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Original Article

Exploring the Metamorphosis of Building Facade Elements: A Comprehensive Study of Gopalasamudram Agraharam in Tirunelveli District through Qualitative and Quantitative Analysis

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Abstract *- Urbanization is a global phenomenon that has evolved profound changes, fostering growth and development whereas circumstantial posing challenges to historical areas and heritage values. This research delves into the intricate dynamics of "Transformations of Building Facade Elements of a Traditional Streetscape," with a specific focus on the "Gopalasamudram Agraharam in Tirunelveli district". Employing a combined methodological approach confluent the qualitative and quantitative surveys as well as analysis. This study systematically observes the transformation of building facade elements over distinct historical periods, encompassing post-independence, modern, and late modern eras, on a qualitative basis. Generally, architecture has highlighted six crucial categories, namely facade planning, elements, materials, color, design principles, and iconography, as pivotal contributors to the sustenance of traditional identity. To empirically assess these factors, a well-structured questionnaire serves as a quantitative measuring scale, examining the significant correlation between factors affecting the sustenance of traditional identity in Gopalasamudram Agraharam of Tirunelveli district using Pearson Correlation and Multiple regression. Based on the hypotheses testing, this study reveals a positive association between building facade transformation factors and the sustenance of traditional identity. However, the results conclusively prove that Facade planning, color, materials and principles factors have a crucial impact on the sustenance of traditional identity with the exception of Facade iconography and facade elements/details factor. Hence, the case study of Gopalasamudram Agraharam at Tirunelveli not only contributes to the understanding of facade element transformations but also provides valuable insights into the delicate balance between architectural transformations and the preservation of traditional identity.*

Keywords *- Tirunelveli, Agraharam street, Traditional identity, Heritage, Building facade transformations, Pearson correlation, Multiple regression.*

1. Introduction

Facades serve as the public face of architecture, encapsulating the essence of a building's exterior while providing a functional and aesthetically pleasing enclosure [1]. They wield significant influence in shaping a building's cultural identity and contribute to the evolving landscape of urban aesthetics. Comprising distinct zones-base, middle, and roof-building facades are not merely structural elements but symbolic representations of historical, environmental, socioeconomic, and technological contexts [2].

Designing a building facade entails a multifaceted consideration of durability, weather resistance, maintenance needs, aesthetic appeal, and harmonious integration with the surrounding urban fabric [3]. As the external "skin" of a structure, the facade holds a dual role, serving both functional and symbolic purposes. Preservation of historical facades underscores the significance of architectural heritage, contributing to the cultural prestige of districts.

Scholars examining visual analysis delve into the diverse factors influencing house facade design within urban contexts. The literature review aims to delineate these factors, encompassing climatic considerations, site-specific attributes, construction materials and cultural influences [4]. Houses, as cultural artifacts, reflect societal norms, embodying remnants of past cultures. Cultural identity, expressed through architecture, manifests in unique architectural features that communicate a sense of place and time [5].

The rapid pace of urbanization poses challenges to preserving heritage towns, including their unique architectural and cultural heritage [6]. Historical towns face the threat of

architectural discontinuity and loss of historical coherence due to urban development pressures [7]. The transformation of traditional house facades in Tirunelveli district necessitates a delicate balance between heritage preservation and modern adaptation during the period of post-independence, modern and late modern. This study focuses on the sustenance of traditional identity while maintaining its elements with authentic aesthetic appeal, exemplified by intricate carvings, traditional roof designs and decorative elements, doors and windows, balconies and verandas.

Most of the earlier studies have majorly focused on qualitative analysis, but few with quantitative analysis with survey questions. However, the survey majorly discusses the transformation of facade elements, color, planning, and materials but not the facade iconography and facade design principle majorly. Hence, this study survey questionnaires concentrated on investigating the transformation factors of building facades in Gopalasamudram Agraharam of Tirunelveli in terms of facade planning, elements, materials, color, principles, and iconography. Moreover, this research focuses on determining the exact finding of the positive impact relationship in the transformation of building facade and sustenance of Traditional identity through Pearson correlation analysis and multilinear regression modelling. Thus, the research aims to evaluate the sustenance of traditional identity amidst facade transformations.

2. Literature Review

The literature review delves into several key themes surrounding the visual aspects and transformations of traditional building facades, as well as their significance in maintaining traditional identity. Taywade and Shejwal note that the term "facade" originates from the French word "facade," denoting the front or face of a structure, which serves as the initial point of visual engagement for observers [8]. Setiawan and Zubaidi emphasize the pivotal role of facade elements such as doors, windows, and aesthetic openings in defining a building's image [9, 10], with Elkadi highlighting how configurations of these elements contribute to a facade's distinct character and identity. [11]

Keshtkaran et al. delineate aesthetic preferences over high-rise buildings with respect to the primary and distinctive factors [12], while Emmitt et al. and Chitham expound on how architectural elements like arches, columns, and ornamentation enrich a building's form and coherence [13, 14]. Additionally, articulation, as described by Niezabitowski, involves partitioning facades into base, body and roof sections, profoundly influencing a structure's identity [15].

The literature also explores the impact of facade configuration on overall visual impressions [16, 17], with attention to specific factors such as color utilization, rhythm, and scale [18]. Hui underscores the role of building facades in shaping urban landscapes and city images, suggesting that addressing challenges related to style, color, and material is vital for enhancing district image [19]. Studies by Mao et al., Hollander, Anderson and others emphasize the importance of facade quality and its correlation with affective feelings and human perception [20, 21]. Moreover, the literature highlights the pressures faced by historic core areas due to modern urban development, leading to transformations that threaten their identity [22-24].

As per Hall, identity mirrors cultural heritage and shared cultural norms. It tends to remain stable over time because it is a legacy passed down and reinforced by numerous generations [25]. Additionally, architectural identity comprises two opposing forces: one emphasizing similarity and continuity, while the other emphasizes difference and disruption. Consequently, architectural identity serves as a bridge connecting the past with the future. According to Elkadi, visual elements of buildings significantly influence identity [11]. Facades, in particular, play a crucial role in shaping the location's identity. The facade aesthetics have led architectural identity towards new directions over the built environment. The deal and unique characteristics of facade elements contribute to defining the identity of a place.

Whyte suggests that modernity encompasses various meanings, representing the current and present state as opposed to the past or old [26]. Conversely, Simon defines modernity as an era of innovation and novelty. It signifies historical changes across diverse fields, time periods, and locations by linking past events, individuals, and ideas to construct significance in the present [27]. Thus, modernity signifies a continual period of change impacting all facets of life, including science, philosophy, urbanization and governmental structures [27-29]. Architecture has evolved over time, with each period having its own distinct characteristics shaped by philosophy and history. This study aims to understand how modernity has influenced each era by identifying its beginnings in each phase. The periods are divided into three categories commonly used in architectural history and theory [30-32].

During the post-independence period (1947-1970), traditional building facades underwent a notable transformation, blending historical elements with emerging modern influences. They serve as a means of preserving local heritage amidst the rapid processes of urbanization and globalization. Molnar describes the modern period of architecture (1970-1990) as focusing on functionality, using new technologies and materials to create a fresh sense of space [33]. Modernity in this era means embracing the new and rejecting old traditions to invent innovative forms. Patel delves into the socio-cultural dimensions of modern period transformations on traditional building facades. Patel highlights how changing lifestyles, urbanization processes, and global influences contributed to the reinterpretation of

traditional architectural motifs and design elements, resulting in hybridized facades that reflect both local traditions and global trends [34]. Khan delves into the aesthetic dimensions of late modern transformations (late 1990's) on traditional building facades. Khan highlights the emergence of innovative design approaches, such as parametric modeling and digital fabrication, which have enabled architects to create dynamic and visually striking facades that reinterpret traditional motifs in contemporary contexts [35].

The unique case of the Walled City of Jaipur exemplifies the socio-political and economic transformations impacting historic urban areas [36], while studies on Erbil city [37] and Kumbakonam Town [6], investigate factors influencing architectural identity preservation and built heritage conservation, emphasizing the need for policy frameworks to safeguard architectural heritage.

Overall, the literature review underscores the multifaceted aspects of traditional building facades, encompassing their visual aspects, periods of transformations and their significance in sustaining the architectural identity amidst urban development pressures. Additionally, it sheds light on the transformative effects of building facade modifications on traditional identity and the challenges faced by historic urban areas in maintaining their architectural heritage.

3. Research Methodology

An integrated mixed-methods approach, combining both quantitative as well as qualitative methodologies, is strategically adapted to enhance the result accuracy. This methodology employs dual measurement approaches. The first approach focuses on employing case studies as the primary research strategy to explore specific ideas in detail (qualitative method). The subsequent method utilizes surveys as the strategy for research in testing probabilistic propositions within a population (quantitative method).

With respect to the primary data collection by the researcher during observations as well as interviews inside Tirunelveli district, Gopalasamudram Agraharam, a case selected outside Tirunelveli town in South Tamilnadu analyzed traditional building facade elements that transformed from its original form shown in Figure 1. The evaluation of building facades is deemed crucial due to the influential parameters encompassing facade planning [38], facade details and elements [39], facade materials [40], facade color [41], facade design principles [42] and facade iconography [43]. Each parameter consists of various factors assigned values within a relevant range. These elements collectively contribute to the creation of highly efficient architectural details as well as serve as pivotal factors in shaping traditional architectural identity. Features of architecture have increased the building's form uniqueness, complexity, and variety that endow with visual isolation using representation of these details in analyzing the viewer's attention through Pearson correlation coefficient and determined through Multilinear Regression (MLR). The research focuses on creating a comprehensive framework (model) to capture and evaluate all key parameters, measuring how traditional building facade elements transform while maintaining their original identity.

Fig. 1 Transformation of building facade at Tirunelveli Gopalasamudram Agraharam streetscape, Tamilnadu

Source: The Author

3.1. Qualitative Case Study Method

This kind of case study method has been employed to gather insights into the evolution of building facades over time, particularly focusing on the physical features of the facades during three distinct periods (Post-independence, Modern and late Modern) of transformations observed in Gopalasamudram Agraharam, Tirunelveli. This approach aims to discern characteristic features unique to each period and illuminate stylistic discrepancies in architectural identity across different phases of transformation. This paper examines a selection of three houses as an example to illustrate image analysis as seen in Figures 2 and 3, a comprehensive documentation and analysis comprising drawings, existing floor plans, roof plans, front elevations and envisaged plans of the past as seen in Figures 4 and 5. Additionally, the paper presents comparative results in the form of a tabular form of the visual elements of building facades across three distinct transformation periods for the three houses, as shown in Table 1.

3.2. Quantitative Case Study Method

This kind of case study method has been employed to establish and apply research assumptions regarding traditional identity phenomena. The principles of quantitative research involve testing the hypotheses regarding the correlation between transformations in building facades (independent variable) and the preservation of traditional identity (dependent variable). Additionally, it aims to ascertain the relationship among independent as well as dependent variables and to comprehend the various dimensions of these variables. This study purpose discusses the structured questionnaire survey that was conducted to collect statistical data as well as to identify and statistically model individual variables.

3.3. Sampling Method

3.3.1. Qualitative Sampling Technique

With respect to the building facade transformation classification observed in Gopalasamudram Agraharam at

Tirunelveli, which divided the periods of transformations into three distinct categories, an "enumeration survey" or "Census sampling" method (Non-probability sampling) is chosen where every individual or household within the defined street or area is included in the sample, rather than selecting a subset of the population [44, 45]. Currently, the Gopalasamudram settlement comprises 117 buildings. The subsequent criteria guide the sample selection process: identification of households currently residing in each house of the Agraharam settlement, conducting brief interviews with households to obtain necessary permissions for photographic and video documentation through drone cameras, as well as gathering information regarding transformations in building characteristics such as planning and principles, construction materials, roofing type, number of floors, facade details, etc.

3.3.2. Quantitative Sampling Technique

This study opted for a probability sampling design, employing a stratified sampling method. This method has utilized representatives from every subgroup over the requirement of the population to be recognized in the sample [46, 47]. The collection of dataset from the people living in the Gopalasamudram Agraharam based on the building category through a structured questionnaire survey is conducted through Google form, and the population for this survey involved are from 117 buildings that have been distributed in terms of years living in the buildings as shown in Figure 6.

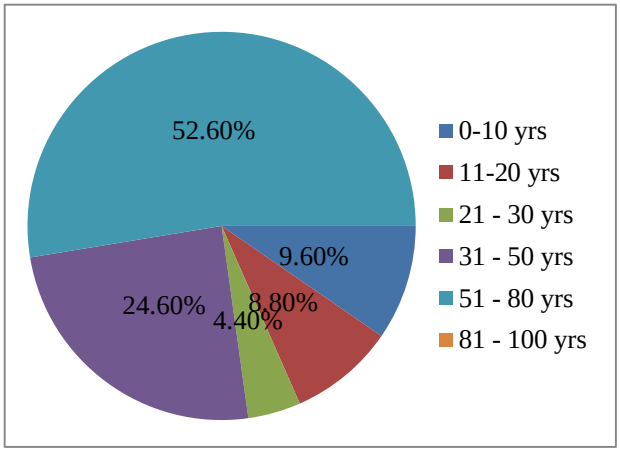

Fig. 6 No. of years living in the Gopalasamudram Agraharam buildings at Tirunelveli

However, the research encompasses independent variables related to six diverse categories of building facades, such as planning, elements/details, materials, color, design principles and iconography.

The dependent variable, focused on the sustenance of traditional identity, is utilized for statistical analysis and variable segmentation, and they have been structured and modelled accordingly. A questionnaire featuring multiple-choice options has been devised.

4. Study Area

4.1. Tirunelveli

One of the south towns of Tamil Nadu, India, is Tirunelveli, as shown in Figures 9 and 10, which is well known for its cultural heritage richness, religious and traditional buildings, and historic and significance architecture. The city showcases a blend of architectural styles that involves influences of Islamic, Dravidian and colonial. The traditional agraharam houses inside Tirunelveli district are usually located near the temples and along the banks of River Tamirabharani, have a distinct architectural style and are known for their traditional architecture. These are characterized by their old-style houses, narrow streets and a serene atmosphere. They reflect the history and cultural significance of the particular Brahmin community in Tirunelveli.

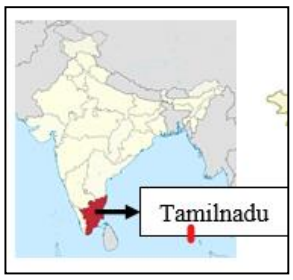

Fig. 7 India map showing Tamilnadu state

Fig. 8 Tamilnadu state map showing showing Tirunelveli district

Fig. 9 Map showing tirunelveli district

Fig. 10 Map showing gopalasamudram agraharam settlement inside tirunelveli district

4.2. Case Study – Gopalasamudram Agraharam Settlement, Tirunelveli District

Gopalasamudram Agraharam settlement, situated inside Tirunelveli district of Tamil Nadu, India, is a panchayat town positioned approximately 0.5km along the southern banks of

the Tamirabharani River, as seen in Figure 11. Established during the Nayak dynasty in the 17th century, this settlement served as both a residential and religious center for the Brahmin community.

Fig. 11 Drone map showing Gopalasamudram Agraharam settlement 0.5km along southern banks of River Tamirabharani
Source: The Author

Characterized by the traditional Tamil Brahmin architectural style, the houses are arranged in rows with a uniform layout, aligned on both sides of the streets and connected by pathways. The Agraharam street extends from East to West, covering a total distance of approx. 0.4 km (400ms) stretch, as seen in Figure 12. Front-facing verandas with Thinnai serve as transitional spaces, providing shaded areas for sitting, socializing and observing street activities. The central courtyards of these houses function as open-air spaces for family activities and gatherings. The roofs, typically sloping and made of clay tiles or thatch, add to the traditional charm of Gopalasamudram Agraharam. Situated on the outskirts of Tirunelveli town, approximately 14 km away, this settlement features numerous traditional buildings that exhibit architectural styles deeply rooted in the cultural heritage of the region, with a history spanning over 100 years. At the core of Gopalasamudram Agraharam stands the ancient Sri Kailasanathar Temple, dedicated to Lord Shiva on one end of the street and Sri Srinivasa Perumal Temple on the opposite end, both facing east direction, as seen in Figure 13. Renowned for its architectural magnificence and religious significance, the agraharam has diligently preserved its cultural heritage. The Brahmin community actively engages in traditional rituals, music, dance, and cultural practices passed down through generations.

Festivals such as Maha Shivaratri, Panguni Uthiram, Garuda Sevai, Varshabishegam, Thiruvonam, Chithirai Swadhi, Margazhi Thirupaavai, Ekadesi and Brahmotsavam are celebrated with great enthusiasm on a monthly and yearly basis, featuring vibrant temple processions, rituals and captivating music and dance performances. The Sannadhi streets comprise a total of 117 buildings, with 39 buildings along Perumal Kovil Street and 78 buildings along Sivan Kovil Street, as seen in Figure 14 of the existing site cum roof plan. The traditional buildings inside Gopalasamudram Agraharam exhibit distinctive facade elements such as terracotta tiles, wooden carvings, intricate designs with floral motifs and mythological figures on door frames, window shutters and pillars, Jali Works and Stucco Ornamentation on walls, arches, Colourful frescoes, Ornate Balconies with intricate railings and brightly coloured facades. These elements contribute to Tirunelveli's architectural heritage, enhancing the city's unique charm and cultural identity.

5. Data Collection

This study employed both qualitative and quantitative methods for data collection. This data collection aimed to gather information on the building facade transformation analysis across three periods and the sustenance of traditional identity within the facades of Gopalasamudram Agraharam at Tirunelveli.

