

Urban Mining Potential in Demolition and Design for Innovative Material Reuse within a Circular Model

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ABSTRACT

A significant Soviet-era building from the 1970s in Moscow was demolished in 2019 after being excluded from the heritage list and left abandoned for an extended period. Constructed with bricks, precast slab panels, and a steel roof, the building underwent rapid destruction by machinery. The metals were sent to a recycling facility, while the concrete-brick mixture was transported to a dumping site, where it was partially stored and landfilled.

The demolition process was monitored daily and documented through photographs, forming the initial phase of the current research. This research focused on creating an urban mining strategy to enhance the circularity of materials within an innovative architectural design.

Detailed observations were made regarding the unit types and bonding style, the characteristics of the precast panels and jointing technique, the materials and fabrication of the trusses. This information was used to identify potential end-of-life applications for the materials within a circular model from around the world.

The research identified a strategy that prioritized deconstruction and reuse, which included cutting and reshaping walls into new load-bearing blocks, slicing slab panels and reassembling them into perforated facades, and converting the trusses into cross-braced columns. Using 3D modelling, each stage of the proposed scenario—including the state of the components and their transformation into new architectural materials—was digitally visualized. Additionally, the necessary tools and processes for this transformation in a real-world context were determined.

Finally, the innovative architectural appearance created from these repurposed materials, showcasing their rich composition and textures, was presented. The benefits of the proposed management strategy were highlighted, emphasizing the intrinsic and architectural value of the materials, as well as their positive environmental and social impacts.

KEYWORDS: *Deconstruction, demolition, design for reuse, circularity, material cycle.*

1 Introduction

Urbanization and population growth not only hasten the construction of new structures but also have additional effects on the built environment, such as a drastic increase in the number of demolitions worldwide. Researchers from a variety of fields, including architecture, concentrate on finding solutions to reduce this problem because the ongoing accumulation of demolition waste triggers environmental threads.

Russia also faces a comparable issue regarding the rate of urbanization and the management of old, abandoned buildings. The research material for this study is one of those, an old movie theatre building of Moscow, and its demolition process.

The state of the art with waste disposal strategies in a circular economy, especially innovative solutions with architectural potentials, are presented in the literature survey section of this report to set the stage for a worldwide backdrop. The brick, precast concrete, and steel that were the three main materials heavily utilized in the inspected building were the focus of the literature search. First, a general overview of common strategies was given, followed by a closer examination of one unique reuse example for each material, complete with data and images of real applications.

The architectural characteristics of the examined building are then presented in the research material section using historical records and first-hand observations made during the demolition. The research method section provides a design idea and uses 3D visualization

to demonstrate how the generated waste can creatively be transformed into new building materials. A sample architectural space formed with a newly produced set of materials is shown in the report's results section. The discussion part demonstrates the quality of the final product, and the applicability of the suggested approach compared to the examples from the literature review. The significance of this study and the lessons learned that can assist future researchers in the field are finally listed in the conclusion.

2 Literature Survey

In circular economic systems, product chains are interconnected from the extraction of raw materials to final disposal, emphasizing the efficient management of waste as a critical component (Potting et al. 2017). These connections minimize the use of natural resources and reintegrate waste into production processes, significantly benefiting the environment. Various circularity strategies are employed, such as energy recovery through incineration or transitioning to innovative, environmentally friendly product designs. Importantly, solutions differ in their level of circularity, with low-energy approaches proving more sustainable and effective than energy-intensive alternatives (Potting et al. 2017).

Accordingly, reuse offers less environmental impact compared to recycling and therefore, prioritizing it is vital, particularly in sectors with substantial waste production, such as construction. Similarly, the significant rise in deconstruction and demolition activities