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Adaptive Reuse of Abandoned Textile Mills in Mumbai

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***Abstract*— Mumbai - today is the economic capital of India, as a capital city of Maharashtra. But 600 years back it was just a bunch of seven islands. The native people's primary occupation was farming and fishing as being 18km long coastal line. In late 15th century the land was invaded by Portuguese and in 1661, the island was gifted to British & by 1850, former Bombay became the Powerhouse of the Industries due to availability of coastal region for transportation which became the hub of cotton textile mills. And over the years it was popularly known as Manchester of East.**

With the rise in the textile mills & job opportunities got boosted and there was a tremendous shift of people from rural to urban area for jobs and luxurious life. (with the rise in industries & economy Mumbai attracted millions of people towards it and until now on-going phenomenon). But after 18th century, due to modernization, development of parallel industries and other reasons, declination of textile mills started, the scenario today is the India United Mills area of 6 Ha. is located in a very prime location, in a dilapidated state, but the character of the building (Victorian Style), its location, socio-economical values, it becomes necessary to retain some of the buildings which is in comparatively good state. (as per the survey by Charles Correa Study group).

The study focuses on the thorough analysis of existing industrial buildings that can be retained and going for the adaptive reuse of them. So, the socio-economical value, building characters will be retained and the history of Mumbai as well. The methodology of the adaptive reuse will be survey of the buildings, knowing in which category they fall, selection of suitable material to retain original essence and while converting it into a commercial building, the façade treatment is also very important.

***Keywords*—Modernization, Job Opportunities, Dilapidated, Socio-Economy, Adaptive Reuse, Original Identity.**

I. INTRODUCTION

Continuously advancing developments has driven cities to more architectural improvement. Development, expansion, social and urban improvement are a few of the reasons to create modern development technologies. But as we move forward the shortage of land plays an imperative part in hindering the improvement. In Mumbai city particularly, people have started to move towards the mill districts inside the cities having large areas, great connectivity and found inside the prime regions, as there's a shortage of land with the city's quick paced advancement, the mill area came to a positive light for the new improvements within the city. So to protect the authentic & historic setting and progress the improvement of the zone, individuals are moving towards adaptive reuse of the mills.

Adaptive reuse has developed as a feasible alternative to possible opportunity for the built environment. Adaptive reuse is the method where existing buildings are reused in several capacities to their unique reason. Buildings that experience this process are generally at the end of their life expectancy. Reusing them permit components of their appearance, plan, social heritage, emotional value, save the economy and noteworthy to be kept up, whereas serving an unused work and avoiding them from being demolished in forms that consume a critical sum of energy. While developing a modern building may be more energy efficient, it can take a long time to counterbalance, the quantity of energy expended in its development.

A. Aim

The aim of the considered project is to demonstrate the advantage of repurposing noteworthy structures, which can be utilized as out of date forms, and to remodel them by bringing them into the 21st century simultaneously, portion of the memory and their imperative commitment of their life course. The essential point is to conceptualize a redevelopment procedure that jam authentic exteriors, adjusts contribute into modern commercial spaces, and contributes to economic urban advancement.

B. Research Objectives

1. Preservation of Historical Identity:
   Investigate methods to restore textile mill facades, ensuring a visual link between Mumbai's industrial past and present.
2. Adaptive Reuse and Modernization:
   Develop a strategy for transforming interiors into modern commercial office spaces while integrating advanced structural elements.
3. Sustainable Urban Development
   Integrate green spaces within the redevelopment plan to contribute to sustainable urban development.
4. To Develop Affordable Commercial Office Spaces:
   Design modern commercial office spaces within the mill, catering to contemporary work environments and fostering economic growth.

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C. Research Question

The project addresses the direness to overcome differences between conservation and modern urban functionality in central Mumbai. What is the advanced way of economical utilization of ancient mills abandoned within the modern valuable buildings?

D. Research Problem

Companies construct industrial facilities to deliver good in bulk. They utilize them to the fullest degree possible and later, they construct modern and bigger spaces for the developing request. Old buildings are regularly changed over into distribution centers or abandoned through and through – the latter often leads to their demolition to create modern ones, and the cycle proceeds.

E. Limitations

1. Balancing structural concerns with preserving architectural features.
2. Assuming the project has secured adequate funding.

