The Mansarda-Hybrid Framework: An Integrated Approach to Architectural Design and Planning

1. Introduction: Towards a Holistic Architectural Design and Planning Framework

Contemporary architectural practice is characterized by escalating complexity. Projects demand the seamless integration of diverse disciplines, rapidly evolving technologies, multifaceted stakeholder requirements, and critical sustainability imperatives.[1] This intricate landscape necessitates robust frameworks that can guide the design and planning process from inception to post-occupancy, ensuring that all constituent parts coalesce into a coherent and high-performing whole. The drive towards greater efficiency, error reduction, and enhanced collaboration, often supported by digital tools like Building Information Modeling (BIM), further underscores the need for structured yet adaptable methodologies.[3] The very definition of architectural success is expanding, moving beyond purely aesthetic or functional achievements to encompass broader societal and environmental responsibilities. This evolution in expectations calls for design processes that are not only technically proficient but also deeply attuned to the wider context and impact of the built environment.

This report introduces the Mansarda-Hybrid Framework, a novel conceptual structure for architectural design and planning. This framework is predicated on the synergy between two core ideas: the "Mansarda" principle and an iterative top-down/bottom-up (TDBU) design methodology. The "Mansarda" principle, drawing inspiration from the architectural feature of the mansard roof, emphasizes the maximization of potential within given constraints, the thoughtful integration of multiple levels of design engagement, and inherent adaptability. The mansard roof, known for its ability to create additional habitable space within the roof volume, often with unique and flexible interior configurations [5], serves as a potent metaphor for a process that seeks to unlock latent value and creatively navigate complexity. When combined with an iterative TDBU approach—which harmonizes visionary, holistic planning with detailed, emergent problem-solving [8]—the framework offers a comprehensive means of addressing the multifaceted challenges of modern architecture. The "Mansarda-Hybrid" name itself suggests a thoughtful blend: "Mansarda" evokes established architectural wisdom and ingenuity in resource utilization, while "Hybrid" points to a proven, synthesized process methodology. This combination signals a framework that is both innovative in its integration and grounded in sound architectural and procedural principles, aiming for practical applicability and conceptual richness.

The aim of the Mansarda-Hybrid Framework is to provide a robust and adaptable structure for navigating the complexities of architectural projects, from initial visioning through detailed design and implementation to post-occupancy evaluation and learning. It seeks to ensure that all aspects of a project—functional, aesthetic, technical, environmental, social, and economic—are effectively integrated, leading to comprehensive and well-resolved design solutions.

This report will unfold as follows: Section 2 will delve into the "Mansarda" principle, exploring its architectural origins and translating its characteristics into process analogues for design planning. Section 3 will examine the top-down and bottom-up design methodologies, detailing their synthesis into an iterative hybrid approach. Section 4 will present the comprehensive lifecycle framework, outlining five key phases and demonstrating how the Mansarda-Hybrid process is applied within each. Section 5 will discuss the integration of cross-cutting considerations throughout the framework. Finally, Section 6 will offer concluding perspectives on the benefits and implications of adopting such an integrated approach to architectural design and planning.

2. The "Mansarda" Principle in Architectural Process: Maximizing Potential and Integrating Levels

The "Mansarda" principle, as a component of this proposed framework, draws its inspiration from the distinct architectural characteristics and utilitarian advantages of the mansard roof and the habitable "mansarda" spaces it creates. Understanding these origins is key to appreciating its metaphorical application to the design and planning process.

2.1 Architectural Origins and Characteristics of the Mansard Roof and "Mansarda" Space

A mansard roof, also known as a French roof or curb roof, is a multi-sided, gambrel-style hip roof. Its defining feature is the presence of two distinct slopes on each of its sides: the lower slope is significantly steeper than the upper slope, which may be nearly flat and sometimes not visible from street level.[5] These roofs are frequently punctuated by dormer windows, particularly on the steeper lower slope, which allow light and ventilation into the attic space.[5]

The primary purpose of the mansard roof, historically and practically, has been to maximize the usable interior space within the attic, effectively creating an additional storey or "garret" without dramatically increasing the overall height of the building from the main cornice line.[6] This design was often employed for aesthetic reasons, allowing for a more articulated roofline, and sometimes for pragmatic reasons such as tax avoidance, where taxes might have been based on the number of full storeys beneath the cornice.[6]

The term "mansarda" often refers to the habitable space created beneath such a roof. These spaces are characterized by their unique, often sloping, ceilings and the quality of light, frequently admitted from above through skylights or dormer windows.[7] Mansardas tend to evoke a sense of warmth and intimacy. Due to their irregular geometries, they often necessitate tailor-made solutions for furnishings and fittings, encouraging flexible and adaptable interior design approaches.[7] For example, projects have featured movable furniture and walls to allow the character of the mansarda to change according to use, such as hosting a party or providing a quiet retreat.[10]

2.2 The "Mansarda Process" Metaphor: Efficient Resource Utilization, Multi-Level Integration, and Adaptability in Design Planning

Translating these architectural characteristics into a process metaphor provides a rich set of guiding principles for the Mansarda-Hybrid Framework:

- **Efficient Resource Utilization:** The mansard roof's genius lies in its ability to create valuable, habitable space from what might otherwise be underutilized attic volume.[6] Analogously, the "Mansarda Process" encourages a design and planning approach that seeks to maximize the potential of all available resources—be it budget, time, site conditions, programmatic requirements, or creative talent. It is about ingeniously "carving out" value and functionality from existing constraints, rather than simply assuming that more resources are the only solution to complex problems. This suggests a philosophy that actively looks for clever workarounds and optimizations, turning perceived limitations into opportunities for inventive value creation, much like the mansard roof itself was an ingenious solution to add space within restrictive building height regulations.
- **Multi-Level Integration:** The distinctive double slope of the mansard roof [5] offers a powerful metaphor for integrating different levels of design engagement. The lower, steeper slope can symbolize the intensive, detailed work required for specific components, critical systems, or challenging problem areas within a project. This is where deep dives into technical specifics, material properties, or complex programmatic requirements occur. Conversely, the gentler upper slope, which caps the structure and ensures its overall integrity, represents the holistic integration of these detailed elements into the overarching vision, the broader context, and the project's primary objectives. The dormer windows, often situated

on the lower slope, become crucial points of connection, articulation, or focused insight, linking the detailed investigation with the comprehensive overview and allowing light (clarity) to penetrate complex areas.

