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Adaptive Reuse: Transforming Mumbai's Underutilized Buildings in to Healthcare Facilities

A Framework for Sustainable and Efficient Hospital Development

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Abstract

Mumbai's urban landscape, characterized by its dense population and relentless expansion, faces a critical shortage of healthcare facilities. This deficit is exacerbated by land scarcity, escalating construction costs, and the increasing prevalence of lifestyle diseases and pandemic-related aftereffects. Adaptive reuse, the strategic conversion of underutilized buildings like offices, malls, and banquet halls into functional hospitals, offers a pragmatic and sustainable solution. This research delves into the potential of such transformations within Mumbai's unique architectural and regulatory context. By meticulously analysing existing adaptive reuse projects in the city, this study aims to develop a comprehensive, architecturally grounded framework of regulations and best practices. Current "Change of User" approvals often prove inadequate due to the inherent discrepancies between existing building services and the stringent requirements of healthcare facilities. This research addresses these discrepancies, acknowledging the common practice of granting concessions on certain mandatory provisions while sometimes imposing burdensome additions, like external steel fire escapes, which can compromise both aesthetics and functional integration. The proposed framework will ensure repurposed facilities meet stringent healthcare standards while optimizing existing urban resources. It will bridge the gap between current regulations and the practicalities of adaptive reuse for healthcare, addressing challenges like incompatible services, inconsistent application of building codes, and the critical need for architectural integrity. Ultimately, this research strives to contribute to a more efficient and sustainable healthcare infrastructure for Mumbai by streamlining the process and ensuring the architectural and functional suitability of repurposed buildings.

Keywords: Adaptive reuse, unused buildings, healthcare facility, underutilized buildings

Aim:

The research aims to develop a tailored, architecturally informed framework that streamlines the adaptive reuse process for hospitals in Mumbai, ensuring compliance with stringent healthcare standards while maximizing the efficiency, sustainability, and architectural integrity of these projects.

Objectives:

Analyse the transformative potential of adaptive reuse for developing healthcare facilities in Mumbai, focusing on the architectural, regulatory, economic, and socio-cultural considerations that shape its viability.

Examine the challenges and opportunities within Mumbai's healthcare infrastructure landscape, particularly in relation to land scarcity, regulatory hurdles, financial constraints, the abundance of underutilized buildings, growing demand for healthcare, and technological advancements.

Methodology:

1. Identify needs of the increasing demand of healthcare facilities in the city.

2. Identify the benefits and challenges occurring in building a healthcare project in a clear plot versus reusing the unused built structure for the said cause.

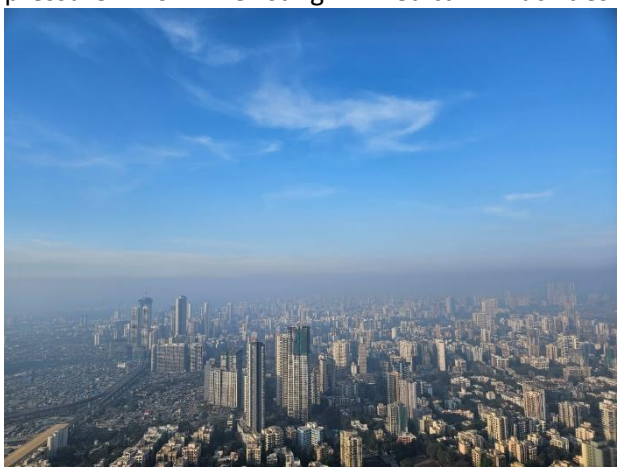
3. Study of various documents such as city's development control regulations, healthcare planning guidelines, fire safety act etc. w.r.t. hospital planning and designing.

4. Investigate the critical architectural considerations for successful adaptive reuse projects, with a focus on the following parameters:

- Structural stability and safety.
- Space planning and layout for functional and therapeutic environments.
- The integration of complex building services.
- Infection control and hygiene.
- Accessibility for inclusive design.
- Aesthetics and patient experience for creating a healing environment.
- Analyse case studies of successful and unsuccessful adaptive reuse projects in Mumbai and other relevant locations to identify best practices and common pitfalls.

1. Introduction: The Urban Healthcare Imperative and the Potential of Adaptive Reuse

Mumbai, a megacity that epitomizes India's economic dynamism, is also a crucible of urban challenges, particularly in its healthcare sector. The city's relentless growth, fuelled by migration from across India, has resulted in a population density that strains existing infrastructure, especially healthcare. The critical healthcare infrastructure deficit, aggravated by the rising incidence of lifestyle diseases (such as diabetes, cardiovascular ailments, and respiratory disorders) and the enduring impact of pandemics, has placed immense pressure on existing medical facilities.



