Complete Case Study

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

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1. General Characterization of the Building

This case study addresses the **full and detailed application of the M+1A Method** to an **existing single-family residential building**, located in a consolidated urban area and representative of the broader stock of existing buildings found in medium-sized cities. The building was originally conceived to meet a specific residential program, **without any formal structural, architectural, or regulatory provision for future vertical expansion**.

As is typical of most existing residential buildings, the original design prioritized immediate functional needs and construction practices prevailing at the time, rather than long-term adaptability. The structural system was dimensioned according to conventional criteria for permanent and variable loads associated with its initial configuration, without allowance for future increases in vertical demand.

The building exhibits a conventional structural typology, composed of load-bearing elements designed for a specific distribution of forces and service conditions. Over time, the property underwent **localized functional adaptations**, minor renovations, and usage-related adjustments, resulting in a structural and constructive condition that reflects **real-world, non-idealized circumstances** rather than textbook assumptions.

An important characteristic of the case is the **absence of complete original structural calculation documentation**, a common condition in existing buildings. This factor, combined with the evolution of construction technologies, regulatory frameworks, and technical standards over time, establishes a realistic and technically challenging scenario for decision-making regarding vertical expansion.

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2. Problem Statement and Motivation for Analysis

The motivation for applying the M+1A Method did not arise from an a priori architectural or structural design intent. Instead, it emerged from a **real functional and strategic need**, associated with the potential expansion of usable space and the long-term valorization of the property as a built asset.

This context led to the central question of Vertical Engineering:

> **Is it technically, legally, economically, and strategically coherent to promote the vertical expansion of this existing building?**

This question could not be answered through intuition, isolated structural checks, or urban planning parameters alone. Any premature decision to design or build without a structured evaluation would expose the project to significant technical, legal, economic, and operational risks. The situation therefore demanded a **methodological decision-making process** capable of integrating all relevant variables before committing to design or construction.

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3. Application of the M+1A Method — Methodological Framework

The analysis was conducted in strict compliance with the **methodological architecture of the M+1A Method**, which is grounded in the principles of Vertical Engineering. The foundational premise adopted throughout the study was unequivocal:

technical decision must precede architectural or structural design.

The method was applied through a sequence of **decision gates**, each representing an independent analytical stage with the explicit authority to interrupt the process if critical infeasibilities were identified. No assumption was made, at any point, that vertical expansion would necessarily proceed.

GATE 1 — Structural Assessment of the Existing Building

The first decision gate focused on a **comprehensive assessment of the existing structural system**, with the objective of understanding not only its theoretical capacity, but its real behavior as an integrated system. The analysis addressed:

- structural typology and load-bearing configuration;
- actual load paths and force distribution mechanisms;
- observable foundation conditions and constraints;
- potential structural reserves and redundancies;
- material aging, degradation, and long-term performance;
- impacts of previous modifications and interventions.

Given the absence of original calculation records, the assessment relied on engineering judgment, field observations, and conservative assumptions consistent with professional best practices for existing structures. Particular attention was paid to identifying whether additional permanent loads could be safely introduced without compromising global structural performance.

The analysis revealed **significant limitations** regarding the direct transfer of new vertical loads to the existing structure. Conventional vertical expansion approaches, based on load accumulation over original elements, would substantially increase structural risk and uncertainty.

Gate 1 Conclusion:
The building did not support traditional vertical expansion strategies. Any potential growth would require **non-conventional structural solutions**, explicitly designed to minimize additional permanent loads on the original system.

GATE 2 — Analysis of Legislation and Technical Standards

The second decision gate examined the **legal, urbanistic, and normative framework** governing the property. This analysis included:

- zoning regulations and land-use classification;
- allowable floor area ratio and building envelope constraints;
- maximum height and setback requirements;
- fire safety, accessibility, and performance regulations;
- technical standards applicable to existing buildings and structural interventions.

In contrast to conventional practice, regulatory compliance was not treated as a post-design verification. Instead, it was incorporated as a **primary feasibility filter**, capable of halting or redirecting the decision process at an early stage.

The analysis established strict boundaries for any vertical expansion hypothesis, eliminating solutions incompatible with the regulatory framework before any design effort was undertaken.

Gate 2 Conclusion:
Vertical expansion was legally feasible only within **narrow and clearly defined limits**,

reinforcing the necessity for controlled, low-impact solutions aligned with regulatory constraints.

GATE 3 — Evaluation of Technology and Materials

With structural and legal constraints clearly defined, the third decision gate focused on the evaluation of **technological alternatives and construction systems** compatible with the existing building. The analysis prioritized:

- lightweight structural systems;
- industrialized and modular construction techniques;
- structural coupling or partial load transfer strategies;
- minimization of additional permanent loads;
- constructability and execution feasibility within an occupied building context.

This stage demonstrated that technical feasibility cannot be reduced to structural resistance alone. Instead, it depends on the **coherence between selected technologies, structural behavior, execution risk, and long-term performance**.

Gate 3 Conclusion:
Technically viable alternatives existed, provided that **non-conventional, carefully controlled solutions** were adopted and integrated into a broader risk-managed strategy.

GATE 4 — Engineering Economics and Value Engineering

The fourth decision gate addressed the **economic dimension of the expansion**, evaluating whether the proposed intervention would generate real and measurable value. The analysis considered:

- incremental construction and indirect costs;
- execution and schedule risks;
- long-term asset valorization;
- opportunity costs and competing alternatives, including internal requalification and non-intervention;
- alignment between investment magnitude and expected return.

The results demonstrated that technical feasibility alone does not ensure economic rationality. The economic outcome was highly sensitive to the technological approach adopted and the degree of risk mitigation achieved in previous stages.

Gate 4 Conclusion:
Vertical expansion could be economically justified **only under specific, tightly controlled conditions**, underscoring the strategic nature of the decision.

GATE 5 — Risk Analysis and Final Decision

The final decision gate integrated all preceding analyses into a **comprehensive risk assessment**, identifying and prioritizing:

- structural risks;
- legal and regulatory risks;
- operational and execution risks;
- economic and financial risks.

This integrated evaluation enabled a **clear, documented, and defensible technical decision**, explicitly acknowledging uncertainty and incorporating the possibility of **not proceeding with vertical expansion**.

Final Decision:
The outcome of the M+1A Method was grounded in the decision-making process itself, rather than in preconceived expectations. The method fulfilled its role as a **Decision Engineering framework**, ensuring that any potential intervention would be justified, controlled, and technically defensible.

Final Considerations of the Case

This complete case study demonstrates that the M+1A Method transforms an initial intention to expand into a **fully engineered decision**, capable of reducing uncertainty, mitigating risk, and preventing inconsistent investments. More than the final outcome, the value of the case resides in the **structured, transparent, and auditable decision-making process**.

The study confirms that **Vertical Engineering**, when applied through the M+1A Method, constitutes a robust technical discipline capable of addressing the complexity of interventions in existing buildings. It establishes a paradigm in which **decisions are engineered before designs are drawn**, aligning safety, legality, economic rationality, and long-term asset performance.

Further Reading

Readers seeking a comprehensive and formal presentation of the methodological, theoretical, and institutional foundations underlying this case study are referred to the official IVEXSI publication:

The IVEXSI System and the M+1A Method

This volume presents the complete framework of the M+1A Method and the discipline of Vertical Engineering, including decision logic, governance principles, and standardization architecture.