A SHIFT IN TEACHING ARCHITECTURAL DESIGN STUDIO: ADAPTATIVE REUSE AND RETROFIT AS THE MAIN FOCUS TO PREPARE STUDENTS FOR COMPLEX CHALLENGES OF A CHANGING PROFESSION

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INTRODUCTION

In 2007, Carl Elefante declared, "The greenest building is... one that is already built."[1]. In recent years, sustainability in architecture has focused on understanding and leveraging the potential of the existing built environment. This trend was further reinforced in 2021 when Lacaton & Vassal were awarded the Architecture Pritzker Prize. Their design philosophy is rooted in the mantra of "Never demolish, never remove or replace, always add, transform, and reuse!"[2] Given the significant paradigm shift in the profession, it becomes imperative to adjust our teaching to equip students with specific tools to navigate this complex scenario. Re-use and retrofit are never an easy task, and the constraints the existing building generates are an expression of the complex changing world. Since 2018, an interdisciplinary research and teaching group comprising academics and professionals based at the University of Hertfordshire has comprehensively explored the topic to help students to improve and decode the world while preserving cultural value.

REUSE AND RETROFIT, A CONTEXTUALISED ANALYSIS

Adaptive reuse and retrofitting have roots in the history of architecture, where updating an existing building was a common practice that did not require differentiation from the usual design process. On certain occasions, particularly for significant or religious structures, building atop of an existing one was an opportunity to reassert the importance of a particular location for a community, city, or site at large. One notable example is the Syracuse Cathedral in Sicily, an exceptional display of "successful harmonisation of so many dissimilar elements into a perfected work of art" [3], a Greek temple embedded within a Christian edifice, re-designed throughout the centuries. In its present form, the structure retains the DNA of every era: a magnificent emblem of the site's long history[4]. In other cases, the practice of adaptive reuse has extended beyond reappropriation of building remains. The study by Carlos Marti

Aris on Hagia Sophia in Constantinople (360-537 AC) is particularly fascinating in comprehending how reuse has been instrumental in generating new architectural forms: a structure that blends and reuses two of the principal Roman typologies of the Massenzio's Basilica and the Pantheon, giving rise to a new central-plan church typology. This typology ultimately established itself in Constantinople and became the model for Ottoman mosques designed by Mimar Sinan at the zenith of the Ottoman Empire.[5]
In other cases, the process of reuse was more direct, focused on material reuse, whereby abandoned buildings were stripped down to reuse their construction materials for building new structures. In all of these cases, the reuse was driven either by the very meaning of it or by the convenience of reusing something that was already in place, be it a building or its materials, rather than building anew.
Nowadays, the catalyst for us to prioritize reuse after a long period where new construction was considered more expedient and convenient is the urgent need to address climate change: we can no longer afford to generate more waste, and we must make more prudent use of our resources to preserve our planet and ourselves. As professionals, architects have been at the forefront of this issue. In 1974, Alex Gordon, the president of the RIBA, emphasized the importance of designing buildings with the principle of "Long life, loose fit, low energy." More recently, in 2007, Carl Elefante (who would later become the president of AIA in 2017) stated that "The greenest building is... one that is already built."[6]
In her book "Building for Change – The Architecture of Creative Reuse" (2022) Ruth Lang further highlighted that, according to the UN's net zero carbon emissions target, 80% of the buildings that will exist in 2050 have already been built.[7] Lang's statement is in line with the 2017 UK Green Building Council report: 80% of the UK building stock by 2050 already exists, and 34% of the UK's carbon emissions will be caused by the operational energy of existing buildings.[8] Further, the World Resource Institute[9] concludes that retrofitting buildings offer the most significant opportunity for the reduction of emissions at a 'lower' cost. Taken together, these suggest that retrofitting buildings to increase energy efficiency plays a critical role towards reducing the carbon footprint and achieving net zero targets by 2050.
There are other significant benefits to extending the lifespan of existing buildings: the embodied carbon of a brand-new building can be equivalent to the operational carbon emissions from the building for the next 20 years. Considering the increased performance of new builds, this ratio could double to 40 years[10]. This would suggest that if net zero is to be achieved by 2050, retrofitting the existing stock has a much greater impact than new construction being energy efficient.
While industry must adapt to meet market needs, at the same time, architectural education needs to adapt to meet the realities of the profession shift associated with the climate emergency and to better equip students with skills relevant to contemporary practice.[11]
The curriculum should be structured to be adaptive, evolving and aligned to industry to address present and future challenges. Collaboration between industry and academia would yield significant growth in developing effective climate-responsive strategies.[12] In this context, RIBA's "The Way Ahead" new Education and Professional Development Framework set out the climate emergency as a new direction for the whole sector. On the other hand, other initiatives leverage collaboration to foster retrofitting practices via a bottom-up approach. London Energy Transformation Initiative (LETI)[13], a network of built environment professionals founded in 2017, has made significant contributions by raising awareness of the urgency of retrofitting existing buildings, formulating practical guidance and advocating for changes to building regulations and standards to support sustainable practices[14]. Likewise, the UK-based Architects Climate Action Network (ACAN), founded in 2019, aims to take collective action against the climate and ecological crisis and has had a significant impact on architecture education[15], alongside its student arm Students Climate Action Network (StuCAN).

