the world were identified & later showcased through construction of Light-House Projects across six states under PMAY-U. The successful completion of light house projects & handing over the houses with latest technologies to EWS beneficiaries have helped in confidence building, further learning & will nudge the construction sector to adopt these systems as future technologies of construction.

I am pleased to publish BMTPC's special E-newsletter ''निर्माण सारिक' on World Habitat Day's theme. I am sure that the articles appearing in the publication will provide deep insights towards better urban future & will help in combating the urbanization in sustainable & holistic manner. The help and support of BMTPC's staff specially Shri Sharad K Gupta & Shri Dalip Kumar and the contributors for bringing out this publication is appreciatively acknowledged.

It is opportune time to make collective efforts to transform our cities for sustainable & resilient future.

dutgranal

(Dr. Shailesh Kr. Ågrawal)



Engaging Youth in Infrastructure Development for Better Urban Future



Dr. K. M. Soni

he 2030 agenda for sustainable development, adopted by all United Nations member countries in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. The 17 SDGs are part of a transformative agenda adopted by 193 Member States at the UN General Assembly summit in September 2015, and which came into effect on 1 January 2016. At the core of this global agenda for 2030 is the principle of universality: 'Leave

No One Behind'. Development in all its dimensions must include all people, everywhere, and should be built through the participation of everyone. The 17 SDGs are listed below:

- 1. No poverty
- 2. Zero hunger
- 3. Good health and well-being
- 4. Quality Education
- 5. Gender equality
- 6. Clean water and sanitation
- 7. Affordable and clean energy
- Decent work and economic growth
- Industry, innovation and infrastructure
- 10.Reduced inequalities
- 11.Sustainable cities and economies



* Former ADG, Central Public Works Department (CPWD), New Delhi

- 12.Responsible consumption and production
- 13.Climate action
- 14.Life below water
- 15.Life on land
- 16.Peace, justice and strong institutions
- 17. Partnership for the goals

Partnership for the goals is listed as 17th SDG but is included in all other goals therefore for any development, participation is important. Participation brings transparency, quality, growth, economy, education, gender inequality, innovation, and sustainability so also in urban infrastructure development. Urban infrastructure is developed by the engineers hence the interaction of practicing engineers and engineering students is important for better urban future.

Role of Civil Engineering in Urban Infrastructure Development

Civil engineering is a professional engineering discipline dealing with the planning, design, construction, and maintenance of the physical habitat, and related infrastructure of services. Public



works are owned by government such as government buildings, roads, bridges, canals, dams, airports, sewage systems, water supply lines, railways while private infrastructure is owned by private companies or individuals.

In civil engineering discipline, works are generally carried out by contractors through contracts entered between the employer and the contractor. The planning, and design of the infrastructure is either carried out through "inhouse" engineers or consultants while in EPC contracts, planning and designing may also be carried out by the contractor. Thus, builders and contractors also engage engineers for planning, designing and supervision. Government engineering departments always have their own engineers. Thus, there are professionals in government as well as in private sectors.

Civil engineers have to carry out multi-disciplinary works and to take decisions regarding health, safety and environment of the workers at site, ensure quality of work and make payments to the contractors. The engineers have to ensure that there is no overpayment to the contractor simultaneously make statutory deductions like income tax, works tax, cess according to The Building and Other **Construction Workers (Regulation** of Employment and Conditions of Service) Act, 1996, and ensure that the workers are paid at least according to Minimum Wage Act. Therefore, engineers have to get familiar of all such requirements which are to be understood and implemented by the engineers on joining the engineering organisation. By implementing workers welfare measures, SDG of good



health and wellbeing of workers is partly ensured.

As per SDGs, civil engineering also has the responsibility towards sustainable cities and climate action. To implement this SDG, the engineers have to plan and use green materials, green energy, and green processes to curtail carbon emission. Thus, green buildings and net zero energy or net plus energy structures are gaining popularity. Green buildings ensure better IAQ, thus SDG of good health for the occupants. SDG of clean water and sanitation is implemented through water efficiency by using recycled water and water efficient faucets, which save the water so that clean water is available for the potable use. Green structures also fulfill the purpose of SDG 6 - Clean water and sanitation, SDG 7 - Affordable and clean energy, SDG 9 - Industry, innovation and infrastructure and SDG 12 - Responsible consumption and production.

Therefore, civil engineers have to play a major role in implementing SDGs through development of urban infrastructure.

Quality Management

Civil engineers have to provide guarantee of the quality of infrastructure developed as the quality of infrastructure is directly related to quality of life. In India, development of quality infrastructure is not yet guaranteed by the engineers. However, with the participatory approach and thirdparty audits, one day the same may become possible. In the time to come, Third Party Quality Audit (TPQA), environmental/sustainability audit, rating of structures, stagewise quality inspection for quality assurance, and quality checks may even be carried out by the consultants. Quality management is extremely essential as it saves useful natural resources, stops generating construction and demolition waste before the economic life of the structure, is durable, has less maintenance, and provides comfortable and enjoyable conditions in case of habitat. Quality partly helps in achieving the purpose of SDG3 - good health and well-being and SDG 8 - Decent work and economic growth.





Time and Cost Management

Time overrun apart from leading to cost overrun and litigation, delays the use the assets. In case of inflation, cost of materials and wages of workers also go up as such quality of work may get affected. Therefore, civil engineers have to learn the time control in which the projects are to be completed. The methods and checks by which time management can be achieved should be shared during the interaction of civil engineering professionals with the civil engineering students. Use of new and innovative technologies may also reduce the time of construction. Therefore, to cope up the demand, major construction from the site will have to be taken to the factory by using prefab construction, more mechanization and robotics techniques.

A developing country cannot sustain time overrun due to financial constraints. Therefore, civil engineers have to use the costeffective techniques and ensure completion of projects within the time and also within the estimated cost. Availability of a habitat within time and cost makes life easy fulfilling partly the purpose of SDG 15 - Life on land

Project Management

Civil engineers have to be efficient in project management. Many a times, a project is divided into survey and investigation, preparation of DPR, design, preparation of bill of quantities, tendering & contract formation, execution & supervision, billing, and completion recording. A successful project manager has the knowledge of all such subjects.

Modern project management involves use of digital technologies like MS Project, Primavera, BIM and CDE. Project management is not simple and straight subject which can be implemented by software or digital methods as digital techniques and software are the tools but these are to be operated and implemented by the engineers. Hence, project management requires qualification, experience, intelligence, knowledge, coordination, control and team approach. Interaction of civil engineering students with experienced project managers may be very useful to the society for the development of urban infrastructure for better urban future.

Urban Future

The future of quality of life of majority of people is integrally tied to cities as by 2050, more than 70 per cent of the world's population will be living in urban areas. So, town planners, architects, civil engineers, electrical and mechanical engineers and IT engineers have to successfully plan the cities for urban future, knowing the city will develop beyond any plan. Development of urban areas has to be thought immediately as for planning and implementation even a city 25 years is not much time.

Then, no city can be planned only for infrastructure development as the humanity, social attachment within the citizens and peace living are the basics of better quality of life hence these are to be built in during infrastructure development. Apart from this, food items come from rural areas hence the rural areas are also to be integrated during the planning. SDG16 - Peace, justice and strong institutions prescribes peace, justice and strong institutions as the requitement of human being.

Urban future planners learn from the urban past, and predict for its future considering the bonds



PROJECT MANAGEMENT PROCESS STAGES





of rural future and industrial future which make the planning difficult. The urban future has to consider many important factors, including infrastructure, political issues, literacy requirements, eradication of poverty, migration, scale, climate change, and other potential issues, most of which are in SDGs. AI can help to the urban planners in this direction. No poverty and zero hunger are SDG1 and SDG2 being basic requirements of every human being. Therefore, urban planning has to be based upon them.

By studying urban future for a good city of the future, the researchers have to arrive at a solution making a transformative impact on better urban policy and planning, regulation and infrastructure, inspiring collective deliberation including youth by surveying and learning around towards a better urban future.

Recall the situation of Delhi during winter where the city is full of smog, citizens breathing the smog, with clean air being a luxury even on the roof of a building of 20 storeyed building, thus, diminishing their life without any choice. The policy makers and urban planners have to ensure availability of clean air and non-toxic food items not only in new urban areas but in existing cities which will be a real challenge for the urban planners. Thus, planners and engineers have

URBAN Custer Custer to involve local youth for their requirements in the process.

Drainage has become a major issue in all the urban areas. Life is stalled in the cities during heavy rains, resulting into loss of resources, property and even lives. Water stagnation results into mixing of storm water, sewage and municipal waste. Certainly, youth is not going to accept such conditions and urban planners and engineers will have to provide clean atmosphere and clean environment in their cities. It is a vision, no longer a futuristic fantasy but a pressing necessity. The burgeoning cities face an unprecedented strain on infrastructure and resources due to drainage issue, maybe due to climate change, which will result into more severe conditions of rising temperature, heat and rains.

Smart Infrastructure

Smart infrastructure is defined with the facilities connected digitally for users and service providers, such as sustainable waste management, transport with zero caron emission, energy generated through zero carbon emission sources, 24x7 clean water supply, seamless integration of ICT, IoT enabled real-time data availability, smart physical infrastructure of roads, bridges, water supply, sewerage system, institutions, hospitals, commercial centres, business centres and so on. However, it has to be remembered that these facilities are to be used by the people who need to be socially connected. Therefore, smart infrastructure should not get carried away only with the infrastructure development which make the life mechanical and ICT controlled. Smart living and smart life are more important in this regard. Therefore, a blend of youth and old has to come forward to decide the requirements of the urban future.

Civil Engineering Youth in India

With close to 2 million engineers graduating in India every year, the country has about 8 million graduate engineering students. The country has 23 IITs having seats of about 16,000, and 31 NITs having seats of about 96,000 altogether pursuing BTech. Apart from IITs and NITs, there are large number of state and private engineering colleges. Having interaction by the students with the professionals is gigantic task and possible only if government takes initiative as the students are from various branches of engineering including civil engineering. For civil engineering youths, the interaction with the

> professionals along with proper trainings at site will help in preparing qualitative engineers which will not only be helpful in developing qualitative infrastructure in India but will help in getting assignments globally.





Concluding Remarks

In the time to come, urbanization will take over rural life. It is a matter of debate whether quality of life is better in urban future or rural future. Even now, many urban citizens are running towards rural areas at least for leisure. Rural youth always get attracted to opportunities and glitter however all that glitters is not gold. Therefore, urbanization should be considered as a necessity but urban planning should be blended with the traditional culture, human values and social knitting to get the benefits of urbanization and rural bonding. Planners and policy makers should also think whether rural areas itself can be developed as urban areas of the future.

Youths are the future of any nation hence their involvement in urban planning is essential. This involvement should be from the institutions as the youth in the institutions come from different social and economic backgrounds, religions, and demography, hence their participation will result to better urban planning and better urban future for its citizens.

References

- 1. https://sdgs.un.org/goals
- https://www.dreamdesigninc.com/ news/4-reasons-why-civil-engineeringis-trending/
- 3. https://www.urban-future.info/
- https://www.sciencedirect.com/topics/social-sciences/smart-infrastructure
- 5. https://businessmap.io/project-management/process
- https://www.projectsmart.co.uk/bestpractice/project-management-scopetriangle.php
- https://corporatefinanceinstitute. com/resources/management/qualitymanagement/
- 8. https://www.c-r.org/news-and-insight/how-well-are-we-doing-peace-

and-sustainable-development-goals ****

Training Programme on "Urban Risk Mitigation - Focus on Seismic Safety of Structure"

national level Training Programme on "Urban Risk Mitigation - Focus on Seismic Safety of Structure" was organized from 13-15 March, 2024 at New Delhi for senior officers including engineers, architects, Urban Planners, disaster managers, and academicians from government departments, SDMAs, engineering institutions and private practitioners by NIDM in collaboration with BMTPC, BIS, DDMA and Seismic Academy (an initiative by HILTI India Pvt. Ltd.). The programme created awareness among professionals about safety standards in design and construction, focusing on seismic design, safety of non-structural elements, and structural retrofit. The programme also provided insights into industrialized building systems, active and passive seismic protection, emphasizing the importance of ensuring safety during earthquakes to save lives, protect assets, and enhance building performance. A similar programme was also organized by BMTPC in association with NIDM in August 2023.





Beyond the Stars: Engaging Youth to Drive the Dream of 'Viksit Bharat'



Hitesh Vaidya

oi Bhi Desh Perfect Nahi Hota, Use Perfect Banana Padta Hai" (No country is perfect, it has to be made perfect) - this iconic line from "Rang De Basanti" encapsulates the spirit of India's journey towards a 'Viksit Bharat.' As we celebrate our nation's remarkable achievements in space exploration on India's Space Day, we are reminded that perfection is not a given but a goal we must strive for. It's a goal that policymakers, urban planners, economists, and individuals interested in India's economic development and urban planning have to play in achieving.

India's ambitious space program, exemplified by missions like Chandrayaan and Mangalyaan, has showcased our technological prowess and cost-effectiveness. It has shown us that dedication and innovation can realise even the most ambitious dreams. But as the quote from "Rang De Basanti" reminds us, no nation is perfect; it must be continuously shaped and improved. This imperative for progress extends beyond the cosmos and into the heart of our country - our cities. From launching satellites into orbit to building sustainable cities, India's journey towards progress will be fueled by innovation. Innovative solutions in urban development are necessary and an opportunity to inspire change and shape a better future for our cities, stressing the importance of creativity and forward thinking that should inspire us all.

The prospect of a \$30 trillion economy by 2047 is not just a goal; it's a vision of a promising future. While space exploration inspires technological advancement, achieving this ambitious economic target hinges on transforming India's cities. However, as the World Bank's 2024 report suggests, we must be mindful of the 'middleincome trap' that has hindered many developing nations. This trap, characterised by stagnant growth and the inability to transition to high-income status, can be overcome through strategic urban development and governance. This strategic approach reassures us that we can avoid the pitfalls that have affected other nations. Also, a cautionary tale comes from China, which has been grappling with rising youth unemployment in recent

years. While China's rapid ascent to a \$19 trillion economy offers valuable lessons, it also reminds us that economic progress must be accompanied by inclusive development and a focus on long-term sustainability.

It's not just about building more but about creating innovation with a clear vision for the future and a plan to get there. Strategic urban development is not just a buzzword; it's a necessity. It's about planning for the future, anticipating challenges, and creating solutions that will stand the test of time. This emphasis on foresight and preparedness should reassure us that we are ready to face the challenges.

With over half of India's population projected to live in cities by 2030, we are at a critical juncture. The aspiration to transition from a three trillion-dollar economy is commendable, but this growth, concentrated in urban centres, comes with immense challenges. Projections indicate that India's urban population could reach 800 million, a nearly 70% increase from

* Urban Practitioner, India (Former Director, Former Director NIUA and Country Representative UN-Habitat)



the current levels, making the 'Bakasur' of unsustainable growth loom more significant than ever. The resulting strain on resources and infrastructure could lead to deforestation, loss of biodiversity, and increased carbon emissions. Indian cities account for over 60% of the country's GDP and 70% of its energy consumption. The time for action is now, and the urgency cannot be overstated. We must act swiftly and decisively to avert these potential crises, emphasising the need for immediate action.

India's unique challengespoverty, inequality, water scarcity, and vulnerability to climate change- demand immediate, decisive action. The transition from a three trillion-dollar economy to a 30 trillion-dollar economy is commendable, but this growth, concentrated in urban centres, comes with immense challenges. However, we must focus on improving service quality and ease of living and prioritise economic growth and job creation. Innovation is not just a choice but a necessity in these challenging times. It is the key to unlocking a sustainable, prosperous future for our cities and nation. We must embrace innovation as the inevitable path for our towns and country, as it is our best tool for overcoming these challenges.

Cities are the pulsating engines that power economic progress. They are the crucibles of innovation, the hubs of commerce, and the magnets for talent. However, these engines need a significant upgrade to achieve the monumental tenfold growth we aspire to. They must be robust, efficient, and firing on all cylinders.

We all know the roadmap-

'How,' the 'Why,' and the 'What' and possess the ingenuity and resolve to navigate it. Yet, amidst this ambitious vision lies a crucial, often overlooked question: 'Who' will be the driving force behind this transformation? Who will steer us towards the promised land of 'Viksit Bharat'?

As we reimagine our cities as powerful engines of growth, we must prioritise investments in the city's governance institution, human capital, finances, and technologies. Institutions are known by their people. Just as ISRO's focus on a skilled workforce and cutting-edge technology has propelled India's space program, similar investments in our cities will enhance productivity and foster a culture of innovation, essential for escaping the middle-income trap.

This demands a fundamental shift, a re-engineering of the very core of our urban thinking. We cannot run our cities with old templates or replicate models from developed countries with vastly different urban growth patterns and challenges. We need to create new urban templates and devise new pathways and milestones tailored to the unique context of India's rapidly growing cities. Our urban thinking must go beyond traditional master plans, focusing solely on land use and physical infrastructure. We must integrate ease of living, quality of life, and job opportunities as critical drivers of economic growth. This means creating efficient, well-planned cities that are also vibrant, livable, and conducive to innovation and entrepreneurship.

It is not a journey of numbers but about transforming millions of lives. It's about building a nation where prosperity, progress, and well-being are accessible. And this transformation begins in our cities. The potential for transformation is immense, and it is this potential that should inspire hope and optimism in our hearts.

It's time to shift our focus from the grand vision to the granular reality. We must reimagine our cities as population centres and as powerhouses of productivity. This requires a paradigm shift, a radical re- engineering of our urban landscapes. We must empower our cities, equip them with the necessary tools and resources, and unleash their full potential.

Just as Lord Krishna guided Arjuna in the Bhagavad Gita and Moses led his people to the Promised Land, we need visionary leaders and empowered institutions to act as the 'Saarthi' (charioteer) of our urban transformation. These 'Saarthis' will navigate the complexities, inspire collective action, and ensure that our cities stay on course towards a sustainable and prosperous future. The 'City Engine' require structural robustness and operational efficiency to navigate the challenging terrain toward the promised land of Viksit Bharat. These 'Saarthis' will drive the transformation, steering us towards the 'Viksit Bharat' we envision.

1. Precision Engineering— Empowering Urban Local Bodies (Chassis and Frame):

As ISRO meticulously crafts spacecraft for structural integrity, it is critical to empower urban local bodies with greater autonomy and resources. These bodies, which include municipal corporations, councils, and panchayats, play a crucial role in the 'Viksit Bharat'



vision. Decentralisation, local independence, adequate resources, and capacity building will allow these bodies to respond effectively to their unique challenges and opportunities, thereby contributing to the city's overall development. However, to truly empower urban local bodies, we must also revisit and redefine the 74th Constitutional Amendment, ensuring a robust framework for decentralised governance and fiscal autonomy. Like the engine control unit orchestrates a spacecraft's complex systems, effective management is crucial for coordinating city functions and fostering sustainable growth. A clear delineation of roles and responsibilities among the three tiers of government-central, state, and local—is imperative for effective urban governance. The central government should provide a supportive policy framework and financial assistance, while state governments should facilitate coordination and capacity building. Local governments, being closest to the citizens, should be empowered to take ownership of their development and implement context-specific solutions. The World Development Report 2024 highlights the need for transparent, accountable institutions and efficient public service delivery. Embracing technology, data-driven decision-making, and citizen participation will enhance the efficiency and responsiveness of urban governance, creating a fertile ground for economic progress.

2. Fueling Innovation—Fostering Entrepreneurship (Spark Plugs and Ignition System):

Fostering a vibrant startup ecosystem and reducing bureaucratic hurdles can further ignite

economic dynamism in our cities. Creating an enabling environment for startups, promoting research and development, and facilitating access to funding will unleash the creative potential within our cities. Beyond this, we need a clear vision for economic drivers, identifying and nurturing key growth sectors that will generate jobs and fuel our economic engine. The 'Make in India' spirit that drives ISRO's Indigenous innovation can be a model for cities. Innovation is not just a choice; it's a necessity, and it's this necessity that should drive our actions.

3. Skilling for the Future -Nurturing a Skilled Workforce (Engine Oil and Lubrication System):

A well-trained and adaptable workforce is the lubricant that ensures the smooth functioning of the city engine. Investing in education and skills training, aligning curricula with industry needs, and promoting lifelong learning will equip citizens to thrive in the evolving economic landscape, including the skills required for managing cities in the 21st-century economy. India must also invest in digital skills to create innovative planning approaches in the digital age.

4. Navigating with Precision -Effective Governance (Engine Control Unit):

The engine control unit orchestrates the complex interplay of various systems. Similarly, effective governance and administration are crucial for coordinating city functions, ensuring policy coherence, and fostering sustainable growth. Embracing technology, data-driven decision-making, and citizen participation will enhance the efficiency and responsiveness of urban governance. The World Development Report 2024 highlights that effective management and administration are crucial. Embracing technology, data-driven decision-making, and citizen participation will enhance the efficiency and responsiveness of urban governance. Our current planning often focuses heavily on land use and physical infrastructure, overlooking the crucial economic drivers that will fuel growth and job creation. We need to move beyond simply providing basic amenities and create cities that are vibrant economic hubs, attracting investment, fostering entrepreneurship, and generating ample employment opportunities.

5. Maintaining Equilibrium -Social Well-being and Inclusivity (Cooling System):

A well- functioning cooling system prevents overheating. Likewise, social well-being and inclusivity are vital for maintaining a healthy and harmonious urban environment. Addressing issues of poverty, inequality, and social exclusion will ensure that the benefits of economic growth are shared equitably, fostering social cohesion and stability. Just as a spacecraft needs a reliable fuel supply, our cities require careful and sustainable management of natural resources like water, energy, and waste. As cities expand, proactive planning for resource conservation and efficient utilisation is crucial to ensure a healthy and resilient future. We must integrate innovative solutions, such as rainwater harvesting, renewable energy adoption, and circular waste management practices, into our urban planning frameworks.



To truly unleash the potential of our cities and achieve 'Viksit Bharat,' we must adopt a 'One City, One Plan, One Agency' approach for results. This approach should bring efficiency, integration, and a laser focus on results that foster shared ownership through a blend of tradition, innovation, and citizenled decision-making. The "One City, One Plan, One Agency" approach provides the necessary framework to implement these transformative principles. Streamlining governance and fostering collaboration ensures a unified vision and efficient execution of urban development initiatives. This approach will empower local bodies, enhance accountability, and promote datadriven decision-making, paving the way for sustainable, inclusive, and prosperous cities.

The decisions we make today will shape the future our youth inherit. Yet, the disconnect between long-term master plans and the harsh realities of floods, heatwaves, and unsafe cities erodes their trust in policy and governance. We cannot afford to alienate the generation that will drive India's progress. Our digital journey must transcend a mere "garbage in, garbage out" approach. It's time to leverage technology to revolutionise urban planning, fostering transparency, citizen participation, and datadriven decision-making. This shift requires a planning framework anchored in space, time, strategy, flexibility, bottom-up engagement, citizen-centricity, and accountable institutions. We can't afford adhoc and short-sighted changes; we must make bold decisions and adopt a "bull by the horns" approach to achieve this vision.

Today's actions will shape our cities and build the trust and confidence of our youth, ensuring they remain active participants in shaping the 'Viksit Bharat' of tomorrow. The road ahead is challenging, but the destination is clear. By learning from our own space program's triumphs and the experiences of other nations, India can chart a unique path towards 'Viksit Bharat'. With unwavering commitment, strategic investments, and a focus on innovation, we can transform our cities into powerful engines that will drive us towards a future where prosperity, progress, and well-being are accessible to all. By embracing the 'One City, One Plan, One Agency' approach and focusing on infrastructure development, investment in human capital, and creating cities as economic, sustainable and inclusive growth drivers with a commitment to innovation, India can use these powerful engines to drive towards the 'Promised Land', a future where 'Viksit Bharat' is not just an aspiration but a tangible reality.

References:

- Ministry of Housing and Urban Affairs, Government of India. (N.D.). Urban Growth. Retrieved from https://mohua.gov.in/ cms/urban-growth.php
- United Nations, Department of Economic and Social Affairs, Population Division (2018).
- World Urbanization Prospects: The 2018 Revision (ST/ESA/ SER.A/420).
- World Bank. (2024). World Development Report 2024: Cities - Engines of Growth and Prosperity

Youth Unchained: Click for Change

Stuck on a path, but dreams call you away? Arjuna felt it, too, that choice-filled day. Rumi said, "Light enters through your every scar," Face your fears, and they'll make you go far.

The world says, "Fit in!" but your heart says, "Change!" Power plays games, keeping things in their range. Maya's illusion, like a social media craze, You can find your dharma. It's your unique, brave haze.

Don't let them dim your light; keep that fire bright! Even if it's hard, even if it's a fight. Change needs guts, it's a less-trodden track, But rewards await, so don't ever look back. Clicks can empower, break barriers we face, Courage fuels progress at your fingertip's pace. Youth leads the charge with passion and might, For a sustainable world where dreams take flight. So let's use your skills, let's make your mark, From every click, a brighter spark!

~ Hitesh Vaidya



Education for Sustainable Construction



Dr. J. S. Chauhan

ntroduction

In the 21st century, the rapid urbanization of the world's population presents a formidable challenge to sustainable development. Cities are expanding at an unprecedented rate, and with this growth comes an increased demand for infrastructure that is not only functional but also sustainable. As we face issues like climate change, resource depletion, and social inequality, it's imperative that future generations are equipped with the knowledge and skills necessary to address these challenges. Engaging youth in sustainable construction through education is a critical strategy for creating a better urban future. This extensive discussion explores how educational initiatives can empower young people to lead the charge in sustainable urban development.

Sustainable Construction

To engage youth effectively, it is crucial first to define sustainable construction and its importance. Sustainable construction refers to the practice of designing, building, and operating structures in a way that minimizes their environmental impact, optimizes resource use, and enhances the quality of life for occupants and communities. Key principles include energy efficiency, use of renewable materials, waste reduction, and creating healthier living environments.

The Role of Education in Sustainable Development

Education is a powerful tool for fostering understanding and inspiring action. It can equip students with the knowledge of sustainable practices, the importance of environmental stewardship, and the skills needed to implement innovative solutions. By integrating sustainability into the curriculum, schools can help students appreciate the impact of their choices and encourage them to contribute to a more sustainable future.

Curricular Integration of Sustainable Construction

Integrating sustainable construction into educational curricula involves several strategies:

• Incorporating Sustainability

in STEM Education: Science, Technology, Engineering, and Mathematics (STEM) subjects provide a foundation for understanding sustainable construction. Lessons can include topics like energy systems, materials science, and environmental impact assessments. Projects can involve designing energyefficient buildings or creating models of green technologies.

- Project-Based Learning: Handson projects allow students to apply theoretical knowledge to real-world problems. For example, students might work on a project to design a sustainable community space or analyze the environmental impact of different building materials. This approach not only enhances learning but also fosters creativity and problem-solving skills.
- Interdisciplinary Approaches:
 Sustainable construction encompasses aspects of various disciplines, including environmental science, architecture, urban planning, and econom-

^{*} Senior Professor & Former Director, Samrat Ashok Technological Institute, Vidisha (M.P.), Email : jschauhan@satiengg.in



ics. Interdisciplinary education can help students understand the broader context of sustainability and how different factors interact.

Engaging Youth Through Extracurricular Activities

Extracurricular activities can play a significant role in engaging youth with sustainable construction:

- Clubs and Competitions: School clubs focused on sustainability or engineering can provide students with opportunities to explore sustainable construction in a collaborative environment. Competitions such as building design contests or eco-challenges encourage innovation and practical application of knowledge.
- Workshops and Seminars: Organizing workshops and seminars with professionals in the field can expose students to real-world practices and career opportunities in sustainable construction. These events can also provide networking opportunities and inspire students to pursue further education or careers in the field.
- Field Trips and Internships: Visits to construction sites, green buildings, or sustainable development projects can give students a firsthand look at sustainable practices in action. Internships with construction firms or environmental organizations can provide practical experience and mentorship.

Utilizing Technology and Digital Tools

Technology plays a crucial role in modern education and can be leveraged to engage students in sustainable construction:

- Virtual Reality (VR) and Augmented Reality (AR): These technologies can create immersive experiences, such as virtual tours of green buildings or interactive simulations of sustainable design principles. They can help students visualize concepts and understand their real-world applications.
- Educational Software and Apps: There are numerous apps and software tools designed to teach concepts related to sustainable construction. These can include building simulation programs, energy modeling tools, or design software that incorporates sustainability features.
- Online Courses and Resources: Online platforms offer a wealth of resources, including courses, webinars, and instructional videos. These can complement traditional education and provide students with additional learning opportunities.

Fostering Partnerships with Industry and Community

Collaborations between educational institutions, industry professionals, and community organizations can enhance the effectiveness of sustainability education:

- Industry Partnerships: Construction firms and sustainable design companies can collaborate with schools to provide resources, guest lectures, or real-world projects for students. These partnerships can also facilitate internships and job placements.
- Community Involvement: En-

gaging with local communities can provide students with practical experience and a deeper understanding of the challenges and opportunities in sustainable construction. Communitybased projects can address local needs and demonstrate the impact of sustainable practices.

Government and Non-Profit Organizations: Government agencies and non-profits focused on sustainability can offer grants, educational materials, or programs that support sustainable construction education. These organizations can also advocate for policy changes that promote sustainability in education.

Challenges and Solutions

Despite the benefits, there are challenges to effectively engaging youth in sustainable construction through education:

- Lack of Resources: Many schools may lack the resources to implement comprehensive sustainability education programs. Solutions include seeking grants, forming partnerships with local businesses, or utilizing online resources.
- Curriculum Constraints: Integrating new topics into an already crowded curriculum can be difficult. Schools can address this by adopting interdisciplinary approaches or incorporating sustainability into existing subjects.
- Student Motivation: Keeping students motivated and engaged can be challenging. Providing hands-on learning experiences, real-world applications, and opportunities



for creativity can help maintain interest and enthusiasm.

Measuring Impact and Success

Assessing the effectiveness of educational initiatives in sustainable construction involves evaluating various factors:

- Student Engagement and Achievement: Measuring student interest, participation in related activities, and performance in sustainability-focused projects can provide insights into the success of educational programs.
- Behavioral Changes: Observing changes in students' attitudes and behaviors regarding sustainability can indicate the impact of education on their values and actions.
- Long-Term Outcomes: Tracking students' career choices, further education in sustainabilityrelated fields, and contributions to sustainable construction can provide a measure of the longterm success of educational initiatives.

Future Directions

To enhance the engagement of youth in sustainable construction, future efforts could include:

- Expanding Curriculum Offerings: Schools could develop specialized programs or courses dedicated to sustainable construction and urban planning.
- Innovative Teaching Methods: Adopting new teaching methods, such as experiential learning or gamification, can make sustainability education more engaging and effective.

- Increased Collaboration: Strengthening collaborations between educational institutions, industry, and community organizations can enhance resources, opportunities, and impact.
- Global Perspectives: Incorporating global perspectives on sustainability and construction can help students understand the broader context and learn from diverse practices and innovations.

Conclusion

Engaging youth in sustainable construction through education is a vital strategy for shaping a better urban future. By integrating sustainability into curricula, offering hands-on experiences, leveraging technology, and fostering partnerships, we can empower young people to become leaders in creating environmentally responsible and socially equitable urban environments. As the world faces increasing urbanization and environmental challenges, the education of future generations will be instrumental in driving progress towards a more sustainable and resilient future. Through dedicated efforts and innovative approaches, we can inspire and equip the next generation to build a better world.

References:

- 1. T. B. Venkatesh: "Sustainable Development and Urbanization in India" (2009).
- 2. B. B. Bhasin: "Sustainability and Education in India" (2011).
- 3. Becker, K., & Park, K. (2011). Integrating Technology into Project-Based Learning: The Role of Teacher Support. Journal of Technology Education.
- 4. R. K. Agarwal: "Partnerships for Sustainable Development: Case Studies from India" (2014).
- 5. S. C. Nair: "Challenges in Implementing Sustainability Education in India" (2017).
- 6. Miller, J. D., & Phipps, L. (2019). Project-Based Learning and STEM Education: The Ultimate Engagement Strategies. Journal of STEM Education.
- 7. K. K. Rao: "Future Trends in Sustainable Education and Urban Development in India" (2019).

Round Table Session on Emerging Technologies organised by Indian Chamber of Commerce on June 15, 2024 at Guwahati





Engaging youth in Creating a better Urban Future



Neha Sharma

ntroduction:

India's urban infrastructure faces significant challenges in today's generation compared to many other countries around the world. Rapid urbanization, coupled with inadequate planning and investment, has resulted in a multitude of issues that has impacted the quality of life of millions of urban residents.

One of the most noticeable challenges is the strain on existing infrastructure, particularly transportation network. Road, Railways, and public transport systems are often overcrowded, leading to sever congestion, traffic jams, and increased pollution. The lack of proper planning, investment in modern infrastructure, coupled with rapid population growth, has created an exacerbated problem. Additionally, the inadequate maintenance, upkeep of existing infrastructure contributes to its deterioration and inefficient operation, leading to utilization of resources more than what should have been used.

Another challenges that we face is the provision of basic services, such as water, sanitation, and electricity. Many urban areas in

India still to the date faces struggle to meet the minimum requirement and the growing demand for these essential services, leading to shortage, inequitable distribution, and poor quality, which results in degradation of health and the society. This lack of inefficiency infrastructure, coupled with limited resources and inefficiently management, has created a lot of problem in development of reliable and accessible basic services. Furthermore, the issue of housing affordability and availability is a major concern in many Indian cities. The rapid influx of migrants and the growing middle class have led to a housing shortage, driving up the prices and making it difficult for low-income households to find affordable housing. This has been resulted in the proliferation of informal settlements, often characterized by poor living conditions, inadequate infrastructure, and lack of basic services. Additionally, the rapid growth of cities has put strain on social infrastructure, including healthcare and education facilities. The lack of adequate facilities and trained personnel has let to long waiting times, overcrowding, and poor quality of services across all the spectrums.

Energy supply is another area that is not looked upon so deeply, but increasing demand for electricity, coupled with inadequate power generation capacity and transmission losses, has resulted in power shortage and load shedding. This has disrupted industries, households and economy.

Environmental pollution is another major challenge faced by Indian cities. Air Pollution, water pollution, and waste management issues have become significantly increasingly severe due to rapid industrialization, urbanization, and the growing number of vehicles. The lack of effective environmental regulations and enforcement has contributed to the degradation of air and water quality around us, which ultimately affecting the health and well-being of present and future generation residents.

To address this type of challenges, we require a multi-modal approach that involves increasing investment in infrastructure, improved urban planning, creating awareness, and sustainable development practices. It is essential to prioritize the need of urban residents, especially those who are most vulnerable groups, and ensure that infrastructure develop-

* Energy Efficiency Specialist, Global Green Growth Institute (GGGI), New Delhi, E-mail: neha.sharma@gggi.org



ment is inclusive and equitable. By investing in sustainable infrastructure and addressing the underlying cause of urban problems, our country can create more liveable and resilient cities for its ever-growing population.

Importance of Youth's in development:

Our Country's urban landscape presents a variety of opportunity due to its vast demographic nature, for youth to play a pivotal role in shaping its future. With their enthusiasm, energy, creativity, and innovative spirit, young people can contribute significantly to the development of sustainable, inclusive, and resilient urban society and projects.

Youth of today possess a fresh perspective and are often more receptive to new ideas and technologies. They are better equipped to understand and address the challenges faced by the cities, such as rapid urbanization, traffic congestion, environmental degradation. Their ability to think critically and creatively can lead to innovative solution that are tailored to address specific needs of the urban areas.

As youth's are engaged in digital technologies and social media, making them a perfect match to leverage these tools for development. They can use technologies to collect date, analyse trends, and engage with the communities to identify and point out the pressing issues. They can also play a vital role in promoting sustainable urban development practices. By advocating for green infrastructure, awareness of energy savings, renewable energy, and sustainable transportation, can help create cities that are environmentally friendly and resilient to climate change.

Contributing to development of inclusive and equitable cities by advocating affordable housing, accessible transportation, and social justice. Their involvement can help ensure that urban settlements benefits all segment of society, including marginalized communities by bridging the gap and maintaining a perfect harmony between Future, Present and Past.

Youth-Led Initiative:

India's urban landscape offers a vast canvas for young minds to contribute to sustainable and inclusive development. Numerous initiatives have surfaced across the country, demonstrating the potential of young minds to drive positive changes in their cities.

One such initiative is the "Youth for Urban Development", a nonprofit organization working towards improving urban infrastructure and quality of life in different cities across our country. They have undertaken various projects, including slum upgradation, community development, and urban planning initiatives. Their work has involved conducting surveys, organizing community meetings, spreading awareness, and collaborating with the local authorities to address the pressing challenges the urban community is facing.

Urban Design Collective (UDC), a platform for young urban planners and designers to collaborate on projects that promote sustainable and equitable urban development. The UDC has organized many workshops, hackathons, and design competition to engage young people in urban planning and design. Their projects have focused on issues such as affordable housing, public transportation, and urban green spaces.

Youth Against Plastic Pollution (YAAP), is a movement led by the youths of our country that aimed at reducing plastic waste in the cities. YAAP has organized many awareness campaigns, clan-up drive, and workshops to educated, aware the public about the harmful effects of plastic pollution. Their efforts have led to increased awareness and action towards reducing plastic consumption and promoting sustainable waste management practices.

Youth for Environmental Action (YEA), initiative which empowers young people to address environmental challenges in their communities. YEA has successfully implemented various projects, including urban gardening, waste management initiatives, and awareness campaigns on climate change. Their efforts have not only improved the environment but have also fostered a sense of community engagement and civic engagement among young people.

