

Sustainable Residential And Commercial Spaces Using Capsule Buildings

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Abstract- *The exploratory paper addresses how sustainable residential and commercial spaces might be built using capsule building systems. It is accomplished by classifying and examining instances of early 20th-century capsule architecture. The Nakagin Tower is the first fully developed tower to result from this movement, and it has been classified as an architectural heritage since 2006. The purpose of the study is to give a description of sustainable development in India and weigh the benefits and drawbacks of green sustainable building structures and comprehend their prospects. Exploring spatial layout precisely involves a combinatorial arrangement in structure. This means that the developer must break down a structure into lower factors to completely understand the space. This includes cabinetwork and accessories, which are the most intimate rudiments a person encounters. By breaking down a structure into lower spaces, A greater understanding of the area will benefit the developer. The indicator terms of the paper are Sustainable structure, Capsule Building, Residential Space, Commercial Space, and Metabolism. A sustainable structure is a type of structure that's designed to be environmentally friendly and energy effective. A building style that consists of tiny, independent units is known as a capsule building.*

Keywords- Sustainable Structure, Capsule Building, Metabolism, Residential Space, Commercial Space

I. INTRODUCTION

The ability of a structure to provide a friendly, efficient, and healthy environment is referred to as sustainability. Since 2006, the Nakagin Capsule tower by Kisho Kurokawa has been recognized as a work of architectural heritage. So, examining Nakagin Capsule Tower as a case study offers a once-in-a-lifetime chance to reconsider Metabolism's historical place in postwar modernism, its impact on contemporary architecture, and its potential as an inspirational model for the future metropolis. A type of construction known as metabolically planned architecture is centered on an infrastructure resembling a spine with replaceable, prefabricated cell-like components. It is simple to attach and detach a component when its useful life is through.

This kind of architecture is intended to be sustainable, which means that it is made to survive the elements and last for a very long time. It is recorded for the future to be energy-efficient, which means that it consumes less energy than conventional structures. It is also simpler to maintain and repair equipment when prefabricated, interchangeable parts are used, as well as to upgrade or replace components when necessary. Following are the objectives of our research paper to analyze the feasibility of Pre-engineered Capsule building structures in sustainable housing and commercial spaces. To analyze the applications of Capsule structure in P.C.M.C. To design suitable vertical structures catering to public needs and upgradation as per by-laws.

II. REVIEW OF LITERATURE

Zhongjie Lin (2011) Nakagin Capsule Tower and the Metabolist Movement Revisited⁶. In this paper, the author discusses the Nakagin Capsule Tower and the Metabolist Movement, which was a romantic movement in the early 20th century. The movement was characterized by its romantic enterprises and polemical schemes against the sanctioned master plans of reconstruction. The author argues that the Nakagin Capsule Tower was the first completely realized structure to develop from this movement. The paper also discusses the combinatorial arrangement in structure, which is the precise approach to exploring spatial arrangement.

Aki Ishida (2016) Paradox of a landmark that is not the life of the Nakagin capsule tower¹. It's mentioned in the paper that a piece of land is veritably desirable for new development. This means that the land is seen as an asset and is desirable for new development systems.

Volodymyr Derezhnichenko and Taishin Shiozaki (2021) Concept and physical characteristics of capsule architecture⁵. This paper aims to produce a comprehensive view of the history of the development of the capsule armature. This means that the paper will look at the development of the capsule armature from its onsets to the present day. It'll also look at the colorful aspects of the capsule

armature, similar to its design, accouterments, and construction ways.

Paul Kim (2017) Rationalization of combinatorial design in Architecture for micro-housing³. Combinatorial design is a technique used in architecture to create a building or structure by disassembling it into smaller parts. With this method, there are many alternatives for modular units that can be used to produce a wide range of diverse designs. Bureau Of Indian Standards (2016) National Building Code of India². It ensures the safety of the personnel during construction operations.

Town and Country Planning Organisation Ministry of Urban Development (2016) Model Building Bye-Laws⁴. It provided us with the standard dimensions and area requirements for building structures concerning various parameters and areas.

III. OBJECTIVE

The objectives of the research paper are to study the feasibility of using pre-engineered capsule building structures in sustainable housing and commercial spaces. This means that the researchers are investigating whether it is practical and possible to use these types of structures in buildings that are environmentally friendly and can be used for both residential and commercial purposes.

To analyze the potential use of capsule structure in the Pimpri Chinchwad area. The capsule structure is a type of building design that is characterized by its compact and modular nature, which allows for easy construction and customization.

