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Domino Proportions System: Structural, Functional, and Aesthetic Analysis in Modern Architecture

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ABSTRACT: Le Corbusier's Domino system, introduced in the early 20th century, marked a turning point in modern architecture by proposing a modular framework based on slender columns and reinforced concrete slabs. This structural innovation facilitated standardization, industrialization, and rapid construction, influencing landmark projects such as Villa Savoye and the Pessac housing complex, as well as later mass housing developments. Despite these advantages, limited research has critically examined the relevance of the Domino system in light of contemporary architectural and environmental standards. This study aims to evaluate the strengths and limitations of the Domino system within its historical context while exploring its potential adaptability to present-day needs. The research employs a descriptive approach to explain the system's conceptual features, an analytical approach to assess selected case studies, and a comparative approach to measure its performance against current architectural criteria. Data sources include scholarly literature, visual and graphical documentation, and environmental records, enabling both historical and technical analysis. Findings reveal that the Domino system significantly contributed to the rationalization of building processes and provided a foundation for prefabrication and modular construction. However, its emphasis on structural regularity often resulted in spatial monotony and insufficient responsiveness to cultural, climatic, and ecological factors. The study highlights the importance of integrating adaptive strategies, sustainable materials, and advanced technologies. Contemporary tools such as Building Information Modeling (BIM), parametric design, and modular prefabrication can reinterpret the Domino framework, ensuring flexibility, contextual sensitivity, and ecological performance. By bridging historical innovation with modern requirements, the Domino system demonstrates enduring relevance when reimagined through contemporary architectural practices.

Keywords: *Domino System, Structural Innovation, Open-Plan Architecture, Flexibility, Contemporary Architecture.*

INTRODUCTION

Modern architecture in the 20th century underwent significant changes aimed at optimizing construction processes and addressing social, economic, and cultural needs. One of the most important innovations of this era was the introduction of new structural systems that facilitated the rapid, cost-effective, and standardized production of buildings. The Domino system, introduced by Le Corbusier in the 1910s, was one such innovation. By eliminating load-bearing walls and utilizing columns and concrete slabs, this system created more opportunities for designing open floor plans, allowing architects to adjust interior spaces with fewer structural constraints. This paper analyzes the structural framework, geometric proportions, functional characteristics, and critiques of the Domino system. Additionally, several of Le Corbusier's projects that employed this system, such as Villa Savoye, the Unité d'Habitation, Maison Cook, and Villa Stein, will be examined.

Research questions: In what ways has the Domino system contributed to the standardization and industrialization of architectural design?

What are the inherent limitations of the Domino system in terms of spatial, environmental, and functional performance, and how can they be addressed?

How can the Domino framework be adapted or reinterpreted to meet contemporary architectural needs, sustainability

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requirements, and modern technological approaches?

Research Hypotheses: The Domino system appears to have significantly contributed to the standardization and industrialization of architecture.

It seems that the Domino system has limitations that require improvements to align with contemporary architecture.

Despite its notable advantages, such as construction speed and cost-efficiency, the Domino system requires updates to meet contemporary needs and integrate modern technologies. The research employs three approaches:

• Descriptive (explaining concepts, proportions, and features),
• Analytical (examining projects, identifying strengths and weaknesses, suggesting solutions), and
• Comparative (evaluating performance across projects).

Data collection includes:

• Library sources (books, articles, historical texts, and critiques by scholars like Curtis, Frampton, and Eisenman),
• Visual/graphical materials (images, diagrams, plans of Villa Savoye, Unité d'Habitation, and Maison Cook, with redesigned diagrams for analysis). (Fig 1)
• Field data (climatic and environmental conditions or recorded data).

The diagram below presents a visual representation of the research model, outlining the key variables and their relationships. (Fig 2)

Integrated Analytical Framework and Literature-Based Research Methodology

This research examines the Domino system in modern and contemporary architecture through case studies (Villa Savoye, Pessac housing, Villa Stein). It compares structural, functional, proportional, and aesthetic variations, using digital tools (AutoCAD, Rhino) for geometric and spatial analysis. Proportional systems (Fibonacci, golden ratio, Le Corbusier's grid, Modulor) are tested for contemporary adaptability. The study also examines the cultural and climatic influences on reinforced concrete and evaluates how Domino-based designs adapt to local traditions, social expectations, and environmental challenges.

The literature review reinforces the relevance of the Domino system as a pivotal response to the demands of industrialization and mass housing in the early 20th century. Scholars such as Curtis (1986) and Frampton (2020) acknowledge the system's role in construction efficiency, while Hartoonian's (2022) review underscores its lasting impact on architectural discourse. At the same time, critiques by Eisenman (1985) and Loos (1930) highlight the system's aesthetic minimalism and limited contextual sensitivity. These insights inform the study's approach to addressing the limitations of the Domino system by proposing adaptive strategies that incorporate sustainable materials, responsive design technologies, and culturally integrated spatial configurations. In conclusion, this integrated analytical methodology not only enables a comprehensive understanding of the Domino system's original intent and legacy but also provides a robust framework for its reinterpretation in the context of 21st-century architectural challenges.

Case Study Analysis Methodology

To thoroughly examine the selected projects, a combination of quantitative and qualitative methods has been utilized:

1. Quantitative Analysis:
- Measurement and calculation of geometric proportions in the projects.
- Evaluation of modular dimensions (e.g., 5×5 meters) and golden ratios in the plans.
- Comparison of structural dimensions across projects and analysis of standardization.

2. Qualitative Analysis:
- Identification of the advantages and disadvantages of the Domino system in terms of design, functionality, and climate.
- Examination of architects' perspectives on the projects (e.g., Adolf Loos's critiques of the excessive simplicity in design).