(Image: Mumbai Suburban Landscape; Photograph by Author)

Land scarcity and the exorbitant costs associated with greenfield construction further compound the problem. In a city where land is a premium, acquiring space for new hospitals is a daunting, if not insurmountable, task. This is where the process

of repurposing existing buildings for new and often radically different uses, emerges as a compelling architectural and urban solution. It offers a way to leverage the city's existing building stock, minimizing the need for new land acquisition and reducing the environmental impact associated with demolition and new construction.

The core premise of adaptive reuse, from an architectural perspective, is rooted in sustainability, resource optimization, and the preservation of urban fabric. With this, we can minimize demolition waste, reduce the embodied carbon footprint associated with new construction, and revitalize underutilized urban spaces, contributing to urban regeneration. For healthcare, this approach offers the added advantage of rapid deployment, addressing the urgent need for medical facilities.

2. The Landscape of Healthcare Infrastructure in Mumbai: Challenges and Opportunities

Mumbai's healthcare infrastructure is a complex and multifaceted ecosystem, woven from a diverse array of public and private institutions.

The city's healthcare landscape is characterized by a stark contrast between the well-resourced facilities in affluent central areas and the underserved, often overcrowded, facilities in suburban and peri-urban regions. This uneven distribution leads to a situation where a substantial portion of Mumbai's population faces significant challenges in accessing timely and quality healthcare.

(Image: Fortis Hospital Mulund; https://www.goaid.in/top-10-hospitals-in-mumbai)

The existing healthcare facilities, both public and private, frequently struggle to cope with the sheer volume of patients, a consequence of Mumbai's dense population and the influx of patients from surrounding regions. This strain manifests in overcrowded waiting rooms, extended waiting times for consultations and procedures, and a compromised patient experience. The pressure on existing infrastructure is further exacerbated by the rising prevalence of chronic diseases, the lingering effects of pandemics, and the increasing life expectancy of the population.

(Image: KEM Hospital, Mumbai; https://www.asianage.com/metros/mumbai/020417/mumbai-kem-hospital-gets-additional-security-guards.html)

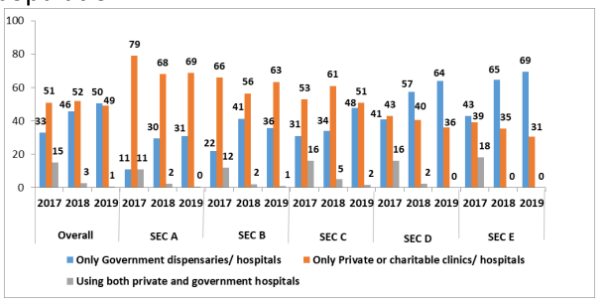
Regulatory Hurdles: The "Building Approval" process, particularly the "Change of User" approvals, is often fraught with ambiguity, bureaucratic delays, and inconsistent interpretations of regulations by different authorities. This complex regulatory landscape creates significant obstacles for healthcare providers seeking to establish or expand their facilities. The lack of clarity and consistency in regulations leads to prolonged approval processes, increased costs, and uncertainty for investors. Furthermore, the varying interpretations of building codes and healthcare standards by different regulatory bodies create confusion and impede the efficient development of healthcare infrastructure. This regulatory labyrinth not only delays projects but also discourages potential investors from entering the healthcare sector.

In Mumbai, Bombay Nursing Home Registration Act (Amendment) 2005, is still not clear about certain aspects of detailed planning and designing of such premises. The Act provides guidelines for a Nursing Home, with respect to the management and ownership structure and qualifications, operations, human resources, and basic space planning carpet areas. Whereas, as Architects/ Planners, we have been referring to respective Development Control Regulations of respective Cities e.g., DCPR 2034,

UDCPR updated in January 2024, which are primarily framed for planning and designing hospitals on a new plot or under redevelopment scheme. For services and fire fighting regulations, architects refer to NBC 2016. For beds capacity and detailed hospital planning guidelines, architects must refer to NABH guidelines as per targeted bed capacities. These guideline documents are not accessible to everyone thus, architects cannot educate the client/owner for following the norms.

Again, all these guidelines must be co-related and sometimes certain clauses are contradictory to each other.