- **Adaptability and Flexibility:** Mansarda interiors, with their sloping ceilings and unique configurations, often demand bespoke, tailor-made solutions and flexible furnishings to be truly functional and comfortable.[7] This translates directly to a design process that is inherently adaptable and responsive to the specific context and evolving needs of each project. The "Mansarda Process" encourages customized methodologies and solutions rather than imposing a rigid, one-size-fits-all approach. It values the ability to adjust to emergent conditions, incorporate new information effectively, and allow the design to evolve organically. This "tailor-made" aspect implies that while the framework provides structure, it must be highly customizable to the specific "occupants" (stakeholders, users) and "spatial conditions" (project context, constraints) of each endeavor.
- **Light and Perspective:** The common emphasis on natural light in mansarda spaces, often achieved through strategically placed dormer windows or skylights [7], can be metaphorically linked to the critical need for clarity, vision, and multiple perspectives within the design process. Just as light illuminates the physical space, a well-structured process should illuminate the complexities of the project, allowing for clear understanding and informed decision-making. The dormer windows, as points of light and view, can also symbolize the importance of seeking out diverse viewpoints and specialized insights to enrich the design solution.

The following table further clarifies the relationship between the architectural features of the mansard and their analogous process characteristics:

Table 1: The "Mansarda" Principle: Architectural Features and Process Analogues

Architectural Feature	Description	Process Analogue in Design Planning	Benefit to the Design Process
Double Slope	Two distinct pitches on each side, lower steeper than upper.[5]	Dual-level analysis: strategic (overall vision) & tactical (detailed components).	Balances comprehensive overview with in-depth examination of specific issues.

Habitable Attic/Garret	Maximized usable interior space within the roof volume.[6]	Maximized project potential and value extraction from given constraints (brief, budget, site).	Achieves greater outcomes and innovative solutions within defined parameters.
Dormer Windows	Windows projecting from the sloping roof, providing light and space.[5]	Focused points of connection, insight, or articulation between different levels/aspects of the design.	Facilitates inter-level communication, targeted problem-solving, and integration of specialized knowledge.
Steep Lower Slope	The more sharply inclined portion of the roof, often containing dormers.[5]	Deep-dive investigation into complex components, critical systems, or specific challenges.	Ensures thorough resolution of critical issues and detailed development of key project elements.
Gentle Upper Slope	The less inclined upper portion, sometimes nearly flat.[5]	Holistic integration of all components and systems into the overall design vision and context.	Ensures overall coherence, system integrity, and alignment with strategic project goals.
Adaptable Interior Space	Mansardas often require custom, flexible solutions due to unique geometries.[7]	Customizable project methodologies and adaptable design solutions tailored to specific needs.	Tailors the design process and outcomes to unique project requirements, fostering innovation and responsiveness to change.
Emphasis on Light (from above)	Mansardas often prioritize natural light, creating bright and airy spaces.[7]	Pursuit of clarity, vision, and diverse perspectives throughout the design process.	Enhances understanding, promotes informed decision-making, and enriches the design solution through multiple viewpoints.

By internalizing these aspects of the "Mansarda" principle, the design process can become more resourceful, integrated, adaptable, and insightful, leading to architectural solutions that are both efficiently derived and richly conceived.

3. Synergizing Design Perspectives: The Iterative Top-Down and Bottom-Up Approach

Architectural design, particularly for complex projects, benefits immensely from a methodological approach that can reconcile grand visions with intricate details. The Mansarda-Hybrid Framework achieves this by synergizing two fundamental design perspectives—top-down and bottom-up—within an iterative cycle.

3.1 The Top-Down Approach: Vision, Structure, and System-Level Design

The top-down design approach commences with a comprehensive understanding of the desired end result, the overarching goals, or the high-level vision for the project.[11] It is a deductive process that breaks down this holistic concept into progressively smaller, more manageable components, sub-systems, or phases.[11] This methodology emphasizes extensive planning, research, and the establishment of a clear framework or "skeleton" model at the outset, which serves to capture the core design intent and guide subsequent development.[11]

Strengths of the top-down approach are particularly evident in large, complex projects. It provides a mechanism for maintaining comprehensive control over the design process, ensuring that all individual parts align with the overall project objectives and strategic vision.[8] This centralized perspective facilitates the management of changes, as modifications to the guiding framework can be propagated systematically to dependent components.[11] Furthermore, it ensures a strong focus on fulfilling initial requirements and stakeholder expectations.[14]

However, the **weaknesses** of a purely top-down approach can include significant upfront time investment in defining the overarching framework, which might delay the commencement of detailed design work.[8] If the initial framework is too rigid or ill-conceived, it can stifle innovation and flexibility at the component level, forcing solutions into a preconceived mold that may not be optimal.[8]

3.2 The Bottom-Up Approach: Detail, Innovation, and Component-Level Development

In contrast, the bottom-up design approach begins with the individual parts, modules, or the most granular elements of a system.[12] It is an inductive process where these foundational components are designed, developed, and then progressively assembled or integrated to form larger sub-systems, and ultimately, the complete project.[13] The emphasis is on creating well-defined, often reusable, low-level components and exploring their potential before necessarily finalizing the overall systemic structure.[13]

Strengths of the bottom-up approach include its inherent flexibility, allowing for the optimization and innovation of individual components without the immediate constraints of a predefined overarching structure.[8] This supports modularity and the reuse of proven solutions or standardized parts, potentially saving time and resources.[13] It also facilitates parallel development, where different teams can work on separate components concurrently.[8] This method is particularly well-suited for experimental scenarios, projects where requirements are emergent or not fully defined at the outset, or when exploring novel technologies or materials.[12] Testing and validation of individual components can also be more straightforward.[13]

The primary **weaknesses** of an exclusively bottom-up strategy lie in the potential for integration challenges. Without a clear, guiding vision or framework, independently developed components may not fit together cohesively in the final assembly, leading to costly rework or compromised system integrity.[8] There is also a risk of developing redundant components or a design that lacks overall coherence if the integration phase is not carefully managed.[15] Moreover, the solutions developed might not always align closely with the overarching problem structure if that structure is not considered early enough.[14]

3.3 Forging the Synthesis: An Iterative Framework for Integrating Top-Down and Bottom-Up Methodologies

Recognizing the complementary strengths and weaknesses of these two approaches, the Mansarda-Hybrid Framework advocates for their synergistic integration through an iterative process. Many complex design tasks, including those in architecture, inherently require elements of both top-down and bottom-up thinking to achieve optimal outcomes.[12] The integration is not a simple sequential application but a dynamic, ongoing cycle where each methodology informs and refines the other.[14]

This iterative hybridization typically works as follows:

1. **Initial Vision (Top-Down):** The process often begins with a top-down phase to establish an initial project vision, core values, primary functional requirements, and strategic objectives. A preliminary "skeleton" model or conceptual framework is developed to provide overall structure and direction.[11]
2. **Focused Exploration (Bottom-Up):** Concurrently or subsequently, bottom-up exploration is initiated for key components, critical systems, challenging details, material research, or technological innovations. This allows for detailed

investigation and creative problem-solving at a granular level.

