

A Study on The Hurdles and Pollution Caused Due to High-Rise Buildings Within Urban and Sub-Urban Area in Chennai and Proposing an Effective Remedial Measures

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ABSTRACT: High-rise buildings are vast in development now-a-days; they are the identification for the urbanization of a city. A modern developing city consists of several high-rise structures in it. Even though there are many advantages due to high-rise buildings there are also some hurdles and pollution caused due to them. The main objective of the study is to achieve a proper high-rise building which will cause minimum hurdles and pollutions to its environment. Case study on three residential high-rise apartments namely, Arun Excello Estancia Township in Guduvancheri, Akshaya The Belvedere in Urapakkam and S.I.S SAFAA in Urapakkam has been selected and thoroughly studied with their respective specifications, amenities and floor plans. Fire accident is a major problem in high-rise structures. Sewage and waste disposal is a key factor which creates pollution to its environment. This study mainly focuses on the fire fighting and sewage disposal methods.

KEYWORDS: high-rise; skyscrapers; chennai; pollution

I. INTRODUCTION

Skyscrapers mark the advent of a city economical growth. They mark the onset of a city rise to prominence in the socio-economic status of a country. The beginning of industrial revolution catalyzed urbanization which led to migrations on huge scale towards bigger cities. As a direct result of which the landscape of cities changed to adapt to the demand for space. Skyscrapers were built to meet this demand by optimally utilizing the given area. Without disrupting the existing structure of the city, the high-rise buildings simply met the challenge by making use of the vertical space. Apart from being an outstanding visual representation of civilization growth, these tall buildings were not exempt from disadvantages of their own. They need a lot of resources to build and run on energy inputs higher than an average commercial building. If the energy output is unregulated it could present serious damage to the surrounding environment. The structure is so massive that it could alter the local weather patterns by disrupting the heat and wind flow.

High rise buildings also have a safety problem. Due to their massive structure it becomes difficult to evacuate in case of an emergency. They pose a considerable amount of challenge for structural and geo-technical designers while planning a building in areas with unpredictable seismic activity. Repurposing old buildings with upgrades like the HVAC system (Heating, ventilation and air conditioning) and the Fire sprinkler system becomes cumbersome because of the sheer scale of the building structure. But the buildings are often designed to also meet the aesthetic requirements, thereby compromising the aforementioned functional needs. Factors like these leads to many high rises having major design setbacks.

Chennai is one of the biggest metropolitan cities in India. Recent measure by the government to initiate the city expansion project has sped up the growth rate of high rise buildings in the city. Chennai has become the Centre of attention for foreign investors and the demand has aggravated the vertical growth of the city. Many IT companies and multinational corporations have set up skyscrapers and contributed to the impressive skyline of the city. LIC was the

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first known skyscraper built in Chennai located at Anna Salai stretching 177 feet tall. LIC building is a 15 storied building that serves as the southern regional headquarters of the Life Insurance Corporation of India. LIC building is a RCC framed structure with 15 floors and floor area of 11,700 m². Currently, seven towers of Hiranandani Upscale Egattur are the tallest buildings in Chennai with a total height of 134 meters. Still many more high-rises are already under construction in the city and dozens are proposed.

The objectives of this study are as follows:

- To study on the various hurdles and pollution caused due to the high rise building.
- To develop feasible remedial measures to overcome these hurdles and pollutions.
- To achieve a good quality high rise buildings which will have a social benefits to the environment.

II. SITE DETAILS

Three sites has been chosen for the study located in Chennai city in Tamil Nadu. The sole purpose of making the study is to analyze the construction of high-rise structure. Following are the three sites namely and their respective master plan is shown in the Fig. 1, Fig. 2 and Fig. 3.

- Arun Excello Estancia Township in Guduvancheri.
- Akshaya The Belvedere in Urapakkam.
- S.I.S SAFAA in Urapakkam.