II. METHODOLGY

Literature Review
1. Literature Case Study 1 – Flourmill Studios, Sydney
2. Literature Case Study 2 – Judson Mills, South Carolina

Site Survey
Advance Construction Techniques

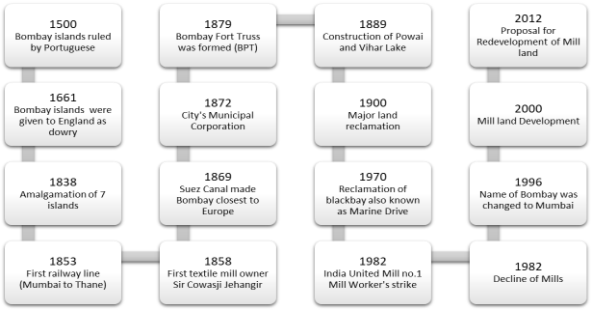
A. Literature Review

Flourmill Studios is situated in Newtown, Sydney while Judson Mills lies in Greenville, South Carolina; these are examples of how old industrial constructions can adapt to the modern age. Flourmill Studios is located in the core of a busy city suburb and grown into place for artists, creatives and small businesses. The project not only gives a new lease on life to an ancient flour mill but also preserves the local history through providing affordable working spaces. They are also sustainable by using materials that do not harm the environment and energy saving devices to lower their carbon footprint. Additionally, Flour Mill studios mixes classic industrial look with contemporary design making it one of its kinds.

On another note; Judson Mills shares these same sentiments as well considering what happened with textile mills during this time period where they were once booming factories but now house people's homes, stores or parks for example While being transformed into an apartment complex among other things it brought life back into that particular part of town by attracting investors and giving residents more options down to jobs etcetera. They also care about nature since they employ ecofriendly construction methods alongside preserving Reedy River which is nearby natural beauty spot. To sum up everything; both Flourmill Studios and Judson Mills demonstrate how we can embraces the adaptive reuse of an old industrial building not only provides affordable venues but also injects vitality into the local economy, potentially boosting commerce and tourism. Environmental challenges are tackled through repurposing of existing structures, lessening the environmental burden while incorporating energy-efficient features for long-term sustainability. Architecturally, the studio preserves the industrial charm while infusing modern design elements, creating an aesthetically pleasing and functional space that pays homage to its historical roots. Similarly, by developing a mix of residential and commercial spaces, the project not only advances economy but also encourage the development of community engagement and cohesion. Environmental sustainability remains a priority, with green building techniques and proximity to natural resources like the Reedy River promoting conservation efforts and outdoor recreation. Urban benefits abound as these projects enhance their respective cityscapes, revitalizing once-disused industrial areas and seamlessly integrating with surrounding neighborhoods, ultimately contributing to the overall vibrancy and livability of the urban fabric.

B. History of Textile Mills

Mumbai, located on the western coastline of Maharashtra, covers about 603 sq km in area and has a coastline of around 18 km. It was formerly known as Bombay and seven islands – Colaba, Malabar Hill, Worli, Mazgaon, Parel, Mahim and Sion – were joined together to form the city.The city then grew into a major commercial centre with a cosmopolitan populace. The British took advantage of the ownership they had over these islands during their tenure as rulers by making them one entity which set Mumbai up for becoming an industrial giant later on. The Cowasji Nanabhai Davar founded India's first cotton textile mill here in 1850 marked a turning point in the history of this industry in Bombay. Following that many other mills were established across the city over subsequent years which employed lakhs workers from different parts of India.Girangaon – covering areas from Parel to Lal Baug – became synonymous with textile mills.



Source: Author

Fig. 1. Timeline of development of Mumbai Mill Land.

The advent of 'Chawls' communal living spaces comprising numerous buildings surrounding a central courtyard, provided affordable housing for mill employees and their families. These chawls functioned not only as residences but also

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emerged as hubs of social activity nurturing a sense of community among residents.

In contrast the textile industry suffered a significant decrease in the late 20th century. This was worsened by elements like globalization and advancements in technology, resulting in extensive unemployment and economic tribulations. A number of mills had to close their doors and halt operations. It sparked protests initiated by employees. They demanded improved wages and better working conditions through strikes. The map below shows the positions of 52 mills in Girangaon that set up the urban texture of the region and gave a distinct character to Girangaon.

In Girangaon's urban landscape, key features include mills, worker housing, recreational areas for worker colonies, as well as places of worship and entertainment.

(Source: https://l1nq.com/vTPN4)

Fig. 2. Girangaon Precinct map showcasing the locations of 52 textile mills of Mumbai.

