

**IMPACT OF BUILDING SERVICES
INTEGRATION ON HERITAGE SHOPHOUSE
FAÇADE IN GEORGE TOWN, PENANG**

by

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Thesis submitted in fulfillment of the requirements

for the degree of

Doctor of Philosophy

June 2017

ACKNOWLEDGEMENT

First and foremost, I bow before Almighty Allah in deep gratefulness that His limitless wisdom and mercy granted me enough strength to complete this thesis.

I would like to express my sincere thanks to my supervisor, Associate Professor Dr. Muna Hanim Binti Abdul Samad for her constant encouragement, advice, direction, patience, trust, and crucial contributions to my research. She has profoundly influenced not only this dissertation but also my approach to and understanding of the academic field of architecture.

I would also like to thank faculty members at the University of Sains Malaysia-School of Housing, Building, and Planning (HBP) who have offered their time, ideas and numerous references. I would like to forward a word of gratefulness to all USM mentors, staff and technicians, especially those from HBP, and deep appreciations for Malaysia, which offered me the opportunity as a Ph.D. candidate. Thank you for your hospitality, kindness, and generosity.

Most important, this research would have been impossible without the Duaa', love, encouragement and support of my mother; Ibtehal, my father; Adil, my brother Asim, my sister (my little one); Elaf, and my brother; Mohammed Hashim. Words cannot properly express my appreciation for Zinah, my wife and my best partner in life, for encouraging, motivating, and cheering me to completion. Thank you all for your limitless patience, infinite sacrifices and endless support throughout the years were sources of sustenance and powerful motivation. I owe you as long as I live.

I am obliged to the Department of Architectural Engineering/ College of Engineering – the University of Mosul for the scholarship offer that covered my study in Malaysia as well as the Ministry of Higher Education/ Iraq in providing me the financial support during my study.

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IMPAK INTEGRASI PERKHIDMATAN BANGUNAN PADA RUMAH KEDAI
WARISAN DI GEORGE TOWN, PULAU PINANG

ABSTRAK

Penyelidikan ini adalah kajian terhadap fasad rumah-rumah kedai di George Town, Pulau Pinang dan bagaimana ianya terkesan oleh pemasangan elemen perkhidmatan bangunan moden. Penempatan peralatan tersebut yang tidak terancang boleh merosakkan karakteristik visual fasad rumah-rumah kedai. Justeru itu, objektif utama kajian ini adalah mengenalpasti kaedah yang diperlukan bagi mencapai integrasi terhadap kedua sistem seni bina iaitu, ketulenan fasadnya dan penambahan elemen perkhidmatan secara positif. Analisis visual adalah satu alat pengukuran yang menjadi kunci bagi menghubung kait kedua bahagian permasalahan ini, dengan menerapkan kaedah reka bentuk penerokaan kualitatif kerana kesesuaian bagi memenuhi objektif kajian, sejajar dengan persoalan dan bertepatan dengan skop kajian. Persampelan teoritikal dan tertentu telah digunakan untuk memilih enam stail fasad rumah kedai di Tapak Warisan Dunia George Town (GTWHS). Analisis kerangka di samping teknik analisis kandungan digunakan untuk menganalisa pelbagai jenis data yang dikumpulkan. Pelbagai jenis penemuan telah dihasilkan daripada analisis; karakteristik visual bagi setiap stail fasad rumah kedai di Georgetown, berdasarkan prinsip reka bentuk. Di samping itu, impak perkhidmatan bangunan pada rumah kedai, kerana sesetengah jenis pemasangan perkhidmatan bangunan mempunyai impak lebih besar terhadap rumah kedai berbanding yang lain. Impak tertinggi adalah unit-unit penghawa dingin, papan tanda komersial dan bahagian peneduhan yang menjelaskan lebih daripada 60% impak visual rumah kedai. Kajian ini mengenal pasti transformasi jenis hubungan dan tahap integrasi visual antara perkhidmatan bangunan dan fasad ini dalam keadaan asli dan keadaan masa kini rumah kedai tersebut. Akhirnya, hasil utama kajian adalah merumuskan pemberian garis panduan bagi komponen fasad bangunan yang berhubung kait dengan pemasangan perkhidmatan bangunan. Antara cadangan terperinci termasuk warna cat asal, mengikut bentuk tradisional dan perletakkan sepatutnya bagi pemasangan yang baru. Cadangan-cadangan ini boleh diterapkan bagi integrasi optima integrasi visual bagi pemuliharaan rumah-rumah kedai warisan bagi masa depan.

