Case Study — Technical Summary

Application of the M+1A Method to an Existing Residential Building

This case study presents the application of the **M+1A Method**, within the framework of **Vertical Engineering**, to an existing residential building, used as a **technical object for practical validation of the method**. The objective was not to develop an architectural or structural design, but to **technically assess the feasibility of vertical expansion before any project or construction decision**, in accordance with the principles of the method.

Building Context

The analyzed building corresponds to a consolidated single-family residence, originally constructed without any formal provision for future vertical expansion. As is common in a large portion of the existing urban building stock, the property exhibited typical characteristics of existing buildings: a structural system designed for a specific original program, incomplete structural calculation documentation, adaptations carried out over time, and relevant urban planning constraints.

The motivation for the analysis arose from a **real functional need**, associated with the potential expansion of use and the long-term valorization of the asset. This condition reproduces, at real scale, the same scenario faced by owners, investors, and managers of existing buildings.

Application of the M+1A Method

The analysis was conducted in a **sequential manner**, respecting the stages of the M+1A Method and the central principle of Vertical Engineering: **technical decision must precede design**.

1. Structural Assessment of the Existing Building

The first stage focused on analyzing the existing structure, including verification of the structural system, actual load paths, possible structural reserves, and physical limitations for vertical additions. The assessment considered not only the theoretical capacity of structural elements, but also the effects of material aging and previous interventions. At this stage, factors were identified that limited conventional vertical growth solutions and required technical caution.

2. Analysis of Legislation and Technical Standards

In parallel, an analysis of the applicable legal and regulatory framework was carried out, including zoning regulations, height limits, floor area ratio, safety requirements, and relevant technical standards. Unlike traditional approaches, this verification was not treated as a final step, but as a **determinant feasibility criterion**, capable of interrupting or redirecting the decision at an early stage.

3. Evaluation of Technological Alternatives and Materials

Based on the identified constraints, technological alternatives compatible with the existing building were evaluated, with emphasis on lower-impact structural systems, lightweight solutions, and possibilities for structural coupling. This stage demonstrated that the technical feasibility of vertical expansion depends not only on classical structural calculations, but on the **coherence between technology, existing structure, and overall risk**.

4. Engineering Economics and Value Engineering

The economic analysis assessed the incremental cost associated with vertical expansion in comparison with the value added to the asset. Competing alternatives, such as requalification of existing spaces and non-intervention, were also considered. This stage demonstrated that technical feasibility alone does not guarantee rational decision-making, making it essential to evaluate **effective value generation**.

5. Risk Analysis and Final Decision

Risk analysis integrated all previous stages, identifying structural, legal, operational, and economic risks. The method enabled the hierarchy of these uncertainties and supported a clear, documented, and defensible technical decision. Importantly, the process explicitly considered the possibility of **not expanding**, reinforcing the decision-neutral nature of the M+1A Method.

Results and Lessons Learned

The application of the M+1A Method demonstrated that vertical expansion of existing buildings cannot be treated as an intuitive or purely design-driven decision. The study highlighted the importance of **interrupting unviable decisions at early stages**, reducing risks, unnecessary costs, and future conflicts. The case validated the method as a **decision engineering tool**, capable of organizing complex information and guiding responsible technical choices.

More than the final outcome, the value of the study lies in the **structured decision-making process**, which transformed an intention to expand into an engineered, coherent, and justifiable decision. This case confirms the applicability of the M+1A Method as a central tool of **Vertical Engineering** in the real context of existing buildings.