Youth councils have been formed in many cities to provide a platform for young people to voice their advocate for policy changes. These councils have played a crucial role in influencing urban planners in making decision and promoting sustainable development. Policy researchers and activist have conducted studies and research to inform policy decisions on urban issues. Their work contributed to evidence-based policy making and advocacy.

In addition to these, numerous individuals have taken the pledge



to address urban challenges in their communities. A group of students in Mumbai launched a project to improve the infrastructure of their local slum community. They raised funds, mobilized volunteers, and collaborated with local authorities to construct new homes, improve sanitation facilities, and provide access to basic services.

Education and its role in creating young mind ready for the future:

Education is a cornerstone of progress, and it plays a pivotal role in empowering youth to become effective agents of change in urban development. In India, where urbanization is rapidly accelerating, the quality and accessibility of education are crucial for equipping young people with the knowledge, skills, and critical thinking abilities necessary to address the challenges and opportunities presented by urban growth.

A comprehensive education system that prioritizes STEM (Science, Technology, Engineering, and Maths) subjects, along with social science & humanities, can equip youth with the tool they need to understand and analyse complex urban issues. By developing a strong foundation in these subjects, young people can develop skills to critically evaluate policies, propose innovative solutions, and contribute meaningfully to urban planning and development.

Furthermore, education can foster a sense of civic responsibility

and social consciousness among youth. By learning about the history, culture, and social dynamics of their cities, young people can develop a deeper understanding of the challenges faced by their communities and potential for positive change. This can motivate them to become active participants in civic engagement and community development initiatives. Quality education, particularly for marginalized and disadvantaged groups, is essential for ensuring equitable urban development. By providing educational opportunities to all, our country can bridge the gap between different socioeconomic groups and create more inclusive cities. Quality and good education can foster creativity, innovation, and critical thinking, which are essential for addressing the complex challenges of our urban communities are facing during development stage. By encouraging young people to think outside the box and develop innovative solutions, we create more sustainable and resilient cities.

Proper education is a vital component of youth-led urban development. By providing access to all, fostering civic engagement, and developing practical skills, we can empower young people to become active participants in shaping the future we want to have for our next generation. A well-educated and engaged youth population is essential for creating sustainable, inclusive, and resilient urban environment.

Conclusion and way forward:

Together with a conducive policy regime, the government of India's active adoption of youth involvement across urban governance is significantly boosting the economic growth and development. The rapid urbanisation and demographic transition have significant implications for our country, making it one of the largest urban agglomerations and youngest nations in the world. Each of these involves complex and multi-layered changes, especially with liberal transformations leaving their impact on youth lives, aspirations, and culture. While the 'urban' remains the site for realising youth aspirations, youth faces many barriers in realising their dreams for a secure future.

We are living in an increasingly urbanized world and it is evident that cities will be the principal agents for addressing the global development agenda. Due to the size and density in our urban communities, cities are most susceptible to impacts of crisis, in terms of quality of life, disaster risks etc. We need to develop a framework to measure the development, measure exposure to multidimensional vulnerabilities. The absence of a framework and a robust evidence eco-system not only make it difficult to assess the situation in a granular manner but impedes the efficiency policy and programme development by the Government at all levels and its resource allocation.



Youth Power: Catalysing Urban Transformation





S Vikash Ranjan *

Avisek Bardhan *

| ntroduction

Youth, as the future leaders of our cities, possess a unique perspective and energy that can drive positive transformation of urban infrastructure. They are actively engaging young people in the planning, design, and implementation of urban development initiatives, we can create more inclusive, sustainable, and vibrant cities for the nation. Engaging youth, as the future leaders of these cities, is crucial to addressing the challenges of the society faces, and building sustainable, resilient, and equitable urban communities. Urban areas are the engines of economic growth and development, but they also face a myriad of challenges such as coping up with the rapid urbanization, pollution, congestion, and social inequality.

In recent times, the escalating global climate crisis has prompted

nations to pursue environmentallyfriendly transformation. The shift towards sustainability, however, requires active involvement from everyone. This is especially true for India, as we are particularly vulnerable to the impacts of climate change. As of August 2023, India has the world's largest youth population, with around 66% (808 million) under the age of 35. Youth possess unique perspectives, energy, and creativity that can be harnessed to drive positive change in urban areas. They are more likely to be open to innovative solutions and have a deep understanding of the issues affecting their communities. By empowering them and providing them with the necessary tools and resources, we can foster a new generation of urban leaders who are not only committed to building a better future but to be a symbol of hope to the global community about.

The world is growing younger and densely populated than ever before. Globally, young people are on the move, often migrating from rural settings to urban locations, seeking employment and better opportunities. Looking at the huge diverse demographics in urban settings, particularly in developing context, urban populations are very youthful and becoming increasingly so.

Informal settlements, often referred to as slums, are disproportionately inhabited by children and youth, who confront escalating pressure related to infrastructure, economic conditions, security, inadequate basic services, and environmental concerns. These challenges exacerbate the difficulties faced by all residents of informal settlements, particularly their substantial young populations. While our cities grapple with the challenge of excessive popula-





tion, including a disproportionate number of young people, they also possess a remarkable opportunity. As our cities become increasingly populated by young individuals, they are enriched with a wealth of energy, creativity, innovation, skills and knowledge-precisely the resources necessary to address the pressing challenges and pressure they confront.

In India informal settlements possess a significant portion of the urban population, particularly marginalized groups. These settlements are characterized by inadequate infrastructure, overcrowding, and limited access to basic services like sanitation, healthcare, and education. The challenges faced by residents are exacerbated by factors such as poverty, unemployment, and social exclusion. Despite the challenges this group represents a vast pool of untapped potential. Young residents among them possess a unique perspective and resilience, often demonstrating remarkable creativity and resourcefulness. By providing them with opportunities for education, vocational training, and community engagement, India can harness the immense potential of its young population to drive the urban development and create more inclusive and sustainable ideas. This not only will improve our country's situation by will be a beacon to other nations as a symbol of continuous improvement and will help in fulfilling the pledge taken by us to create a better future.

"When democracy, human rights, and poverty reduction are discussed by national and world leaders, excluding cities and young people from the equation, it is

akin for attempting to combat a significant forest fire with a garden hose."

Why is it important to engage with young people regarding urban growth and development of our cities?

The reason varies from statutory, democratic and stewardship arguments to social cohesion, economic and innovation. Young people have the right to be involved and possess the agency to change their communities specially in a country like India, where maximum population consists of youth. If we are serious about retaining young people in their communities, they must have a say and if heard they can offer new perspective on the place where they live. Engaging young people can also benefit them personally by developing skills and knowledge, acting as agents of change within their communities, challenging the status quo and creating new cultures. Young people's activities can also be an economic boost, shaping physically the built environment around them and innovate.

Youth voices have historically been left out of the urban planning conversation. It's not a domain most are exposed to until university, college, at the earliest, and youth voices are rarely central in the planning consultation of major



city-building projects. Even more so, we need youth voices to be a part of the change, hearing their perspective on what's important to them, and learning how we can respond to the challenges of the future. That's how we create better projects and better cities. It's a winwin situation for everyone.

In urban context, the substantial presence of young people presents an opportunity, driven by workforce expansion and the simultaneous decline in dependency rates. To capitalize on this demographic boom, countries must strategically invest in human capital development. This necessitated a shift in perspective for policymakers and decisionmakers, recognizing young people as active partners in development, valuable resources for their communities, and agents of positive transformation. When engaged in their communities, young people contribute significantly through their initiatives, the employment opportunities they generate, and the skills and knowledge they cultivate within others, fostering social and financial capital. Through their active participation, they gain valuable insights into the necessary policy and institutional solutions to address the challenges, they may realize that they have been overlooking a vital resource's that has been steadily growing within their mind set.

Youths of our country have untapped economic resource and needs to be viewed and treated as asset and driver of safe, resilient, and sustainable cities. However, significant gaps remain in understanding how to apply these ideas through policies and practices in the urban context, and ensure



global and national policies and regulations apply to the level where people are finding themselves faced with the most pressing and dynamically evolving issues in the cities. Influencing legislation and regulations, or contributing to economic policies, they are empowered to take ownership and support the realization of integrated, inclusive, and sustainable cities. This approach leverages youth to establish a positive correlation between urbanization and development, effectively prioritizing people and human rights at the heart of urbanization. The New Urban Agenda presents an opportunity and responsibility to ensure that policies and action informing urban development are inclusive. As vast majority of the city dwellers continue to face marginalization, often due to their perceived youth. Within the new development framework, the government is expressing interest in, integrating the Sustainable Development Goals, a sustained emphasis and momentum must be maintained to recognize youth as integral component. Their meaning participation in creating youth friendly legislative framework and urban plans, while harnessing the demographic dividend for urban economic opportunities, will be a pivotal in achieving more integrated, sustainable, and inclusive cities.

Youth-Led Initiatives:

In the recent years Government of India has introduced several measures and schemes for upgrading, developing and provisioning of facilities in urban areas of the country. Several Schemes under the Government such as Nurturing Neighbourhoods Challenge (NNC),



AMRUT, Swachh Bharat Mission, Pradhan Mantri Awas Yojana, Atal Mission etc. The aim and goal of such schemes is to do the overall development of urban areas including providing adequate basic facilities.

This community based infrastructure projects young people can take the lead in identifying and addressing infrastructure needs within the communities. This could involve organizing clean-up drives, repairing damaged infrastructure, or constructing new things. Such initiatives not only improve the physical environment but also fosters a sense of ownership and community engagement. Youth can participate in workshops and forums to learn about urban planning principles and design concepts. This knowledge can empower them to propose innovative solutions for infrastructure challenges, such as improving public transportation, creating pedestrian-friendly streets, or designing sustainable housing.

Young people are often adept at using technology. They can develop, implement technologybased solutions to address infrastructural issues. For example, they can create application to report different problems in infrastructure, design smart city solutions for energy efficiency, or utilize drones for infrastructural monitoring and maintenance.

Youth can advocate for policy changes and investment in urban infrastructure. They can organize lobby government officials, and raise awareness about the importance of well-functioning infrastructure. By influencing policy designs, young minds can ensure that urban development plans prioritize the need of their communities. They can collaborate with local government to implement projects, can involve providing technical expertise, mobilizing community support, and ensuring that projects align with broader urban development goals.

Youths of today are more into promoting sustainable projects, practices, such as renewable energy sources, reducing waste, and promoting green transportation. They can organize workshop, educational campaigns, and community events to raise awareness about the benefits of sustainable infrastructure.

However, the experienced professionals can mentor and guide the much younger people in their respective initiatives. This can



help them develop the skills and knowledge needed to successfully implement projects and contribute to urban development. By actively participating in these initiatives, young people can play a significant role in shaping the future of their cities. Their creativity, energy, and fresh perspective can lead to innovative solutions and sustainable development and future.

Educational Programs:

In today's rapidly urbanizing world, youth possess a unique perspective and energy that can significantly contribute to the development goals/targets set. Youth-Led Educational programs play a vital role in empowering young people, aspiring them to become active participants in shaping the future. These programs equip you with the knowledge, and necessary tools to understand, address complex challenges faced in the urban areas. By providing hands-on experience and opportunities for critical thinking, these programs foster a sense of ownership and responsibility among young people. They encourage youth to identify local issues, develop sustainable infrastructure, develop innovative solutions, and implementation. This also fosters civic engagement and community involvement.

By participating in these type of program they trend to develop essential skills such as leadership, communication, and teamwork. These skills are invaluable for building strong communities and promoting social cohesion.

It will help bridge the gap between young people and decision makers. By providing them with a platform for youth to voice their concern ideas, these programs can ensure that the needs and perspective of young people are reflected in urban planning and development policies.

Technology and Development:

Technology helps improving life, enhances health and wellbeing of infants, toddlers and their caregivers, it not only enhances but also helps in developing it to their full potential. With India's urban population expected to double by 2050, this approach offers a big opportunity to stay on the correct path of country's rapid urbanization. Technology has revolutionized the way we live, work, and interact, and young people are at the forefront of this transformation. Their familiarity with emerging technologies, such as Artificial Intelligence, Big Data, and the Internet of Things, enables them to develop innovative applications



that address urban population. For instance, youth-led initiatives have utilized technology to optimize traffic flow, improve energy efficiency in buildings, and create a smart waste management system across the country.

Moreover, youth's entrepreneurial spirits and willingness to take risk can drive the creation of new businesses and social enterprises that address urban challenges. By leveraging technology and innovation, young entrepreneurs can develop sustainable and scalable solutions that benefit entire communities. For example, youth-led start-ups have developed affordable housing solutions, community-based transportation systems, and renewable energy initiatives. It furthermore leads to more inclusive and equitable cities. Their fresh perspective and understanding of the needs of diver's population can help inform decision-making and ensure that urban infrastructure projects benefits all residents. By involving young people in planning and implementation, cities can create more liveable and sustainable environment that meet the need of the present and future generations. By harnessing the creativity, adaptability, and technological proficiency of young people, we can develop innovative solutions to address pressing urban challenges and build better cities for all.

Collaboration with Industries and Local Government:

Industries play a crucial role in shaping urban landscape, and their collaboration with youth can offer invaluable insights into the practical working and foster development. This synergy benefits today's generation by providing hands-on





learning experience, skill development, and career opportunities.

By partnering with industries, youth can gain exposure to realworld application of their academic knowledge. Internship, apprenticeships, and mentorship programs allow young people to learn from industry professionals, understand industry challenges, and develop practical skills. These experience bridge the gap between theoretical knowledge and practical application, making them more employable and contributing to their overall development.

The overall strategy is to work with harmony and synchronization with city managers, engineers, urban planners, urban designers, architects and other practitioners to incorporate the focus on early development into design, planning and management of cities.

Additionally, the commitment and active involvement of city policy makers in youth programmes and projects is an important factor for the success of youth-led city development projects. Participants also felt that local government need to build partnership to leverage their resources more effectively. This might happen, like by encouraging private sector engagement to youth-let empowerment programmes through CSR (Corporate Social Responsibilities) programme or tax benefits. It is also important to address the issue of transparency. Suggestion is that youth want to be able to utilise city spaces and access economic opportunities. A mutual responsi-

bility with regard to taxes, and that the other side of paying taxes is a watchdog role of seeing how taxes are spent. Transparency, means responsibility to share information, including information about what decision are made and how city resources are allocated.

Conclusion:

Engaging youth in urban development is crucial for creating sustainable, equitable, and resilient cities. By Providing opportunities for participation, education, and empowerment, the creativity, energy, and passion of young people can be harnessed to address pressing urban challenges our country faces.

Community-based projects, educational programs can foster a sense of ownership and civic responsibility among young people. By involving youth in decision-making process and providing them with the necessary resources, urban development plans can be ensured to reflect their needs and aspirations. Collaboration between the government, business, and NGO's is essential for creating inclusive and sustainable urban environments. By working together, the expertise and resources of different stakeholders can be leveraged to address complex challenges and create positive changes.

Recognizing and celebrating the achievement of young people is essential for motivating and inspiring them to continue their efforts. By providing awards, incentives, and opportunities for recognition, youth participation and a culture of innovation and civic engagement can be encouraged.

It is not only a moral imperative but also a strategic necessity. By providing opportunities for participation, education, awareness, and empowerment, a better future for cities can be created, ensuring their sustainability, equity, and resilience for generations to come.





Mission LiFE : A Govt's initiative towards Engaging Youth to Create a Better Urban Future



Dr. Shailesh Kr. Agrawal

n the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow 2021, Hon'ble Prime Minister of India introduced Mission Lifestyle for Environment (LiFE) to the world. Mission LiFE urges the people of the world to become Pro-Planet People with the overarching aim of *planet for the people, by the people* & of the people.

Indian culture known for its sustainable practices in daily life since its ancient days has always taught the lesson of living in harmony with nature and through LiFE mission, it has become a India-led global mass movement to nudge individuals & communities especially the youth towards conserving the precious natural resources & protecting the mother earth. World is grappling with extreme events owing to steep rise in earth's surface temperature & subtle climate changes, it is opportune time to practice simple yet climate-friendly sustainable actions in our daily lives. In order to build better tomorrow, the changes in our daily chores right from what we eat, things we buy, the kinds of homes we live in, the kind of appliances we use, amount of water & energy, we consume

need to be looked from different perspective i.e. from *mindless consumption to mindful utilization*. Our choices will help us sustainable future.

There are seven pillars of LiFE mission which are guide to make positive impact together nudging individual & collective action towards protecting & preserving the environment :

- Save Energy
- Save Water
- Say No to Single Use Plastic
- Reduce E-waste
- Adopt Sustainable Food Systems
- Reduce Waste
- Adopt Healthy Lifestyles

Save Energy

Growing urbanization & better life styles has led to enhanced energy consumption contributing to greenhouse gas emissions, which is the primary cause of climate change. Reduction in energy use can bring down our carbon footprint and help mitigate the effects of climate change.

Energy efficient processes and investing in renewable energy sources, we can reduce our over dependence on natural resources which are primarily non-renewable resources and ensure a sustainable future. Therefore, saving energy may help preserve our natural resources. These small steps to save energy will reduce the costs and help create a healthier environment and an energy secure nation. The suggested pointers to save energy are :

- 1. Switch off vehicle engines at red lights and railway crossings
- 2. Use LED bulbs/tube-lights
- 3. Use public transport wherever possible
- 4. Use smart switches for appliances that are used frequently
- 5. Use bicycles for local or short commute
- 6. Install community earthen pots for cooling water
- 7. Use biogas for cooking and electricity needs
- 8. Prefer CNG or electric vehicles over petrol/ diesel vehicles
- 9. Switch off irrigation pumps after use
- 10.Switch off appliances from plug points when not in use
- 11.Install a solar water or solar cooker heater on rooftops
- 12.Keep temperature of air conditioners to 24 degrees

^{*} Executive Director, Building Materials & Technology Promotion Council (BMTPC), New Delhi, E-mail: shailesh.agrawal@gov.in



- 13.Prefer pressure cookers over other cookware
- 14.Defrost fridge or freezer regularly
- 15.Take the stairs instead of an elevator wherever possible
- 16.Run outdoors instead of on a treadmill
- 17.Use carpooling with friends and colleagues
- 18.Keep your electronic devices in energy-saving mode
- 19.Drive in the correct gear. Keep your foot off the clutch when not changing gears

Save Water

Water is precious & to be used with great care in every sector & life. Out of total volume of water on earth, 97.5% is saline & only 2.5% is fresh water. This earth's fresh water is very unevenly distributed & there is a risk of water scarcity in many regions of the world, due to rapidly increase demand for water.

Water being finite resource, saving it can help to meet the needs of the current and future generations. Saving water will further help in reducing the water bills for households and businesses and strain on water treatment facilities & associated infrastructure. Water is also important for plant and animal life, and water scarcity can have severe consequences for natural habitats and the species.

The small actions taken now to save water will secure a sustainable future, reduction in energy consumption and greenhouse gas emissions, saving money, and preserving ecosystems and biodiversity. The actionable points to save water as per LiFE mission are as follows:

1. Invest in a water metre for

your house to measure water consumption regularly

- 2. Turn off running taps when not in active use
- 3. Practice crop diversification
- 4. Prefer cultivation of less waterintensive crops like millets
- 5. Fix leaks in flushes, taps and waterpipes
- Create rainwater harvesting infrastructure in home/ schools/ offices
- Do not discard unused stored water every time the tap water supply resumes
- Use buckets instead of hose pipes to water plants/ floors/ vehicles
- 9. Participate in recharge of rural water bodies through the Amrit Sarovar Scheme
- 10. Reuse water from washed vegetables and the washing machine to water plants and for other purposes
- 11.Use drip irrigation systems created with waste materials, wherever possible
- 12.Use water-efficient fixtures for taps, showerheads, and toilet flush units
- 13. Use efficient water saving technologies (like micro-irrigation, bunding, laser levelling, farm ponds, zero tillage, direct seeded rice, alternate wetting and drying and others)
- 14.Pre-soak heavy pots and pans before washing them
- 15.Prefer a water purification system that wastes less water
- 16.Reuse water drained out from AC/RO for cleaning utensils, watering plants

Say No to Single Use Plastic

Single-use plastics made from fossil fuels, a non-renewable resource are designed to be used once and then discarded, contributing to the massive amount of plastic waste that is polluting our planet. Discarding single-use plastic can help to conserve natural resources and reduce greenhouse gas emissions.

According to the Central Pollution Control Board, India generated around 3.7 million tonnes of plastic waste in 2022-23. Avoiding the use of items made from plastic that can only be used once is an important step to reduce its damaging impact on our health and environment. From the 1st of July 2022, the Government of India decided to ban certain single-use plastic items, such as plates, cups, glasses, cutlery such as forks, spoons, knives, straws, trays and cigarette packets, plastic or PVC banners of less than 100 microns.

Single-use plastics take hundreds of years to break down, and they harm wildlife that ingests or becomes entangled in them. Therefore, refusing single-use plastic also helps to protect our marine and terrestrial ecosystems. By making small changes in our daily lives to refuse single-use plastics, we can help to create a more sustainable and resilient future for all. The following few steps can be taken in this direction:

- 1. Use recycled plastic over virgin plastic, wherever possible
- 2. Use menstrual cups instead of sanitary napkins
- Prefer non-plastic eco-friendly cutlery during gatherings and events
- Use cloth bag for shopping instead of plastic bags
- 5. Use steel/ recyclable plastic lunch boxes and water bottles
- 6. Carry your own non-plastic water bottle wherever possible
- 7. Reuse glass containers/ pack-



aging plastic items as storage boxes

- 8. Opt for bamboo toothbrushes and neem combs
- 9. Participate in and mobilize participation for clean-up drives of cities and water bodies
- 10.Cut the packaging bags used for milk, buttermilk, etc., only partially to avoid plastic bits from mixing into biodegradable waste

Reduce E-waste

Electronic waste, or e-waste, is a growing environmental problem that results from the improper disposal of electronic devices. These devices contain hazardous materials, such as lead, mercury, and cadmium, which can pollute the environment and pose a risk to human health.

Electronic devices also contain valuable materials, such as gold, silver, and copper, which can be recycled and reused in the production of new devices. By recycling ewaste, we can conserve our natural resources and also create jobs and stimulate local economies.

We must take action to reduce E-waste, while ensuring the proper disposal and recycling of the same as detailed below:

- 1. Repair and use electronic devices over discarding the devices
- 2. Discard gadgets in nearest erecycling units
- 3. Use rechargeable lithium cells
- Prefer cloud storage over a pen drive / hard drive

Adopt Sustainable Food Systems

Consuming locally available and seasonal foods are key ways of contributing to sustainable food systems. By doing so, we can support local farmers and communities, and reduce the carbon footprint associated with transporting food long distances.

Food waste is another critical issue that must be addressed to ensure our food systems are sustainable. According to the Food and Agriculture Organization of the United Nations, around one-third of all food produced globally is lost or wasted each year. This waste has economic, social, and environmental implications, including the loss of valuable resources such as water, land, and energy. By reducing food waste, we can conserve these resources and reduce greenhouse gas emissions. Our consumer choices and sustained efforts by our farming communities can ensure that the food systems of the future are resilient and sustainable. A few points to ponder are:

- Prefer locally available and seasonal foods
- 2. Compost food waste at home
- 3. Use smaller plates for daily meals to save food wastage
- Create kitchen gardens/ terrace gardens at homes/ schools/ offices
- 5. Include millets and nutri cereals in diets
- 6. Prepare organic manure from cow dungs and apply to farms

Reduce Waste

Reducing, Refusing and Recycling are key ways to reduce the heavy burden of waste on our environment and health. Efficient waste management is key to keeping our surroundings clean, which in turn leads to a lot of social, economic and environmental benefits.

Many of the products we use and consume require the use of finite resources, such as fossil fuels and minerals. By reducing waste, we can conserve these resources and use them more efficiently.

By taking action to reduce waste in our daily lives, we can help to create a more sustainable future for all. Doing so will set a good example for others and encourage more sustainable behaviours. The following can help create a culture of sustainability and inspire others to take action to reduce waste:

- Use agricultural residue, animal waste for composting, manuring and mulching
- Recycle and reuse old newspapers, magazines and agricultural by-products (coconut leaves, bamboo, jute/ coir and ash)
- Contribute cattle waste, food waste, and agricultural waste to biogas plant (provided under GOBARDHAN)
- 4. Do not discard waste in water bodies and in public spaces
- 5. Feed unused and uncooked vegetable leftovers to cattle
- 6. Donate old clothes and books
- 7. Set printer default to doubleside printing
- 8. Repair, reuse and recycle old furniture
- 9. Buy paper products made from recycled paper
- 10.Practice segregation of dry and wet waste at homes
- 11.Do not let pets defecate in public places

Adopt Healthy Lifestyles

Indigenous herbs and medicinal plants are an important part of the natural ecosystem, providing important habitats for wildlife and promoting biodiversity. Many local communities rely on these plants for traditional medicine and other uses. Indigenous trees are essential



for maintaining a healthy environment, providing a range of benefits such as absorbing carbon dioxide, preventing soil erosion, and providing shade and shelter for wildlife.

Biodiversity conservation efforts, both at the individual and community level (through green clubs and volunteer groups, for instance), are essential enablers of healthy lifestyles. By taking following actions to protect the environment and promote sustainability, we can help to create a better world for ourselves and future generations.

- 1. Encourage use of indigenous herbs and medicinal plants
- 2. Prefer consuming natural or organic products
- 3. Plant trees to reduce the impact of pollution
- 4. Start biodiversity conservation at community level
- 5. Create and volunteer at community food and cloth banks, and at animal shelters
- Avoid purchasing products/souvenirs made from skin, tuskers and fur of wild animals
- Initiate and/or join green clubs in your residential area/ school/ office
- Plant medicinal plants such as neem, tulsi, giloy, mint, curry leaves, ashwagandha, etc., within household premises

Closure

The above article is sourced from Mission Mission LiFE (https:// missionlife-moefcc.nic.in) which is India-led global mass movement to nudge people to protect & preserve the environment so as to have better future. Let us draw inspiration from the LiFE mission & build a sustainable future.

Technical Group Meeting for monitoring the progress of Demonstration Housing Projects and propagating emerging technologies

A meeting of the Technical Group comprising of representatives of IIT Jammu, J&K Housing Board, Jammu Municipal Corporation and BMTPC officials was organised on July 4, 2024 to oversee the progress of Demonstration Housing Projects (DHPs) at Bhalwal, Jammu and also to propagate emerging technologies being used in the DHP for wider acceptability within the State Government.





Housing the Nation with Young Ideas and Energy



A.K. Jain

"If youth knew, if age could" - Sigmund Freud

bstract The Pradhan Mantri Awas Yojana 2.0 launched recently aims to build 1 crore housing units, (in addition to about 1.20 crore units built under PMAY 1.0). The paper looks at the new approaches and green and circulatory technologies, which are in line with the aspirations of a developed India by 2047. This means intersecting the energy of the youth and wisdom of the age.

India's youth population, between 15 to 29 years age, is 37.14 crore, or about 27.3% of the country's total population. In 2047, India will have a population of 1,640 million, i.e. one- sixth of world's population. Its urban population is projected to increase from 377 million (2011) to 820 million in 2047. India will be the world's largest workforce, and world's third largest economy of \$36 trillion. It is projected that 75% of GDP and new jobs will be created in the cities. This poses huge challenges for urban housing and infrastructure development, together with the issues of pollution, climate change,

jobs, water, energy, etc. This calls for radical changes in housing development and construction with new technologies which are climate and disaster resilient, sustainable and innovative.

The Government of India is committed to house the nation. Its flagship- Pradhan Mantri Awas Yojana Urban (PMAYU) during 2015-24 has built/sanctioned 11.863 million housing units, which cover in-situ slum redevelopment, subsidised housing, affordable housing in partnership, and individual housing. The PM Awas Yojana 2.0 aims to build one crore housing units. This involves Rs.10 lakh crore investment, including Rs.2.2 lakh crore Central assistance. This will be a milestone for the construction industry which contributes approximately 8% to the nation's GDP, with ripple effect on employment generation and industrial development, including transportation, real estate and infrastructure sectors. It is also an opportunity to rethink the lessons learnt from PMAY-1.0 in the context of India becoming a developed nation by 2047.

Housing Design and Form

In view of the pace of 7 to 8 % economic growth, the Niti Aayog projects that per capita residential space in India should increase from the present 5.9 m² to 35 sqm in 2047. This means a revision of spatial standards of housing that aligns with the economic growth. Even the poor now realise that a house is adequate at least for one generation and refuse to have pigeon-hole dwellings, as seen during last 5 years in response to Delhi **Development Authority housing** schemes. It is rather unfortunate that the space standards of public housing (EWS, LIG, etc.) have not been reviewed during last 50 years. The PMAY 2.0 may consider this aspect. It may also be mandatory that in all housing schemes, at least one-third of the dwellings are reserved for the rental housing for the slum dwellers, homeless. and informal sector workers.

In 1923 Le Corbusier declared a house is a machine for living in, reflecting the industrial age. A 100 year later, today's networked environments, condition respon-

^{*} A. K. Jain worked as Commissioner (Planning), Delhi Development Authority. He was a member of the Committee of the Ministry of Housing and Urban Affairs on the DDA (2015) and UN Habitat (2007-12). He is visiting faculty in housing, planning and building. E-mail: ak.jain6@gmail.com



sive building envelopes, digital windows, composting toilets with water jets and heaters, bio-remediated waste water recycling, sensor based lighting, solar air conditioning, smart plumbing that monitors epidemiology, transformable structures, remote controlled smart robotic, modular kitchen, biotic and biogas generating waste processing, and artificial intelligence have made modern houses into machines.

Omnipresent Wi-Fi, electric/ hydrogen powered transport, networked traffic control, ubiquitous surveillance, integrated command and control centres, smart utilities and continuous renovation of the built fabric amplify the complex digital interactions that characterise the communities and cities.

Multi-storied housing makes a house a commodity. Most of the multi-storeyed housing are neither disaster proof (lacking fire escape, storm, earthquake and structural safety) nor universally accessible. On the contrary, low-rise housing helps in community led housing programs that synchronises with poverty reduction, street-based livelihoods, facilities, gender equity and security. While dealing with the slums, I always remember John Turner that the slums are not a problem, but a solution. The extensive field work during last 50 years by Geoffery Payne, David Satterthwaite (IIED), Sheela Patel (SPARC), Jockin Artputhan, UN Habitat and others endorse John Turner. Site and Services Schemes allow community participation and are more economical as compared to multi-storied housing.

The community formation should be the basis of housing layout and spatial organisation.

The layout should allow evolutionary and participatory housing and infrastructure development. The Aranya township at Indore by B V Doshi is based on self-help and principle of incremental housing with simple precast elements and components. The service core and slots on alternate streets allow upgradation and modifications of local services. The service cores are grouped into fours over suspended platforms, which define the framework for construction of the dwellings by the residents themselves according to their needs and resources. Simple prefab elements- columns, beams, floor, roof tiles can be used for construction.

As most of the poor families cannot afford to own a house. they depend on rental housing. The idea of rent as a source of livelihood is true for the informal settlements and resettlement colonies. These areas are dense suppliers of informal rentals, which are inhabited by poor and temporary occupants of the city. They go by the oral agreement, and abide by the dictate of the owner, like not getting a ration or identity card issued from the address of the landlord. The economic transition of these spaces is very informal in nature, resulting into densification, increased Female Labour Force Participation (FLFP) and caste-based community networks. The Draft National Urban Rental Housing Policy (NURHP, 2019) mandates various administrative and legal measures, compulsory reservation and financial incentives for rental housing, These provisions may be invoked for PMAY 2.0, which would go a long way in augmenting housing supply for the poorest of the poor.

Global Housing Technology Challenge - India

The Global Housing Technology Challenge - India (GHTC-India) provides a platform to promote innovative technologies for the housing and construction. It has three components (i) Construction Technology Platform to exchange knowledge and business (ii) Identifying technologies from across the world, and mainstreaming them through Light House Projects (LHPs), (iii) Promoting potential future technologies through the Affordable Sustainable Housing Accelerators-India (ASHA-India) for incubation and accelerator support.

Accordingly, 54 alternative technologies have been shortlisted, and categorized as given below:

- a. Precast Concrete Construction
 System 3D Precast volumetric
 (4 Technologies)
- b. Precast Concrete Construction System –Precast components assembled at site (8 Technologies)
- Light Gauge Steel Structural System & Pre-engineered Steel Structural System (16 Technologies)
- d. Prefabricated Sandwich Panel System (9 Technologies)
- e. Monolithic Concrete Construction (9 Technologies)
- f. Stay-in-Place Form work System (8 Technologies).

These technologies are being showcased through six Light House Projects (LHPs) being built at Indore, Rajkot, Chennai, Ranchi, Agartala and Lucknow. Each LHP as a model covers approximate 1,000 houses. The housing development



includes onsite infrastructure development, such as internal roads, pathways, common green area, boundary wall, water supply, sewerage, drainage, rainwater harvesting, solar lighting, external electrification, etc.

With the aim to build efficient, more sustainable and economical housing, the following technologies have been demonstrated in Lighthouse and other projects:

- Welded Wire Fabric Rapid Wall Panel System
- Glass Fibre Reinforced Gypsum
 Panels
- EPS and Wire Reinforced Panel
- Light Gauge Steel Frame Structure with Concrete Panel
- Modular Tunnel Framework
- Steel Frame Modular Building
 System
- Total Open Prefab Systemengineered systems
- Speed Floor System
- Gypsum Units Housing Systems
- Fibre cement board with expanded polystyrene (EPS) blocks, light gauge steel studs and concrete
- Light weight interlocking sandwich panels with 4mm facing sheets, thick fibre
- Reinforced cement boards, aerated cement core, and silicious and micaceous material aggregate.
- 3-S Prefab system with hollow structural components

Simultaneously, plethora of alternative building materials such as blended cement, bricks from different waste materials, steel from recycled steel, replacement of partial sand component with stone dust, aggregates from different sources other than natural ones, have also emerged.

Total Quality Management

With the increasing economic level, the consumers are more demanding and quality conscious. The building industry is facing global competition. The privatization of construction activity is creating a competitive environment where it is the survival of the fittest. As such the concept of "total quality management" (TQM) has become an indispensable aspect of building industry for private and public sectors.

Through a combination of quality systems, modern statistical techniques, the belief and commitment that customers have to be involved at various stages of the product/service delivery system and through continuous improvement programmes. TQM seeks to influence business competitive-

ness in the areas of cost reduction and adding value to consumer products and services. It is generally agreed that quality has to be management led covering all aspects of organizational systems. It is everybody's responsibility; the emphasis must be made on prevention rather than correction. The standard must be right time; the effort has to be based on continuous improvement and control via quality

costing. At the heart of any TQM effort is the establishment of the customer-supplier chain, with the following attributes:

- Customer satisfaction
- Common goals and objectives
- Integrated production process
- Equity without any distinction.

Precast Building Systems

Depending on the load-bearing structure, precast systems are divided into the following categories:

- Large-panel systems
- Frame systems
- Slab-column systems with walls
- Mixed systems/Modular-Plugin-Unit

In urban scenario, high density -low rise housing design allows the adoption of one of the above options, or a combination, as demonstrated by Moshe Safdie in his housing design for Coldspring New Town (Fig. 1).



first time and every time; the effort has to be based on continuous improvement invois improvement



Large-Panel Systems

The "large-panel system" refers to multistorey structures composed of large wall and floor concrete panels connected in the vertical and horizontal directions so that the wall panels enclose appropriate spaces for the rooms within a building. These panels form a boxlike structure. Both vertical and horizontal panels resist gravity load. Wall panels are usually one story high. Horizontal floor and roof panels span either as one-way or two-way slabs. When properly joined together, these horizontal elements act as diaphragms that transfer the lateral loads to the walls.

Depending on layout, there are three basic configurations of largepanel buildings:

 Cross-wall system: The main walls that resist gravity and lateral loads are placed in the short direction of the building.



Fig 2.: Readymade Housing for Disaster Prone Settlements Source: Jaggi, I R, Readymade Housing, Indian Architect and Builder, October 1991 sified as wet and

- Longitudinal-wall system: The walls resisting gravity and lateral loads are placed in the longitudinal direction; usually, there is only one longitudinal wall.
- Two-way system: The walls are placed in both directions.

Thickness of wall panels ranges from 120 mm for interior walls to 300 mm for exterior walls. Floor panel thickness is varies from 60 mm to 150 mm. Wall panel length is equal to the room length, typically on the order of 2.7 m to 3.6 m. In some cases, there are no exterior wall panels, and the facade walls are made of lightweight concrete. Readymade housing for disaster prone settlements can be built locally with precast wall and roof panels economically and speedily (Fig. 2).

Panel connections represent the key structural components. Based on their location within

> a building, these connections can be classified into vertical and horizontal joints. Vertical joints connect the vertical faces of adjoining wall panels and primarily resist vertical seismic shear forces. Horizontal joints connect the horizontal faces of the adjoining wall and floor panels and resist both gravity and seismic loads.

Depending on the construction method, these joints can be classified as wet and dry. Wet joints are constructed with cast-in-place concrete poured between the precast panels. To ensure structural continuity, protruding reinforcing bars from the panels (dowels) are welded, looped, or otherwise connected in the joint region before the concrete is placed. Dry joints are constructed by bolting or welding together steel plates or other steel inserts cast into the ends of the precast panels for this purpose. Wet joints are often cast-in-place.

Frame Systems

Precast frames can be constructed using either linear elements or spatial beam-column subassemblies. Precast beam-column subassemblages have the advantage that the connecting faces between them can be placed away from the critical frame regions.

