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The Adaptive Reuse Strategies for Heritage Buildings: A Case Study of Retrofit Investments

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Abstract

Every research and analysis begins with a thorough review of the facts and data available. To reflect the project's position in the city, we used basic documentation that included references to the urban environment. Pictures and plans, sections, and details from both eras of the structure's existence have been included in the study of the structure's history. Virtual models for each case study were also created.

Keywords

adaptive reuse, retrofit investments, heritage buildings

1. Introduction

A long-term retrofitting plan and good housekeeping practises are the first steps. Buildings are constantly being retrofitted. The first step is to guarantee that these retrofits organically increase a building's performance. Sustainable purchasing may turn inefficient buildings into highly efficient ones. With a result-oriented yearly maintenance contract and ownership of the efficient operation, a BMS may be greatly improved in terms of operational efficiency by updating its software, calibrating sensors and devices, and extending its reach via new field devices. Saved energy may readily cover the costs of such retrofits, which can be incorporated into annual O&M budgets. If the BMS must be completely replaced, an ESCO model may be the most cost-effective option. To summarise, we must shift our attitude from a refit to a retrofit. Similar to periodic preventive maintenance, a well-planned retrofit procedure may make a building's performance more efficient and sustainable [4].

In an effort to decrease carbon emissions, public historic and traditionally-built buildings are increasingly being considered for alternate uses. A traditional building is often characterised as one built before to 1919. Natural, vapor-permeable materials were used in their construction. A considerable majority of these buildings are used for housing, where there is a high requirement for energy efficiency, and therefore are typically seen as inefficient in terms of energy use. Energy efficiency is an important consideration in many historic restoration projects, especially those involving homes, since it helps architects and engineers determine what is technically and logistically feasible. However, despite the importance of these interventions in the conversion of historic public buildings, the topic of how to do so effectively and to what quality in conversion projects is becoming a rising cause of concern.' [5].

1.1 Research Objectives

This research aims to investigate the viability of adaptive augmentation and reuse of existing building with an emphasis on resource optimization and energy efficiency. It has following objectives to be fulfilled:

- To explain the adaptive reuse strategies for heritage buildings.
- To study the importance of retrofit investments.

- To explain the benefits of adaptive reuses using a case studyof Hungarian Energy Efficiency Retrofit Investments.

2. Literature Review

Academic research on adaptive reuse of older (including historic) buildings shows that functional, technical, and economic factors were the most important factors in their reuse from the 1970s forward [1]. Energy efficiency improvements, on the other hand, have received little to no attention at all. Balance or counterpoint may be achieved by using the present building's mass, size, rhythm, and form. As far asMac Ginty and Richmond [2] are concerned, the study of the existing building's form and structure is very vital to the intervention.

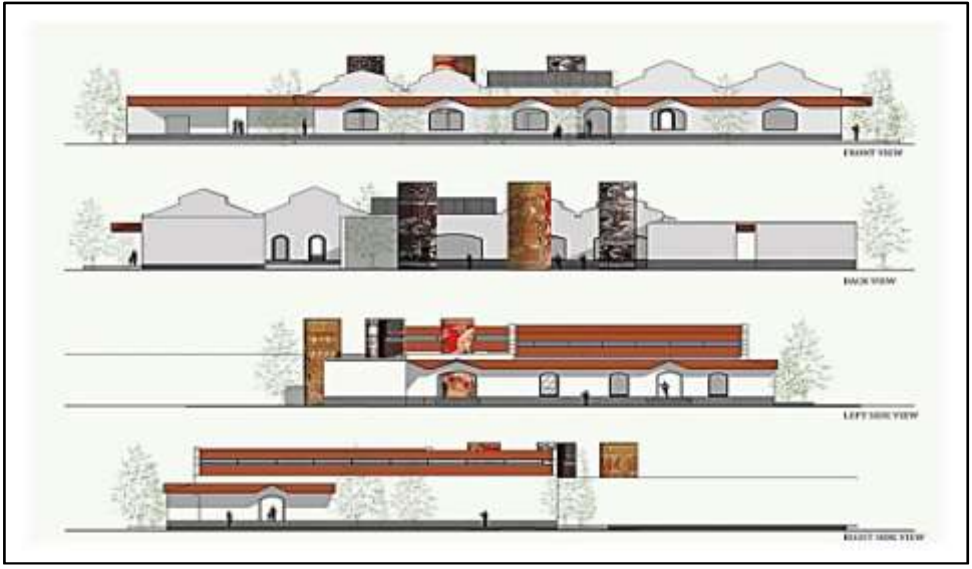
According to Moere and Wouters[3], we believe that architectural concepts exist in the physical world, and hence we present a series of formal analyses based on their patterns of architecture. It's also important to categorise the distinct antecedents depending on how they were renovated, as well as the kind of refurbishment they underwent. Based on a single case study, a comprehensive set of analyses is offered. To create the framework for an automated adaptive reuse precedent search technique, we group sixteen case studies together.