3. **Iterative Reconciliation and Refinement:** The crucial step is the regular, systematic reconciliation of bottom-up findings and developments with the top-down framework. Discoveries made at the component level may necessitate adjustments to the overall vision or structure. Conversely, the strategic goals of the top-down vision will guide the selection and integration of bottom-up solutions. This creates a "middle-out" dynamic, where strategic direction informs detailed work, and detailed discoveries refine the strategic direction. The "skeleton" is not a static edict but a living document, constantly informed and reshaped by these bottom-up explorations, ensuring its relevance and feasibility.
4. **Feedback Loops:** The process incorporates continuous feedback loops. Prototypes, analyses, or partial solutions developed bottom-up are evaluated against the top-down criteria. System-level decisions made top-down are tested for their implications on component design and feasibility.

The success of this hybrid approach relies heavily on establishing clear "interfaces" and robust communication protocols between teams or individuals working at different scales (e.g., system-level architects and specialist consultants focusing on component design). This ensures that information flows effectively between the macro and micro levels of the project, preventing silos and facilitating coherent integration. This is analogous to how complex software systems require well-defined Application Programming Interfaces (APIs) for inter-module communication, as seen in frameworks like the Abstract Modular AI Language (AMAL), which emphasizes the need for "clear interfaces" and "semantically rich inter-module communication".[17] In architecture, this translates to well-defined briefs for component design, regular interdisciplinary review meetings, shared digital models (e.g., BIM), and transparent decision-making processes.

The iterative nature of this integrated model is particularly vital for managing the inherent uncertainty and complexity of architectural projects.[16] It allows the design to "learn" and adapt as it progresses, incorporating new information, responding to unforeseen challenges, and refining solutions based on ongoing evaluation. This contrasts with more rigid, linear processes that assume all requirements and solutions can be perfectly defined upfront.

The **benefits of this integrated hybrid approach** are significant. It achieves a balance between the clarity and control of top-down vision with the creative freedom, innovation, and detailed resolution of bottom-up exploration.[9] This synergy helps manage complexity effectively while fostering innovation, leading to designs that are more robust, adaptable, and responsive to the full spectrum of project requirements.

The following table provides a comparative summary of the top-down, bottom-up, and integrated hybrid design approaches:

Table 2: Comparison of Top-Down, Bottom-Up, and Integrated Hybrid Design Approaches

Aspect	Top-Down Design	Bottom-Up Design	Integrated Hybrid Design
Starting Point	Overall system, vision, or concept.[11]	Individual components, modules, or details.[12]	Initial vision/framework (Top-Down) combined with parallel or subsequent exploration of key components/details (Bottom-Up).[14]
Primary Focus	System architecture, overall structure, fulfilling high-level requirements.[14]	Component functionality, detail resolution, reusability, innovation at micro-level.[13]	Balancing overall vision with detailed realities; ensuring coherence between macro and micro scales; adaptability and evolution.[9]
Key Process	Decomposition, refinement of system into sub-systems/components.[11]	Composition, integration of components into larger systems.[13]	Iterative cycles of decomposition and composition; continuous feedback between system-level design and component-level development.[14]
Information Flow	Primarily from general to specific.	Primarily from specific to general.	Bidirectional and continuous; dialogue between holistic vision and granular

			findings.
Strengths	Control, alignment with objectives, good for complexity, strong requirements focus.[8]	Flexibility, component optimization, modularity, reuse, parallel development, innovation.[8]	Combines strengths of both; robust, adaptable, manages complexity while fostering innovation; responsive to evolving requirements.[9]
Weaknesses	Can be rigid, stifle component innovation, time-consuming upfront.[8]	Integration issues, potential lack of cohesion, risk of redundancy.[8]	Requires careful management of interfaces and communication; can be more complex to manage than a purely linear process.
Typical Application	Large, complex systems where overall architecture is paramount early on.[12]	Experimental projects, systems with many reusable components, when requirements are emergent.[12]	Most complex architectural projects benefit from this balanced and adaptive approach.
Role of Initial Vision	Central and directive; "skeleton" defines the design.[11]	May be loose or emergent; focus is on component capabilities first.	Initial vision provides direction but is treated as adaptable and subject to refinement based on bottom-up discoveries and iterative feedback.
Handling of Detail	Details are derived from the overall structure.	Details are developed first and then integrated.	Details are explored (bottom-up) within the context of an evolving overall structure (top-down), with mutual influence.

This synergistic approach, combining the foresight of top-down planning with the insights of bottom-up exploration, forms a critical pillar of the Mansarda-Hybrid Framework, enabling a design process that is both visionary and deeply grounded in practical realities.

4. A Comprehensive Lifecycle Framework: Integrating the Mansarda-Hybrid Process

The Mansarda-Hybrid Framework is actualized through a comprehensive lifecycle, structured into five distinct yet interconnected phases. This phased approach ensures systematic progression from initial idea to occupied reality and beyond, with the "Mansarda" principle and the iterative Top-Down/Bottom-Up (TDBU) methodology actively applied at each stage. This transforms these principles from passive concepts into active methodological drivers, prompting specific inquiries at each phase: "How can potential be maximized here (Mansarda)?" and "What is the current interplay between our overall vision and emerging details (TDBU)?"

Phase 1: Visioning and Contextual Foundation

(Corresponds to AIA Pre-Design/Programming & TOGAF Phase A: Architecture Vision)

- **Objectives:** This initial phase is dedicated to laying a robust foundation for the entire project. Key objectives include thoroughly uncovering client and stakeholder needs, aspirations, and functional requirements; identifying potential opportunities and constraints; defining clear metrics for success [18]; and developing a high-level, aspirational vision for the architecture.[19] It involves confirming overarching business goals, strategic drivers, and operational constraints that will shape the project.[19] A critical component is a deep understanding of the project's context, encompassing physical site conditions (topography, climate, existing structures), cultural significance, historical precedents, and existing infrastructure.[21] Evaluating the client's organizational capabilities and readiness for the proposed transformation is also essential.[19]
- **Activities:** Activities are research-intensive and collaborative. They include detailed client interviews, stakeholder workshops to gather diverse perspectives, comprehensive site visits and analyses, and extensive data collection (e.g., surveys, existing maps, zoning regulations, building codes, environmental studies).[18] Feasibility studies, preliminary budget discussions, and initial schedule development are also undertaken to frame the project's practical boundaries.[18]
- **"Mansarda" Application:**
  - *Maximizing Potential:* The "Mansarda" principle guides a thorough exploration of the project brief, site characteristics, and stakeholder inputs to uncover "hidden" opportunities or underutilized potentials. This means looking beyond