3.Analytical Tools:
- Charts and Diagrams: To illustrate structural, spatial, and

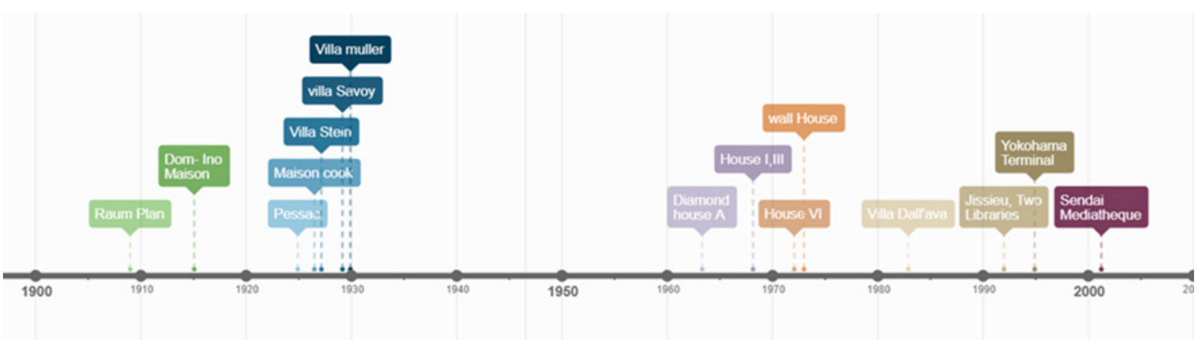

Fig. 1: Diagram of the timeline of the studied samples

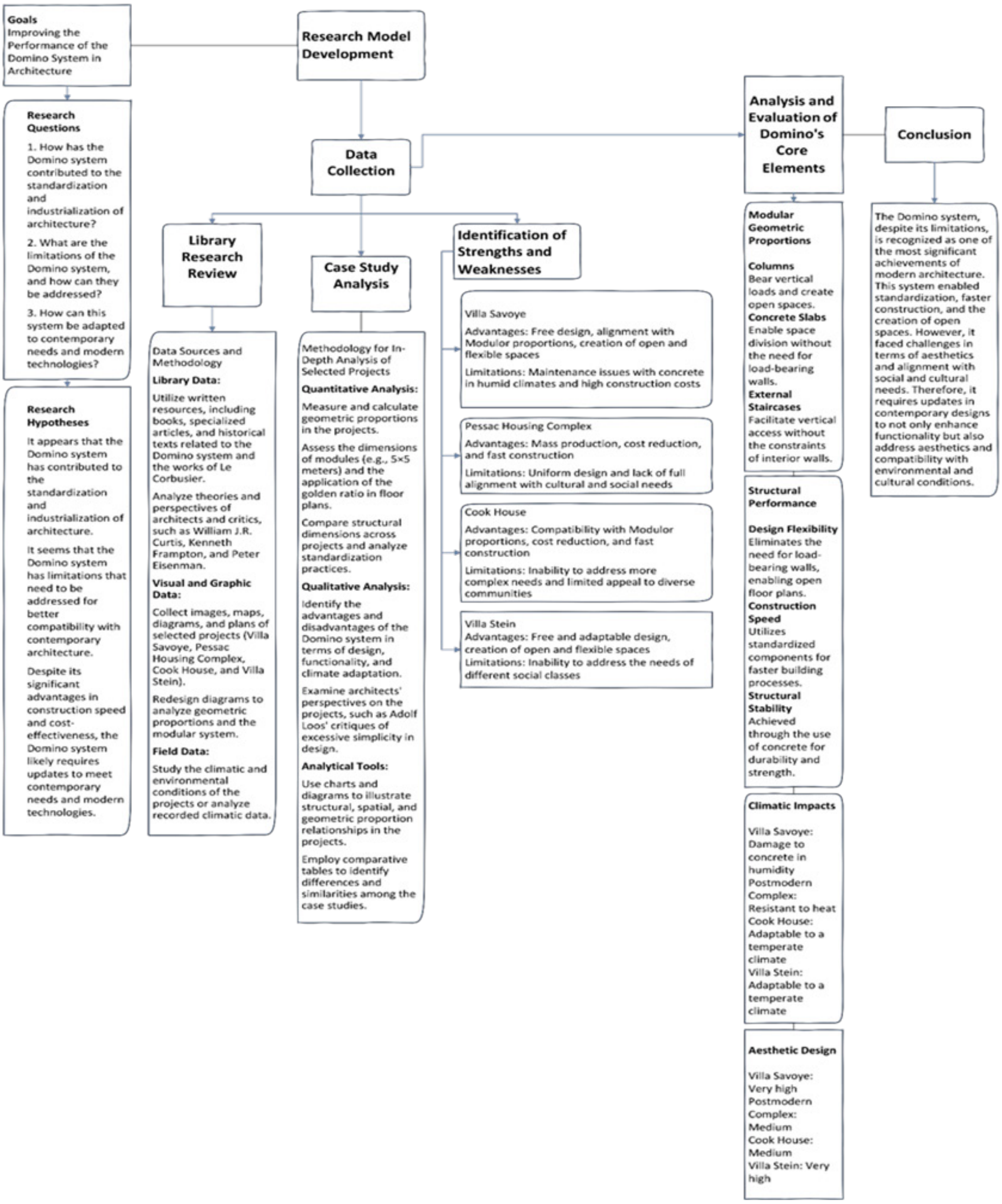

Fig. 2: Diagram of Representation of the Research Model

geometric proportion relationships in the projects.
- Comparative Tables: To identify differences and similarities among case studies.

Analysis of Key Concepts in the Domino System and Geometric Proportions

The Domino System represents one of the earliest attempts to establish modular design and standardization in architecture. This system is composed of three main elements:

1.Columns: These bear vertical loads and create open spaces.

2.Concrete Slabs: These allow for the division of spaces without relying on load-bearing walls.

3.External Staircases: These facilitate vertical access without the constraints of internal walls.

The Modulor System, introduced by Le Corbusier in 1945, is considered a complement to the Domino System. The Modulor is based on human body proportions and the Fibonacci sequence, aiming to harmonize aesthetics and functionality. (Colquhoun, 2002)

Le Corbusier employed the Modulor system to create rhythm and order in architectural spaces. For instance, in the Villa Savoye project (1929), the Domino System was combined with the Modulor. The dimensions of columns, openings, and interior spaces were designed in accordance with these principles. (Curtis, 1986)

The Domino System possesses the following characteristics:

• Flexibility in Plan Design: By eliminating load-bearing walls, designers can easily modify spaces.