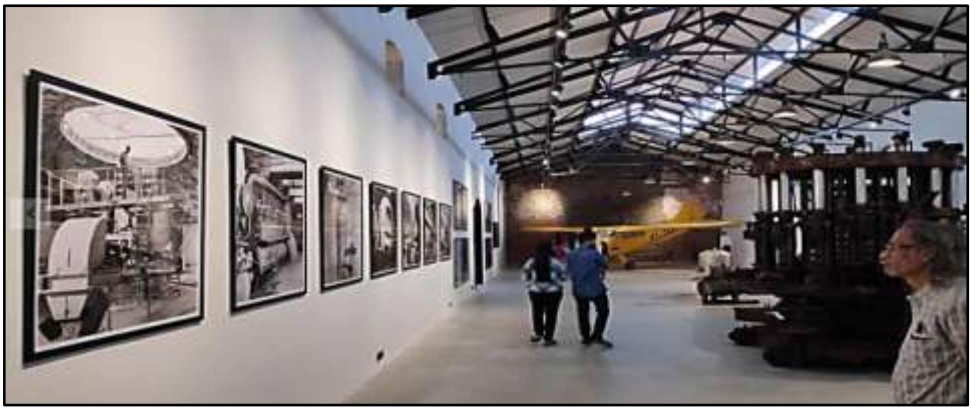
2.1 Some Instances of Adaptive Reuse in India

Repurposing an existing building for a different use than it was originally intended is known as adaptive reuse. Despite the fact that this form of renovation may be applied to any type of building, it is most often utilised on historic structures that have a significant cultural or historical value. A building's cultural aspects are also benefited by adaptive reuse, which is good for both the environment and economy. The environmental impact of a building that is reused in this way is lower than that of a structure that is demolished.

2.1.1 Alembic Industrial Heritage Development, Vadodara

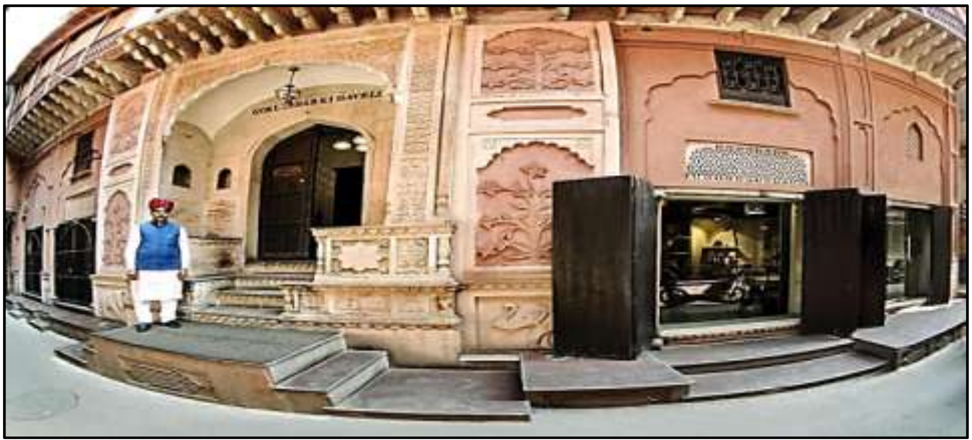
This 113-year-old Alembic Industrial building in Vadodara was renovated by Karan Grover and Associates. After serving as a factory to create penicillin, this building became a museum that houses an art studio and displays of works of art. Despitethe building's many alterations, the building's original character remains intact.The original materials, physical quality of the rooms, and riveted trusses in the roof were not significantly altered to preserve the industrial building's historic physical appearance.