However, linear elements are generally preferred because of the difficulties associated with forming, handling, and erecting spatial elements. The use of linear elements means placing the connecting faces at the beam-column junctions. The beams can be seated on corbels at the column, for ease of construction and to aid the shear transfer from the beam to the column. The beam-column joints are hinged. However, rigid beam column connections are used in some cases, when the continuity of longitudinal reinforcement through the beamcolumn joint needs to be ensured (Fig. 3).

Slab-Column System with Shear Wall

These systems rely on shear walls to sustain lateral load effects, whereas the slab-column structure resists mainly gravity loads. There are two main systems in this cat-







egory:

- Lift-slab system with walls
- Pre-stressed slab-column system

For the connections, the steel bars (dowels) that project from the edges of the slabs are welded to the dowels of the adjacent components and transverse reinforcement bars are installed in place. The connections are then filled with concrete poured at the site.

Most buildings of this type have some kind of lateral load-resisting elements, mainly consisting of cast-in-place or precast shear walls, etc. In case lateral loadresisting elements (shear walls, etc.) are not present, the lateral load path depends on the ability of the slab-column connections to transfer bending moments. When the connections have been poorly constructed, this is not possible, and the lateral load path may be

incomplete. However, properly constructed slab column joints are capable of transferring moments as shown by full-scale vibration tests. Another type of precast system is a slab-column system that uses horizontal pre-stressing in two orthogonal directions to achieve continuity. The precast concrete column elements are usually 1 to 3 stories high. The reinforced concrete floor slabs fit the clear span between columns. After erecting the slabs and columns of a story, the columns and floor slabs are pre-stressed by means of tendons that pass-through ducts in the columns at the floor level and along the gaps left between adjacent slabs. After pre-stressing, the gaps between the slabs are filled with insitu concrete and the tendons then become bonded with the spans. Seismic loads are resisted mainly by the shear walls positioned between the columns at appropriate

locations.

In any structure equilibrium, resistance and stability are the basic pre-requisites. In the past the gravity was added to defeat gravity, resulting in massive masonry, compression structures, such as the pyramids. The new materials like steel and carbon fibre have brought higher values of tension capability of structure, reducing the consumption and weight of building materials. Pre -engineered building is based on the dictum of 'less is more' that is enclosing the given space with more flexibility and stability by using lesser materials. This implies the adoption of Newton's laws in design of a structure, that is, counteract the pull and push forces by ranging them off against each other, a game of action and reaction. While the minimalist philosophy has permeated everywhere-computer, telephone and vehicles, buildings are still to witness this phenomenon. This is essential not only for economy, speed and quality of construction, but also for the reasons of ecological sustainability and inclusive growth.

Mixed System/Modular Plugin-Unit - Portable modular home units have been around for guite some time but have not been able to make an impact largely due to problems of costs, services, transportation, land and sprawl. If properly defined, they could have a modest carbon footprint compared with traditional, permanent housing. Brazilian architect Felipe Campolina has proposed high- density trailer parks. Steel framed skyscrapers provide a plugin skeleton into which modular homes can be slotted as required. The homes would be built from



standard 1.2mx2.4m board panels and could telescope in and out for transportation or installation. Each one-bedroom unit would have thermo-acoustic insulation, water recycling, a combined heat and power unit, and tempered glass windows. When the time comes to move house, residents could use a lift or crane and ship it to a new location.

New materials and cost-effective technologies for foundation, walls and roofing include a range of conventional as well as modern, evolved materials and technologies, new or recycled waste materials (industrial, agriculture, building construction, etc.). These not only reduce the cost of building construction, but also save energy and resources. Some of the sustainable and low energy materials, technologies and services are given in table 1. Metal alloys such as nickel-titanium can change form as directed. Super fibres, such as carbon and glass fibres, provide greater stiffness, strength, flexibility and economy, coping with higher tensile and compressive stresses achieved with the least amount of mass. Techno-fabrics can incorporate micro encapsulated phase change material for improved thermal insulation. Self-repairing and carbon negative building materials and concrete are emerging as the ideal materials for roof covering, external cladding or structural elements.

Green Building and Resources

A green building is defined as the one which is environmentally responsible and resource-efficient through its design, construction, operation, maintenance, renovation and demolition. It integrates

Table 1: Sustainable, low energy building materials

	Traditional/ Conventional	Modern/ Evolved
•	Sun dried Bricks	Bagasse Board
•	Precast cement concrete	Bricks from Coal Washery
	blocks, lintels, slab, modular	Rejects
	elements	Building Blocks from Mine
•	Cellular Light Weight	Waste
•	Elv-ash Sand Lime Bricks and	Burnt Clay Flyash Bricks Cair Comont Board
•	Paver Blocks	Compressed Farth Blocks
•	Gypsum Board, Tiles, Plaster,	 EPS Composites and Door
	Blocks, gypsum plaster fibre	Shutters
	jute/ sisal and glass fibre	Fiber Flyash Cement Boards
•	Bamboo Bamboo Based	Fiber Reinforced Concrete
•	Particle board and ply board,	Precast Elements, Wall panels, Blocks, Manhole Covers
	Bamboo Matting, Calcined	Fibrous Gynsum Plaster Boards
	Phospho-Gypsum Wall Panels	 Flyash Cellular Concrete.
٠	Ferro-cement Roofing	Flyash Cement Brick, Blocks
•	Channels Particle Boards	Flyash Lime Cellular Concrete
•	Epoxy Resin System, Flooring,	Flyash Lime Gypsum Brick,
	sealants, adhesives and	Rice Husk Ash Bricks
	admixtures	Jute Fiber Polyester
•	Ferro-cement boards for door	Non Erodable Mud Plaster
	and window shutters	Polytiles Timber alternatives such as
•	tiles	 Infiber alternatives, such as Poplar, Rubber, Fucalyptus
•	Cement Paint	 Precast walling roofing
•	Clay roofing tiles	components
•	Water, polyurethane and	Prefab Brick Panel System
	acrylic based chemical	
	admixtures for surface	
•	Laminated Wood Plastic	
	Components	
•	Marble Mosaic Tiles	
•	MDF Boards and Mouldings	
٠	Micro-concrete Roofing Tiles	
٠	Polymerised waterproof	
	compound	
•	Coment Elyach/ Calcinod Clay	
•	Based/ Portland Slag Cement	
•	RCC Door Frames	
•	Ready Mix Cement Concrete	
•	Rubber wood Finger jointed	
	Board	
٠	Stone dust	

Source: Building Materials & Technology Promotion Council (BMTPC), New Delhi



the following:

- Sustainable site planning and ecosystem-based neighbourhood model.
- Energy conservation and netzero energy with natural ventilation and passive design
- Reduced air and water pollution
- Sustainable building materials with recycled and renewable contents and low emissions.

It is necessary that the housing development focuses on health, wellbeing and improved quality of life of the inhabitants. It needs to be planned in a wider framework of natural resources (air, water, soil, food, energy and climate), places (the built environment, buildings, streets), local activities (living, working, playing, learning, shopping) and community networks and people.

A healthy building is free from sick building syndrome (SBS) caused by microbial, allergy, toxins, dust and mites. According to the Covid 19 Guidelines for Air-conditioning and Ventilation, issued by the CPWD (2020), room temperature should be set at 24° to 30° C, humidity of 40% to70% with regular fresh air flow to inactivate aerosol droplet virus. As AC ducts are potential careers of virus and bacteria, the system should be selfcleansing and sensor controlled.

In view of impending warming, air pollution and water shortage, it is time to conceive zero net-energy buildings, which use sustainable building materials and detox the air, work as bioreactors and energy generators. They provide water loops for its conservation and rainwater, provide space for pneumatic, underground scrapers for waste treatment. They multiply the space and promote urban agriculture, blurring the borders between urban and rural. The design of building adopts biomimicry, the emulation of nature's model, processes and systems, that is clean and organic.

Building Resources Pyramid

Like food pyramid, building materials pyramid can be a new way of building design, based on the use of materials with least environmental footprints (Fig. 4). It is projected that India produces 62 million tons of municipal waste annually. In the up-cycle scenarios, the building materials have to be sustainable, local, recycled, organic and affordable. Ways and means must be promoted whereby the urban waste of one industry feeds another, described as circular economy. Such measures accord priority to efficient disposal and reuse of waste and adopting zero waste. This involves a new design thinking based on reversible solutions, reuse and recycling of building components and wastes.

Life cycle analysis (LCA) and Life Cycle Costs (LCCs) are the basis for absolute sustainability and green transition with the



Fig. 4: The Building Resources Pyramid Source: Cinark, Kdak (2019) Circular Construction Materials, Architecture Tectonics, Unwelt, Udgivet, Copenhagen, Denmark



following principles:

- Prioritise renewable, bio-based materials over non-renewable materials
- Avoid environmentally harmful materials and construction processes
- Use green energy sources
- Ensure that such resources are included in the standards, specifications, technologies and biological circuits, and
- Incorporate the social and cultural dimensions of green transition.

Self-Healing Concrete: Victor Li, a professor of materials science at the University of Michigan in the US, has developed Self-healing concrete that fills up the cracks and cavities by itself. Small amounts of hydrated cement form a tiny calcium carbonate 'sear', sealing the cracks within a concrete structure. Genetically modified bacterium knits together crack in concrete structures by producing special glue. The microbe, created by a team of researchers at the Newcastle University has been programmed to seal fine cracks in the concrete. Once in contact with surface, it produces a mixture of calcium carbonate and a bacterial glue which combines with the filamentous bacterial cells to "knit" the cracks together. Ultimately hardening to the same strength as the surrounding concrete, the "bacila filla".

Rapid Wall: In India millions of tons of Sulphur-Gypsum wastes are produced as by-products of coal fired power stations and chemical fertilizer industries, disposal of which is a huge environmental problem. The Rapid Wall helps to overcome these problems by turning waste into rapid wall panels that can be manually erected and is energy efficient, aesthetically pleasing and is useful in construction where time and costs are key issues (Fig.5).



Fig. 5: Rapid Wall Source: Jain A.K. (2019) Housing for All- Planning, Design, Financing and Management, Khanna Book Publishing, New Delhi

Green Building Rat-

ing provides third-party validation of the design and/or performance of Finish Materials a building. Certification systems are vital as they provide an independent assessment of the green performance of projects, increasingly a key consideration for owners, tenants, agents and capital providers. These have been successful in raising awareness of ing in greater market

demand and industry response. By defining what is considered 'green', rating tools recognize and reward best practice and building codes have become more stringent. There are currently 31 different certification systems currently supported by Green Building Councils; the most widely used examples include LEED, Green Star, GRIHA and BREEAM. The GRIHA System evaluates 34 criteria from the site selection, planning, design, water, energy, building materials, all throughout the construction phase and building life cycle (Table 2).

Building Information Modelling (BIM)

As building design and construction are becoming more complicated with smart materials, services and digital networks, understanding and coordination of various systems becomes crucial.

Building Information Modeling (BIM) provides computerized layers of information, planned details of the structure containing everything from 3D drawing and planning documents, service plans and controls to



Fig. 6: End-to-end control of building design, manufacturing, construction, and operations achieve targets at lower cost and time

green buildings, resultsource: Kattera, K A, and Curtis, Craig (2020) Architecture at Scale: Reimagining One-Off Projects as Building Platforms, Architectural Design



the specifications of building materials, components, light fitting and fixtures. BIM is an end to end, and integrated, collaborative process that enables engineers, architects, contractors and clients to work from a single, digital model and share reliable, coordinated information at every stage of a project life cycle (Fig 6).

Digital fabrication uses designto-fabrication workflows to enable a faster construction process, minimise resources, and material-specific design solutions. It integrates design, simulation, and digital fabrication to create complex, customized products using ubiquitous manufacturing hardware. Digital manufacturing has facilitated opportunities of surface patterning and the fabrication of offsite building components, removing the constraints of standardisation in the construction industry. Material feedback allows adjusting the digital fabrication to negotiate material properties and to calibrate a precise relation between the whole and the individual units of construction.

Circular and Sustainable Construction

The idea of circular construction is based on the continuity of raw materials, products and waste streams in a closed circular loop. It involves an energy centered approach towards design, materials and construction. Adoption of circular models for the building design and construction requires formulating guidelines, calculating resources, labour and material flows, their environmental footprint and impact and lifetime scenarios. The basic approach of circular construction is zero emissions and wastes

Table 2: Green Rating for Integrated Habitat Assessment(GRIHA)

	Criteria	Points
Criteria 1	Site Selection	1 Partly mandatory
Criteria 2	Preserve & protect landscape during	5 Partly
	construction/ compensatory forestation	mandatory
Criteria 3	Soil conservation (post construction)	4
Criteria 4	Design to include existing site features	2 Mandatory
Criteria 5	Reduce hard paving on site	2 Partly
Criteria 6	Enhance outdoor lighting system efficiency and use Renewable Energy system.	3
Criteria 7	Plan utilities efficiently and optimise on site circulation efficiency	3
Criteria 8	Provide minimum level of sanitation/safety facilities for construction workers	2 Mandatory
Criteria 9	Reduce air pollution during construction	2 Mandatory
Criteria 10	Reduce landscape water requirement	3
Criteria 11	Reduce building water use	2
Criteria 12	Efficient water use during construction	1
Criteria 13	Optimise building to reduce conventional energy demand	6 Mandatory
Criteria 14	Optimise energy performance of building within specified comfort	12
Criteria 15	Utilisation of fly ash in building structure	6
Criteria 16	Reduce volume, weight and time of construction by adopting efficient technology	4
Criteria 17	Use low-energy material in interiors	4
Criteria 18	Renewable energy utilization	5 Partly mandatory
Criteria 19	Renewable energy based hot water system	3
Criteria 20	Waste water treatment	2
Criteria 21	Water re-cycle & re-use (including rainwater)	5
Criteria 22	Reduction in waste during construction	2
Criteria 23	Efficient waste segregation	2
Criteria 24	Storage and disposal of waste	2
Criteria 25	Resource recovery from waste	2
Criteria 26	Use of low VOC paints/ adhesives/ sealants.	4
Criteria 27	Minimize ozone depleting substances	3 Mandatory
Criteria 28	Ensure water quality	2 Mandatory
Criteria 29	Acceptable outdoor and indoor noise levels	2
Criteria 30	Tobacco and smoke control	1
Criteria 31	Universal accessibility	1
Criteria 32	Energy audit and validation	Mandatory
Criteria 33	Operations and maintenance protocol for electrical and mechanical equipment	2 Mandatory
	Total score	100
Criteria 34	Innovation (beyond 100)	4
		104

Source: TERI (2010) Green Rating of Integrated Habitat Assessment (GRIHA), New Delhi



by on-site recycling to save the environment.

The approach begins with the reduction of materials consumption, their recycling and reuse considering the following:

- Prioritise renewable, bio-based materials over non-renewable materials, keeping in view their environmental impact
- Avoid environmentally harmful materials and construction processes
- Use green energy sources
- Ensure that such resources are included in the standards, specifications, technologies and biological circuits
- Incorporate the social and cultural dimensions of green transition.

Mainstreaming Sustainability

Design and sustainable green building are driven by the following key factors:

- Net Zero Energy design, materials, construction and operations
- Environmental concerns about climate change and reducing emissions of greenhouse gases, primarily CO₂
- Conservation and recycling of water in view of the changing global patterns of rainfall and increased consumption rates.

The use of energy, water and other resources in a sustainable construction is dependent on three factors:

- Building design built form and building fabric
- Operation, building uses and maintenance - building services, water, lighting, maintenance and controls, occupancy pattern and waste management



Fig. 7: Ten Basic Principles of Green Building Design Source: Jain A.K. (2023) Climate Resilient, Green and Low Carbon Built Environment, Springer Nature, Singapore

• Energy conservation and efficiency.

Passive design strategies such as day lighting, natural ventilation and an appropriate building fabric, should be integrated into the design to reduce energy consumption. Efficient building services for space and water heating should be accompanied with effective controls and management. Use of energy-efficient lighting and equipment, water saving fixtures and minimization of waste during operation, are other important areas of consideration (Fig.7).

For a building to be sustainable and climate/disaster resilient, its design and construction should contextualise the local climate, heat, floods, storms, or rising sea levels.

A rotating house has been built in Australia that harvest solar energy by following the sun. The octagonal home is set on a turntable and spins around a central core of plumbing and electrical fittings. The rooms capture as much natural light as possible. The entire structure is powered by two electric engines not much bigger than a washing machine motor. It generates its own power and features a host of energy-efficient elements. Rooftop solar photovoltaic panels generate power, with a smart electricity meter that tracks the amount of energy consumed as well as surplus power dispatched onto the grid. The house features fiberglass insulation and triple glazed windows with low-e coatings. A hot water recovery system recovers wastewater for reuse. Energy-efficient waterfall balances interior humidity. Renewable resources have been used in the house, such as cork flooring, bamboo cabinetry, recycled glass, etc.

The windows of buildings can also produce electricity with transparent solar cells or "smart energy" glass. Transparent photo voltaic cells are being produced which fit between two panes of a window.


Smart glass technology saves on air- conditioning and high energy cost. This is being used for Boeing 787 Dream Jet plane and in some high-speed trains in Germany.

It is estimated that 350 litres of water is consumed for 1 sq. m of construction. Products like Rhino Brick (Hyderabad) are mincing 20% plastic shreds and 80% sand and dust to make eco brick, hollow bricks and interlocking bricks. Paper and wood can be mixed with plastic waste, like bottles, polyester bags, packings, etc. for making colourful tiles.

Construction is one of the largest industries in India. It involves generation of construction and demolition wastes. Building waste needs to be disposed of and recycled as per the Construction and **Demolition Waste Management** Rules, 2016. Recycled products reduce the demand for new materials. Such materials include reused brick, steel, concrete, gypsum, sulphur, wood alternatives, reconstituted wooden pallets, combination of straw, bamboo, lime tiles wood waste and cement for wall, roof and positions, insulating felts and boards, blocks, etc. The C&D waste should be segregated at site and exclude the inert, chemical or hazardous wastes. such as oil, paint, batteries and asbestos. Recyclable wastes, such as plastics, timber, steel, aluminium, bricks, wood, concrete, etc. can be reused in building construction.

There are several examples of successful use of C & D wastes in new buildings, e.g. Editt Tower, Singapore (Fig. 8) and New Moti Bagh Government Housing Complex, New Delhi. C & D waste has also been successfully used for paving of roads, footpath and



Fig. 8: Concrete Recycling, Editt Tower, Singapore Source: Hamzah TR and Yeang Ken (1999) Ecology of Skyscrapers, Images Publishing, Australia

landscaping.

Apropos of PMAY 2.0, it is time to make it mandatory that all new constructions should use at least 25 percent of recycled materials. It is also necessary to think of the vertical waste scrapers in place of large landfill sites. Vertical waste scrapers can act as green filter, air purifier, for O_2 enrichment, and SPM for recycling.

The waste collection modules separate the leachate and treat, recycle and compost the wastes. The gasification process for organic wastes uses an oxygen starved high pressure and high temperature environment to kill the virus and germs and remove impurities before full combustion. The decomposition of organic wastes produces methane gas, which can be used as fuel and allows emission free composting.

Mainstreaming Sustainable Social Housing in India project (MaS-SHIP) funded by the United Nations identifies the impacts and benefits of housing production for environment, economy, and communities, and provides a method for identifying the most optimal building materials and systems. The Fig. 9 indicates the attributes of sustainable housing, under 4 categories viz. Resource Efficiency, Operational Performance, User Acceptability and Economic Impacts.





Fig. 9: 18 Attributes of Sustainable Housing Categorised under Four Criteria

Source: Rajat Gupta, Sanjay Seth, Zeenat Niazi, Jesús S Villanueva, Sanjoli Tuteja, Megha Behal, Pratibha Caleb and Ayushman Banerjee (2018). Mainstreaming Sustainable Social Housing in India: findings and insights from the MaS-SHIP project, Oxford Brookes University, TERI, Development Alternatives and UN-Habitat, New Delhi.

Contracting and Optimising Housing Costs

The conventional PPP and contracting models are collapsing. Creative ideas and innovations are taking precedence over conventional engineering, procurement and contracting (EPC) procedures and tendering systems, which have produced matchbox towers, inconsistent with the local community, climate and ecology. It is necessary that the outsourcing and contracting system are reviewed which allow exploration of new ideas and innovations.

We need to rethink about the model of public-private binary and evolve a third option, where the local community is the core actor in the shelter process. It controls the money and resources and decides on the options of upgrading, retrofitting and improvement of existing shelters and composite development of fragmented properties. This involves systemic changes in contracting, capacity development, community empowerment and slum networking.

It is necessary to optimize the housing cost together with quality, productivity and sustained maintenance. According to McKinsey Global Institute, the critical housing cost reduction strategies at design and construction stage include the following:

- Pre-manufacturing: build components off-site using industrial processes, deliver parts as needed.
- Planning Optimization: apply critical path management techniques to optimize plan implementation by realistic scheduling.
- In-site lean execution: use lean techniques to standardize procedures that eliminate waste in individual activities and improve construction flow balancing.
- Process Step Productivity: eliminate low value added activities and wasted time to optimize

process efficiency.

- De-specification of structural design: Avoid over-specification of non-value-added components.
- Standardization of micro-design: Identify substitutes and use design-to-cost to set specifications.
- Determine sourcing strategy for each category of construction activity, detail sub-contractor management
- Housing Optimization by volume increase through bundling, labour saving production, lowcost sourcing, and capacity optimisation of housing agencies, including the public, private and community sectors
- Technical Optimization: Standardize and identify substitutes with advanced costing tools.

Automated procedures can give efficiency, economy and precision to building construction and components. Computer-Aided Manufacturing (CAM), Computer



Integrated Manufacturing (CIM) for prefabricated components, and simulation of construction process enables better control of time, machine, expenditure and the manpower, which could be reduced at least by half to one-third in comparison to the conventional construction.

Conclusions

India with its demographic dividend, youth power and technological advantage can unleash its potentials towards housing the nation. This needs a fresh outlook and a young mind which learns and observes. The engagement of youth is essential to bring in new ideas, energy and technology towards housing and infrastructure development.

'To be free of all authority, of your own and that of another, is to die everything of yesterday, so that your mind is always fresh, always young, innocent, full of vigour and passion. It is only in that state one learns and observe.'- J Krishnamurti

References

- Agarwal Shailesh, S.K. Gupta and Dalip Kumar (2024) Lighthouse Projects- A Journey for Transformation of Construction Sector, IBC National Seminar, New Delhi
- Building Materials and Technical Promotion Council (2024), New Delhi
- Cinark, Kdak (2019) Circular Construction Materials, Architecture Tectonics, Unwelt, Udgivet, Copenhagen, Denmark
- Community Architects Daily.blogspot.com
- CPWD (2020) Covid 19 Guidelines for Air Conditioning and Ventilation, New Delhi
- Davis, M (2006) Planet of Slums,

London, NewYork

- Delhi Development Authority (2007) Master Plan for Delhi-2021, DDA, New Delhi
- Hamzah TR and Yeang Ken (1999) Ecology of Skyscrapers, Images Publishing, Australia
- Jaggi, I.R. (1991) Readymade Housing, Indian Architect and Builder, October
- Jain A.K. (2023) Climate Resilient, Green and Low Carbon Built Environment, Springer Nature, Singapore
- Jain A.K. (2019) Housing for All-Planning, Design, Financing and Management, Khanna Book Publishing, New Delhi
- Jain A.K. (2021) Environment, Urbanisation and Development, Discovery Publishing House, New Delhi
- Jain A.K. (2024) Urban Challenges and Innovations for Viksit Bharat, IBC Annual Seminar (July), New Delhi
- Kattera, K A, and Curtis, Craig (2020) Architecture at Scale- Reimagining One Off Project as Building Platform, Architectural Design
- Le Corbusier (1923/1985) Towards a New Architecture, Dover Publications, New York
- McKinsey Global Institute (2010) India's Urban Awakening: Building Inclusive Cities, Sustaining Economic Growth, Mumbai
- Ministry of External Affairs, Govt. of India. One of The Youngest Populations in the World India's Most Valuable Asset. https:// indbiz.gov.in/one-of-the-youngestpopulations-in-theworld-indiasmost-valuable-asset/
- Ministry of Housing and Urban Affairs (MOHUA) (2018) National Urban Innovation Stack: Strategy and Approach. New Delhi, Ministry of Housing and Urban Affairs
- Ministry of Housing and Urban

Affairs (MOHUA) (2019) Draft National Urban Rental Housing Policy, Ministry of Housing and Urban Affairs, New Delhi

- Ministry of Housing and Urban Affairs (MOHUA) (2019) Urban Transformation through Housing for All- 1 Crore and More, Ministry of Housing and Urban Affairs, New Delhi,
- Ministry of Youth Affairs and Sports, Govt. of India. 2014. National Youth Policy, 2014. https://yas. nic.in/sites/default/files/National-Youth-Policy-Document.pdf
- NIUA (2023) Urban 20 Initiatives, MOHUA, NIUA, New Delhi
- Payne, Geoffrey, Urban Housing in the Third World, TBS, London, 1977
- Rajat Gupta, Sanjay Seth, Zeenat Niazi, Jesús S Villanueva, Sanjoli Tuteja, Megha Behal, Pratibha Caleb and Ayushman Banerjee (2018). Mainstreaming Sustainable Social Housing in India: findings and insights from the MaS-SHIP project, Oxford Brookes University, TERI, Development Alternatives and UN-Habitat, New Delhi
- Shanahan, Mike (2024) David Satterthwaite- Urban Legend, One Man, 50 Years, Countless Seeds of Hope, IIED, London
- TERI (2010) Green Rating of Integrated Habitat Assessment, GRIHA), New Delhi
- Turner, John, Fisher R. (ed 1972) Freedom to Build: Dwelling Control of the Housing Process, MacMillan, New York
- UN Habitat, The Challenges of Slums, Earthscan, London, 2003
- United Nations (2015) Sustainable Development Goals, UNGA, New York

Engaging Youth for an Urban Future: The Role of Awareness in Sustainable Development



Kshitiz Agarwal¹ Dr. Mahua Mukherjee²

ntroduction

Urbanization is one of the most significant phenomena of our time. It represents the shift of populations from rural areas to cities, transforming a nation's social, economic, and physical landscapes. As urbanization accelerates globally, cities increasingly become the focal points of human activity and innovation (Fund, 2007). Historically, urbanization has been linked to economic growth, technological advancement, and improved living standards. However, the rapid pace of urban expansion has also introduced a range of challenges, including environmental degradation, resource scarcity, and social inequality. India is projected to have 600 million people living in cities by 2031, a demographic shift that poses immense infrastructure, housing, and resource management challenges (Cohen, 2006). In this context, architects play a pivotal role in shaping the future of urban environments by adopting sustainable practices and technologies.

A significant proportion of the Indian population is under 35

years of age. Engaging this vibrant population segment is crucial for shaping a sustainable urban future (Das et al., 2016). This youthful demographic is a potential force for innovation and change, especially in urban development. Harnessing this energy can help address the pressing issues associated with urbanization and pave the way for more sustainable and resilient cities. However, the effective engagement of young architects in these efforts hinges on their awareness of key organizations, policies, and innovations driving sustainable development. This article explores the role of awareness in promoting sustainable architecture among Indian youth.

2. Urbanization and Sustainability: The Role of Young Architects

India's rapid urban growth presents significant economic development opportunities and severe environmental concerns. According to the UN, 68% of the world's population will live in urban areas by 2050, with developing countries like India leading the charge. The environmental impact of this shift includes increased energy consumption, waste generation, air pollution, and strain on water resources (Nations, n.d.). To address these challenges, the built environment must evolve to incorporate sustainability principles, such as energy efficiency, waste reduction, and eco-friendly materials. Sustainable development is a holistic approach to growth that balances economic, social, and environmental goals to meet current needs without compromising resources for future generations. Sustainable development promotes resilience in communities and ecosystems, fosters innovation, and strives for inclusivity and fairness (Brundtland, 1991).

Architecture plays a critical role in shaping sustainable urban environments. Some aspects in which architecture can help in sustainable development are Green buildings and Net-zero buildings. Green buildings are designed to minimize environmental impact using sustainable materials, energy-efficient systems, and water conservation measures (Ragheb et al., 2016). Certifications such as LEED (Leadership in Energy and Environmental

2 Head & Professor, Department of Architecture and Planning, IIT Roorkee, E-mails: mahuafap@iitr.ac.in

¹ Research Scholar, IIT Roorkee, E-mails: kshitiz_a@ar.iitr.ac.in



Design) and GRIHA (Green Rating for Integrated Habitat Assessment) provide frameworks for assessing and promoting green building practices.

LEED Certification: As of 2021, there are over 100,000 LEEDcertified projects globally, covering over 2.6 billion square feet of space (Abdelkhalik & Azmy, 2022).

GRIHA Certification: GRIHA has certified over 1,500 projects in India, amounting to more than 1.5 billion square feet of built-up area (Singh & Gupta, 2021).

Net-zero buildings are designed to produce as much energy as they consume, often through renewable energy sources such as solar panels and wind turbines. These buildings also incorporate energy-efficient technologies and design strategies to minimize energy consumption. Energy Efficiency: Net-zero buildings can reduce energy consumption by up to 50% compared to conventional buildings. Global Impact: According to the World Green Building Council, net-zero buildings could reduce global carbon emissions by 84 gigatons by 2050 (Matthews, 2019).

Youth engagement in sustainable development is essential for several reasons. Young people bring fresh perspectives, innovative ideas, and a solid commitment to sustainability. Young architects, the future custodians of urban spaces, are critical stakeholders in this transition. However, the extent to which they can contribute effectively depends on their awareness and understanding of sustainable technologies, construction materials, and design principles. This requires access to comprehensive information and training on sustainable practices and active engagement with organizations that promote innovation in the field.

In India, the BMTPC is one of the key organizations promoting advanced sustainable construction technologies and building capacity among professionals. Some of BMTPC's most notable initiatives include the development of the Vulnerability Atlas of India, which maps areas prone to natural disasters, and promoting technologies under the Global Housing Technology Challenge – India (GHTC-India). BMTPC has also launched various training programs and courses, such as the NAVARITIH course on new-age housing technologies, designed to build the capacity of professionals to adopt sustainable and disaster-resilient construction methods. Still, its visibility and outreach efforts need to be amplified to better engage young architects. For young architects and designers, pursuing such buildings offers an opportunity to innovate and contribute to environmental sustainability. Integrating renewable energy systems, efficient insulation, and passive design strategies can help create energy-efficient and environmentally friendly buildings (Chel & Kaushik, 2018). However, they must be well-informed about sustainable practices and the organizations that promote them for effective engagement.

3. Assessing Awareness: Insights from a Recent Survey

A small survey was conducted among Indian architects aged 18-35 to assess their awareness of BMTPC and its initiatives and their understanding of sustainable construction practices. The results revealed a significant gap in knowledge and engagement, with **nearly** **60% of respondents unaware of BMTPC's role** in promoting sustainable construction and disaster resilience. Even among those who had heard of BMTPC, only a tiny fraction could describe its core objectives or identify the technologies it promotes.

One of the key findings from the survey was the reliance on traditional information channels, such as academic courses and professional networks, for learning about BMTPC. Respondents who were aware of the council mainly encountered its initiatives through educational institutions or industry events. However, 75% of respondents were unaware of BMTPC's training programs, such as the NAVARITIH course or workshops on the Vulnerability Atlas of India. This suggests that while BMTPC's efforts to engage professionals exist, they have not effectively penetrated the channels most frequented by young architects.

Furthermore, when asked about adopting BMTPC-promoted technologies, only 30% of respondents were familiar with these innovations and still needed to implement them in their projects. This highlights the need for greater outreach and practical demonstrations to showcase the benefits of these technologies in real-world applications. Respondents expressed interest in disaster-resilient construction methods, with over 80% agreeing on the importance of such practices for sustainable urban development. Still, they needed more knowledge of how to implement these solutions.

4. The Way Forward

The survey results underscore



the importance of making sustainable construction technologies and knowledge accessible to young architects. By increasing awareness and offering more tailored training programs, BMTPC can empower young professionals to become advocates for sustainable development. This, in turn, can lead to the widespread adoption of ecofriendly materials and technologies that align with India's goals for a green and resilient future.

To bridge the existing gap between BMTPC and young architects, several strategies can be implemented. Firstly, enhancing digital outreach is crucial. Expanding BMTPC's online presence through professional development and social media channels can help it get in front of more people. Young architects' exposure and engagement may be greatly increased through webinars, interactive material, and regular updates. Second, working together with academic institutions is crucial. Incorporating BMTPC's programs into the curriculum through partnerships with universities and colleges may introduce students to sustainable practices at an early age, therefore promoting a sustainabilityconscious culture from the start. Furthermore, increasing the accessibility of training materials online might promote involvement. Encouraging young professionals to participate in sustainable practices may be achieved by providing incentives and certificates for completing these programs. Challenges and competitions may also be quite effective in attracting young people. Sustainable urban development-related design challenges may stimulate creativity and innovation and provide a forum for young architects to work together

and present their work. Finally, it's critical to provide networking and mentoring possibilities. The establishment of mentoring programs that pair up novice architects with seasoned pros may offer direction and assistance while networking gatherings and seminars can promote information exchange and teamwork.

5. Conclusion

The challenges posed by rapid urbanization in India require a wellrounded and innovative approach to sustainable development, in which young architects play a pivotal role. As future leaders and designers of urban spaces, their knowledge and engagement in sustainable practices are crucial. However, the survey results demonstrate that awareness of key organizations like BMTPC remains low among this demographic, limiting their ability to contribute meaningfully to sustainable urbanization.

To address this, BMTPC must enhance its outreach by utilizing digital platforms, collaborating with academic institutions, and offering more accessible training and mentorship opportunities. By making its programs more relevant, accessible, and visible to young professionals, BMTPC can foster a generation of architects equipped to design and build future sustainable cities.

Engaging youth through competitions, hands-on training, and continuous professional development is essential in ensuring sustainability becomes a core aspect of India's urban development efforts. As architects take on more significant roles in designing the country's future cities, their capacity to implement sustainable practices will define the urban landscape for future generations. India can empower its youth to build resilient, eco-friendly, and inclusive urban spaces through a concerted focus on education, innovation, and collaboration.

6. References

- Abdelkhalik, H. F., & Azmy, H. H. (2022). The role of project management in the success of green building projects: Egypt as a case study. Journal of Engineering and Applied Science, 69(1), 61. https://doi.org/10.1186/ s44147-022-00112-5
- Brundtland, G. H. (1991). Our common future. In M. K. Tolba & A. K. Biswas (Eds.), Earth and Us (pp. 29–31). Butterworth-Heinemann. https://doi.org/10.1016/ B978-0-7506-1049-0.50009-5
- Chel, A., & Kaushik, G. (2018). Renewable energy technologies for sustainable development of energy efficient building. Alexandria Engineering Journal, 57(2), 655–669. https://doi. org/10.1016/j.aej.2017.02.027
- Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. Technology in Society, 28(1), 63– 80. https://doi.org/10.1016/j. techsoc.2005.10.005
- Das, S., Gupta, M., & Bose, S. (2016). Assessing the Need of Adaptive Changes for Emerging NORCs in Urban India. Creative Space, 4(1), Article 1. https://doi.org/10.15415/ cs.2016.41007
- Fund, U. N. P. (2007). State of World Population 2007: Un-



Expectations of Youth in India: Shaping a Sustainable and Innovative Future



Dr. Anil Kashyap

"Take up one idea. Make that one idea your life, think of it, dream of it, live on that idea, let the brain, muscles, nerves, every part of your body be full of that idea and just leave every other idea alone. This is the way to success"

- Swami Vivekananda

aving spent a significant time span in the United Kingdom's education system, I have had the privilege of witnessing first- hand how the system functions over there. It has a long-standing tradition of education excellence along with a strong focus on academia, research and innovation. Along with that it has emphasis on problem- solving.

In my journey back to India, I was pleasantly welcomed to witness the nation standing on a cusp of momentous transformation, along with an unprecedented growth.

With approximately over 65% of our population under the age group of 35 India is a nation brimming with innovation and ready to take on the world. And this is only because of the youth of our country. They not only are the leaders of tomorrow but also the innovators of today who will drive

growth. Hence it is extremely imperative that we harness this potential to the fullest, to address the challenges of sustainability, urbanization, population, and the issues of unemployment.

Where is India today from a global standpoint?

From a global platform India today is uniquely positioned to become be the pinnacle of this metamorphosis. What gives us this edge? Our rich culture wrapped in modernity gives us that extra edge and makes us unique. We are a nation who have reached heights but have never forgotten our roots. As we stand on the cusp of growth it is important though there are enough job opportunities created that contribute to the overall betterment of the society and at the same time contribute to the betterment of our environment.

As educators we see our role as one of the profound responsibili-

ties to guide, educate and inspire our students to become the designers of a Sustainable Future. A future that will be equipped with modern amenities alongside caring for the environment.

The young blood of our nations represents a major chunk of our population. Not only do they represent the future of India, but they are vocal, confident, optimistic and know their needs. As they take the baton to lead for their future roles as leaders, their aims are simultaneously shaping the road map around urban development, sustainability and the overall quality of life.

So, what are the needs of India's youth? What are their expectations overall from the employment sector, sustainability issues, the overall quality of life and overall active civic participation.

This article delves into these key issues. Let us look.