To emphasize the increasing significance of retrofitting, the prestigious Pritzker Prize, awarded to architects who profoundly influence the field through their designs, was presented in 2021 to Anna Lacaton and Jean-Philippe Vassal. Their guiding principle of "Never demolish, never remove or replace, always add, transform, and reuse!"[16] and their incorporation of adaptive reuse as a fundamental element have shaped both their architectural approach and manifesto.

TEACHING STRUCTURE AND MODULE CROSS-CONNECTIONS

The semester-long Integrated Design Studio, designed for Year 3 students in the BA (Hons) Architecture programme, comprises two modules: Final Project Studio (FP) and Advanced Design Skills (ADS). While FP forms the backbone of Year 3, ADS provides a comprehensive understanding of Sustainability, Technology, and Professional aspects of design. Throughout the first semester, students will develop crucial awareness and reuse skills pertinent to the built environment, which are highly relevant to their future careers.

Given the brief duration of this studio and the students' initial exposure to the topic, it is imperative to ensure that they receive a comprehensive understanding. To achieve this, students engage in team-based learning during the ADS module, in which they collaborate as design teams of four individuals to develop different design solutions to analyse the strengths and weaknesses of each solution collectively. Meanwhile, in the FP module, students work independently on their design resolution.

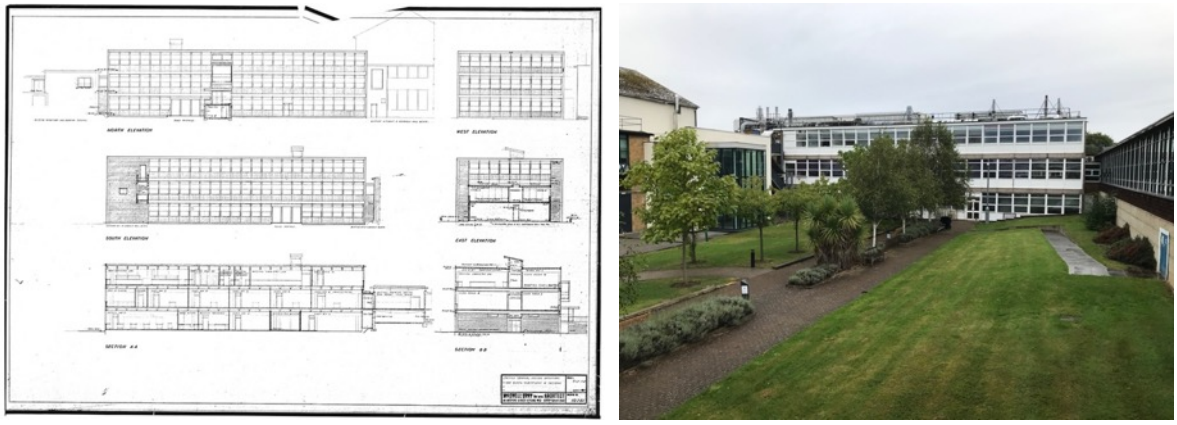

Figure 1. Old Science Block: original drawings from 1958 and its current state

The building assigned to students is a simple 3-storey 1958 concrete structure measuring 17 x 42 meters and 10.5 meters in height. Situated within the University campus and 2-minute walk from the architecture studio, the building provides students with opportunities for frequent surveys. The University Estate Department acts as an advisor and client. Guided to concentrate on retrofit strategies, students are required to maintain the current building functions (classrooms, offices, and labs) while reimagining 3 specific spaces to unleash the building's potential:

- One 150-seat lecture theatre, it is not possible to accommodate this space within the existing building, so it should be designed as an extension.
- "The Space That Did Not Exist" is an atrium that connects all three levels of the building, providing students with an opportunity to explore the spatial potential of the existing building and facilitate a seamless flow of movement between levels.
- New informal learning in-between spaces, encouraging the shift from conventional corridors to interconnected spaces.

THE BUILDING STRUCTURE FIRST