The research paper aims to investigate the various applications of this structure in the specific context of Pimpri Chinchwad, which is a rapidly growing urban area in India. The researchers will examine the suitability of Capsule structures for different purposes, such as residential, commercial, and public use. The second part of the objective is to design suitable Capsule structures that meet the needs of the public and comply with local by-laws.

IV. METHODOLOGY

To increase infrastructure in emerging countries, vertical construction has been developed because of the shortage of land in urban areas. In the practice of vertical construction to make the most use of the restricted land, construction should go upward rather than outward. This is crucial, especially in cities where land is expensive and in

short supply. Building higher allows for the housing of more people in a smaller space and the quick construction of new infrastructure. This is advantageous for developing countries because it enables them to efficiently build up their infrastructure and increase the number of homes available to their inhabitants.

The exploration process was conducted to identify the problem that the paper is addressing. The experimenter collected papers, papers, and theses related to the problem statement and studied them completely. Through this process, the experimenter was suitable to identify the problem that the paper is addressing. This process of collecting and studying accouterments is a common exploration system used to identify a problem and develop an exploration paper.

We chose a capsule building structure for the nakagin capsule tower construction to land acquisition costs and make the most of the area that was already available.

Concerning the nakagin capsule tower construction, we chose a capsule building structure to minimize the land acquisition costs and utilize the existing area to the best extent possible.



Fig 1. Elpro city squire mall

The Elpro City Squire Mall was the subject of a comparison study. The aim of this study was to find the best way to utilize the available space. The study involved evaluating how other similar locations are used and comparing the mall to them. This comparison was made to determine the best methods for making the most of the available space. This could include the way the room is organized, the kinds of furniture and accessories that are used, and the way the room is decorated overall. The designer can produce a more effective and sustainable design by being aware of the best methods for making the most of the available space.

V. RESULT AND DISCUSSION

Elpro City Mall is a shopping mall located in the city of Pune. It is a large complex that consists of several different

components, including retail stores, restaurants, entertainment venues, and other services.

Description	No. of Units	Total Built-Up Area	FSI	GSI
1300 sq. m. <	12	16000 sq. m.	0.86	1.2
92 sq. m. –	24			
140 sq. m.				
46 sq. m. >	49			
Residential	0			

Table 1 - Components of Elpro City Mall

The table contains five columns: Description, Number of Units, Total Area, Floor Space Index (FSI), and Ground Space Index (GSI). The Description column contains information about the size of the units in the mall. The first-row states that there are 12 units with an area of 1300 square meters or less. The second-row states that there are 24 units with an area between 92 and 140 square meters. The third-row states that there are 49 units with an area greater than 46 square meters. The fourth-row states that there are no residential units. The Number of Units column states the number of units for each size range. The Total Area column states the total area of the units in each size range. The FSI column stands for Floor Space Index.

FSI Calculation of Elpro City Mall -

$$16000 \times 4 = 64000 \text{ (1)}$$

$$64000 / 74000 = 0.86 \text{ (2)}$$

COMPARISON OF FSI BETWEEN ELPRO CITY MALL AND CAPSULE STRUCTURE

Capsule	No.	Length	Breadth	Sq. m.	Area	Total Area
1BHK	12	6	8	50	600	2024
2BHK	8	8	8	70	560	
Studio Apt.	36	6	4	24	864	

Table2 - FSI Calculation for Residential

It is a comparison of the Floor Space Index (FSI) between Elpro City Mall and Capsule Structure. A building's total floor area is compared to the size of the plot of land it is constructed on using the FSI ratio. It is determined by dividing a building's total floor area by the size of the property on

which it is situated. In the table, the first column is the type of Capsule, the second column is the number of Capsules, the third and fourth columns are the length and breadth of the Capsules respectively, and the fifth column is the area of each Capsule in square meters, the sixth column is the total area of all the Capsules of the same type, and the seventh column is the total area of all the Capsules.

Capsule	No.	Length	Breadth	Sq. m.	Area	Total Area
Capsule 1	72	15 m	10 m	150	10800	15600
Capsule 2	48	10 m	10 m	100	4800	

Table 3- FSI calculation for Commercial

The table contains information about the number of capsules, their length, breadth, and total area. The first column of the table is labeled "Capsule" and it indicates the type of structure being compared. The second column is labeled "No." and it indicates the number of capsules in each structure. The third column is labeled "Length" and it indicates the length of each capsule in meters. The fourth column is labeled "Breadth" and it indicates the breadth of each capsule in meters. The fifth column is labeled "Sq. m." and it indicates the area of each capsule in square meters. The sixth column is labeled "Area" and it indicates the total area of each capsule in square meters. The seventh column is labeled "Total Area" and it indicates the total area of all capsules in each structure.