* President I Chancellor I NICMAR University Pune & Hyderabad

Profile - https://www.nicmar.ac.in/pune/leadership; Linkedin - https://www.linkedin.com/in/anilkkashyap/



The desire for Sustainable Development

Climate change has become an extremely pressing and important issue in today's world. With natural calamities, wars, earthquakes knocking on our doors unexpectedly, it has become even more important to address these issues and tackle them. There is growing awareness among the youth for environmental sustainability and hence the latter are demanding key changes in terms of environmental stewardship.

About NICMAR University

As India's most progressive Built Environment University, NIC-MAR, is synonymous with discovery, knowledge, and innovation of the highest order. Since its inception in 1983, NICMAR has been diligently pursuing its mission to advance education, refine skills, and provide unparalleled training in the built environment domain as a distinguished society and public trust, steered by esteemed academicians and industry leaders.

NICMAR leads the way in cultivating and fostering the future leaders in multidisciplinary domains of sustainable energy, architecture, infrastructure, construction, real estate, project, and business management with a comprehensive range of niche undergraduate, postgraduate, and doctoral programs. With an unwavering commitment to producing industry-ready graduates, NICMAR is poised to empower the built environment sector with the next generation of forward-thinking and visionary youth.

https://www.nicmar.ac.in/

We explore them

The demand for Green urban spaces

With the green cover rapidly depleting, it is a much more pressing issue to provide with green parks and spaces for India's future citizens. They envision that urban spaces must be integrated with green infrastructure that will focus on environmental efficiency and focus on reducing pollution.

Energy-efficient infrastructure

The pressing need for infrastructure, energy efficient buildings along with a robust public transportation system is the way ahead to drastically reduce carbon emissions. In conjunction with this propaganda the youth are advocating the cause of energy-efficient resources along with smart grids that will create a base for a Sustainable Future.

Being climate resilient

Building climate resilient cities is the need of the hour. With floods, droughts and other natural calamities, the youth demand that urban planning should be done keeping in mind the various facets of climate change that will protect the communities from its adverse effects.

The Employment and the Entrepreneurial Opportunities

Employment and Entrepreneurial sectors are the top key concerns for today's youth. Today seeking a job is not just about a degree, or the pay-package. As the job market involves key changes, the youth are seeking jobs that will align with their thought process and will give a meaningful impact.

The Job scenario in the Sustainable sectors

It is a welcoming change to see

that today's youth are increasingly focusing on taking up jobs related to sustainable sectors and that will contribute to environmental sustainability.

The entrepreneurial spirit

From the 9 to 5 jobs to charting out their own territory the Indian youth are particularly focused on starting out their own ventures and offer solutions to problems that involve the smart city technologies, ease of transportation and most importantly affordable housing solutions that is the need of the hour.

India is home to some of the innovative and interesting startups and this is just the tip of the iceberg. With the entrepreneurial spirit burning it only seems a matter of time that India becomes the hub of startups in the coming years.

Improving the quality of life

Quality of life is one of the key factors that today's youth would want to focus on. Unfortunately, with stress and work-related issues being the key concerns for today's youth, it is no wonder youngsters in the age ground from 25 to 40 are prone to heart attacks and depression. Hence it is very important that work-life balance is adequately maintained so that the youth can focus on improving the quality of life and subsequently a health life span,

Good quality urban amenities

Well-constructed urban amenities complete with the latest technologies that include sanitation, well placed healthcare facilities along with improving the overall quality of life is one of the top priorities of India's youth.



Transportation

With a booming population, no wonder India's transportation scene should be the topmost priority. This will make the daily commute of office goers easy, comfortable and at the same time take care of their well-being. Added to that if the transportation solutions are efficient and sustainable then it is a win- win situation. A good cycling infrastructure, electric buses and integrated transportation are the way to go that will drastically reduce pollution and traffic congestion.

Affordable housing

One of the pressing concerns that reminds the youth today is an affordable home. This is especially critical for the low and the middle-income families. The youth demand affordable housing along with sustainable amenities in a place essential for a peaceful community life.

The Smart city initiatives

The youth is all for the concept of smart cities initiatives that incorporates using technology along with digital infrastructure. The key pressing issues in a top metro city are congested traffic, along with haphazard vehicles fleet management. Hence planning of traffic management and urban planning that incorporates data should be adopted is what India's youth thinks about.

The significance of Civic participation

Civic participation is on the rise in India's urban youth. They are going out of their way to focus on issues affecting society and helping in their own small way to shape the city's futures.

Increasing participation in Community engagement

The youth are increasingly participating in community engagement activities, that involve discussions and initiatives that will contribute to the well-being and impact the local environments positively.

The importance of social media

One cannot really ignore the importance of social media and the significance it holds. It is one of the key tools for voicing your opinions, helping your thoughts reach society and at the same time advocate for the cause of sustainable practices.

World Habitat Day

World Habitat Day is celebrated every year on the first Monday of October. The day holds tremendous significance as it serves as a global platform to focus on the state of our towns and cities and advocates the basic right to provide adequate shelter for all.

It was first initiated by the United Nations in the year 1985. It brings to attention that it is the collective responsibility of the citizens for shaping the urban environments and promoting activities that boost sustainable development along with improving the living conditions overall worldwide.

Every year the UN focuses on a theme that will resonate with the key issues affecting urban development.

The UN-Habitat's Theme 2024: "Engaging Youth to Create a Better Urban Future"

For 2024, the UN has chosen the theme Engaging the Youth to Create a better future. This theme is very important as it highlights the importance of youth that is so critical in shaping the urban futures of tomorrow. As the world continues to make rapid strides in urban development it is even more important the youth bring into fore innovative ideas for a transforming skyline of cities.

As the theme suggests, it encourages the participation of the youth in planning, execution and participation of the urban spaces. By involving the young minds, we not only pave the way for sustainable living but also address the diverse needs, wants and expectations of the citizens.

How is the UN theme important for Contemporary Urban Planning and development

"The youth of today are the leaders of tomorrow."- Nelson Mandela

Today's youths as torch bearers of change

Change begins when the youth of the country strive for it. And today's youth are the torch bearers of change. Why do you think it is so? Today the youth have easy access to information, they are clear about their choices, wants, needs and are empowered to fulfill them. With a plethora of vast information available for them, they can make informed choices, zero down decisions and possess the ability to address the pressing issues the country faces.

They can act as catalysts of change through social media campaigns, community organizations and strive for the changes to create robust solutions for the future.

Addressing Urban Inequalities

The problem of urban inequalities is extremely rampant in mod-



ern cities that ranges from access to housing, employment opportunities, and education. Youth can help address these challenges by bringing in innovative perspectives and fresh approaches that will help tackle these problems.

Creating community friendly environment

Having a harmonious community is extremely important for the progress of a nation. If there are disparities withing the community how can the citizens come together and help tackle the nation's problems. There should be cohesion between the communities. Why is it so important? It is because when young people take active participation in shaping the future of the cities, they are more likely to feel ownership and responsibility towards the environment and its importance. This in turn will lead to building stronger communities where people of all age groups, caste and religion stay together in peace.

The Status of the Youth in INDIA

India is the home ground of one of the largest populations in the world. Among them approximately 65% of them are in the age group below 35. It also represents a significant portion of the widespread population.

According to the recent statistics, the youth of India that is between 15 to 29 is approximately 50% of India's population that roughly translates to around 200 to 350 million people.

So, as you can see this pivotal group is driving India in the economic, social and cultural development overall.

Urban migration is one of the

most common trends in India where the youth from small cities migrate to big cities in search of employment, work life balance and of course an overall improvement in the quality of life. It presents equal work opportunities along with an improved standard of living.

However, it also puts strain on urban infrastructure of the cities, alongside the increased competition for jobs along with strain on residential living standards. This in turn gives rise to crime and thefts that can negatively impact a city's overall development.

The positive impacts of Urbanization

Urbanization of the cities has impacted the lifestyles of the youth that offer both opportunities and challenges. The positive sides of these are access to education, better job opportunities, healthcare facilities etc., in some cases a rise in the disposable incomes.

They are also the grounds for proving the opportunities in innovation, entrepreneurship and allowing the youth to explore new opportunities and avenues.

However, while cities offer numerous opportunities, they are not evenly distributed giving rise to imbalance in wages and job security. It is also the breeding ground for informal economy that absorbs a significant chunk of the workforce, but at times fails to provide the social protection, that leaves the workers in a loop.

The Current state of Education and skills that are relevant to the Urban development of the country

It is no wonder that India has made significant strides in the

upgrading the education system over the past few years. But one cannot ignore the fact that when it comes to education and the skills required for a job there are some glaring instances where there are noticeable gaps involved.

Technical and vocational education and training should be included in every syllabus that aligns with the industry's needs.

Which are the gaps in education that need to be addressed for overcoming the shortfalls

Industry specific practical training

- Soft skills and communication development especially while entering the job sector
- Focusing on sustainability
- Interdisciplinary education and training
- Inclusion of technology

Addressing the issues of Unemployment, underemployment and the imbalance of infrastructure

Despite several opportunities available for urban youth due to urbanization, there remains the missing pieces of puzzles that are unemployment, underemployment and infrastructure problems.

Unemployment remains a highly critical issue especially for the age group of 15 to 29. It is also one of the stark issues the country is facing with no concrete solution to the same. There needs to be adopted a proactive approach for solving the problem of unemployment. We look at the statistics-

According to the DATA by the CMIE (Centre for Monitoring Indian Economy) unemployment stood at 9.2 percent in June 2024 as compared to 7% in May 2024.



What are the social and economic barriers for Youth Engagement in the process of Urban planning?

The lack of representation in the decision-making process is one of the pressing concerns for the Youth. Secondly economic inequality is also one of the main causes of wherein the youth are unable to participate in urban planning and development. Unfortunately, in today's digital world, there are instances where the youth lack access to information that can act as a huge barrier for information, networking and simultaneously for urban planning.

So how can a better future be created for the Urban youth?

It goes without saying that today's youth are at the forefront in making key decisions related to urban planning, innovation, technological advancement etc. With their natural inclination towards digital tools and the optimum use of the latter they are a force to reckon with. The youth with their zeal, enthusiasm and go-getter perspective can contribute significantly to urban planning and development by using the power of big data analytics and the IOT (Internet of Things).

Addressing these barriers headon will solve the problem and create a more inclusive urban planning process. This is possible by integrating urban planning into the school academic curriculum, creating several youth councils that focus on urban planning.

Below we look at some of the successful Youth led start-ups

1. Yulu- A company headquar-

tered in Bangalore; it provides bike-sharing services in urban areas. And the bikes are electric!

- 2. Aarambh- It is non-profit organization based in Mumbai that provides education, vocational skills to the marginalized, underprivileged youth, children and women.
- 3. Ather Energy- In order to reduce air pollution, Ather Energy was established in Bengaluru in the year 2013. It manufactures electric automobiles that drive on AI and IOT.

Sustainability Initiatives by the Youth

It is great to see that the youth today are getting involved in sustainability projects that focus on building greener environments.

More and more youth today are taking sustainability projects and implementing them with an aim to create green environments. They are involved in initiatives such as green building practices and waste management that address environmental challenges.

Below we look at some of the case studies by the youth for sustainability and green environment-

The Green School Project

The KV AFS Akkulam in Kerala has been awarded the Green School Program award for its step towards green initiatives. They have adopted sustainable transportation along with promoting the use of bicycles and electric vehicles. The school follows a recycling concept that manages waste material effectively and promotes healthy soil growth.

Clean Ganga project

The Ganga is more than just a river in India. Having said that it is also one of the most sacred of all rivers. It holds tremendous cultural and spiritual significance. However, in recent years improper waste disposal was at its peak and was posing a major concern. Hence several youths led initiatives were taken up by the community that involved cleaning up the Ganga by the cleanup drives along its riverbank along with several awareness campaigns.

The Ganga initiative forms the very basis of involving the community and involving the youth. Youth Engagement is extremely essential to create sustainable environments and moreover protect the environment.

The importance of the Engagement of the Youth for a Sustainable Future

It is extremely important that today's youth take the lead in creating a Sustainable Future. Young people can bring fresh ideas, perspectives and moreover an innovative approach that can help tackle the contemporary urban challenges.

Youth involvement in urban planning, technology, along with the community Leadership is extremely crucial for creating the base ground for sustainable cities along with a Sustainable Future.

However, all this can be achieved only when the stakeholders, along with government and organizations provide the required support and give an impetus for their future vision. This can be done by investing in youth Leadership by providing



the necessary resources alongside equal opportunities.

Why are youth councils and participation of Government important in urban areas?

Youth councils in the urban areas will provide the necessary platforms for the young population to voice their opinion, to feel head and ultimately act.

It also ensures that the young people have a say in urban planning and leading the way for sustainable initiatives.

What's more the youth councils can serve as advisory models that offer key insight and information on several issues ranging from infrastructure management, education and sustainable development.

It needs to be seen that the participation of youth in these initiatives is highly important and moreover necessary. As they possess the vision, the ability and most important the practical ability to turn the thought process.

Leadership and Youth Engagement

Both Leadership and Youth Engagement are crucial for the development of a sustainable urban future. However, developing the necessary Leadership skills are also important so that they lead the noble cause and have the potential to be the torch bearers of change in the long run. A change that will prove extremely beneficial for the future generations to come.

At the same time organizations can also play a key role in sup-

porting these initiatives. But this is possible only when they have access to resources and most importantly the vision to support this noble cause.

NICMAR

At NICMAR we are extremely proud of the fact that we are focused on supporting sustainable urban development. In the coming years India is going to need industry related professionals that are skilled and possess the abilities to create infrastructure, buildings that support the environment. With campuses across Pan India- Mumbai, Pune, Hyderabad, our curriculum offers specialized expertise in the field of urban planning, infrastructure development, and construction management. We want to create ambitious professionals who will be skilled in solving global challenges with a focus on research and development.

As a Chancellor and President at NICMAR University, I am extremely fortunate to lead this noble cause. I am on a mission to lead this transformation at NICMAR and ensure that our students contribute significantly with their skills and expertise.

It is essential to recognize that the challenges we face today, whether related to urban development, planning, or infrastructure, require an innovative approach.

Our goal is to equip our graduates to drive for change and who will lead sustainable practices in the future.

Contd. from Page 42

leashing the Potential of Urban Growth. United Nations. https:// doi.org/10.18356/fe74b223en

- Matthews, K. (2019, July 21). The Complete 101 Guide to Net-Zero Buildings. Green Building Insider. https://greenbuildinginsider.com/450/complete-101guide-to-net-zero-buildings
- Nations, U. (n.d.). 2018 Revision of World Urbanization Prospects. United Nations; United Nations. Retrieved 18 September 2024, from https://www. un.org/en/desa/2018-revisionworld-urbanization-prospects
- Ragheb, A., El-Shimy, H., & Ragheb, G. (2016). Green Architecture: A Concept of Sustainability. Procedia - Social and Behavioral Sciences, 216, 778– 787. https://doi.org/10.1016/j. sbspro.2015.12.075
- Singh, A., & Gupta, K. (2021). AN OVERVIEW OF THE GREEN BUILDING CONSTRUCTION IN INDIA. International Journal of Engineering Applied Sciences and Technology, 6(2). https:// doi.org/10.33564/IJEAST.2021. v06i02.022



Empowering the Youth to Transform the Urban Landscape Through Systems Thinking





Divya Davis^{*}



Sarah Khan^{*}

Kunal Jagdale

rbanisation is reshaping human settlements at an unprecedented pace, creating a complex interplay of identities, cultural practices, resources, and values within urban spaces. As India progresses towards becoming a developed nation, it is vital to ensure that every citizen enjoys a dignified life amidst this transformation. Currently, Indian cities are under tremendous pressure to accommodate the growing demands of the urban population. Addressing the challenge of resources scarcity is critical, especially as housing shortages intensify. In 2018, India faced a housing deficit of 29 million units, according to the Indian Council for Research on International Economic Relations (Roy & ML, 2020). Thus, housing emerges as a crucial focus area for this decade, and how we tackle this crisis will shape the future of our urban environments.

Urban planning and sustainable cities

Cities are complex ecosystems where factors like resource availability, waste management, and infrastructural connectivity influence growth. While urban planning must take these into account, it is essential to position housing at the center of the urban system. Housing connects various sectors-from infrastructure to social well-being—and serves as the foundation for inclusive urban development. As migration to cities continues to rise, the strain on housing markets is mounting, leading to substandard housing conditions that increase vulnerabilities. Inadequate housing exposes residents to health risks and extreme weather, and diminishes the overall quality of life. Access to affordable and adequate housing is not only a basic need, but also a social right that indicates how inclusive and equitable a city is. Marginalised communities residing in urban areas usually bear the major brunt of social and economic inequalities, which are often reflected in stark housing disparities (gated communities and slums).

Towards addressing these issues, the Indian government launched the Pradhan Mantri Awas Yojana Urban (PMAY-U) in 2015, a scheme aimed at achieving the goal of 'housing for all'. The scheme targets the urban poor and middle class by providing good quality, affordable housing, with a mission to build 1 crore houses in the next 5 years. By combining financial assistance with innovative technologies and building practices, PMAY-U aims to create inclusive and sustainable housing solutions for Indian cities (Press Information Bureau, 2024).

The United Nations Sustainable Development Goal (SDG) 11 identifies sustainable cities and communities as essential for ensuring a prosperous future (United Nations, n.d.). Youth must be at the forefront of this transformation, advocating for equitable, inclusive, and sustainable urban policies. Their activism on issues like climate change is already prompting shifts toward more sustainable urban development practices. While government-led urban development strategies such as the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart City Mission (SCM) are underway to modernise urban areas, they can be enhanced through the active engagement of local communities, especially the youth. Cities attract

^{*} Center for Study of Science, Technology and Policy (CSTEP)



the youth by offering numerous employment opportunities. The significant concentration of youth in urban areas allows for engaging them deeply in redesigning cities. By harnessing the power of its youth, India can craft solutions to transform its cities into socially inclusive hubs of economic and environmental prosperity.

Youth as catalysts for urban transformation

With 66% of its total population under 35 years of age, India has one of the largest young population in the world today (Young Voices, 2023). India can leverage the potential of this valuable asset to build sustainable cites. The techsavvy youth, with critical thinking skills and innovation potential, are well equipped to deal with the challenges of urban living and generate a new wave of sustainable practices.

The youth's potential to influence urban development can be further strengthened through policies and initiatives that foster skill development and entrepreneurial spirit. The support provided to the youth through initiatives like Startup India and Atal Innovation Mission (AIM) has resulted in social start-ups which are not just businesses, but can act as catalysts for social change, addressing some of the urgent social and environmental challenges in urban areas. Similarly, the Youth Co:Lab National Innovation Dialogue India is an annual flagship event that showcases and supports initiatives aimed at empowering the youth. It highlights the importance of investing in youth to help them lead and advance the Sustainable Development Goals (SDGs) by enhancing their leadership, social innovation, and entrepreneurship skills. Further, programmes like the Youth for Gov-

ernance (Y4G) Fellowship – Mysuru 2024, a collaboration between Grassroots Research and Advocacy Movement (GRAAM), Participatory Research in Asia (PRIA), and the Hanns Seidel Foundation (HSF) India, aim to empower Mysuru's youth to actively participate in governance (GRAAM India, 2023). Such programmes can provide capacity building for the youth to contribute to sustainable and inclusive urban development. Additionally, youth involvement in community development projects like the Swachh Bharat Mission and SCM, as well as in environmental conservation efforts under the Green India Mission, can enable them to drive positive change and create a more sustainable urban environment.

To effectively build skills, support businesses, and drive economic growth, youth need a thorough understanding of the urban landscape and its complex interlinkages. As urban challenges evolve and intensify, developing an integrated understanding of the urban ecosystem becomes increasingly vital. This presents both significant opportunities and formidable challenges for the youth. Systems thinking offers a valuable framework in this regard, providing a holistic approach to grasp the dynamics and interconnections between various sectors. By applying systems thinking, decision-makers can design more informed and sustainable solutions, considering a range of factors that impact urban outcomes. This method of problem-solving opens new possibilities for the youth to transform the ways for creating a resilient and sustainable urban environment.

Systems thinking as a tool for youth-driven decision-making

Involving the youth in decisionmaking processes is essential, as it is they who will experience the outcomes of today's choices. As an approach, systems thinking looks at systems holistically, capturing interlinkages and dynamics, and identifying feedback loops via causal loop diagrams, that enable us to model and analyse complex systems. It provides a robust framework for the youth to understand and influence complex urban systems, positioning them as key players in the sustainable development journey. By identifying the interlinkages and feedback loops, the youth can gain crucial insights into how various elements of urban ecosystems interact and evolve over time. This knowledge would empower them to shape decisions, advocate for impactful solutions, and contribute to building resilient and thriving communities.

Core Components of Systems Thinking

These collectively offer a comprehensive view of how different elements within a system interact and change over time.

Feedback and Causal Loops

Causal Loops: These are diagrams that present the causeand-effect relationships within a system, illustrating how changes in one part of a system affects the others. They thus help to visualise how different system elements are interconnected and how they influence each other.

Feedback Loops: These are diagrammatic representations of how the output of a system influences its own input, creating cycles of reinforcement or balance. They



are of two types: positive feedback loops (reinforcing) and negative feedback loops (balancing).

Positive Feedback Loops: As more people move to suburban areas, demand for new housing and services there rises. This drives infrastructure development, which attracts more residents, continuing the cycle of growth. Such loops offer an understanding of how initial advantages or trends can create self-reinforcing cycles of expansion. By recognising and leveraging such dynamics, the youth can drive initiatives that build on initial successes to achieve greater impact.

Negative Feedback Loops: An increase in population raises the housing demand, leading to more construction activities. However, limited resources initially slow down construction. As the supply of resources increases, construction accelerates, catching up with demand. Due to this, eventually the market reaches a balance between the demand and supply of houses for the urban population (CSTEP, 2024). This demonstrates how systems self-regulate to maintain stability. The youth can incorporate this understanding to manage resources and advocate for strategies that balance growth with sustainability, preventing issues like overdevelopment or resource depletion.

A sound understanding of feedback and causal loops provides a holistic view of urban systems. Causal loops help to map out interactions and effects within a system, while feedback loops show how these interactions create cycles of change. Figure 1 shows a simplified causal loop diagram of an urban ecosystem, visually representing the key feedback loops and causal



Figure 1 Simplified causal loop diagram of urban ecosystem dynamics

relationships that drive the dynamics of urban growth, infrastructure development, and land use.

By analysing the interdependent relationships between housing, transport, industry, land use, and public services, the youth can gain a holistic view of how changes in one aspect of the city ripple through other sectors, influencing everything from economic development to environmental sustainability. This knowledge equips them to actively engage in urban activism, advocating for sustainable solutions to pressing challenges. For instance, youth can promote the use of cycles and public transport, push for adopting alternative building material and technology choices that are less energy-intensive and provide better thermal comfort, and become more responsible with resource use, thus steering the cities away from unsustainable practices.

Systems thinking can empower the youth to participate in climate change conversations, enabling them to model the impacts of urban policies on carbon emissions and energy consumption, and eventually to push for lowcarbon, climate-resilient pathways. Through the comprehensive understanding provided by systems thinking, the youth can foster innovation, identifying key leverage points within urban systems where small interventions can lead to significant improvements in the quality of life and ultimately help in achieving sustainability. Their involvement in participatory urban planning can contribute to the formulation of balanced policies that enhance urban infrastructure, mitigate traffic congestion, and promote sustainable growth. Figure 2 illustrates the positive role youth can play in an urban ecosystem.

Challenges and opportunities in incorporating systems thinking

There are several challenges in incorporating systems thinking, the first one being a lack of awareness among the youth and the general public about this approach. Despite its effectiveness in addressing complex problems, systems thinking is relatively unknown and, thus, underutilised. Many educational systems do not





Figure 2: Youth participation in shaping the urban ecosystem

emphasise interdisciplinary approaches like systems thinking, resulting in limited awareness and inadequate training. Students may lack interest in pursuing systems thinking due to unclear academic rewards or career opportunities. So, without strong institutional or employer support, the youth are less likely to engage with it.

However, despite these challenges, the opportunities for incorporating systems thinking for deeper youth engagement and participative decision-making processes are significant. The knowledge gap can be addressed by introducing systems thinking into academic programmes across disciplines such as pure sciences, economics, and environmental sciences. Programmes/courses in systems thinking, such as those offered by the Massachusetts Institute of Technology's (MIT) Sloan School of Management (MIT Management Sloan School, n.d.), can serve as models for other institutions globally. Further, short-term training programmes, certifications, and workshops—especially through online learning models like massive open online courses (MOOC)—can raise awareness and equip the youth with the essential skills.

A mindset shift towards systems thinking can also be fostered by highlighting success stories of using it effectively to address real-world challenges, and in climate action and urban planning. For instance, the United Kingdom (UK) government employed systems thinking to forecast the employment impacts of various economic policies (Swanson, 2020), allowing for more informed decision-making. Additionally, the UK's use of systems thinking for its COVID-19 response planning showcases its relevance in tackling pressing global challenges (George et al., 2023). Governments can advance systems thinking by adopting it in policy formulation, setting a precedent for educational institutions and inspiring the youth to explore its potential.

Collaborations between think tanks and educational institutions

present another significant opportunity to boost systems thinking by equipping students with tools, models, and learning experiences. These partnerships can create a bridge between academic learning and practical policy work, allowing students to apply theoretical knowledge in addressing complex societal challenges like climate change, urban development, and sustainable resource management. For example, the Centre for Study of Science, Technology and Policy (CSTEP)—a think tank in India—has developed the Sustainable Alternatives Futures for India (SAFARI) model (CSTEP, 2020; Kumar et al., 2021), using systems thinking and integrating the key economic sectors to explore various low-carbon pathways to support India's transition to a net-zero future. Through collaborations with educational institutions, think tanks can offer students hands-on training on such models, enabling them to simulate and analyse different interventions and their impact on the environment.

Conclusion

In today's rapidly urbanising world, cities are at the forefront of both opportunities and challenges. Urban environments are evolving into complex ecosystems where issues like housing shortages, infrastructural pressure, resource scarcity, and environmental degradation are becoming increasingly intertwined. In India, where urbanisation is accelerating, the manner in which cities evolve will shape the quality of life for generations to come. This warrants actively involving the youth—the primary stakeholders who will inherit the future—in today's decision-making process.



Systems thinking embodies a powerful approach for addressing the urban challenges. By providing a framework that allows for a deeper understanding of the interconnectedness within urban systems, and by modelling the cause-and-effect relationships that determine urban growth, resource management, and infrastructure development, it enables a holistic view of how cities function and evolve over time. For the youth, in particular, it can be a transformative tool as they will live through the outcomes of today's urban policies and planning. Systems thinking not only equips them with the ability to analyse these complex urban systems but also empowers them to actively participate in shaping the solutions.

Using the systems thinking framework/approach, the youth can advocate for balancing growth with environmental and social needs, and can inform and drive policies that promote long-term sustainability. As cities continue to grow and evolve, it is crucial to empower the youth with the skills and tools to navigate the complexities of urban living, while also equipping them with a comprehensive understanding of the intricacies of the various elements of an urban system, so that they can play an active role in reshaping the urban futures to make them both inclusive and sustainable.

It is evident that involving the youth as key participants in governance is crucial for bringing about a transformative impact. Given that systems thinking is a powerful tool for readying the youth to play this role well, it must be advanced within educational and policy frameworks. The median age of India's population is around 28 years, giving it a significant demographic advantage, which can be utilised to foster a sustainable and inclusive future. A strategic emphasis on systems thinking that equips and engages its large youth population meaningfully in participative decision-making and sustainable development efforts can enable India to become a global leader in these areas.

The authors work in the climate change mitigation team of the Climate, Environment and Sustainability sector at the Center for Study of Science, Technology and Policy (CSTEP), a research-based think tank.

References

- Center for Study of Science, Technology and Policy. (2020). SAFARI
 Sustainable alternative futures for India. https://safari.cstep.in/ safari/#/
- Center for Study of Science, Technology and Policy. (2024).
 Pathways to steer India's buildings sector towards a net-zero future. https://cstep.in/drupal/ sites/default/files/2024-03/ Pathways%20to%20Steer%20 India%E2%80%99s%20Buildings%20Sector%20Towards%20 a%20Net-Zero%20Future.pdf
- George, A., Lacey, P., Badrinath, P., Gray, A., Turner, P., Harwood, C., & Gregson, M. (2023). Planning for healthcare services during the COVID-19 pandemic in the Southeast of England: A system dynamics modelling approach. Pub Med. https://doi.org/10.1136/ bmjopen-2023-072975
- Grassroots Research and Advocacy Movement India. (2023, October 6). Youth for governance fellowship. https://graam. org.in/blog/youth-for-governance-fellowship#:~:text=To%20

bring%20the%20same%20 philosophy,to%20be%20 agents%20of%20change.

- Kumar, P., Natarajan, R., & Ashok, K. (2021). Sustainable alternative futures for urban India: The resource, energy, and emissions implications of urban form scenarios. Environmental Research: Infrastructure and Sustainability, 1(1), 011004. https:// doi.org/10.1088/2634-4505/ ac048e
- Massachusetts Institute of Technology Management Sloan School. (n.d.). Courses and programs—System dynamics [Online post]. https://mitsloan.mit.edu/ faculty/academic-groups/systemdynamics/courses-and-programs
- Press Information Bureau. (2024, August 10). Pradhan Mantri Awas Yojana-Urban 2.0: A step towards inclusive urban development [Press release]. https://pib. gov.in/PressNoteDetails.aspx? NoteId=152011&ModuleId=3
- Roy, D., & ML, M. (2020). Housing for India's low-income urban households: A demand perspective. Indian Council for Research on International Economic Relations. https://icrier.org/pdf/Working_Paper_402.pdf
- Swanson, J. (2020). UK Government Uses System Dynamics to Forecast Employment Impact. https://systemdynamics.org/ urban-dynamics/
- United Nations. (n.d.). Goal 11: Make cities inclusive, safe, resilient and sustainable. https://sdgs. un.org/goals/goal11
- Young Voices. (2023, August 2). National Youth Policy—Will it help India reap the promised demographic dividend?. Expert Speak. https://www.orfonline. org/expert-speak/national-youthpolicy

Engaging youth to create a better urban future



Deepak Bansal

ndia is the most populous country in the world, with a population of about 145 Cr (1.45 billion) people and India has the largest number of people in the working category, who have many skill sets (unskilled, semi skilled, skilled and highly skilled in various categories). About 65% of Indian population is below the age of 35 years and youth in the age of 15-29 years are about 27.5% in the Indian population. The contribution of youths in Indian GNP is about 34% and continuously rising, which is very significant. Youth not only provide for economic development of any country, but also provide for good citizenship, environmental consciousness, technological advancements, innovations, social intuitiveness, entrepreneurship, disaster preparedness, inclusivity, social harmony, society leadership, social causes championship, sustainability, diversity, freedom of speech, circular economy, new Ideas, etc. So having more population is not a disadvantage but is a blessing in disguise, as working population is shrinking in many countries, whereas this is increasing in India, resulting in more working man power means more development and more prosperity.

Urbanization is increasing in

India, which is at present estimated to be about 30% and expected to reach to about 40% by the year 2030, which is creating tremendous potentials for jobs availability and entrepreneurship in urban areas, which not only a boon to develop related skills sets in youths as cities are engines of growth. The economic activities in cities are much higher than in rural areas. India is shifting from being an agrarian state to manufacturing hub, IT services providers, manufacturing hub, service sector oriented, renewable energy developer, export oriented country, etc., and a giant in make in India products. People of Indian origin are heading many fortune 500 companies and are holding top positions in many countries. Now, India is a major superpower and is the fifth largest economy in the world with the aim to become third largest economy in the world soon. The growth of the Indian GDP is the highest (about 7%) in the world in spite of many internal factors.

Skill development is an important parameter to achieve SDG 8 (Sustainable Development Goals) in developing countries. Massive programs for skill developments are taking place in India to sustain and increase its economic development, which is the fastest in the world. There are many such programs at central and state level to achieve it. The total numbers of such program currently running in India are about 75, which are also the highest in any country in the world. Skill development has several advantages as it makes youth employable, able to contribute in economy, increase in self esteem and in nation building. Those with technical knowledge are much more in demand and likely to find good & lucrative jobs. As with changing technical scenario, where menial jobs are decreasing and skilled & super skilled jobs are increasing due to advent of modern technologies/machines like 3D printing, AI (Artificial intelligence), ML (Machine Learning), Quantum Computing, etc., where machines are being made more intelligent to replace menial labors and to some extent perform task done by semi skilled labors also. The requirement of very specialized skill is increasing in all walks of life due to development and uses of cutting edge technology in almost all the sectors. Construction sector is not aloof of this trend, as earlier construction of buildings used to take months and years to complete, now buildings are getting completed in couple of hours due to better planning, coordination, prefabrication and using cutting edge technology. Various new construction materials and construction techniques have also being used in construction sector resulting in speed, economy in construction and sustainability along with better Life Cycle experiences. In India, many light houses demonstration projects have been successfully launched and they have delivered houses with new materials and technology in less time. The Life cycle assessment and users experiences of these houses have to be seen in due course of time.

Since, we are working in built environment; we have experienced many failed and weak infrastructures in many cities/urban areas, where there is a chaotic condition on the front of water, sanitation, solid waste management, traffic, parking, pollution, over crowdedness, dilapidated structures and ineffective civic facilities. There are no public spaces in cities, and wherever these spaces are available, these have been encroached upon by squatters. We have to make our urban areas more livable, healthy, inclusive, resilience and sustainable by giving equal opportunities to all residents. Nobel laureate, Malala Yousufzai, one remarked "one child, one teacher, one book and one pen can change the world'. The youth process the capacity to start dialogues, challenge the status quo and lead transformation in a sustainable way. Further, Dr A P J Abdul Kalam had said "Dream Dream and Dream". Dream transform into thoughts and thoughts results in action. Hence now youths can be trained, motivated and deployed in the development of nation to create better future for all. Dr Kalam also gave a concept called "PURA" Providing urban amenities in rural areas, so that rural areas can also be developed and migration from rural areas to urban areas can be stopped/minimized. This will help in removing social & economic disparities and will provide equal opportunities to all people. Mn-REGA (Mahatma Gandhi National Rural Employment Guarantee program) has helped in bridging this gap to certain extent and rural areas are also being provided with basic facilities like community centers, banks, hospitals, schools, roads, drains, electricity, water and sanitations and skill developments opportunities. The migration from rural to urban has been positively affected due to this program.

Construction sector require massive amount of fossil fuel based primary energy (as presently most of the energy is produced from fossil fuels), which is estimated to be around 30% and construction sector uses 16% of potable water globally and this sector emits lots of GHGs (Green House Gases) at around 30-40% globally, resulting in global warming and is responsible for change in climate. The global temperature is rising due to emission of GHGs and it is believed that if concentration of GHGs reaches more than 450 ppm in atmosphere, the global temperature will rise by more than 2 degree from pre-industrialization era, and the changes that will happen then, will be irreversible and disastrous. This trend of development is a grave threat to our survival as we are already experiencing extreme weather conditions and related events like failures of crops, decrease in manpower outputs, diseases, early deaths, excess/



deficient rains, severe heat/cold conditions, melting of glaciers and flooding/droughts, cloud bursts, landslides, subsidence and submergence of low lying areas due to increase in water level in seas/ oceans. Countries like Maldives, Mauritius, etc., will not exist in near future if the same trend of development continues.

Youth must act now and they should become a part in finding innovative & new solutions to stop this unsustainable development by inclusive & resilient development, in which local recourses are used locally with minimal uses of primary energy and with more renewable energy based development, which will result in less social & environmental adverse impact of the physical development. Ample skill development program are available in the country to give them training in the area of their choice and having demands so that they can be gainfully employed in the sector. Lots of opportunities are available in service sector, start up, entrepreneurships, manufacturing, consulting and many new types of business are coming up. We must follow circular economy and reduce, reuse and recycle all the materials for better energy and resources management. India is very fortunate that with the current strength of youths and growth in GDP, India can gainfully employ its youth in nation buildings and sustain/increase in GDP growth to become third largest economy soon. India is expected to be a develop nation before year 2047 and will be a super power on the basis of its large and talented youth power.

🎯 bmlpc

Augmenting the Alternative Aggregates Utilisation in Sustainable Construction



Anchal Aggarwal¹



S. K. Singh²

bstract The construction industry is one of the largest consumers of natural resources, leading to significant environmental impacts such as resource depletion, habitat destruction, and greenhouse gas emissions. Sustainable construction gains importance in using alternative materials, including industrial rejects in construction. This article explores the value addition in alternative aggregates sourced from industry and others, including slags, construction and demolition (C&D), rubber, ceramic, and plastic waste. Various studies using alternative aggregates in concrete have shown the potential benefits of enhanced concrete properties, reducing environmental impacts and contributing to the circular economy. The incorporation of these materials in the production of concrete not only helps in waste management but also helps in sustainable alternatives to conventional construction materials. However, several key requirements must be addressed

to ensure widespread adoption and efficacy. Alternative aggregates must meet or exceed the established mechanical performance criteria, particularly in terms of strength and durability and longterm behaviour under various environmental conditions. The properties need to be thoroughly evaluated along with development mixture optimisation guidelines. The life cycle assessments must quantify net environmental benefits and economic viability through cost-benefit analyses, efficient processing techniques, and supply chain models to ensure consistent quality and availability at the commercial scale.