explicitly stated needs to identify latent possibilities, akin to discovering additional "habitable space" within the initial constraints of the project.
    - *Multi-Level Integration:* High-level client aspirations and strategic goals (the "upper slope" of the mansard metaphor) are systematically integrated with detailed site constraints, specific user needs, and granular contextual data (the "lower slope"). Specific insights derived from contextual analysis or stakeholder feedback act as "dormer windows," illuminating key relationships and informing the overall vision.
- **TDBU Application:**
    - *Top-Down:* This phase is heavily reliant on top-down thinking to establish the overall project vision, core values, primary goals, and strategic objectives that will guide all subsequent decisions.[19] The "big picture" is defined.
    - *Bottom-Up:* Simultaneously, intensive bottom-up data gathering occurs through detailed site analysis, user research, precedent studies, and technical feasibility assessments. This identifies specific constraints, micro-level opportunities, and granular requirements that must be accommodated.[21]
    - *Iteration:* The initial top-down vision is continuously tested and refined against the bottom-up contextual findings. Data gathered from the site and stakeholders helps to ground the vision in reality, ensuring it is both aspirational and achievable.
- **Key Deliverables:** A comprehensive Program of Requirements (or Project Brief), an Architecture Vision Document articulating the high-level goals and design direction, a Stakeholder Register, an initial Risk Assessment, and a refined project scope, budget, and schedule.[18]

Phase 2: Conceptual and Schematic Development

(Corresponds to AIA Schematic Design)

- **Objectives:** The primary goal of this phase is to translate the foundational research and vision from Phase 1 into tangible design concepts.[24] This involves creating basic design proposals that define the project's overall shape, size, spatial organization, and fundamental functional relationships.[18] Multiple design options are typically explored to identify the most promising avenues for development.[25]
- **Activities:** This is a highly creative phase characterized by sketching, diagramming, and the development of 2D and 3D conceptual models.[23] Activities include exploring various massing strategies, site plan configurations, preliminary floor plans, and initial building elevations. Preliminary consideration is given to materials, structural approaches, and environmental strategies. These conceptual

options are presented to the client for feedback, often accompanied by rough order-of-magnitude cost estimates.[25]

- **"Mansarda" Application:**
  - *Maximizing Potential:* The "Mansarda" principle encourages the generation of diverse design options, exploring multiple "levels of ideas" within the conceptual "attic space" defined by the project vision and brief. This ensures a broad exploration of possibilities before committing to a single direction.
  - *Adaptability:* Conceptual sketches and models are intentionally fluid and iterative, allowing for rapid adaptation and refinement based on client feedback and emerging insights. This reflects the flexible and responsive nature often required in designing unique mansarda interiors.[7]
  - *Light & Perspective:* The use of various conceptual modeling techniques (physical models, digital renderings, diagrams) helps to bring "light" to different design possibilities, enabling the team and client to gain new perspectives on how the project requirements can be met.
- **TDBU Application:**
  - *Top-Down:* The overall massing studies, primary spatial organization, and fundamental functional relationships are guided by the architectural vision and program established in Phase 1. The initial "skeleton" [11] of the design begins to take tangible form, outlining key parameters and relationships.
  - *Bottom-Up:* Simultaneously, bottom-up exploration occurs through the conceptual design of specific programmatic elements, initial structural ideas, and direct responses to key site features or constraints. Experimentation with forms, materials, and spatial qualities at a conceptual level allows for innovation from the ground up.
  - *Iteration:* Multiple design concepts are developed and systematically evaluated against the vision, brief, and key performance criteria. Client feedback is integral to this iterative loop, leading to the refinement, combination, or selection of a preferred schematic design.
- **Key Deliverables:** A set of preliminary drawings including site plans, floor plans, key sections, and elevations; conceptual models or 3D renderings illustrating the design intent; an outline specification describing major systems and materials; and an updated preliminary cost estimate.[18]

Phase 3: Detailed Design and System Integration

(Corresponds to AIA Design Development & Construction Documents)

- **Objectives:** This phase focuses on refining the approved schematic design into a fully detailed and technically resolved architectural solution. All major design decisions are finalized, including material selections, structural systems, mechanical, electrical, and plumbing (MEP) systems, and the specification of all significant equipment, fixtures, and finishes.[18] The ultimate goal is to prepare a precise and comprehensive set of construction documents that will be used for permitting, bidding, and construction.[25]

- **Activities:** This phase involves the production of detailed architectural drawings (plans, sections, elevations, construction details), comprehensive specification writing, and close coordination with a team of consultants (structural engineers, MEP engineers, landscape architects, interior designers, etc.).[25] Value engineering exercises may be conducted to optimize cost without compromising quality or design intent. Building Information Modeling (BIM) typically plays a central role in this phase, facilitating coordination and clash detection between different building systems.[3] Cost estimates are refined to a greater level of accuracy.
- **"Mansarda" Application:**
    - *Multi-Level Integration:* The "double slope" metaphor of the mansard roof is highly relevant here. The "lower, steeper slope" represents the deep, detailed design of individual building systems (structural, MEP, envelope) and components (windows, doors, specific assemblies). The "gentler upper slope" symbolizes the critical integration of these diverse and complex systems into a cohesive, functional, and aesthetically unified whole. The "dormer windows" in this context are the critical interface points and details where different systems meet and must be resolved (e.g., where the façade system connects to the structure, or where MEP services penetrate building elements).
    - *Tailor-Made Solutions:* The resolution of complex interfaces and the achievement of specific performance criteria in detailed design often require custom, "tailor-made" solutions, much like the fitting out of a unique mansarda space.[7] Standard details may not suffice for innovative or highly integrated designs.
- **TDBU Application:**
    - *Top-Down:* The approved schematic design provides the essential framework and guiding principles for detailed development. System-level decisions (e.g., the overall structural strategy, primary MEP distribution routes, main building envelope performance criteria) are made to serve the overall design intent and functional program.
    - *Bottom-Up:* Intensive bottom-up design occurs in the detailing of individual components, assemblies, and junctions. Specific materials, products, and equipment are selected and specified based on performance, cost, and aesthetics. Technical challenges at a micro-level are identified and resolved by specialist consultants and designers.