FSI Calculation of Capsule Structure –

$$2024 + 15600 = 17624 \text{ [(From Table 2 and 3) 1]}$$

$$17624 / 16000 = 1.10 \text{ (2)}$$

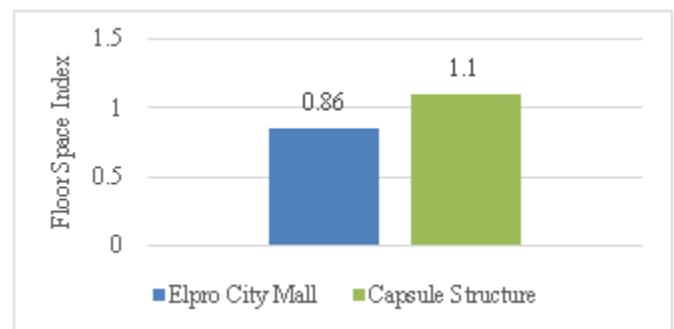


Fig 2- Floor Space Index

COMPARISON OF GSI BETWEEN ELPRO CITY MALL AND CAPSULE STRUCTURE

Description	No. of Support	Area	Total Area	No. of Floors	Sum
Support	4	500	2000	6	12000

Table 4 - GSI Calculation of Capsule Structure

The process of calculating a capsule structure's Ground Space Index (GSI). A building or structure's overall area, including the area of the building itself and the amount of land it occupies, is determined by its GSI score.

The table contains six columns: Description, Number of Support, Area, Total Area, Number of Floors, and Sum. The Description column lists the components of the Capsule Structure, such as the number of supports and the area of the building. The Number of Support column lists the number of supports that the Capsule Structure has. The Area column lists the area of each component of the Capsule Structure.

GSI Calculation of Capsule Structure –
 $6 \times 2000 = 12000$ (1)
 $12000/16000 = 0.75$ (2)

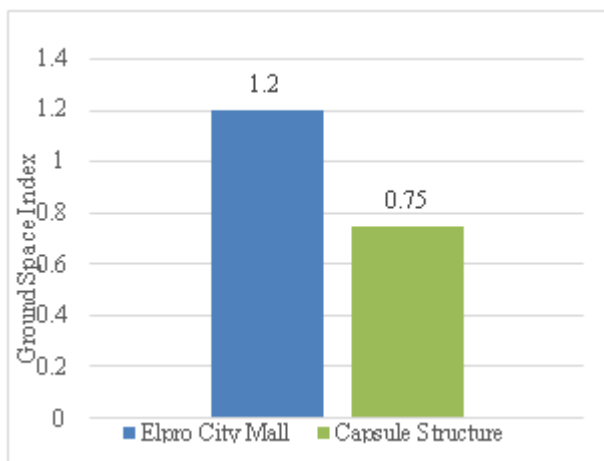


Fig 3 – Ground Space Index

COMPARISON OF OSI BETWEEN ELPRO CITY MALL AND CAPSULE STRUCTURE

Description	Total Area	Built-up Area	Calculation	OSI
Elpro City Mall	74000	16000	58000	0.78
Capsule Structure	74000	9600	64400	0.87

Table 5 – OSI Calculation of Capsule Structure and Elpro City Mall

The process of calculating capsule structures and Elpro city Mall Open Space Index (OSI). Description, Total Area, Built-up Area, Calculation, and OSI are the four columns in the table. The Description column contains the names of the two structures being compared, Elpro City Mall and Capsule Structure. The Total Area column contains the total area of the plot on which each structure is built, which is 74000 square meters for both. The Built-up Area column contains the total built-up area of each structure, which is 16000 square meters for Elpro City Mall and 9600 square meters for Capsule Structure.