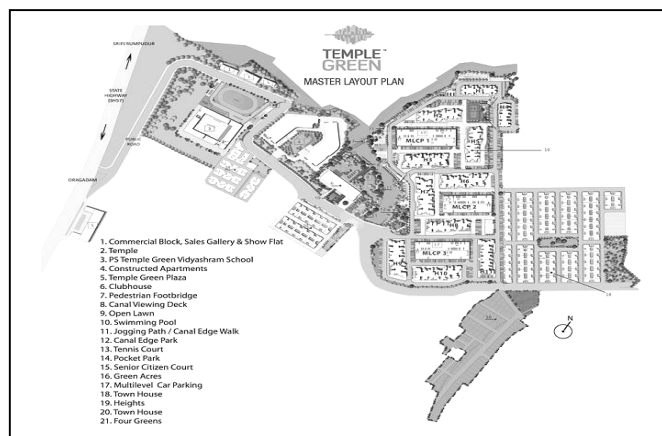


Fig. 1 Master Plan of Arun Excello Estancia Township

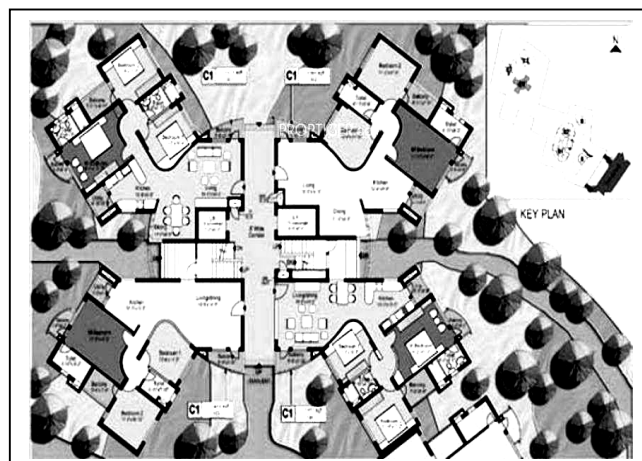


Fig. 2 Master layout plan of Akshaya the Belvedere

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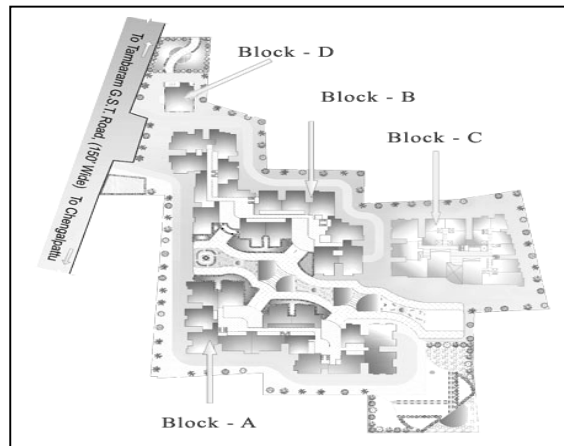
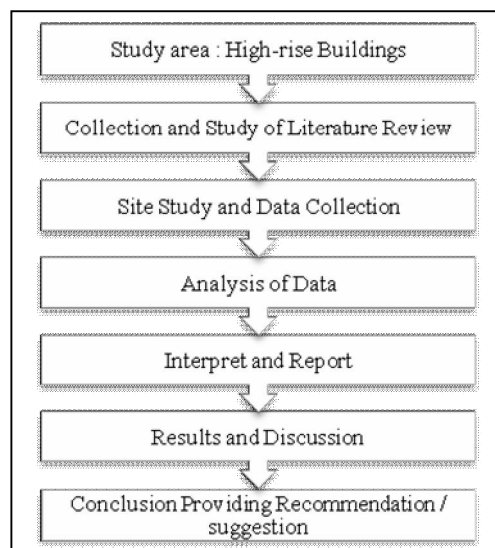


Fig. 3 Master Layout Plan of S.I.S Safaa

III. METHODOLOGY

The methodology adopted for this study is shown in the flow chart 1 below. The literatures can be seen in the references of the current paper.



Flow chart 1

IV. FACTORS AFFECTING BEHAVIOUR OF CONCRETE UNDER FIRE CONDITIONS

Concrete is an incredibly strong manmade mixture of aggregate (sand and gravel), cement and water that has been used in construction since Roman times. It is very hard and in its normal state can withstand high compression loads but it has one major weakness that it cannot resist tension loads. Many factors will affect how concrete will behave under fire conditions. These may include:

- Quantity and type of aggregate used in the mix
- Thickness (and thus protection of reinforcement)

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- Type of Cement used
- Water content of the concrete
- Load bearing
- Fire Exposure time
- Temperature
- Application of water (fire fighting Jets)
- Cladding or covering
- Age

V. FIRE PROTECTION METHODS

The fire protection methods available for use in high-rise buildings include as follows.

- Sprinklers
- Fire detection and alarm (smoke, hear, manual)
- Riser mains
- Means of escape
- First aid firefighting (fire extinguishers, hose reels, emergency lighting)
- Stair pressurization
- Smoke control system
- Voice communication and evacuation systems.
- Access and facilities for the fire brigade

Although not specifically “fire protection systems” the following can contribute to the fire safety of occupants in high-rise buildings.