In reaction to the newly formed economic environment the Mumbai government put forth development legislation. Their aim was to reassign the now empty mill campus for new uses. This sequence of actions resulted in the splitting of mill campus. They were reserve for various purposes such as public housing and business pursuits. It signaled towards a shift to urban redevelopment. There was also a move toward revitalization.

Despite, the steep fall of the textile industry, Mumbai still maintains its vitality as a metropolis. The city keeps drawing individuals from different circumstances with its potential and multicultural appeal. The transformation of the city from an assembly of islands to an economic dynamo is a reflection of its capacity for resilience. City shows adaptability even in the face of transformation.

III. SITE ANALYSIS

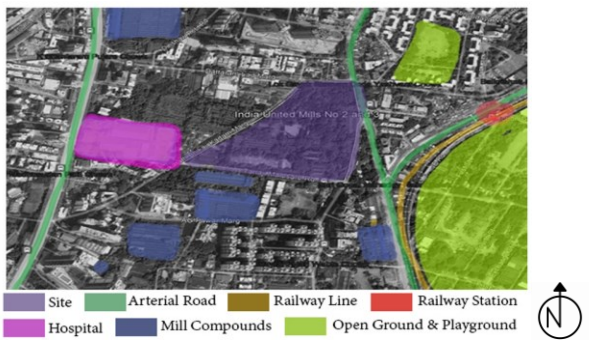
India United Mills no. 2 & 3 (previously known as Indu Mills) located within the Kalachowki area, Byculla, Mumbai. A large plot separated in two parts by an intermediate compound wall forms the compound of India United Mills No 2 and 3. Located along Ram Bhau Bhogale Marg and Tanaji Malusare Marg at Kalachowki. The structures appear in varying degrees of ornamentation and façade characteristics. The buildings are built within the industrial typology with an impact of elements from Neoclassical elements utilized extensively on the façade. The mill as a whole includes a solid built form and makes an interesting skyline because of variety in height and floors of each building.

A. Site Use

TABLE I. FUTURE USE OF SITE

Future Use	Reasoning		
	Pros	***Cons***	***Remarks***
Histoical Use	1. Heritage Preservation 2. Social Esteem	1. Restricted Financial Return 2. Maintenance Cost	Revenue generated due to redevelopment will be less than redevelopment cost.
Commercial Use	1. Economic Development 2. Infrastructure Enhancement	1. Environmental Effect 2. Gentrification & Displacement	Helpful for the community ; will generate economy, employment opportunities.
Reidential Use	1. Addressing Housing Demand 2. Community Advancement	1. Strain on Infrastructure 2. Gentrification & Displacement	Existing structures will be demolished; and new structures will be built.

B. Site Analysis



Source: Author

Fig. 3. Site Vicinity in the adjacent 1 km. of the selected mill compound .

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Mumbai has a Tropical Wet & Dry climate with temperatures ranging from 16ºC to 42ºC annually. April is the hottest month, while July is the wettest, with an annual precipitation of 1288.1 mm and humidity around 67%. It rains about 130 days a year. Due to these conditions, moisture management in buildings is crucial. Rainwater collection and flood risk assessment are necessary, especially for wooden structures, given the dynamic climate and site changes.

The mill was developed about 200 years ago. Hence it has an historical importance as it gave the mill precinct an individuality as well as it created a neighborhood for all the mill workers working there through chawls. This also created a close-knit family of all the people living in the neighborhood, thus this characteristic of the neighborhood should be preserved even in the face of redevelopment.

All in all, it is important to note and design a strategy to preserve these characters of the neighborhood while giving the old buildings of the site a new identity and purpose so that the history isn't lost. And the people living over there accept this new change as revival of culture and honor the traditions.