Keywords

Alternative aggregates, Industry rejects, Sustainable construction, Waste management

1. Introduction

The global construction industry is a major driver of economic growth, but it also poses significant environmental challenges. The extraction and processing of natural aggregates contribute to resource depletion, energy consumption, and greenhouse gas emissions [1]. As the demand for construction materials continues to rise, there is an urgent need to identify sustainable alternatives that can reduce construction activities' environmental footprint [2]. One promising approach is the use of industrial rejects as aggregates in construction. Industrial by-products such as iron and steel slag, copper slag, and C&D waste offer a sustainable alternative to natural resources. The annual generation and utilisation of wastes from C&D and industries in India are shown in Fig. 1. These materials, often considered waste, can be processed and utilised in construction while reducing the need for virgin materials [3]. The utilisation of these materials aligns with the principles of the circular economy, promoting resource efficiency and waste minimisation.

This article discusses the value addition in aggregates sourced from industrial rejects, highlight-

2 Chief Scientist, CSIR-Central Building Research Institute, Roorkee-247667, Uttarakhand; E-mail: sksingh_cbri@yahoo.co.in

¹ Research Scholar, CSIR-Central Building Research Institute, Roorkee-247667







ing their potential benefits in sustainable construction. The discussion includes an analysis of these materials' physical and chemical properties, their impact on performance, and their environmental advantages. This article also highlights the challenges in adopting alternative aggregates, which could help future researchers resolve the critical problems in sustainable construction.

2. Reclaimed Alternative Aggregates

The repurposed aggregates derived from construction, demolition, and industrial by-products as illustrated in Fig. 2 present a gamechanging, resource- efficient solution to natural aggregates. Integrating these reclaimed materials into the construction matrix facilitates environmental impact and making them viable and eco-friendly choice for diverse architectural and infrastructural applications. This section explores key alternative aggregates that generate substantial solid waste, including their production processes, applications in construction, and the potential drawbacks associated with improper use.

2.1 Steel Slag

Steel slag, an industrial byproduct, is generated during steel production. Approximately 180-250 million tonnes of steel slag are generated annually worldwide [4]. To manage the legacy slag, researchers have explored its possible utilisation as an alternative aggregate in construction. The slag utility offers several advantages, including improved mechanical properties, such as higher compressive strength and durability, due to the material's high density and angular texture [5-7]. Steel slag also enhances the concrete's resistance to abrasion, freezethaw cycles, and chemical attack, making it suitable for use in harsh environments [8-10]. Additionally, using steel slag in construction contributes to repurposing waste, reducing the demand for natural aggregates, and diverting slag from

landfills.

However, the use of steel slag in construction is challenging. One of the primary concerns is its potential issues of volumetric expansion due to the presence of free lime (f-CaO) and magnesia (f-MgO), which can react with water and cause cracking if not stabilised adequately through ageing [11-12]. Moreover, the variability in the chemical composition of steel slag, depending on the steel production process, can lead to inconsistent construction performance, particularly in concrete applications. Despite these drawbacks, recent studies have shown that steel slag can be converted as a viable aggregate in road construction and marine applications with proper processing and quality control. However, the inconsistent performance and the expansion risks associated with slag have limited its widespread adoption. Environmental concerns regarding the potential leaching of traces of heavy metals have also contributed to its limited use in certain regions [13-14]. However, masking effects can significantly reduce these challenges in concrete applications. As a result, while steel slag shows excellent potential as a sustainable aggregate in construction, its full utilisation remains constrained by these technical and environmental challenges.

2.2 Blast Furnace slag / Iron slag

Blast furnace slag or iron sag is obtained from the iron manufacturing process. Approximately 250-300 million tonnes of iron slag are generated annually worldwide [4]. This has been widely studied as an aggregate in cement, concrete and road construction applications. When used as iron slag aggregates,



particularly in its air-cooled form, it improves concrete properties, such as enhanced durability, reduced permeability, and better resistance to chemical attacks. Its pozzolanic nature, especially when ground to a fine powder (granulated blast furnace slag), helps improve longterm strength and reduces the cement content in concrete mixes, lowering the carbon footprint of construction activities [15]. Additionally, using blast furnace slag as aggregate promotes sustainability by recycling industrial waste and reducing the dependence on natural aggregates, leading to resource conservation and waste minimisation [16-17].

Despite these benefits, several challenges have limited the full utilisation of blast furnace slag as an aggregate in concrete. One of the main issues is the variability in its physical and chemical properties, which can affect the consistency and performance of concrete [18]. The availability of high-quality slag that meets the necessary standards for use in construction can also be inconsistent, depending on the steel production process and the specific properties of the slag produced. Furthermore, there are concerns about the potential leaching of substances from slag aggregates, which could pose environmental risks, especially in sensitive ecosystems. Recent research has focused on addressing these challenges through improved processing techniques and quality control measures. However, the additional costs and technical complexities associated with these measures, as well as concerns about long-term durability and environmental impact, have prevented the widespread adoption of blast furnace slag as a primary

aggregate in concrete.

2.3 Copper Slag

Copper slag, a by-product of copper smelting, has a global production of approximately 40 million tonnes annually [19]. Copper slag has been investigated as an alternative aggregate in concrete due to its promising properties. It offers several advantages, including high density and hardness, which contribute to the production of durable, high-strength concrete [20-21]. Copper slag's angular particles enhance the interlocking of aggregates within the concrete mix, improving its mechanical properties [22]. Additionally, its use in concrete supports sustainable construction by repurposing industrial waste, reducing the demand for natural aggregates, and minimising the environmental impact of copper slag disposal.

However, the full utilisation of copper slag as an aggregate in concrete is hindered by several challenges. One of the primary concerns is its high specific gravity, which can increase the concrete's weight, potentially limiting its use in applications where weight is a critical factor [23]. Moreover, copper slag can contain traces of heavy metals, raising concerns about leaching and potential environmental contamination. Variability in the chemical composition of copper slag, depending on the source and smelting process, can also affect its performance in concrete, making quality control essential. Recent research has focused on mitigating these issues, such as optimising mix designs and conducting long-term durability studies. Despite these efforts, the environmental concerns, potential health risks, and the need for stringent quality control have limited the widespread adoption of copper slag as a primary aggregate in concrete, particularly in regions with strict environmental regulations.

2.4 Construction and Demolition (C&D) Waste

C&D waste includes concrete, bricks, tiles, and asphalt from demolished infrastructure. C&D waste is one of the largest waste streams, with an estimated 2-3 billion tonnes generated globally yearly [24]. This waste has been explored as an aggregate in new concrete to promote sustainability and resource efficiency. Utilising C&D waste in concrete can significantly reduce the environmental impact of construction activities. Additionally, using recycled C&D waste can be cost-effective, especially in urban areas where construction activities generate large amounts of debris and the supply of natural aggregates may be limited.

However, the full utilisation of C&D waste as an aggregate in concrete is constrained by several challenges. One of the primary issues is the variability in the quality and composition of C&D waste, which can include contaminants like wood, glass, gypsum, and other debris [25]. These contaminants can negatively impact the performance of the concrete, leading to reduced strength, increased porosity, and lower durability. Furthermore, C&D waste often contains old mortar or residual cement, which can result in higher water absorption and lower density, making the concrete more prone to shrinkage and cracking [26-28]. Recent research has focused on improving the processing and sorting of C&D waste to enhance the quality of the recycled aggregates and optimising mix



designs to address the material's shortcomings. Despite these advances, the perceived lower quality and inconsistent performance of C&D waste aggregates and the lack of standardised regulations and quality assurance processes have limited their widespread adoption in concrete, particularly in structural applications where high strength and durability are critical.

2.5 Plastic Waste

Plastic debris is a substantial solid waste that substantially impacts the environment worldwide. The world produces over 400 million tonnes of plastic annually, with approximately 40% ending up in landfills or the environment [24]. Shredded plastic waste (polyethene, polypropylene) can replace up to 10-15% of fine aggregates (sand) in concrete without negatively affecting the material's structural integrity [29]. Plastic waste, a significant environmental concern due to its non-biodegradable nature, has been studied as an alternative concrete aggregate to address waste reduction and sustainable construction goals. Incorporating plastic waste into concrete can help mitigate the growing plastic pollution crisis by diverting waste from landfills and oceans while reducing the demand for natural aggregates. Some research indicates that plastic-modified concrete can offer benefits such as reduced weight, improved impact resistance, and enhanced thermal and acoustic insulation, making it suitable for specific applications like lightweight structures and nonload-bearing components [30].

However, the full utilisation of plastic waste as an aggregate in concrete is hindered by several challenges. One major issue is the reduction in mechanical strength; plastic aggregates are less rigid and do not bond well with the cement matrix, leading to weaker concrete with lower compressive strength. This can limit its use in structural applications. Additionally, the variability in plastic waste types and quality can result in inconsistent performance, making standardisation difficult. There are also concerns about the longterm durability of plastic-modified concrete and the potential for micro-plastic pollution during the concrete's lifecycle. Despite ongoing research to improve the compatibility of plastic with concrete, such as through surface treatments or blending with other materials, these challenges have prevented the widespread adoption of plastic waste as a primary aggregate in concrete. Moreover, the need for clear regulatory guidelines and standards for using plastic waste in concrete limits its broader application in the construction industry.

2.6 Rubber Crumbs

Rubber crumbs are derived from recycled tyres. Over 1.5 billion tyres are discarded annually worldwide, producing more than 17 million tonnes of waste rubber [31]. Rubber crumb has been explored as an alternative aggregate in concrete to address environmental and engineering challenges. Rubber crumb waste in concrete can improve specific properties, such as enhanced flexibility, increased impact resistance, and better damping of vibrations, making it particularly suitable for applications like pavements, sports surfaces, and structures requiring shock absorption. Additionally, using rubber crumbs in concrete helps divert large volumes of tyres from landfills, reducing waste and promoting sustainable construction practices [32-34].

However, the widespread utilisation of rubber crumbs in concrete is limited by several drawbacks. One of the primary concerns is the significant reduction in compressive strength when rubber replaces natural aggregates, as rubber's softer, more elastic nature leads to a weaker concrete matrix. This strength reduction restricts the use of rubber-modified concrete in load-bearing or structural applications [35]. Additionally, the non-binding nature of rubber with cement can result in poor interfacial adhesion, further compromising the mechanical properties of the concrete. Another area for improvement is the variability in the size and quality of rubber particles, which can lead to inconsistent performance. While recent research has focused on optimising mix designs and improving the surface treatment of rubber particles to enhance their compatibility with concrete, these solutions often involve additional costs and technical complexities [36]. Furthermore, the need for standardised guidelines and concerns about rubber-modified concrete's long-term durability and environmental impact has also prevented widespread adoption in the construction industry.

2.7 Marble Waste

Marble waste is obtained from marble processing and cutting. The global marble production is estimated to be around 55-60 million tonnes per year [37]. The leading marble producers are China, India, Turkey, Italy, and Spain, which account for over 70% of the world's marble production [38]. Marble



waste presents a promising opportunity for use as an aggregate in concrete. Its utilisation offers several benefits. Marble waste can enhance the aesthetic appeal of concrete due to its bright, white colour. It can improve the mechanical properties of concrete, such as compressive strength and durability when used in appropriate proportions. Additionally, using marble waste in concrete helps recycle industrial by-products, reducing the environmental impact of waste disposal.

However, there are notable drawbacks that have limited its widespread adoption. One significant issue is the potential for increased water absorption due to the porous nature of marble waste, which can affect the water-cement ratio and reduce concrete strength if not adequately managed [39]. Additionally, marble waste aggregates can be more expensive compared to traditional aggregates due to the processing costs involved [40]. Recent research has focused on optimising the mix design and processing methods to address these challenges, such as blending marble waste with other materials to mitigate its impact on concrete performance. Despite these advances, the higher costs and specific handling requirements continue to hinder its full-scale utilisation in the concrete industry.

2.8 Ceramic Waste

Ceramic waste includes byproducts from the manufacturing of tiles, porcelain, and other ceramic products. Global ceramic production is estimated to generate approximately 30-50 million tonnes of ceramic waste annually [41]. The largest ceramics producers are China, India, Brazil, Vietnam, Spain, and Italy, accounting for a significant share of global production. For example, China alone produces over 60% of the world's ceramic tiles [42]. This is increasingly being considered as an alternative aggregate in concrete. The use of ceramic waste offers several advantages. It can improve the durability and hardness of concrete due to its high compressive strength and low water absorption. Additionally, incorporating ceramic waste helps recycle industrial byproducts, reduce landfill use, and reduce the environmental impact associated with waste disposal. Using ceramic waste can also enhance the aesthetic appeal of concrete with its varied textures and colours.

However, several challenges limit its full utilisation. One major issue is the high brittleness of ceramic waste, which can lead to reduced tensile strength and potential issues with cracking in concrete [43]. The irregular and sharp edges of ceramic fragments can affect the workability and mix consistency. Furthermore, the variability in the chemical composition of ceramic waste can lead to inconsistent performance in concrete, and there may be concerns about the potential leaching of harmful substances. Recent research has been focused on overcoming these challenges by developing methods to process and treat ceramic waste to improve its compatibility and performance in concrete [44-45]. Despite these efforts, the challenges related to brittleness, workability, and variability continue to obstruct its widespread adoption in the concrete industry.

3. Barriers and Challenges

The utilisation of alternative aggregates derived from industrial by-products in construction production faces a multifaceted array



Fig. 2: Alternative aggregates from industry rejects







of challenges that impede widespread adoption. The inherent variability in the physicochemical properties of these materials presents a significant obstacle to consistent quality control, potentially compromising the mechanical performance and durability of resultant applications. This technical uncertainty is further exacerbated by a dearth of long-term performance data and standardised specifications, fostering a conservative stance within the construction industry. The economic viability of these alternatives is often undermined by elevated processing and transportation costs, while regulatory frameworks need help to keep pace with material innovations. Environmental concerns persist regarding the potential leaching of deleterious substances and the carbon footprint associated with processing. Moreover, integrating these aggregates necessitates specialised processing techniques and equipment, adding layers of complexity to an already intricate production process. These barriers collectively contribute to a

reluctance in industry adoption, as demonstrated in Fig. 3, despite the potential sustainability benefits, underscoring the need for comprehensive research and policy interventions to bridge the gap between theoretical promise and practical implementation.

4. Conclusion

Utilising non-conventional aggregates derived from industrial byproducts and others has garnered significant attention in sustainable construction. These secondary raw materials offer potential benefits in terms of waste diversion, natural resource conservation, and enhanced cementitious composite properties, including improved durability, impact resistance, and chemical inertness. However, the widespread implementation of these alternative aggregates faces substantial impediments, including compromised mechanical strength, variable chemical compositions, potential environmental leachates, and challenges in standardisation and quality assurance protocols. While ongoing research endeavours aim to optimise the beneficiation and performance of these materials in cementitious matrices, factors such as economic viability, regulatory constraints, and technical complexities have hindered their integration into mainstream construction practices. Consequently, the application of most alternative aggregates remains limited, predominantly confined to non-load-bearing or specialised applications rather than serving as direct substitutes for conventional aggregates in high-performance or critical infrastructure projects. Therefore, there is an urgent need to modify the code provisions stipulated in IS 383-2016 [46] for applications of processed aggregates from industrial by-products and C&D waste in construction.

Acknowledgement

The authors are grateful to the CSIR-CBRI for granting the permission to publish this work. The financial support provided by M/s NBCC (India) for supporting project No. GAP-0018 is also gratefully acknowledged.



References

- Sabau, M., Bompa, D.V. and Silva, L.F., 2021. Comparative carbon emission assessments of recycled and natural aggregate concrete: Environmental influence of cement content. Geoscience Frontiers, 12(6), p.101235.
- 2. Ding, G.K., 2008. Sustainable construction—The role of environmental assessment tools. Journal of Environmental Management, 86(3), pp.451-464.
- 3. Sandanayake, M., Bouras, Y., Haigh, R. and Vrcelj, Z., 2020. Current sustainable trends of using waste materials in concrete—a decade review. Sustainability, 12(22), p.9622.
- 4. The World Steel Association 2023. https://worldsteel.org/data/ world-steel-in-figures-2022/
- 5. Goyal, P.K., Mudgal, M. and Ghosh, P.K., 2024. Assessing the viability of using BOF steel slag treated with tartaric acid as coarse aggregate in concrete. Construction and Building Materials, 436, p.136912.
- Kurecki, M., Meena, N., Shyrokykh, T., Korobeinikov, Y., Jarnerud Örell, T., Voss, Z., Pretorius, E., Jones, J. and Sridhar, S., 2024. Recycling perspectives of electric arc furnace slag in the United States: A review. Steel Research International, p.2300854.
- Pasetto, M., Baliello, A., Giacomello, G. and Pasquini, E., 2023. The use of steel slags in asphalt pavements: A state-of-theart review. Sustainability, 15(11), p.8817.
- 8. Li, Y., Liu, F., Yu, F. and Du, T., 2024, May. A review of the application of steel slag in concrete. In Structures (Vol. 63, p. 106352). Elsevier.
- Alves, H.C. and Gomes, G.J., 2023. Weathering resistance of Linz– Donawitz (LD) slag as ballast

material using freeze-thaw and sulphate soundness. Transportation Geotechnics, 40, p.100973.

- 10. Abendeh, R., Alhorani, R., Ahmad, H. and Baker, M.B., 2021. Effect of steel slag as fine and coarse aggregate on pore structure and freeze-thaw resistance of highstrength concrete. Jordan Journal of Civil Engineering, 15(4).
- 11. Zago, S.C., Vernilli, F. and Cascudo, O., 2023. The reuse of basic oxygen furnace slag as concrete aggregate to achieve sustainable development: Characteristics and limitations. Buildings, 13(5), p.1193.
- 12. Brand, A.S. and Roesler, J.R., 2015. Steel furnace slag aggregate expansion and hardened concrete properties. Cement and Concrete Composites, 60, pp.1-9.
- 13. Riley, A.L., Cameron, J., Burke, I.T., Onnis, P., MacDonald, J.M., Gandy, C.J., Crane, R.A., Byrne, P., Comber, S., Jarvis, A.P. and Hudson-Edwards, K.A., 2024. Environmental behaviour of iron and steel slags in coastal settings. Environmental Science and Pollution Research, pp.1-17.
- 14. Nguyen, L.H., Nguyen, T.D., Tran, T.V.N., Nguyen, D.L., Tran, H.S., Nguyen, T.L., Nguyen, T.H., Nguyen, H.G., Nguyen, T.P., Nguyen, N.T. and Isawa, T., 2022. Steel slag quality control for road construction aggregates and its environmental impact: case study of Vietnamese steel industry leaching of heavy metals from steel-making slag. Environmental Science and Pollution Research, pp.1-9.
- 15. Majhi, R.K. and Nayak, A.N., 2020. Production of sustainable concrete utilising high-volume blast furnace slag and recycled aggregate with lime activator. Journal of Cleaner Production, 255, p.120188.

- 16. Ali, B., Ouni, M.H.E. and Kurda, R., 2022. Life cycle assessment (LCA) of precast concrete blocks utilising ground granulated blast furnace slag. Environmental Science and Pollution Research, 29(55), pp.83580-83595.
- 17. Amran, M., Murali, G., Khalid, N.H.A., Fediuk, R., Ozbakkaloglu, T., Lee, Y.H., Haruna, S. and Lee, Y.Y., 2021. Slag uses in making an ecofriendly and sustainable concrete: A review. Construction and Building Materials, 272, p.121942.
- 18. Mohammed, A.M., Asaad, D.S. and Al-Hadithi, A.I., 2022. Experimental and statistical evaluation of rheological properties of selfcompacting concrete containing fly ash and ground granulated blast furnace slag. Journal of King Saud University-Engineering Sciences, 34(6), pp.388-397.
- 19. Home International Copper Association India | ICA India (copperindia.org)
- 20. Singh, N., Gupta, A. and Haque, M.M., 2022. A review on the influence of copper slag as a natural fine aggregate replacement on the mechanical properties of concrete. Materials Today: Proceedings, 62, pp.3624-3637.
- 21. Wang, R., Shi, Q., Li, Y., Cao, Z. and Si, Z., 2021. A critical review on the use of copper slag (CS) as a substitute constituent in concrete. Construction and Building Materials, 292, p.123371.
- 22. Mirnezami, S., Hassani, A. and Bayat, A., 2023. Evaluation of the effect of metallurgical aggregates (steel and copper slag) on the thermal conductivity and mechanical properties of concrete in jointed plain concrete pavements (JPCP). Construction and Building Materials, 367, p.129532.
- 23. Ahmad, J., Majdi, A., Deifalla, A.F., Isleem, H.F. and Rahmawati, C., 2022. Concrete made with



partially substitutions of copper slag (CPS): State of the art review. Materials, 15(15), p.5196.

- 24. United Nations Environment Programme- UNEP - UN Environment Programme
- 25. El-Haggar, S., Samaha, A., El-Haggar, S. and Samaha, A., 2019. Sustainable utilisation of construction and demolition waste. Roadmap for Global Sustainability—Rise of the Green Communities, pp.169-188.
- 26. Silva, R.V., De Brito, J. and Dhir, R.K., 2014. Properties and composition of recycled aggregates from construction and demolition waste suitable for concrete production. Construction and Building Materials, 65, pp.201-217.
- 27. Abadel, A.A., Nasr, M.S., Shubbar, A., Hashim, T.M. and Tuladhar, R., 2023. Potential use of rendering mortar waste powder as a cement replacement material: fresh, mechanical, durability and microstructural properties. Sustainability, 15(15), p.11659.
- 28. Kurzekar, A.S., Waghe, U.P., Nagose, T., Sharma, A., Sonekar, T., Kohade, S., Tijare, G. and Nehare, M., 2024. A comprehensive review of utilisation of construction and demolition waste as fine aggregate in concrete. Engineering Access, 10(2), pp.213-229.
- 29. Harihanandh, M. and Karthik, P., 2022. Feasibility study of recycled plastic waste as fine aggregates in concrete. Materials Today: Proceedings, 52, pp.1807-1811.
- 30. Abukhettala, M., 2021. Potential use of plastic waste materials in pavement structures applications (Doctoral dissertation, Université d'Ottawa/University of Ottawa).
- 31. The World Business Council for Sustainable Development (WBC-SD)
- 32. Mohammed, B.S., Adamu, M.

and Shafiq, N., 2017. A review on the effect of crumb rubber on the properties of rubbercrete. International Journal of Civil Engineering and Technology, 8(9), pp.599-615.

- 33. Mohajerani, A., Burnett, L., Smith, J.V., Markovski, S., Rodwell, G., Rahman, M.T., Kurmus, H., Mirzababaei, M., Arulrajah, A., Horpibulsuk, S. and Maghool, F., 2020. Recycling waste rubber tyres in construction materials and associated environmental considerations: A review. Resources, Conservation and Recycling, 155, p.104679.
- 34.Hassan, M.R. and Rodrigue, D., 2024. Application of waste tyre in construction: A road towards sustainability and circular economy. Sustainability, 16(9), p.3852.
- 35. Olatunji, O., 2024. Plastics in construction: Toward green buildings and climate-resilient cities. In re-envisioning plastics role in the global society: Perspectives on food, urbanisation, and environment (pp. 219-239). Cham: Springer Nature Switzerland.
- 36. Surehali, S., Singh, A. and Biligiri, K.P., 2023. A state-of-the-art review on recycling rubber in concrete: Sustainability aspects, specialty mixtures, and treatment methods. Developments in the Built Environment, 14, p.100171.
- 37. Shokshok, M.M. and Naimi, S., 2024. The use of waste from marble workshops as an alternative to fine and coarse aggregates for the production of concrete. Migration Letters, 21(S8), pp.21-43.
- 38. Conway, E., 2023. Material World: A substantial story of our past and future. Random House.
- 39. Kore, S.D., Vyas, A.K. and Kabeer KI, S.A., 2020. A brief review on sustainable utilisation of marble

waste in concrete. International Journal of Sustainable Engineering, 13(4), pp.264-279.

- 40. Danish, A., Mosaberpanah, M.A., Salim, M.U., Fediuk, R., Rashid, M.F. and Waqas, R.M., 2021. Reusing marble and granite dust as cement replacement in cementitious composites: A review on sustainability benefits and critical challenges. Journal of Building Engineering, 44, p.102600.
- 41. Ceramic World Review 150/2023 | Ceramic World Web
- 42. Mukwaya, G.W., 2023. Investigation of mechanical properties of ceramic tiles developed from selected clay deposits in Uganda (Doctoral dissertation, Kyambogo University [unpublished work]).
- 43. Gomes, M. and de Brito, J., 2009. Structural concrete with incorporation of coarse recycled concrete and ceramic aggregates: durability performance. Materials and Structures, 42, pp.663-675.
- 44. Garg, N. and Shrivastava, S., 2023. Mechanical, durability and sustainability assessment of rendering mortar with synergistic utilisation of recycled concrete and ceramic insulator fine aggregates. Journal of Building Engineering, 76, p.107269.
- 45. Kshirsagar, P.R., Upreti, K., Kushwah, V.S., Hundekari, S., Jain, D., Pandey, A.K. and Parashar, J., 2024. Prediction and modeling of mechanical properties of concrete modified with ceramic waste using artificial neural network and regression model. Signal, Image and Video Processing, pp.1-15.
- 46. IS 383: 2016-Coarse and fine aggregate for concrete - Specification: Bureau of Indian Standards (BIS), New Delhi.



Engagement of Youth for a better Urban Growth and Development



Prof.A.K.Watal

ith more than half of the global population now residing in cities, urbanization is rapidly transforming our world. As this trend continues, it is essential to prioritize the voices and aspirations of urban youth who represent the future leaders and catalysts for change. Recognizing the significance of engaging young people in shaping sustainable urban development, the UN-Habitat Assembly stands as a critical platform. The UN-Habitat Assembly is vital for urban youth and their active involvement can pave the way for a more inclusive and sustainable urban future.

The UN-Habitat Assembly is responsible for setting priorities for the United Nations Human Settlements Programme (UN-Habitat) and providing guidance on its work. Its main focus is on sustainable urbanization and the implementation of the New Urban Agenda, a global framework for urban development adopted by UN member states in 2016. UN-Habitat Assembly is a high-level gathering of representatives from member states and other stakeholders that takes place every two years.

UN-Habitat Assembly vis-a-vis the youth

The importance of the UN-Habitat Assembly for youth can be understood from the fact that, it provides a platform for them to engage in discussions and decisionmaking processes related to sustainable urban development. As young people are often the most affected by urbanization, they have a unique perspective on the challenges and opportunities facing cities and towns around the world. Through participation in the UN-Habitat Assembly, youth can advocate for their needs and priorities, contribute to policy development, and collaborate with other stakeholders to create more inclusive, equitable, and sustainable communities.

Besides, the Assembly provides opportunities for youth to network with other young leaders, share best practices and innovative solutions, and build their skills and knowledge in areas such as urban planning, design, and governance.

The UN-Habitat Assembly aligns with the United Nations' Sustain-

able Development Goals (SDGs), particularly Goal 11: Sustainable Cities and Communities. Urban youth are key stakeholders in achieving this goal, as they are directly affected by urbanization and play a crucial role in its success. Their active involvement in the Assembly ensures that their needs and aspirations are integrated into urban development plans and policies, contributing to the realization of the SDGs.

It serves as a vital platform for urban youth to engage, contribute, and shape the future of sustainable urban development. By amplifying youth voices, fostering youth-led solutions, promoting empowerment and leadership, supporting the achievement of the SDGs, and nurturing a culture of inclusion, their contribution becomes wholesome.

A pathway for young people to make meaningful changes in their communities is provided by the Assembly. It is essential for policymakers, governments, and stakeholders to recognize the importance of youth engagement and ensure their active participation in decision-making processes.

^{*} Chairperson, Construction Management and Technology Department, Shri Vishwakarma Skill University, Dudhola Palwal; E-mail: akwatal@svsu.ac.in



Together, we can create cities and communities that are inclusive, sustainable, and vibrant, enabling urban youth to thrive and lead us toward a better future.

Aggrandizing Youth-Led Solutions

The youth possess incredible innovation, creativity, and energy. Their perspectives and experiences are invaluable in finding effective solutions to urban issues. The UN-Habitat Assembly serves as a platform to showcase youth-led initiatives and innovations that contribute to sustainable urban development. It encourages collaboration, knowledge sharing, and peer-to-peer learning among young people from diverse backgrounds, facilitating the creation of transformative solutions that address urban challenges.

The importance to engage with young people regarding urban growth and development of our cities and towns.

Understanding what is the worth of engaging young people in the development and maintenance of place matters, if proper funding and importance is to be allocated to such activities. This can be summarised citing ten key reasons that we need to consider. The reasons vary from statutory, democratic and stewardship arguments to social cohesion, economic and innovation. Young people have the right to be involved and possess the energy and hidden acumen to change their communities. If we are serious about retaining young people in their communities, they must have a say and if heard they can offer new perspectives on the place where they live. Engaging young people can also benefit



them personally by developing skills and knowledge, acting as agents of change within their communities, challenging the status quo and creating new cultures. Young people's activities can also be an economic boost, shaping physically the built environment around them and innovate. Our aim should be focused on expanding those reasons and establishing a much-needed framework that can provide justification for youth inclusion in envisioning our collective urban futures.

Younger people may have different views or perspectives around the growth of cities and neighbourhoods compared to older generations.

Adolescents are at the stage of their development as human being where socialisation and peer opinions become paramount. There is a definite manifestation of this process in the form of communityoriented ideas and concerns in teenagers which is distinct to the individualistic responses traditionally presented by older adults. Their ideas for future housing on small sites in the area and their views would normally result in the introduction of a community principle – aimed at promoting a sense of community and fostering community life. This is an element of the proposals which was overlooked in the development of the policy until young people stepped up.

Young people's expectations about their housing needs and where they want to live may be different (or not) to older generations.

In the past three years, after consulting with young people in Gurugram between the ages of 18-29 regarding their preferences about housing and urban developments during and after the pandemic. Whilst short-termism was present in some of the answers reflexing the anxiety around the pandemic, there were definite long-term trends which have remained strong - such as that young people want housing, which is solving the issue of climate change, which tackles inequality and presents designs which are suitable for maintaining personal health and wellbeing. Specifically, affordability has been a top issue for this generation. Trends are changing too - main-



taining physical and mental health are challenges which young people consider much more now ,when choosing accommodation. Access to community services to combat loneliness and access to immediate external space are also key issues. Post-pandemic the size of the accommodation, light, air and noise quality indoor are paramount in the criteria to select housing.

In terms of community engagement practices, what are effective ways to get young people motivated and involved in consultation/ engagement processes?

Demographics are hard to reach in a system where the presumption is passive consultation. If we take an initiative-seeking approach this demographic responds positively.

Be creative and open to innovative ideas. Young people respond to approaches which challenge and engage them, ideally in an entertaining way. For example, we develop an engagement tool in the form of a board game called CLIMANIA¹ together with more teenagers who act as co-researchers. The game aims to engage the demographic in built environment climate research, and it is free to download, print and play. Using serious play as a tool of engagement and research can benefit not just young people by making complex issues accessible, but also challenge understanding by policy makers.

We have to be honest and respectful. Young people are coached from an early age to spot fake content online. So, it is no wonder that they spot dis-ingenuity offline



too. We have make sure to not overpromise anything, be honest about the results and follow back with feedback. Respect their opinions and labour and reward it appropriately, all consultations are transactional so make sure you live up to your end of the bargain!

Even New Education Policy (NEP-2020) envisages critical thinking, ability enhancement and encouragement to the youth and entrepreneurship.

The changing technology or enhancing opportunities for engagement with young

Technology is undoubtedly enfranchising young people in community consultations. But technology can also carry bias and entrench inequalities. We have come across many smart city strategies that do not aim to fundamentally rethink the relationship between youth and planners, but rather just digitalise current physical tools, thus perpetuating inequalities that already exist such as access, financial barriers and language.

What has come across during long term research ,so far is the general desire of this demographic to be involved in the processes of city-planning, however, contrasted to their lack of knowledge about how to. In trying to dissect future city visions, we have been uncovering the perceptions that young people hold towards ideas of 'smartness' and their preferences. Across cultures, issues of community cohesion, climate injustice and better education prevail.

Distribution of youth as a percentage of the population across the world is unequal and in a late capitalist society, we cannot assume the relationship between youth and labour as a given datum. It is important that we acknowledge the role young people need to play on international stage by establishing much stronger interdisciplinary connections.

We at Vishwakarma Skill University are trying to engage youth in such activities through NSS Camps, Workshops, Seminars, Competitions and plantation drives." Ek ped Maa ke nam" is the latest drive conducted by the University and we aim at creating a lush green habitat, with "No carbon, net carbon" mission.

¹ https://climaniathegame.com/



Engaging Youth to Create a Better Urban Future: The Power of Volunteering for a Sustainable Tomorrow



Anand Kumar Bolimera

"We cannot always build the future for our youth, but we can build our youth for the future." - Franklin D Roosevelt.

n an era defined by rapid urbanisation, cities are facing unprecedented challenges. Housing shortages, environmental degradation, and socio-economic disparities are growing concerns, particularly in urban areas. In India, urbanisation has been accelerating, with 35% of the population now living in cities¹. This growth comes with significant challenges: as of 2020, 49% of India's urban population was living in slums², highlighting the severity of inadequate housing. Cities like Mumbai and Kolkata have over 30% slum dwelling households³. However, this also presents us with opportunities. Youth, as the future leaders, hold immense potential to address these issues and create more sustainable, equitable, and vibrant

3 The Times of India: Urban India: 17% of urban India lives in slums: Census | India News - Times of India (indiatimes. com) urban environments.

While governments and various institutions are working towards tackling these challenges, the role of young people in shaping the future of cities is becoming increasingly important. Youth, with their energy, creativity, and passion for change, are stepping forward to lead the charge. This is particularly evident in the areas of volunteering and raising awareness through digital platforms. At Habitat for Humanity India, youth engagement is critical in our vision of building a world where everyone has a decent place to live. We actively work along with youngsters to help create a more sustainable and equitable future for families living in poor and vulnerable housing conditions and enable them to achieve strength, stability, and self-reliance.

The Importance of Youth Engagement

Youth engagement is essential for building resilient communities. Cities thrive when residents are actively involved in solving local issues, and young people bring fresh perspectives and eagerness to address old challenges. Urban areas are home to some of the most vulnerable populations, where access to affordable housing remains a persistent challenge. Migration is one of the key drivers of rapid urbanization. Many youths from rural areas are pulled towards urban areas for better livelihood, employment, education and a dream to improve their living conditions. When individuals and families migrate, they may end up settling in urban slums due to lack of resources. These slums, which are already under-resourced and frequently located in vulnerable areas, face further strain due to extreme weather events, such as flooding and heatwaves, exacerbated by climate change. Young people, often witnessing these hardships first-hand, are in a unique position to advocate for change and contribute through various programmes. Whether it's through hands-on volunteering

Rapid Urbanization: Slum Settlements in India's Mega-cities (arcgis.com) and Press Release: Press information Bureau (pib.gov.in)

² World Bank and United Nations Human Settlements Programme: https:// data.worldbank.org/indicator/EN.POP. SLUM.UR.ZS?locations=IN

 ^{*} National Director of Habitat for Humanity India, a housing non-profit organisation working in India since 1983.
E-mail: anandb@habitatindia.org | www.habitatindia.org



in construction projects, raising awareness through social and digital platforms, youth involvement can drive meaningful change and transformation.

The Government of India has introduced a new internship scheme as part of the Prime Minister's package, aimed at providing meaningful work experience to youth across the country. Announced in the Union Budget 2024-25 by the honourable Union Finance Minister, Smt. Nirmala Sitharaman, this initiative seeks to offer internships in 500 of India's top companies to one crore young people over the next five years. Youth will gain exposure to realworld business environments and various professions for a duration of 12 months. This initiative aligns with the government's broader focus on skill development and youth engagement, and it offers an ideal platform for young people to contribute to building a sustainable urban future.

Youth Volunteering: Building Homes, Communities and Hope

Volunteering is a powerful way for young people to make a direct impact. Habitat for Humanity India's programmes, which focus on providing affordable housing to low-income families, have seen significant involvement from youth volunteers around the world. Young people participate in a unique programme knows as a 'Volunteer Build', which includes active engagement of volunteers in physical construction of homes. Time and again, we have observed that the experience of a volunteer build is transformational and gives people a first-hand experience of how their involvement is having a

real impact on the life of a family.

One such 'Volunteer Build' was a build organised by Habitat for Humanity India in Igatpuri, located in Nashik district of Maharashtra in March 2024, where more than 20 volunteers, including 14 young people from Japan worked alongside future homeowners. Utana Arai, a young volunteer from Japan, recounted building a home for a family of five who were living in a mud house without access to clean water and sanitation, and how it changed her perspective on the global housing crisis. She shared her realisation of the challenges the families faced during the monsoon, enduring flooded floors and extreme humidity during the summer. She said, "Our group built a home for a mom, a dad, and their three young kids. Before seeing it in person, I couldn't have imagined what the mud house where they lived was like. The family had to walk a long way to get clean water, and they charged their phone with a small solar panel. The inside of the home was hot and humid, and I could tell that in the rainy season the house would flood. I realised how hard it must be to study, work, and raise those three young children in these conditions. It made me think about just how many people around the world need a decent place to live, with Japan as no exception."

This powerful example demonstrates the ability of youth to "Build Beyond Boundaries"— both in a literal sense by constructing homes and in a figurative sense by connecting with people from different countries, cultures, and socio-economic backgrounds. By volunteering, young people not only contribute to the physical infrastructure of urban communities but also build bridges of understanding and compassion.

Leveraging Technology and Digital Platforms To Advocate For Change

In addition to hands-on volunteering, young people are increasingly using technology and social media platforms to raise awareness about issues important for community development and nation building. These digital tools allow them to connect with wider audiences, share their experiences, and advocate for change. Social media, in particular, plays a vital role in mobilising support and educating the public about pressing urban issues such as affordable housing, climate-resilient infrastructure, and inclusive city planning.