- Training (staff and occupants)
- Maintenance of essential fire protection systems
- Fire safety and preparedness planning
- Lifts and lift management
- Duplication and redundancy of fire protection systems

VI. FIRE SAFETY IN HIGH-RISE STRUCTURES

The refuge area is a location in a building designed to hold occupants during a fire or other emergency, when evacuation may not be safe or possible. Occupants can wait there until rescued or relieved by firefighters. For floors above 24m and up to 39m one refuge area on the floor immediately above 24m. For floors above 39m one refuge area on the floor immediately above 39m and so on after 15m refuge area shall be provided. The following Fig. 4 shows the location of refuge area respectively.

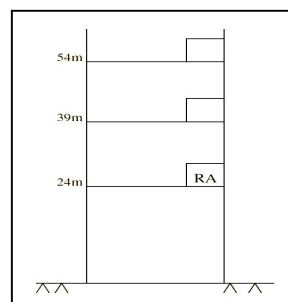


Fig. 4 Refuge area

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Sprinkler system is a built-in fire fighting system in a high-rise building. Sprinkler system is a must for basement parking and other risk areas where large quantities of combustible materials are stored. Each sprinkler should cover 6.96m^2 area. Normally a separate sprinkler should be provided for a separate car. Sprinklers may connect to main water tank and pump, but capacity of the tank & pump shall be increased in that proportionate. The capacity of water tank shall be calculated on the basis of sprinklers. Fig. 5 represents a typical sprinkler system in a high-rise structure.

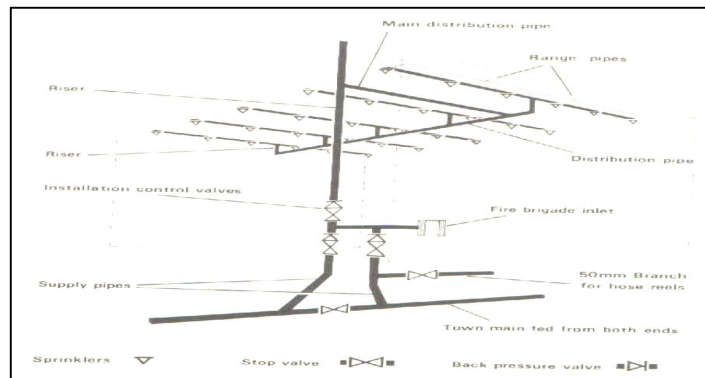


Fig. 5 Sprinkler system

VII. WASTE DISPOSAL IN HIGH-RISE BUILDING

The physical collection of waste in high rise buildings continues to pose many challenges; the traditional approach is commonly based on setting up vertical refuse chutes to collect waste, and loading docks in the parking areas. Although in general terms this is a convenient method for residents, waste chutes don't keep up with current trends and strategies for example source segregation of waste. Skyscrapers usually have limited space for containers in the loading dock, making recycling activities even more challenging.

As population increases and technology develops, skyscrapers seem to be conquering the city landscape, and reaching heights beyond expectation. One of the tallest skyscrapers currently under construction the Kingdom Tower in Saudi Arabia, is set to become the first building in the world to reach a staggering height of 1 kilometer. A building that tall would roughly generate 12 tones per week, the equivalent to about 600 homes. In a building that tall a considerable amount of waste will be generated within a relatively small surface area, representing a huge impact for ground level waste management systems and those ground level collection points. With urbanization increasing and space in cities becoming tighter, this scenario is likely to become more frequent in the future.

In order to develop more efficient and sustainable approaches to dealing with waste in the new generation of skyscrapers, not only do we have to rely on technology, but on a shift in behavior. We have to stop focusing on dealing with waste and look at understanding how waste would be generated in developments like the Kingdom Tower, putting more effort into preventing waste from being generated. This change of behavior is needed if we are to move from a throwaway society, to one in which waste is predominantly reduced, and the remaining is seen as a valuable resource.

In that regard, the waste industry offers an additional advantage as it is a fast growing sector. Waste to energy technologies such as gasification and anaerobic digestion have the benefit of being scalable. A gasifier can decompose solid waste in order to produce syngas, which may be used to generate electricity and heat for the building. Similarly, anaerobic digestion makes use of organic waste to generate methane, which can also be used to generate power in a variety of ways. These localized technologies have the potential to be implemented in this new generation of vertical cities and could provide renewable energy.

