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A Critical Appraisal On The Investigation On Techniques Suitable For Affordable High-Rise Buildings

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Abstract

Due to hasty urbanization and the current rising invasion of immigrants from diplomatically fragile countries, many cities and towns face an imminent housing issue. In developing countries like India, housing issues, including economic, humanitarian, and environmental emergencies, are apparent. On these lines, the traditional construction model for individual houses has ultimately become insufficient for the affordable mass housing construction industry because of India's rapid rate of construction. Therefore, it is essential to have state-of-the-art technologies to construct mass housing faster and deliver decent quality and durability of the structure cost-effectively. The rise of ghettos might be measured as the side-effect during the development of urban areas in India. Urban areas are the locomotives of monetary growth, adding to the critical deviations in the overall public instigating financial turn of events and modernization. Since the population is expanding, and at the same time, the land is limited. Therefore, there is a need to expand the buildings vertically, i.e., making the structure tall. The present work aims to point out the various aspects of building methodologies for affordable housing by highlighting the various existing techniques. The work also aims to study the implementation of the techniques in green affordable housing and the various challenges faced in its implementation. Various techniques utilized in present-day construction are studied in details. It also highlights the advantages that shall be achieved by adopting those techniques. With the advent of technology, affordable housing is being seen to provide communities' need for shelter and social well-being. Thus, it is clear from the study that the current needs for affordable housing in India have spurred massive construction and

development of residential areas. Also, the study reveals that societal and environmental sustainability in housing must improve domiciliary fulfilment by safeguarding the safety and well-being of its inhabitants, adjust to its immediate environment, be adequate, be maintained with the public facility to fit in the community through involvement, and, finally, accomplish household utility effectively and efficiently.

Keywords: Affordable housing, high-rise building, low-cost, housing, India

Introduction

The current requirement for affordable urban housing in India have prodded enormous development and improvement of neighbourhoods. With the direness to execute government guarantees in the electoral drive, affordable urban housing is being seen to provide communities' necessity for shelter and social well-being. Affordable housing is a dwelling where the total cost of the housing is even affordable to the low-income clusters. The housing development carries heavy subsidisation from the government or the private sectors. It is also one reason that governments around the world are trying to provide affordable housing to all. The requirement for high-quality and affordable high-rise buildings has given rise to science, technology, and engineering progression. The propagation of information technology (IT) has enabled the design and construction of high-rise buildings with endless options. Geographical Information System (GIS) and Building Information Modelling (BIM) are now abundantly utilised by architects, planners, and engineers worldwide.

Premier institutions for R&D in India are engaged in the domain of building technology like the Structural Engineering Research Centre (SERC), Madras; the Central Building Research Institute (CBRI), Roorkee; the Regional Research Laboratories, and the National Council for Cement and Building Materials (NCB) Ballabhgarh; etc. have played a vital role in the development of cost-effective construction techniques and materials. Conversely, organisations like the Building Materials and Technology Promotion Council (BMTPC), New Delhi; the National Building Organisation (NBO), New Delhi; HUDCO has been involved in promoting the inventive construction techniques evolved by the above-mentioned research institutions in India.

The global challenge for creating affordable, safe and sustainable housing

Increasing the amount of housing has long been an essential priority for governments throughout the world. Globally, an estimated 1 billion new houses will be needed by 2025 at an estimated cost of US$11 trillion, many of these for low-income households (UN Habitat,

2016). As per reports, if there are no transformative actions taken,the number of people affected by the worldwide affordable housing gap will increase by 30 per cent to 1.6 billion by 2025 (Woetzel et al., 2014). Large-scale public housing agendas have been unsuccessful in delivering affordable housings anywhere near the value or amount of houses essential to address the deficit. This condition is most severe in developing countries (Choguill, 2007). Building affordable and energy-efficient homes in towns and cities would contribute pointedly to the United Nations' SDGs (World Green Building Council). It is imperative to note that there are complex trade-offs to be made between the current and urgent requirement for the practical, affordable and long-term benefit of having energy-efficient housing. There is a dire necessity to deliver more affordable housing, especially in low-income countries and worldwide. For instance, in the United States, there is a shortage of between 7 and 12 million units (National Low Income Housing Coalition, 2018). Similarly, many nations worldwide face such issues, and therefore, there is an urgent need for affordable housing.

Urban Housing Shortage in India

According to recent reports, 80% of India's urban housing deficiency is in the structure of prevailing but insufficient housing that is also overcrowded (Technical Group on Urban Housing Shortage by the Ministry of Housing and Poverty Alleviation). It has been revealed that nearly 96 per cent of the mentioned housing shortage is faced by the economically weaker sections (EWS) and low-income group (LIG) categories which is evident from the income categories that the government has set. The private companies cater the remaining four per cent. The Ministry also states that it must not cost more than five times the household's annual income for a housing unit to be considered affordable housing (Figures 1and 2). Existing demand and supply mechanisms of housing do not observe the scales of affordability. While conceptualising an affordable housing unit, most parameters limit themselves to the price and affordability of the unit, but there are also other parameters such as well physical, social infrastructure and suitable location.