5.1. Study of Qualitative Method

Qualitative data collection methods employed in this study comprised direct observation and documentation of visual characteristics. The observations were complemented by employing a "drone camera" as a digital documentation tool to capture high-quality photographic and video documentation of each building facade, offering a detailed and comprehensive perspective that conventional ground-level methods may not achieve, as depicted in Figure 15. Additionally, a "laser distance meter," a tool using laser technology, was utilized to accurately measure the distances and heights of the building, providing precise measurements crucial for creating detailed floor plans and elevation drawings. Direct interviews with households were also conducted to enhance the documentation process and ensure data reliability. To facilitate structured data collection, building facade checklist factors survey form for six parameters was utilized in addition to visual observations during site visits as seen in Table 2 for planning parameters, Table 3 for elements/details, Table 4 for materials, Table 5 for colour, Table 6 for iconography and Table 7 for principles. This method aims to demonstrate the varying degrees of similarity and diversity among facades and to assess the importance of individual facade elements. Consequently, a comprehensive database was constructed to efficiently organize relevant data, including case study notes, tabular materials, observation lists, documented photographs during site visits and measured drawings for documentation purposes.

Fig. 12 Gopalasamudram Agraharam street covering a distance of 0.4kms stretch taken from drone camera (Source: The Author)

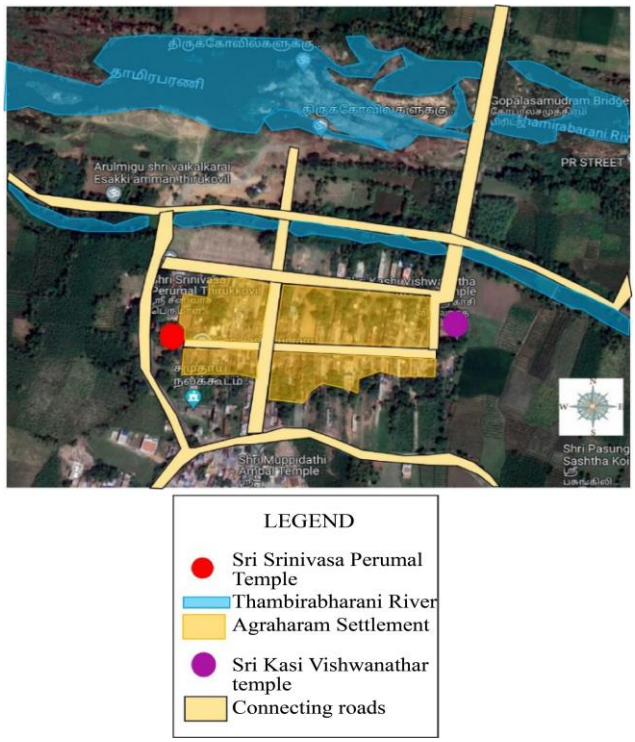

Fig. 13 Drone map of Gopalasamudram Agraharam settlement showing two temples at both ends of the street

Source: The Author

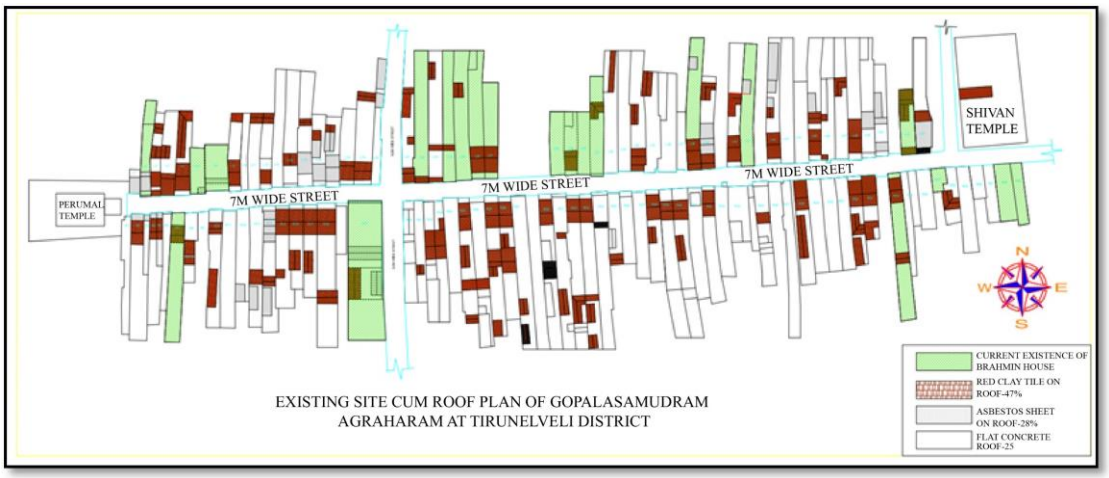

Fig. 14 Existing site cum roof plan of Gopalasamudram Agraharam at Tirunelveli district

Source: The Author

Fig. 15 Drone-captured visual documentation of building facades in Gopalasamudram Agraharam Settlement

Source: The Author

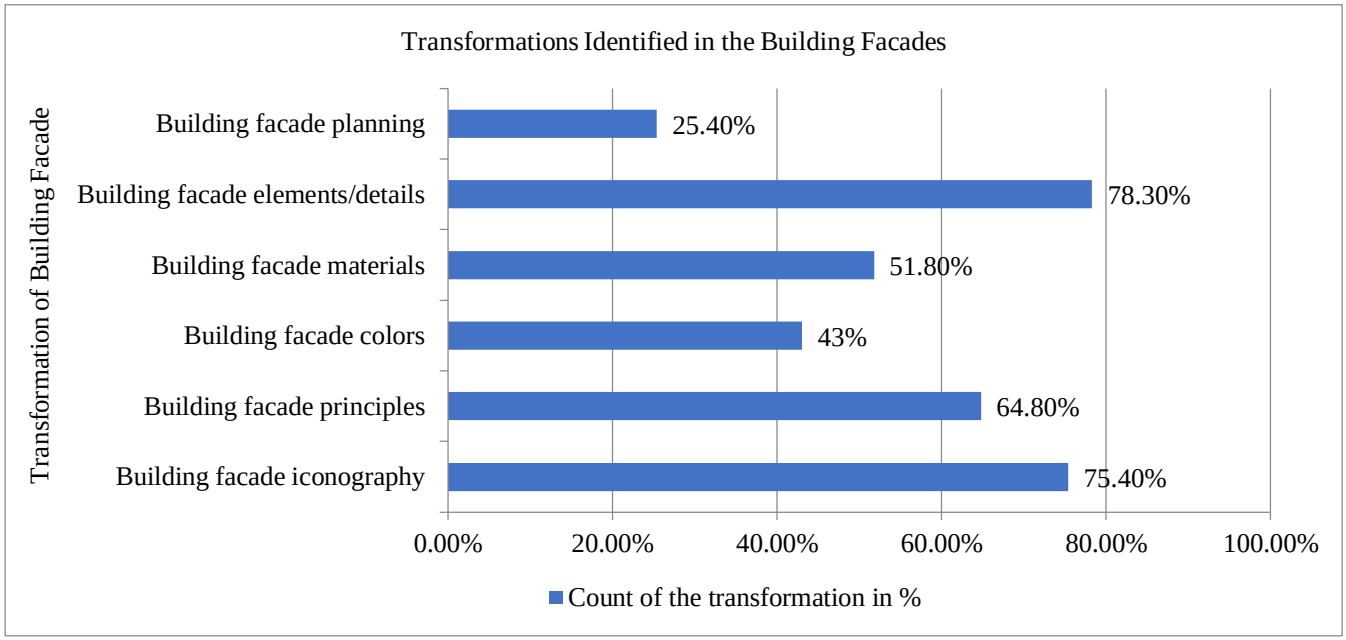

Fig. 16 Transformations identified based on six different independent categories

5.2. Study of Quantitative Method

In the quantitative part of this study, data collection primarily relied on surveys and interviews. Conducting the survey (questionnaire) was justified to obtain standardized data suitable for statistical analysis. A self-administered questionnaire featuring multiple-choice questions was designed to investigate the impact of building facade transformations on the sustenance of traditional identity. Based on the survey questionnaires, the transformation of the building facade is identified through six different independent categories. The maximum transformations identified in this study for 117 buildings are building facade elements/details, which is about (78.30%), followed by building iconography (75.40%), building facade principles (64.80%), building

facade materials (51.80%) and building facade colour (43.0%). The least transformation identified in this study is building facade planning (25.40%), as seen in Figure 16. Moreover, the factors for building facade transformation are also identified through observations, questionnaires and multiple answers with choices. Hence, the factors are determined through a statistical horizontal bar chart shown in Figure 17, in which visual aesthetics plays a major role in initiating the transformation of the building facade with 91.2% followed by large family size and change of usage as 42.1% and 37.7%, respectively.

In this research, fifty six questions have been initiated for a survey to understand the reasoning of transformations in building facades with the six different categories as well as sustenance of traditional identity. The parameter and its description are listed in Table 8.

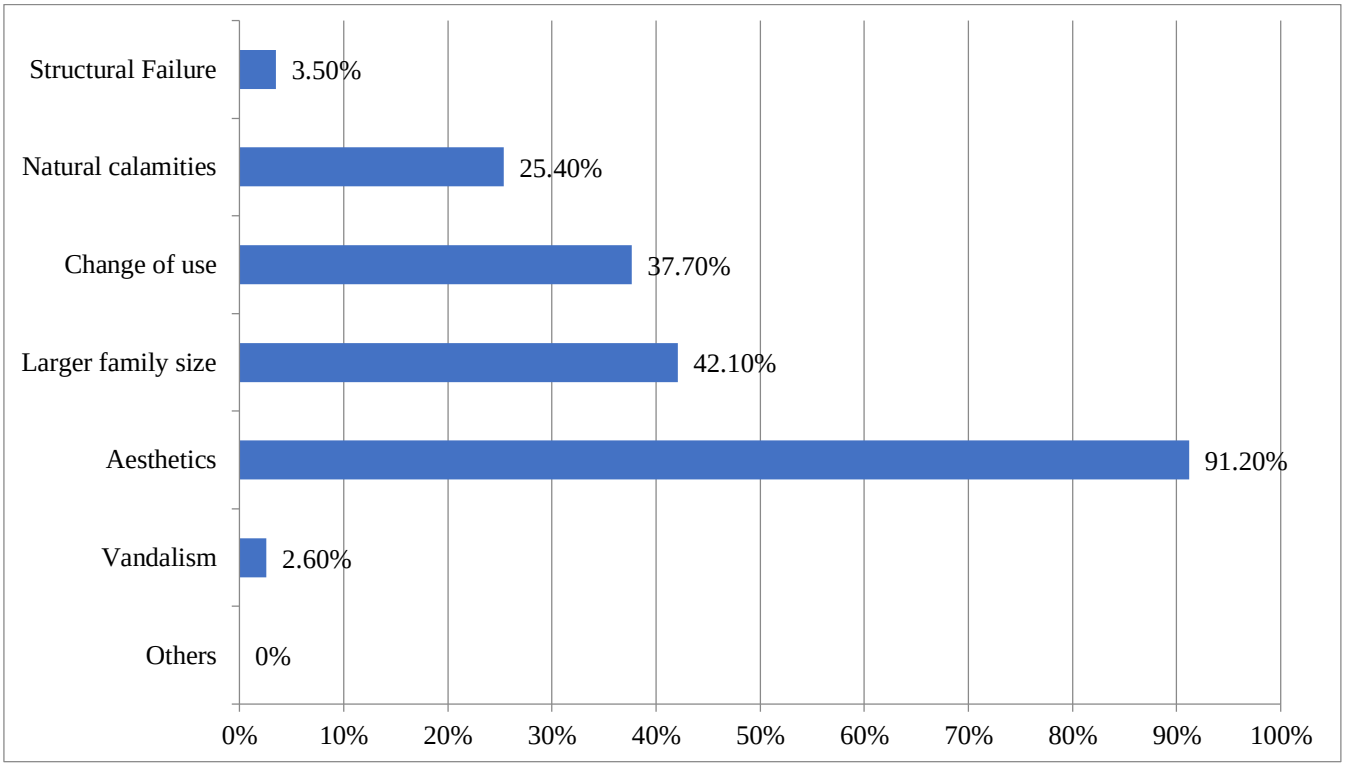

Fig. 17 Factors for the transformation of building facades

Table 8. Parameters and descriptions listed for various categories

Parameter	Description
TF	Transformation of Facade
TI	Traditional Identity
PL	Planning of building facade
DM	Detail parameters of building material
AM	Architectural Material of building facade
C	Color parameter of the building facade
DP	Design Principle of the building facade
IC	Iconography of building facade
G	General building facade

For instance, the TF-PL1 represent the transformation of the facade in the building facade planning session with the first question over Google form with the title 'PERCEPTION ANALYSIS'. However, the positive impact of the transformation of building facade associated with traditional identity has been listed below:

- TF-PL9: Architectural form configurations in the land area have obtained a positive impact on the sustenance of traditional identity
- TF-DM4: Efficient use of techniques for preserving architectural details in the building facades assists in maintaining the sustenance of traditional identity.
- TF-AM1: Efficient use of local materials for the walls, columns, roofs, parapets, doors and windows in building facades assists in revamping the sustenance of traditional identity.
- TF-C10: In contrast to modern buildings, historical building facades provide a sense of belonging and harmony with a strong traditional identity due to the street's consistent color scheme and facade design.
- TF-DP3: Transformation of the symmetry and the building facade axis will have an impact on the symbolic expression of traditional identity.

There are eight major sustenance of Traditional Identity (TI) questionaries listed below:

- TI-DM1: Transformation in a variety of building facade elements and details has an impact on the sustenance of traditional identity.
- TI-G: Transformation in the articulation of facades and openings minimizes the vocation of place and has an impact on the sustenance of traditional identity.
- TI-PL: Transformation in architectural Planning like form, size and style, layout, and building line will have a significant impact on the sustenance of traditional identity.
- TI-DM: The efficient use of local architectural details and materials will result in sustenance of traditional identity
- TI-AM: Transformation in the consistency of building facade form contributes significantly to cultural and traditional identity.
- TI-C: Transformation in the color of the building facade in walls, columns, openings, roofs, and parapets contributes to the sustenance of traditional identity.
- TI-DP: Transformation in the Design principles of the building facades has a significant impact on the sustenance of traditional identity.
- TI-IC: Iconography symbolized on the building facades contributes to the preservation of traditional identity.

The overall transformation of the building facade is evaluated through 38 numbers. Therefore, out of 38 transformations of building facades, overall transformations in each building are identified through survey reports, which are categorized through total TF-PL, total TF-DM, total TF-AM, total TF-C, total TF-DP and total TF-IC. The obtained survey reports are data preprocessed through the Python library of pandas in which missing imputation is done and proceeded further for scaling the ordinal data using the MinmaxScaler() function. Once the data preprocessing is done, the featured relationship can be analyzed through the correlation method, namely Pearson correlation, and even evaluated through the MLR model to determine the sustenance of TI while transforming building facades. This analysis of the positive impact of the transformation of building facades at Gopalasamudram Agraharam, which is located in the panchayat town of Tirunelveli district in the Indian state of Tamil Nadu, may potentially contribute to preventing the complete demolishing of traditional building facades across the country.

6. Data Analysis

6.1. Qualitative Analysis Method

The qualitative data analysis method utilized in this case study involves a visual observation process aimed at identifying similarities and differences among various building facades. The objective is to comprehend the unique character of each building by visually assessing its parameters, particularly focusing on how these facades and their character evolve across three distinct periods. The qualitative analysis methods comprised several steps. Initially, image data of building facades, captured through drone camera photographs, were meticulously organized by sorting them into relevant categories through image analysis, as seen in Figure 18. Subsequently, detailed documentation and analysis were shown in the form of drawings, including existing floor plans, roof plans, front elevation and the envisaged plans of the past to gain a deeper understanding, as shown in Figure 19. The data were then structured into comparative framework tables, facilitating the identification of key elements for each building facade. Visual characteristics of each building within specific categories for three periods were thoroughly analyzed and documented. Finally, the findings were presented through various visual aids such as figures, drawings, charts, tables, and descriptive discussions.

6.2. Quantitative Analysis Method

In this experimental research, quantitative analysis is done through SPSS tools/python software, which includes the library of numpy, pandas and scipy.stats have been utilized in providing statistical analysis of data and generating details to in-depth data access as well as preparation, graphics, analytical reporting, and modelling. The data from quantitative analysis is segregated into two different stages:

1. Correlation Analysis: This analysis is majorly focused on identifying the relationship among the factors that are involved in identifying the building facade transformations considered individually with the target

variable as sustenance of traditional Identity. The correlation between each independent variable and target-dependent variable is considered as an outcome in this analysis. The correlation role is to capture the similarities or differences among the variables. This measure assists in identifying the degree of association among the values of the related variables provided in the dataset. Hence, the Pearson correlation is considered to be the coefficient value of correlation.