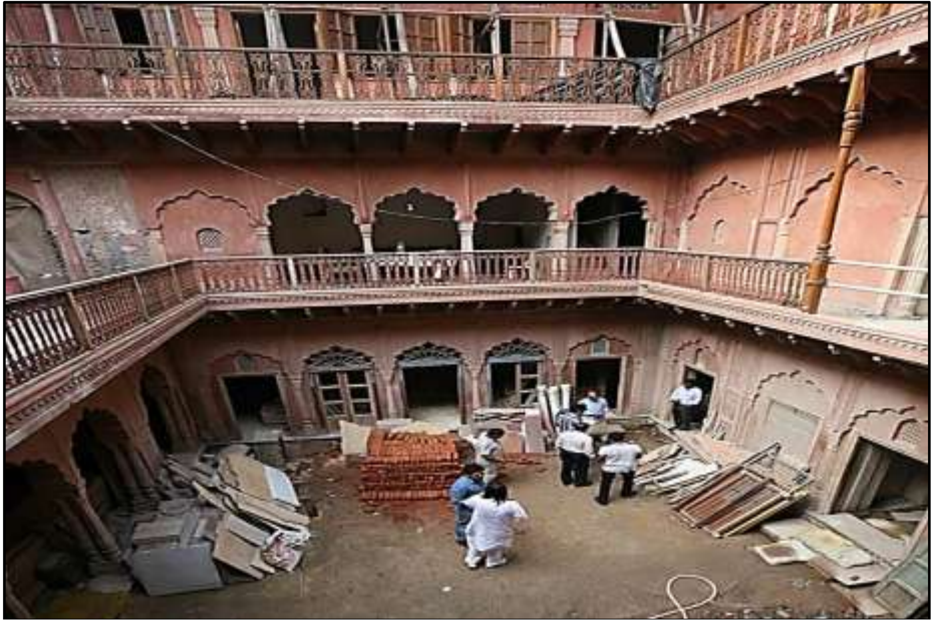




2.1.2 Haveli Dharampura, Chandni Chowk, Delhi

The Haveli Dharampura was constructed in the Late Mughal style in 1887 A.D. in Old Delhi's bustling Shahjanabad district. There is business space on the ground level, and residential space on the first storey of the building. The second storey, which was constructed in the latter half of the twentieth century, is heavily influenced by European styles. It was restored to its original state in 2011 by Mr. Vijay Goel and Mr. Siddhant Goel, who worked together on the project. Traditional Mughal cuisine is served at the Haveli, which is now an outstanding Mughal restaurant. As well as a stage for classical music and dance acts on the rooftop, the restaurant also provides an excellent view of Chandni Chowk.





3. Research Methodology

This is the kind of study that's both descriptive and experimental. Our next step is to design the study, after which we'll collect and manage the data. A descriptive study would be conducted once the data had been gathered.

We will follow the following way of **data collection strategies**:

3.1 Primary Data Collection

Sources from which we get first-hand data or material that is unique to a subject are called primary sources. Open-ended questionnaires will be used mainly to gather data that may be used to support 40 percent of the world's main energy usage and 24 percent of global carbon dioxide emissions are accounted for by existing structures. Because of this, it is essential to examine the possibilities for sustainable building management via energy retrofitting initiatives.

3.2 Secondary Data Collection

We will collect secondary data from the published statements of the firms, newspaper and articles. This is the minor part of this research but important as well. In this part data would be collected from the internet sites, journals, books, published articles, records of an organization. This type of data have been collected and recorded by another person or organization, sometimes for altogether different purposes.