IMPACT OF BUILDING SERVICES INTEGRATION ON HERITAGE

SHOPHOUSE FAÇADE IN GEORGE TOWN, PENANG

ABSTRACT

This research is a study on the facade of shophouses in George Town, Penang and how they are affected by the installation of modern building services elements. The unplanned insertion of their equipment distorts of the visual characteristics of the shophouses facade. Thus, the research's primary objective is to explore the necessary means to achieve integration between these two architectural systems namely, the authenticity of the facade and the positive inclusion of the services elements. Visual analysis as a measurement tool is the key for linking the two sides of its equation, by adopting qualitative exploratory designed methodology, as it is adequate to fulfill the research objectives, lines with inquiries and fitting for the scope of research. Theoretical and purposeful sampling were utilized to select the six known styles of the shophouses facade in George Town, and also to choose from the six conservation areas in George Town World Heritage Site (GTWHS). Framework analysis, as well as content analysis techniques, was used to analyze the different types of the collected data. Various kinds of findings have resulted from the analysis: Visual characteristics of each style of the shophouses facade in George Town based on principles of design analysis. Also, the impact of the modern building services on the shophouses facade, as some types of building services installations have more visual impact on the shophouse facade than others. The highest impact is the outdoor air-conditioning units, commercial signboards, and shading parts, which affect more than 60% of the visual characteristics of the shophouse facade. The study identified the transformation of the relation type and visual integration level between building services and the facade in the original and the current state of the shophouse. Finally, the primary outcome of the study is concluding improvements of the guidelines for the building facade components that related to the building services installations. The refined recommendations included original colors paintings, traditional shapes mimicking, and precise positioning for any new installations. These recommendations can be adopted for the optimum visual integration for conserving heritage shophouses in future.

CHAPTER 1: INTRODUCTION

1.1 Introduction:

The year 2008 is considered as an important turning point for George Town, Penang, Malaysia (Nasution, 2008). George Town has been awarded the World Heritage Site coveted title under serial nomination, and the UNESCO world heritage committee has listed it under the cultural heritage category (UNESCO, 2008). Hence, that increased its value, and it became more important and attractive place for tourists and visitors as well. All that leads to pay more attention to its heritage generally and its architecture specifically (which is relating the research subject). Moreover, researchers from different specializations have turned their attention towards this area.

One of the most important components of the George Town heritage architectural fabric is the heritage streets in the town, which are mostly commercial in their usage, and owned by the locals (Nasution, 2014). These owners are willing to conserve the heritage value of their facilities intact for its commercial, tourists attraction, and historical identity preservation benefits for them as individuals as well as the whole town's level. However, they also try to provide a proper contemporary level of the building services, such as air-conditioning equipment, electric power supply, artificial lighting, etc. These modern building services can keep pace with increasing demands of all types of occupants (owners, tenants, visitors, and customers) by all available means of modern equipment they can afford (Ariffin & Alias, 2016). Consequently, that affects the architectural features of the heritage buildings unwillingly and appears clearly on the building's facade. For instance, the architectural styles of the buildings within these

streets are mostly recognizable by their external facade. Importantly, that gives the distinguished value to the buildings' facades and a special necessity of its proper maintenance and conservation.

Undoubtedly, the comfortable indoor environment of a building is considered as one of the vital factors that measure the architectural success, and that rule is applicable for all different types of buildings, including residential, commercial, etc. (Kuehn, 1998). Each of these types may have its special demands in addition to the general requirements. For example, there are some other commercial demands for the shops in the streets, such as commercial advertisements, and many other services that depend on the function of the shop. Thus, these different types of services; in a way or another, affect the visual characteristics of heritage facades.

After this brief description of the research nature, this chapter contains the basic points of the research, as the research significance, background, problem statement, the research questions, and objectives.

1.2 Research Significance (Contribution)

Heritage conservation is the continuity of touching with the past, which is so important since it represents people's identity, culture, and sense of belongingness. Historical buildings are the physical appearance of cultural and social past, and conserving them secures their heritage value for future generations. That is possible through conducting adequate research on these points:

- The main goal of the research is preserving the historical value of the heritage streets in George Town, Penang upon conserving the visual characteristics of the shophouse facade. Particularly, that will be possible through understanding their architectural visual properties and the factors affecting them, especially those related to the modern building services, as the research subject.
- The tropical climate of Penang island affects the architectural treatments in both general and detailing visual levels of the buildings' facades as when they have been designed in the first place. Thus, changing or inserting any new elements will affect the visual properties of the shophouse facade in George Town. These new installations may cause changes in the architectural typology of the general cityscape, which affects the special heritage value of George Town negatively and causes irreversible damage.
- The undeniable evolving and increasing human needs impose and impact the architecture, and that necessarily meant changing old methods of achieving building services, and then the visual characteristics of the building, which are opposed the heritage buildings' conservation.