Financial Constraints: Public healthcare funding, while crucial, is often inadequate to meet the growing demands of Mumbai's population. The financial constraints faced by public healthcare institutions limit their ability to invest in infrastructure development, equipment upgrades, and staff training. On the other hand, private sector investment, while substantial, is primarily driven by profitability, potentially neglecting underserved areas, and focusing on specialized, high-revenue services. This disparity in funding and investment leads to a situation where affluent areas have access to state-of-the-art facilities, while poorer neighbourhoods struggle with inadequate resources. The profit-driven nature of private healthcare investment also leads to a focus on specialized services that cater to high-income patients, leaving a gap in the provision of primary healthcare and preventive services for the general population.



(Image: Type of Facilities used by the citizens across different Socio-Economic Classes (SEC), 2019; Report on The STATE of HEALTH in Mumbai.pdf by Praja.org)

Abundance of Underutilized Buildings: Mumbai's urban fabric is dotted with a substantial inventory of vacant or underutilized buildings, including offices, malls, banquet halls, and industrial structures. These buildings, often located in strategic locations, offer a valuable resource for adaptive reuse into healthcare facilities. Repurposing these existing structures can significantly reduce the time and cost associated with greenfield construction, allowing for the rapid expansion of healthcare capacity.

3.1. Structural Stability and Safety: The Foundation of Healthcare Adaptive Reuse

In the context of adaptive reuse for healthcare facilities, structural stability and safety are not merely regulatory requirements; they are the bedrock upon which the entire conversion process rests. The transition from an underutilized structure, such as an office building or a commercial complex, to a fully functional hospital necessitates a rigorous and meticulous assessment of the existing structure's load-bearing capacity and overall integrity. This assessment is far more than a cursory review; it is a comprehensive engineering investigation that delves into the very core of the building's structural framework.

The inherent challenge lies in the fact that buildings designed for commercial or residential purposes rarely account for the specific demands of a modern hospital. Hospitals are characterized by significantly higher live loads due to the weight of specialized medical equipment, such as MRI machines, CT scanners, and heavy diagnostic apparatus. Furthermore, the constant flow of patients, staff, and visitors creates a dynamic load pattern that differs substantially from the static loads typically considered in commercial building design. The implementation of specialized healthcare systems, including medical gas pipelines, heavy HVAC equipment, and sophisticated electrical infrastructure, also adds to the overall load on the structure. Therefore, a thorough structural analysis is essential to determine whether the existing structure can safely accommodate these increased loads. Modern non-destructive testing methods, such as ultrasonic testing, ground-penetrating radar, and core sampling, play a vital role in this process, providing valuable insights into the condition of concealed structural elements without causing significant damage.

(Image: https://www.wsp.com/en-us/insights/2024-adaptive-reuse-of-healthcare-facilities)

Reinforcing existing structural elements, adding new columns or beams, or even underpinning the foundation may be necessary to ensure the building's structural integrity. The architect plays a critical role in coordinating the structural engineering aspects of the project, ensuring that the modifications are seamlessly integrated into the building's design and do not compromise its aesthetic appeal.

Fire safety is another paramount consideration in healthcare adaptive reuse. Hospitals are inherently high-risk environments, requiring stringent fire safety measures to protect patients, staff, and visitors. The existing building must be retrofitted with a comprehensive fire protection system, including fire suppression systems, smoke detectors, and emergency exits that meet stringent healthcare standards. The design of emergency exits must consider the specific needs of patients, including those with mobility impairments. The placement of fire-rated partitions and doors is also crucial for compartmentalizing the building and preventing the spread of fire.

3.2. Space Planning and Layout: Crafting Functional and Therapeutic Environments

Space planning within a hospital setting is a critical architectural endeavour that significantly impacts patient well-being, staff efficiency, and overall operational effectiveness. It involves the meticulous organization of spaces to facilitate seamless patient flow, optimize staff movement, and create a conducive environment for healing.

Adaptive reuse projects often require architects to reimagine existing floor plans, transforming spaces designed for commercial or residential purposes into functional healthcare environments.

- **Patient Flow and Circulation:**
    - A well-designed hospital layout prioritizes clear and intuitive patient flow, minimizing congestion and reducing waiting times. This involves creating distinct pathways for patients, staff, and visitors, ensuring smooth transitions between different departments and services.

(Image: New Hospital Tower Rush University Medical Center / Perkins&Will)

    - The strategic placement of waiting areas, reception desks, and diagnostic facilities is crucial for optimizing patient experience. Clear wayfinding, using legible signage and visual cues, is essential for guiding patients and visitors through the facility.