• Speed of Construction: The use of standardized components reduces construction time.

• Structural Stability: The use of reinforced concrete and a skeletal system increases resistance to both horizontal and vertical loads.

However, the system also has its limitations:

• Aesthetic Constraints: The focus on functionality often resulted in designs with minimal ornamentation, which some critics found unattractive.

• High Costs at the Time: When introduced, reinforced concrete technology was still expensive, which limited its widespread adoption. (Huxtable, n.d.)

Geometric Rationalism and Proportional Systems in Le Corbusier's Domino Framework

Geometric thinking rooted in numerical logic has historically played a fundamental role in the architectural design process. Classical and modern architects alike have relied on numerical proportions, ratios, and geometric constructs to establish a sense of spatial order, balance, and harmony. The use of geometry is not merely a formal exercise, but a conceptual strategy that aligns human perception with architectural expression, reflecting a universal aesthetic grounded in mathematical clarity.

Le Corbusier's Proportional Framework: Golden Ratio and Guiding Lines

Le Corbusier's early design explorations were deeply informed by efforts to discover universal laws of visual harmony. Among his key tools were the Golden Ratio, vertical axes, and a system of guiding lines—which he classified into four categories:

Diagonal lines, Number-based lines, Self-regulating lines, Human dimensions

The Domino system (1914) introduced a reinforced concrete grid (2.5 × 5 m module) that freed walls from structural roles, enabling standardized design, efficient material use, and flexible spatial layouts. It promoted open-plan adaptability, allowing diverse interior configurations while preserving visual balance and proportional harmony. While celebrated

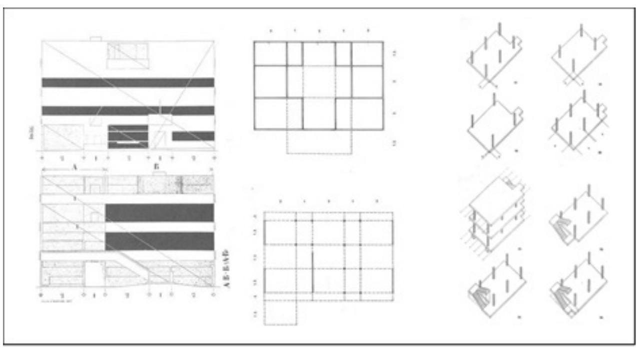

Fig. 3: Design of Free and Flexible Plans

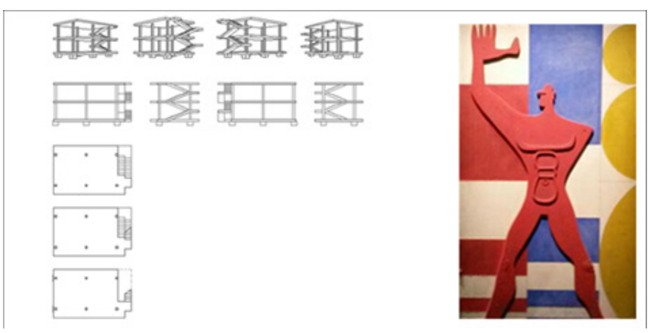

Fig. 4: Right, wooden template from 1954, related to the Modulor System, described by Le Corbusier as "a set of harmonious measurements, adapted to the human scale and universally applicable in architecture and mechanical objects."

for modular efficiency, the system has also faced technical and aesthetic criticisms, leading to proposals for improvement. The Domino System: Critical Perspectives, Architectural Debates, and Case-Based Reflections.

Technical and Functional Criticisms

Despite its recognized influence on the development of modern architecture, the Domino system has been the subject of sustained critique from both aesthetic and functional standpoints. Key architectural theorists and practitioners have raised concerns regarding the system's reductive formal language and its limitations in addressing complex design contexts. (Table 1)

Analysis of Critics and Reconciling Perspectives

Advantages from Le Corbusier's Perspective:

Le Corbusier regarded the Domino System as a revolutionary innovation in architectural design, combining the principles of functionality, construction speed, and geometric proportions (Le Corbusier, 1980).

Functional Criticisms:

• Kenneth Frampton highlighted the system's positive impact on architectural industrialization but also emphasized the climatic challenges associated with concrete (Frampton, 2022).

• Peter Eisenman criticized the system for its lack of flexibility in projects requiring complex designs (Eisenman, 1985).

Aesthetic Criticisms:

• Adolf Loos objected to the absence of ornamentation and the removal of human elements in the system (Loos, 1930).

• Some theorists argued that the focus on functionality diverted the design away from visual creativity (Eisenman, 1985).

Case Studies:

This section provides a detailed analysis of various Le Corbusier projects that utilized the Domino system, including Villa Savoye, Pessac Housing Complex, Cook House, and Villa Stein. These projects illustrate the impact of the Domino system on modern design.(Fig. 5, Table 2)

The Domino System as a Structural Method

Rooted in Viollet-le-Duc's idea that architectural form must respond to the needs of its era, Le Corbusier's Domino system (Dom-Ino, 1910, with Max Dubois at Peter Behrens's office) provided a pioneering structural framework for modern housing. It mechanized construction through the use of standardized reinforced concrete slabs and columns, enabling mass production, flexibility in façades, and open floor plans (Sung-Hyun & Chu-Kyu, 2004).

The system consists of 4×4 m slabs (10 cm thick) supported by six 30×30 cm columns, with cantilevers and staircases for circulation. Organized on a 3×5 grid of 2.5×2.5 m bays, it separates structural elements from walls, reinforcing the principle of the "free plan." By replacing I-beams with wooden molds and using flat two-way slabs and the "lost-tile" method, it reduced dead loads and concrete use, while showcasing the visual continuity of reinforced concrete (Le Corbusier, 1997, 226).