All the reasons mentioned are leading to the necessity of finding the optimum solutions for integration between heritage architecture and increasing human needs as related to building services.

1.3 Research Background

This research studies the relationship of the building services integration within the architecture of heritage shophouse facade in George Town, Penang, and also the changes

made by the effects of that kind of services. Thus, multiple types of studies have been reviewed as the research background, some of them are about the heritage architecture of George Town and its unique characteristics of the buildings' facades. Other types of studies searched about the individual building types in the heritage streets, their components, and unique features, to explore the transformations in these properties made by the impact of different categories of the modern building services used especially in the building facades. These studies reviewed other types of concepts about the relationship and integration between architectural systems and the building services. The Main benefits of those studies are: Reviewing the literature on the research topic, concluding the part of the research problem related to knowledge gap, strengthening the research's significance, and extracting the primary variables for practical study.

Accordingly, the research suggests these types of studies as they related to its aspects:

1.3.1 Historical and Documental Studies of George Town

There are several studies about George Town, Penang, the area history, urban, and architecture including the study by Hassan (2012) which reviewed the architecture and heritage buildings in George Town, Penang. Firstly, by giving a brief history of George Town itself. Also, its most significant heritage buildings history, their types; religious buildings, government institutions, educational institutions, historical buildings, and the shophouses, architectural characteristics, and the kinds of influences behind their architectural features such as cultural backgrounds, colonial era, climate effect, and other linked elements. Also, Keith Hockton book of Penang's homes, buildings,

monuments and parks (Tan, 2011) enumerates multiple types of historical facilities in George Town, Penang, their history, and general information about each.

Another critical study is "Streets of George Town, Penang" by Khoo Su Nin (2012) about the streets of George Town; enumerating them in alphabetical order, giving a brief history, describing them and mentioning the most famous buildings and monuments located in each of them.

A paramount study for the research is the "Special Area Plan GEORGE TOWN, Historic cities of the Straits of Malacca" (AJM, 2013). This study contains background information about George Town area (core zone and buffer zone), illustrated with historical maps upon different periods, explains geographic locations and development stages. Also, this report illustrates multiple maps that provide information such as: Activity zone, landmarks, socio-cultural topography map, heritage buildings and site category map, map of the open spaces and network of pedestrians. It explains architectural types of buildings and takes the shophouse as a featured example of an architectural type; its definition, evolution and its construction methods, materials and techniques. Moreover, this study talks about the guideline for conservation practices in the area and heritage buildings in George Town world heritage site. It also contains vision and strategy for the area upon history, existing, future, and conservation principles. Further, it talks about important variables to protect historic streetscape as the surrounding buildings' heights, scale, and rhythm to ensure the street elevation continuity.

"Penang Shophouses/ A Handbook of Features and Materials" (Wooi, 2015) is a particular study about shophouse in Penang. This study gives an overview of the shophouse design, its evolution, distribution within Penang, styles with the main features and form of each one along with its chronological building period. Furthermore, within these styles, the study explored each one facade parts, architectural elements, building parts, details, in addition to the materials of each part. It is efficiently illustrated with adequate photos, figures, and drawing that explains the architectural components and elements in the shophouse of Penang.

These studies give the heritage impressions and characteristics of George Town buildings and street's history generally, and the building type of shophouse especially, in addition to heritage architecture properties that will be pivotal for the research.

1.3.2 Architectural Analytic Studies

Many studies take the subject of architectural analysis, each of them on a different aspect, as the study by Clark & Pause (2005) is dealing with the graphic analysis of existing buildings designed by famous architects. The variables selected for the graphical analysis are structure, natural light, massing, the relationship between plan and section, circulation to use/space, unit to the whole, repetitive to unique, and also included the symmetry and balance, geometry, additive and subtractive, and hierarchy.

With all variables mentioned before, there are some explanations and brief definitions when showing the examples of the graphic analysis. After showing the examples, the study discusses some formative ideas for each variable, and also some concepts related to the examples visual analysis and concludes several types of possible

values for each variable based on the analysis results with examples of each type. This study will be very helpful for the research for its various types of analysis, that can be used for the facade architectural analysis.