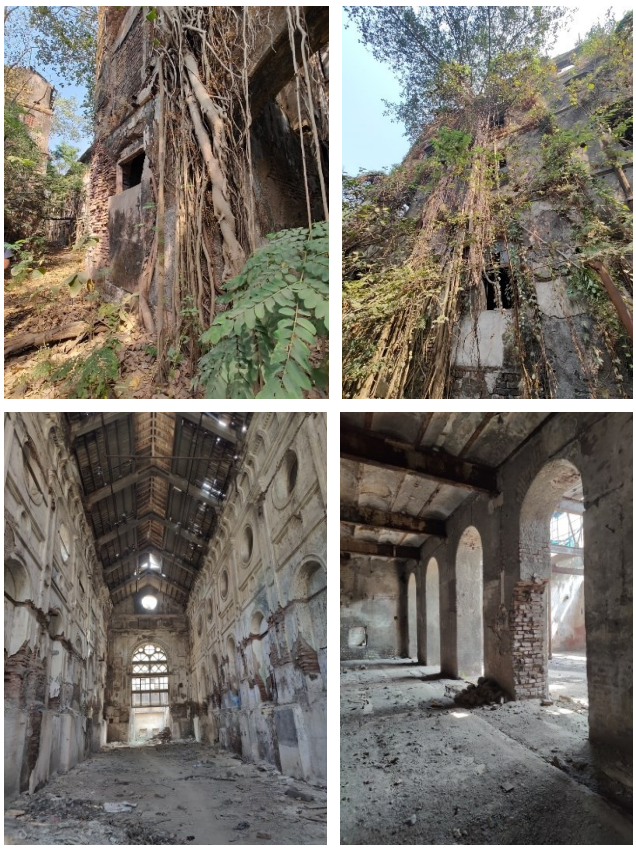
Source: Author

Fig. 4. Site topography with an slope of 4 Metres.

The site has an abundance of vegetation. Major percentage of that goes to perennial evergreen trees so as to give shade and to provide a cool working environment. Major species seen on-site are Chestnut tree, Banyan tree, Neem tree, Gulmohar tree. These trees can be preserved during the redevelopment as they are spread out on the entire site. Having said that, some tree roots have taken hold of building structure gaps and cutting down those trees is the best solution for returning the buildings to its original strength. Otherwise it doesn't cause any harm to the site. The soil typology includes black clay soil besides yellowish clay soil which was found on further depth during excavation which holds the trees and provides groundwater to the trees easily.

The mill has 23 buildings out of which 8 have been demolished by natural forces such as wind, rain or by the government for the redevelopment. And out of the remaining 15 buildings, about 8-9 are in the condition to be strengthened and to be accessed for adaptive reuse. Other buildings are in no state to be strengthened for adaptive reuse and will result in liability in the long run and hence demolition shall be the best course of action suggested. While considering adaptive reuse, this site has a lot of buildings which could take advantage in upcoming years if the structure is given proper strengthening.

Site topography with a slope of 4 Meters.



Source: Author

Fig. 5. Existing Site Conditions

Strengtths & Opportunities:

India United Mill no. 2 & 3 are located in prime location and existing amenities offer abundant redevelopment prospects. Structural soundness and architectural features of many buildings support adaptive reuse, facilitating their repurposing for new functions while maintaining original identity.

Weaknesses & Challenges:

The tropical wet & dry climate, coupled with historical water storage practices, has weakened wood columns, necessitating their analysis and reinforcement for redevelopment. Neglect has allowed tree roots to damage building structures, requiring evaluation of the scale of harm. Risk management and structural evaluation are pending to determine buildings suitable for adaptive reuse and requiring demolition.

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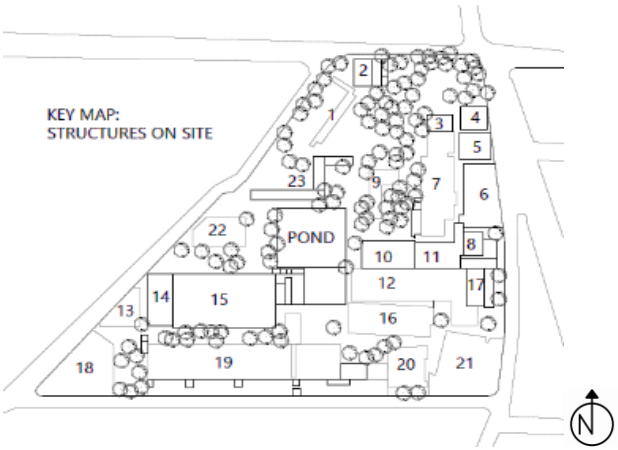
Structural Analysis:

Concurring with Charles Correa et al. (1996), Report of the Study group on the Cotton Textile mills in Mumbai a systematic study of structures within the mill campus were conducted by a group of conservation architects. This study was conducted by visually analyzing all structures to recognize their heritage importance, structural quality, development technology and potential for adaptive reuse. These overviews were crafted visually.

Contrary to the 1996 observations, the buildings have deteriorated while some have been demolished. So the below given structural analysis is given by the author on the basis of the observations made visually on the site in 2024. This study was conducted by visually analyzing all structures to recognize their heritage importance, structural quality, development technology and potential for adaptive reuse.