VIII. SUMMARY AND CONCLUSION

As we all know that the population keep on increasing day by day and these population needs space for their accommodation on land. Since the availability of land is very limited efficient usage of the land is necessary. High-rise

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buildings utilize the vertical space in land providing more space to accommodate for the people. This study mainly focuses the various hurdles and pollution caused by the high-rise structures to the environment. Case study on Arun Excella Estancia Township in Guduvancheri, Akshaya The Belvedere in Urapakkam and S.I.S SAFAA in Urapakkam are done thoroughly and reported with their respective specifications, amenities and floor plans used for its construction. Fire safety and sewage disposal in high-rise building is thoroughly studied based on the literature and the respective fire fighting equipment and sewage disposal techniques are reported in this study. Also in this study it is recommended that those waste generated from the high-rise structures should be efficiently utilized and regenerated to electricity by the use of biogas plant and gasifier.

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REFERENCES

- [1] Aldeberky, Amal 2005. Environmental adaptation of urban design for desert settlements in Upper Egypt, Ph.D. thesis, Faculty of Engineering, Ain-Shams University, p. 82-117.
- [2] Charles A.J.(1981),The Language of Post-Modern Architecture, Rizzoli N.Y.
- [3] Givoni B. (1998), Climate Consideration in Building and Urban Design , Van Nostrand Reinhold, p. 244296.
- [4] Fathy, Nahed 1997, Housing in desert area – studies for air flow pattern through out-door spaces in new cities in Egypt. Ph.D thesis, Faculty of Engineering, Zakazik University, p. 148-189.
- [5] Givoni B. (1998), Climate Consideration in Building and Urban Design , Van Nostrand Reinhold, p. 244296.
- [6] Lechner, N. (1991), Heating, Cooling , Lighting -Design Methods For Architects, John Wiley & Sons Inc , p. 104.
- [7] Merghani, A. 2002, Control of wind- blown sand and dust by town planning and building design, Urban Development in Arid Regions & Associated Problems, Ministry of Public Work & Housing Conference, K S A, p. 725.
- [8] Raafat, A. 2007. Design creation: contents and form between rationalism and consciousness, Arab Contractors press, p. 223- 356.
- [9] Sleeper, R (1981), Architectural Graphic Standards, American Institute &Architecture, p.112. William, P. Cunningham et al (1977), Environmental science, McGraw – Hill.
- [10] Kareem (1983), "Mitigation of Wind Induced Motion of Tall Buildings," Journal of Wind Engineering and industrial Aerodynamics, Vol. 11, Nos. 1-3.
- [11] Anshuman.S, DipenduBhunia, BhavinRamjiyani, "Solution of shear wall location in multistory building", International journal of civil and structural engineering, 2011.
- [12] Shahzad Jamil Sardar, Umesh. N. Karadi, "Effect of change in shear wall location on story drift of multi-story building subjected to lateral loads", International journal of innovative research in science, 2013.
- [13] A.G. Davenport, (1967): "Gust Loading Factors," Journal of Structural Engineering, ASCE., 93(ST3)
- [14] "Plea to okay draft Master Plan". The Hindu (Chennai: The Hindu). 18 July 2008. Retrieved 14 Sep 2012.
- [15] Proulx, G., Richardson, J.K. (2002) The Human Factor : Building Designers Often Forget How Important the Reactions of the Human Occupants Are When They Specify Fire and Life Safety Systems. In: Canadian Consulting Engineer 43, p. 35-36.
- [16] Purser, D.A., Bensilum, M. (2001) Quantification of Behaviour for Engineering Design Standards and Escape Time Calculations. In: Safety Science 38, p. 157-182.
- [17] Raubal, M., Egenhofer, M.J. (1998) Comparing the Complexity of Wayfinding Tasks in Built Environments. In: Environment and Planning B 25 (6), p. 895-913.
- [18] Sandberg, A. (1997) Unannounced Evacuation of Large Retail-Stores. An Evaluation of Human Behaviour and the Computermodel Simulex, Lund University, Lund.
- [19] SFPE (2002) Engineering Guide to Human Behaviour in Fire: Review Draft.
- [20] Sime, J.D. (2001) An occupant response shelter escape time (ORSET) model. In: Safety Science 38, p. 109-125.
- [21] Tillander, K. (2004) Utilisation of statistics to assess fire risk in buildings. Dissertation for the degree of Doctor of Science in Technology at Helsinki University. VTT Building and Transport, Espoo, Finland.
- [22] Tong, D., Canter, D. (1985) The Decision to Evacuate: A Study of the Motivations which Contribute to Evacuation in the Event of Fire. In: Fire Safety Journal 9, p. 257-265.
- [23] Tubbs, J.S. (2004) Developing Trends from Deadly Fire Incidents: A Preliminary Assessment. ARUP, Westborough, MA, 2004.