    - *Iteration:* There is constant iterative feedback between component-level design and system-level integration. BIM plays a crucial role here, as clash detection routines [3] provide an automated bottom-up check of detailed models against the top-down architectural model and against each other, forcing reconciliation and refinement. For instance, an MEP engineer's detailed ductwork layout (bottom-up) is checked against the architect's ceiling height requirements and the structural engineer's beam locations (top-down).
- **Key Deliverables:** A complete set of fully detailed architectural, structural, and MEP drawings; a comprehensive specification book (often following CSI MasterFormat or similar standards); detailed interior design drawings and schedules; a final, detailed cost estimate; and all documents required for building permit applications.[18]

Phase 4: Implementation Strategy and Execution

(Corresponds to AIA Bidding/Negotiation & Construction Administration)

- **Objectives:** This phase encompasses the translation of the detailed design documents into a physical reality. Key objectives include selecting a qualified contractor through a bidding or negotiation process, effectively managing the construction process to ensure adherence to the contract documents (drawings and specifications), maintaining quality control, and managing project timelines and budgets.[18] It also involves defining and executing an appropriate technical strategy for producing the solution, considering buildability and resource allocation.[4]
- **Activities:** Activities include preparing bid packages, managing the tendering or negotiation process with contractors, and awarding the construction contract.[26] During construction, the architect's role typically involves regular site observation and supervision, responding to contractor Requests for Information (RFIs), reviewing material and shop drawing submittals, conducting quality inspections, certifying contractor payments, managing change orders, and overseeing project closeout procedures.[24] BIM is increasingly used for construction management, logistics planning, and as-built documentation.[3]
- **"Mansarda" Application:**
    - *Efficient Resource Utilization:* The "Mansarda" mindset is applied to construction planning and execution by seeking efficiencies in construction sequencing, material procurement and use, labor deployment, and waste management.
    - *Adaptability:* Construction sites often present unforeseen conditions or

challenges. The "Mansarda" principle of adaptability is crucial for effective on-site problem-solving, allowing for necessary adjustments without compromising the core design intent or quality.

- **TDBU Application:**
  - *Top-Down:* The comprehensive construction documents and the project schedule provide the overall top-down plan and quality standards for execution. The architect and project manager maintain oversight to ensure that the "big picture"—the design intent and specified quality—is realized throughout the construction process.
  - *Bottom-Up:* Contractors, subcontractors, and tradespeople bring specialized knowledge and skills to execute specific portions of the work and resolve on-the-ground technical issues. Their practical experience and feedback can lead to minor, iterative adjustments in detailing, sequencing, or means and methods, often communicated through RFIs or site discussions.
  - *Iteration:* The construction phase is inherently iterative. Regular site meetings, the RFI process, submittal reviews, and change order management are all mechanisms for iteration, facilitating the reconciliation of planned work with actual site conditions and resolving discrepancies or new requirements that emerge during construction.
- **Key Deliverables:** An executed construction contract, site observation reports, responses to RFIs, reviewed submittals, approved change orders, certificates of payment, a punch list identifying items for completion or correction, and final project closeout documentation including warranties and as-built drawings.[24]

Phase 5: Post-Occupancy Evaluation and Evolutionary Adaptation

- **Objectives:** This final phase, often occurring six months to a year after project completion and occupancy, is critical for assessing the actual performance of the building in use.[29] Key objectives are to gather feedback from building occupants and users, evaluate how well the design meets their needs and the original project goals, identify successes and any areas requiring improvement or adjustment, and capture valuable lessons learned for future projects.[29]
- **Activities:** POE activities typically include conducting user surveys and interviews, performing building performance monitoring (e.g., energy consumption, thermal comfort levels, lighting quality, acoustics), undertaking systematic walkthroughs and inspections, and comparing the findings against the pre-design goals and performance targets.[29]
- **"Mansarda" Application:**
  - *Maximizing Potential (Long-term):* The "Mansarda" principle extends to the building's operational life. POE findings are used to optimize the building's

ongoing use, functionality, and adaptability, ensuring it continues to provide maximum value to its occupants. The "habitable space" is understood to evolve with user needs and operational experience.
    - *Multi-Level Integration (Feedback):* Feedback from individual users and specific operational data (a "lower level" of detail) is integrated into a broader understanding of the overall building performance, design success, and strategic impact (an "upper level" of strategic insight).
- **TDBU Application:**
    - *Top-Down:* The POE evaluates whether the original top-down vision, project goals, and intended overall system performance were successfully achieved.
    - *Bottom-Up:* Detailed, bottom-up feedback is gathered on the performance of individual spaces, specific building components, user experiences with particular features, and any granular operational issues or unexpected successes.
    - *Iteration (Evolutionary):* POE findings inform potential minor modifications or operational adjustments to the existing building. Crucially, these findings provide an invaluable feedback loop into the firm's knowledge base, refining both top-down strategic approaches and bottom-up design solutions for future projects. This makes the entire Mansarda-Hybrid framework evolutionary, aligning with principles of continuous improvement seen in agile methodologies [16] and the concept of adaptive pressures shaping system evolution, such as those described for the AMAL language framework.[17] This POE phase closes the loop, transforming what might seem like a linear process into a cyclical, learning one, where each project informs the next.
- **Key Deliverables:** A comprehensive Post-Occupancy Evaluation Report detailing findings and analyses, specific recommendations for improvements or adjustments to the occupied building, updated building documentation if changes are made, and a "lessons learned" document to inform future design efforts.[29]

The phased implementation roadmap from "Greg's Digital Project Masterplan" [17], where personal goals are mapped to digital implementation tasks, offers a useful analogy for how architectural design tasks align with overall project phases, ensuring synergy between different scales of activity. Similarly, the concept of "Plausible Evolutionary Trajectories" from the AMAL framework [17] mirrors how architectural designs evolve through these phases, with POE feedback being a key driver for the evolution of design knowledge and practice. Even highly abstract frameworks, such as the "Reality Injection Protocol" described in the "Quantum Code" document [17]—with its stages of Intent Definition, Resource Allocation, Preparation, Transmission, Injection, Stabilization, and Monitoring—offer a conceptual parallel to the architectural lifecycle of Vision > Design > Construction > Occupancy > Evaluation, highlighting the universal pattern of translating intent into manifested reality through structured phases.

The integration of Building Information Modeling (BIM) throughout this lifecycle naturally supports the Mansarda-Hybrid framework. BIM provides a shared digital platform where top-down architectural models and bottom-up detailed component information (from various specialist consultants) can coexist, be visualized, coordinated, and checked for consistency through processes like automated clash detection.[3] This facilitates the iterative reconciliation crucial to the TDBU approach, making the interplay between vision and detail more transparent and manageable.