Students, and at times even architects, have a tendency to conceive designs before considering how the building will be supported. Often the issue of structural system is rarely mentioned during critiques, preliminary and final.[17] One of the primary advantages of working with an existing building is the ability to anticipate structural problems prior to embarking on design exploration. Since architects are responsible for coordinating different professionals throughout the design process, conducting an appraisal of potential structural issues at an early stage allows students to ensure the alignment and coherence of design and structural solutions and to enhance their wider structural engineering knowledge.[18]

During the first session of the project, following an extensive survey of the building and its surroundings, students were instructed to produce drawings and a 1:100 model of the bare structure. A prerequisite of this task was to select a material for the structure that was easy to cut in the event of design or structural alterations.

The structural rhythm of the building presents a tightly spaced grid of 1500x8100 mm, with the exception of the central structural spine. This creates a distinct visual identity where the mullions on the elevations are, in fact, columns. In the model, the absence of other ancillary elements highlights the structural framework as a design feature in itself. The structural model allows students to appreciate the aesthetics of construction while also learning about the capacity of design to withstand gravitational force.[19]

Figure 2. Ana Belen Andino Sarango: structural model

The building is now seen as a conceptual sculpture, where the space between the elements serves as a ground for imagination. Students are now empowered to approach the design creatively and contemplate effective strategies for generating new spatial configurations within the existing structural framework. To this end, cardboard was employed as the primary material, with the students using it to construct slabs and ramps to gain insight into the possibilities presented inside the existing structure.

Figure 3. Thomas Peacock and Serena Yu: studies around the structure.

The primary propositions arising from the students' explorations at this stage were centred around broad atriums and vertical connection spaces, cantilever extensions, and objects designed atop the current building. The work allowed opportunity to enhance their learning process by engaging in a problem-based learning studio environment[20] and explore how design ideas may be realized through structurally sound solutions or how, conversely, the exploration of structural solutions may foster innovative design ideas. By comprehending these issues at an early stage, while the frame (in their models) was still exposed, students gained a better grasp of the technical challenges involved in maintaining structural integrity following the removal of existing elements. Furthermore, given the weak structure, the class was able to comprehend how to support heavy new extensions atop the building with a structure passing through the existing one while also gaining an understanding of the functioning of cantilever elements.