A reinterpretation of the Hennebique system (Fairbairn, 1892), it integrated pre-tensioned reinforcing bars and clay tiles to counter the tensile weaknesses of concrete, thereby speeding construction and improving economic efficiency in mass housing (Sung-Hyun & Chu-Kyu, 2004). The Domino system was applied in projects such as the Monol House (1919) and the Pessac Housing Complex (1925). Ultimately, it represents modern architecture's aspiration for rational structural form aligned with function, though design challenges emerged in free plans when slabs and cantilevered beams complicated

Table 1: Strengths and Limitations of the Domino System

Strengths	Limitations
Standardization and Mass Production: Reduced construction time and costs (Rowe, 1976).	**Limited Design of Complex Forms**: The structure is confined to a grid of columns and slabs (Curtis, 1986).
:Flexibility in Plan Design Removal of load-bearing walls creates an open spaces (Le Corbusier, 1980).	:**Performance in Specific Climates** Concrete requires more maintenance in harsh climates (Frampton, 1980).
:Structural Reinforcement Reinforced concrete provides stability and durability (Curtis, 1986).	:**High Costs at Introduction** Reinforced concrete technology and Formwork was expensive at the time (Eisenman, 1985).
:The Modulor A harmonious measure to the human scale universally applicable to architecture and mechanics (P. de Francia & A. Bostock, Trans.). Harvard University Press. (Original work published 1948; Le Corbusier, 1948).	:**Emphasis on Function Over Aesthetics** Simplification of forms sometimes leads to unattractive designs (Loos, 1930).

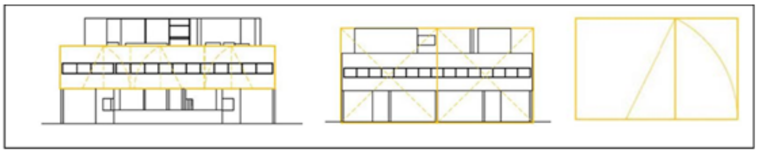

Fig. 5: Golden Rectangle, Rectangles of the North and Southeast Facades of Villa Savoye (Source: Grimley, n.d.).

Table 2: Swat Table - Review of Studied Samples

project	Features	Advantages	Limitations
Villa Savoye *(1929, France, Poissy)* 	A combination of Modulor proportions with the Domino system, flexible design, and creation of fluid spaces.	Freedom in open-plan design, harmony with geometric proportions.	Issues with concrete in humid climates, high construction and maintenance costs.
Pessac Housing Complex *(1925, France, Pessac)* 	Economic design and use of simple modules for mass production.	Cost reduction and construction speed, optimal use of the Domino system for workers' housing.	Uniform design, lack of visual appeal, and unintended modifications by residents.
Cook House *(1926, France, Boulogne-Billancourt)* 	5x5 module, open façade.	Compatibility with Modulor proportions, cost reduction, and construction speed.	Inability to meet more complex needs and limited appeal to diverse communities.
Villa Stein-de Monzie *(1927, France, Garches)* 	Concrete pilotis (supports), open plan, ribbon windows, use of simple materials, and natural light.	Natural light, proper ventilation, efficient space utilization, simple design, and close connection with the environment.	High construction costs.

curved wall compositions.

Analyzing the Proportional System of the Dom-Ino House Based on a Grid Form (Advanced Case Study Analysis)

The proportional system of the Dom-Ino House, based on a grid form, was developed in alignment with Le Corbusier's modular and geometric principles. This system enables architects to create efficient and flexible spaces that adapt seamlessly to users' needs. By utilizing this grid-based form, it becomes possible to design and construct high-quality, cost-effective modern housing. Through the maintenance of specific width-to-height ratios and the regular repetition of the Domino frame structure, a grid is established for the plan. Houses such as Cittrohan, Pessac, and Cook serve as examples of residences that employed cantilevered slabs, demonstrating the system's practical application in modern architecture.

Villa Savoye (1929, Poissy, France)

Villa Savoye belongs to the fourth type of residential composition, with its exterior appearing as a pure framework accommodating various functions, while the interior reveals the structural framework. The house represents interconnected volumes. (Fig. 6)

In Villa Savoye's design evolution (1928), the external staircase was replaced by an internal ramp, and column spacing was reduced from 5 to 4.75 meters. The structure is organized on a 4.75 × 4.75 m orthogonal grid, with circular and"= "-shaped columns on the ground floor for car and pedestrian access, and square columns on the upper floors. Villa Savoye exemplifies Le Corbusier's Five Points of Architecture: horizontal windows for light, ventilation, and views; a rooftop garden as a multifunctional, light-filled space (Fig. 7); An open plan enabled by pilotis; and reinforced concrete columns (pilotis) that free the walls from structural roles, allowing flexible layouts and modern aesthetics.

Modular Design and Spatial Organization of Villa Savoye

In Villa Savoye, a 1.25-meter module—one-quarter of the 5-meter Dom-Ino base—governs the design of canopies, windows, and the rooftop garden, forming the building's modular grid. The plan also incorporates a 4.75-meter module in the entry spacing, with columns and the sloped entry arranged in a proportional ABCBA pattern (1.25 m base units: 4, 3, 2, 3, 4), reinforcing the Domino system's modular principles.

Evolution of the Structural System

The final design's 4.75-meter spacing was adjusted during the design phase for cost considerations. The vertical column system evolved from 5 rows and five columns with a 5-meter spacing to 4 rows and 4 columns with a 5-meter spacing, and finally to 4 rows and 5 columns with a 4.75-meter spacing. The plan is contained within a balanced cubic form resembling a box, where partition walls are used to divide spaces as needed, creating an open-plan layout. A sloped ramp located at the center of the plan separates the left and right spaces into primary and auxiliary areas, serving as a vertical boundary that distinguishes the upper and lower floors. (Fig. 8-9)

Functional Zoning

• Ground Floor: This level features the garage, laundry room, and management office.

• Second Floor: Houses bedrooms, the kitchen, and the reception area.

• Third Floor: Dedicated to the rooftop garden, featuring screen walls for privacy and shade. (Mehmeti, 2014)

Villa Savoye is fundamentally constructed from geometric shapes and proportions. Geometrically, the villa is composed of circles and rectangles, while in terms of proportions, it utilizes golden rectangles and square roots (root proportions). (Grimley, n.d.)