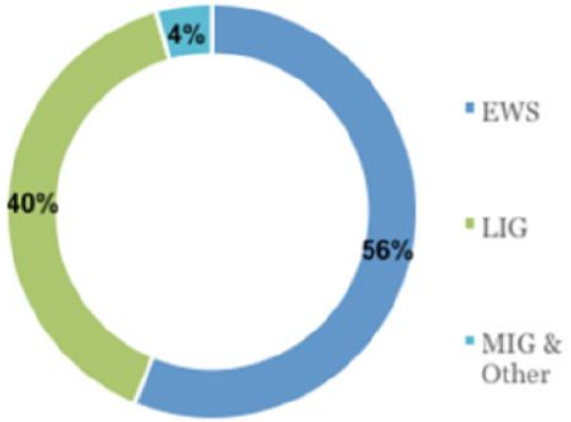


Figure 1: Urban Housing Shortage across Income Categories

Source: Report of the Technical Group on Urban Housing Shortage, MoHUPA 2012

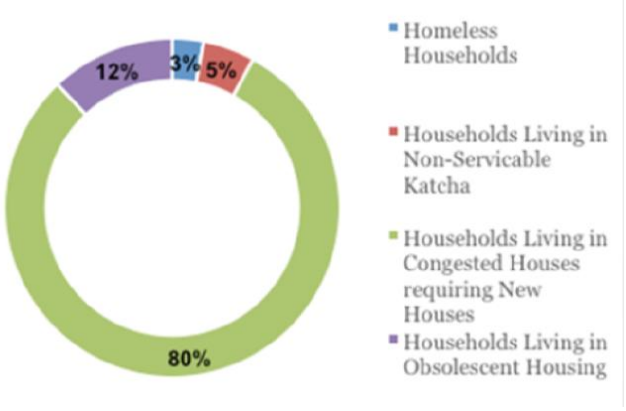


Figure 2: Urban Housing Shortage

Source: Report of the Technical Group on Urban Housing Shortage, MoHUPA 2012

Development of Affordable Housing

Many types of research have been carried out to know the importance of affordable housing and the government rules and regulations for the same. NerurkarandSakpal(2019) found the factors that must be considered for the successful selection of the location of an affordable housing project. Factors such as social infrastructure and everyday needs within a 2-5kms radius, affordable amenities within and outside a community, livelihood opportunities in the neighbourhood, availability of well-connected public transportation and others during site selection will help finalise the appropriate land for the developer and the consumer as well. Other factors that were prominently found out through the study were depending upon the nature of the project.The study revealed that eventually, implementing more affordable housing projects will certainly ensure housing for all. For residential projects to be affordable

for middle-class and low-income families, the land purchase part of the sale price must be kept to an optimal minimum possible.

Rogena (2019) conducted a study and focussed not only on affordability but also adequacy of the housing. It was revealed from the study that 'adequate housing' is critical to the continuous improvement of living conditions and of importance to the enjoyment of social, economic and cultural rights.The author stated that the right to adequate housing with its rights and freedoms has seven minimum standards. These standards are significant to ensure a right to an adequate standard of living for himself and his family like the security of tenure, habitability, accessibility and availability of services, affordability etc. The study also concluded that the problem in India and many other countries is that housing is commonly viewed as a commodity of commercial value, though for families, housing is far more than a commodity.The author specified many recommendations. One of the most important oneswas that the local authorities should ensure maintenance or upkeep on properties.

Another researcher in the year 2017 highlighted the significant factors on public-private partnership (PPP) for affordable housing as per the Report of the Technical Group on Urban Housing Shortage (2012-17) under the chairmanship of the author (Kundu, 2017). It was revealed that the housing shortage is estimated to be around 18.78 million units. Out of this, 56.18 percent was reported for the economically weaker sections, while 39.44 percent was for lower-income sections. Due to this, the Indian government had launched its ambitious mission of Housing for All by 2022. It is universally documented that the public sector alone cannot meet the requirements for affordable urban housing, including those for the urban poor. In this sense, partnerships have appeared as a tool to fast-track delivery of affordable urban housing to all in need. Hence, PPP may deliver a solution to resolve the problems of housing shortage in India. Private sector participation is critical to reaching the ambitious housing target by 2022 as there are many interruptions in achieving the same. Specific project management and related administrative issues and others requiring policy decisions at the government level were identified to be addressed to have a robust framework for private sector participation (Report of the Technical Group on Urban Housing Shortage, 2012**)**. Sengupta (2013) studied the affordable housing development in India. It was found that the private developers in India, who have been identified as the primary suppliers of such housing, viewed affordable housing as an attractive proposition which guarantees high velocity of sale and minimum risk. Nevertheless, affordable housing construction is rapidly becoming the fastest-growing segment in the Indian construction industry, with reputed

national developers and numerous leading private developers showing a keen interest in this sector. For the housing allocation purpose, affordability is interpreted based on an individual household's income rather than the housing unit price. In the absence of any housing price's upper limit, individual developers work out their definition to constitutes an affordable range. The study also revealed many difficulties in designing acceptable normative frameworks for affordable high-rise housing in India, which may defeat the overall goal of increasing the affordable housing supply. It has been a fertile ground for the government agencies for policy experimentation while trying to fulfil obligations for affordable housing provision. The housing market is an entirely new segment of consumers, leading to high profitability and reputation. Many developers are the ideal target group, tapped using the same marketing templates, design and construction used for luxury housing.

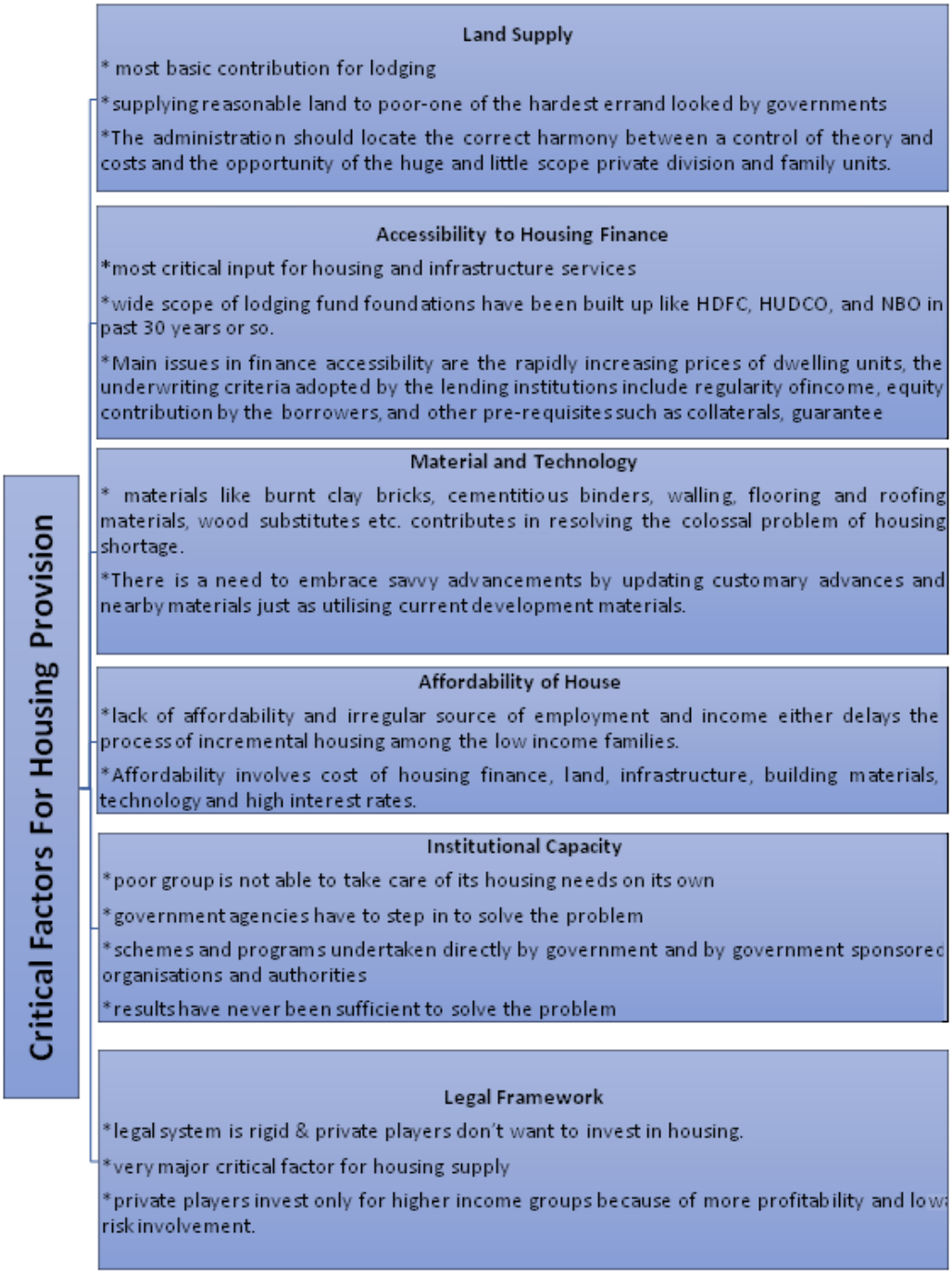
Sinha and Bhargavi(2012) found the new frontiers available in affordable housing and the opportunities for the private sector. They found the opportunities that can provide potential residents proximity to employment centres, access to hospitals and schools, creche, and other forms of social infrastructure, but real estate prices may allow the construction of affordable units. The study revealed three distinct success drivers, i.e.business model, location and design & technology. The design of affordable units must be attractive to buyers to maximise land value and minimise construction costs. Consumers' preference dictates the technological choice in terms of look, feel, and the most cost-effective material for the builder. The study revealed that the private sector models might never address the needs of the millions who live in absolute poverty. They stressed that the collaborative efforts between the private and public sectors would ensure more efficient and cost-effective delivery of housing services to the poor.