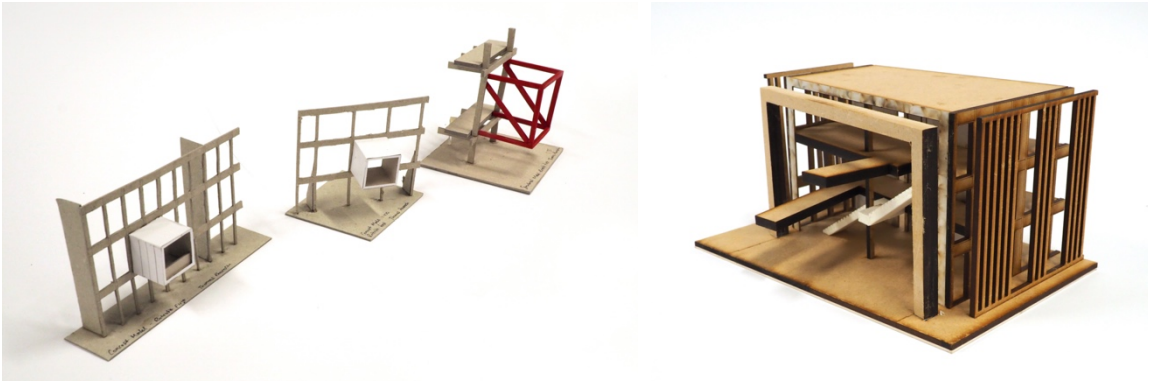

Figure 4. Thomas Peacock: structural cantilever models.
Figure 5. Lukasz Deptuch: study for cutting and reconfiguring the existing structure through "the space that did not exist".

A DIFFERENT CREATIVE APPROACH

Giving students the task to work with an existing building, and asking them to transform it might at first seem restrictive in terms of stimulating design creativity. However as showcased by Ruth Lang,[21] through the case studies presented, when designers are presented with reduced resources, they are compelled to engage in unconventional thinking and develop novel solutions. Such limitations may

serve to disrupt engrained patterns of utilising repetitive methodologies or materials and inspire individuals to explore new possibilities. Furthermore, working with the available resources can lead to the development of sustainable and resourceful solutions.

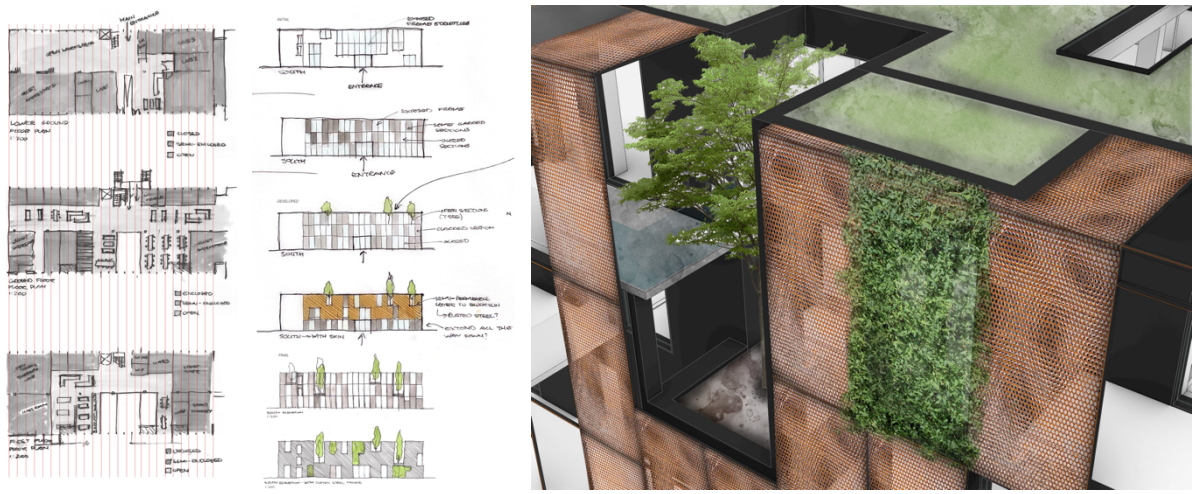

Figure 6. Sebastian Evans: the structural grid as the generator of the new spatial configuration

In view of architecture's relationship with art, a beautiful analogy can be drawn with Michelangelo: "The sculpture is already complete within the marble block before I start my work. It is already there, I just have to chisel away the superfluous material". This resembles an uncanny similarity to the approach of architectural retrofitting, where the dynamic between the artist and the medium is characterized by an interplay wherein the former engages in a process of discovery and uncovering, rather than merely imposing on the medium. Some students adopted this sculptural approach to showcase the inner workings of the building. They selectively removed sections to create atriums and connections, revealing the structural elements that now play a significant role in the creative design process, demonstrating a unique and innovative approach to their designs.