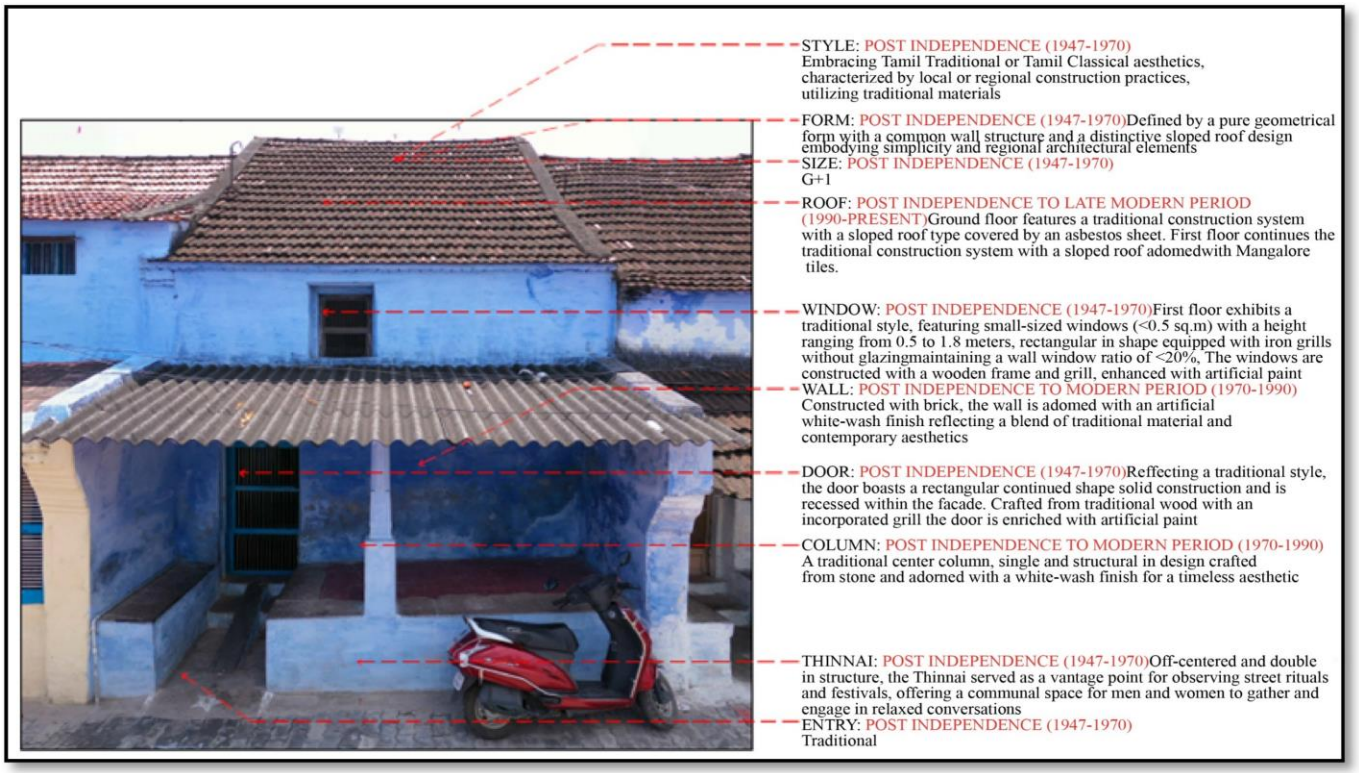

Fig. 18 Sample house 1 - Image analysis of facade transformations

Source: The Author

2. Regression Analysis: The multiple regressions purpose is to predict the dependent variable with respect to its covariance with all the disturbed independent variables. The best prediction of the sustenance of TI from several independent variables and formula is expressed in Equation (1) as:

$$Y = a + b_1X_1 + b_2X_2 + \cdots + b_tX_t + u \quad (1)$$

Where,

Y = Dependent variable to predict or explain.
X = Explanatory (independent) variable(s) used to predict or associate with Y.
a = y-intercept
b = Slope of explanatory variable (β-beta coefficient)
u = Regression residual or error term

7. Analysis and Results

7.1. Qualitative Analysis

Visual analysis is conducted to understand the distinctive features of building facade elements across three distinct periods, shedding light on the transformation analysis of facade elements over time. The primary focus of qualitative analysis involves physical observation and visual investigation of facade parameters. These analyses aim to facilitate comparative assessments between different periods. As a result, qualitative analysis yielded the following results:

7.1.1. Facade Planning

This parameter comprises five factors aimed at clarifying the transformation analysis of building facades, namely, architectural style, form, size, layout and building line. Through observations and documentation of visual characteristics, the results indicate the impact of these factors on the morphology of each facade. Analysis reveals that during the Post-Independence period (PI), architectural styles accounted for 34.63% of transformations, while in the modern period, this accounted for 26.39%. Conversely, during the Late Modern period (LM), it accounted for 38.98%, as seen in Figure 20. During the PI period, facades showcased intricate Tamil traditional styles with ornate carvings on columns and decorative patterns. In the modern era, designs became simpler with fewer decorations, reflecting a contemporary look. In the LM period, facades blended classical and modern

elements, using traditional materials alongside modern construction methods, as seen in Figure 21. Based on on-site visits, observations, and photographic documentation, it was observed that architectural form played a significant role in transformations during the PI period, accounting for 41.41% of changes. In comparison, during the modern period, this figure decreased to 30.44%, and during the LM period, it further declined to 28.15%. Similarly, architectural size contributed to 30.66% of transformations during the PI period, 40.91% during the modern period, and 28.43% during the LM period. Traditional building facades were typically small in scale and size, with compact layouts featuring small doors and windows to meet functional needs during the PI period.

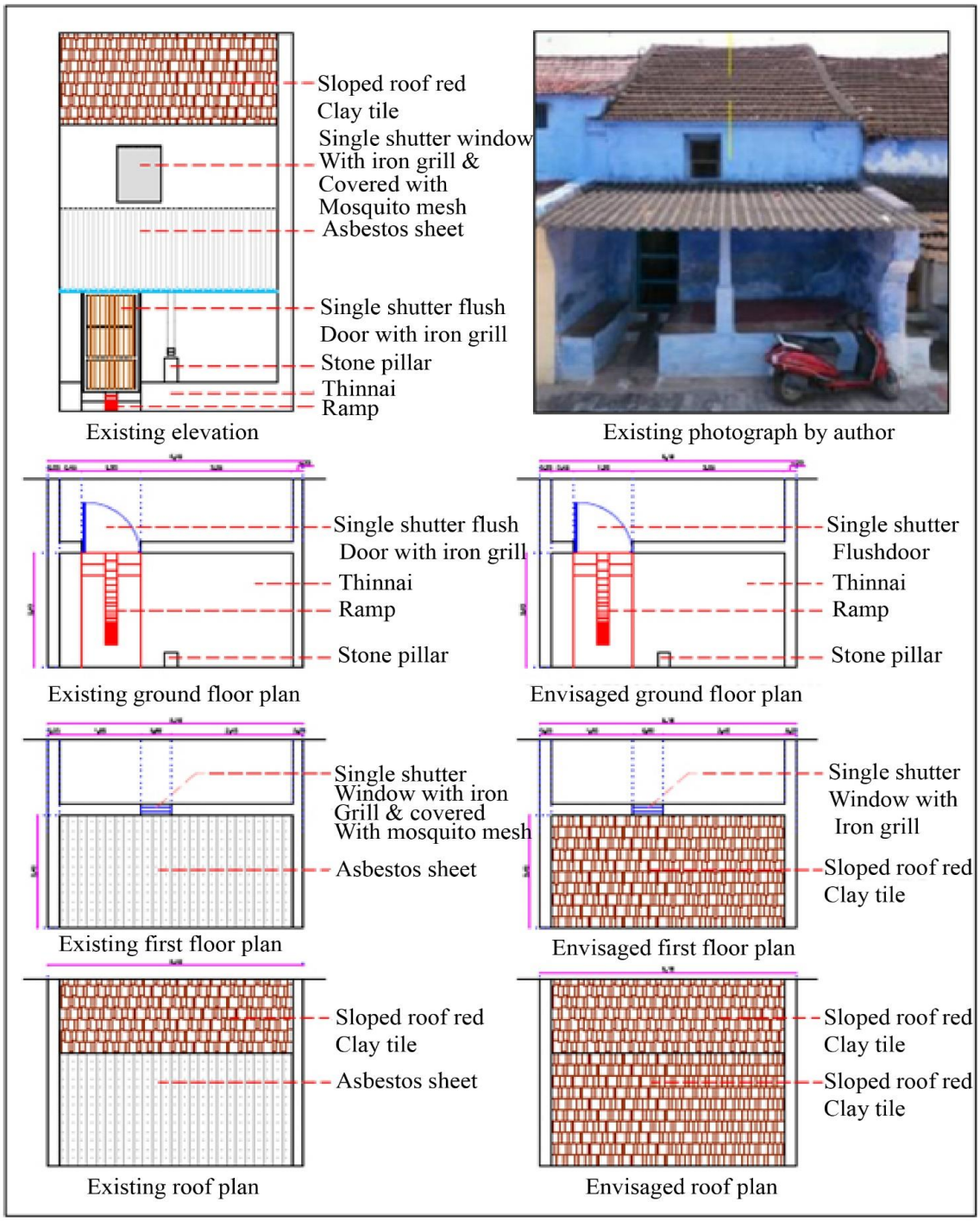

Fig. 19 Sample house 1 – Detailed documentation and analysis of facade transformation

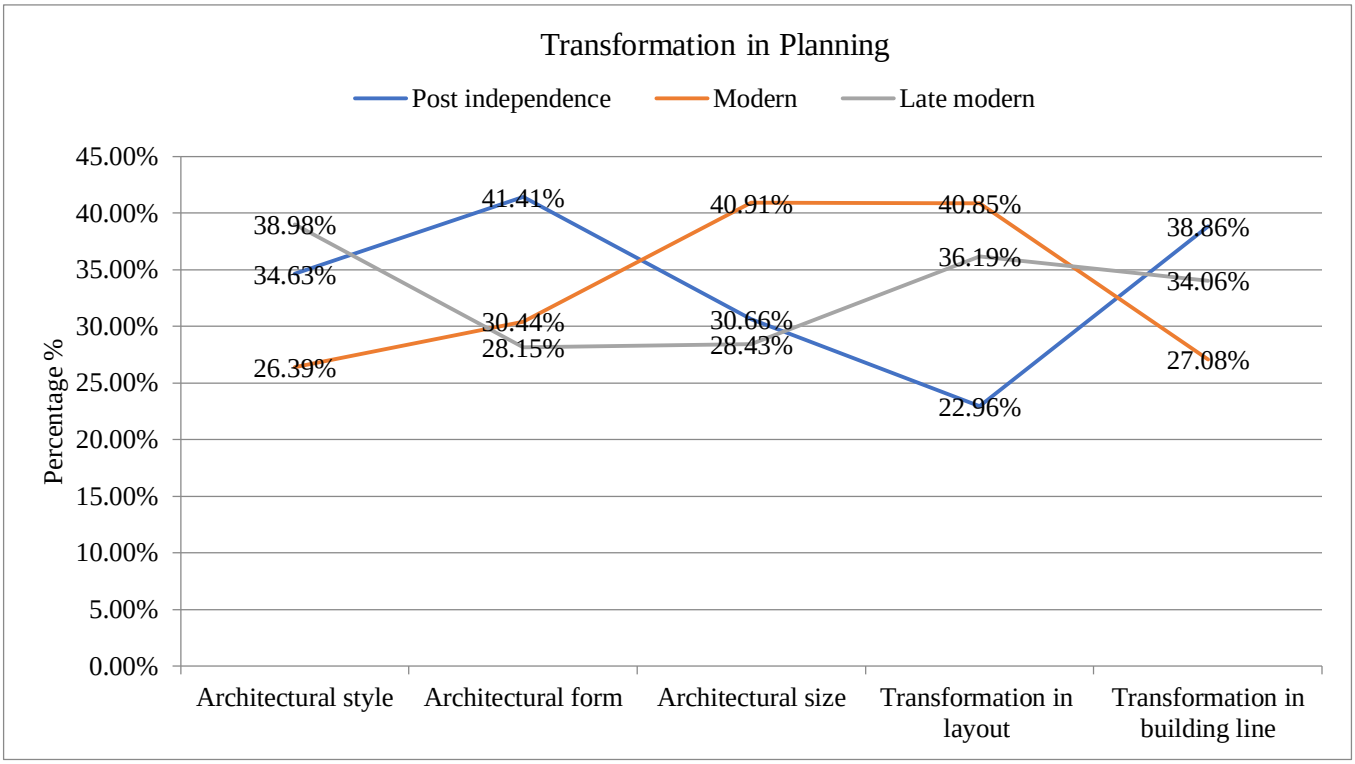

Fig. 20 Transformation analysis of facade planning across 3 periods

In the modern period, there were significant changes, with facades becoming larger and taller, featuring multi-story structures, spacious floor plans, and bigger doors and windows. Transitioning to the LM period, facades underwent further changes to accommodate evolving lifestyle preferences, blending traditional and modern elements to showcase architectural evolution over time, as seen in Figure 22. The findings reveal that during the PI period, the layout transformations were minimal at 22.96%. However, in the modern period, this increased to 40.85%, and in the LM period, it was 36.19%. In the PI period, layouts typically featured thinnais supported by stone pillars.

But in the modern era, thinnais were enclosed by walls to expand living space. The LM period saw a complete overhaul with contemporary layouts featuring compound walls and gates for safety, as seen in Figure 23. Additionally, transformations in building lines were notable, accounting for 38.86% during the PI period, 27.08% during the modern period, and 34.06% during the LM period.

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 1 : PLANNING ARCHITECTURAL STYLE			
	Tamil traditional or tamil classical style seen during post independence period (type of local or regional construction method that utilizes traditional materials and resources sourced from the area where the building is situated)	Modern style depicted (style based upon new and innovative technologies of construction, particularly the use of steel and reinforced concrete)	Contempoary style seen during late modern period (20th century that is characterized by an eclectic mishmash of classical and modern styles)

Fig. 21 Architectural style transformation analysis in three different periods (Source: The Author)

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 1 : PLANNING ARCHITECTURAL SIZE			
	During the post independence period, traditional building facades typically exhibited a modest scale and size with compact layouts featuring small openings such as doors and windows and intimate spaces, reflecting the functional needs.	During the modern period, substantial transformations were evident in the size and scale of traditional building facades, leading to larger proportions, taller structures feathering multi-storey configurations and expansive floor plans accompanied by larger windows and doors	Transitioning into the late modern period, traditional building facades underwent further transformations through renovations or expansions aimed at accommodating shifting lifestyle preferences. This led to facades incorporating a blend of traditional and modern elements, showcasing the dynamic evolution of architectural size overtime.

Fig. 22 Architectural size transformation analysis in three different periods (Source: The Author)

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 1 : PLANNING TRANSFORMATION IN LAYOUT			
	In the post- independence period, the layout of an agraharam featured thinnai's on two sides, each supported by two stone pillars, serving the dual purpose of resting and facilitating interaction.	Gradually, in the modern era, the thinnai was enclosed by walls for personal use, often repurposed as parking space or expanded rooms for familial needs.	In the late modern, the entire layout underwent transformation into a contemporary style, featuring the addition of a compound wall and gate primarily for safety reasons.

Fig. 23 Transformation in layout analysis in three different periods (Source: The Author)

7.1.2. Facade Elements / Details

This parameter comprises eleven factors influencing the transformation of building facades: walls, ornamentation and details, arches, niches, columns, roofs, parapet walls, thinnai, doors, windows, and balconies. Results show their impact on facade morphology during the PI, modern, and LM periods. During the PI period, walls had a small change of 1.82%, while ornamentation saw a bigger change at 8.67%. Arches changed slightly by 1.36%, while niches changed noticeably by 4.10%. Columns had a moderate change of 7.76%, and roofs saw a big change at 11.41%. The biggest change was in

the parapet walls, accounting for 20.09%. Thinnai elements also changed noticeably at 12.78%. Doors had a moderate change of 7.76%, windows had a big change at 10.50%, and balconies changed noticeably at 13.69%. In the modern period, transformations were notable in walls (15.58%), ornamentation (12.73%), arches (15.96%), niches (2.66%), columns (12.73%), roofs (8.36%), parapet wall (2.47%), thinnai (6.08%), door (10.07%), window (9.31%), and balcony (3.99%). During the LM period, changes were observed in walls (8.15%), ornamentation (6.04%), arches (8.15%), niche (25.67%), columns (4.83%), roofs (6.94%), parapet wall (4.83%), thinnai (8.76%), door (9.06%), window (6.64%), and balcony (10.87%) as seen in Figure 24. During the PI period, walls were mainly built using bricks and coated with natural lime plaster.

However, during the modern period transformation, the walls were painted with whitewash accented with blue tones. Moving into the LM period transformation, the facades underwent additional changes, such as tile cladding and artificial painting, as depicted in Figure 25. Ornamentation and details in the traditional building facades included wooden entablatures embellished with floral motifs. However, in the modern period, these intricate designs were absent, and the space was repurposed for room usage. In the LM period, transformations revealed entablatures and cornices featuring a blend of traditional and modern styles, incorporating various motifs and cement moldings for a contemporary aesthetic. Niches during the PI period were carefully carved into the thinnai's side walls for lighting clay candles, following local customs. In modern times, with thinnai walls enclosing spaces, niches shifted to the front of houses. But in the late modern period, niches vanished from facades, marking a change in design as seen in Figure 26. During the PI period, traditional-style columns featured intricate floral designs and served both decorative and structural purposes. In the modern period, plain columns were randomly placed, solely providing structural support.

However, in the LM period, columns serving only structural purposes were not identifiable in any facades, as seen in Figure 27. Doors during the PI period were made of the rectangular single-shuttered solid flush door with a width of a minimum of 3’6” and placement recessed within the wall. During the modern period, doors were made of rectangular single-shuttered hollow grilled door recessed within the main wall with a width of a minimum 3’6”. During the LM period, single shuttered solid flush doors with carvings were seen in the doors with a minimum width of 3’ recessed within the wall.