Housing policies in India: A review

Lodging strategies of the Government of India have made substantial advancement since the 1950s. While toward the beginning of "arranged turn of events", the approaches were more government assistance driven. However, later on, these cameto be driven by a very much characterised heavenly body of financial interests. Simultaneously, the legislature's job has likewise changed step by step from being a lodging supplier to being just a facilitator of lodgingaction. Lodging-related enactments and reports are identifying with different lodging plans. For a more straightforward understanding, it partitions the period since the 1950s into four stages. The principal stage usually includes the initial two decades,when the fundamental provisions were coming to fruition, and the legislature was struggling to address the issues of

all segments of society. The subsequent stage is usually the period from the mid-1970s to the mid-1980s. In this period, the legislature acknowledged that it could not serve all the segments of society and subsequentlyfocused on more fragile areas, i.e. the weaker section. The third stage is usually the period from the mid-1980s to the mid-2000s. In this period, neoliberal tactics progressed into the conversation, and its centre transformed from physical arrangement of lodging to its financing. The last stage suggests about the last 10-12 years. In this period, the administration had firmly received the job of facilitator. It is currently progressing the support of the private part in lodging exercises for all the segments of society while itself assuming a lower priority in every one of these exercises.

On further studying the policy, the following critical factors for housing provision were found. They are described in the figure (Compendium of Best Practices in States Compilation by Ministry of Housing & Urban Poverty Alleviation,2015; MoHUPA, 2017).



Affordable Housing: Opportunities, Realities and Challenges

Ramakrishnan (2015) discussed the challenges in affordable housing from a case study in Bangalore.There are various participants in the property market in providing affordable housing needs for the flowing population. The reality housing developers can be classified as premium segment housing providers- catering to the specification of high-end users with high-income network and moderate, affordable housing – catering to the needs of the lower, average and middle-income groups. At the same time, the administrative authorities have

taken the unorganised and informal groups of economically weaker sections to care. The ratio of actual end-user demand in the Bangalore housing market changes with investors capitalising on lower prices, higher rental yield and favourable yield. In order to encourage affordable houses development fiscalsops, need to be given to developers as otherwise there is no incentive or policies to improve affordable housing stock where margins are considered minor nowadays with the hike in the cost of land, labour, materials and input costs. The affordable housing segment is said to range from 15-20% of the total residential supply. Several issues, significant problems and challenges have been identified before affordable housingsector to mention the most noteworthy one like procedures taken for clearance, approval, the average time taken for implementation, impact on sale value, continuous growing population, availability of land following city's urban population for the particular segment. Another researcher, Jagdale (2018), carried out a study on the parameters to promote affordable housing successfully. The Government of India (GOI) has recognised the need to fill the gap in urban affordable high-rise housing. Large-scale housing projects that are affordable are sure to help. So, the government announced an ambitious project,"Housing for All by 2022. The accessibility to cheap finance is also driving the demand for affordable housing. Also, the private sector plays a noteworthypart in connecting the current deficit of affordable housing in India. There is an increasing need for information on appropriate methods for affordable housing. An effort at coordination can be highly beneficial to affordable housing, which forms a part of development programs all over the country. The information on PPP intervention and recent improvements to these, if adequately involved in affordable housing programs, can result in attractive cost savings, increased affordability turns to urban segment and the emergence of an aesthetically and economically more appropriate built environment in all areas.

Social Impact of Affordable Housing

There is a massive impact of affordable housing on communities and families. Various studies have been carried out to assess the social impact of affordable housing. Williams (2016) described the impact of affordable housing on communities and families through the study. The study described seven different types of affordable housing programs: mixed-income housing, senior housing, supportive housing, entry-level homeownership, rent stabilised housing, public housing, and rental assistance. The first impact on property values will decline as a result of proximity to affordable housing increases when (1) the quality,

design, and management of the affordable is inadequate; (2) affordable housing is located in dilapidated neighbourhoods that contain disadvantaged populations; and (3) when affordable housing residents are clustered. The second impact is considered neighbourhood crime. The third impact considered on health as poor housing creates numerous health problems to humans, especially in children and the connection between poor housing and poor health is considered to"unarguable". The subsequent impact that the research has shown is that there is a direct link between housing stability and educational performance. It is a proven fact that the minimisation of affordable housing directly impacts a household's life quality. Furthermore, substandard or degraded housing not only affects an individual or a families' physical and mental health, but it also affects educational outcomes and can determine the path of one's future. The objective of affordable housing is to provide quality affordable like urban living environments for the resident families that are low to moderate-income and considered elderly and disabled.