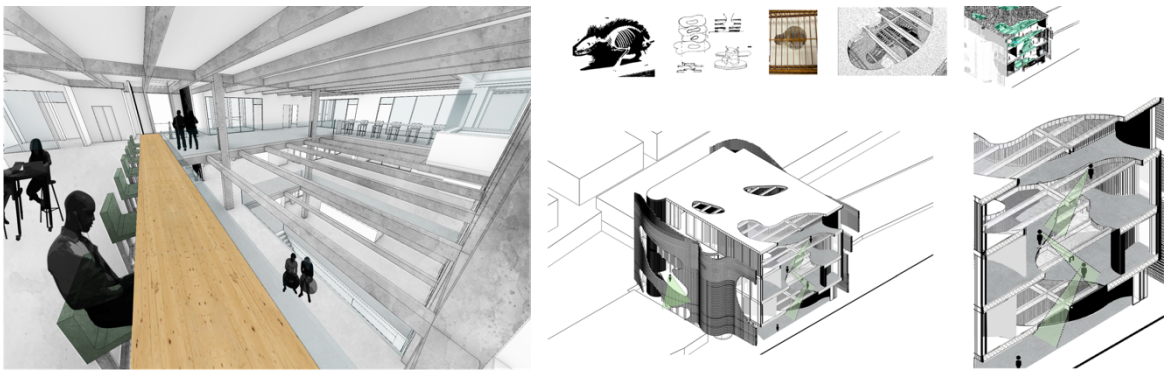

Figure 7. Sebastian Evans and Dominic Monasterial undertook projects that involved removing horizontal elements while retaining the existing structure to establish diagonal cross views.

Regarding this contemporary creative architectural practice, the Pritzker Prize winners, Lacaton & Vassal, have long advocated re-using existing architectural structures and unleashing the opportunities and possibilities within them.

> We are at a point in the history of architecture where the question of inhabiting becomes an essential subject. We do this by constructing the conditions for freedom through space, in a positive and open relationship with the climate, and by starting from the existing, without ever demolishing anything. This is the essence of our work… It is urgent to stop demolishing, eliminating, deleting, cutting, and to start from the city as it is, exactly as it is. To do and to invent with all what we have. Any building can be transformed, reused. Any tree can be carefully conserved. Any constraint can be turned positively.[22]

Using the existing structure of buildings as a basis for developing innovative and sustainable design solutions that address a particular building's distinctive characteristics, students are able to produce fresh, aesthetically appealing and operationally functional structures that are responsive to the specific context in which they are situated.

Figure 8. Timothy Turner's project: reimagining the original façade by employing a classicism rhythm, while a deconstructivist parasite serves as a contrasting feature.

Therefore, this approach does not restrict students' creativity, to the contrary, it introduces a new methodology in terms of thinking about the existing built environment and unleashes a magnitude of new challenges that generate different and unexpected creative solutions.

DESIGN CHOICES DRIVEN BY TECHNOLOGY AND SUSTAINABILITY

To ensure a cohesive and interconnected delivery of FP and ADS modules, their integration was accomplished by adopting student-centred strategies in accordance with Biggs' theory. This approach aimed to foster an environment that encourages critical thinking and the practical application of knowledge through diverse teaching methods and content formats.[23]

The brief for ADS requires students to collaborate as a cohesive team, applying their expertise in architectural technology and sustainability to various design exercises, and achieve an aesthetically impactful final proposal encompassing the following elements:

- Engaging with the building's occupants and incorporating their feedback into the retrofit design proposal.
- Assessing the existing building envelope and evaluating its performance.
- Prioritizing the preservation of historical and architectural significance.
- Exploring passive design strategies and incorporating sustainable design principles.
- Implementing modifications to enhance accessibility for all individuals.