Table 3: Overview of the Mansarda-Hybrid Lifecycle Framework

Phase	Key Objectives	Primary Methodological Emphasis	"Mansarda" Application	Key Deliverables
1. Visioning & Contextual Foundation	Define success, high-level vision, stakeholder needs, goals, context; assess feasibility & readiness.[18]	Predominantly Top-Down (vision setting) with intensive Bottom-Up data gathering (contextual analysis).	Uncovering latent potential in brief/site; integrating aspirations with constraints.	Program of Requirements, Architecture Vision Document, Stakeholder Register, Initial Risk Assessment, Refined Project Brief.[18]
2. Conceptual & Schematic Development	Translate vision into basic design concepts (shape, size, function); explore multiple options; preliminary costing.[18]	Balanced TDBU Iteration: Top-Down "skeleton" guides Bottom-Up formal/spatial exploration.	Exploring diverse conceptual "levels" within vision; adapting concepts via feedback.	Preliminary drawings (plans, elevations), conceptual models/renderings, outline specifications, updated cost estimate.[18]
3. Detailed Design &	Refine design with full detail;	Predominantly Bottom-Up	Integrating detailed	Fully detailed drawings

System Integration	finalize materials, structure, MEP; coordinate consultants; prepare construction documents.[18]	detailing (components, systems) within an established Top-Down schematic framework.	systems (lower slope) within overall form (upper slope); tailor-made solutions for complex interfaces.	(architectural, structural, MEP), comprehensive specifications, final cost estimate, permit documents.[24]
4. Implementation Strategy & Execution	Select contractor; manage construction, quality, budget, schedule; ensure adherence to documents.[4]	Top-Down oversight (design intent, quality standards) with Bottom-Up execution (trades, on-site problem-solving).	Adapting to on-site realities efficiently; optimizing resource use during construction.	Executed contract, site reports, RFI responses, submittal reviews, change orders, payment certs, closeout docs.[24]
5. Post-Occupancy Evaluation & Evolutionary Adaptation	Assess building performance; gather user feedback; identify successes/improvements; capture lessons learned.[29]	Balanced TDBU evaluation: Top-Down assessment of goal achievement, Bottom-Up gathering of specific user/component feedback.	Optimizing long-term building use & adaptability; integrating user feedback for current/future projects.	POE Report, recommendations, updated documentation, lessons learned documentation.[29]

This lifecycle provides a comprehensive roadmap, ensuring that the architectural process is both structured and responsive, systematic and creative, from the earliest conceptual stages through to the building's long-term performance and evolution.

5. Integrating All Aspects: Cross-Cutting Considerations in the Framework

A truly holistic architectural framework must do more than just sequence activities; it must ensure the deep integration of numerous cross-cutting considerations throughout the entire design and implementation lifecycle. The Mansarda-Hybrid Framework is designed to achieve this not by treating these aspects as a mere checklist to be addressed at isolated points, but by fostering an environment where they become interdependent variables, continuously influencing and shaping each other. The "Mansarda" principle of maximizing potential is re-interpreted here as maximizing the *synergy* between these diverse considerations, aiming for designs that are more than the sum of their parts—where, for example, a structural system might also serve an aesthetic purpose and enhance natural ventilation, achieving functional, environmental, and visual integration simultaneously.

Effective integration requires a "common language" or shared understanding among diverse specialists (architects, engineers, consultants) and stakeholders (clients, users, community members). This is analogous to how the AMAL framework aims to be a "cognitive lingua franca" for AI modules, enabling seamless and semantically rich communication.[17] In architectural practice, Building Information Modeling (BIM) serves as a powerful practical platform for this shared understanding, allowing diverse data streams to coexist and be coordinated.[3] However, the Mansarda-Hybrid framework also emphasizes the crucial role of process: structured dialogue, collaborative decision-making workshops, and transparent information sharing at key junctures in each lifecycle phase.

The following subsections explore how key cross-cutting considerations are woven into the fabric of the Mansarda-Hybrid Framework:

- Functional, Aesthetic, and Experiential Dimensions:
  Functional requirements, identified during Phase 1 (Visioning and Contextual Foundation) through client briefing and user needs analysis, are not static. They are continuously refined and tested through the iterative TDBU design process in Phases 2 and 3. Bottom-up explorations of spatial arrangements or component functionalities feed back into the top-down understanding of how the overall building will operate. Aesthetic goals, also established conceptually in Phase 1 and developed through schematic design in Phase 2, are translated into tangible design elements—form, material, light, texture—during detailed design (Phase 3). The "Mansarda" principle encourages creative and resourceful solutions to achieve these aesthetic ambitions within given constraints. User experience (UX) is a paramount consideration, extending beyond mere functionality. It is informed by contextual analysis and stakeholder engagement from Phase 1, actively shaped during design development (e.g., circulation, wayfinding, comfort, psychological impact of space 2), and critically evaluated in Phase 5 (Post-Occupancy Evaluation). This ensures that spaces are not only efficient but also respond to human social, psychological, and sensory needs. The integration of UX, visual identity, and narrative cohesion, as detailed in planning for digital projects 17, finds a direct parallel in architectural design, where the building itself

should tell a coherent story and provide a positive experience.

- Structural, Material, and Technological Integration:
  The TDBU approach is particularly effective for integrating structural, material, and technological systems. Initial top-down structural concepts developed in Phase 2 are rigorously tested and refined in Phase 3 through bottom-up detailed analysis, considering specific material properties, connection details, and constructability. The "Mansarda" principle of efficient resource utilization can guide material selection towards sustainability, durability, and optimal performance, seeking value beyond just first cost. The integration of new technologies—whether advanced building systems, innovative materials, or digital fabrication techniques—is facilitated by the framework's iterative nature, allowing for bottom-up experiments and pilot studies within the context of the top-down vision. BIM is an indispensable tool in this regard, enabling the 3D modeling and coordination of complex structural and technological systems, ensuring they fit within the architectural design and function as intended.3
- Environmental, Social, and Economic Sustainability:
  These three pillars of sustainability are not add-ons but foundational to the Mansarda-Hybrid Framework. Environmental considerations—such as energy efficiency, water conservation, sustainable material sourcing, waste reduction, and ecological protection 1—are incorporated from the earliest stages (Phase 1: site analysis, climate analysis, sustainability goal setting) and are actively designed for and tracked throughout all subsequent phases. Social impact, including community engagement, accessibility, inclusivity, and the reflection of cultural values 2, is addressed through stakeholder participation in Phase 1 and translated into design responses that foster positive social interaction and well-being. Economic viability—encompassing initial budgeting, ongoing cost control, value engineering, and consideration of lifecycle costs 23—is managed iteratively. The "Mansarda" principle encourages the creation of long-term value and resource efficiency within defined economic constraints. Integrated construction approaches further support these goals by optimizing resource use and reducing waste.4
- Regulatory Compliance and Risk Management:
  Adherence to regulatory requirements, such as zoning ordinances, building codes, accessibility standards, and health and safety regulations 24, is a non-negotiable aspect. These are identified and documented in Phase 1 and systematically addressed in the design and construction documents developed in Phase 3. The detailed nature of Phase 3 ensures that all compliance issues are resolved before construction begins. Risk management is also an integral part of the framework. Potential risks (technical, financial, schedule-related, regulatory)

are identified as early as Phase 1 19 and are continuously monitored and mitigated throughout the project lifecycle. The iterative TDBU approach provides the flexibility to develop adaptive responses to emerging or unforeseen risks, enhancing project resilience.