Sanghavi and Francis (2017) carried out a study on the critical success factors and risk factors for implementing a public-private partnership model in the affordable housing segment in India. The study revealed that the success of PPP would primarily depend on designing PPP structures with appropriate risk allocation mechanisms, denoting clear division of responsibilities, imposing rewards and consequences appropriately, and offering enticements for value creation. Proper allocation of all risks is the first requisite to succeed in PPP in affordable housing, which can be achieved by developing a successful 'Model Concession agreement'. It should clearly state the roles and responsibilities of each party and should identify all the risks and allocate it to the most suitable entity in each segment. By ensuring proper allocation of risks, a sense of security could be provided to the private entities, encouraging them to invest and perform in this segment confidently. Another point revealed by the study was that political risk is also a common risk for most projects.However, the study identifies that its impact on affordable housing under the PPP model would be high because housing a social infrastructure with a low-profit motto. Hence, the stability of the government and its capacity to perform would be serving as a critical factor for all private entities to join hands with it in providing this social need. Read and Tsetkova (1999) reviewed the literature on housing and social issues that housing affordability has multiple dimensions in the desired segment related to children's educational attainment, crime, and community health. Children exposed to the positive socialisation process and heighten social control mechanisms often experience more success in the classroom.

High Rise Affordable Housing

Aliand Al-Kodmany (2012) briefed about the tall buildings and urban habitat of the 21st century. Tall buildings construction is cost-intensive, but they are and will be needed to save the agriculture land, reduce the carbon footprint, and save energy and automobile dependency. Gifford (2007) presented an excellent review on the effect of high-rise buildings on the psychology and behaviour of humans. Strain, crowding, suicides, and mental health are the main problems that need to be tackled for the persons dwelling in high-rise buildings. When residents are assigned randomly to high rises and low rises (or single-family dwellings), they do not have control over the type of dwelling they will live in. The survey indicated that children who live in high rises exhibit more behavioural problems than children who do not. Acuna (2000) stated that there are significant factors that emerged concerning management methods to reduce construction schedules of tall buildings. The Big Canopy system was discussed in details in the study. Ghasemi and Ghasemi (2017) carried out physical and health-related studies on the people living in high rise buildings. White (2017) discussed the methodology of air drainage in high-rise buildings. The technique of carrying air directly into the system influences the structural design of a building, challenging the Mechanical, Electrical and Plumbing (MEP) design engineers to discover an alternative of supplying air for the drainage system without aestheticallycompromising the design. Kavilkar and Patil (2014) put forth the investigation that high-rise residential constructions are not famous due to user sensitivity, and they are costly and the associated fear of safety during the fire. Ibrahim (2007) highlighted the needs and impacts of high-rise buildings at local and strategic levels. The study reveals that the sizeofabuildingdirectly influencestheemotional response in several aspects. High-rise building is a phenomenon encroaching all over the world as functionally and economically such buildings make sense. Demands for multiple housing have rapidly built tower blocks, providing maximum profits per unit area, making the building more desirable and therefore more valuable to their cities. The study also states that the land costs create the direct effect that raises the per-floor cost of building a given height and creates the incentiveto build high-rise buildings to adjust the land cost over a more significant number of floors.The main focus of Oldfield et al. (2014) in their study was on the sustainability of high-rise buildings at both urban and building scale. Energy Performance, Metrics, and Generationhave the highest mean priorityvalue denoting that research in this broad area is a top priority to evolve the typology of high-rise buildings. Karlessi et al. (2017) described smart and NZEB (Nearly Zero Energy Buildings) buildings and integrated design

approach that the implementation of highly efficient smart buildings is feasible through the renewable systems acting as generators/storage, integration of smart metering and energy management. A successful design and construction of a ZEB (Zero Energy Buildings) include an effective grid integration to achieve the suitable balance between consumption and production and energy-efficient procedures, and implementation of RES targeting the minimisation of the energy needs. It was concluded from the study that the various levels of analysis allow for adequate consideration of essential concepts such as the users engagement, integrated design, exploitation of ICT capabilities, demand responseoptimised integration and control in smart grids at community and city level.

Construction Cost and Analysis

Shabha (2002) carried out a maintenance cost related study in high-rise buildings located in Birmingham. The author emphasizes a low-energy refurbishment scheme. The building cost and eco-cost aspect of high-rise buildings were represented in the study conducted by DeJong and Wamelinkin 2008. They presented that an estimation of building costs at the component level can be made by first considering the cost of the component and then finding out how much of the component is required for completion of the building. Gandhi (2012) stated the economics of affordable housing in India especially in Mumbai, Maharashtra. The study revealed that the proliferation of slums results from high population growth that is not accompanied by adequate provision or solution of affordable housing—ensuring that the core economic principles—instrumental in the efficient functioning of urban housing and land markets—are met is the key to tackling the issue of slums. The experience of large metropolises like Mumbai demonstrates that the problems of slums regularly rise day by day, and affordable housing can become chronic if policies fail to satisfy the economics of housing and land markets. Agarwal et al. (2013) from their study found the encouraging process of the low-income housing market and the opportunity to realize the dreams of millions.

Negi (2016) studied the way forward for PPP in affordable housing. She found that affordable housing has to be a decision for balancing the needs of the desired people and the objectives. PPP approaches to focus on the problem of housing shortage for the low-income segment. The policy needs to be thought of as a dynamic plan of action capable of changing the scenario. By PPP model, we can sort out the urban housing shortage problem in India to some extent. Namdeo and Gupta (2019) analysed the affordable urban housing projects in India. They found that India's urban population enrolled a decadal development of 32 %,

ascending from (285 – 377) million, somewhere in the range of 2001 and 2011. A few proposals which will give the last push to the portion have been referred to in the study:

- Clearer definitions – In 2017, the administration reported that the merchandise and enterprises charge (GST) would be diminished from 12% to 8% for ease lodging.
- Relaxed Development Norms – The administration should survey the ground zoning arrangements all the time to take into consideration ideal land for reasonable lodging
- Ease of Land availability – The administration needs to regularly release land packages for reasonable lodging ventures, distinguished inside metropolitan points.
- Dedicated approval window for affordable housing – The building projects approval process should be streamlined; a fast track process should be set up for "Reasonable lodging" ventures. For" Affordable lodging" to work, quickening the structure endorsement forms is basic to constrain the development time and the related input cost.
- Use of advanced technologies – There is a requirement for Building project designers to put resources into innovative development advancements to advance mass lodging improvements at sponsored development costs.