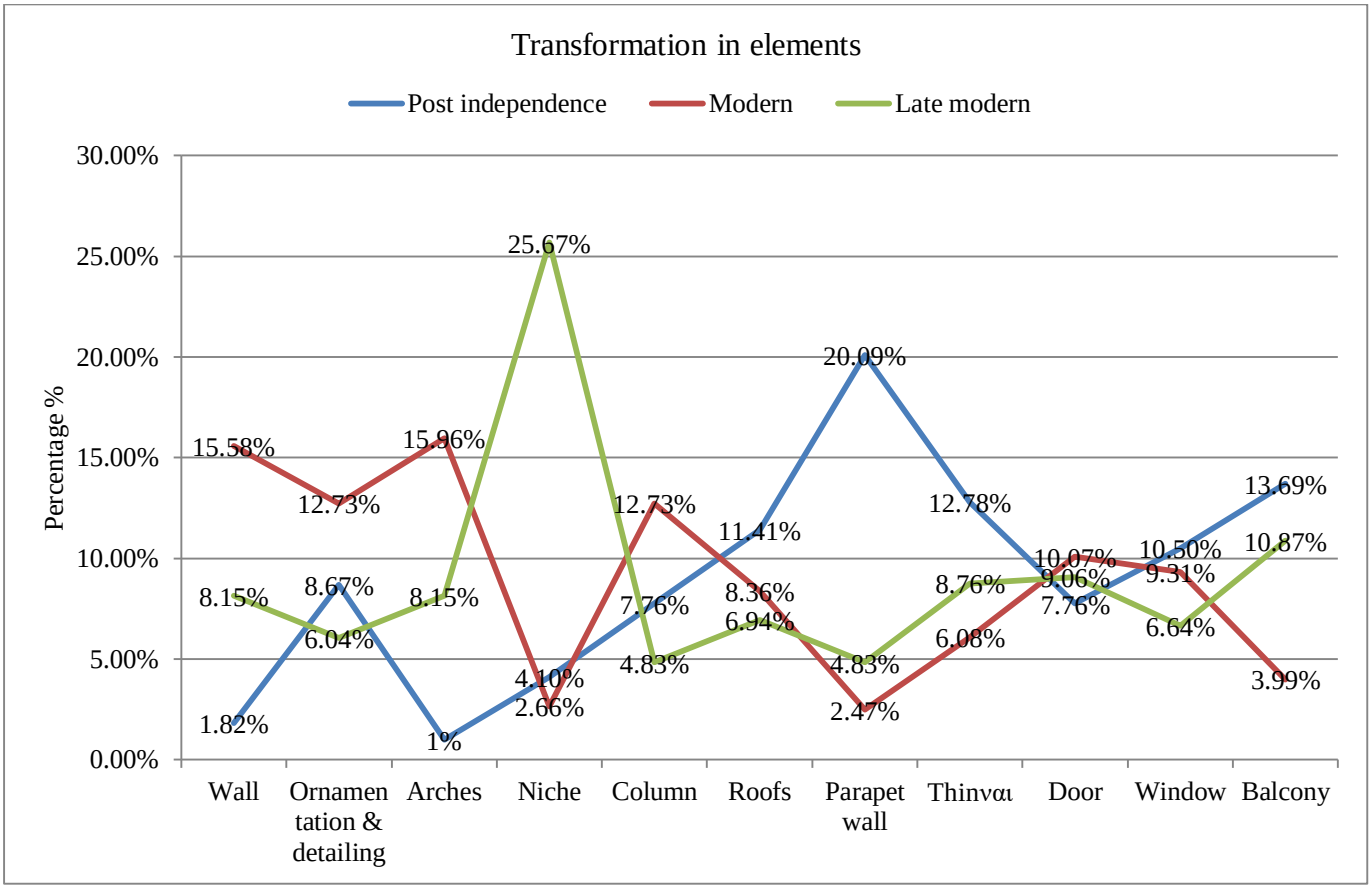

Fig. 24 Transformation analysis of facade elements/details across three periods

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 2 : ELEMENTS/DETAILS WALL			
	During the post independence period, the wall component of the façade distinctly exhibits the utilization of bricks amd is constructed with natural lime plastering.	Gradually, in the modern period, the natural color of the wall underwent alteration, transitioning to a whitewashed appearance with blue color as seen in image	In the late modern, the façade was transformed with tile cladding and artificial painting.

Fig. 25 Wall transformation analysis in three different periods (Source: The Author)

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 2 : ELEMENTS/DETAILS NICHE			
	During the post independence period, niches were intricately carved into the side walls of the thinnai for religious purposes, specifically for lighting clay candles facing the east side. This practice reflected the regions heritage, beliefs and cultural symbolism	In the modern period, with the thinnai's enclosed wall extending the living space , the niche was carved in front of the house for the purpose of lighting clay candles, all while ensuring architectural continuity.	During the late modern period, the niche was absent in all building facades, indicating a transformation in their design.

Fig. 26 Niche transformation analysis in three different periods (Source: The Author)

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 2 : ELEMENTS/DETAILS COLUMN			
	A single traditional style column, consisting of a capital, shaft and base was intricately designed and carved with floral motifs and other complex details during post independence period as seen in image. Its location was radomly chosen and it served both decorative and structural purposes.	A single modern style column, devoid of any design or embelishments was positioned randomly to solely provide structural support.	During the late modern period an unidentifable column, serving purely as structural support, remains elusive and cannot be located.

Fig. 27 Column transformation analysis in three different periods (Source: The Author)

7.1.3. Facade Materials

This parameter encompasses seven factors that influence the transformation of building facades: walls, roofs, doors, windows, balcony balustrades, parapets, and columns. The results demonstrate their impact on facade morphology across three periods: PI, Modern and LM. During the PI period, walls experienced a modest change of 2.45%, while roofs underwent a more significant alteration of 15.51%. Doors showed a slight change at 11.72%, whereas windows exhibited a noticeable transformation of 15.86%. Balconies showed 20.68%, Parapets experienced the most substantial change, at 30.34%, while columns saw a change of 11.72%. In the Modern period, notable transformations occurred in walls (24.69%), roofs (6.62%), doors (15.96%), windows (14.75%), balconies (6.32%), parapets (3.91%), and columns (20.18%). During the LM period, changes were observed in walls (13.70%), roofs (25.38%), doors (15.22%), windows (11.16%), balconies (18.27%), parapets (8.12%), and columns (8.12%), as depicted in Figure 28.

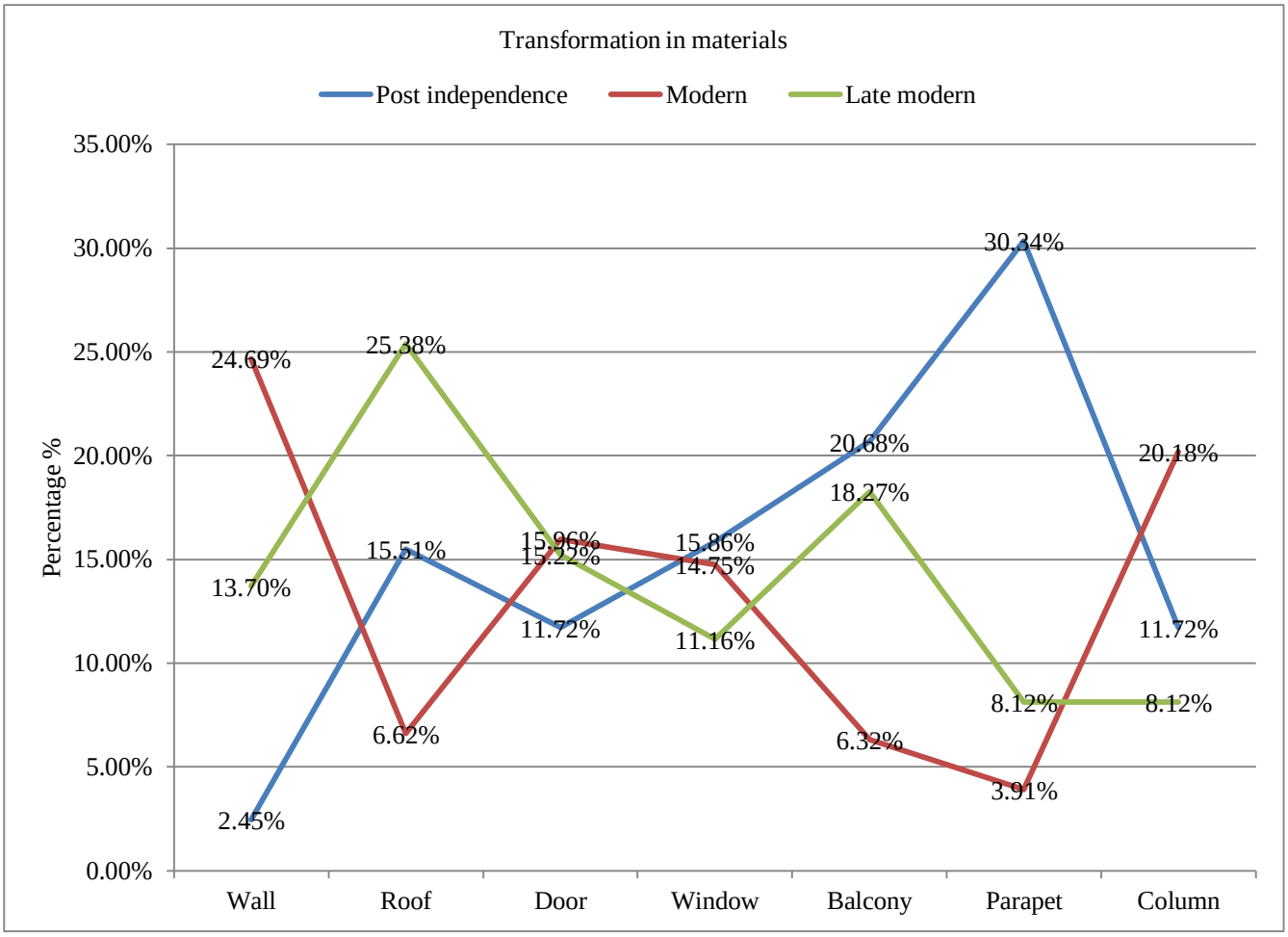

Fig. 28 Transformation analysis of materials across three periods

In the PI period, traditional housing often featured wooden flush doors with iron grills, reflecting prevalent architectural styles. However, as part of the modern period transformation, iron grill doors became the norm for main entrances. Conversely, in the LM period, solid flush wooden doors replaced iron grill doors as the primary choice for main entrances, as illustrated in Figure 29. In the PI era, windows often featured wooden frames adorned with intricate detailing or lattice patterns, complemented by grill rods.

Transitioning to modern times, the prevalent open grill windows were supplanted by aluminium mesh coverings. In the LM period, a shift occurred towards contemporary window designs characterized by wooden frames with a glass finish, seamlessly merging traditional aesthetics with modern performance standards, as seen in Figure 30. In the PI period, the Agraḥaram house had a sloped roof design, which made it difficult to add a parapet wall.

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 3 : MATERIALS DOOR			
	In the post independence period, wooden flush doors with iron grills were commonly utilized , reflecting the traditional style of housing.	During the modern period, iron grill doors were employed as main entrances.	In the late modern period, the iron grill doors were replaced with solid flush wooden doors as main entrances.

Fig. 29 Door material transformation analysis in three different periods

Source: The Author

In the Modern period, the house was redesigned with a parapet wall by extending the ground floor roof, creating extra space enclosed by a brick parapet wall. In the LM period, the parapet wall was decorated with floral or geometric patterns to enhance its appearance. During the PI period, the house had wooden pillars supporting the thinnai. In the Modern period, these were replaced with concrete and steel pillars. However, there were no specific changes to the columns in the LM period. Initially, during the PI period, the house had a ground floor and one additional storey with a sloped roof covered in Mangalore tiles. Later, in the Modern period, the ground floor roof was replaced with a flat one, while the first storey retained its original sloped roof with clay pot tiles. In the LM period, the traditional design was completely changed with the construction of a flat concrete roof, as seen in Figure 31.

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 3 : MATERIALS WINDOW			
	During the post independence period, windows with wooden frames and intricate detailing or lattice pattern and grill rods were commonly utilized.	In modern times, the open grill windows were replaced with aluminium mesh coverings.	In the late modern period, windows were updated to a contemporary style featuting wooden frames with a glass finish, blending traditional aesthetics with modern performance standards.

Fig. 30 Window material transformation analysis in three different periods

Source: The Author

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 3 : MATERIALS ROOF			
	The house was constructed with a ground floor and one additional storey, featuring a sloped roof covered with mangalore tiles during post independence period.	The house originally constructed with a ground floor and one additional storey, underwent modifications during modern period where the roof of the ground floor was replced with a flat roof, while the first storey retained its original sloped roof covered with clay pot tiles.	The traditional style of the agraharam house underwent a complete transformation during late modern or a contemporary style, resulting in the construction of a flat concrete roof.

Fig. 31 Roof material transformation analysis in three different periods

Source: The Author

7.1.4. Facade Colour

This parameter evaluates six factors influencing the evolution of building facades: walls, roofs, doors, windows, balcony balustrades, and parapets. The analysis spans three distinct periods: PI, Modern, and LM. During the PI period, walls experienced a modest change of 1.86%, while roofs underwent a more significant alteration of 20.56%. Doors showed a slight change at 11.21%, whereas windows exhibited a noticeable transformation of 16.82%. Parapets experienced the most substantial change, at 26.16%, while balcony balustrades saw a change of 23.36%.

In the Modern period, significant transformations occurred in walls (25.07%), roofs (15.10%), doors (19.03%), windows (17.82%), balconies (9.36%), and parapets (13.59%). During the LM period, changes were observed in walls (19.10%), roofs (14.64%), doors (19.10%), windows (14.01%), balconies (22.92%), and parapets (10.19%), as illustrated in Figure 32.

During the PI period, wall finishes were achieved by applying natural lime plastering to attain colour. In the modern era, due to erosion and deterioration of the plastering, there was a gradual transition towards whitewashing to maintain wall colour. Subsequently, in the LM period, aesthetic considerations led to the replacement of whitewash with artificial colour paint, as depicted in Figure 33. In the PI period, people used locally available red clay tiles to maintain their architectural identity, a practice still followed today. During the modern period, they also started using cement asbestos sheets for the ground floor roof.

Some houses completely changed during the LM period, transitioning to flat concrete roofs. In the PI period, wooden windows were coated with varnish, preserving their natural wood appearance and featuring iron grills.

In the modern period, wooden windows were finished with varnish to uphold their natural wood look, while the grills were painted black and white. During the LM period, wooden windows were coated with colored varnish, resulting in an appearance resembling artificial coloring, as seen in Figure 34. In the PI period, Agraharam houses did not have parapet walls due to their sloped roofs.

However, in the modern period, parapet walls underwent significant changes, with colors often being crisp whites or soft pastels, reflecting urbanization and modern design preferences.

In the LM period, parapet wall colors became more diverse, with natural pigments or eco-friendly paints being used to support environmental sustainability, as depicted in Figure 35.

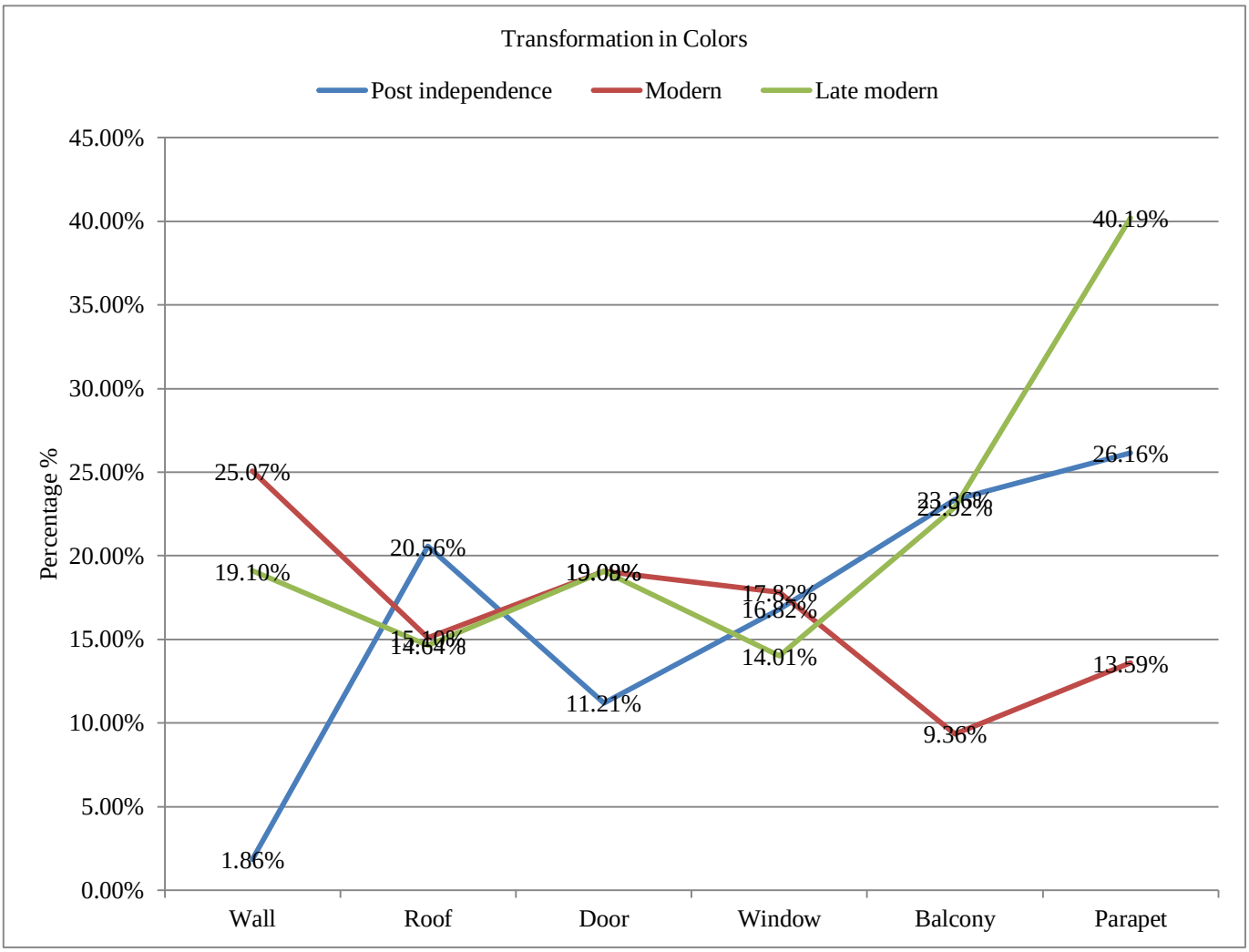

Fig. 32 Transformation analysis of colors across three periods

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 3 : COLOR WALL			
	During the post independence period, the wall finish color were achieved through the application of natural lime plastering.	In the modern period, as erosion and deterioration affected the plastering, a gradual shift towards whitewashing in the wall color occurred	In the late modern period, for aesthetic reasons, the white wash was eventually replaced with artificial color paint as seen in the image.