The following table illustrates how these cross-cutting considerations are addressed across the different phases of the Mansarda-Hybrid lifecycle:

Table 4: Matrix of Cross-Cutting Considerations Across Mansarda-Hybrid Lifecycle Phases

Cross-Cutting Consideration	Phase 1: Visioning & Contextual Foundation	Phase 2: Conceptual & Schematic Development	Phase 3: Detailed Design & System Integration	Phase 4: Implementation Strategy & Execution	Phase 5: Post-Occupancy Evaluation & Evolutionary Adaptation
Functional Performance	Define user needs, space program, adjacencies.[18]	Test functional layouts, circulation, basic ergonomics.[24]	Detail all functional spaces, equipment integration, accessibility compliance.[25]	Verify functional installations, address operational queries during handover.	Assess actual functional effectiveness, user satisfaction with functionality, identify areas for operational improvement.[29]
Aesthetic Expression	Establish design vision, desired character, precedents.[19]	Explore form, massing, materials, overall visual language through sketches/mo	Refine all aesthetic details, material finishes, lighting design, landscape	Monitor aesthetic quality during construction, approve samples, ensure fidelity to	Evaluate long-term aesthetic impact, durability of finishes, user perception of design

		dels.[23]	integration.[25]	design intent.[25]	character.
User Experience (UX)	Identify target users, their needs, behaviors, and aspirations; map user journeys.[21]	Conceptualize spaces for comfort, wayfinding, engagement; test basic UX flows.[2]	Detail interior environments for psychological comfort, sensory experience, inclusivity; refine wayfinding systems.[2]	Observe initial user interactions, provide guidance on building use.	Gather detailed feedback on comfort, satisfaction, ease of use, overall experience; identify UX pain points and successes.[29]
Structural Integrity	Preliminary site assessment for structural implications (e.g., soil conditions).	Develop conceptual structural systems, explore options for load paths and stability.[24]	Engineer detailed structural design, specify materials, connections; coordinate with architectural design.[26]	Inspect structural work for compliance, review structural submittals, address site queries.[25]	Assess long-term structural performance, identify any settlement or material degradation issues.
Material Efficiency & Tech.	Identify locally available/sustainable materials; note existing tech infrastructure.[22]	Explore material palettes, conceptualize integration of key technologies.	Specify materials for performance/durability/sustainability; detail tech systems (BMS, AV, security).[3]	Verify material compliance, oversee technology installation and commissioning.[3]	Evaluate material durability, technological system performance, user satisfaction with tech.
Environmental Impact	Analyze site ecology, climate; set sustainability goals (e.g., energy	Integrate passive design strategies, explore renewable	Perform energy modeling, specify sustainable materials/sys	Monitor environmental compliance during construction	Measure actual energy/water use, assess indoor environment

	targets).[1]	energy options, conceptualize green infrastructure.[2]	tems, detail water conservation, waste management.[1]	(e.g., waste, erosion control), ensure sustainable practices are followed.[4]	al quality, compare against sustainability targets.[29]
Social Equity & Impact	Engage community stakeholders, identify social needs, cultural context; consider accessibility.[2]	Design for inclusivity, community interaction, cultural resonance.	Detail accessible routes, universal design features; ensure spaces support intended social programs.[2]	Ensure equitable access during construction (if applicable), manage community relations.	Assess building's impact on community, user diversity, social interaction patterns; identify opportunities for enhanced social value.
Economic Feasibility	Establish preliminary budget, explore funding, conduct initial cost/benefit analysis.[18]	Develop order-of-magnitude cost estimates for design options; value engineering concepts.[24]	Prepare detailed cost estimates, conduct rigorous value engineering, plan for lifecycle costs.[18]	Manage construction budget, review payment applications, control change orders, track costs.[28]	Analyze operational costs, maintenance expenses, compare with lifecycle cost projections; assess overall economic value delivered.
Regulatory Adherence	Identify applicable zoning, building codes, environmental	Ensure schematic design respects major regulatory constraints.	Prepare all documentation for permit applications, ensure full code compliance	Facilitate inspections, ensure all construction meets permitted documents	Verify ongoing compliance with operational permits or regulations.

	regulations.[24]		in detailed design.[24]	and regulatory standards.	
Risk Mitigation	Identify preliminary project risks (site, budget, schedule, approvals).[19]	Assess design-related risks in schematic options.	Analyze technical risks in detailed systems, develop mitigation strategies in specifications/drawings.	Manage construction risks (safety, delays, quality), respond to unforeseen site conditions proactively.[4]	Identify any emergent operational risks or liabilities.

By embedding these considerations within each phase and fostering their interplay, the Mansarda-Hybrid Framework aims to produce architecture that is not only well-designed in isolated aspects but is holistically successful, resilient, and responsive to the full spectrum of contemporary demands.

6. Conclusion: Building with Vision, Detail, and Adaptability

The Mansarda-Hybrid Framework, as delineated in this report, offers a synthesized approach to architectural design and planning, aiming to equip practitioners and theorists with a robust methodology for navigating the multifaceted demands of contemporary practice. It achieves this by intertwining the "Mansarda" principle—focused on maximizing potential, integrating diverse levels of engagement, and fostering adaptability—with an iterative Top-Down/Bottom-Up (TDBU) design process, all structured within a comprehensive five-phase lifecycle. This lifecycle spans from initial Visioning and Contextual Foundation, through Conceptual and Detailed Design, to Implementation and, crucially, Post-Occupancy Evaluation and Evolutionary Adaptation.

The key benefits of this integrated framework are manifold. It promotes architectural solutions that are more holistic, as diverse considerations (functional, aesthetic, technical, environmental, social, economic) are treated as interdependent variables rather than isolated checklist items. It leads to better-resolved designs by systematically balancing strategic oversight (top-down) with meticulous attention to detail and component-level innovation (bottom-up). The inherent adaptability, drawn from both the "Mansarda" metaphor and the iterative nature of the TDBU process, allows designs to respond effectively to emergent conditions and evolving requirements. Furthermore, by encouraging the exploration of latent potential and synergistic relationships between design aspects, the framework fosters innovation, pushing beyond conventional solutions. It cultivates a dynamic equilibrium between strategic foresight and pragmatic execution, between creative exploration and disciplined realization.

The broader implications of adopting such an integrated approach are significant. It can contribute to a higher quality built environment, one that is more responsive to user needs and societal aspirations. By embedding sustainability and resilience as core tenets, the framework supports the creation of buildings that are environmentally responsible and capable of adapting to future challenges, such as climate change and rapid urbanization. The emphasis on clear communication, collaborative decision-making, and stakeholder engagement can lead to projects that are better aligned with community values and client objectives, fostering greater trust and satisfaction. This is not merely a process model but a shift towards a mindset that values holistic thinking, opportunistic problem-solving, iterative refinement, and deep integration as fundamental to architectural excellence.