Sustainable Design of Affordable Housing

Dowhower (2010) studied and revealed that BIM could be utilized for affordable & sustainable housing design. The study found that BIM can be used as a successful project delivery tool. Karthikeya and Sathish (2016) explained the affordable housing against earthquakes in India. These disasters cause death, injuries to human and animals, significant scale damages, destructions. Disasters due to non-engineered housing development, it is essential to defend against the forces of destruction. Akadiri et al.(2012) explained the design of a sustainable building in their study. It is seen that sustainability is a broader theory, which has rapidly developed to be one of the significant concerns in the building industry. A project with a concept of sustainability is designed, built, renovated, and operated in a resource-efficient and ecological manner. Delgado and Troyer (2011) studied the modelling quality and housing preferences for affordable new housing development.

Tanyer and Emekci (2016) considered in their study the new perspective on more sustainable and affordable housing for lower-income groups in Turkey. According to them, sustainability and housing affordability are the most critical concepts to protect the environment entirely and provide social equity. These concepts can be measured utilizing life cycle thinking

methods. Life cycle cost analysis has been used in a sustainability context for buildings. In the construction industry, LCC is used to measure the number of whole buildings, building components and systems, and materials costs and observing the happened through the life cycle. In Turkey, after the industrialization growth which initiated in the 1950s, massive migration from rural areas to urban areas was begun. The housing needs due to the growing population can cause irregular settlements. Low-cost housing in Turkey has been provided only by the public sector, namely The Housing Development Administration (TOKİ). The private sector cannot produce low-cost housing in Turkey. Every segment of society must reach sustainability to protect the environment completely. Therefore, sustainability should be affordable. Lifetime affordable housing contributes to people's welfare, significantly lower-income households. When designed new housing, if its operational cost and maintenance cost is known, and its cost hot spots are identified, significant saving can be achieved. This can provide not only economic sustainability but also environmental and social sustainability. In terms of environmental sustainability, less cost means less waste, less pollution, and reduced energy demand, reducing environmental impacts and reducing the dependency on fossil fuels by reducing energy demand. Singh (2016), in his study, briefed about the sustainable design for developing affordable housing. The design of a housing project has two main components,i.e., structural and architectural, but a sustainable design that make it affordable has three main components: Structural Design, Architectural Design and Environmental Design. Sustainable design has now proven to be essential for developing affordable housing. Structural engineers and architects should be familiarized with the latest national building code, IS codes, and green techniques to evolve the optimum design for creating durable, safe, eco-friendly and cost-effective housing in India. The government should enforce all concerned agencies for the building codes and sustainable technologies to achieve the mission of “housing for all”.

Green Affordable Housing

Herck and Meganck (2012) studied and then presented about saving the heritage of affordable housing. Barn (2014) explained the eco-friendly building material and construction techniques. Matties (2008) stated about green, excellent and safe, affordable housing. Leung (2018) explained in details the greening strategies for existing buildings. Modi (2014) found the conditions of improving the social sustainability of High-rises. Social sustainability is regarded as a main pillar of sustainability ingeneral. Hayter and Kandt (2011) discussed the renewable energy application for an existing building andreducing existing

building energy consumption. For this to be achieved, two major approaches are considered: First is to reduce the energy requirement by applying energy efficiency measures, and the second is to offset the residual requirement of building energy by utilizing renewable energy systems. Hassan and Gharib (2007) highlighted in their study that renewable energy is the future of high-rise buildings. Chel and Kaushik (2017) studied that renewable energy technologies can be used for sustainable development of energy effcient buildings. Venkata et al. (2015) explained the use of renewable energysources in the construction of Green Building thatSolar energy is the wind and water cycle source. Umar et al. (2014) described the sustainable building material for green building construction, conservation and refurbishing. The study revealed that adopting green building materials is an excellent approach to meet sustainable building material finding the target.

Sharma and Srikonda (2021) studied value engineering in sustainable and affordable housing in India. Since there is a shortage of need-based, i.e.Affordable housing due to the rapidly growing population, the focus must be on using value engineering to meet the shortage of housing needs. The researchers aimed at considering the application of value engineering for optimization of cost, time and quality. They also aimed at enhancing the total value of the project. They considered two case studies of various measure of housing construction projects in their study. They found that substituting a material with similar purposes aids in reducing the cost of the project and, therefore, adding to its value. They concluded that the research would outline the advantages of value engineering in sustainable and affordable housing and the utilization of alternate materials to improve the productivity and effectiveness of a project. Patel and Padhya (2021) studied the challenges and projections of sustainable and affordable housing by identifying a set of built forms for affordable and ecologically sustainable housing. Their study comprised four case studies in different parts of the world, mainly residential developments. The primary research revealed that insufficiencies in the regulatory framework and the apparent belief that integrating sustainability in affordable housing might lead to enhanced project costs were the main obstructions in executing sustainable and affordable housing projects.

Green Building Materials and Technologies

Jeffrey (2011) reviewed the literature onconstruction and demolition (C&D) waste recycling that construction and demolition wastes are usually grouped as C&D waste. Rousseau (2006), in his work, elaborately discussed the green materials that can be implemented for the

construction of buildings. The different materials are also compared. The materials and Low tech-to-high tech discussed in detail are Wood products and other plant fibre, Minerals, Metals, and Petrochemicals. Some economic factors and reusing and installing energy conservations are also discussed in detail. Alaloul et al. (2020) experimentally verified the reuse of plastic bottles composed of polyethylene tetrephthalate (PET) and polyurethane binder by producing interlocking bricks, which aids in reducing the waste in landfills and environmental pollution. The study results revealed that the obtained ratio of the material was appropriate as non-load-bearing masonry brick and suggested to be utilized as partition walls. This will, thus, help in attaining sustainability through the use of waste material. Thia et al. (2020) studied modular construction techniques, which prove to be effective and sustainable for affordable high-rise construction. They found through their study that affordable modular construction offers quicker construction, innocuousengineering, improved quality control, and lesser environmental effects than outdated on-site construction. The work by the researchers could prove to be beneficial for the experts and contractors as it gives a critical evaluation of modular construction and its affordability. The work also highlighted the technical impedances that hamper the extensive implementation of modular construction and suggests possible imminent research results. Chang and Hsieh (2020) studied building information technology (BIM) in green buildings to achieve sustainability of the structures. They found that existing knowledge of the advanced green BIM study is minimal.The main goal of the work was to delivermethodical and wide-rangingperceptions on existing trends and future capacities of green BIM study by analyzing the current literature with their investigationstructures. The work by Chang and Hsieh provided more in-depth studies on BIM research for green building design through building performance analysisin contrast to the more universalinvestigations on green and BIM structures of existing literature by other reviewed works of Wong and Zhou (2015) as well as Lu et al. (2017).