The Calculation column contains the calculation for OSI were,

OSI Calculation of Elpro City Mall –
 $74000 - 16000 = 58000$ (1)
 $58000/74000 = 0.78$ (2)

OSI Calculation of Capsule Structure –
 $74000 - 9600 = 64400$ (1)
 $64400/74000 = 0.87$ (2)

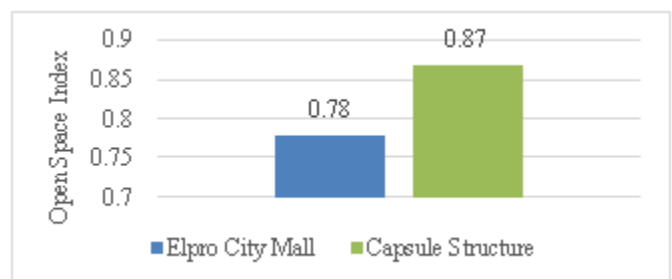


Fig 4 – Open Space Index

COMPARISON OF SPACES BETWEEN ELPRO CITY MALL AND CAPSULE STRUCTURE

Description	Elpro City Mall	Capsule Structure
No. of Commercial Spaces	85	120
No. of Residential Spaces	0	56

Table 6 – Comparison of Elpro City Mall and Capsule Structure in Space Utilization

The table shows that Elpro City Mall has 85 commercial spaces and 0 residential spaces, while Capsule Structure has 120 commercial spaces and 56 residential spaces. This means that Elpro City Mall has a higher FSI than Capsule Structure, as it has more commercial spaces and no residential spaces.

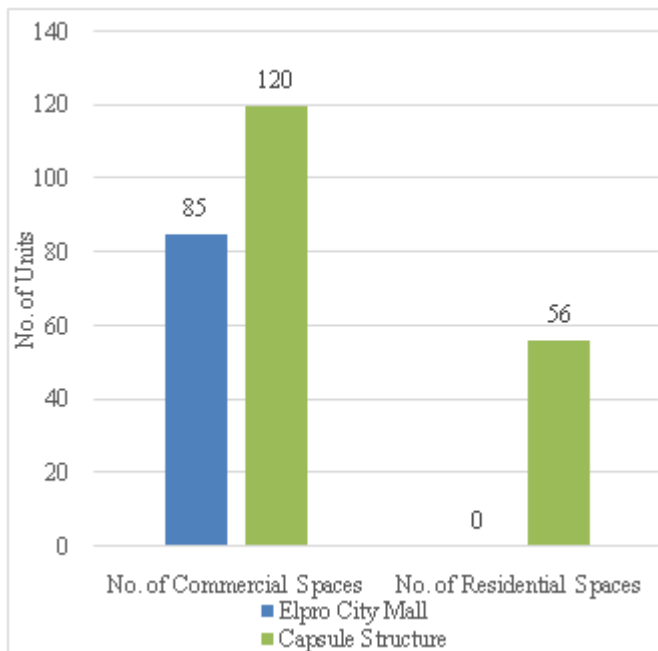


Fig 5 – Spaces

VI. OBSERVATION

Based on the inputs and data summary the project area is 17624 sq m. in total all floors and any outdoor space are included in the building's overall square footage. The Floor Space Index is 1.10 (FSI). This figure represents the relationship between a building's total floor area and the size

of the land on which it is located. It is calculated by dividing the plot's area by the building's total floor area. Mathematically, this can be determined using the formula $FSI = \text{Total Floor Area} / \text{Plot Area}$. The ground space index, or GSI, is 0.6. This indicates how big the building is in relation to the size of the plot it is on. It is calculated by dividing the entire size of the building by the total area of the land. Mathematically, this can be expressed as $GSI = \text{Total Building Area} / \text{Plot Area}$. The Open Space Index, or OSI, is 0.87. The ratio of a building's total open space to the size of the site it is built on is represented by this number. It is calculated by dividing the total open area of the building by the size of the plot. The formula for this is $OSI = \text{Total Open Space} / \text{Plot Area}$. One hundred and twenty capsules are for sale. The total number of capsules used for commercial purposes is shown here. There are 56 housing capsules available. This is an assortment of all residential capsules.

VII. CONCLUSION

The study found that a pre-engineered capsule building structure is a viable option for construction in the Pimpri Chinchwad area. This information could be useful for developers or builders who are considering using this type of building structure in that region.

The study has found that capsule structures can have multiple applications beyond just small living spaces or hotels. It is possible that this design can be used in other types of buildings such as offices, hospitals, or even schools.

The study has identified the potential benefits of capsule structure, such as efficient use of space, and flexibility in design. Elpro City Mall is 1.10, indicating that the total floor area is approximately 110% of the plot area. in comparison The Capsule Structure has a higher FSI of 1.20, indicating that its total floor area is approximately 120% of the plot area. Elpro City Mall is 0.75, meaning that the building occupies, and Capsule Structure has a lower GSI of 0.87, meaning that it occupies approximately 87% of the plot area. Overall, the finding suggests that the capsule structure has the potential to be a sustainable building design option that can be applied in various contexts

REFERENCES

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