The Mansarda-Hybrid Framework can be viewed as a tool for the evolving architect, one who must increasingly act as an integrator of complex systems, a facilitator of diverse expertise, and a steward of environmental and social responsibility. The challenges facing the architectural profession are dynamic and growing; a static design process will prove inadequate. The framework's emphasis on adaptability and continuous learning, particularly through the critical feedback loop of Post-Occupancy Evaluation, positions it as a resilient methodology capable of evolving in response to new knowledge, technologies, and societal demands. This echoes the sentiment that effective plans are not rigid blueprints but flexible guides, launchpads for ongoing exploration and growth, as seen in well-structured personal or digital project masterplans.[17]

Ultimately, the Mansarda-Hybrid Framework aims to empower architects to be more effective and insightful authors of the built environment. It provides a structured yet flexible means to translate complex intentions, client aspirations, and societal needs—the "Implementation of Dreams" at a project scale [17]—into meaningful, well-executed, and enduring architectural realities. This journey, much like the "digital alchemy" that transforms personal experiences into shareable artifacts [17], is about giving tangible form to vision. By designing with a wide-angle lens for overarching strategy, a microscope for critical detail, and an unwavering commitment to maximizing the inherent potential of each unique project, architects can continue to shape a built world that is not only functional and beautiful but also profoundly resonant and responsible. The pursuit of such a framework, like the speculative design of advanced AI languages [17] or even reality-programming systems [17], reflects a fundamental drive to understand and master the processes of creation and manifestation, always guided by the imperative for wisdom and ethical stewardship in the face of transformative power.

Works cited

1. (PDF) From Traditional to Modern: Cultural Integration and Innovation in Sustainable Architectural Design Education - ResearchGate, accessed May 30, 2025, https://www.researchgate.net/publication/388342516_From_Traditional_to_Modern_Cultural_Integration_and_Innovation_in_Sustainable_Architectural_Design_Education
2. How Architecture Impacts Society: Influences on Culture, Economy, and Well-Being, accessed May 30, 2025, https://injarch.com/how-architecture-impacts-society/
3. Integrating Building Information Modelling (BIM) for Effective Construction Planning, Execution, and Lifecycle Management - ResearchGate, accessed May 30, 2025, https://www.researchgate.net/publication/388832694_Integrating_Building_Information_Modelling_BIM_for_Effective_Construction_Planning_Execution_and_Lifecycle_Management
4. Integrating Planning, Design, and Construction — The Canadian Approach, accessed May 30, 2025, https://www.studioforma.ca/integrated-construction/
5. en.wikipedia.org, accessed May 30, 2025, https://en.wikipedia.org/wiki/Mansard_roof#:~:text=A%20mansard%20or%20mansard%20roof,often%20punctured%20by%20dormer%20windows.
6. Mansard roof - Wikipedia, accessed May 30, 2025, https://en.wikipedia.org/wiki/Mansard_roof
7. Mansard style - Relax srl, accessed May 30, 2025, https://relaxsrl.com/en/products/environments/mansard-style/
8. Understanding Assembly Design: Top-Down vs Bottom-Up Modeling - NxRev, accessed May 30, 2025, https://nxrev.com/2025/02/top-down-vs-bottom-up-modeling/
9. Bottom Up / Top Down | BPMInstitute.org, accessed May 30, 2025, https://www.bpminstitute.org/resources/articles/bottom-top-down/
10. Mansarda SL - BAAM arhitekti, accessed May 30, 2025, https://baam.si/en/projekti/mansarda-sl/
11. What Is Top-Down Design and Why You Should Already Be Using It | PTC, accessed May 30, 2025, https://www.ptc.com/en/blogs/cad/what-is-top-down-design
12. Top-down and bottom-up design | EBSCO Research Starters, accessed May 30, 2025, https://www.ebsco.com/research-starters/engineering/top-down-and-bottom-up-design

13. Difference between Bottom-Up Model and Top-Down Model - GeeksforGeeks, accessed May 30, 2025, https://www.geeksforgeeks.org/difference-between-bottom-up-model-and-top-down-model/
14. System Design Strategy – Software Engineering | GeeksforGeeks, accessed May 30, 2025, https://www.geeksforgeeks.org/software-engineering-system-design-strategy/
15. Bottom-up Design Explained - Essensys Technology, accessed May 30, 2025, https://essensys.ro/2024/03/12/bottom-up-design-explained/
16. All about the Iterative Design Process | Smartsheet, accessed May 30, 2025, https://www.smartsheet.com/iterative-process-guide
17. Quantum Code: Reality Manifestation
18. Architectural Design 101 | ASD - Automated Systems Design, accessed May 30, 2025, https://www.asd-usa.com/blog/architectural-design-phases
19. Comprehensive Guide to Phase A: Architecture Vision in the ADM - Visual Paradigm TOGAF, accessed May 30, 2025, https://togaf.visual-paradigm.com/2025/03/06/comprehensive-guide-to-phase-a-architecture-vision-in-the-adm/
20. TOGAF Phase A - Architecture Vision - ALMBoK.com, accessed May 30, 2025, https://almbok.com/architecture/togaf/phase_a_-_architecture_vision
21. Contextual Design: Principles & Techniques | StudySmarter, accessed May 30, 2025, https://www.studysmarter.co.uk/explanations/architecture/architecture-theory/contextual-design/
22. Contextual Analysis: Architecture Importance | Vaia, accessed May 30, 2025, https://www.vaia.com/en-us/explanations/architecture/architectural-analysis/contextual-analysis/
23. Conceptual Design Phase: What It Is and What You Should Expect - BluEntCAD, accessed May 30, 2025, https://www.bluentcad.com/blog/conceptual-design-phase-forms-bedrock-for-architectural-documentation
24. Architectural Design Process | A Quick Guide (2025) - Novatr, accessed May 30, 2025, https://www.novatr.com/blog/architectural-design-process
25. Phases of an Architectural Design Project | Prime Architects, accessed May 30, 2025, https://prime-arch.com/phases-of-an-architectural-design-project/
26. 5 Key Architectural Design Phases Explained - Cedreo, accessed May 30, 2025, https://cedreo.com/blog/architectural-design-phases/
27. Identify Architecture Strategy – Disciplined Agile (DA) - Project Management Institute, accessed May 30, 2025, https://www.pmi.org/disciplined-agile/inception-goals/identify-initial-technical-strategy
28. The Top 9 Architecture Strategy Templates, accessed May 30, 2025, https://www.cascade.app/blog/the-top-9-architecture-strategy-templates
29. What are Post-Occupancy Evaluations | Neumann Monson Architects, accessed May 30, 2025, https://neumannmonson.com/blog/post-occupancy-evaluations

30. Post Occupancy Evaluations | WBDG - Whole Building Design Guide, accessed May 30, 2025, https://www.wbdg.org/resources/post-occupancy-evaluations