Pessac Housing Complex (1925, Pessac, France)

Cité Frugès de Pessac (1924, Pessac, France) is a workers' housing project designed by Le Corbusier and Pierre Jeanneret, commissioned by Henri Frugès. It served as a laboratory for Le Corbusier's ideas from Vers une Architecture (1922) and

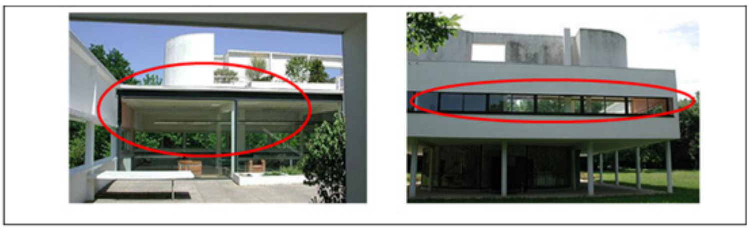

Fig 6: Villa Savoye - Panoramic Windows and Green Roof

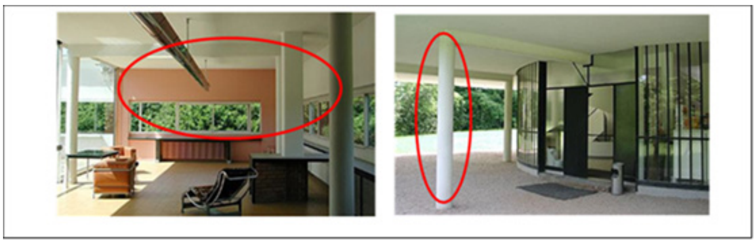

Fig 7: Villa Savoye - Pilotis Columns and Open Plan

marked his first attempt at affordable, mass-produced collective housing.(Le Corbusier, 1987).

Le Corbusier's urban vision—typified by his seminal work The City of Tomorrow (Le Corbusier, 1987/1929)—continues to shape architectural discourse. Recent quantitative and qualitative analysis by Rodríguez-Lora et al. (2021) reveals that his inner-city proposals extend well beyond the conventional paradigm of Plan Voisin, underscoring their conceptual diversity and evolution.

Modular Design Approach

The homes were designed using a modular system with standardized components, producing six styles—including single-family, duplexes, three-story "skyscrapers," zig-zag, and arcaded layouts. Each unit featured private gardens, garages, kitchens, and bathrooms, which were innovative for Bordeaux at the time. The complex displayed a multi-colored scheme, with walls painted differently based on their orientation. (Fig 10- 11)

The Pessac houses were designed using 5-meter reinforced concrete beams and a 5-meter main module, with side spaces and stairwells organized on a 2.5-meter grid, creating a 1:2 ratio. Standardized cells based on these modules were repeated and connected to form the layout of the residential complex, reflecting the principles of the Dom-Ino system. (Table 2)

In 1929, the famous historian Henry-Russell Hitchcock described the Pessac project as "a serious disappointment." He attributed his criticism to the small size of the rooms and rooftop gardens, which he felt were more suitable for the upper class than for factory workers. (Shih, 2002, 78)

Over time, many residents altered their homes, including removing windows, closing off rooftop terraces, and adding garage doors. These modifications led some architectural critics in later years to evaluate the project as a failure.(Le Corbusier, 1980)

The Cook House (1926, France, Danfer-Rochereau)

The Cook House, designed by Le Corbusier in 1926, was built in Boulogne-sur-Seine, Paris, for American journalist William E. Cook and his wife Jean. This house is Le Corbusier's first project to showcase his five principles of modern architecture: (Fig. 12)

1. Pilotis: Columns that support the structure without the need for large load-bearing walls.
2. Free Plan: Since the pilotis support the structure, the façade can be designed freely, including more openings.
3. Flexible Design: The distribution of spaces on each floor can be entirely different, as the walls serve only as partitions and do not bear any load. The only fixed elements between floors are the pilotis.
4. Ribbon Windows: Large openings in the façade to allow natural light and proper ventilation.

Clearly, the five points of modern architecture proposed by Le Corbusier—rooftop gardens, free plan, free façade, panoramic windows, and pilotis—are implemented in this design. The structural elements inside the house are designed with the 5-meter by 5-meter module, featuring 1-meter projecting cantilevers. (Table 5)

Green Roof

One of the prominent features of Le Corbusier's works is the permanent presence of nature in his architecture. He believed in

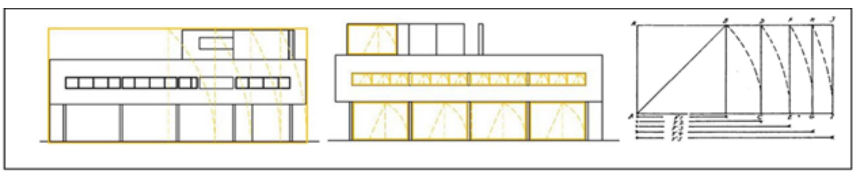

Fig. 8: Form and Structural System of Villa Savoye (Source: Grimley, n.d.)

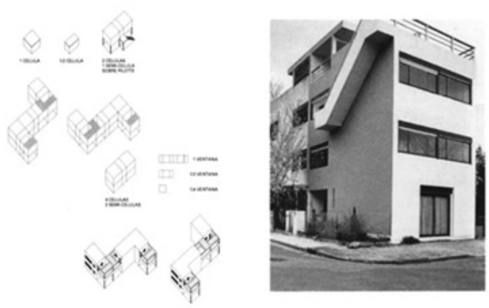

Fig. 9: Conceptual Designs of the Project

Table 3: Analysis of Project Components

Analysis Project	Features	Advantages	Limitations	Cultural Challenges	Climatic Features
Use of Modulor Proportions: This project uses golden geometric proportions to determine the dimensions of the columns, their spacing, and the internal ramp. The open plan and horizontal lines demonstrate the alignment of architectural geometry with the human body.	Use of the Modulor system, open and flexible plan, roof gardens, pilotis, and horizontal windows.	Open design, alignment with Modulor proportions, and creation of open and flexible spaces.	Maintenance issues with concrete in humid climates and high construction costs.	Villa Savoye, unlike economic projects, was designed for the wealthy class. As a result, financial constraints and social issues did not impose limitations on its design.	Reinforced concrete in the humid climate of Poissy has suffered significant damage, resulting in increased maintenance costs.