Source: Author

Fig. 6. India United Mills no. 2 & 3 Site Plan

TABLE II. STRUCTURAL ANALYSIS

Bldg. no.	*Function*	*Age*	*Structural Status*	*Conservation Status*	*Adaptive reuse Potential*
1	Warehouse	75+	Poor	C	Institution, Assembly Hall
2	Grain Godown	50+	Poor	C	Staff Quarters
3	Electric & Switch Gear	75+	Poor	C	------
4	Godown	75+	Moderate	C	------
5	General Stores	100+	Poor	C	------
6	Canteen	50+	Moderate	D	------
7	Carding & Blow Room	100+	Moderate	C	------
8	Ring & Spinning	100+	Moderate	C	------
9	Workshop Transformer	75+	Moderate	D	------
10	Weaving	100+	Moderate	D	Market / Institution
11	Weaving Shed	75+	Moderate	D	Market / Institution
12	Weaving	100+	Moderate	C	------
13	Office	100+	Moderate	D	------
14	Ring & Spinning	100+	Moderate	B	Institution / Offices
15	Weaving Shed	100+	Moderate	B	Institution / Offices
16	Semi-Auto Loom & Sizing Dept.	75+	Moderate	D	------
18	Time Keeper's Office	75+	Moderate	B	------
19	Office	50+	Moderate	D	------
20	Spinning	75+	Moderate	B	Institution / Offices
21	Godown	75+	Poor	C	------
22	Bailing Dept.	----	Moderate	D	------
23	Waste Godown	----	Poor	D	------
	Staff Quarters	100+	Moderate	C	------

Based on this survey structures are graded in four categories: A, B, C & D.

Type A: Buildings that could be retained & re-used.

Type B: Structures that could be retained for their ensemble value, contributing to the character of the place.

Type C: Structures that could be demolished.

Type D: Structures that are demolished.

The structural conditions of these buildings have been categorized as follows:

Fair: Structures in sound structural condition.

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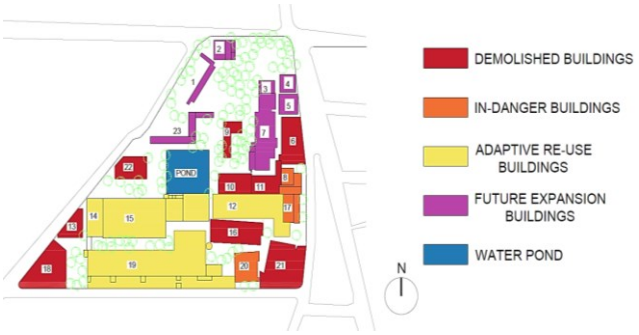
Moderate: Structures requiring a few localized repairs to make them in fair condition.
Poor: Structures requiring major structural repairs to strengthen them.

IV. ADAPTIVE REUSE STRATEGIES



Source: Author

Fig. 7. Adaptive reuse Strategy for India United Mills no. 2 & 3 Site Plan

According to the structural analysis, the building nos. 6, 9, 10, 11, 13, 16, 18, 21 and 22 are demolished. For our proposal we will be using the building nos. 12, 14, 15 and 19, thus as the building nos. 8, 17 and 20 are a threat to the site being in a danger situation, we have a proposal for demolishing it and the remaining buildings are to be left for future expansion. Hence forward we will be hypothetically considering that the buildings in danger have been demolished and we will be using that space for redevelopment with regard to landscape and parking spaces.The wooden beams and columns are either collapsing or on the brink of collapse, requiring urgent attention. Therefore, it is imperative to either reinforce them or replace them with new structural elements. Opting for the latter approach risks compromising the building's structural integrity during the addition and removal of components. Retrofitting, however, offers a solution to maintain the structural integrity of the building while enhancing its strength and stability.

A. Retrofitting Methodology

One method of retrofitting to revive this structure involves connecting steel sections to the existing structural members. Various retrofitting techniques for different parts of existing buildings are outlined below:

TABLE III. RETROFITTING METHOD FOR STRUCTURAL ELEMENTS

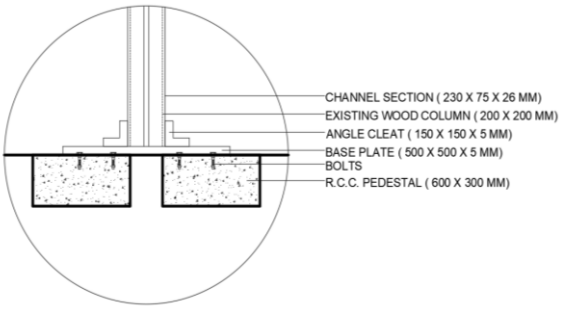
Building Element	*Material*	*Retrofitting Methodology*
Roof	Mangalore Tiles	The original Mangalore tiles on the building's roof have sustained damage from weather and natural elements. Thus, they need to be replaced with new tile.
Column	Steel Sections (C-Section)	To reinforce the wooden columns, channel sections (c-section) will be connected to them, forming a box structure around the existing columns. This method aims to enhance strength and structural stability.
Beam	Steel Sections (I-Section)	To reinforce the wooden beams, I-sections will be affixed to them, creating a box like structure around the existing framework to enhance strength and structural stability.
Wall	Brick Walls	The brick wall shows sign of chipping, and the plaster finish is beginning to peel away. It's essential to renovate these areas, preserving original motifs while also constructing new brick walls where needed.
Flooring	Cement Sheets + Tiling	The original wooden flooring has deteriorated, so to reinforce it, we can lay cement sheets as a base and add tiles to it for finishing touch.
Door	Wooden Frame	The original doors need to be replaced with new doors while keeping the design and character of the building.
Window	Wooden Frame	The original windows need to be replaced with new windows while keeping the design and character of the building.

B. Material Details

The material that is to be used for the steel joinery is given as below for different structural aspects:

1) Channel sections to reinforce the columns of size 200 X 75 X 26 mm.
2) I-sections to strengthen the beams of size 114 X 114 X 27 mm.
3) Similarly Angle Cleat and Base Plate is to be used at joints for strong connection with sizes 150 x 150 x 5 mm and 500 X 500 X 5 mm respectively.

C. Joinery details



Source: Author

Fig. 8. Joinery detail of Wooden Column, Channel Section and R.C.C. Base

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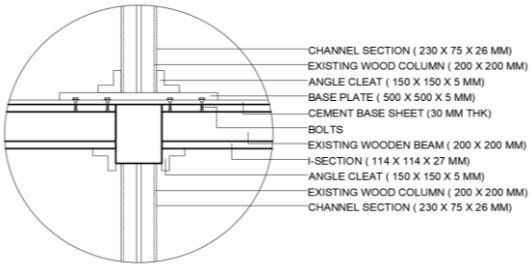
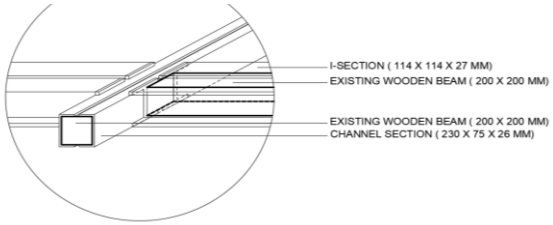


Source: Author

Fig. 9. Joinery detail of Beams at Cross Section



Source: Author

Fig. 10. Joinery detail of beam and column at cross-section.

CONCLUSION

On the ground of above examination, we can conclude that Adaptive Reuse of the Abandoned Textile Mills in Mumbai will help in preserving the heritage value of the building, socio-economic values and new employment opportunities can be generated, while preserving the character of the locality. This building have been abandoned for 25 years now, because of natural forces a few buildings have been demolished and others are still standing, reusing such buildings will help in maintaining the sustainability of the campus. This initiative for the mill complexes will help prolong its life, its prosperous history and good old memories while not letting the campus fall into a dilapidated state while giving out new employment options for the public.

We can also justify the use of steel sections for retrofitting the industrial buildings in the India United Mill complex and going for adaptive reuse of the same while changing the use of buildings to commercial buildings. As India united Mills, has a prime location, building character & some buildings which can be retrofitted for adaptive reuse, we have opted for retrofitting of such buildings which are not in dilapidated state. (Falls in a B-category). The existing site conditions as can be seen now are reformed using different techniques such as Channel Sections, I-Sections to reinforce the columns and beams as for the roof we can use cement sheets to reinforce the slabs and the flooring.

To conclude, adaptive reuse of mill compounds is beneficial with rare negative consequences and will only help enrich the neighborhood and people's lives while preserving the heritage and giving out employment opportunities. We can explore this topic further by reusing the buildings that have not been covered in this research as well as site development for the same heritage preservation as a whole compound instead of part compound. And will help in increasing awareness of old buildings and their architectural richness and how they can be reused without demolishing the historic architecture

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