Affordable Housing & Urban Policies

Gopalan and Venkataraman (2015) stated about the affordable housing policy and practice in India. Developing affordable housing on a large scale is the greatest challenge,especially in urban India, promising a solution to the slums population, unplanned growth, transit congestion, and unorganized real estate development. Jobe (2009) states the connecting goals of affordable housing with commonly used policies and policy tools. Baqutaya et al. (2016) discussed the issues and challenges among middle-income groups in affordable housing. In these situations, the housing issue is one of the most disturbing functional and structural

social problems, with a particular cultural aspect, it became a constraint for some middle-income groups. Roy et al. (2016) studied the changing paradigms of affordable housing in independent India.The policy underlined four financial strategies to implement affordable housing, which is as follows:

i. Subsidy for beneficiary led individual house construction.
ii. Slum redevelopment through private participation.
iii. Affordable housing in partnership with the private sector or public sector, including parastatal agencies.
iv. Affordable housing through credit linked subsidy, by interest subvention subsidy for LIG and EWS.

Gopalan (2014) explained an academic perspective on affordable housing policy and practised that Globally, affordable housing initiatives are divided into two broad strategic approaches.Denmark, the Netherlands, Sweden and Singapore and other countries follow the universal approach, where the entire population is provided with decent and affordable housing. On the other hand, like the USA, Malaysia, Canada, and most of the EU, wherein weaker sections focus, they would not get excluded from the housing market. Many countries combine ownership and rental schemes. DeJong and Wamelink (2008) carried out a cost and ecological effectiveness study on the 'High Rise Ability (HRA) model' of the tall buildings in the Netherlands. The project's cost is evaluated based on gross floor area and some other indices such as environmental consideration, municipal limits etc. This HRA model focus on building height of 150-250m. This is an interview-based approach. In high-rise buildings, the cost is proportional to the floor area, which is a regular thing. In addition to it, various factors such as shaft, stair-case, vertical transport, fire-fighting etc. Social and safety performances of tall buildings were evaluated by Oldfield et al. (2014). Cladding and Skin field way of building is analysed in detail. Steps related to deconstruction need further assessments. Modi (2014) highlighted the challenges posed to the high-rise buildings' social sustainability in India and the world. The challenges are reported incost, maintenance, building regulation and ownerships, access, public-private inter-relations etc. However, it is seen that the maintenance cost and regulation are found to be the essential issues in high rise buildings. Hence, these issues might arise in the case of affordable high-rise buildings that can be studied in detail before the problem arises and the solution can be worked out.

Chippagiri et al. (2021) studied the extensive application of sustainable prefabricated wall technology for affordable and energy-efficient housing in India. The team found that

affordable housing and structures in India necessitate enhancement in execution and design aspect. The study proposed the growth of bio-based urban infrastructure to acclimatize to climatic conditions by adopting sustainable materials in the construction. The sustainable materials include agro-industrial by-products, insulating materials, precast components,prefab technology, flyash bricks, and other materials. A simulation analysis was carried out in terms of cost and energy analysis for 18 cases included in the study. On the basis f the results obtained, the researchers recommended that the feasibility for affordable mass housing is achieved for the housing units above 100, each comprising 25 m^2 of area. This is because the single-unit construction is not viable economically, and prefab construction is costly in terms of transportation cost, material cost, erection cost, etc. Abdel-Rahim et al. (2019) revealed through their study that providing adequate housing for various population groups in a society meets the needs of housing units in Egypt. It is a mobile problem that changes with the development of peoples and a system that integrates economic, social, urban, organizational, administrative, design and planning, and any failure in any part leads to a defect in housing plans and programs. The study dealt with the analysis and found out the problems faced in the following sequence: 1. Basic definitions related to poverty, low income, urbanization and sustainable and affordable housing 2. The challenges and problems faced in providing affordable housing 3. Theoreticallearning of the Egyptian practice in the new cities. 4. investigation of global practicessuch as Thailand, India, Algeria, and Jordan 5. Comparison of Egyptian practiceto analyzing and evaluating different global experiences. Ferreri and Vidal (2021) studied the public-cooperative policy mechanisms for cooperative housing. Cooperative housing is a more independent and inexpensive alternate to dominant housing facility, and it is frequently indicated as an outline for 'housing commons'.This study offered aframework for a laborious and diplomaticallyexpressiverelativemethod topublic-cooperative policy mechanisms for'housing commons' concerning ten international case studies. Three criticalphases in the housing development (manufacture, admittance and management, andtimely maintenance of the model) are recognized and deliberated through tangibleinstances of policy zones and mechanisms. They also concluded that the explorationfor affordable and sustainable housing models is a criticalglobalradical challenge.
Patel and Paneria (2021) concluded from their study that mass housing had developed the same way the low-cost housing and all nationwide energies in this field have been readdressed to builder housing at a lower cost as far as possible. Knowledge of the unique features of mass housing projects is a significant step in developing the right models suitable for such projects. They stated that the application of mass housing necessitates capital from

various agencies for meeting the needs of mass housing projects. They also stated that a participating council must recognize a problem that must be solved, which had risen due to local building plans. The problems may also be due to a lack of appropriate people requirements for specialized care or project and operational management. They concluded that the prime difficulties encountered in the mass housing implementation are urban population growth, housing deficit, urban land shortage, researches accessibility, institutional framework, significant stakeholders of housing delivery.

Conclusion and Future recommendations

Urban areas are the engines of financial development, adding to the severe unconventionality in the overall public, prompting financial turn of events and modernization. Since the population is intensifying, and at the same time, the land is inadequate. Therefore, there is a necessity to develop the structures vertically. The present work aimed to find the different techniquesfor building methodologies for sustainable and affordable housing by highlighting the various techniques. The literature revealed a darn need to adopt the sustainable, affordable housing schemes to be brought down by the government of different nations. The current requirement for affordable urban housing in India have prodded enormous development and improvement of neighbourhoods. With the direness to execute government guarantees in the electoral drive, affordable urban housing is being seen to provide communities' necessity for shelter and social well-being.The work also aims to study the global challenge for creating affordable, safe and sustainable housing, the urban housing shortage in India, the development of affordable housing and implementation of the techniques in green affordable housing and the various challenges faced in its implementation. Various techniques utilized in present-day construction were studied in details concerning green building technique and green materials. It also highlighted the benefits achieved by adopting those techniques. With the advent of technology, affordable housing is being seen to deliver communities' necessity for shelter and social well-being. Thus, it is clear from the study that the current needs for affordable housing in India have spurred immense construction and development of residential areas. Also, the study revealed that societal and environmental sustainability in housing must improve domiciliary fulfilment by safeguarding the safety and well-being of its inhabitants, adjust to its immediate environment, be adequate, be maintained with the public facility to fit in the community through involvement, and, finally, accomplish household utility effectively and efficiently.