the concept of the vertical city and argued that the green space lost due to construction should be compensated for in some way; this compensation was achieved by creating a garden on the roof. (Fig 13)

Explanation of Le Corbusier's Formal Theory

Le Corbusier's Cook House (1926-1927) reflects his formal theory closely tied to his experience in painting, particularly Purism. The design features a nearly cubic square plan with a central cylindrical pilotis and continuous ribbon windows that emphasize symmetry. Reinforced concrete enables varied spatial qualities through curved walls that capture light and evoke shapes from his paintings. The house clearly demonstrates Le Corbusier's five architectural principles: pilotis that lift the structure, a free façade with ribbon windows, a free plan enhanced by curved walls, and a roof garden that replaces lost greenery. The central vertical access divides the interior into main and secondary spaces, while the combination of structural frame and load-bearing walls maintains the Dom-Ino grid. Using local materials, such as stone, reflects

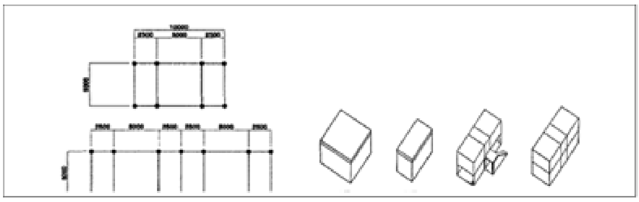

Fig. 10: Conceptual Designs of the Project

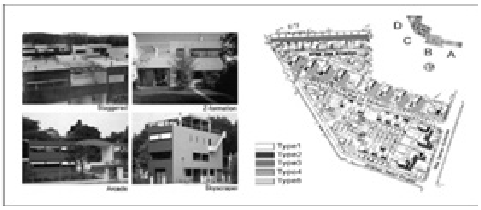

Fig. 11: Spatial Arrangement of Five Housing Types

Table 4: Analysis of Project Components

Project Analysis	Features	Advantages	Limitations	Cultural Challenges	Climatic Features
Focus on Modulor Modules: Use of a plan with a 1:2 ratio, standard components, and the formation of individual units.	Economic Standardization: This project is a successful example of standardization and cost reduction. The modular design enabled the completion of the complex in a short period of time.	Mass production, cost reduction, and construction speed.	The lack of variety in the design of residential units led to criticism of the initial design.	Uniform design and incomplete alignment with cultural and social needs.	Concrete, due to its good heat resistance, was suitable for this climate.

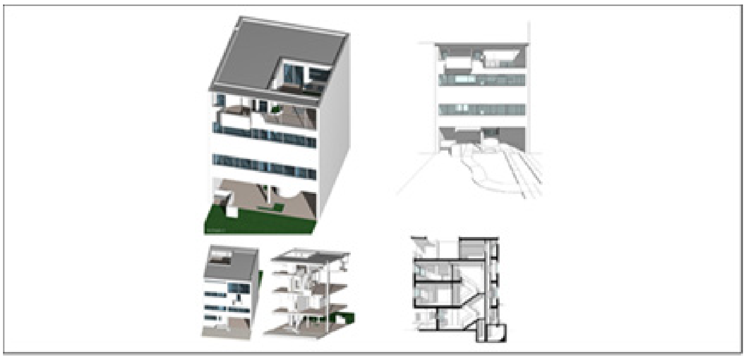
Fig. 12: Form and Modular Structural System of the Cook House

Table 5: Analysis of Project Components

Project Analysis	Features	Advantages	Limitations	Cultural Challenges	Climatic Features
Focus on Modulor Modules: The use of 5x5 meter modules and horizontal windows in this project demonstrates the complete integration of the Domino system with Modulor proportions.	Use of 5x5 meter modules and a simple yet functional design.	Compatibility with Modulor proportions. Cost reduction and construction speed.	Failure to meet more complex needs. Limited appeal for diverse communities.	A simple and functional design may be less appealing to communities with a more complex lifestyle.	This project in Dazur, France, with a temperate climate, was well-suited to reinforced concrete materials.

regional character and supports economical construction. The Cook House represents a transitional phase from a pure to a combined structural system. (Fig 14)

Villa Stein-Garches (1927, France, Garches)

Le Corbusier's Villa Stein (1927) is a key example of modern architecture, designed for an affluent family. It features open interior spaces and modern elements, such as free plans and pilotis, reflecting the changes in social living. The villa's design takes into account the local temperate climate, utilizing ribbon windows to admit natural light and ventilation, along with flat roofs and open surroundings to promote air circulation and minimize reliance on mechanical systems. This highlights Le Corbusier's emphasis on harmonizing architecture with its surroundings. (Fig 15)

In the design of Villa Stein-Garches, Le Corbusier created a rhythmic, repetitive layout using the ABABA arrangement and maintaining a ratio of 2:1:2:1:2, which aligns with a depth ratio of 2:2:1.5. When the grid structure is formed based on initial ratios such as 1 and 2 (for example, 2:1:2:1:2), the form of the plan approaches the golden ratio of 3:5. This principle, in alignment with the basic modules of the 1945 modular system, demonstrates the continuity and influence of the Dom-Ino system as a transitional phase for modular architecture. (Fig 16-17)

Therefore, the structural modules of the Dom-Ino system and their proportions serve as a foundation and precursor for the modular system, aligning with the principles of modular design that take human dimensions into account.

The Dom-Ino system, utilizing a number-one-based proportion, guided the architectural form and rhythm in Le Corbusier's late-1920s residences. Features like balconies and staircases utilized variable Dom-Ino modules, forming the basis for the Modulor system, which served both as a structural framework and a form-generating tool for rational construction. Other similar examples of this type include the Minimum Housing design (1926) and the Stuttgart House (1927).