Fig. 33 Wall colour transformation analysis in three different periods

Source: The Author

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 3 : COLOR WINDOW			
	The wooden windows were coated with varnish, preserving the natural appearnace of the wood while featuring iron grills during post independence period.	The wooden windows were finished with varnish to maintain the natural wood appearance , while the grill was painted with black and white colors during modern period.	During the late modern period, the wooden window was coated with colored varnish, resulting in a finish that resembles artificial coloring.

Fig. 34 Window colour transformation analysis in three different periods

Source: The Author

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 3 : COLOR PARAPET WALL			
	During the post independence period, the parapet wall was not present as the agraharam house was designed and constructed with a sloped roof, eliminating the need for a parapet wall.	In the modern period, traditional building facades saw considerable transformations in parapet wall colors, with crisp whites or soft pastels. These changes mirrored urbanization trends and contemporary design preferences.	In the late modern period, parapet wall colors diversified, including natural pigments or eco-friendly paints with low VOC content to support environmental sustainability.

Fig. 35 Parapet wall colour transformation analysis in three different periods

Source: The Author

7.1.5. Facade Principles

This parameter evaluates eight factors influencing the transformation of building facades: Symmetry of facades, axis, location of main entry, scale and proportion, repetition, balance, rhythm and hierarchy. The analysis spans three distinct periods: PI, Modern, and LM. During the PI period, the symmetry of facades experienced a modest change of 9.83%, while the axis underwent a more significant alteration of 13.45%. The location of the main entry showed a slight change at 12.04%, whereas scale and proportion exhibited a noticeable transformation of 11.64%. Repetition experienced the most substantial change, at 14.45%, while balance saw a change of 13.45%, rhythm saw a change of 13.05% and hierarchy at 11.64%. In the Modern period, significant transformations occurred in the symmetry of facades (14.33%), axis (10.66%), location of main entry (10.66%), scale and proportion (16.17%), repetition (9.19%), balance (10.66%), rhythm (12.13%) and hierarchy (16.17%). During the LM period, changes were observed in the symmetry of facades (17.26%), axis (12.50%), location of main entry (16.66%), scale and proportion (8.90%), repetition (11.90%), balance (12.50%), rhythm (11.30%) and hierarchy (8.92%) as illustrated in Figure 36. In the PI period, symmetry in traditional building facades was achieved by carefully arranging architectural elements like windows and doors around a central axis, along with decorative features such as columns and arches. This created a balanced and harmonious layout. During the modern period, there was a noticeable shift

towards asymmetrical compositions in traditional building facades. This involved experimenting with irregular placements of windows, varied rooflines, and unconventional massing. In the LM period, traditional building facades evolved to blend traditional and contemporary design elements. Asymmetrical elements were balanced to maintain visual equilibrium, as seen in Figure 37. In the PI period, the main entry axis was positioned between the two thinnai spaces. During the modern period, the main entry axis extended towards the road due to the enclosure of the thinnai space for expansion purposes. In the LM period, the main entry axis was completely sealed off by either a compound wall or a gate with a grill, as seen in Figure 38. In the PI period, traditional building facades featured sloped roofs with evenly arranged clay tiles, creating a rhythmic pattern. Thinnai spaces had repetitive elements like intricately carved wooden pillars, contributing to a balanced composition. During the modern period, changes such as altering roof styles and enclosing thinnai spaces with walls disrupted the uniform appearance and repetitive elements of traditional facades. In the LM period, some houses within a continuous row underwent complete changes in facade style and materials, disrupting the repetition observed in surrounding buildings, as seen in Figure 39.

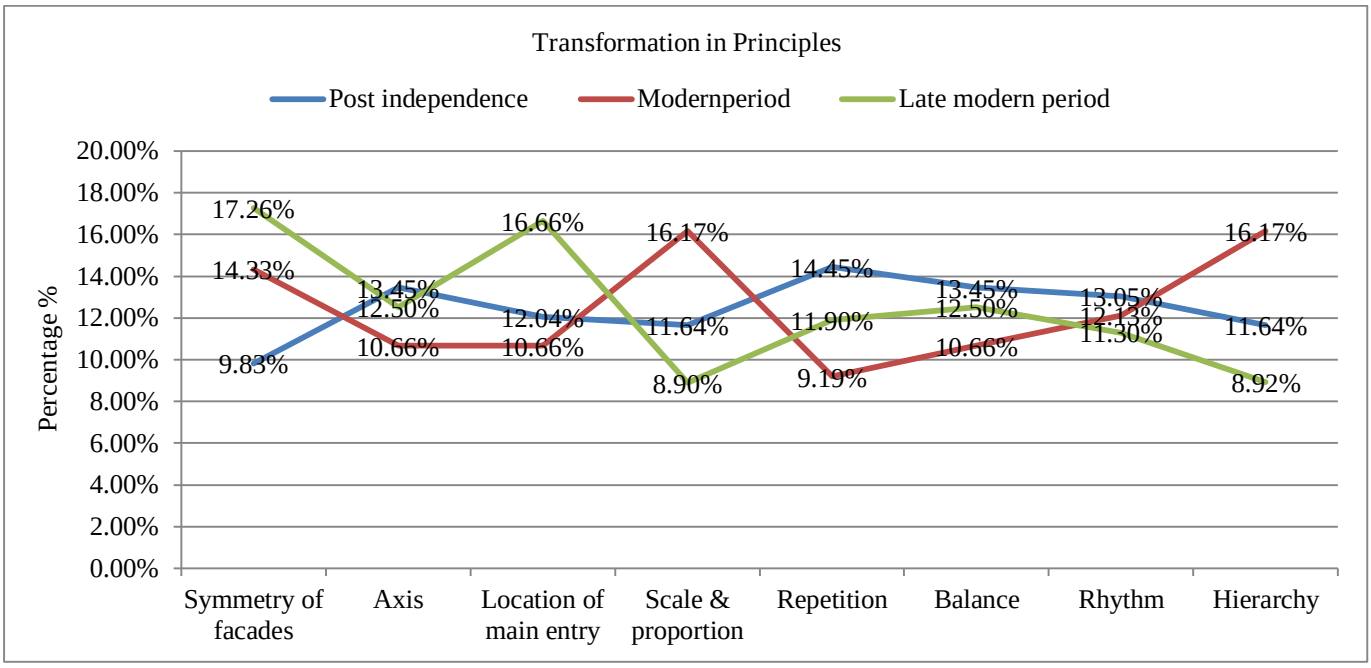

Fig. 36 Transformation analysis of facade principles across three periods

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 5 : PRINCIPLES SYMMETRY OF FACADES			
	In the post independence period, symmetry was attained by carefully positioning architectural elements like windows and doors, complemented by decorative features such as columns, arches and other embelishments on both sides of a cental axis, resulting in a harmonies and balanced arrangement.	During the modern period, traditional building facades experienced notable shifts in symmetry, favoring more asymmetrical compositions. This involved experimenting with irregular placements of windows, diverse roofllines and unconventional massing.	Transitioning into the late modern period, traditional building facades evolved, blending traditional and contemporary design sensibilities. Asymmetrical elements were carefully balanced to create a sense of visual equilibrium.

Fig. 37 Symmetry of facade transformation analysis in three different periods

Source: The Author

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 5 : PRINCIPLES LOCATION OF MAIN ENTRY			
	During the post independence period, the location of the main entry axis was situated between the two thinnai spaces.	The location of the main entry axis extended towards the road as a result of enclosing the thinnai space for expansion purposes during modern period.	The main entry axis was entirely sealed off by a compound wall or a gate with a grill during late modern period.

Fig. 38 Location of main entry transformation analysis in three different periods (Source: The Author)

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 5 : PRINCIPLES REPETITION			
	During the post independence period, traditional building facades had sloped roofs with evenly arranged clay tiles, creating a rhythmic pattern. Thinnai spaces also had repetitive elements like intricately carved wooden pillars, adding to the balanced composition.	In the modern period, changes in traditional facades like altering roof styles and enclosing thinnai spaces with walls disrupted their uniform appearance and repetitive elements.	In the post modern period, certain houses within the continuous row underwent a complete change in façade style and materials, effectively disrupting the repetition observed in the surrounding buildings.

Fig. 39 Repetition of facade transformation analysis in three different periods (Source: The Author)

7.1.6. Facade Iconography

This parameter assesses the influence of "Kaavi," a paint color combination of white and red, on the transformation of building facades across three distinct periods: PI, Modern, and LM period. During the PI period, Kaavi experienced a modest change of 7.81%, as seen in Figure 40. It was commonly observed in traditional facades, playing a significant role in preserving cultural heritage, conveying symbolism, and fostering community identity. In the Modern period, Kaavi exhibited a noticeable transformation of 7.16%.

The fading and diminished visibility of Kaavi, once prevalent in traditional facades during the PI period, can be attributed to a cultural shift as society modernizes. During the LM period, significant transformations occurred, with a change of about 45.33%. The disappearance of Kaavi in LM buildings reflects a shift towards modern aesthetics, neutral color preferences, and changing architectural styles, as seen in Figure 41.

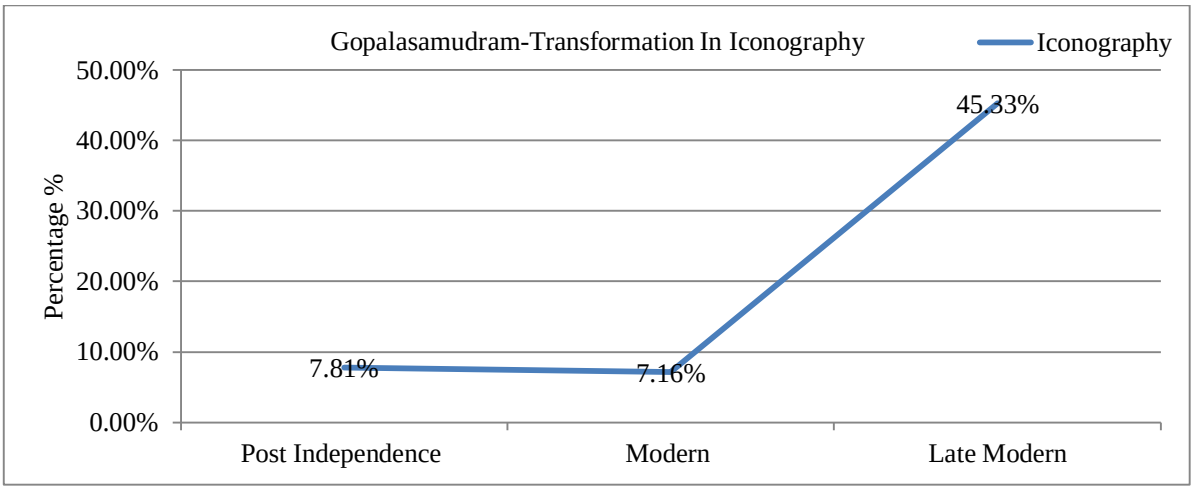

Fig. 40 Transformation analysis of Facade iconography across three periods

VISUAL ELEMENT FACTOR	TRANSFORMATION ANALYSIS		
	POST INDEPENDENCE PERIOD (1947-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)
CATEGORY 5 : PRINCIPLES ICONOGRAPHY			
	Kaavi - a paint color combination of white and red was commonly observed in traditional facades during the post independence period lies in its role in preserving cultural heritage, conveyimg symbolism and fostering community identity.	The fading and diminished visibility of "kaavi" which was once commonly observed in traditional facades during the post independence period, during the modern era of house facades can be attributed to a cultural shift as society modernizes.	The disappearnce of "kaavi" in late modern buildings reflects a shift towards modern aesthetics, neutral color preferences and changing architectural styles.

Fig. 41 Facade Iconography transformation analysis in three different periods

Source: The Author

7.2. Summary of Qualitative Results

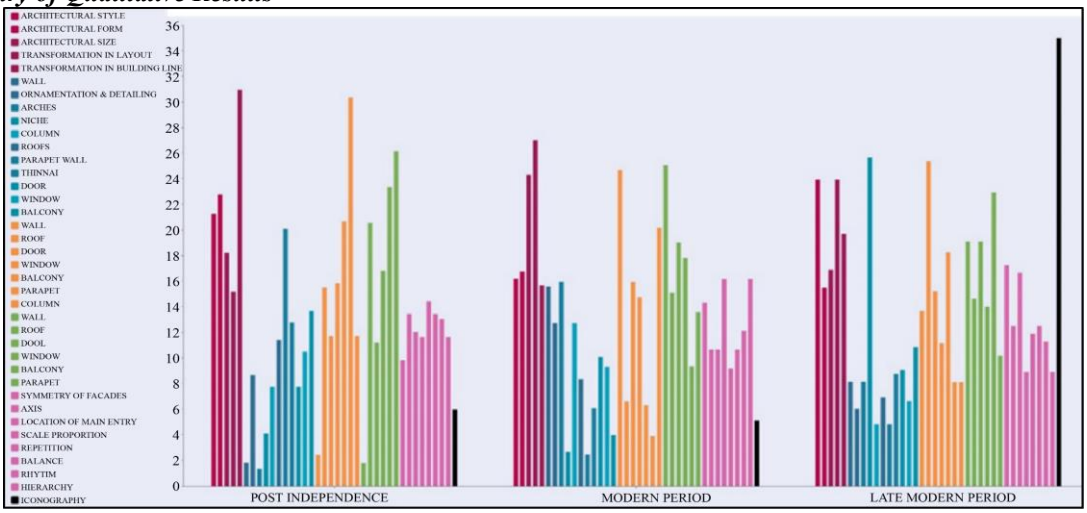

Fig. 42 Graph depicting the summary of qualitative results of each period of transformation analysis

The qualitative analysis indicates that each period of transformations in Gopalasamudram Agraharam encountered various modern forces, impacting its traditional building facade and architectural identity differently. The summary of qualitative results from visual analyses for the study parameters elucidates the distinctive features of each period, as depicted in the graph below, as seen in Figure 42. These findings provide insight into the stylistic variations among the parameters during each period of transformation. During the PI period, the most significant transformations observed in building facades were related to facade principles, accounting for 25.95%. Following this, facade elements/details and planning accounted for 22.82% and 17.14%, respectively. Facade materials, colour, and iconography constituted 15.11%, 11.15%, and 7.81% of the transformations, respectively, as seen in Figure 43. In the Modern period, the most notable transformations in building facades were attributed to facade elements/details, comprising 29.66%. This was followed by facade materials and colour at 18.72% and 18.66%, respectively. Facade principles, planning, and iconography accounted for 15.34%, 10.43%, and 7.16% of the transformations, respectively, as seen in Figure 44. During the LM period, facade elements/details again represented the most prominent transformations, accounting for 20.47%. Following this, facade materials, principles, and colour accounted for 9.70%, 10.38%, and 9.70%, respectively. Iconography and facade planning constituted 45.33% and 4.39% of the transformations, respectively, as seen in Figure 45. The graph shown in Figure 46 illustrates the cumulative results of transformations identified across all three periods for factors including planning, elements, materials, colour, principles, and iconography.