Further study must be carried out to formulate the urban policies and revise them as per the current scenario. The government schemes must comprise supplementary grants for guaranteeing sustainable practices in affordable housing constructions. The emphasis must also be lifted to strengthen sustainable materials' supply chain and make them easily accessible at lower costs. Improved construction practices with fundamental attention to environmental sustainability must be fortified in affordable housing construction projects with negligible budgets. Therefore, affordable housing schemes willlessen poverty and fulfil the visions of a commoner of having their own houses.

REFERENCES:

1. Agarwal Aditya, Jain Vikram and Karamchandani Ashish, State of the Low-Income Housing Market encouraging Progress &Opportunity to RealizeDreams of Millions, 2013
2. Aggarwal P., Siddique R., Aggarwal Y., Gupta S., Self-compacting concrete-procedure for mix design, 2008
3. Akadiri O. Peter, Chinyio A. Ezekiel, Olomolaiye O. Paul, Design of A Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector, 2012
4. Ali M. Mir, Kodmany A1 Kheir, briefed about the Tall Buildings and Urban Habitat of the 21st Century: A Global Perspective, 2012Bhan Gautam, Anand Gitika, Harish Swastik, Policy Approaches to Affordable Housing, 2014
5. Arman Michael,ZuoJian,Wilson Lou,Zillante George, PullenStephen,Challenges of responding to sustainability with implications for affordable housing, 2009
6. Baqutaya S., Ariffin S. A., Raji F., Affordable Housing Policy: Issues and Challenges among Middle-Income Groups, 2016
7. Barn Shivangi, Eco Friendly Building material and Construction techniques in India, 2014.
8. Chippagiri, R., Gavali, H.R., Ralegaokar, R.V., Rliey, M., Shaw, A. And Bras, A. (2021). Application of Sustainable Prefabricated Wall Technology for Energy Efficient Social Housing. *Sustainability* ,*13*(3), 1195; https://doi.org/10.3390/su13031195
9. Choguill, C. L. 2007. The search for policies to support sustainable housing. *Habitat International* 31(1): 143-149
10. Compendium of Best Practices in States Compilation by Ministry of Housing & Urban Poverty Alleviation2015
11. Deb Anushree, The viability of Public Private Partnership in building affordable housing in India, 2016
12. DeJong P., Wamelink H. Building cost and eco-cost aspects of tall buildings. CTUBH 8th World Congress, 2008.
13. DowhowerFiruzJustin, Adapting Building Information Modeling (BIM) for Affordable & Sustainable Housing, 2010.
14. Evans-Cowley S. Jennifer, Lawhon L. Larry, The Effects of Impact Fees on the Price of Housing and Land: A Literature Review, 2007

15. Ghasemi F., Ghasemi N. High-rise Construction in 21st Century according to Health Approaches and Affecting People's Psyche and Life. International Journal of Scientific Study, 2017, 5(4), 262-273.
16. Gifford R. The Consequences of Living in High-Rise Buildings. Architectural Science Review, 2007, 50(1), 1-16.
17. Gopalan K., Venkataraman M. Affordable housing: Policy and practice in India, IIMB Management Review, 2015, 27, 129-140.
18. Gopalan kalpana, Affordable Housing: An Academic Perspective On Policy And Practice In India, 2014.
19. Government of India,Five Year Plan DocumentsReport of the technical group on urban housing shortage (tg-12) (2012-17) MoHUPA
20. GRIHA, Griha For Affordable Housing, Griha Ah V.1, Abridged Manual, Making Affordable Housing Sustainable, 2017
21. Gupta Noopur, NamdeoPurva, Analysis of Affordable Urban Housing Projects in Bhopal, 2019
22. Haryana Government, Town and country planning department, NO. PF-27/48921.
23. Hayter J. Sheila, Kandt Alicen, Renewable Energy Applicable for Existing Building, 2011
24. Herck Van Karina, Meganck Leen, Can we afford to save the heritage of affordable housing?, 2012
25. Huu-Tai Thai, Tuan Ngo and Brian Uy (2020). A review on modular construction for high-rise buildings. Structures 28 :1265–1290.
26. Ibrahim Eldemery, High-rise Buildings-Needs and Impacts, 2007
27. Jagdale A. Sheetal, Current parameters to promote successful deliverance of Affordable housing, 2018.
28. Jeffrey Collin, Construction and Demolition Waste Recycling: A literature Review, 2011
29. Jobe Erick Van, Affordable Housing: Connecting Goals of Affordable Housing with Commonly Used Policies and Policy Tools, 2009
30. Karlessia T., Kampelisb N., Kolokotsab D., Santamourisa M., Standardic L., Isidoric D., Cristallic C. The concept of smart and NZEB buildings and the integrated design approach. International High- Performance Built Environment Conference – A Sustainable Built Environment Conference 2016 Series (SBE16), iHBE 2016.
31. Kavilkar R., Patil S. Study of High-Rise Residential Buildings in Indian Cities (A Case Study –Pune City). IACSIT International Journal of Engineering and Technology, 2014, 6(1), 86-90.
32. Kundu Amitabh, Report of the Technical Group on Urban Housing Shortage (2012-17)
33. Lasalle J.L. Affordable Housing in India: An Inclusive Approach to Sheltering the Bottom of the
34. Leung B. Greening existing buildings [GEB] strategies, Energy Reports, 2018, 4, 159–206.
35. Lubell Jeffrey, Brennan Maya, Framing the Issues – the Positive Impacts of Affordable Housing on Education, 2007 Lu, Y., Wu, Z., Chang, R., & Li, Y. (2017). Building Information Modeling (BIM) for green buildings: A critical review and future directions. Automation in Construction, 83, 134-148.
36. Mara Ferreri& Lorenzo Vidal (2021): Public-cooperative policy mechanisms forhousing commons, International Journal of Housing Policy, DOI: 10.1080/19491247.2021.1877888.