    - In adaptive reuse, the existing structural grid and core elements often dictate the initial layout. Architects must creatively work within these constraints, utilizing strategies such as strategic partitioning, corridor widening, and the creation of dedicated circulation zones.
- **Specialized Spaces:**
    - Hospitals require a diverse range of specialized spaces, including operating rooms, intensive care units, diagnostic imaging suites, laboratories, and patient rooms. Adapting existing floor plans to accommodate these spaces often involves significant structural and service modifications.

- Operating rooms require stringent environmental controls, including precise temperature and humidity regulation, as well as specialized air filtration systems.
- Intensive care units necessitate proximity to support services and monitoring equipment.
- Diagnostic imaging suites require shielding to protect against radiation, while laboratories require specialized ventilation and waste disposal systems.
- Patient rooms must be designed to maximize patient comfort and privacy.
- The existing building type will greatly influence the placement of these specialised rooms.

  For example, a warehouse conversion will allow for large open floor plates, that can be easily partitioned to create large, specialized rooms.

- **Staff Efficiency and Ergonomics:**
  - To enhance staff efficiency by minimizing travel distances and optimizing workflow, the placement of workstations, storage areas, and support facilities should be carefully considered to ensure easy access and efficient operation.
  - Ergonomic considerations are also essential for creating a comfortable and safe working environment for staff. This includes the selection of adjustable workstations, comfortable seating, and adequate lighting.

3.3. Services Re-routing and Modification: Integrating Complex Systems

The integration of complex building services is a critical aspect of healthcare adaptive reuse. Existing buildings often have inadequate or incompatible services that must be upgraded or replaced to meet the stringent requirements of a hospital.

- **Plumbing Systems:**
  - Hospitals require specialized plumbing systems for sanitation, medical gas delivery, vacuum systems, and waste disposal.
  - Existing plumbing systems may need to be extensively modified or replaced to accommodate these requirements.

  - The design of plumbing systems must also consider the need for adequate water pressure and flow rates for medical equipment and sanitation.
- **Electrical Systems:**
  - Hospitals require a reliable and robust electrical system to power medical equipment, lighting, and other essential services. Existing electrical systems may need to be upgraded or replaced to meet the increased power demands of a hospital.
  - The design of electrical systems must also consider the need for backup power generators and uninterruptible power supplies (UPS) to ensure uninterrupted operation during power outages.
- **HVAC Systems:**
  - Hospitals require sophisticated HVAC systems to maintain precise temperature and humidity control, as well as to ensure adequate air filtration and ventilation. Existing HVAC systems may need to be extensively modified or replaced to meet these requirements.

- The design of HVAC systems must also consider the need for specialized air handling units for operating rooms, isolation rooms, and other critical areas.

- **Medical Gas Systems:**
  - The installation of medical gas pipelines, including oxygen, nitrous oxide, and medical air, is a critical aspect of hospital design. Existing buildings may need to be structurally modified to accommodate these pipelines.
  - The design of medical gas systems must also consider the need for safety features, such as alarm systems and shut-off valves.

3.4. Infection Control and Hygiene: Creating a Safe Environment

Hospitals are high-risk environments for infection transmission, requiring meticulous attention to hygiene and sanitation. Architects play a crucial role in creating a safe and hygienic environment.

- **Material Selection:**
  - Materials and finishes must be selected for their ease of cleaning and disinfection. Smooth, non-porous surfaces are preferred to minimize the accumulation of dirt and bacteria.
  - Antimicrobial materials and finishes can also be used to inhibit the growth of microorganisms.

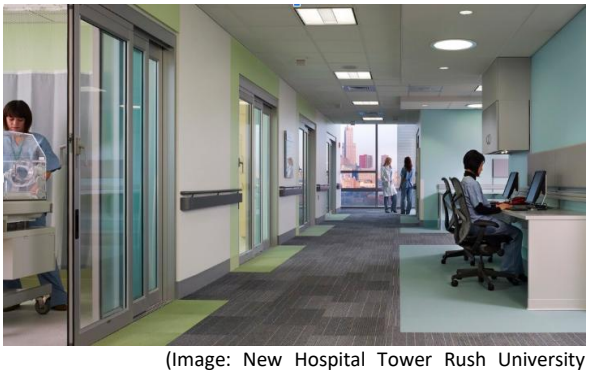
- **Air Filtration Systems:**
  - Advanced air filtration systems, such as HEPA filters, are essential for preventing the spread of airborne infections.
  - The design of air filtration systems must consider the need for adequate air exchange rates and the placement of air intakes and exhausts.