Youth-led initiatives can amplify the work being done by the Government of India, corporate foundations, and non-governmental organisations, bringing greater visibility to social initiatives and urban development programmes. By sharing stories of impact, hosting virtual awareness raising events, and participating in digital advocacy campaigns, young people influence public discourse and contribute to a broader movement for sustainable living. This engagement not only supports the government's mission of creating livable cities for all but also inspires more people to take action in their own communities.

The Long-Term Benefits of Youth Involvement

Youth engagement has both immediate effects and long-term benefits for individuals and communities. For young volunteers, the experience of working on projects



like Volunteer Builds fosters a deep sense of social responsibility and civic duty. It encourages empathy and inspires them to continue contributing to community-based initiatives as they grow older.

For communities, the benefits of youth involvement extend beyond the physical structures built. Young people bring energy, optimism, and fresh ideas to the table. They often find innovative ways to mobilise resources and draw attention to issues that may otherwise go unnoticed. By engaging young people in creating sustainable urban futures, we are cultivating a generation of leaders who are deeply invested in the well-being of their cities, environment and people.

A Call to Action

The challenges facing our urban environments are significant, but they are not insurmountable. By engaging young people in volunteering and awareness-raising initiatives, we can harness their passion, creativity, and determination to build a better future for all. Youth can act as agents of change and influencers to take an active role in shaping their communities. We need to create an enabling environment for them to success in this role.

As India continues to grow, it is essential that we empower the next generation to be custodians of urban transformation. The youth of today will be the leaders of tomorrow, and by involving them in the work of building homes and raising awareness, we are not only creating a better urban future but also investing in the future leaders of society and contributing towards building a better India.

Stakeholder Consultation on Establishing Embodied Carbon Database for Indian Construction Materials

B MTPC in association with Centre for Advanced Research in Building Science and Energy (CARBSE), CEPT University Ahmedabad, and with the support of Shakti Sustainable Energy Foundation organised a Stakeholder Consultation on Establishing Embodied Carbon Database for Indian Construction Materials at New Delhi on July 18, 2024.

This workshop aimed to elaborate on the means and methods for establishing an Embodied Carbon database for Indian construction materials. The discussions covered (a) the creation of a standardized data collection template, formalizing the data requirements, such as the minimum life cycle stages covered, functional units, etc., (b) the development of a data analysis framework, ensuring the highest quality of data, and (c) EC data collection for the most commonly used materials. Around 40 experts from various organisations working in the field participated and deliberated on the subject.





Imagineering Futuristic Urban Infrastructure



Dr. N. Anandavalli

bstract Being relevant not only for today but also for tomorrow is considered as the success of any new development. Forecasting based on the existing system for the next 50 years, needs imagination combined with relevant technological development. Imagineering futuristic urban infrastructure involves combining creative vision with cutting-edge technology to design cities that are adaptable, inclusive, and deeply integrated with the natural environment. It's about reimagining the future of urban living where human life, technology, and nature coexist in harmony. This article aims to identify possible leads towards futuristic urban infrastructure.

Introduction

Futuristic urban infrastructure will have to address the challenges of growing populations, resource scarcity, environmental degradation, and technological advancements. Cities of the future must not only be sustainable and resilient but also adaptable to rapidly evolving societal needs and relevant technological innovations. Such infrastructure integrates cuttingedge technologies like artificial intelligence (AI), the Internet of Things (IoT), robotics, and clean energy solutions to create livable, intelligent, and connected urban environments. The principles that drive the exploration in this article are sustainability, innovation, and inclusive design. Urban Ecosystem Services, Green Infrastructure, and Nature-based solutions are the three concepts behind urban nature (Cheshmehzangi et al, 2021). Fang et al. (2023) have tried integrating the three concepts to address urban sustainability. Resilient and sustainable urban infrastructure is required to alleviate versatile stressors such as traffic congestion, energy shortage, water pollution, water scarcity, waste management, and storm and flooding (Valencia et al 2022). Sustainable Urban infrastructure is an evolving field with multifaceted concepts involving climate change, circular economy, disaster resilience, infrastructure maintenance, and urban metabolism (Ferrer et al., 2018).

Understanding rural-urban interaction is essential for global sustainability, while most of the studies are focused on urbanization as the main driver. Velez et al (2022) have analyzed considering rural and urban as mutually constitutive and bridging the rural-urban divides. A review of literature on interlinkages between smart cities and sustainable development goals conducted by Sharifi et al., (2024) shows that responsible smart city solutions and technologies could contribute to the progress toward SDGs. A need exists to reconceptualize rural-urban transitions and minimize the transition from rural to urban. The uniqueness of the rural is to be protected while allowing them to grow with all the amenities and facilities of the urban. This will also help in reverse migration. Some of the features that is expected in futuristic urban infrastructure, based on existing knowledge and technological development are:

- Smart Cities and Digital Integration
- Sustainable Energy and Net-Zero Buildings
- Hyper-Connected and Autonomous Transportation and networks
- Water Management and Resilience
- Circular Economy Infrastructure

* Director, CSIR-Structural Engineering Research Centre, CSIR Road, Taramani, Chennai 600 113 Email: director@serc.res.in / anandi@serc.res.in



and Sustainable Waste Management

- Expanding Urban Space with compact-design: Floating and Vertical Cities
- Climate Resilience and Adaptation
- Biophilic Design and Nature-Integrated Cities
- Green, Regenerative Cities

Smart Cities and Digital Integration

Future urban infrastructure will be heavily dependent on smart technology to improve efficiency, sustainability, and the quality of life for residents. Smart cities use IoT sensors, AI-driven systems, and big data analytics to monitor and manage everything from traffic systems to water usage and public safety in real-time urban requirements in real-time.

- AI-Powered Infrastructure Management: Intelligent systems will be required to manage traffic flow, energy distribution, waste collection, and water management. For example, smart grids can adjust energy usage based on real-time demand, while AI-driven traffic systems can optimize traffic light patterns to reduce congestion.
- Digital Twins: The creation of real-time, virtual replicas of urban infrastructure to model and test various scenarios before implementation, such as new transportation routes or flood control measures will be essential for cities of the future. Adoption of digital twin technology will be in such cases. Every future city would have a digital twin, which would allow to simulate the changes,

effects of new policies before implementation, resilience to natural disasters etc.

- IoT-Connected Systems: Sensors embedded in roads, buildings, and public spaces will enable seamless data collection and interaction between residents and the urban environment. For instance, smart lighting systems that dim or brighten based on the time of day and foot traffic can improve energy efficiency.
- Augmented Reality (AR) Integration: The future of urban infrastructure would see the seamless blending of physical and digital worlds through AR overlays. AR could guide pedestrians through cities, provide real-time translations for tourists, or create virtual art galleries in public spaces. With the availability of Building Information System, such developments are doable.

Sustainable Energy and Net-Zero Buildings

Future cities will be designed to achieve net-zero carbon emissions by incorporating renewable energy, energy-efficient buildings, and green infrastructure. Towards urban sustainable development, the first step is enhancing the sustainability of infrastructure (Chen et al., 2024, Gürsan et al, 2023), which involves a lot of uncertainties, and implementation difficulties. Significant factors affecting sustainable development are social public participation, pollution, wastewater discharge, and soil pollution.

 Carbon-Neutral Cities: Entire cities would be powered by renewable energy like solar, wind, tidal and geothermal energy. Every aspect of city infrastructure, from buildings to transportation, would operate on a zero-carbon principle, ensuring that cities actively contribute to reversing climate change (Chen et al., 2023). Buildings of the future will be designed to generate as much energy as they consume through a combination of solar panels, wind turbines, and geothermal systems. These buildings will have high-performance insulation, energy-efficient appliances, and smart energy management systems to optimize energy use.

- Climate-Resilient Design: Infrastructure would be designed to withstand extreme weather events, with amphibious buildings that float in case of floods, drought-resistant landscapes, and heat-resilient urban designs that minimize the effects of rising temperatures. Some of the thoughts in this line are floating neighborhoods designed to adapt to rising sea levels, with integrated rainwater harvesting systems and green rooftops that reduce heat.
- Decentralized Energy Grids: Future cities will move towards microgrids powered by locally produced renewable energy. These decentralized grids will be more resilient to disruptions, reduce transmission losses, and integrate seamlessly with energy storage systems. They share the resources effectively.
- Carbon-Capturing Infrastructure: Future buildings and infrastructure will incorporate materials and technologies that capture and store carbon dioxide. Carbon-sequestering



concrete and bio-based materials can absorb CO2, while green roofs and vertical forests enhance urban biodiversity and air quality. Piers of bridges can be built to capture carbon from the atmosphere.

Hyper-Connected and Autonomous Transportation and networks

Urban transportation systems will be electric, autonomous, and hyper-connected, focusing on reducing congestion, emissions, and travel time (Christidis et al., 2024). Multimodal Hubs are smart transport centers would allow citizens to switch between various modes of transportation—like high-speed trains, electric bikes, or hyperloops—seamlessly through a single app. Each hub would be integrated into urban infrastructure, reducing commute times and enhancing mobility options.

- Autonomous Public Transport: Autonomous buses, trains, and shared mobility services will become the norm. These vehicles will use AI to optimize routes in real-time, reducing congestion and improving travel efficiency. Self-driving cars will operate in shared fleets, reducing the need for private car ownership.
- Electric and Hydrogen-Powered Mobility: All urban vehicles will run on electric or hydrogen fuel, greatly reducing emissions. Charging infrastructure will be seamlessly integrated into parking structures and public spaces, with wireless charging stations and fast chargers.
- Underground and Aerial Transport: Futuristic cities may also feature high-speed underground transit systems like the

Hyperloop, capable of transporting passengers at speeds exceeding 700 mph. In densely populated areas, aerial drones and air taxis will offer an alternative form of urban mobility. Imagine a city where autonomous pods whisk residents from home to work without the need for human drivers. These electric pods, part of a shared mobility system, would be programmed to optimize routes and reduce traffic.

- Mobility-as-a-Service (MaaS): MaaS platforms will allow users to access multiple forms of transportation (bikes, buses, trains, cars, scooters) via a single app, offering real-time information on availability and optimizing routes based on individual preferences.
- 5G and Beyond: Imagine a world where 6G connectivity blankets cities, connecting every device, building, and person in real-time. From traffic lights to household appliances, everything would be connected through a smart urban network.
- Quantum Computing and Al Governance: Managing a city would be powered by quantum computers that can handle vast amounts of data, ensuring urban services like electricity, water, and transportation are delivered seamlessly. Al algorithms would predict infrastructure needs, manage resources, and even help prevent crises like traffic congestion or flooding.

Water Management and Resilience

As climate change intensifies,

cities will need to manage water more efficiently, ensuring supply for growing populations while mitigating the risks of floods and droughts. Existing solutions implemented in various cities may be explored for their possible implementation in other places.

- Smart Water Systems: Sensors and AI will manage water distribution, detect leaks, and monitor water quality in real-time.
 Smart irrigation systems will use data on weather patterns and soil moisture to optimize water use in parks, gardens, and urban agriculture.
- Water Recycling and Desalination: Urban water infrastructure will include widespread use of greywater recycling for non-potable uses and advanced desalination plants to ensure a steady supply of freshwater in coastal cities.
- Green Stormwater Infrastructure: Cities will increasingly adopt sponge city principles, using natural and semi-natural systems to manage stormwater. Green roofs, rain gardens, and permeable pavements will reduce the risk of flooding by absorbing and filtering rainwater. Chen et al (2024) proposed a solution for the mitigation of the risk of water logging due to rapid urbanization by coupling natural green infrastructure with artificial gray infrastructure.

Circular Economy Infrastructure and Sustainable Waste Management

Future cities will adopt circular economy principles, where waste is minimized, reused, or recycled, and urban economies operate on


sustainable, regenerative principles.

- Zero waste urban design: Imagine cities where waste is a thing of the past. Urban infrastructure would be designed with circular economy principles, where every material is reused or repurposed. The design itself will incorporate ways and means how the waste will be recycled from the construction of the infrastructure till its safe demolition after living its life. Waste from homes and industries would be processed into new materials or converted into energy through waste-toenergy plants. These plants will be built integrally within the infrastructure enabling the handling of waste on a smaller scale, wherever possible. Household waste is automatically separated and processed by robots, converting organic waste into biofuel, plastics into new construction materials, and metals into 3D-printed parts for urban infrastructure. Prioritization of recycling and upcycling needs to be adopted in urban construction projects.
- Urban Mining: Cities would turn into resource mines, recycling old buildings and infrastructure. Instead of demolishing structures, they would be dismantled and rebuilt using reclaimed materials, ensuring that nothing goes to waste. Waste materials like plastics, glass, and metal will be reprocessed to create new building materials, reducing the demand for virgin resources.
- Automated Waste Collection and Sorting: Autonomous systems will manage waste

collection and sorting, separating materials for recycling, composting, or energy generation. Smart bins equipped with sensors will notify collection services when they are full, optimizing routes and reducing fuel consumption.

 Waste-to-Energy Plants: Nonrecyclable waste will be converted into energy through advanced waste-to-energy technologies, reducing the volume of landfills while generating power for the city.

Expanding Urban Space with compact-design: Floating and Vertical Cities

With increasing urbanization and limited land, future cities will adopt vertical living and compact urban design principles to maximize space and efficiency, while reducing environmental impact.

- Mixed-Use Vertical Cities: Instead of expanding outward, future cities would have to be built upwards. Vertical cities would house not only residential units but also commercial spaces, schools, healthcare facilities, and green spaces, creating self-contained, walkable communities within a single towering structure. These buildings would contain everything from homes to schools, offices, and even forests. Vertical cities reduce the need for extensive land use and make urban areas more energy efficient.
- Compact and Walkable Neighborhoods: Future urban designs will focus on minimum time solutions, where all essential services (schools, hospitals, shops, workplaces) are within a 15-30 minute walk or bike

ride. This reduces the need for long commutes and encourages active lifestyles. Also, energy consumption for those activities will be minimized.

- Multi-Level Green Spaces: Parks, gardens, and forests will be integrated vertically within urban structures, improving air quality, reducing heat islands, and providing residents with easy access to nature.
- Floating Cities: As coastal cities face the threat of rising sea levels, imagine a network of floating cities-entirely selfsufficient, designed to thrive on water. These cities would feature buoyant platforms capable of withstanding storms and natural disasters. With advanced desalination systems and self-contained ecosystems, they would produce their water, energy, and food. This will be effective solution for coastal cities as well as to cities in the bank of major rivers.
- Inclusive Design for All: Future cities would prioritize inclusive infrastructure, ensuring that urban spaces are designed for people of all ages, abilities, and backgrounds. Smart systems would adjust public spaces to meet the needs of residents in real-time, from lighting that adapts for the visually impaired to autonomous vehicles designed to cater to the elderly and disabled.

Climate Resilience and Adaptation

Cities of the future must be resilient to the impacts of climate change, such as rising sea levels, extreme weather events, and resource shortages. Reengineer-



ing the structures to address the climate change has become a reality now. New design philosophies have to be evolved.

- Floating and Amphibious Cities: In response to rising sea levels, coastal cities will experiment with floating or amphibious infrastructure. Floating neighborhoods and water-based transportation systems will mitigate the impact of floods while adapting to changing water levels.
- Heat-Resilient Infrastructure: Buildings will be designed to withstand extreme heat, using cooling technologies like reflective surfaces, green roofs, and shaded public spaces. Urban planners will integrate heatresilient materials and passive cooling techniques to lower energy consumption. Learning from nature and rural as well as traditional arrangement to enhance air circulation and to upscale them for urban infrastructure are some ways to get solutions to address the heat.
- Climate Adaptation Zones: Coastal cities will designate specific areas for adaptation measures such as flood barriers, mangrove forests, and tidal parks, canal integration. These zones will serve as natural buffers against rising sea levels and storm surges.

Biophilic Design and Nature-Integrated Cities

Future urban environments will integrate biophilic design, emphasizing the connection between residents and nature (Fang et al, 2023).

• Urban Forests and Vertical Gar-

dens: Buildings will be wrapped in greenery, with vertical gardens, rooftop forests, and treelined streets integrated into urban designs. These natural elements will improve air quality, reduce the urban heat island effect, and enhance mental well-being.

- Nature-Inspired design: Cities will incorporate nature-based solutions for flood management, air purification, and temperature regulation. Wetlands, urban lakes, and green corridors will not only improve biodiversity but also enhance the resilience of cities to climate change.
- Edible Landscapes: Future cities will encourage urban agriculture by integrating edible plants into public spaces, rooftops, and community gardens, promoting local food production and reducing food transportation emissions.
- **Bio-Engineered Buildings**: Buildings would be designed to live and breathe, responding dynamically to their surroundings. Imagine walls that are alive-built from bioengineered materials that repair themselves when damaged and adapt to environmental changes. These living structures could regulate internal temperatures by adjusting their pores and surfaces to reflect sunlight or capture heat. A building with an exterior skin that changes color based on sunlight intensity, insulating the building during cold months and reflecting heat during summer.
- Shape-Shifting Architecture: Adaptive architecture would

allow cities to **change form** as needed. Buildings could expand or contract depending on occupancy, or even move to different locations when required, ensuring maximum efficiency and flexibility. Public pavilions or temporary market spaces that can morph into different shapes and sizes, providing shade during the day and unfolding into open-air auditoriums at night.

Green, Regenerative Cities

- **Urban Forests and Vertical** Green Spaces: Cities would not only include green spaces but would integrate nature into the fabric of the city. Skyscrapers would be wrapped in vertical forests, filtering air, absorbing carbon, and providing habitats for wildlife. Rooftop farms and gardens would produce fresh food for urban dwellers. Vegetated green infrastructure is essential to provide an ecosystem that improves biodiversity and in turn wellness of the urban residents can be improved (Behm et al., 2022).
- Regenerative Infrastructure: Future infrastructure would not just reduce harm but actively regenerate the environment. Buildings would produce more energy than they consume, capture and purify water, and absorb carbon from the atmosphere through advanced biophilic designs.

Conclusion

Futuristic urban infrastructure will adopt sustainability, resilience, and adaptability and prioritize smart technologies, green energy, and circular economies. By addressing environmental, social, and economic challenges, these cities



will enhance the quality of life for their residents, reduce resource consumption, and build a more sustainable future.

The future of urban infrastructure lies in creating cities that are selfsustaining, adaptive, and designed with both people and nature in mind. These cities would integrate advanced technologies like AI, IoT, and AR with nature-based solutions, creating a harmonious balance between urban living and the natural environment. By embracing circular economy principles, autonomous mobility, and resilient infrastructure, the cities of the future would not only be places to live but thriving, dynamic ecosystems designed for a prosperous, sustainable future.

References

 Jocelyn E Behm, Nadège Bélouard, Jason M Gleditsch, Payton M Phillips, Timothy M Swartz, "Trait-based approaches for understanding how biodiversity generates sustainable benefits in urban vegetated green infrastructure", Current Opinion in Environmental Sustainability, Vol.

57, 2022, 101204.

- Hongyu Chen, Shidong Cheng, Yawei Qin, Wen Xu, Yang Liu, "Sustainability evaluation of urban large-scale infrastructure construction based on dynamic fuzzy cognitive map", Journal of Cleaner Production, Vol. 449, 2024, 141774.
- 3. C. Gürsan, V. de Gooyert, M. de Bruijne, E. Rouwette, "Socio-technical infrastructure interdependencies and their implications for urban sustainability; recent insights from the Netherlands", Cities, Vol. 140, 2023, 140397.
- Lei Chen, Chenxi Guo, Yu Yu, Xuehui Zhou, Yijia Fu, Shuai Wang, Yukun Ma, Zhenyao Shen, "Optimization of green infrastructures for sustaining urban stormwater quality and quantity: An integrated resilience evaluation", Journal of Hydrology, Vol, 640, 2024, 131682
- Xuening Fang, Jingwei Li, Qun Ma, "Integrating green infrastructure, ecosystem services and nature-based solutions for

urban sustainability: A comprehensive literature review", Sustainable Cities and Society, Vol. 98, 2023, 104843.

- 6. Victor H Gutierrez-Velez, Melissa R Gilbert , Dirk Kinsey, Jocelyn E Behm, "Beyond the 'urban' and the 'rural': conceptualizing a new generation of infrastructure systems to enable rural–urban sustainability", Current Opinion in Environmental Sustainability, Vol. 56, 2022, 101177.
- Andrea Valencia, Wei Zhang, Ni-Bin Chang, "Sustainability transitions of urban food-energy-water-waste infrastructure: A living laboratory approach for circular economy", Resources, Conservation and Recycling, Volume 177, 2022, 105991.
- Chen, S., Fang, K., Dhakal, S., Kharrazi, A., Tong, K., & Ramaswami, A. "Advancing urban infrastructure research for a carbon-neutral and sustainable future", Resources, Conservation and Recycling, Vol. 197, 2023, 107049

MoU with Shri Vishwakarma Skill University (SVSU), Dudhola Palwal (Haryana)

n order to promote sustainable building technologies and practices amongst the faculty and students of engineering and architectural colleges, the Council signed a MoU with Shri Vishwakarma Skill University (SVSU), Dudhola Palwal (Haryana). Sensitisation Programmes on New Building System/ Technologies for Sustainable Construction for students and faculty of SVSU University and nearby colleges of engineering and architecture will be orgaganised.





Exploring the use of Rice Straw Waste

to develop the composite panels in sandwich constructions for structural applications





Deepak Jain²



Naveen Kwatra¹

Aimen Javed ³

bstract In this article we explore the potential approach of Rice straw which is a plentiful agricultural byproduct that can be used to create rice straw composite boards, an environmentally responsible and sustainable replacement for traditional wood-based materials and EPS panels. The manufacture and characteristics of rice straw boards are examined in this study, with an emphasis on how they could lessen agricultural waste and environmental effect while offering reasonably priced building materials. These composite boards provide competitive mechanical qualities, making them ideal for use in construction and furniture manufacture. They are made from rice straw fibres and resin matrix.

Introduction

The investigation of agricultural leftovers as potential substitutes for traditional wood and synthetic materials has been prompted by the growing need for environmentally friendly and sustainable building materials. Composite boards made of rice straw have come to light as one of these potential solutions. One easily obtained agricultural byproduct from rice farming is rice straw, which is frequently burned in fields, seriously polluting the air and damaging the ecosystem. This plentiful waste material may be converted into composite boards, which solves the waste management problem and offers a reasonably priced, renewable substitute for conventional building materials.

An indiscriminate burning of rice straw waste in the farms pose a major environmental challenge in the north western parts of India (Punjab, Haryana, Delhi NCR) during the winter season every year. According to current estimates, building energy consumption accounts for around 40% of worldwide emissions of greenhouse gases. Thus, it is necessary to design construction materials that not only have minimal or zero carbon footprints during the manufacturing process, but also offer insulation from heat for structures in different climates. Amongst these materials, the effective use of rice straw waste composite boards has the potential to not only cut GHG emissions but also provide great thermal insulation. The conversion of this stubble waste into valueadded products will not only help to address the environmental issues, but it can also offer several socio-economic advantages to the farmers.



Fig.1 Stubble burning in a field in Punjab (India)

Professor, Civil Engineering Department, Thapar Institute of Engineering & Technology, Patiala, Punjab
Associate Professor, Mechanical Engineering Department, Thapar Institute of Engineering & Technology, Patiala, Punjab

Research Scholar, Civil Engineering Department, Thapar Institute of Engineering & Technology, Patiala, Punjab





Fig.2 (a) Eliminate the use of EPS for the pre-cast civil structures (b) Deploy Stubble waste wire mesh panels instead

In parallel to the stubble burning issue, there exists another environmental concern regarding an increased use of the Expanded polystyrene (EPS) panels in the construction industry. **Polystyrene**, which is widely used for the fabrication of middle core of EPS wall panels has several disadvantages such as:

Environmental and health Impact 2. Non-Renewable Resource
Recycling Challenges 4. Health
Concerns 5. Fragility 6. Fire Hazard
Marine Pollution etc.

Due to several environmental/ health problems posed by the EPS panels, it is need of the hour to develop an alternate material to replace the polystyrene in the EPS sandwich panels. Owed to its environmental impact the government of India has already banned the use of Polystyrene for the purpose of decoration [1]. As of June 2023, nine U.S. states and one territory have passed legislation to explicitly ban polystyrene foam [2]. Owing to its high flammability, the government of Victoria (Australia) prohibited the use of flammable aluminium composite panels (ACP) and rendered expanded polystyrene (EPS) as external wall cladding on all future multi-storey developments such as apartment buildings [3].

Given these recent advance-

ments in environmental concerns, there is a good chance that in the near future, EPS will be completely banned once an alternative is identified. Due of the aforementioned problems, there has been a growing interest in discovering more environmentally friendly and sustainable alternatives to polystyrene for numerous applications.

Need for sustainable materials

"As construction seeks alternatives that are more sustainable, rice straw an ecologically friendly, usually discarded farming byproduct—is emerging as an essential resource in environmentally friendly sandwich panel construction." Sandwich construction panels are composite structures composed of two robust exterior layers, or "skins," and a lightweight core material in the middle of the panel. The outside layers add structural strength, but the middle layer reduces weight and improves insulating characteristics. This design is frequently employed in construction for walls, roofs, and even flooring due to its high strengthto-weight proportions, energy efficiency, and low cost.

Rice straw fits into this structure as an ecologically sound, environmentally favourable core material. Rice straw, which is abundant and frequently considered waste, can be processed, and converted into composite boards that can be utilized as a core/ middle layer for sandwich panels to provide great thermal insulation, soundproofing, and reduced environmental impact. The panels, which use rice straw, not only provide practical advantages but also aid to resolve.

How it is being addressed today

The following options are currently used for the rice straw utilization in present technologies:

- Bio-degradable cutlery.
- Rice straw briquettes
- Paper and Card board
- Packing
- Plastic mixing



Fig.3 Present rice straw utilization in current technologies



However, these alternatives have some associated challenges and it requires multipronged approach to curb the practice of stubble burning.

Novelty

The novelty lies in the development of Rice straw composite boards that have a potential to reduce/replace conventional EPS panels in the near future with tensile strength (~47 MPa) and flexural strength (~70 MPa) (at 70% of stubble volume fraction.) It also has better mechanical and thermal properties in comparison to Polystyrene.the results also concluded that the thermal conductivity of rice straw is 1/100th of the conductivity of concrete (0.035 w/mk).

The results also depicted that the reduction in hemicellulose with water pre-treatment method has significantly improved the biodegradability by the destruction of lingo-cellulosic mass for its utilization in rice straw wall panels for building construction applications in near future.

Application and Future potential

The future of the building sector is expected to be inside the precast industry rather than in on-site buildings. The building industry's increased desire for eco-friendly, inexpensive, and lightweight building materials has sparked an interest in developing creative, adaptable, and versatile composites for a variety of applications.

Incorporating rice stubble panels as a middle core in pre-cast sandwich constructions can provide the following benefits:

1. Ecological Sustainability: By using rice stubble panels, the

construction sector may help to reduce agricultural waste and its negative effects on the environment.

- 2. Renewable Resource: Rice stubble waste is a renewable resource because it is created each year during the rice harvesting season.
- 3. Carbon Footprint Reduction: By redirecting rice stubble from combustion, which emits greenhouse gases, the construction sector can assist to reduce its carbon footprint.
- 4. Cost-Effective: Rice stubble waste is frequently regarded a low-cost or even waste material, making these panels less expensive than traditional construction materials.
- 5. Thermal Insulation: Rice stubble infill panels may provide adequate thermal insulation, making them suitable for energyefficient buildings.
- 6. New Alternative: Straw waste can not only serve as a potential replacement of the EPS (the environmentally hazardous polystyrene used in the production of EPS precast panels) core inside the concrete sandwich panels but is also suitable for ceiling, partition wall and floor tile applications to provide the thermal envelope and improve overall thermal efficiency of the building. The usage of straw as a filler material can also reduce the usage of the conventional cement and concrete materials and makes the construction as an eco-friendly venture.

Economic and social impact

Utilising composite boards made of rice straw as an alternative

building material has substantial social and economic effects, particularly in areas where rice farming is common. The primary points are as follows:

1. Economic Impact:

a) Efficiency of Resources and Waste Utilisation

A byproduct of the cultivation of rice, rice straw is frequently burned or allowed to decay, wasting resources, and polluting the environment. This agricultural waste may be economically utilised by converting rice straw into composite boards, tiles, panels which establishes a sustainable economy from an abundant resource. This increases the value of a resource that was previously neglected, giving farmers new opportunities and lowering their dependency on more costly raw materials like timber.

b) Cost - effective Construction Material

Producing rice straw boards is usually less expensive than producing traditional wood-based goods or synthetic panels. These boards are an inexpensive substitute for furniture, interior design, and building since the lower cost of the raw material (rice straw) results in cheaper manufacturing expenses.

In places where traditional wood products are scarce, their utilisation can assist lower constructing expenses in both rural and urban areas, resulting in more affordable housing and construction projects.

c) Development of the Economy and the Establishment of Jobs

The development of industries focussing on rice straw composite boards has the potential to boost



regional economies by generating employment opportunities across the whole supply chain, from production to processing to transportation. This can boost the income of manufacturing plant employees and farmers who can sell rice straw, bolstering the economy of rural areas.

d) Production cost reduction

When compared to conventional wood-based or synthetic alternatives and existing EPS, the production process for rice straw boards often uses less energy and resources, which lowers overall production costs shown in Fig 4(a,b). Reduced energy use can help manufacturers and support their long-term financial viability.

2. Social impact

a) Decrease in Open Burning and Its Health Advantages

After harvest, rice straw is frequently burned in the fields, which pollutes the air and aggravates respiratory conditions, particularly in rural areas. By using rice straw for composite boards, less open burning is required, which enhances air quality and lowers the risk of respiratory illnesses like bronchitis and asthma. Health gains result in reduced healthcare expenses due to illnesses brought on by pollution and an improved quality of life for nearby populations.

b) Eco-Friendly Construction Materials

The development of sustainable and environmentally friendly building methods is aided by rice straw boards. They encourage environmental protection by offering a substitute for deforestation and excessive use of natural wood resources. This is also in line with the rising demand for environmentally friendly building supplies around the world, which benefits society by tackling climate change issues and lowering carbon footprints associated with construction projects.

c) Development and Empowerment in Rural Areas

Making rice straw boards can promote rural development by giving nearby farmers and communities more opportunity. Farmers can increase their financial security by creating a market for rice straw, which gives them another



Fig.4 (a) Existing Polystyrene panel, (b) Proposed rice straw composite panel

a) Existing Polystyrene panel

The Polystyrene panels of size $1000 \times 1000 \times 50 \text{ mm}^3$ available in the market with the market Price: 550-700 per pc.

b) Proposed Straw board

The proposed straw board is made in different sizes as per the testing standard requirements. The size of the panel made is $1000 \times 1000 \times 50 \text{ mm}^3$. The material Cost is: 275 per pc. (Parali:25 + Adhesive: 250) additionally transportation and fabrication may lead to a final cost of 375-400 per pc.



source of revenue. By decentralising industrial development and generating jobs outside of cities, small-scale businesses making rice straw boards have the potential to strengthen rural communities.

d) Encouragement of the Circular Economy

A circular economy is one in which trash from one industry (agricultural) is converted into useful products for another (construction) by incorporating rice straw into building materials. Society gains from this resource recycling method, which promotes a sustainable lifestyle.

Challenges and solutions

Challenge: Rice straw boards are susceptible to biodegradability, moisture absorption, which can cause swelling, deterioration, and reduced durability, especially in humid areas.

Solution: Water-resistant treatments including wax emulsions, resins, and surface coatings can improve the boards' moisture resistance. Furthermore, employing adhesives such as phenolic or isocyanate resins can improve their effectiveness in humid environment.

Furthermore, for wider application the research work is in progress to improve the hydro- mechanical properties and biodegradability concerns on the usage of rice straw composite materials.

Conclusions

1. The basic significance behind the fabrication of precast sand-

wich panels (precast insulated rice straw concrete panels) is that the portion around the neutral axis of the panel is under minimum bending stress. Therefore, that panel portion can be replaced with a lightweight, isolative, and durable material, reducing the weight of the overall building and is of prime importance in today's scenario. With the reduced moisture coefficient, the pre-treated Stubble waste can meet both lightweight and environmentally durable requirements.

- Rapid construction technology has led to the increased use of EPS panels in the construction industry. The usage of polystyrene in the middle core of EPS wall panels poses environmental problems, recycling challenges, and health risks. The research could lead to the creation of stubble straw boards as an alternative insulating material (rice straw composite board) with lower thermal conductivity, potentially replacing the EPS core.
- The rice straw composite board with a 70 % weight ratio of straw waste is presented as being more efficient in terms of insulation, physical and microstructural properties, and total cost.
- The process of creating composite boards from rice straw concludes by highlighting the material's potential as an economical, ecologically friendly,

and sustainable substitute for traditional building materials. This approach not only solves the issue of rice straw waste but also opens up new economic prospects by turning rice straw, an abundant agricultural byproduct, into usable composite boards, particularly in areas with extensive rice farming.

5. A good chance to balance environmental responsibility with commercial feasibility is to make rice straw boards. This method can help with rural development, encourage green building techniques, and help address global environmental issues like pollution and resource depletion by turning agricultural waste into a useful, sustainable building material. Rice straw boards have the potential to be a significant component of sustainable building and rural empowerment with the right technology innovation and market development.

Refrences

- 1. https://pib.gov.in/ Press-R e l e a s e P a g e . a s p x ? PRID=1837518#:~:text= Th e % 20list % 20of % 20 banned%20items, packing%20 films%20around%20sweet%20 boxes%2C
- https://en.wikipedia.org/wiki/ Phase-out_of_polystyrene_ foam
- 3. https://www.vic.gov.au/banning-dangerous-cladding-andkeeping-victorians-safe



Sensitisation Programmes at Demonstration Housing Project

s part of the capacity building of the professionals/ artisans/ students of engineering & architectural colleges with regard to emerging construction systems, the Council organised sensitisation programmes on the technologies being used in various Demonstration Housing Projects. In the series, Sensitisation Programmes were organised at Demonstration Housing Project site at Dimapur on 17th January, 2024, 13th February, 2024 and 6th June, 2024.





Youth in Urban Emergency and Disaster Management





Dr. Subrata Chattopadhyay ¹ Dr. Haimanti Banerji ² Sumedha Karandikar ³ Tushita Basak ⁴ Munzareen Fatma ⁵

bstract: In India, where youth constitute a substantial portion of the population and contribute significantly to the economy, engaging them in urban emergency and disaster management is increasingly crucial. This article examines how India is leveraging its youthful demographic to bolster disaster resilience through various participation models. With youth representing 27.5% of the population and showing rising workforce participation, there is untapped potential for enhanced disaster preparedness and response. The article highlights key models such as Roger Hart's Ladder of Participation, the Positive Youth Development (PYD) framework, and the Youth-Led Development (YLD) model, alongside practical case studies like the CUJ-DEVS-CCDRR-NIDM and GIDM training programs. These models emphasize empowering youth through education, technology, and leadership roles, reflecting a growing enthusiasm for integrating youth in disaster management strategies. As climate change exacerbates disaster risks, equipping the youth with the skills

and opportunities to lead is essential for building resilient urban communities. To fully harness India's demographic dividend, projected to last until 2055 as per the Economic Survey of India (2019-20), the country must focus on job creation, skill development, and reducing social inequalities to transform this potential into sustainable economic growth along with the climate resilience strategies.

Keywords:

Youth Engagement, Demographic Dividend, Disaster Management, Climate Resilience, India, Urban Planning.

1. Introduction:

1.1 Enhancing youth contribution to India's economy:

Youth Engagement, Disaster Management, Climate Resilience, India, Urban Planning Youth in the age group of 15-29 years represent 27.5% of India's population, contributing approximately 34% of the country's Gross National Income (GNI) as per the report published by National Youth Policy 2014 ((NYP), 2014). However, there is significant potential to enhance this contribution by improving youth labour force participation and increasing their productivity. Efforts aimed at skill development, education, and employment opportunities could further harness this demographic to maximize its impact on the national economy.

1.2 India's Demographic dividend:

India's demographic dividend, as described by the United Nations Population Fund (UNFPA, 2018), marks a critical phase where the working-age population outnumbers the dependent population, creating a unique opportunity for economic growth. Currently, nearly two-thirds of India's population falls within this working-age category, providing the country with significant potential to reap economic benefits. However, this potential can only be realized if investments are made in education, healthcare, and skill development.

The Economic Survey of India (2019-20) highlights a significant demographic advantage for India, projecting that the working-age population (20-59 years) will reach its peak share of 59% around 2041

¹ Professor, Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur

² Professor, Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur

^{3,4,5} MCP Student, Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur



((GOI), 2018). This demographic dividend offers a unique opportunity for sustained economic growth. To fully benefit from this advantage, India must integrate disaster-responsive and resilience strategies to ensure the workforce contributes effectively to long-term economic stability.

1.3 Rising Workforce Participation: A Catalyst for Disaster Management and Resilience:

The Periodic Labour Force Survev (PLFS) Annual Report 2022-2023 highlights significant growth in India's labour market, especially in rural and female workforce participation. The Labour Force Participation Rate (LFPR) increased from 50.7% to 60.8% in rural areas and from 47.6% to 50.4% in urban areas between 2017-18 and 2022-23. Female LFPR saw a sharp rise from 23.3% to 37.0%. The Worker Population Ratio (WPR) grew from 48.1% to 59.4% in rural areas and from 43.9% to 47.7% in urban areas, with female WPR increasing from 22.0% to 35.9%. Unemployment rates dropped significantly, from 5.3% to 2.4% in rural areas, 7.7% to 5.4% in urban areas, and 5.6% to 2.9% for females ((PLFS), 2022-2023).