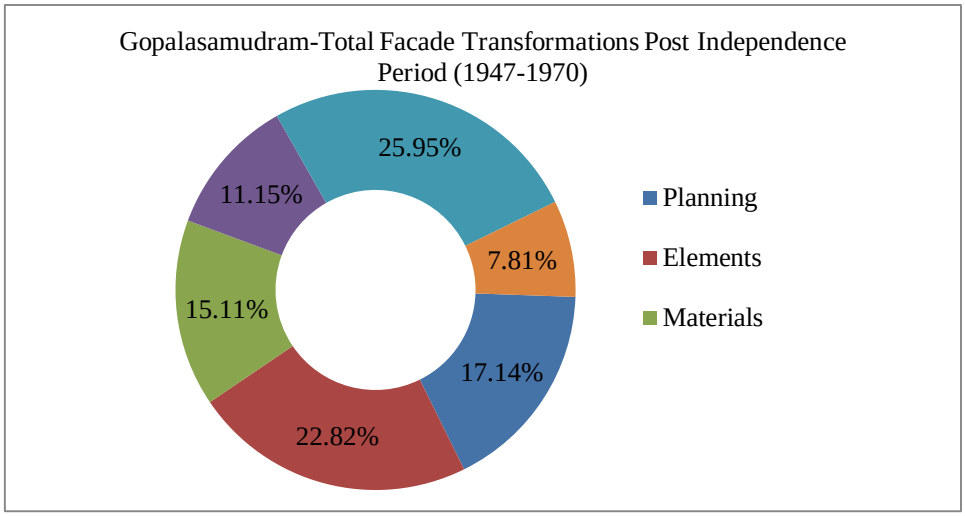

Fig. 43 Total facade transformations during post-independence period

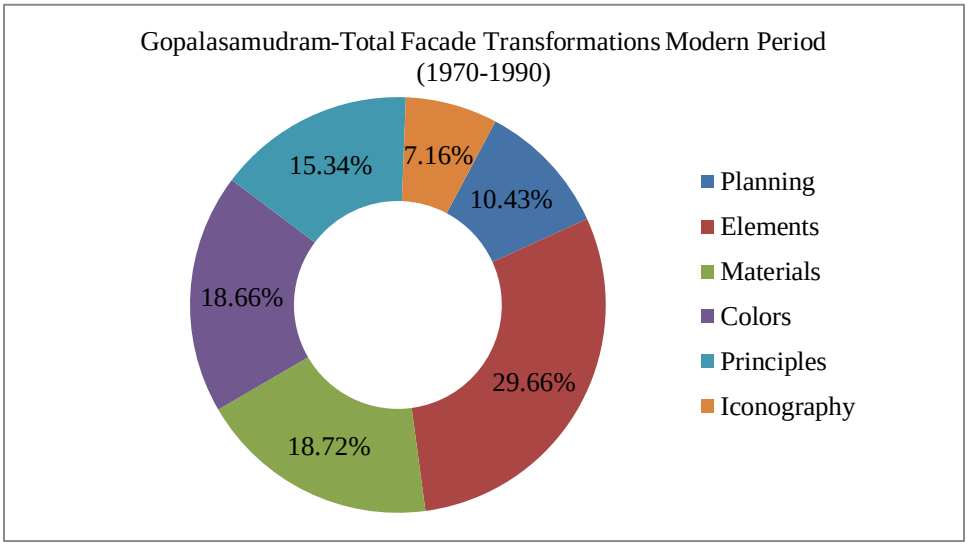

Fig. 44 Total facade transformations during the modern period

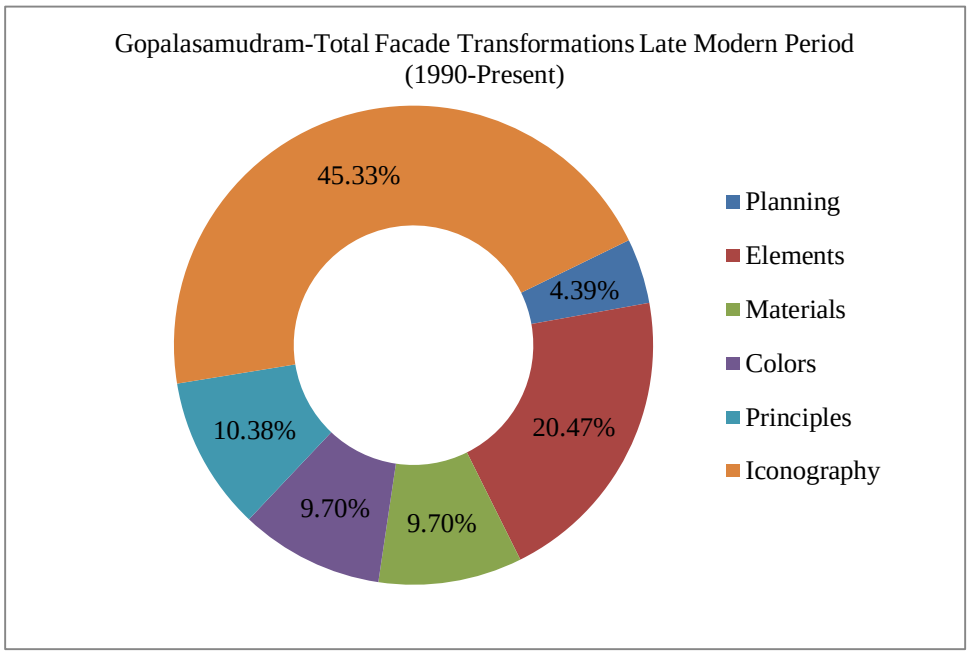

Fig. 45 Total Facade transformations during the late modern period

The qualitative analysis of this study reveals that among the transformations identified for 117 buildings, the average highest % among the three distinctive periods, approximately 24.39%, pertains to building facade elements and details. Following this, building facade iconography accounted for 19.02%, while building facade principles constituted 17.66% of the transformations. Additionally, building facade materials accounted for 14.67%, and facade colour comprised 13.22%. The least significant transformation identified in this study was building facade planning, representing only 11.01% of the total transformations observed, as shown in Figure 47.

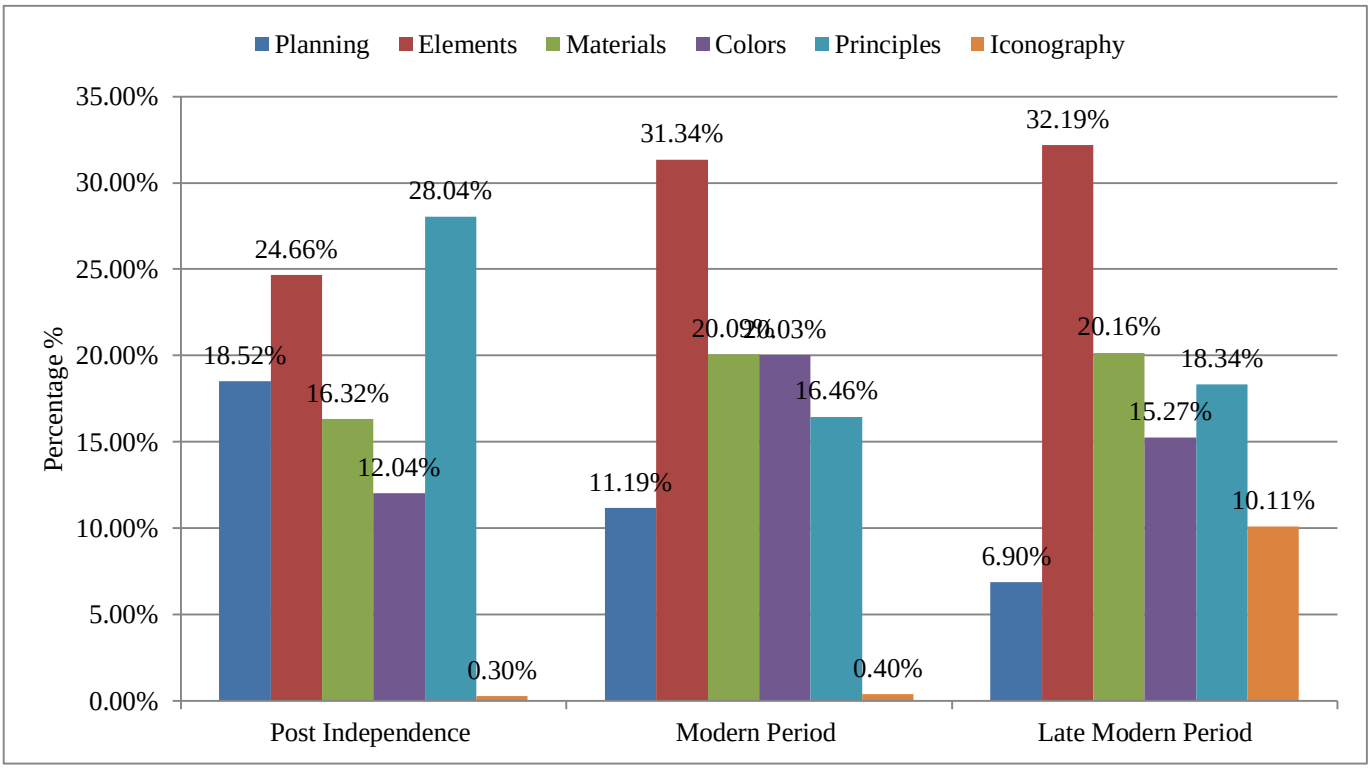

Fig. 46 Graph representing the cumulative results of transformations identified across three periods

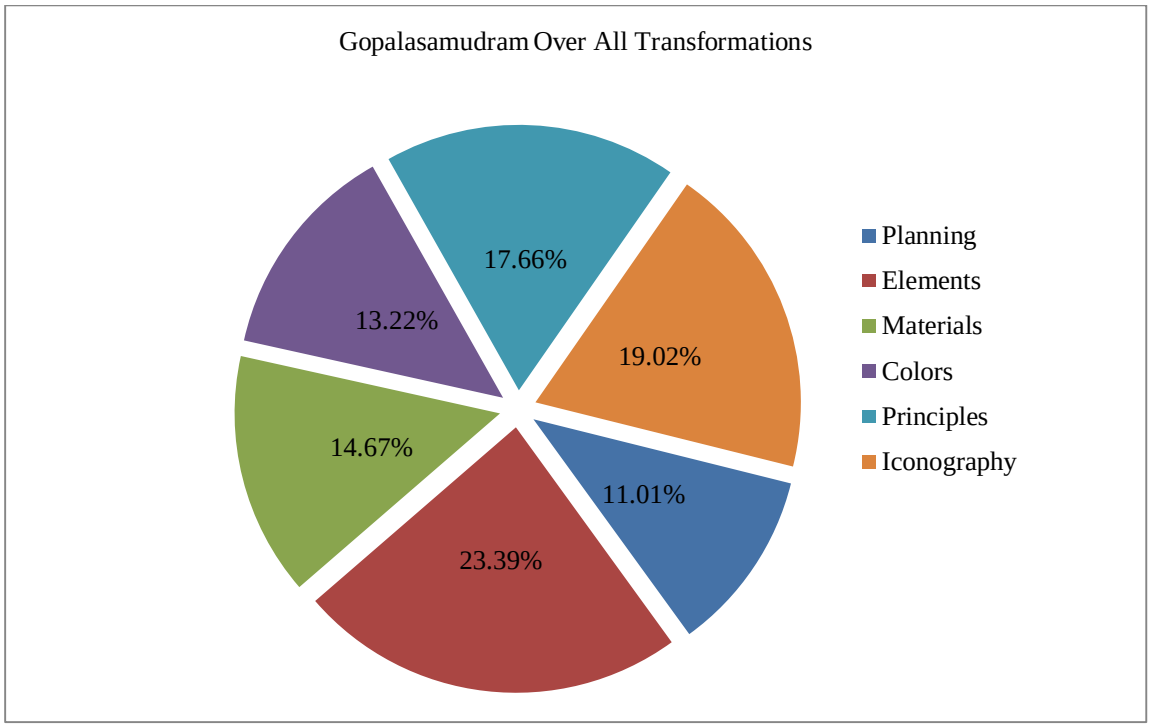

Fig. 47 Graph depicting the % of overall facade transformations using qualitative analysis at Gopalasaumdram Agraharam at Tirunelveli

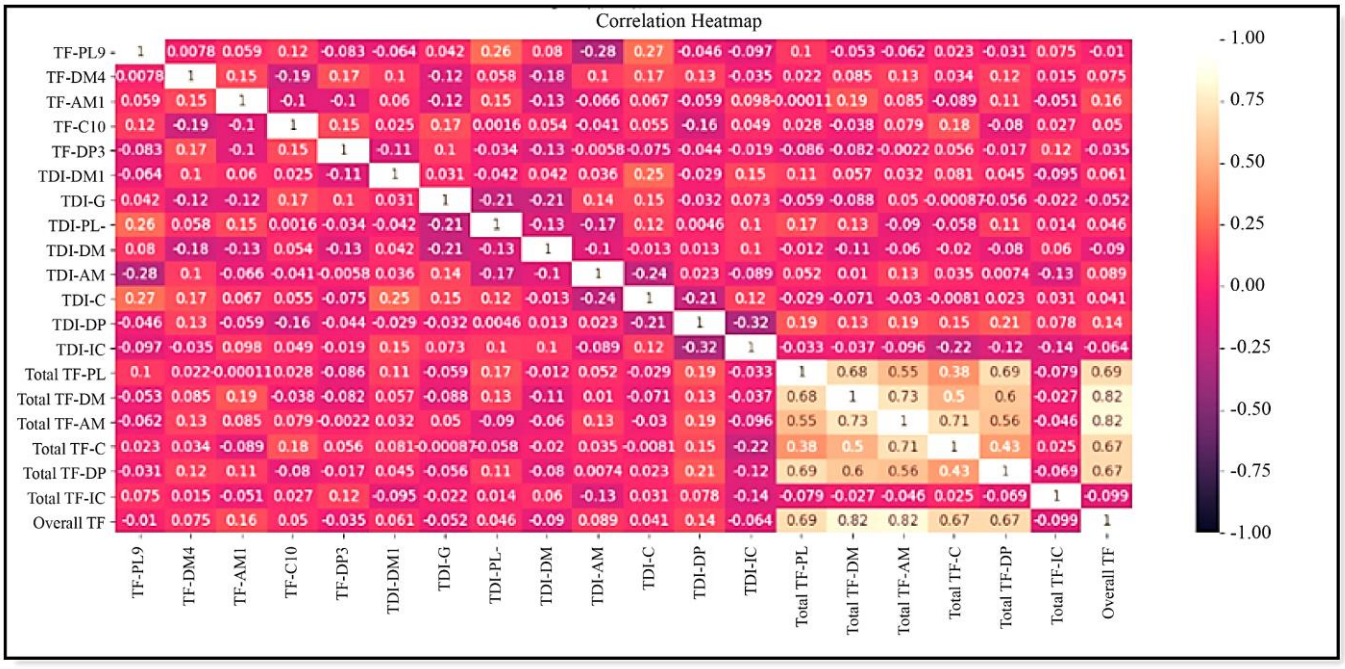

Fig. 48 Correlation heat map for Transformation building facade with sustenance of TI

7.3. Quantitative Analysis

7.3.1. Stage 1- Correlation Analysis

In this experimental study, the relationships of building facade transformation factors considered are Facade planning, facade elements, facade Materials, facade colour, facade principles and Iconography, whereas the dependent variables are the sustenance of Traditional identity. This quantitative analysis will determine the results of the transformation of building facade correlation in Gopalasamudram Agraharam streets of Tirunelveli.

Moreover, this research concentrated on identifying the significant correlation among the factors which affect the sustenance of TI and also in testing the hypothesis. Hence, correlation analysis like Pearson Product Moment and Correlation Coefficient Test are used for exploring the relationships between the variables. Thus, it assists in describing the strength as well as the direction of the linear relationship among variables. Correlation coefficients range from -1.00 to +1.00. The negative correlation is identified through the value of -1.00 represents, whereas the value of +1.00 represents a perfect positive correlation. In the case of lack of correlation, the value is represented as 0.00. The correlation heat map is generated with respect to all independent as well as dependent variables is shown in Figure 48.

Table 9 illustrates the correlation relationships among the positive impact of building facade transformation of the independent variable and traditional identity of the respective factors. This correlation heat map discusses the positive relationship and the negative relationship with the various factors with TI of all factors considered in this experiment. This can be determined with the p-value associated with the hypothesis generated and finally accomplished with the significant results.

Table 9. Pearson correlation between various variables

		TF of Building Facade Planning	TF of Building Facade Elements	TF of Building Facade Materials	TF of Building Facade Color	TF of Building Facade Principles	TF of Building Facade Iconography
TI of Facade Planning	Pearson Correlation	0.26	0.058	0.15	0.0016	-0.0034	0.1
TI of Facade Elements	Pearson Correlation	0.064	0.1	0.06	0.025	0.042	0.1
TI of Facade Materials	Pearson Correlation	-0.28	0.036	0.091	0.041	0.0058	-0.089
TI of Facade Color	Pearson Correlation	0.27	0.25	0.067	0.055	-0.075	0.12
TI of Facade Design Principles	Pearson Correlation	-0.046	0.13	-0.059	-0.16	-0.044	-0.32
TI of Facade iconography	Pearson Correlation	-0.097	-0.035	0.098	0.049	0.019	-0.14

The verification of significant correlation among the independent variables (Transformations) as well as the dependent variable (Sustenance of TI) through subsequent hypotheses are formulated:

H 1 : Positive relation among building Facade planning and the Sustenance of TI
H 2 : Positive relation among Facade elements/details and the Sustenance of TI
H 3 : Positive relation among Facade materials and the Sustenance of TI
H 4 : Positive relation between Facade color and the Sustenance of TI
H 5 : Positive relation among Facade principles and Sustenance of TI
H 6 : Positive relation among Facade iconography and Sustenance of TI.

Table 10 illustrates that the correlation between the overall transformation of the building facade and traditional identity is 0.67, which has a better positive relationship correlation. Therefore, the sustenance of TI has a positive impact on the transformation of the building facade in the Gopalasamudram Agraharam streets of Tirunelveli.

Table 10. Pearson correlation among dependent and independent variables

		Transformations	Traditional Identity
Transformations	Pearson Correlation	1.00	0.67
Traditional Identity	Pearson Correlation	0.67	1.00

7.3.2. Summary of Quantitative Results - Correlation Analysis
The Relationship between Building Facade Planning and the Sustenance of TI

The correlation analysis result for the relationship between facade planning and the sustenance of TI is shown in Table 11. The correlation coefficient is R= 0.2602; the P-value is 0.0049<0.01, which is highly significant. The result represents a highly significantly positive relationship between the Sustenance of TI and building facade planning that clearly determines preserving the cultural identity.

The Relationship among Facade Elements/Details and the Sustenance of TI

The correlation analysis result for the relationship between facade elements/details and the sustenance of TI is shown in Table 11. The correlation coefficient is R= 0.1099, P-value is 0.3150>0.01, which is insignificant. Thus, the result is an indication of an insignificant negative relationship between the Sustenance of TI and building facade element and details that clearly determines in preservation of the traditional identity.

The Relationship among Facade Materials and the Sustenance of TI

Correlation analysis results for the relationship between facade materials and the sustenance of TI as shown in Table 11. The Pearson product-moment linear correlations were conducted. The correlation coefficient is R= 0.1883, P-value is 0.00439<0.01, which is significant. This result determines that facade materials have slight influences on the sustenance of TI. Therefore, facade materials have a direct impact on the sustenance of TI with a positively significant relationship between the both.