(Image: Actual Site Photograph by Author)

Isolation Rooms:

- Isolation rooms are essential for preventing the spread of contagious diseases. These rooms must be designed with negative pressure ventilation to prevent the escape of airborne pathogens.

  The design of isolation rooms must also consider the need for separate entrances and exits for patients and staff.



(Image: New Hospital Tower Rush University Medical Center / Perkins&Will)

- **Waste Management:**
    - Proper waste management is essential for preventing the spread of infections. The design of waste management systems must consider the need for separate collection and disposal of medical waste.

3.5. Accessibility: Ensuring Inclusive Design

Hospitals must be accessible to all patients, including those with disabilities. Architects play a crucial role in ensuring inclusive design.

- **Ramps and Elevators:**
    - Ramps and elevators are essential for providing access to all levels of the building. The design of ramps and elevators must comply with accessibility standards.
- **Accessible Restrooms:**
    - Accessible restrooms must be provided for patients and visitors with disabilities. The design of accessible restrooms must comply with accessibility standards.
- **Accessible Signage:**
    - Clear and legible signage is essential for guiding patients and visitors through the hospital. The design of signage must consider the needs of people with visual impairments.
- **Accessible Parking:**
    - Accessible parking spaces must be provided for patients and visitors with disabilities. The design of accessible parking spaces must comply with accessibility standards.
- **Accessible Patient Rooms:**
    - Patient rooms must be designed to accommodate the needs of patients with disabilities. This includes providing adequate space for wheelchair manoeuvrability and installing grab bars in bathrooms.

4. Case Studies: Successes and Failures

4.1. Case Study 1: Suburban Mumbai – Transformation of a Corporate Office Building into a Multi-Specialty Hospital; a G+3-story office building into a 50-bed multi-specialty hospital, termed as nursing home as per local regulatory norms.

(Image: Photograph by Author showing the previous use building elevation vs changed use building elevation. This project was handed over to the Owner in May 2022.)

Successes:

- Efficient space planning and layout, maximizing patient flow and staff efficiency.
- Successful integration of modern medical technology and equipment.
- Compliance with stringent healthcare regulations, including fire safety and infection control.
- Fast tracked timeline of 8 months.

4.2. Case Study 2: Navi Mumbai– Transformation of a commercial workspace building into a Super-Specialty Hospital (Neurology and Cardiac Care); a G+6 storeyed office building into a 100-bed super-specialty hospital.

Successes:

- Available floor plate was large and with long-span columns, so the healthcare space-planning was efficiently completed.
- The identified building was strategically located along the national highway, if the project would have been successful, this would have been an excellent example of adaptive reuse.

Hurdles:

- Stringent development control regulations demanded for fire exit planning and services, which, if accommodated in planning with structural modifications, were causing huge cost escalation.
- Alternative planning option was suggested by architect, which was saving upon the major structural modifications and suited the regulations, but were not acceptable by the authorities, as they had conventional mindset and approach, and no willingness to accept the latest international technology.
- If this exercise of feasibility and viability of said unused building could have been done before application for regulatory approval, client would have saved his cost and time towards the application process and could have identified another potential "brownfield" building and completed the project within the timeframe envisaged.

4.3. Case Study 3: Rajkot– Transformation of a commercial workspace building into a Super-Specialty Hospital (Cardiac Care); a G+5 storeyed office building into an 80-bed super-specialty hospital.

Successes:

- Due to the clarity given by the client towards the programme for the entire venture, the planning and designing stage was completed within 1 month.

Hurdles:

- There existed a well-established healthcare set-up of 300 beds in the vicinity. So, the challenge was from operations and marketing point-of-view.
- The facade had full glass; hence a lot of burden was there on the internal MEPF services for cooling.
- Addition of fire exit staircase, had to be an external plugin solution in MS structure, which created an eyesore in elevation and disturbed internal circulation flow per floor.

Conclusion:

The process of adaptive reuse, seems easy and economical, many non- architectural facility providers are getting into the field to provide this transformation services without consulting qualified architects, in the go to obtain the profits and perks from construction process.

However, the real challenges are hidden underneath the superficial short-term achievements, where the potential of such building is already not utilised, the structure has already aged for some years, façade, and internal services non-operational, the building must be really resuscitated with the professional's help such as architects, MEPF consultants and structural consultants' expert in healthcare planning and designing, to achieve the targeted results.

The owner must have vision towards long term results, for making these projects financially efficient, result- oriented, successful, and sustainable.

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