In this section, a comparison (Table 6) of Domino-based projects is presented, including social, climate, and cultural impacts, as well as aesthetic appeal. The results of comparing the studied projects show in Table 6.

RESULTS AND DISCUSSIONS

A comparison of Domino-based projects reveals that modular design enhances construction speed and reduces costs; however, an excessive focus on functionality can result in

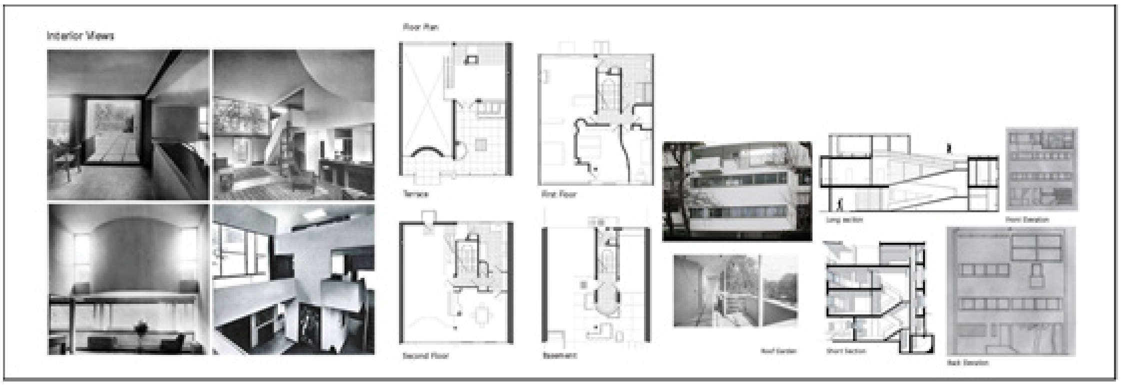

Fig. 13: Plan and Elevation of the Cook House

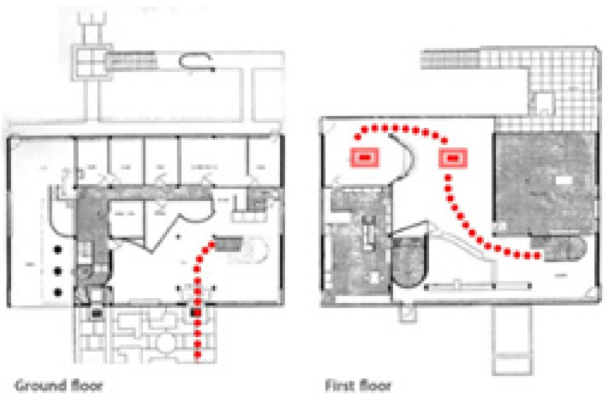

Fig. 14: Form and Structural System of the Villa

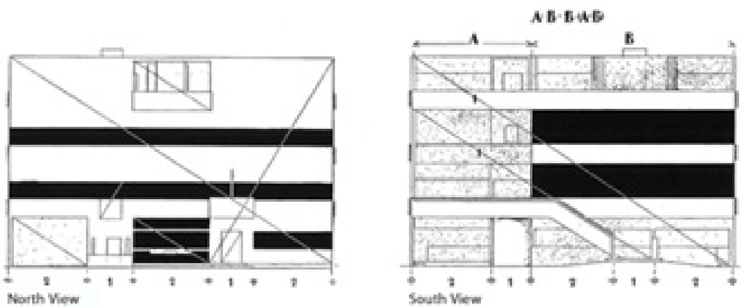

Fig. 15: Form and Structural System of the Villa

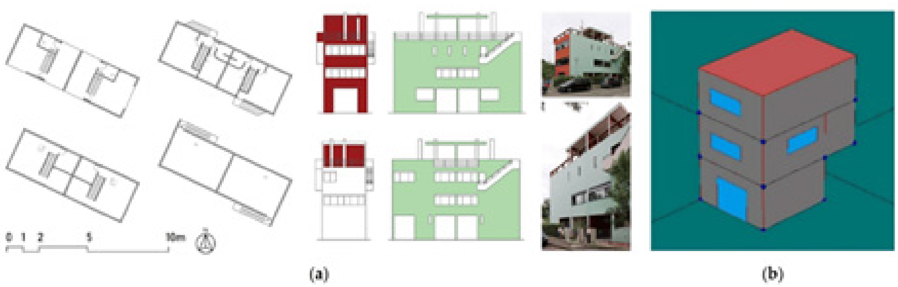

Fig. 16: a) Plans, Sections, and Photos of the Garches Villa b) Computer Model

aesthetic uniformity. Additionally, local adaptation is necessary to address cultural and climatic conditions, as seen in projects like Pessac. (Table 7)

Analysis of Table 8: Structural System (Table 8)

Most of the buildings utilized the Dom-Ino system, which is based on a concrete skeleton. However, in some buildings, such as Villa Garche, a combination of load-bearing walls and concrete framing was used. The proportions in each building are expressed through a specific formula, demonstrating how the various dimensions of the building are interrelated. Factors such as the size of components, the presence of stairs, balconies, and ramps have influenced the proportions of the buildings.

The modified Dom-Ino House employs proportional systems—such as the 5-meter base module, 1.25-meter openings, and the golden ratio (20 × 12.5 m = 1:1.6)—to define main spaces, service areas, and establish a structural order. Examples like Villa Stein and Villa Savoye demonstrate flexible adaptations, with rhythmic plans and functional arrangements. (Table 9) Villa Stein (1927) exemplifies this approach, utilizing a pure framework with columns spaced at 5 m and 2.5 m intervals to organize all functions. (Sung-hyun & Chu-Kyu, 2004)

The Relationship Between the Dom-Ino System and the Modulor System

Applying proportions and harmony in architectural design ensures balance, constructability, and economic efficiency. Accurate proportions guide both early concept development and later façade organization, allowing the plan's grid to extend seamlessly and enhance spatial coherence and form perception.