Design exercises that foster collaborative learning play a crucial role in architecture education.[24] These exercises not only facilitate collaborative learning but also promote constructive dialogue among students, leading to valuable insights and improvement opportunities. To further enhance the

collaborative learning experience, the assessment method incorporated a comparison board, allowing each group to critically assess and provide constructive feedback on each other's work.[25]

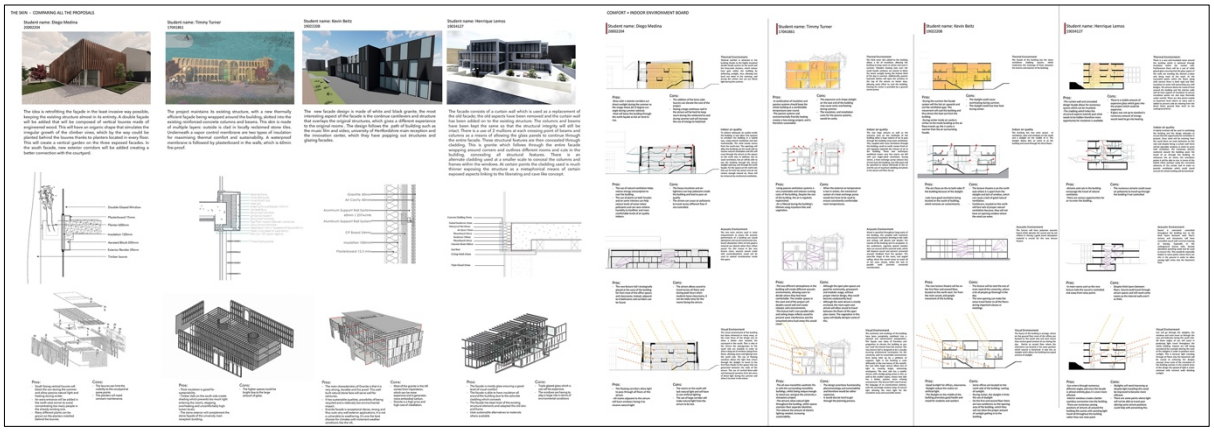

Figure 9. Comparison board: "The Skin and Comfort + Indoor Environment", students Beitz Salas, Lemos, Medina Castrejon, Turner

Additionally, the panel for critique sessions was thoughtfully curated in collaboration with the local RIBA branch, ensuring a bridge between the industry and education, and providing students with valuable insights from professionals.

Working with a real building provided students with a valuable opportunity to delve deeply into the building's current performance and leverage energy analysis findings to identify appropriate retrofit measures. Additionally, this approach enabled students to consider the building as a materially stratified 'document'[26] and prioritize the needs of both current and future occupants, offering a substantial advantage for their learning and the overall retrofit process.[27] The opportunity of multiple site visits and interactions with the client and occupants played a pivotal role in assessing the existing layout's effectiveness.

The outcomes of adopting this retrofitting approach demonstrated that students acquired knowledge in the implementation of technology in architecture and the integration of sustainable design principles within creative retrofitting strategies. This resulted in enhanced building performance and indoor environmental quality, with a focus on the various parameters that influence a building's efficiency.

CONCLUSIONS

As architectural educators, it is our responsibility to continuously explore the world we inhabit and stay abreast of professional trends. As we shape the future generation of professionals, we must strive to anticipate the evolving needs of the field. One prominent aspect within the broader architectural profession is the increasing focus on retrofit and adaptive reuse. This trend is evident through the statements made by renowned architects and theorists.

Furthermore, driven by the urgent challenge of the climate crisis, there is a significant body of work and impact originating from grassroots groups such as LETI, ACAN and STUCAN. These groups engage in data-driven approaches and knowledge exchange through non-traditional collaborative channels, which have contributed to advancements in architectural practice and education pertaining to retrofitting.

The experience of teaching retrofit in design studios has dispelled any doubts that this particular focus might hinder students' ability to create designs of exceptional quality and creativity. In fact, we have discovered that embracing limitations can serve as a powerful tool for fostering a uniquely creative

approach and driving innovation. It allows students to investigate structural challenges and uncover hidden potentials in the existing built environment.

NOTES

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[5] Carlos Martí Arís, *Le variazioni dell'identità*. (Bologna: Città Studi Edizioni, 1990), 66-75.
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