Another essential research for architectural analysis is the book of Architecture: Form, Space & Order (Ching, 2015), firstly; it describes the primary elements of space according to the dimensional level: point, line, plane, and volume. After explaining that, it reviews on the form, its visual properties, and components like shape (primary shapes), platonic solids and regular or irregular forms. It mentioned the form transformation techniques such as dimensional changes, addition, and subtraction, and the methods of elements aggregation to create the form like linear, radial, clustered and grid types. Then, it talks about Articulation of Form, and how it can be done by changing the properties of its edges, corners, and the surface articulations.

The study explains the relationship between form and space and how they define each other by horizontal, vertical elements and also how defining the space through the openings. Methods and types of form and space organization are explained, the concept of circulation in the area. Proportion and scale in architecture are explored, in additional to material, structure, their systems, regulating lines, visual and human scale. Finally, it mentions some principles in architecture such as ordering principles, axis, symmetry, hierarchy, datum, rhythm, repetition and transformation principles.

The research by Sabah (2006) investigates the compositional structure of traditional lanes in old Mosul city, Iraq. It explored the compositional elements: line, shape, color, direction, size, texture and value. These elements are completed by the compositional

relations of harmony, gradation, contrast, balance, repetition: dimensional dominance, proportion, and scale. The study analyzes the individual traditional house facade within these elements and relations by connecting every element and relationship by its architectural, physical meaning to reach the complete genuine lane architectural typology order.

This study found that there is a distinct unity of elements and relationships in the facades of traditional lanes in Mosul city, Iraq, although the high diversity that components have. And this difference affected by various factors related to function, the use of the plan, materials, topography, social and geographic factors, etc. Furthermore, one of the main reasons for traditional building's deterioration is the deficiency in water waste system, and that even affects generating the new elements in the facades to tackle the harmful impact of that shortcoming. The research advised studying the effects of using modern technology on traditional buildings.

Another critical study is "Responsive Environment" by Bentley (1985). It explored the visual appropriateness and cues, by dividing these cues into large-scale cues (vertical rhythms, horizontal rhythms, and the skyline) and small scale cues represented by: (windows, wall details and ground floor details). Then, it classified them into four groups to form the contextual cues for the whole surrounding area: similar elements in similar relationships, similar elements in different relationships, different elements in similar relationships or different elements in different relationships. Also, it studies visual richness and the variables affecting it like visual contrast, viewing distance and viewing time.

"Analyzing Architecture" by Unwin (2003) gives another type of architectural analysis. By mentioning the essential elements of architecture and their fundamental proposes, they include: define an area of ground, raised area or platform, lower area or pit, marker, focus, barrier, roof, supporting posts or columns, path, and openings. The study claims that these elements are abstract ideas, and they has the ablity of being modified in order to contribute lots of experience to the architecture, by using other types of effecting elements to change each of the essential elements such as light, color, temperature, ventilation, sound, smell, texture, scale and time. These elements had the capability to do more than one function at the same time and also can be created by the existing natural elements like caves or hills, to get their distinctive architectural character that will not be the same in another place.

An important thing in this study is the geometrical analysis to find the effects of elements as circles of presence, lines of sight, lines of passages, measuring, six-directions-plus-center, the social geometry, the geometry of making, ideal geometry, complex and overlaid geometry.

All these studies are imperative in any attempt to analyze shophouse facade to find its unique visual characteristics, after selecting what are appropriate from them to be used in the analysis process.

1.3.3 Studies of Building Services Integration in Architecture

To diagnose the effects and problems caused by adding new types of building services and their appliances to the heritage building, generally, and then to the shophouse facade architecture specifically, such kind of studies will be needed, even for the next stage

which will be finding a solution to these problems. The reasons why these studies are vital include: Firstly, to know what kind of appliances or their parts are used in the building's exterior (facade), and also to find out the relation between using them and the effects on heritage value. Another thing is to determine the possibility of changing or re-arrangement them to reach the integrity state to the original heritage facade architecture.

The most important issue in "Special Area Plan of GEORGE TOWN" study (AJM, 2013) is the part that related to the urban infrastructure improvement. That part remarks the essential building services in the area (sewerage, drainage, water supply, fire prevention system, telecommunication, and electrical supply), and their current stations for each one, the problems, and finally, some proposed solutions. Most of these points are on the level of urban, although, they mention an important issue about heritage buildings and exterior (facade) aesthetic.