37. Maria Isabel Acuna. Reducing Time in the Construction of High-Rise Buildings. M.E. Thesis, Massachusetts Institute of Technology, 2000.
38. Matties De Fedrico, Good,Green and Safe Affordable housing, 2008
39. Mekheimar I. Shahinaz, Shehayeb K. Dina, Affordable Healthy Housing, 2000
40. Merril Sam, Environmental Finance for Affordable Housing, 2007Modi S. Improving the social sustainability of high rises, CTUBH Journal, 2014, 1, 24-30.
41. Ministry of Housing and Urban Poverty Alleviation, National Network of BuildingCenters, http://muepa.nic.in/programs/housing/nnbc.htm
42. Modi Suruchi, Improving the social sustainability of High-rises, 2014
43. Nakai M. Advanced structural technologies for high-rise buildings in Japan. CTBUH Journal, 2015, 22-29.
44. National Low Income Housing Coalition. 2018. The Gap: A Shortage of Affordable Homes. Available at: https://nlihc.org/sites/default/files/gap/Gap-Report_2018.pdf
45. Negi Manika, Way forward for PPP in Affordable housing, 2013
46. NerurkarSarvesh S., Sakpal Swati; International Journal of Advance Research, Ideas and Innovations in Technology, 2019.
47. Oldfield P., Trabucco D., Wood A. Roadmap on the Future Research Needs of Tall Buildings. Council on Tall Buildings and Urban Habitat (CTBUH), 2014.
48. P K Manoj, Construction Costs in Affordable Housing in Kerala: Relative Significance of the Various Elements of Costs of Affordable Housing Projects, 2017
49. Peace Robin, Kell Susan, Pere Lynne, Marshall Kate, Ballantyne Suzie, The Mental Health and Independent Housing Needs – Part 1 : A summary of Research, 2002
50. Perlova E., Platonova M., Gorshkov A., Rakova X. Concept Project of Zero Energy Building. 25th DAAAM International Symposium on Intelligent Manufacturing and Automation, DAAAM, 2014.
51. Poulos H.G. Tall building foundations: design methods and applications. Innovations in Infrastructure and Solutions, 2016, 1:10.
52. Prof. Ashraf Abu El-Ayoun Abdel-Rahim , Dr. Osama Helmy Haddad2 and Eng. Umniah Nagy Abdel-Hafez (2019). Learned lessons from global experiences in developing affordable housing projects, Journal of Advanced Engineering Trends (JAET), 38(2): 21-43.
53. Pyramid, Real Estate Intelligence Service (REIS).
54. R. Karthikeyan, Sathish G., Affordable Housing against Earthquakes in India, 2016 Raj G. Patel, Dipali B. Paneria (2021).Mass housing: features, challenges and its implementation, International Research Journal of Modernization in Engineering Technology and Science, 3 (3): 307-312.
55. Raj G. Patel, Himanshu J. Padhya (2021). Challenges and Prospects of Sustainable & Affordable Housing, International Journal of Research in Engineering and Science (IJRES), 9(1): 51-56.
56. Ram Kana, Affordable Housing: Opportunities in the Indian cities – A case study of industrial migrants, 2014
57. Ramakrishnan Hemalatha, Affordable Housing – Reality Challenge A Case Study In Bangalore City , 2015
58. Read C Dustin, Tsetkova Alexandra, Housing and Social Issues: A cross disciplinary review of existing literature, 1999
59. Rousseau D. Environmentally friendly building materials, Sustainable Built Environment Environmentally Friendly Building Materials, 2006, 1st edition.
60. Roy K. U., Biswas A., Arora K., De B., Srivastava A, Changing paradigms of Affordable Housing in Independent India Mukherjee, 2016

61. Sanghavi Bhumit, Francis Ann, Soni Yogesh, Visaria Kaivan, Saxena Rai Prakap, Critical success factors and risk factors for implementation of public private partnership model in affordable housing segment in india, 2017
62. Sengupta Urmi, affordable housing development in India: a real deal for low-income people, 2013
63. Shabha, G. Low-Cost Maintenance Approach to High-Rise Buildings: A Critical Appraisal of Low-Energy Refurbishment Scheme in Birmingham. Proceedings of the CIB W070 2002 Global Symposium, 2002.
64. Shelter. Affordable housing, vol 17(1), ISSN 2347-4912, 2016.
65. Singh Narender, Sustainable Design for Developing Affordable Housing, 2016
66. Sinha Nikhilesh, TM Bhargavi, Dastur Shahen,LodhaSwapnil,MonaniDhaval, RaghvanRoopali, New Frontiers in Affordable Housing, 2012.
67. Sterling Rogena,Focus on adequate, not only affordable, housing—Part2* (2019) 13 BRMB 5
68. Tanyer M. A., Emekci S.0, New Perspective on More Sustainable and Affordable Housing for Lower Income Group in Turkey -Assessing Life Cycle Cost, 2016
69. Umar Aminu Usman, Khamidi F. M., Tukur Hassan,Sustainable Building Material for Green Building Construction, Conservation and Refurbishing, 2014
70. UN Habitat 2016. *World Cities Report*. Nairobi: United Nations.
71. Venkata Guduru, Bhargav Suresh, Choudhary Sumit, Sharma.M. P. S.S.B., Use of Renewable Energy Sources in Construction of Green Building, 2015
72. Wamelink Hans, DeJong Peter, Building cost and eco-cost aspects of tall buildings, 2008
73. Wesam Salah Alaloul, Vivekka Olivia John and Muhammad Ali Musarat. (2020). Mechanical and Thermal Properties of Interlocking Bricks Utilizing wastedpolyethyleneTerephthalate, Int J Concr Struct Mater, 14:24. Https://doi.org/10.1186/s40069-020-00399-9
74. White S. Limiting roof penetrations in high-rise buildings: How to supply enough air to the drainage system, Manage water for better high-rise living, 2017.
75. Williams Tahlia, Affordable housing and its impact on communities and families, 2016 Wong, J. K. W., & Zhou, J. (2015). Enhancing environmental sustainability over building life cycles through green BIM: A review. Automation in Construction, 57, 156-165.
76. Woetzel, J., S. Ram, J. Mischke, N. Garemo and S. Sankhe. 2014. *A Blueprint for Addressing the Global Affordable Housing Challenge*. New York: McKinsey.
77. World Green Building Council. No date. Green building and the Sustainable Development Goals. Available at: https://www.worldgbc.org/green-building-sustainable-development-goals
78. Yun-Tsui Chang, Shang-Hsien Hsieh (2020). A review of Building Information Modeling research for green building design through building performance analysis. Journal of Information Technology in Construction (itcon), Vol. 25, pg. 1-40, DOI: 10.36680/j.itcon.2020.001.