The Relationship among Facade Colour and the Sustenance of TI

The correlation analysis result for the relationship between facade colour and the sustenance of TI is shown in Table 11. The correlation coefficient is R= 0.1948, P-value is 0.00373<0.01, which is significant. Thus, the result represents a significantly positive relationship between the Sustenance of TI and building facade colour that clearly determines better visual aesthetics.

The Relationship among Facade Principles and Sustenance of TI

Correlation analysis results for the relationship between the Facade principle and the sustenance of TI as shown in Table 11. The correlation coefficient is R= 0.2067, P-value is 0.00266<0.01, which is significant. This result implies that the facade principle has a direct impact on the sustenance of TI, which is an indication of a positively significant relationship.

The Relationship between Facade Iconography and Sustenance of Traditional Identity

Correlation analysis results for the relationship among facade iconography and the sustenance of TI as shown in Table 11. The Pearson product-moment linear correlation is conducted, and the correlation coefficient is R= 0.1026, P-value is 0.439>0.01, which is insignificant. This result involves that facade iconography has slight influences on the sustenance of TI. Thus, the result is an indication of a weak relation between the mentioned variables that is statistically insignificant. The relationship between facade iconography and the sustenance of TI is an indication of a negative relationship, and that building facade iconography has less influence than the other variables.

Table 11. Summary of correlation analysis of dependent and independent variables

	Hypothesis	R-Value	P- Value	Result
H1	Positive relation among Building facade planning and the Sustenance of TI	0.2602	0.00497<0.01	Highly Significant
H 2	Positive relation among Building facade elements/details and the Sustenance of TI	0.1099	0.3150>0.01	Insignificant
H3	Positive relation among Building facade materials and the Sustenance of TI	0.1883	0.00439<0.01	Significant
H4	Positive relation among Building facade color and the Sustenance of TI	0.1948	0.00373<0.01	Significant
H5	Positive relation among Building facade principles and Sustenance of TI	0.2067	0.00266<0.01	Significant
H6	Positive relation among Building facade iconography and Sustenance of TI	0.1026	0.439>0.01	Insignificant

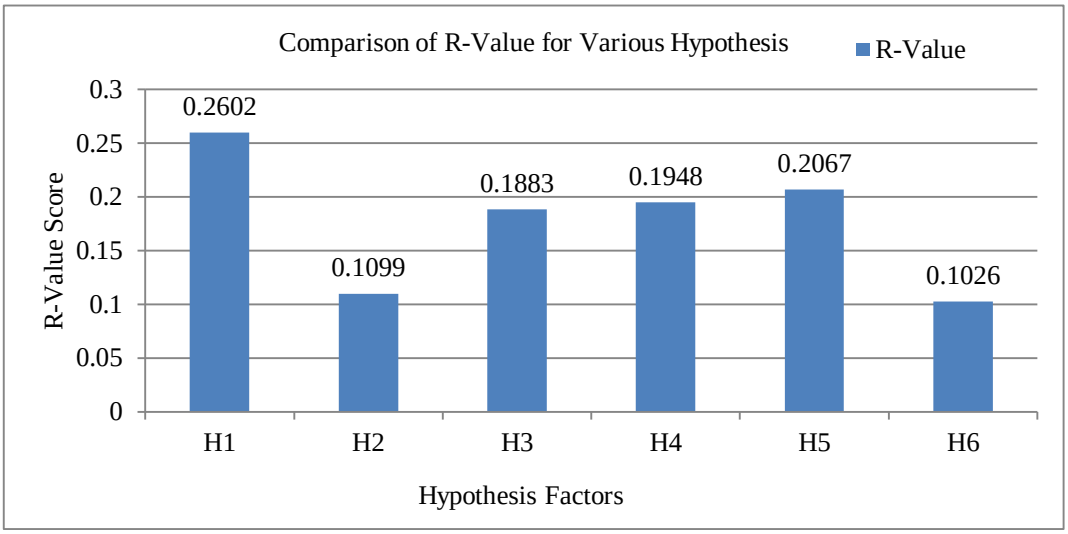

Fig. 49 Comparison of R-value for various hypothesis

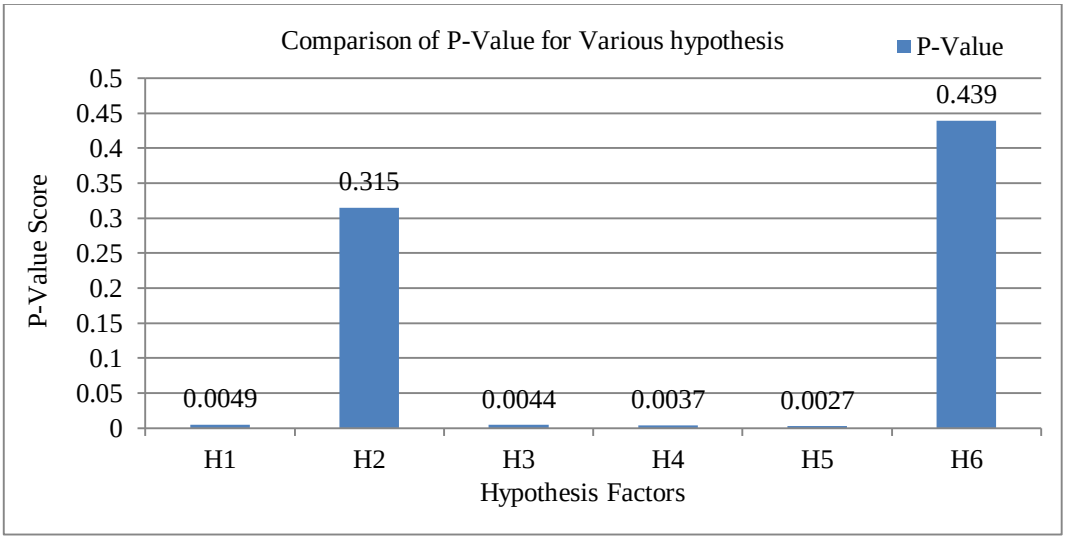

Fig. 50 Comparison of P- value for various hypotheses

Table 11 illustrates the positive and negative relationships between the sustenance of TI and building facade factors that can be evaluated through R-value as Pearson correlation coefficient, P-value and the status of significance.

Figure 49 illustrates the R-value of the hypothesis with positive impacts of building facade factors and substance of TI. R-value can determine the high significance of the hypothesis factors with high value. As the R-value increases, the hypothesis factors get more significant.

The R-value is high for H1 at 0.2602, followed by H5, H4 and H3 at 0.2067, 0.1948 and 0.1883 respectively. The insignificant hypothesis factors are H2 and H6, with the least R-value at 0.1099 and 0.1026 correspondingly.

Figure 50 illustrates the P-value of the hypothesis with positive impacts of building facade factors and substance of TI. The high significance of the hypothesis factors can be determined by the P-value with the least value. As the P-value is less than 0.01, the hypothesis factors become significant and highly significant. The P-value is lesser than 0.01are H1 as 0.0049. The insignificant hypothesis factors are H2 and H6, with higher than 0.01 values as 0.315 and 0.439 respectively.

7.3.3. Stage 2 – Multiple Regression Analysis

In regression analysis, those factors are made into variables. The Traditional Identity General (TI-G) is the dependable variable which has the main factor to understand or predict.

However, independent variables like building facade planning, building facade elements and details, building facade materials, building facade colour, building facade principles and building facade iconography are involved in this experimental research.

Table 12. Model summary of multiple regression analysis between Dependent and Independent variables

Model Name	R	R-Square	Adjust R-Square	Std. Error of the Estimate
MR	0.636	0.405	0.278	0.159

There are six individual parameters associated with building facade considered as independent variables, and the dependent variable involved is TI-G. The MLR model is as follows:

$$TI-G=\beta+\beta_1 PL+\beta_2 DM+\beta_3 AM+\beta_4 C+\beta_5 DP+\beta_6 IC+\varepsilon \quad (2)$$

Where,

TI-G = Traditional Identity of General
β = Constant
ε = Standard Error

Hence, these factors have an impact on the dependent variable, whereas the R-square adjusted R-Square of MLR helps to determine the model efficiency in determining the sustenance of TI with respect to the transformation of building facade factors shown in Table 12.

7.3.4. Summary of Quantitative Results - Multiple Regression Analysis

In terms of importance, the Traditional Identity General as a constant parameter (β=-0.521, p= 0.001) and the "Building facade planning" values (β=0.045, p=0.014) have highly significant positive associations with TI. These results prove that the "Building facade planning" parameter has the most influence in interpreting the architectural Identity continuity due to every unit of change in this parameter gets associated with a 0.096 change in the TI. Each unit of change represented in the "Building facade elements" factor is related to a 0.164 change in the TI.

Every unit of change in the "Building facade materials" parameter is related to a 0.126 change in the TI. Interestingly, "Facade materials" (β=0.074, p=0.006), "Facade colour" (β=0.050, p=0.0069) and "Facade design principles" (β=0.019, p=0.0117) is considered to be significant and have positive relationships with the traditional identity. In the case of Facade iconography (β=0.049, p=0.58) and "Facade Elements/details" (β=0.103, p=0.001), the p-value associated with insignificant results determines that facade iconography and elements/ details have no impact with the sustenance of TI as shown in Table 13.

Table 13 illustrates the results obtained from the MLR analysis in which the β represents the unique contribution of each independent variable. Hence, the MLR model formula is calculated as follows:

$$TI-G=(-0.521)+(0.045)PL+(0.103)DM+(0.074)AM+(0.050)C+(0.019)DP+(0.049)IC$$

Therefore, the MLR model assists in defining the TI-G of the building facade analyzed through quantitative analysis of transformations in Gopalasamudram Agraharam encountered various modernity forces, positive impact on traditional building facades and architectural identity differently.

Table 13. Summary of multiple regression analysis

	β	Std. Error	Standardized β	t-Value	p-value
(Constant)	-0.521	0.159	-0.205	-3.272	0.001
Facade Planning	0.045	0.026	0.096	1.759	0.014
Facade Elements	0.103	0.031	0.164	3.375	0.001
Facade Materials	0.074	0.026	0.126	2.790	0.006
Facade Color	0.050	0.027	0.104	1.842	0.0069
Facade Design Principle	0.019	0.027	0.072	0.711	0.0117
Facade iconography	0.049	0.026	0.101	1.916	0.58

8. Conclusion

This paper discloses the positive impacts of the building facade transformation factors and the sustenance of TI in Gopalasamudram Agraharam of Tirunelveli district. There were several questionnaires involved in the various factors of Facade planning, facade elements, facade Materials, facade colour, facade principles and Iconography. The juxtaposition of qualitative and quantitative findings served to corroborate the accuracy of the results and offered enhanced cohesion. Qualitative data yielded crucial contextual insights into the transformation analysis of building facades across three distinct periods in Tirunelveli Gopalasamudram agraharam. The qualitative findings have provided numerous valuable insights by elucidating and documenting the physical characteristics of the built environment's facade. Additionally, the depiction of the facade visual elements transformation analysis across various periods enriches the study and establishes a sturdy platform for future research endeavors. Moreover, qualitative analysis elucidated both the commonalities and distinctions among building facades.

On the contrary, the quantitative results assessed how factors impacting the transformation of building facades affect the sustenance of traditional identity. The Pearson correlation coefficient has determined that facade planning is highly significant with a positive impact relationship among Sustenance of TI. Similarly, the Pearson correlation coefficient of facade colour, facade materials and facade principles are significant with a positive impact relationship among Sustenance of TI, but facade iconography and facade elements/details are insignificant with a negative impact relationship among Sustenance of TI. These results convincingly proved that the building facade transformation factors encompass a vital impact on the sustenance of TI.

In contrast, the MR results designate the proposed model as determined statistically, which corresponds to the prediction of the sustenance of TI from building facade transformation factors. The significance of the building facade transformation factors enlightens more than a quarter of the variation towards the sustenance of TI. The MR results determined that the “Facade planning”, “Facade colour”, “Facade materials”, and “Facade principles” factors are the most significant in interpreting the sustenance of TI due to each unit of change identified in these factors as related with significant positive impacts in the sustenance of TI.

Hence, both qualitative and quantitative findings strongly correlate in discerning the visual characteristics of building facades across three distinct periods of transformation analysis in Gopalasamudram Agraharam, Tirunelveli. The integration between qualitative and quantitative findings facilitated a vital link between empirical observations gathered from field surveys and statistical interpretations derived from respondent perspectives.

The research has important socioeconomic consequences despite its qualitative and statistical findings. The local community is affected throughout by the beneficial link discovered among facade transformation elements and the sustenance of traditional identity. This study promotes a sense of community pride as well as identity among locals through facilitating community involvement in the preservation process. Educational institutions can benefit from the research's institutional value that fosters more understanding and respect for cultural heritage. Additionally, the possible effects on travel and business prospects highlight the significance of protecting cultural identity for supporting the region's socioeconomic growth. Urban development policies are influenced by this research, which promotes a balanced approach that prioritizes modernity and cultural preservation, which leads to more environmentally friendly and culturally sensitive urban planning methods if metropolitan areas face rapid transformations. Living in a setting that upholds traditional identity values and fosters a sense of continuity and affiliation to cultural roots ultimately improves social well-being. Considered as entire, this research highlights the vital connection between architectural heritage as well as the continuity of traditional identity, as well as advancing scholarly understanding and highlighting the wider societal advantages of conscientious architectural preservation.