The Relationship Between Structural Module Proportions and Spatial Composition

The Dom-Ino system employs a 1:2 ratio to separate primary and secondary spaces, freeing walls from their structural roles to allow for open, flexible layouts. It provides a modular framework that organizes functional zones, optimizes circulation, and improves space efficiency and user experience. (Sung-Hyun & Chu-Kyu, 2004)

Discussion

The Dom-Ino system pioneered modernist architecture by promoting open, flexible spaces, structural rationalism, and standardized construction methods, though it faced challenges in aesthetics and cultural adaptability. While recognized as a major architectural achievement, its limitations include

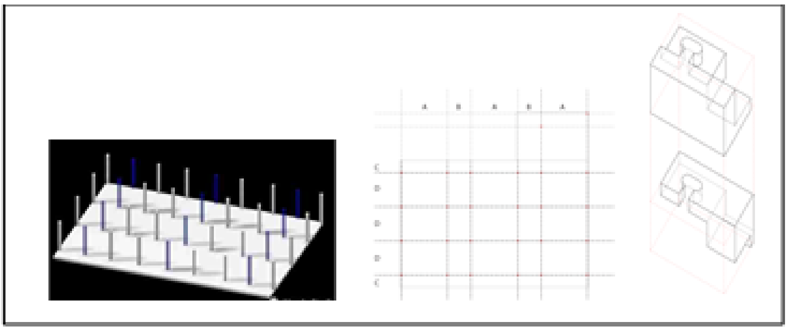

Fig. 17: Diagram of Hidden Relationship 2:1:2:1:2 in the Plan of Villa Stein

Table 6: Comparison of Social, Climatic, and Aesthetic Impacts

Project	Social Impacts	Climatic Impacts	Cultural Impacts	Aesthetic Appeal
Villa Savoye	Limited to the wealthy class	Concrete damage in humidity	Appealing to modern European culture	Very High
Pessac Housing Complex	Provision of affordable housing	Resistant to heat	Incomplete alignment with cultural needs	Medium
Cook House	Economic design	Suitable for a temperate climate	Simple and adaptable	Medium
Villa Stein-de Monzie	Economic design	Suitable for a temperate climate	Addressing the needs of the bourgeois class	Very High

Table 7: Comparison of Domino System-Based Projects in Terms of Goals, Features, Benefits, and Limitations

Projects	Design Goals	Features	Advantages	Limitations
Villa Savoye (1929)	Integration of Functionality, Aesthetics, and Spatial Fluidity	Free-Standing Columns Concrete Slabs Internal Ramp	Open Spaces Harmonious Proportions Golden Ratio	High Cost Concrete Maintenance
Pessac Housing Complex (1925)	Affordable Housing Mass Construction	Standard Module Simple Concrete Columns and Slabs	Cost Reduction Construction Speed	Repetitive Design Cultural Incompatibility
Cook House (1926)	Economic Design Aesthetics, Simplicity	5x5 Module Open Façade	Modular Compatibility Construction Speed	Uniform Form Lack of Functional Diversity
Villa Stein-de Monzie (1927)	A Modern, Simple, and Efficient Home for a Wealthy Family	Concrete Piloti (Pilotis) Open Floor Plan Strip Windows Use of Simple Materials and Natural Light	Natural Light Proper Ventilation Optimal Use of Space and Simplicity in Design Close Connection with the Environment	High Construction Cost

Table 8: Structural System and Proportions of Standard Dom-Ino Houses

Building	Structural System	Proportions
Villa Savoye (1929, France, Poissy)	Dom-Ino	ABCBA
Pessac Housing Complex (1925, France, Pessac)	Load-Bearing Wall + Dom-Ino (Concrete Frame)	Module 2.5x5 meters, Aspect Ratio 1:2
Cook House (1926, France, Boulogne-Billancourt)	Load-Bearing Wall + Dom-Ino (Concrete Skeleton)	Module 5x5 meters, Aspect Ratio 1:2
Villa Stein-de Monzie (1927, France, Garches)	Load-Bearing Wall + Dom-Ino (Concrete Structure)	ABABAX(a+CCC+a)

Table 9: Structural System and Proportions of Modified Dom-Ino Houses

Building	Structural System	Proportions	Factors Influencing Change
Villa Stein-de Monzie (1927, France, Garches)	Load-Bearing Wall + Dom-Ino (Concrete Frame Structure)	ABABAX(a+CCC+a)	Plot Size Balcony
Villa Savoye (1929, France, Poissy)	Dom-Ino (Concrete Frame Structure)	ABCBA	Ramp (Gentle Slope)

formal simplicity, high costs, and weak responsiveness to diverse contexts. To ensure contemporary relevance, proposed improvements include: adopting sustainable materials, integrating cultural and social diversity, using advanced digital technologies, and redefining aesthetic principles. Ultimately, its future lies in striking a balance between functional rationality, innovation, sustainability, and contextual sensitivity.

CONCLUSION

The Domino system has been a fundamental innovation in modern architecture, facilitating the standardization and industrialization of building design. By introducing a modular framework with reinforced concrete slabs and independent vertical supports, it allowed for mass production and simplified construction processes. This rational approach laid the groundwork for prefabrication and large-scale housing developments, profoundly influencing 20th-century architecture.

However, while the Domino system promoted openness and modularity, it also exposed certain limitations. Its structural regularity often resulted in spatial monotony and an inadequate response to environmental, cultural, and energy contexts. Recognizing these limitations underscores the need to integrate adaptive design strategies, sustainable materials, and responsive technologies to enhance its ecological and cultural relevance.

Looking ahead, the Domino framework can be reinterpreted using contemporary tools such as Building Information Modeling (BIM), parametric design, and modular prefabrication. These techniques offer flexibility and customization within standardized systems, bridging the divide between efficiency and contextual sensitivity.

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AUTHOR CONTRIBUTIONS

F. Jansetan performed the literature review, collected and analyzed the data, and prepared the initial draft of the manuscript. Prof. Dr. S. Dashtgard conceptualized and supervised the research, contributed to data interpretation, and critically revised the manuscript for intellectual content. Both authors approved the final version of the manuscript.

CONFLICT OF INTERESt

The authors declared no potential conflicts of interest concerning this article's research, authorship, and publication.

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