This expanding, skilled workforce—particularly the rise in female participation—can significantly impact disaster management and resilience-building efforts. With rural populations increasingly engaged in economic activities, local capacities for disaster response are enhanced, and greater female involvement brings inclusive approaches to resilience. The decline in unemployment, coupled with a growing workforce, suggests more trained human resources are available for disaster preparedness, emergency response, and sustainable recovery across both rural and urban regions.

1.4 Harnessing Youth Potential for Climate-Responsive Disaster Resilience:

The Time Use Survey 2019 by the National Statistical Office reveals that 67.2% of rural youth and 55% of urban youth aged 15-29 are engaged in unpaid activities, while 33.1% of urban youth participate in paid work (MOSPI, 2022). This significant involvement in unpaid activities highlights an opportunity to enhance youth skills through community-driven initiatives like volunteering and capacity-building workshops. By focusing on climateresponsive practices and disaster preparedness, these programs can empower youth to protect local ecosystems, fostering selfsufficiency and resilience.

With India's population projected to reach 1.67 billion by 2050 ((UN), 2022).skilling the growing youth workforce becomes critical in addressing the increasing frequency of natural and man-made disasters driven by climate change. This presents both a challenge and an opportunity to strengthen disaster preparedness through timely workforce training and crisis management initiatives.

2. Climate change & Disaster:

2.1 Impact of Climate Change on Disasters in India:

Climate change is intensifying natural and man-made disasters in India, with severe consequences for communities and ecosystems. Between 1971 and 2008, India experienced significant losses from natural disasters. Floods and storms caused 2,489 deaths and affected 22.3 million people, while droughts impacted 25.3 million people and led to 8 deaths. Economic losses reached \$61.6 million from droughts and \$1.06 billion from floods and storms, representing 2.5% of GDP. Cyclones in Orissa (1971 and 1999) and Andhra Pradesh (1977) resulted in 10,000, 9,000, and 20,000 deaths respectively. Earthquakes, including those in Uttarkashi (1991), Latur (1993), and Bhuj (2001), caused over 18,723 deaths combined. Landslides and floods, such as the 2004 tsunami, resulted in significant casualties and economic damage. Projections for 2050 predict a 1.6°C rise in temperature, a 10.8-day longer heatwave season, and more intense rainfall, which will raise disaster risks.

2.2 India's increasing Disasters Amid Climate Change:

The IMD Annual Report 2022 highlights the increasing severity of natural disasters in India, exacerbated by climate change. Major events included unprecedented heat waves with temperatures 3°C-8°C above normal, affecting regions like the western Himalayas, Punjab, Haryana, Delhi, Rajasthan, and Uttar Pradesh. These heat waves triggered 300 large forest fires, impacting 70% of the country by late April. Other states like Odisha, Gujarat, and Jharkhand saw temperatures reach 40°C-44°C. India also experienced 1257.0 mm of rainfall (108% of the LPA), causing floods and landslides that claimed over 660 lives across Assam, Bihar, Maharashtra, and Himachal Pradesh. Cyclonic disturbances were above average, with 15 events, including 2 severe cyclonic storms. These extreme weather events, worsened by climate change, underscore the urgent need for enhanced disaster



preparedness and resilience-build-ing efforts.

2.3 Empowering Youth for Climate Resilience and Disaster Management:

Frequent disasters severely impact vulnerable communities by compromising security, disrupting access to essential resources like food and shelter, and intensifying inequalities. These events reduce access to clean air and water, compromise health, and weaken social cohesion. Youth can play a crucial role in enhancing climate resilience by assessing vulnerabilities, analyzing climate risks, and formulating innovative adaptation strategies. Their involvement in scoping, designing, and adapting projects brings fresh perspectives and technical skills, making climate solutions more dynamic and effective.

Also, Implementing National Mission on Strategic Knowledge for Climate Change objectives can greatly (NMSKCC) enhance youth capacity training by involving them in thematic knowledge networks, technical reports, and climate modelling. Engaging young professionals in climate science and technology fosters a skilled workforce, ensuring they are well-equipped for effective climate resilience and disaster management.

3. Youth Participation and Engagement Models:

Youth participation and engagement models involve frameworks that empower institutions to incorporate youth participation in community development and decision-making processes effectively. These models allow for society at large to build on the strengths of the youth population today and in turn, provide them with meaningful opportunities.

3.1 The Ladder of Participation: Roger Hart's Model of Youth Engagement:

Roger Hart's Ladder of Participation is a widely recognized model used to evaluate and understand the varying levels of youth involvement in decision-making processes. Developed in 1992, Hart's model is built on the foundation of Arnstein's Ladder of Citizen Participation (1969) but adapted specifically for children and young people. The model emphasizes the importance of youth having a real say in matters that impact their lives and communities, while also critiquing forms of "tokenism" that can limit genuine youth participation. The ladder highlights both the risks of non-participation (where young people are manipulated or used for appearances) and the potential for true collaboration and leadership. Each rung represents a step toward more significant, authentic youth engagement. To this today, Hart's Ladder remains an essential tool for prompting reflection on how to engage youth authentically. It provides a clear, visual framework to understand the varying levels of youth engagement in decision-making processes.

3.2 Positive Youth Development (PYD) Framework:

Positive Youth Development (PYD) framework is a strengthsbased approach that focuses on fostering the inherent potential of young people. Unlike traditional models that often focus on preventing risky behaviours, PYD emphasizes building assets, skills, and relationships that empower youth to thrive across multiple domains of life. It identifies five key outcomes—often referred to as the "5 Cs"—that are essential for youth to flourish.

- Competence: This refers to the ability of youth to develop specific skills in areas such as academic achievement, social interaction, and vocational abilities.
- Confidence: Confidence is the sense of self-worth and belief in one's abilities. It involves a positive view of one's strengths and the capacity to achieve goals.
- Connection: Connection refers to the positive bond's youth form with others, including family, peers, school, and the broader community.
- Character: Character involves the development of values such as responsibility, empathy, and ethical decision-making.
- **Caring:** Caring refers to the development of empathy and compassion toward others.

The Positive Youth Development framework this offers a powerful approach to helping young people realize their full potential. By focusing on strengths, fostering supportive relationships, and providing opportunities for skill-building and leadership, PYD equips youth to become confident, competent, and caring individuals. As more communities, schools, and organizations adopt this holistic model, youth are better positioned to thrive and contribute to a brighter, more equitable future for all.

3.3 Youth-Led Development Model:

The Youth-Led Development (YLD) model is a transformative approach to development that positions young people as active leaders and decision-makers in shaping the future of their communities. Rather than being passive beneficiaries of programs, youth are empowered to take the lead in identifying challenges, proposing solutions, and implementing initiatives that address the unique needs of their environments. The YLD model reflects a paradigm shift in development thinking, recognizing the energy, creativity, and innovation that young people bring to the table. This model goes beyond traditional youth participation by giving young people actual decisionmaking power and leadership roles in the planning, implementation, and evaluation of development projects. Collaboration and partnerships are central to the success of the Youth-Led Development model. As more communities and organizations adopt this approach, the Youth-Led Development model will play a pivotal role in shaping a brighter, more equitable future, where young people are not only participants but also the architects of their development.

4. Models for Youth Participation in Disaster Management:

Youth engagement in disaster management is increasingly recognized as a critical aspect of building resilient communities. Youth have the energy, creativity, and motivation to contribute to disaster preparedness, response, and recovery efforts. Various models have been developed to effectively engage youth in disaster management, each emphasizing different levels of participation, capacity building, and collaboration with stakeholders.

4.1 Youth-Led Disaster Preparedness Model:

The Youth-Led Disaster Pre-

paredness Model is an innovative approach that emphasizes the leadership and active participation of young people in disaster risk reduction and preparedness initiatives. Traditionally, disaster preparedness efforts have been managed by governmental bodies and expert organizations, often leaving youth in passive roles as beneficiaries. However, this model shifts the focus, recognizing the unique perspectives, energy, and creativity that young people bring to the table. By involving youth directly in planning, decisionmaking, and implementation, communities can build more resilient systems that are better equipped to handle crises. An important aspect of the Youth-Led Disaster Preparedness Model is the emphasis on peer-to-peer education and community engagement. By organizing workshops, public awareness campaigns, and school-based programs, youth can educate their peers and other community members about the importance of disaster preparedness. It also promotes the use of technology and social media as tools for disaster risk reduction. Today's youth are digital natives, and they are often adept at using social media platforms to mobilize communities, share critical information, and raise awareness. In the context of disaster preparedness, young people can leverage these platforms to disseminate early warnings, provide real-time updates during emergencies, and coordinate relief efforts. Additionally, youth can use technology to develop innovative solutions to disaster risks, such as mobile apps that track weather patterns, interactive hazard maps, and online platforms for community resource-sharing during



crises. By integrating technology into disaster preparedness efforts, the Youth-Led Model ensures that communities can respond more quickly and effectively to emerging threats.

4.2 Technology-Driven Youth Engagement Model:

In today's digital age, technology plays an integral role in the lives of young people, influencing how they communicate, learn, and engage with the world around them. As a result, youth engagement has evolved, with technology driving new forms of participation, activism, and leadership. The Technology-Driven Youth Engagement Model capitalizes on this reality, enabling young people to leverage digital tools and platforms to actively shape their communities, address societal challenges, and participate in decision-making processes. This model reflects a shift from traditional engagement methods to more dynamic, inclusive, and innovative approaches, where young people can amplify their voices, mobilize communities, and lead social change. One of the key strengths of the Technology-Driven Youth Engagement Model is its flexibility and adaptability. Technology enables youth to engage in a variety of ways, from grassroots organizing and activism to entrepreneurship and innovation. In addition to facilitating activism, the Technology-Driven Youth Engagement Model fosters collaboration and networking among young people. Digital platforms allow youth to connect with like-minded individuals, share resources, and collaborate on projects, regardless of their location. This global connectivity has given rise to youth-led movements that transcend borders. Movements



such as Fridays for Future, led by climate activist Greta Thunberg, have mobilized millions of young people worldwide to demand action on climate change. Through these digital networks, young people are building global communities of changemakers united by a common goal of social progress. As more young people embrace digital tools to lead change, the Technology-Driven Youth Engagement Model will continue to play a critical role in shaping the future of youth participation and activism in the 21st centuries.

5. India in Mobilizing Youth for Urban Emergency and Disaster Management:

5.1 Case Study 1: CUJ-DEVS-CCDRR-NIDM-Training Program:

Context: The CUJ-DEVS-CCDRR-NIDM-Training Program is a collaborative initiative between the Central University of Jharkhand (CUJ), the Department of Environmental Sciences (DEVS), the Centre for Climate and Disaster Risk Reduction (CCDRR), and the National Institute of Disaster Management (NIDM). This program targets youth and adolescent coordinators involved in various national forums like the National Service Scheme (NSS), Nehru Yuva Kendra Sangathan (NYKS), Bharath Scouts and Guides (BSGs), and National Cadet Corps (NCC), focusing on enhancing their skills in disaster risk management (DRM) (DES & NIDM, 2022)

Methods of Management:

Capacity Building through Training Modules: The program offers a detailed training module covering fundamental DRM concepts, youth roles in DRM, and engagement strategies. Training methods include role plays, group discussions, videos, and games, promoting interactive learning and practical skill development (DES & NIDM, 2022). This hands-on approach equips participants to apply their knowledge effectively in real-world scenarios.

Focus on Youth Empowerment: Training emphasises youth empowerment by teaching disaster management and climate change mitigation, preparing them to lead community-based initiatives such as evacuation drills and awareness campaigns (DES & NIDM, 2022). This empowerment leverages youth energy and creativity for proactive disaster risk management.

Integration with Existing Forums: The program integrates with existing youth forums (NSS, NYKS, NCC), ensuring trained youth can collaborate with these organizations to contribute to broader DRM strategies. This integration facilitates a more organized and extensive approach to disaster management (DES & NIDM, 2022).

Takeaways:

- Effective Youth Engagement: The program underscores that structured education and practical training can significantly enhance youth involvement in disaster management. Engaged youth have shown improved understanding and active community participation during emergencies (DES & NIDM, 2022).
- 2. Real-world Impact: Success is evident in increased youth involvement in DRM activities, including organizing relief operations and awareness campaigns. This active participation highlights the vital role of youth in effective disaster manage-

ment (DES & NIDM, 2022) .

3. Enhanced Collaboration: The program's integration with established youth forums demonstrates the importance of collaboration among stakeholders, leading to more coordinated and impactful disaster risk reduction efforts (DES & NIDM, 2022).

5.2 Case Study 2: Training Module Role of Youth and Volunteers for Disaster Risk Management Virtual Classroom-based Training Program by Gujarat institute of disaster management:

Context: The Gujarat Institute of Disaster Management (GIDM) has been at the forefront of equipping youth and volunteers with DRM skills, primarily through virtual classroom-based programs. This initiative is implemented in urban areas like Surat, where rapid urbanization increases disaster vulnerabilities. Stakeholders include local governments, NGOs, community-based organizations, and national volunteer groups such as the National Cadet Corps (NCC) and National Service Scheme (NSS).(Gujarat Institute of Disaster Management, 2020)

Methods of Management:

These virtual programs adopt an interactive learning methodology, incorporating simulations, case studies, and collaborative activities. Youth participants are trained in risk assessment, early warning systems, and disaster preparedness. Surat's model, for example, emphasizes flood risk management, given its historical vulnerability to flooding. The training focuses on enabling youth to participate in emergency evacuation, awareness campaigns, and



post-disaster recovery efforts. (Gujarat Institute of Disaster Management, 2020)

Takeaways:

(Gujarat Institute of Disaster Management, 2020)

- The Surat case illustrates that involving youth as active stakeholders in DRM enhances disaster preparedness and strengthens community resilience. The training equips them to take leadership roles in awareness campaigns and disaster response, leading to quicker, more effective local recovery processes.
- Initiatives such as the CUJ-DEVS-CCDRR-NIDM-Training Program emphasize youth empowerment through capacity building, equipping them with disaster management skills that are critical for mitigating the impact of emergencies. By integrating with national forums like the National Service Scheme (NSS) and National Cadet Corps (NCC), these programs ensure that young people are not just participants but active leaders in disaster risk reduction.
- The Gujarat Institute of Disaster Management (GIDM) case shows the importance of technology-driven models, where youth are trained in risk assessment and early warning systems via virtual programs. The emphasis on flood management in Surat demonstrates youth's practical role in enhancing local resilience.
- Both case studies highlight how skilling and engaging India's growing youth population in disaster preparedness directly

contributes to building resilient urban communities. They reflect a practical application of Roger Hart's Ladder of Participation and the Positive Youth Development (PYD) framework, ensuring that youth are fully engaged in shaping their communities' futures.

Conclusion:

India's youth hold significant potential to drive both economic growth and disaster resilience through targeted skills development and community engagement. By empowering them with climate-responsive strategies and capacity-building opportunities, they can play a critical role in disaster preparedness and sustainable development. Effectively using this potential will be essential for addressing the growing challenges posed by climate change. India's increasing severity of climate-related disasters highlights the need for stronger disaster preparedness and resilience efforts. By equipping youth with the necessary skills and involving them in climate adaptation initiatives, they can play a crucial role in addressing these challenges and building a more resilient future. As active leaders and changemakers, youth have the potential to drive meaningful transformation in their communities when given the right tools, resources, and opportunities. The youth engagement models provide effective methodologies that leverage regulatory and technological drivers to empower the youth. With the tools, knowledge, and leadership opportunities they need, we can create a future where young voices lead the way in building more inclusive, and innovative communities. Similarly,

youth-led disaster preparedness models, in particular, demonstrate how involving youth in proactive disaster planning and response not only builds community resilience but also fosters a culture of preparedness and collaboration across generations. India's youth have immense potential to be key players in urban emergency and disaster management. By integrating models like Youth-Led Development and Technology-Driven Youth Engagement, along with best practices like those seen in the CUJ-DEVS-CCDRR-NIDM and GIDM training programs, the nation is cultivating a generation of young leaders equipped with the skills, creativity, and drive necessary to build resilient communities. As climate change accelerates disaster risks, empowering youth with knowledge and leadership opportunities ensures they are well-prepared to protect and shape the future of urban India.

References

- (GOI), G. o. (2018). India's Demography at 2040: Planning Public Good Provision for the 21st Century. Economic Survey, Government of India.
- (NYP), M. o. (2014). National Youth Policy. Government of India.
- (PLFS), P. L. (2022-2023). Increasing Trend in Labour Force Participation Rate and Worker Population Ratio Constant Decrease in Unemployment Rate. Delhi: Ministry of Statistics & Programme Implementation. Retrieved from https://pib.gov. in/PressReleaseIframePage. aspx?PRID=1966154.
- (UN), U. N. (2022). World Population Prospects. Department



of Economic & Social Affairs, United Nations .

- MOSPI. (2022). Youth In India. Social Statistice Division, National Statistical Office, Government of India.
- UNFPA. (2018). Harnessing India's Demographic Dividend. UNFPA India.
- Arnstein, S. (1969.) A ladder of citizen participation. Journal of

the American Planning Association.

- DES, C., & NIDM, G. (2022). Flyer-NIDM-CUJ-Training Programme. https://nidm.gov.in/ pdf/trgReports/2022/August/ Report_03-05August2022ccdrr. pdf
- Gujarat Institute of Disaster Management. (2020). Training Module Role of Youth and Volunteers for Disaster Risk

Management VIRTUAL Classroom based Training Program. https://gidm.gujarat.gov.in/ sites/default/files/educate_ your_self_document/Virtual%20Classroom%20Based%20 Training%20Module%20on%20 Role%20of%20Youth%20 and%20Volunteers%20for%20 Disaster%20Risk%20Management.pdf

Technical Committee under the Panel for Building Materials CED46:P3 of BIS for revision of Part-5 of National Building Code (NBC)

ational Building Code (NBC) is being revised and the new version will be rolled out by the end of 2025. There are 22 panels entrusted to revise different parts. Towards progressively revising the Part 5 Building Materials of NBC, a meeting of the Expert Panel was convened on March 12, 2024 under the Chairmanship of Dr. Shailesh Kumar Agrawal, Executive Director, BMTPC in hybrid mode.

Some of the focus areas decided for revision include:

Sustainability: Emphasis will be placed on incorporating sustainable practices throughout the building material lifecycle.

3D Printing: Integration of 3D printing technology in construction will be addressed with specific guidelines.

Alternate Technologies: Detailed requirements for alternative build-

ing methods will be established. **Recycled Materials:** The use of recycled materials in construction will be encouraged through regulations.

Stakeholders from the construction industry, including architects, engineers, and material suppliers, are also encouraged to suggest their inputs to BIS to ensure practical implementation.





Technology Transition through Light House Projects under Pradhan Mantri Awas Yojana – Urban (PMAY-U)



Dr. Shailesh Kr. Agrawal

ntroduction

Urban India is transforming at an unprecedented rate as regards urban renaissance is concerned. Besides, Atal mission for rejuvenation and urban transformation (AMRUT), there are other flagship programmes run by Ministry of Housing & Urban Affairs such as Smart Cities Mission, Swachh Bharat (Urban) Mission, Heritage City Development & Augmentation (HRIDAY) Scheme, Urban Transport & Pradhan Mantri Awas Yojana - Urban (PMAY-U). The PMAY-U has been the landmark in the annals of India history where it is dreamt to provide shelter security to one and all. It is one of the biggest missions ever thought of around the globe with the objective of providing 1.1224 crore houses. Under the mission, 1.1864 crore houses have been sanctioned, out of which 1.1441 crore houses are grounded and 85.55 lakh houses are completed/ delivered to beneficiaries. More than 16 lakh houses are being constructed with emerging construction technologies in various States. It is high time to bring paradigm shift in the traditional construction practices through sustainable

technologies which can speed up delivery of quality durable houses. The global pandemic COVID-19 have further accelerated disruption in the construction sector and modularization, standardization, off-site construction, introduction of new and lighter materials, safety and sustainability are going to be new normal in the sector. The PMAY(Urban) Scheme not only provides housing for urban poor but also contribute towards economic growth of the country through consumption of sizeable amount of steel and concrete and generating employment directly and indirectly to more than 3 crore persons.

The cast-in-place brick by brick construction and RCC beam-column construction are the things of past and are slow track construction practices. Also, it has been realized that these methodologies often offer time & cost overruns and are unsustainable in the long run. The world over, building construction has been shifted from site to the factory where building components partially or fully are manufactured and then transported to the site for their erection, assembly and finishing. This is known as typically precast or

prefabricated construction where building components as a whole or in parts are cast in the factory. In addition, there are other options also such as replacing the wall by sandwich panels or creating a customized formwork for the building or manufacturing the entire threedimensional building in the factory which can be pre-finished or printing the building layer by layer manufacturing at site. Most of these techniques are time-tested and proven and it is high time that we look at these global construction practices and adapt them to suit Indian conditions. These are fast track construction systems with much improved structural & functional performance, better durability, low life-cycle cost, resource-efficient, with minimum wastages, air & land pollution than the cast-in-situ RCC construction.

In order to have an integrated approach for comprehensive technical & financial evaluation of emerging and proven building materials & technologies, their standardization, developing specifications and code of practices, evolving necessary tendering process, capacity building and creating appropriate delivery mechanism, MoHUA set up a Technology Sub-

* Executive Director, Building Materials & Technology Promotion Council (BMTPC), New Delhi, E-mail: shailesh.agrawal@gov.in



Mission (TSM) under PMAY-U with the Mission statement as 'Sustainable Technological Solutions for Faster and Cost Effective Construction of Houses suiting to Geo-Climatic and Hazard Conditions of the Country'.

Global Housing Technology Challenge - India

To give it further impetus Ministry of Housing and Urban Affairs (MoHUA) conceptualized the Global Housing Technology Challenge - India (GHTC-India) as a platform with which a holistic eco-system can be facilitated so that appropriate technologies from around the world and relevant stakeholders can be catalysed towards effecting a technology transition in the housing and construction sectors of India. GHTC-India was organised through Construction Technology India – 2019 (CTI-2019) : Expo-cum-Conference at Vigyan Bhawan, New Delhi during 02-03 March, 2019 to bring together multiple stakeholders involved in innovative and alternative housing technologies, for exchange of knowledge and business opportunities and master classes. The Expo was inaugurated by Hon'ble Prime

Minister of India. The purpose of CTI-2019 was to study & evaluate globally available time tested & proven construction systems which can help build at a much faster rate than the conventional construction cost-effectively suiting to Indian geo-climatic conditions. Through a high level Technical Evaluation Committee, 54 innovative technologies were shortlisted out of globally participating agencies based on the technical framework. These are being promoted as future technologies for the construction sector and have been further categorized into 6 broad categories.

- A. Precast Concrete Construction System - 3D Precast volumetric (4 Technologies)
- B. Precast Concrete Construction System – Precast components assembled at site (8 Technologies)
- C. Light Gauge Steel Structural System & Pre-engineered Steel Structural System (16 Technologies)
- D. Prefabricated Sandwich Panel System (9 Technologies)
- E. Monolithic Concrete Construction (9 Technologies)
- F. Stay-in-Place Formwork System (8 Technologies)

Construction of Six Light House Projects under GHTC-India

The shortlisted technologies are showcased through six Light House Projects (LHPs) constructed across six locations namely, Indore, Rajkot, Chennai, Ranchi, Agartala and Lucknow, using distinct technologies from each of the six broad categories. The details of the LHPs are given in Table 1.

These LHPs are pilot housing projects which are paving the way for further adaption and use of these innovative technologies in the construction sector. The projects are showcasing construction of ready-to-live houses which are sustainable, cost-effective, resilient and built in much lesser time from the conventional cast-in-situ RCC framed construction. The Light House Projects at Chennai, Rajkot and Indore have been completed & handed over to the beneficiaries by the Hon'ble Prime Minister. The LHPs at Lucknow, Ranchi & Agartala are at advanced stage of completion.

These light house projects is acting as open live laboratories for different aspects of transfer of technologies to field applications. An online drive for Enrolment of

S. No.	Location	DUs, Storeys	Technology
1.	Indore, MP	1024, S+8	Precast Sandwich Panel system (Precast RCC Columns & Beams, Hollow Core Slabs, EPS Cement
2.	Rajkot, Gujarat	1144, S+13	Monolithic Concrete Construction (Tunnel Form)
3.	Chennai, Tamil Nadu	1152, G+5	Precast Concrete Construction –Precast components assembled at site
4.	Ranchi, Jharkhand	1008, G+8	Precast concrete construction – 3D Volumetric Construction
5.	Agartala, Tripura	1000, G+6	Light Gauge Steel Structural System & Pre-Engineered Steel Structural System
6.	Lucknow, UP	1040, S+13	Stay-in-Place Formwork System (Steel Structural System, composite decking floor & Stay-in-Place Formwork for walls)

Table 1: Details of the LHPs



TECHNOGRAHIS under GHTC-India: Light House Projects was launched by MoHUA. Technograhis are the Change Agents of innovative and sustainable technologies who will bring about technology transition in the construction sector for its adoption & replication in the country. They will act as Catalysts to Transform the Urban Landscape for New Urban India to full the vision of AatmaNirbhar Bharat. So far more than 35000 Technolograhis have registered for various LHPs. Technograhis are being exposed to the innovative construction technologies through onsite activities to learn different phases of use of innovative technologies in LHPs as well as through offsite Workshops/ Webinars, Webcasting, Mentoring on Technical know-how/Module etc.

The details of innovative technologies used in six Light House Projects are as under:

Light House Project at Chennai, Tamil Nadu

Project Brief:

- No. of Dwelling Units : 1152 Nos. (G+5)
- No. of Block / Tower : 12 Blocks
- Units in each Block / Tower : 96 Nos.
- Technology Used: Precast Concrete Construction System-Precast Components Assembled at Site

Technology Details:

- Precast building components (beams, columns, slabs, staircases, sunshades) are cast in casting yard near site
- Precast components erected sequentially to construct the entire building
- The joints between precast

components (i.e. beam-column, beam-slab, column-foundation) are cast-in-situ for structural integrity and monolithic action

- The walls comprise of light weight and environment friendly Autoclaved Aerated Concrete (AAC) Block masonry.
- Internal services are pre planned in sync with precast components
- Minimum use of shuttering and scaffolding materials

About the Precast Concrete Construction System-Precast Components Assembled at Site

3S system incorporates precast dense reinforced cement concrete hollow core columns, structural RCC shear walls (as per design demand), T/L/Rectangular shaped beams, stairs, floor/roof solid Precast RCC slabs, lintels, parapets and chajjas. AAC blocks are used for partition walls. Hollow core columns are erected above substructure, over which beams are integrated in the column notches followed by erection of slabs. Structural continuity and robustness is achieved through wet jointing using Dowel bars/ continuity reinforcement placed at connections and filling the insitu self-compacting concrete in hollow cores of columns. All the connections and jointing of various structural framing components is accomplished through insitu self-compacting concrete/ micro concrete/non-shrink grout as per design demand along with secured embedded reinforcement of appropriate diameter, length and configuration to ensure monolithic, continuous, resilient, ductile and durable behavior.

3S Prefab Technology completely eliminates the use of timber



Fig.1: Structural configuration of 3S System

and forest produce of any category. On the contrary, use of flyash and GGBS enhances the sustainability. The thermal and acoustic insulation provided by the AAC block masonry, facilitates reduction in energy towards maintaining comfort level temperature within enclosed habitat space. Also, considerable reduction in dead load is achieved due to use of form finish precast components & AAC material resulting into better performance under seismic loads.

All the structural components are pre-engineered and manufactured in factories / site factories with objective quality control resulting into dimensional accuracy, correctness in spacing of reinforcement, uniform protective cover, full maturity of components and assurance on design strength due to use of design mix concrete having minimal water-cement ratio which ultimately results into durable structure.

Essential Requirements : Precasting yard / factory set up is required with facilities such as Casting Yard, Computerised batch-





Fig.2: Beam – Column jointing



Fig.3: Completed Light House Project at Chennai



Fig.4: Inauguration of the Light House Project Chennai by Hon'ble Prime Minister on May 26, 2022

ing plant, Moulds, Transportation facility, Stacking yard for materials & components, Lifting and loading facility, Laboratory to test raw material & finished products, Water tank of enough holding capacity as required for 2 – 3 days, Service road, etc. Utmost attention is required for process engineering before taking up any field work. Close co-ordination between design crew, field staff and quality crew is essential.

Light House Project at Rajkot, Gujarat

Project Brief:

- No. of Dwelling Units : 1144 Nos. (S+13)
- No. of Block / Tower : 11 Blocks
- Units in each Block / Tower : 104 Nos.
- Technology Used: Monolithic Concrete Construction using Tunnel Formwork

Technology Details:

- Conventional RCC foundation is first laid upto plinth level
- Over the plinth, customized Tunnel formwork, made in the factory, is installed along with reinforcement cage
- Concrete is then poured into the Tunnel formwork to cast monolithically the entire module of the Unit.
- Next day, tunnel formwork is removed and taken to the next floor.
- During installation of the formwork for a floor, the service lines i.e. electrical, plumbing are also installed in the already cut openings.
- Once the structure is finished, finishing items are installed.

About the Monolithic Concrete Construction using Tunnel Formwork

Tunnel formwork is customized engineering formwork replacing conventional steel/plywood shuttering system. It is a mechanized system for cellular structures. It is based on two half shells which are placed together to form a room or cell. Several cells make an apartment. With tunnel forms, walls and slab are cast in a single day. The structure is divided into phases. Each phase consists of a section



of the structure that will be cast in one day. The phasing is determined by the program and the amount of floor area that can be poured in one day. The formwork is set up for the day's pour in the morning. The reinforcement and services are positioned and concrete is poured in the afternoon. Once reinforcement is placed, concrete for walls and slabs shall be poured in one single operation. The formwork is stripped the early morning next day and positioned for the subsequent phases.

The on-site implementation of 24 hour cycle is divided into following operations.

• Stripping of the formwork from

the previous day.

- Positioning of the formwork for the current day's phase, with the installation of mechanical, electrical and plumbing services.
- Installation of reinforcement in the walls and slabs.
- Concreting and if necessary, the heating equipment.

The types of Formwork System are given below:

i. Modular Tunnelform

Tunnel forms are room size formworks that allow walls and floors to be caste in a single pour. With multiple forms, the entire floor of a building can be done in a single pour. Tunnel forms require



Fig.5: Installation of Tunnel Formwork



Fig.6: Concreting

sufficient space exterior to the building for the entire form to be slipped out and lifted up to the next level.

This Tunnelform consists of inverted L-shaped half tunnels (one vertical panel and one horizontal panel) joined together to create a tunnel. Articulated struts brace the horizontal and vertical panels. These struts enable the adjustment of the horizontal level of the slab and simplify the stripping of the formwork. The vertical panel is equipped with adjustable jacking devices and a triangular stability system. Both devices are on wheels.

A range of spans is possible by altering the additional horizontal infill panel's dimensions. Due to the distribution of the horizontal beams on the vertical plank, the formwork also cast staggers and offsets in the layout of the walls as well as differing wall thicknesses. The half-tunnels shall be equipped with back panels to cast prependicular shear walls or corridor walls. Assembly and levelling devices ensure that the formwork surfaces are completely plumbed and levelled.

ii. Wallforms

Wallforms are temporary moulds in which concrete is poured in order to build a structure. Once the concrete is poured into the formwork and has set, the formwork is stripped to expose perfect finished concrete. These forms constitute a system approach for construction and are particularly suited to build structural walls, columns, bridge piers, culverts etc. This system adopts well to daily work-phase of both repetitive and non-repetitive tasks. The equipment used each day is produc-



tive and is reused in subsequent phases. The four daily operations which outlines the daily production cycle for wall form equipment are identical to those for Tunnel form equipment with the exception that it is solely used for casting concrete walls. The slabs are cast as a secondary phase. The existing equipment can be adapted on a day-to-day basis by the addition of standard elements and cornerwall formwork to take into account different wall configurations on site. All safety and stability devices shall be fully integrated into the standard version of Wallform equipment.

These Wallforms are tools specially designed to be used on specific buildings and structures. This vertical wallform panel is a multi-purpose formwork system. This system has been designed and developed to ensure that it is simple and quick to assemble and position the following:

- A full range of standard dimensioned components
- Multiple combination of panels for simple adoption to specific configurations
- Basic standard equipment incorporates complete safety, circulation and stability equipment
- Caliper–device opposing Wallform packages are craned into position in one lift.

Light House Project at Indore, Madhya Pradesh

Project Brief:

- No. of Dwelling Units : 1024 Nos. (S+8)
- No. of Block / Tower : 8 Blocks
- Units in each Block / Tower : 128 Nos.
- Technology Used: Prefabricated



Fig.7: Placement of Tunnelform and casting of concrete



Fig.8: Completed Light House Project at Rajkot



Fig.9: Inauguration of the Light House Project Rajkot by Hon'ble Prime Minister on October 19, 2022

Sandwich Panel System with Pre-Engineered Steel Structural System

Technology Details:

• Over RCC foundation up to

plinth level hot rolled steel columns and beams are erected, aligned and assembled to form structural skeleton frame

 Subsequently, deck slabs are laid with in-situ concrete screed



for floors

- The factory-made Rising EPS Cement Panels are erected as wall panels. These are sandwich panels having light weight concrete core with thin cement fibre board as outer faces.
- While laying walls the service lines i.e. electrical, plumbing are also installed in the already cut openings
- Once the structure is finished, finishing items are installed.

About the Prefabricated Sandwich Panel System with Pre-Engineered Steel Structural System

These are lightweight composite wall, floor and roof sandwich panels made of thin fiber cement/ calcium silicate board as face covered boards and the core material is EPS granule balls, adhesive, cement, sand, flyash and other bonding materials in mortar form.

The core material in slurry state is pushed under pressure into preset molds. Once set, it shall be moved for curing and ready for use with RCC or steel support structure beams and columns. These panels are primarily used as walling material but can also be used as floor and roof panels. These are non-load bearing panels to be used with structural support frame only. However, if used in G+1 structure, these can be used as load bearing panels.

Size and Type of Panels

- Size: Panels are normally produced in sizes and dimensions as given below:
- Length: 2440 mm (may be increased up to 3000 mm)
- Width: 610 mm (may be altered as per requirement but should not be too wide



Fig.10: Placement of Prefabricated Sandwich Panels in Steel Structure Frame



Fig.11: Completed Light House Project at Indore



Fig.12: Inauguration of the Light House Project Indore by Hon'ble Prime Minister on October 5, 2023

since handling of the panels become difficult) Thickness: 50-250 mm.

Panels are produced in 4 types i.e. Pole holes, Solid heart, Rod holes and Block hole. These four types of panels have different applications depending on the requirements e.g. Solid heart should be used as walling material in any type of construction and pole, rod and block hole may be used where



different types of inserts are used like iron rods or wires for security etc.

In steel structure frame, panels can be fixed with either with steel clips or U type channels to hold the panels with the structure. Clips should be welded with the frame pillars or beams to hold the clips / U cannel firmly with the pillars /beans and floor. Then only the panels should be inserted into the U channels. There after PU glue should be applied to hold the panels firmly. The thickness of the panels shall determine the size of U channel. After installation of the panels in both the above systems, all gaps should be checked and filled with additives, PU and cement mixers and later thin putty should be applied to give uniform smooth surface ready for paint.

Light House Project at Lucknow, Uttar Pradesh

Project Brief:

- No. of Dwelling Units : 1040 Nos. (S+13)
- No. of Block / Tower : 4 Blocks
- Units in each Block / Tower : A(494), B(130), C(208) & D(208)
- Technology Used: Stay in-place PVC Formwork with Pre-Engineered Steel Structural System

Technology Details:

- Over the RCC foundation up to plinth level factory-made hot rolled steel columns and beams are erected, aligned and assembled to form structural skeleton frame
- Subsequently, deck slabs are laid with in-situ concrete screed for floors
- The pre-finished PVC wall forms are then erected and filled with light weight concrete to construct walls

- While laying walls the service lines i.e. electrical, plumbing are also installed
- Once the structure is finished, finishing items are installed

About the Stay in-place PVC Formwork with Pre-Engineered Steel Structural System

The rigid poly-vinyl chloride (PVC) based form work system serve as a permanent stay-inplace durable finished form-work for concrete walls. The extruded components slide and interlock together to create continuous formwork with the two faces of the wall connected together by continuous web members forming hollow rectangular components. The web members are punched with oval-shaped cores to allow easy flow of the poured concrete between the components. The hollow Novel Wall components are erected and filled with concrete, in situ, to provide a monolithic concrete wall with enhanced curing capacity due to water entrapment, as the polymer encasement does not allow the concrete to dry prematurely with only the top surface of the wall being exposed to potential drying. The polymer encasement provides crack control vertically and horizontally for the concrete, and provides vertical tension reinforcement thus increasing the structural strength of the wall. The resulting system is unique and provides substantial advantages in terms of structural strength, durability enhancement, weather resistance, seismic resistance, design flexibility, and ease of construction. Steel dowels are necessary to anchor the wall to the concrete foundation.

This System is suitable for residential and commercial buildings of any height from low rise to high rise. In order to achieve speedier construction, strength and resource efficiency, the composite structure with Pre-Engineered Steel Structural System as structural members is being used in the present project.

Size of Panels

PVC Wall Forms have been developed in various cross-sectional sizes as per project requirement. The common sizes are 64mm, 126mm, 166mm & 206mm.