4. Results and Discussion

4.1 Findings

In 2020, the industry's revenue is expected to range from 23.7 billion euros to 34.3 billion euros. The low-development scenario has 261,400 professions, whereas the high-development scenario has 378,000. According to the studies presented, climate change is changing the labour economy. Skills shortages can limit energy efficiency and retrofit initiatives. Finding people with the requisite expertise to accomplish the work required to achieve the emission reduction goals will be tough.

Refuting the concept that ancient buildings are difficult to retrofit for energy efficiency measures with a mix of readily available state-of the art renewable energy technologies, this may be utilised to demonstrate that this is not the case. Even though careful planning is necessary when repurposing ancient buildings, it is impossible to generalise what is accessible in one building to other structures, and each building must be dealt with individually.

Figure 1: Before and after shots of the renewable energy home in Brussels

For the most part, historic public buildings are repurposed because of their long-term economic value. As a result, energy use in these constructions is seen as an afterthought. There are several great options for reducing energy use in these constructions in the meanwhile.

4.1.1 Synergies in Energy Efficiency and Building Conservation

Fabric-related demand-reduction strategies are the most typical cause of conflict between historic preservation and energy conservation in listed historic buildings. Wall insulation may be problematic because of the historical, aesthetic, and cultural value of a wall's external and interior surfaces, or the features around the windows. Although it may seem to be aesthetically pleasing, there may be technical issues, such as those connected to moisture, that prevent this solution from being implemented. It may be possible to retrofit a more efficient boiler and control systems and convert to a lower-carbon fuel source in the same building.

Additionally, renewable energy sources and microgeneration may play a major role in reducing energy use. Solar thermal, biomass, and photovoltaic panels are the most common solutions to these problems. Solar panels may only be installed on historic buildings if they are concealed and removed with little long-term harm in most countries.

This old church in Withington, Gloucestershire, has been designated a Grade I listed building because of its national significance. As with other listed churches, this historic edifice has a number of notable features. The majority of listed churches and other Grade I listed buildings include exterior and interior aspects of interest (i.e. ornate façades, windows, and doors), as well as interior features of interest (i.e. ornamented and painted surfaces, wall and ceiling decorations, and internal spaces). Because they serve as the building's most important features that are cherished, admired, and conserved, many energy-saving solutions are hindered by them (e.g. insulation).

This combination of solar photovoltaic (PV) and biomass boilers was selected to meet the building's energy needs because of its distinctive character and attractiveness.

For the listed building, the roof's characteristics make the installation unobtrusive and less visually invasive. Before the intervention, the initial oil consumption was 4,000 l/year and the carbon emissions were 12,116 kg CO2e/year. As a result, the biomass installation may save more than 12 tonnes of carbon emissions, which is estimated to be roughly 2 tonnes (i.e., about 0.052 kg CO2e/year) by converting to biomass pellets as its fuel. This has a significant impact on lowering carbon emissions from buildings that have been recognised as historic. It is also reasonable to deduce from the perspective of historic conservation possibilities to boost energy efficiency while reducing carbon dioxide emissions may complement rather than conflict with architectural conservation. This demonstrates the need of considering the impact of different energy-saving strategies in any historical endeavour.

4.2 Case Study: Hungarian Energy Efficiency Retrofit Investments

Given the benefits of thorough retrofitting under a less aggressive national energy efficiency programme, Hungary has been singled out for particular consideration. The conclusions of this study, together with the execution of specific retrofit projects advised, may be helpful to other member states contemplating comparable refit plans. A study on the consequences of large-scale deep building energy retrofits in Hungary indicated that such a programme might reduce heating energy use and CO2 emissions by up to 85%.

As a consequence, by 2030, a comprehensive refurbishment may save up to 39% of annual natural gas imports and 59% of demand in January, the most critical month for energy security. Simultaneously, the investigation has shown the actual risks of less thorough retrofitting.

A secure impact is reached if renovations attempt to maintain current retrofit depth (i.e., decreasing about 40% of current energy demand in existing buildings).

By the end of the programme, this substandard repair scenario saves around 45 percent of 2010 building heating-related emissions and nearly 22 percent of total national emissions.