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Appendix

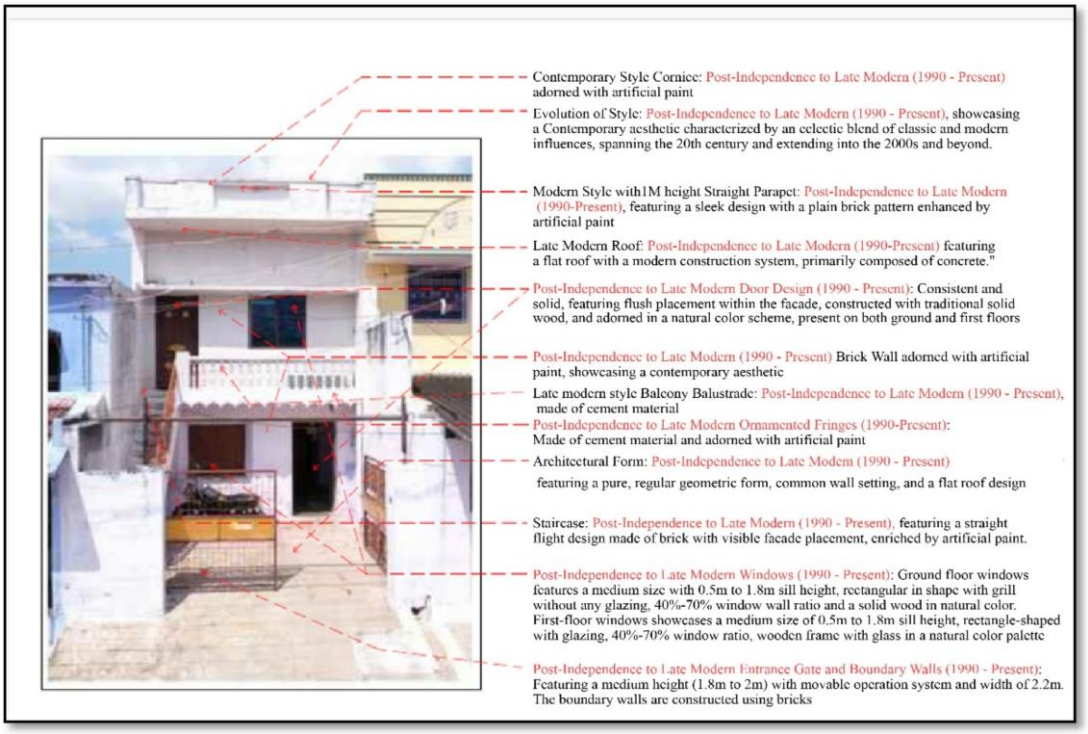

Fig. 2 Sample house 2 - image analysis of facade transformations

Source: The Author

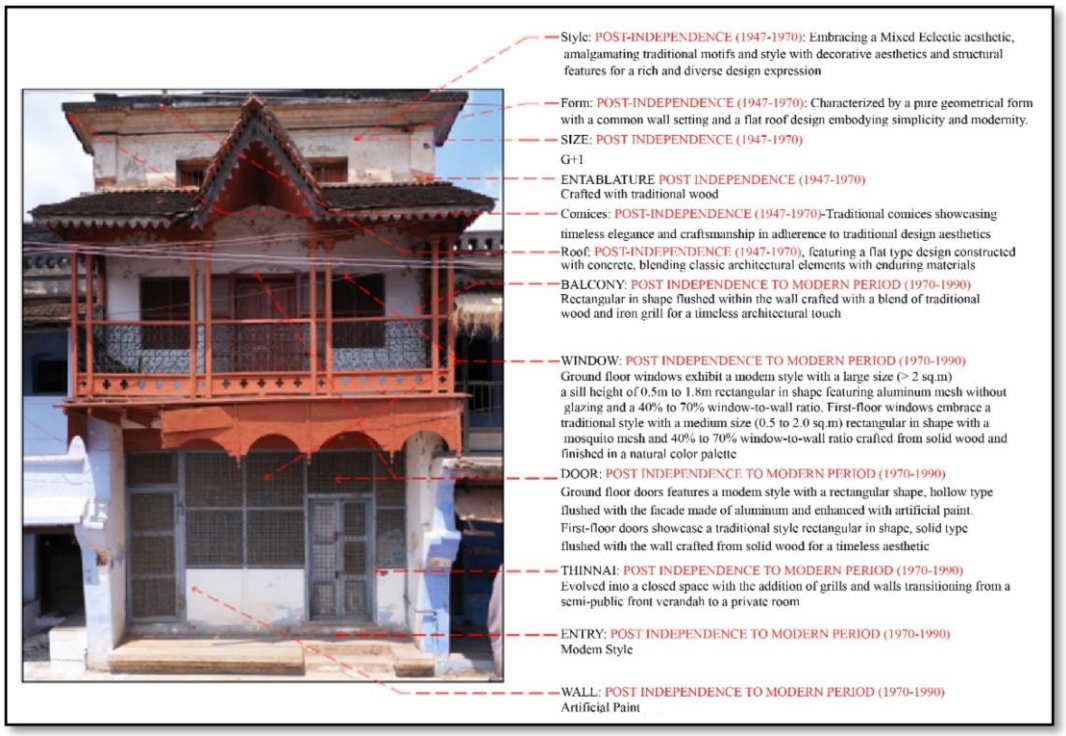

Fig. 3 Sample house 3 - image analysis of facade transformations

Source: The Author

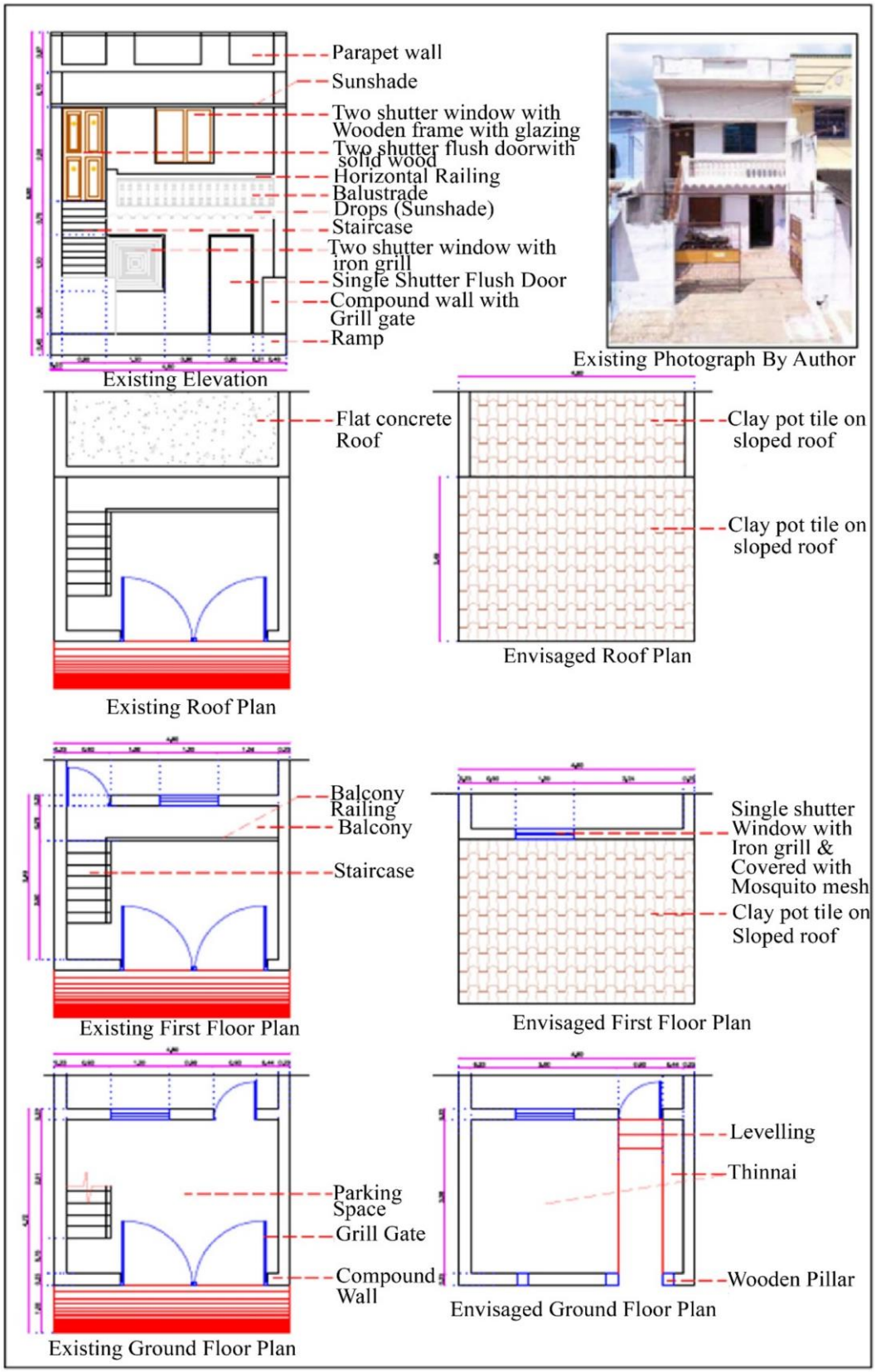

Fig. 4 Sample house 2 – detailed documentation and analysis of facade transformations

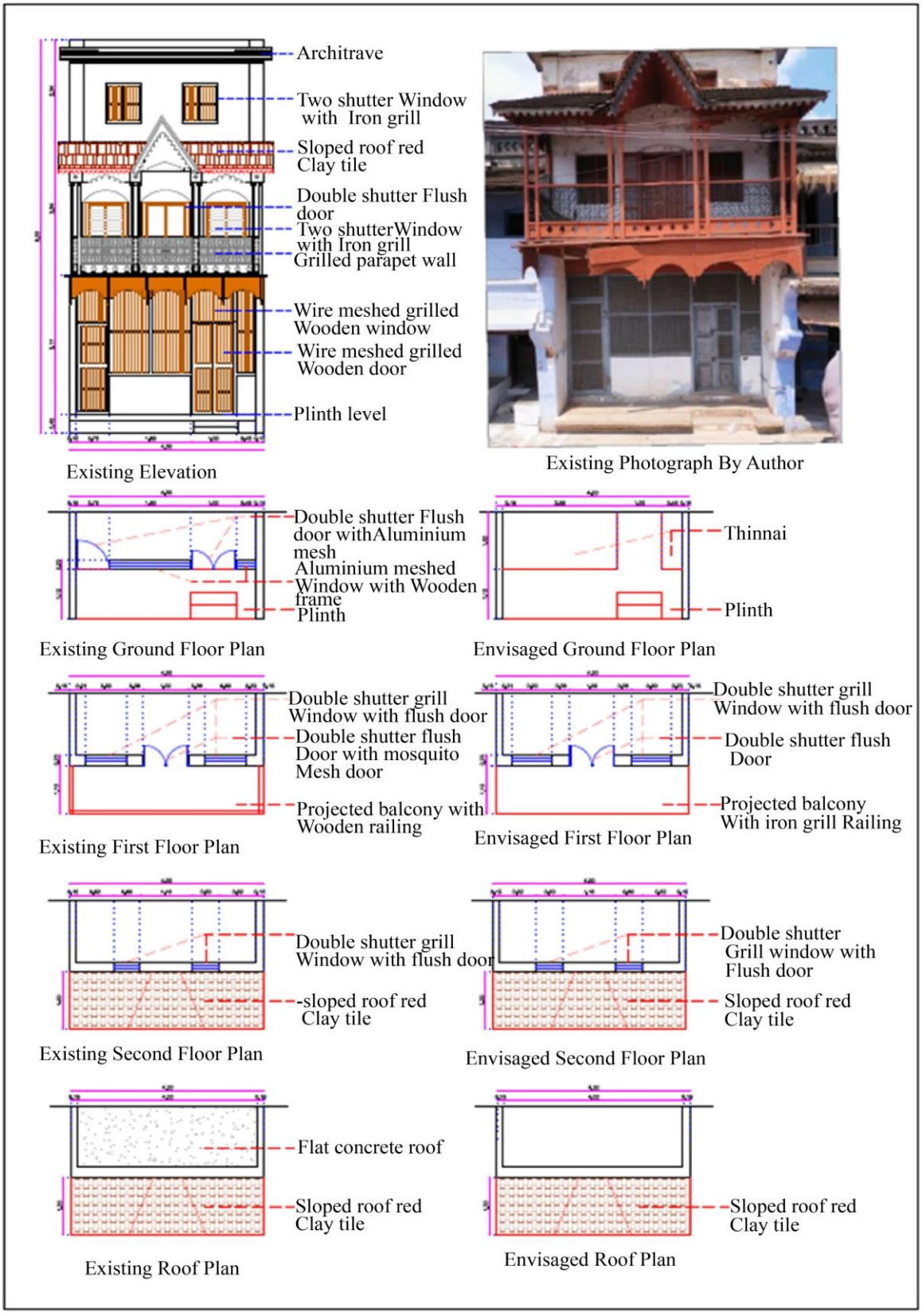

Fig. 5 Sample house 3 – detailed documentation and analysis of facade transformations

Table 1. The comparative results of building facade visual elements of three sample houses in three different transformation periods of Gopalasamudram Agraharam at Tirunelveli district

		SAMPLE HOUSE-1			SAMPLE HOUSE-2			SAMPLE HOUSE-3		
FACADE ELEMENT TRANSFORMATION		POST INDEPENDENCE PERIOD (1950-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)	POST INDEPENDENCE PERIOD (1950-1970)	MODERN PERIOD (1970-1990)	LATE MODERN PERIOD (1990-PRESENT)	POST INDEPENDENCE PERIOD (1950-1970)	MODERN PERIOD (1970- 1990)	LATE MODERN PERIOD (1990-PRESENT)
PLANNING	ARCHITECTURAL STYLE									
	ARCHITECTURAL FORM									
	ARCHITECTURAL SIZE									
	TRANSFORMATION IN LAYOUT									
	TRANSFORMATION IN BUILDING LINE									
ELEMENTS/DETAILS	WALL									
	ORNAMENTATION AND DETAILING									
	ARCHES									
	NICHE									
	COLUMN									
	ROOF									
	PARAPET									
	THINNAI									
	DOOR									
	WINDOW									
	BALCONY BALUSTRADE									
MATERIALS	WALL									
	ROOF									
	DOOR									
	WINDOW									
	BALCONY BALUSTRADE									
	COLUMN									
	PARAPET									
COLORS	WALL									
	COLUMN									
	ROOF									
	PARAPET									
	THINNAI									
	DOOR									
	WINDOW									
	BALCONY BALUSTRADE									
PRINCIPLES	SYMMTERY OF FACADE									
	AXIS									
	LOCATION OF MAIN ENTRY									
	SCALE & PROPORTION									
	REPETITION									
	RHYTHM									
	BALANCE									
	HIERARCHY									
ICONOGRAPHY	BRAHMIN CULTURE RELIGIOUS SYMBOLS/KAAVI									
SAMPLE HOUSES										

Table 2. Summary of planning parameter factors and values

Parameter Categories	Visual Element Factors	Possible Values
Category 1: Planning		
	Architectural Style	Colonial or Western Classical
		Art Deco or Western Classical
		Tamil Tradition or Tamil Classical
		Mixed Eclectic
		Modern
		Contemporary
	Architectural Form (Building Form Types)	Pure Regular Geometric Forms
		Non Regular Geometric Forms
		Curvature (Non-Geometric)
		Mixed Form
	Architectural Form (Building Setting)	Street Housing
		Row Housing
		Street Aligned With Setbacks
		Common Wall
		Bungalow Type With Compound Wall Isolated In A Plot
	Architectural Form (Entrance Orientation)	Parallel to street line
		Perpendicular to street line
		Oblique to street line
		Abutting street line
		No relationship to street line
	Base Relationship To Ground Line	At The Same Level With Ground Line
		Rising above the ground line
		Stepped Down From Ground Line
		No obvious relationship
	Architectural Size	Building height
		No.of Floors
		Building width-frontage

Table 3. Summary of elements / details parameter factors and values

Parameter Categories	Visual Element Factors	Possible Values
Category 2: Elements/ Details	Ornamentation & Detail	Decorative Concrete Mass
		Column As Support And Decorative Element
		Parapet As Decorative Element
		Cornices/Entablature As Ornamental Detal
		Entry As Ornamental Detail
		Door and Window As Decorative Detail
	Arches	Arch Depth-Surface Depth/Setback Into Wall Thickness/Deep Depth
		Type of Arch-Segmental Rounded Pointed Flat/Islamic/Triangular
		Arch Level-Gf/Ff/Other Floors
	Niche	Niche Height And Width
		Placement Location In The Wall

		Purpose And Usage of Niche
	Column	Column Height & Diameter
		Column Location-Centre/Corner Random
		Column Style-Ionic/Doric/ Corinthian/Composite
		Column Function-Decorative/ Structural/Arcade
		Column Capital/Shaft/Base-Details
		Column Shape Square Rectangular Circular
		Column Type-Square Column With No Base, Shaft And Capital/Simple Column With A Square Base And Rectangular Capital Shaft Having Circular Band And Rectangular Capital/ Decoratively Carved Capital With Stepped Pedestal Capital With Intricate Carvings, Brackets And Pendants/Circular Capital With Decoration Towards The Base Of The Shaft/Plain Concrete Column Finished With Painting With Simple Capital And Base Rectangular Column With Rectangular Capital, Pedestal And Circular Base/Circular Column With Simple Base, Capital And Pendant

Parameter Categories	**Visual Element Factors**	**Possible Values**
Category 2 elements/ Details	Roofs	Roof Height
		Roof Type-Sloper Fl Pitched Gable Vault Dome/Conical Saw Tooth Pyramежal
	Parapet	Parapet Height
		Parapet Type-Straight/Curved
		Parapet Style Tradition/Modern
		Parapet Pattern-Plain Perforated/Panelled
		Parapet Motifs Flower Religion/ Political Symbol
	Thinnai	Thinnai Herght & Width
		Location-Centered Off-Centered
		Type Single/Double
		Function and Purpose
		Thinnai Transformations-Closed With Grill Closed With Wall Closed Using Collapsible Gates
		Thinnat Usages Used As Two Wheeler Parking Used As Room For Commercial Purposes
	Door	Door Height and Width
		Door Shape and Type
		Placement Within Facade Flush Projected Recessed
		Door Type Simple Single Panel Double Door Will Decortive Frame/Double Door Without Panels With Simple Frame /Double Door With Frame/Panelled Door With Fixed Glass/Panelled Door With Intrkate Carvings
	Window	Window Size Small <0.55qm/Medium 6.5-

		2asqm/Large 265qm
		Sill Heght-0.5m 0.3-1.8mm
		Window shape rectanglilar square triangular circular others
		Window Grills Found Not Found
		Type Of Glazing-Normal Shaded
		Window Wall Ratio-20%/20-40%/40% 70%
		Wimdow dimensionality-linear/ Punctual solid superficial
		Window type: framed wooden window with wooden grill framed window with shutters and bron grills/wooden framed windows with shutters, tron grills stained glass panels on top wooden framed window with iron grill and glass panel
		Balustrades Hekht
		Balustrades shape rectangular square circle
		Balcony Placement Within Facade Line Flushed Recessed Projected

Table 4. Summary of materials parameter factors and values

Parameter Categories	Visual Element Factors	Possible Values
Category 3: Materials		
	Walls	Brick with lime plastering
		Rcc
		Brickwork with artificial paint finish
		Stone cladding finish
		White wash finish
	Foche	madras terrace
		mangalore tiles
		asbestos
		clay pot tile
		flat concrete roof
	Door	Solid wooden flush
		Hollow wooden door with grill
		Solid flush door with carvings
		Fully grilled door
		Battened and ledged
		PVC
	Window	Framed wooden window with iron Grills
		Timber
		Glass
		Steel
		UPVC
		Grilled window with aluminum mesi
		Wooden frame with glass finish
	Balcony balustrade	Traditional wood
		Concrete brick
		Steel

		Others
	Column	Plain concrete
		Iron
		Wood
		Brick
		Stone
		Granite
	Parapets	Concrete
		Iron
		Wood
		Brick
		Stone
		Others

Table 5. Summary of colour parameter factors and values

Parameter Categories	Visual Element Factors	Possible Values
Category 4: Color	Walls	Natural color
		Artificial paint color
		Mixture of both
	Roof	Natural color
		Artificial paint color
		Mixture of both
	Door	Natural color
		Artificial paint color
		Mixture of both
	Window	Natural color
		Artificial paint color
		Mixture of both
	Balcony balustrade	Natural color
		Artificial paint color
		Mixture of both
	Parapets	Natural color
		Artificial paint color
		Mixture of both

Table 6. Summary of iconography parameter factors and values

Parameter Categories	Visual Element Factors	Possible Values
Category 6: Iconography	Metaphor of Symbols	Religious iconography
		Cultural iconography
		Historical iconography
		Geometric iconography
		Political iconography
		Functional iconography

Table 7. Summary of principles parameter factors and values

Parameter Categories	Visual Element Factors	Possible Values
Category 5: Principles	Symmetry	Bilateral symmetry of facade
		Asymmetrical
		Broken symmetry
		Radial symmetry
	Axis	Vertical
		Horizontal
		Central
		Diagonal
		Transversal
	Main entrance	Entrance accessbility-direct access to street indirect access to street/ access through outer fence
		Main entry location concentrated in centre/concentrated on sides/ random distribution
	Scale & proportion	Human scale relation and proportion
		Hierarchial scale
		Golden ratio
		Symmetrical proportion
		Asymmetrical proportion
		Incremental proportion
	Repetition	Symmetrical repetition
		Asymmetrical repetition
		Altering repetition
		Regular rhythm
		Irregular rhythm
		Structured/non structured
	Balance	Dynamic balance
		Stable balance
		Unbalanced form
		Symetrical/assymmetrical balance
		Vertical/horizontal/radial/ diagonal / hierarchy balance
	Rhythm	More than one rhythm
		Non unified rhythm
		Regular irregular
		Symmetrical/assymmetrical
		Sequential alternating
	Hierarchy	Hierarchy by size
		HIERARCHY BY SHAPE
		HIERARCHY BY PLACEMENT
		NO HIERARCHY