- N64 walls are erected individually and not preassembled, except for headers and sills.
- Pre-assembled walls sections are used for walls over 4300 mm (14') high
- The height of walls made with the Formwork vary according to the requirement.
- N126 walls less than 4300 mm (14') high are erected individually except for walls of unique projects and for headers and sills.

Manufacturing Process in the Plant

The formwork Components are manufactured from extruded polyvinyl chloride (PVC). The extrusions consist of two layers, the substrate (inner) and Modifier (outer). The two layers are co- extruded during the manufacturing process to create a solid profile. The raw material is fed into the screw barrels of the extruders & heated in the barrels to molten form, where the temperature is electronically controlled. The extruded profile is cut to designed length, labelling of the components takes place in the coring, cutting, foaming or assembly areas, and the stay in place sections are ready to move for erection at site.





Fig.13: Placement of PVC Wall Form Panels in Steel Structure Frame



Fig.14: Completed buildings of Light House Project at Lucknow



Fig.15: Virtual Inauguration of the Light House Project Lucknow by Hon'ble Prime Minister on March 10, 2024

Light House Project at Ranchi, Jharkhand

Project Brief:

- No. of Dwelling Units : 1008 Nos. (G+8)
- No. of Block / Tower : 7 Blocks
- Units in each Block / Tower : 144 Nos.
- Technology Used: Precast Concrete Construction System – 3D Volumetric

Technology Details:

- The building units are manufactured like Lego blocks in the casting yard in complete form including finishes
- These blocks are then transported, aligned and erected over the already laid RCC foundation to construct the entire structure
- These building units are also finished with services in the casting yard
- The building units are connected horizontally and vertically with proper jointing arrangements using base-plates, mechanical fasteners, nut bolts and concrete grouting.

About the Precast Concrete Construction System – 3D Volumetric

An already established System for building construction in Europe, Singapore, Japan & Australia, this 3D Volumetric concrete construction is the modern method of building by which solid precast concrete structural modules like room, toilet, kitchen, bathroom, stairs etc. & any combination of these are cast monolithically in Plant or Casting yard in a controlled condition. These Modules termed as MagicPods are transported, erected & installed using cranes and push-pull jacks and are integrated together in the form of complete building unit. Subject



to the hoisting capacity, building of any height can be constructed using the technology.

Manufacturing process of the Building Modules/MagicPods

- 3D Steel moulds are created as suiting to various sizes of building Units
- High strength steel as per the structural design is placed inside 3D moulds
- Electrical and plumbing lines are set up. Block outs for doors and windows are also set up at the same time.
- The pods are cast into their final shape using high-performance concrete.
- Stringent quality checks is taken for each pod before they are packed for shipping, which ensures that the construction project adheres to strict quality standards.
- The pods are then loaded and shipped. Care is taken to ensure that the shipping is done as per the sequence of erection at the site.

Construction & Installation Process

Sequential construction in the project here begins with keeping the designed foundation of the building ready, while manufacturing of precast concrete structural modules are taking place at the factory. Factory finished building units/modules are then installed at the site with the help of tower cranes. Gable end walls are positioned to terminate the sides of building. Pre stressed slabs are then installed as flooring elements. Rebar mesh is finally placed for structural screed thereby connecting all the elements together. Consecutive floors are built in similar manner to complete the structure.



Fig.16: Placement of MagicPods



Fig.17: Completed building of Light House Project at Ranchi



Fig.18: Virtual Inauguration of the Light House Project Ranchi by Hon'ble Prime Minister on March 10, 2024



Light House Project at Agartala, Tripura

Project Brief:

- No. of Dwelling Units : 1000 Nos. (G+6)
- No. of Block / Tower : 7 Blocks
- Units in each Block / Tower : A(112), B(154), C(118), D(168), E(168), F(168) & G(112)
- Technology Used: Light Gauge Steel Framed (LGSF) System with Pre-engineered Steel Structural System

Technology Details:

- Over the RCC foundation up to plinth level hot rolled steel columns and beams are erected, aligned and assembled to form structural skeleton frame. Subsequently, deck slabs are laid with in-situ concrete screed for floors.
- The factory-made Light Gauge Steel Panels (cold formed steel panels) are then erected to form wall panel and connected with the structural frame using self-driven metal screws.
- The Light Gauge wall panels are later covered with thin precast concrete panels (which are cast at site), and the hollow space between the panels is filled with light weight concrete.
- While laying walls, the service lines i.e. electrical, plumbing are also installed
- Once the structure is finished, finishing items are installed.

About the Light Gauge Steel Framed (LGSF) System with Pre-engineered Steel Structural System

Light Gauge Steel Framed Structure with Infill Concrete Panels (LGSFS-ICP) Technology is an innovative emerging building and construction technology using factory made Light Gauge Steel Framed Structure (LGSFS), light weight concrete and precast panels. The LGS frame is a "C" cross-section with built in notch, dimpling, slots, service holes etc. produced by computerized roll forming machine. These frames are assembled using metal screws to form into LGSF wall and roof structures of a building. Provisions for doors, windows, ventilators and other cutouts as required are incorporated in the LGSFS. The LGS frames are manufactured in a factory and assembled in to LGSF wall structures and then transported to the construction site and erected wall by wall on a pre-built concrete floor as per the floor plan of the building. Steel reinforced concrete panels of size 800mm X300mm X20mm thick are manufactured at factory and transported to site. These panels are fixed on either side of the LGSFS wall using self-



Fig.19: Placement of LGS frames in Steel Structure System



Fig.20: Placement of Precast Concrete Panels filled with Light Weight Concrete in LGS frames



drilling/tapping screws to act as outer and inner faces of the wall leaving a gap between them. This gap is then filled with light weight concrete using a special mixing and pumping machine. Electrical and plumbing pipes/conduits are provided in the service holes of the LGSFS before concreting is done. Self-compacting concrete is mixed and pumped into the gaps between two panels. The concrete flows and fills the gap and provides adequate cover to the LGS frames and joints. The concrete shall also adhere to the concrete panels. After curing, LGSFS with in-fill concrete and panels (LGSFS-ICP) forms a monolithic sandwich composite wall structure with thermal and sound insulation properties.

The roof structure of LGSFS-ICP building is constructed using metal/plastic formwork system with steel reinforced concrete as per structural design. Standard procedures are employed to concrete the roof slab. After curing for 96 h, the formwork is demoulded and the wall and roof are putty finished. Door and window frames are fixed to the LGS frames and shutters fixed with necessary accessories. Finishing work such as laying floor tiles, fixing electrical and sanitary fixtures and painting is carried out using standard conventional methods.

After completion of ground floor, first, second and third floors of the building is constructed using the same procedure that of the ground floor. The staircase, chajja and parapet walls of the building are also constructed using LGSFS-ICP Technology.

Epilogue

Through GHTC-India under

Technology Sub-Mission of Pradhan Mantri Awas Yojana (Urban), the Ministry of Housing & Urban Affair in association with State Governments have successfully implemented the first of its kind Light House Projects with innovative construction technologies showcasing field level application and in turn assimilating their usages for further adaptation and replication. BMTPC being technical partner to the Ministry has since been advocating use of these SAFER (Sustainable, Affordable, Functional, Economical, Resilient) fast track construction technologies for housing and it is more apt now since India is committed to climate change mitigation, reduction of carbon foot print, resourceefficient & environment-responsive clean technologies. These construction technologies being based on industrialized systems claim to bring resource-efficiency with regard to natural building material and human resource, waste reduction, energy efficiency and eco-friendliness bringing down GHG emissions and disaster & climate resilience.

Introduction of the identified innovative construction systems will bring not only paradigm shift in construction sector but also bring cost-effective systems, better environment, enhanced building marketability, reduced liability, improved health & productivity, low life cycle cost. Already, a sizeable number of companies have set up plants for manufacturing customized building components in India. It is required to give them little nudge and create an enabling eco-system which facilitates use of these systems. The day is not far when India will start manufacturing buildings.

References

- Operational Guidelines for Implemenation of Light House Projects (LHPs) issued by Ministry of Housing & Urban Affairs, June 2020.
- Compendium of Innovative Emerging Technologies shortlisted under Global Housing Technology Challenge – India by Ministry of Housing & Urban Affairs, 2021 (https://ghtc-india.gov.in)
- Booklet on Light House Projects at Chennai, Tamil Nadu by Ministry of Housing & Urban Affairs, 2021
- Booklet on Light House Projects at Rajkot, Gujarat by Ministry of Housing & Urban Affairs, 2021
- Booklet on Light House Projects at Indore, Madhya Pradesh by Ministry of Housing & Urban Affairs, 2021
- Booklet on Light House Projects at Lucknow, Uttar Pradesh by Ministry of Housing & Urban Affairs, 2021
- Booklet on Light House Projects at Ranchi, Jharkhand by Ministry of Housing & Urban Affairs, 2021
- Booklet on Light House Projects at Agartala, Tripura by Ministry of Housing & Urban Affairs, 2021
- Compendium of Light House Project at Chennai, Tamil Nadu under Global Housing Technology Challenge – India by Ministry of Housing & Urban Affairs, 2022
- Compendium of Light House Project at Rajkot, Gujarat under Global Housing Technology Challenge – India by Ministry of Housing & Urban Affairs, 2022.
- Performance Appraisal Certificates issued under PACS by BMTPC.



Technical Advisory Committee (TAC) meeting of Asia Low Carbon Buildings Transition (ALCBT) Project

Technical Advisory Committee (TAC) meeting of Asia Low Carbon Buildings Transition (ALCBT) project for India, Vietnam, Thailand, Indonesia & Cambodia was held on July 31, 2024 under the Chairmanship of Dr. Shailesh Kr. Agrawal, Executive Director, BMTPC. The ambitious project is steered by GGGI with consortium partners EESL, ACE & HEAT, GmBH.

The project led by Dr. Soumya Garnaik has targets of studying about 300 buildings in three states namely UP, Haryana & Kerla for energy efficiency & suggest retrofit along with capacity building through training modules of more than 1500 professionals across country. Also, data base on building materials & energy efficiency for cooling will be prepared.



India Green Summit 2024 on World Earth Day

ndian Army in association with IIT Kanpur organised India Green Summit 2024 on World Earth Day on April 22, 2024 at Jhansi Military Station wherein BMTPC actively participated.

Carbon-neutral development, innovative environment solutions, climate change & energy efficiency, sustainable building solutions are few topics deliberated by galaxy of experts from IMD, CSIR, IIT, BMTPC and public & private entities during the day long summit & exposition. The event was led by Col Akhil Singh Charak, CWE, MES who has been implementing emerging construction systems for buildings & infrastructure at MES. The summit was attended by Indian Army & Air Force officers. Jhansi Military Station has taken a lead and playing a proactive role to use innovative design, technologies & strategies to combat climate change.





Paradigm shift in Rental Housing in India: Affordable Rental Housing Complexes (ARHCs) Scheme of Government of India



Kana Ram Godha

ntroduction:

India is the second largest urban system in the world, with almost 11% of the world's urban population residing in its cities¹. Although urban areas occupy just 3% of the country's land mass, they contribute a significant 60% to India's Gross Domestic Product (GDP)². Urbanization in India has emerged as one of the megatrends of the twenty-first century, and India has also been urbanizing rapidly.

As per the 2011 census in India, 37.7 crore people³ (31.2% of the population) lived in urban areas. The number of towns (statutory and census towns) had increased from 5,161 in 2001 to 7,935 in 2011⁴. Further, 15% of India's population resides in very large and large villages (population > 5000), indicating the need to treat urban, peri-urban, and large rural villages as an urban continuum and

- 1 Reforms in Urban Planning Capacity in India (2021), NITI Aayog, Government of India, New Delhi
- 2 Cities as Engines of Growth (2022), NITI Aayog, Government of India, New Delhi
- 3 Census of India 2011, Govt. of India, New Delhi
- 4 Census of India -2001 & 2011, Govt. of India, New Delhi

to overhaul the existing rural-urban definition dichotomy. Similarly, the number of metropolitan cities with a million-plus population also increased, from 35 in 2001 to 53 in 2011⁵. The Economic Survey of India 2017 stated that the extent of interstate migration was almost 90 lakh⁶ per annum between 2011 and 2016. As per the 2011 report of the High-Powered Expert Committee (HPEC), the urban population is projected to grow to 60 crore by 2031 and over 87 crore by 2051⁷.

Housing Demand in India:

In the cities, there is diversity in rental housing demand across various income groups of the country, which includes urban migrants, homeless, destitute, industrial workers, working women, single women/construction workers, students, long-term tourists, contractual employees, and professionals, among others in the EWS, LIG, and MIG segments. Therefore,

- 5 Census of India 2001 & 2011, Govt. of India, New Delhi
- 6 Economic Survey of India -2017, Govt. of India, New Delhi
- 7 High Powered Expert Committee (HPEC) for estimating the investment requirement for urban infrastructure service, Ministry of Housing and Urban Affairs, Government of India, New Delhi

it is pertinent to support the abovementioned segment for ease of living. In 2012, it was estimated that the housing shortage in urban areas by 2017 would be 18.78 million⁸. Also, over the years, due to rapid industrialization in urban and suburban areas, the need for housing became prevalent, proportionate to urban growth. The demand for houses, including rental houses, in urban areas is increasing with industrialization, migration, and the formation of new cities and towns.

The demand for housing in Indian cities far outpaces the supply, particularly for affordable options. Skyrocketing land prices, rising construction costs, and limited government intervention have exacerbated the issue. The lack of affordability leads to problems like overcrowding, the development of slums, and informal settlements. In order to maximize savings, the migrants often compromise with living conditions to send remittances to the family left behind at their native places. Usually, they live in slums, informal or unauthor-

* Lead Urban Planner, Project Management Unit of PMAY-U at Ministry of Housing and Urban Affairs, New Delhi

⁸ Report of the Technical Group (TG-12) on Urban Housing Shortage 2012-2017, Ministry of Housing and Urban Poverty Alleviation, Govt. of India





ARHC by State Industries Promotion Corporation of Tamil Nadu at Sriperumbudur, Tamil Nadu

ized colonies, or peri-urban areas to save on higher rental charges.

The house on rent provides the much-needed 'room for maneuver' for individuals and households in the context of rapid urbanization. Rental housing provides a stable urban status for the migrants and is their economic starting point. On the supply side, landlords are providing services simultaneously to put their assets to productive use. In India, rental housing has all but disappeared from nationallevel debate, except for occasional discussions of a possible housing "bubble" and the all-too-brief concern about rental housing needs.

Affordable Rental Housing Complexes (ARHCs)⁹:

In 2020, to provides ease of living and to promote economic activities through the vision of "AatmaNirbhar Bharat", the Ministry of Housing and Urban Affairs (MoHUA) had launched Affordable Rental Housing Complexes (ARHCs) for urban migrants/ poor a subscheme under Pradhan Mantri Awas Yojana – Urban (PMAY-U). ARHCs aim at creating vibrant, sustainable and inclusive affordable rental housing avenues for urban migrants/ poor by 'aggregation of their demand at a given site'. This scheme is being implemented through two models as under:

- Model-1: Utilizing existing Government funded vacant houses constructed under Jawaharlal Nehru National Urban Renewal Mission (JnNURM) and Rajiv Awas Yojana (RAY) to convert into ARHCs through Public Private Partnership (PPP) or by Public Agencies,
- Model-2: Construction, Operation & Maintenance of ARHCs by Public/Private Entities on their own available vacant land.

Under both the Models, construction/ repair cost is borne by the concessionaire and Public/ Private Entities. However, under Model-2, MoHUA is providing a Technology Innovation Grant (TIG) of ₹ 1,00,000/- per dwelling unit in case of double bedroom (up to 60 sqm carpet area), ₹ 60,000/- per dwelling unit (up to 30 sqm carpet area) in case of single bedroom and ₹20,000 per Dormitory bed (up to 10 sqm carpet area) for the projects using innovative and alternate technologies. Further, to encourage proactive participation from public /private entities following incentives have been proposed by Government of India and by States/ UTs/ULBs/Parastatals. These incentives are:

By Central Government:

- Concessional Project Finance under Affordable Housing Fund (AHF) & Priority Sector Lending (PSL)
- Exemption in Income Tax & GST on any profit & gains from ARHCs
- Technology Innovation Grant (TIG) for promoting use of innovative technology

By States/UTs/ULBs/Parastatals

- Use Permission changes, if needed
- 50% additional FAR/FSI, free of cost

⁹ Operational Guidelines of Affordable Rental Housing Complexes, (ARHCs) Ministry of Housing and Urban Affairs, Gol.



- Statutory approval of ARHC projects through Single window system (within 30 days)
- Trunk infrastructure upto the project site
- Municipal charges at par with residential property

Objectives:

The Objectives of the ARHCs Scheme was as under:

- To address the vision of 'AatmaNirbhar Bharat Abhiyan' significantly by creating a sustainable ecosystem of affordable rental housing solutions for urban migrants/ poor.
- To achieve overall objective of "Housing for All" encompassing the need of affordable rental housing for urban migrants/ poor. ARHCs will provide them dignified living with necessary civic amenities near their place of work.
- To create a conducive environment by incentivizing Public/ Private Entities to leverage investment for creating affordable rental housing stock to take care of their own requirements for workforce and also cater to

neighboring areas, if they have available vacant land.

Coverage and Duration:

ARHCs is being implemented in all Statutory Towns as per Census 2011 and Towns notified subsequently, Notified Planning Areas and areas of Development/ Special Area Development/ Industrial Development Authorities. States/ UTs may consider any project as ARHCs in any other areas after due notification.

Target Beneficiaries:

Beneficiaries for ARHCs scheme is from Economically Weaker Section (EWS)/ Low Income Group (LIG) who are urban migrants/poor. They include labour, urban poor (street vendors, rickshaw pullers, other service providers etc.), industrial workers, and migrants working with market / trade associations, educational / health institutions, hospitality sector, long term tourists / visitors, students or any other persons of such category. Also, preference under the Scheme has been given to persons belonging to Scheduled Castes/Scheduled Tribes/Other Backward Classes, Widows and working Women, Divyang, Minorities, subject to beneficiaries being from EWS/LIG segments as provisioned by the Government.

Progress so far:

The Scheme has made significance progress in providing the ease of living to the urban migrants/poor. Under Model -01, So far, 5,648 existing Government funded vacant houses (2,195 at Chandigarh, 393 at Surat 1,376 at Ahmedabad & 698 at Rajkot, Gujarat, 480 at Chittorgarh, Rajasthan, 70 at Dehradun, 100 at Lalkuan, Uttarakhand and 336 at Jammu, UT of Jammu & Kashmir), have been converted into ARHCs. Further, proposal for converting 7,413 existing Government funded vacant houses into ARHC units has been processed in the States of Gujarat, Himachal Pradesh, Haryana, Madhya Pradesh and Rajasthan.

Under Model -2 of the Scheme, MoHUA has approved proposals of 82,273 new ARHC units in Seven States with a Technology Innovation Grant (TIG) of ₹173.89



ARHC by SPR SPD Private Limited at Sriperumbudur, Tamil Nadu



crore on receipt of duly approved Detailed Project Reports (DPRs). So far, Construction of 52,293 ARHC units with new innovative technologies has been started in various cities, out of which 35,425 units have been completed at Sriperumbudur, Chennai & Hosur in Tamil Nadu. The construction of remaining 16,868 units is in advance stage of construction. Further, Construction of 1,682 ARHC units using conventional technologies is also under progress in Ahmedabad and Bharuch, Gujarat.

Conclusion:

The ARHCs scheme has succussed in promoting rental housing for urban poor/migrants across the country. The scheme ensured inclusive urban development by providing rental housing options to the urban migrants/ poor at reasonable rent. The Scheme has also provided an opportunity and enabling framework for States/ UTs Government to convert existing vacant housing stocks constructed from their own funds into ARHCs.

References:

- Dev, S. (2006). Rent Control Laws in India A Critical Analysis. Summer Research Internship Programme 2006, Centre for Civil Society Sir Ratan Tata Trust.
- Dewandeler, K. (2006). Quick Guide on Rental Housing, UNESCAP/UN-Habitat.
- Frans B. (1995): "Rental and Rent Free Housing as Coping Mechanisms in La Paz, Bolivia, Environment and Urbanization, Published by Sage Publication
- Meera Mehta and Dinesh Mehta, (1991): Housing Finance System and Urban Poor, Economic and Political Weekly, Published by: Economic and Political Weekly.
- Mehta, M & Mehta, D. (1989): "Metropolitan Housing Market: Housing Supplies, Demand & Residential Behavior in Ahmedabad
- Ministry of Housing and poverty alleviation. Government of India (2012): Technical Group (TG-12) on Urban Housing Shortage 2012-2017.
- Ministry of housing and urban affairs, government of India: (2020): Operational guideline for Afford-

able Rental Housing Complexes (ARHCs)

- NIUA (National Institute of Urban Affairs, India), (1989a), Rental housing in a Metropolitan City: A case study of Delhi, NIUA Research Study Series, No. 37.
- October 2008."BMTPC's endeavour towards Creating Enabling Environment for Affordable Housing". New Building Material & Construction World, Vol.14, Issue-4
- Sengupta, U. (2007) Housing reform in Kolkata: changes and challenges, Housing Studies 22:6, 965 – 979.
- UNCHS (2003) Rental Housing: an essential option for the urban poor in developing countries, Nairobi.
- UN-Habitat, (2006), Enabling Shelter Strategies, Review of experience from Two Decades of implementation, Nairobi
- UN-Habitat, (2008) "State of the World's Cities 2008-09"
- Wadhva, K., (1993), "Rental Housing in India: An Overview, NIUA Research Study Series" No. 31. National Institute for Urban Affairs, New Delhi, India





ARHC by Vidiyal Residency Pvt. Ltd. at Hosur, Tamil Nadu



जवरीतिः NAVARITIH – Certificate Course on Innovative Construction Technologies

he Ministry of Housing & Urban Affairs in collaboration with School of Planning & Architecture (SPA), New Delhi and BMTPC, started NAVARITIH : Certificate Course on Innovative Construction Technologies to build capacities of engineers and architects including students in the area of industralised building systems. It is of paramount importance that building professionals learn about the new and emerging building materials and technologies for housing and building construction. The objectives of the Certificate Course are to (a) Familiarize

the professionals with the latest materials and technologies being used worldwide for housing, (b) Provide an awareness of the state of art of materials and technologies in terms of properties, specifications, performance, design and construction methodologies so that professionals can successfully employ these in their day to day practice and (c) Provide exposure to executed projects where such materials and technologies have been implemented.

The NAVARITIH Course was launched by Hon'ble Prime Minister through video conferencing in January 2021 during the foundation stone laying ceremony of six Light House Projects (LHPs) being constructed under Global Housing Technology Challenge - India – Pradhan Mantri Awas Yojana (Urban). Subsequently, first batch of NAVARITIH was inaugurated by Secretary (HUA) in 2021.

The Course has received very good response and in 19 batches conducted so far, 1199 participants comprising of civil engineers, architects, faculty & students from various engineering and architectural colleges successfully attended the online Course.



Resource Faculty delivering the lecture during the NAVARITIH Course







Demonstration Housing Projects – propagation of sustainable emerging construction systems under PMAY (U)

MTPC is entrused to promote use of new / alternate building materials & technologies in housing through identification, evaluation, standardization, certification, capacity building, training and field level application by demonstration construction. Under Technology Sub-Mission of PMAY(U), MoHUA has taken an initiative to construct Demonstration Housing Project (DHP) through BMTPC using emerging construction systems shortlisted through GHTC-India & certified under PACS of BMTPC.

These DHPs are pilots which help build confidence and create enabling environment for the large scale adoption of such materials & technologies suiting to different geo-climatic regions of the country, thus making housing more affordable and sustainable. So far, 14 DHPs have been undertaken with emerging construction systems shortlisted under GHTC-India (an initiative under Technology Sub-Mission of PMAY-U) and certified under Performance Appraisal Certification Scheme (PACS). Out of which, Demonstration Housing Projects (DHPs) at Nellore, Andhra Pradesh; Bhubaneswar, Odisha; Bihar Sharif, Bihar; Lucknow, Uttar Pradesh; Hyderabad, Telangana; Panchkula, Haryana; Agartala,

Tripura were completed earlier. Recently, four DHPs at Bhopal, Madhya Pradesh; Ahmedabad, Gujarat; Tiruppur, Tamil Nadu and Ayodhya, UP have also been completed.

The Demonstration Housing Projects at 3 locations namely, Guwahati (Assam); Jammu (J&K) and Dimapur (Nagaland) are at different stages of construction.

The construction of demonstration housing projects in different parts of the country aims to facilitate wide spread dissemination and adoption of both existing proven, emerging and sustainable building materials and technologies replacing conventional construction and create eco-system for mainstreaming such materials & technologies in the construction sector & adapt them as future technologies for construction. During the construction of demonstration houses, training to professionals, artisans & students is also being imparted.



DHP at Bhubaneshwar, Odisha using Prefabricated Sandwich Panel System -Reinforced Expanded Polystyrene sheet core with sprayed concrete


DHP at Biharshariff, Bihar using Structural Stay In Place Steel Formwork System



DHP at Lucknow, Uttar Pradesh using Stay in place EPS based double walled panel system with infill concrete



DHP at Hyderabad, Telengana using (i) Structural Stay In Place Steel Formwork System (16 houses) and (ii) Light Gauge Steel Structural System (16 houses)



DHP at Nellore, Andhra Pradesh using Glass Fibre Reinforced Gypsum Panel (GFRG) technology for houses and flyash blocks with filler slabs for community building



DHP at Panchkula, Haryana using Light Gauge Steel Structural System



DHP at Agartala, Tripura using Structural Stay In Place Steel Formwork System



Completed Demonstration Housing Projects



DHP at Ahmedabad, Gujarat using Precast Concrete Construction System - Integrated Hybrid Solution-One



DHP at Bhopal, Madhya Pradesh using Stay In Place Formwork System - Insulating Concrete Forms (ICF)



DHP at Ayodhya, Uttar Pradesh using Light Gauge Steel Framework System (LGSF) with Cement Fibre board on both side of walls and infill of rock wool.



DHP at Tiruppur, Tamil Nadu using Precast Concrete Construction System – Precast Components Assembled at Site



<image>

DHP at Bhalwal, Jammu being constructed using Prefabricated Sandwich Panel System - EPS core Panel using Quikbuild Panels



DHP at Dimapur, Nagaland being constructed using EPS Cement Sandwich Panels with steel structure



DHP at Guwahati, Assam being constructed using Light Gauge Steel Framework System (LGSFS) with V-infill walls and Pre-engineered Building (PEB) steel structure



Performance Appraisal Certification Scheme (PACS)



erformance Appraisal Certification Scheme (PACS), being operated by BMTPC (vide Gazette Notification No. I-16011/5/99 H-II in the Gazette of India No. 49 dated December 4, 1999), is a third party voluntary scheme for providing Performance Appraisal Certificate (PAC) to manufacturers or installers of a product which includes building materials, products, components, elements, systems etc. after due process of assessment giving independent opinion about fitness of its intended use in building construction sector.

Since the Scheme is operated for the products/systems where no relevant Indian Standards are available, it is required to first work out the desired specifications for Performance Appraisal. For the items where no Indian codes are available, international practices are also being referred. In few cases the specifications recommended by the manufacturers have to be modified based on global practices to improve the quality and performance.

Various States/UTs, its Housing & Urban Development Departments, Housing Boards and other concerned departments are also promoting and using emerging technologies and materials for construction of mass housing in their States. As such PACS is proving to be an important tool for introduction of emerging technologies in mass housing.

The details of activities carried out recently under Performance Appraisal Certification Scheme (PACS) are highlighted below:

Renewal of Applications

Based on receipt of Renewal applications along with requisite details, the following PACs were renewed during the year. During the renewal process, technical conformance aspects are ensured based on recent test reports & inspection of manufacturing units along with some of TAC members;

- i) PUF Sandwich Panel with Pre Engineered Building Structure
- ii) Concrete 3D Printing Technology (C3DP)

Received for Renewal & Under Process

- i) Factory Made Fast Track Modular Building System – IN-STACON
- ii) Integrated Hybrid Solution ONE (IHS – ONE)
- iii) Elastomeric Paintable Plaster

Preliminary Applications (PA) for the following new products/ systems have been received from the manufacturers on the basis of which Detailed Application Forms (DAF) are being issued for submitting information along with other documents for processing the applications:

- i. 3D Printed Wall Panel
- ii. Concrewall Reinforced EPS Structural Panels (RESP System)
- iii. Natural Fibre Composite Products (Indowud NFC)
- iv. Infratop Polymer Wall & Ceiling Panels
- v. Admixture for Concrete

PACs Approved and Issued Till Date

Within the framework of power and functions of Technical Assessment Committee (TAC), Applications for appraisal of new building materials and construction technologies were received by BMTPC. Performance Criteria, based on National & International practices were framed in consultation with TAC members.

So far 19 meetings of TAC have been held and 84 PACs have been issued and out of these, 44 are emerging technologies/systems.



PRECAST CONCRETE CONSTRUCTION SYSTEM – 3D PRECAST VOLUMETRIC			
1	Volumetric (3D) Concrete Printing Technology (VCPT)	1059-S/2022	
2	Concrete 3D Printing Technology (C3DP)	1067-S/2023	
PRECAST CONCRETE CONSTRUCTION SYSTEM – PRECAST COMPONENTS ASSEMBLED AT SITE			
3	SRPL Building System (Waffle-Crete)	1021-S/2015	
4	Walltec Hollowcore Concrete Panel	1022-P/2015	
5	Precast Large Concrete Panel System	1027-S/2016	
6	Industrialized 3-S system using RCC precast with or without shear walls, columns, beams, Cellular Light Weight Concrete Slabs/Semi-Precast Solid Slab	-	
7	Robomatic Hollowcore Concrete Wall Panels	1040-S/ 2018	
8	K-Wall Panels	1043-S/2019	
9	Urbanaac Precast Construction Technology	1046-S/2019	
10	Integrated Hybrid Solution - One	1048-S/2020	
11	Kon_Crete Reinforced Autoclaved Aerated Concrete Panels	1056-P/2021	
LIGHT GAUGE STEEL STRUCTURAL SYSTEM & PRE-ENGINEERED STEEL STRUCTURAL SYSTEM			
12	Factory Made Fast Track Modular Building System	1011-S/2013	
13	Speed Floor System	1013-S/2014	
14	Light Gauge Steel Framed Structure (LGSF)	1014-S/2014	
15	Light Gauge Steel Framed Structure with Infill Concrete Panel Technology	1028-S/2016	
16	Continuous Sandwich (PUF) Panels With Steel Structure	1038-S/2018	
17	PUF Sandwich Panel with Pre Engineered Building Structure	1060-S/2022	
18	Ferron Panel as part of Ferrobuild Design System	1066-S/2023	
PREFABRIC	ATED SANDWICH PANEL SYSTEM	1	
19	Advanced Building System – Emmedue	1010-S/2014	
20	QuickBuild 3D Panels	1019-S/2015	
21	Reinforced EPS Core Panel System	1020-S/2015	
22	Rapid Panels	1026-S/2016	
23	Prefabricated Fibre Reinforced Sandwich Panels	1030-S/2017	
24	Concrewall Panel System	1031-S/2017	
25	Rising EPS (Beads) Cement Panels	1032-S/2017	
26	PIR Dry Wall Pre-Fab Panel System	1039-S/2018	
27	Baupanel system	1041-S/2018	
28	Flyash EPS (Beads) Cement Sandwich Panels	1042-S/2018	
29	V-Infill Wall (Light Weight EPS Wall)	1045-S/2019	
30	Nano Living System Technology	1047-S/2019	
31	Factory Assembled Insulated Sandwich Panels using Mineral Wool	1057-P/2021	
32	Factory Assembled Insulated Sandwich Panels using PUF	1058-P/2021	
33	Everest Rapicon Panel / Solid Wall Panel	1061-S/2022	
MONOLITH			
34	Monolithic Concrete Construction System	1006-A/2011	
35		1018-5/2015	
	CEFORMWORK SYSTEM	1000 5/2011	
35	Glass Fibre Reinforced Gypsum Panel System	1008-5/2011	
3/	Sismo Building Technology	1025-5/2016	
38	Insulating Concrete Forms	1029-5/2017	
39	Lost-in-place formwork system- Plasmolite Wall Panels	1033-5/2018	
40	Lost-III-place formwork system- Plaswall Panel system	1034-5/2018	
41	Structural Stay-In-place formwork system	1035-5/2018	
42	Stev In Place DVC Well Forms	1044 5/2018	
43	Stay-In-Place PVC Wall Forms	1044-5/2019	
44	Permanent Wall Form (PVC)	1050-5/2020	

EMERGING CONSTRUCTION SYSTEMS CERTIFIED UNDER PACS



S.No.	Name of Product/System	PAC No.
1	HDF Board Empanelled Eco-friendly Solid Core Door Shutter	1/2003
2	Moulded Raised HDF Paneled Door Shutter	2/2003
3	Sakar Block Making Machine	3/2003
4	Sakar Pan Mixer	4/2003
5	Gypcrete Building Panel /Rapidwall Panel	5/2003
6	Recron 3S Fibres	6/2004
7	Vertical Shaft Brick Kiln Technology	5/2006
8	Endura Door	1/2009
9	Fomura Door	2/2009
10	PVC Flush Door	3/2009
11	PVC Profile Door	4/2009
12	Frontura Door	5/2009
13	Underground Water Storage Tank (SUMP)	6/2009
14	Plastocrete Panel	7/2009
15	Insulated Roof Panel	8/2009
16	Polyethylene Underground Septic Tank	1001-C/2011
17	Continuous Sandwich Panel	1002-S/2011
18	Marshal Door	1003-C/2011
19	uPVC Window	1004-C/2011
20	FRP Manhole	1005-C/2011
21	Marble Slurry Based Binder	1009-M/2011
22	Fluorogypsum Based Anhydrite Binder	1012-M/2014
23	Polystyrene Based Insulation Tile - Kooltile	1015-P/2014
24	Roof Insulation Tile –Insulla	1016-P/2015
25	Bamboowood Products	1017-P/2015
26	Plastic Honeycomb Toilet Structures	1023-P/2015
27	Soundproof Drainage Piping System	1024-P/2015
28	Resin Bonded (Plastic Waste) Tiles	1037-S/2018
29	Bamboowood Flooring	1049-P/2020
30	Strand Woven Bamboo Wood Floor Tiles & Wall Panels	1051-P/2020
31	Apollo Chaukhat Door and Window Frame Sections	1052-P/2020
32	Bamboowood Flooring & Wall Cladding	1053-P/2020
33	Elastomeric Paintable Plaster	1054-P/2020
34	Dalmia Magic Premium Skim Coat	1055-P/2021
35	WPC Door Shutter & WPC Frame	1062-C/2022
36	Geopolymer Coarse Aggregate (GPCA)	1063-M/2023
37	Nano Concrete Aggregate (NACA)	1064-M/2023
38	Geopolymer Fly Ash Fine Aggregate (GFS)	1065-M/2023
39	Kinzok Aluminum Alloy Panels	1067-S/2023
40	uPVC Door & Window Systems	1069-C/2023

INNOVATIVE BUILDING MATERIALS / PRODUCTS CERTIFIED UNDER PACS





Disclaimer: The views expressed in various articles are those of the authors. They do not necessarily represent those of the BMTPC.

Promotional Publications of

- Piloting Innovative Technologies through Demonstration Construction
- **BMTPC** Newsletters
- Explanatory Handbook on Performance Appraisal Certification Scheme (PACS)
- Disaster Mitigation and Management Initiatives
- Design & Construction of Earthquake Resistant Structures – A Practical Treatise for Engineers and Architects
- Disaster Risk Reduction A Handbook for Urban
- Guidelines on "Manual on Basics of Formwork"
- GFRG/Rapidwall Building Structural Design
- Training and Certification Manual for Field and Lab Technicians working with concrete
- Training Manual for Supervisor (English & Hindi)
- Waste to Wealth: Green Building Materials and Construction Technologies using Agricultural and Industrial Waste.
- Guidelines for Multi-Hazard Resistant Construction for EWS Housing Projects
- Guidelines on "Aapda Pratirodhi Bhawan Nirman : Sampurn Bharat ke liye Margdarshika
- Design Packages using Alternate Building Materials & Technologies for Western and Southern Regions.
- Criteria for Production Control of Ready Mix Concrete for RMC Capability Certification
- **Building Artisan Certification System**
- Guidelines on "Rapid Visual Screening of Buildings of Masonry and Reinforced Concrete as Prevalent
- Methodology for Documenting Seismic Safety of Housing Typologies in India
- Compendium of Emerging Construction Technologies for Housing & Infrastructure - Fourth
- Demonstrating Cost Effective Technologies -A Case Study of Bawana Industrial Workers
- Margdarshika for Masons (in Hindi)
- Pocket Book on Emerging Construction Systems
- Building Materials and Housing Technologies for Sustainable Development
- Brochure on Vulnerability Atlas of India
- Compendium on Building Technologies





Building Materials & Technology Promotion Council (BMTPC) under the Ministry of Housing & Urban Affairs strives to bridge the gap between laboratory research and field level application in the area of building materials and construction technologies including disaster resistant construction practices.

Vision

"BMTPC to be world class knowledge and demonstration hub for providing solutions to all with special focus on common man in the area of sustainable building materials, appropriate construction technologies & systems including disaster resistant construction."

Mission

"To work towards a comprehensive and integrated approach for promotion and transfer of potential, costeffective, environment-friendly, disaster resistant building materials and technologies including locally available materials from lab to land for sustainable development of housing."