As a result, meeting mid-term climate goals like the frequently stated 75-85% reductions necessary by 2050 would be challenging and expensive. A partial remodelling situation necessitates other sacrifices, such as energy security enhancements. Instead of saving 39% of national natural gas imports, it saves over 10%, and peak consumption (January import needs) is reduced by just 18% instead of 59% in the deep scenarios. For example, adopting a high efficiency retrofitting standard like passive home would result in significantly more work possibilities than traditional and difficult remodelling solutions.

It estimated that a large-scale, comprehensive restoration effort in Hungary might create up to 130,000 net new employment by 2020, vs 43,000 under the problematic scenario. In the case of major regional heating renovation, these estimates include employment losses in the energy supply company. Notably, up to 38% of the job gains are due to indirect effects on other companies that feed the construction industry, as well as induced effects from increased purchasing power due to increased employment.

As previously said, the probe shows that the government must support a complete repair effort rather than a patchwork one. There are 131,000 jobs in the first scenario, compared to 78,000 in the second and 52,000 in the third, which aim for comparable renovation levels but with more consistent implementation rates (150,000 and 100,000 dwelling-equivalent per year, as opposed to 250,000 in the first scenario).

But the yearly investment requirements are higher (up to 4.5 billion Euros per year for the first scenario in the underlying phase of the programme, against 2 billion for the second and 2.8 billion for the third). While it may be possible to free up and disperse money, significant re-channeling and drastic changes in both the material and labour markets would have more negative implications, as shown in the paper.

From this perspective, a more progressive, longer-term rehabilitation effort is better. This figure would cover the whole annual expenditures of rehabilitating 100,000 units of Hungarian buildings during the initial years of the initiative. The gradual implementation of a major restoration effort is thus far more cost effective. They will almost likely be more expensive initially than after a period of learning, when knowledge has been gathered and more mature markets and competitive supply chains have been developed.

With 250,000 renovated annually instead of 150,000 or 100,000, the total renovation expenses for the Hungarian building stock rise to 60 billion euros, 50 billion euros, and 44 billion euros, respectively. A more aggressive programme would provide quicker energy savings: by 2050, the first scenario would have saved 97 billion euros, while the second and third scenarios would have created 80 and 60 billion euros in energy investment funds.

The program's length is considered to ensure the employment produced are long-term in nature. Because the whole building portfolio is being assessed for rehabilitation, new employment are projected to be dispersed around the nation.

Concerned about supply bottlenecks (for example, work, material, or finance supply), general society administration should actively participate in the program's planning and financing to ensure the renovations provide the expected energy funds and that the intervention is financially viable.

Increasing job opportunities while lowering home and open-building energy costs and increasing commitments to combat climate change is possible. Compared to the problematic issues in this case, considerable (passive house-type) adjustments are suggested. Energy efficient renovations create more employment, save more energy, decrease emissions, and lessen the country's energy dependency.

5. Conclusion and Future Scope

Retrofitting existing buildings is one of the most ecologically friendly, cost-effective, and proven solutions for improving energy efficiency and perhaps extending the life of existing structures, particularly historical structures. As a result, retrofitting should be pushed across the building and conservation sectors. More study is needed to obtain comprehensive sets of specific data on the direct and indirect environmental implications of retrofit, cost disparities between retrofit and traditional building construction, maintenance costs, and affects on end-users and the surrounding region of converted buildings.

The deeper the refurbishment, the less risk of asset deterioration. To attract significant institutional investors in retrofit finance, energy efficiency projects must be aggregated. Aggregators may be public or private, and they might be driven by government or client demand. Clear energy-performance objectives, uniform contract structures, data gathering and transparency are all essential for success.Firms and member states need more data on the performance of their energy efficiency programmes to attract large investment.

The effect of disregarding retrofits on depreciation is another key factor. Quantifying the rewards is crucial to attracting large investors. The second, assessing depreciation losses, will be crucial in persuading shareholders to spend in both protecting current value and expanding portfolio value over time.Finally, both evaluations should seek to quantify co-benefits of energy efficiency such as improved occupant comfort, lower maintenance costs, etc.

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