Another research (Prihatmanti, 2011) studied a common heritage building conservation method, which is adaptive reuse of the heritage building by applying the right materials with the suitable methods on buildings listed on the UNESCO world heritage site in George Town, Penang. The study suggested that the adaptive reuse can be achieved by changing the building physical components with the least impact on the building. The building can gain several advantages by adaptive reuse, as increasing building lifespan, economic benefits, not just for the building, but also for its surroundings. Moreover, adaptive reuse is supported by those who are concerned with environmental issues during the term of sustainability.

An initial inspection on the defects and deterioration in the building has been done, which can give a negative impact on its occupants. After that, a set of questionnaire to the designated building occupants has been distributed to get the satisfaction of their indoor working environment elements (lighting level, noise level, air quality, layout and spatial planning, furniture and storage as well as building cleanliness). Based on all of that, the study discovered that the improper application of adaptive reuse might cause occupant dissatisfaction in four of five buildings in the study.

One of the main findings of this research is the user dissatisfaction that can be resulting from inappropriate applications of the adaptive reuse. The study also provided a source of information on user satisfaction. Another thing, the indoor environmental quality can be affected by heritage building's inappropriate adaptive reuse which is threatened by the poor physical conditions of the building and finally reflected on the occupants' health. Moreover, research shows the importance of the heritage building and sample method of conservation which is adaptive reusing buildings, and the possibility of changing building physical components that have the least impact on buildings. However, It is paramount to ensure the current research significance.

Another study by (Azarshahr, 2013) explored using variety of modern technologies and modern building materials in architecture generally, in addition to the investigation on how the extent of modern technology utilization and enrolled in architecture, and their integration and merging ability with the traditional buildings and heritage structures and architectural elements in order to preserve their cultural values and the local traditional architecture's principles are not harmed.

The research suggests that the modern technology should be applied to the traditional local buildings' elements and structure with harmony, congruity to the local circumstances, but at the same time, that there are a lot of benefits gained from new technologies in contrast with traditional architecture, such as thin walls, space flexibility that can be adjusted to user's needs. This is a descriptive study about the relationship between Iranian local traditional architecture with the use of modern technology and is aware of the crisis of the architectural identity definition and its determining factors such as aspect, prospect, spatial organization, reminiscence, interpretation and unity, and how to use technologies without affecting them negatively. As a matter of fact, the research demands the use of modern technologies and suggests for the local architects to adapt them for their necessity for the modern human life.

The main findings of the study are about the necessity of changing and re-examining the constructional styles and building materials according to the increased and changed peoples' needs, and the modern technologies could be very useful in preserving and protecting the traditional architecture on a certain location in harmony with these days conditions and needs of modern life. Although the consideration of this study as an important one in the field of the relationship between traditional architecture and modern technologies, but it seems more biased towards modern technologies and its importance in modern human life, and ignored important things such as heritage value and the sustainability that may the traditional methods provides. Finally, this study talked generally about modern technologies of building materials and structural methods and was not specifically about other additional services' appliances and technologies, which our study adopts.

1.3.4 Previous Studies on George Town's Shophouse

Generally, the building type of the heritage shophouse has been studied previously from more than one aspect, in George Town, Penang or in other cities in Malaysia. Some of these studies explored its environmental features, other studies have investigated its documentation and conservational issues, some other scholars looked at it from the occupants, owners, tenants, or even the tourist's point of view. Similarly, other studies are descriptively analyzing the architectural elements of the shophouse or explored its potentials of adaptive reuse. All these types of studies are viewed to understand it as a building type, and to overview, the previous researchers work in this field of knowledge. These studies are:

Study of (Omar & Fadzil, 2011) reviews the importance of reducing energy consumption in the commercial and residential buildings by passive methods. This research has taken the heritage shophouse in George Town and its environmental key elements as an efficient tool to reduce cooling loads in buildings, especially in the humid climate in Malaysia. Thermal measurements have been taken to clarify the shophouse design efficiency of cooling the indoor environment. Main findings of this study are the thermal difference made by the shophouse passive design between indoor and outdoor, as well as generating some recommendations to improve the thermal performance of the general shophouse design.

Conservation studies like (Baroldin & Din, 2012), (Ismail & Mohd Ali, 2011), and (Ismail & Shamsuddin, 2005) are more focusing on the negative role of the urban development of the heritage state of the historical building and the shophouse in particular. The essential goal of these studies is mainly to focus on the conservation

problems on the aesthetic, environmental, and also building structural and finishing material state. The initial findings are producing comprehensive planning of maintenance processes, more detailed conservation guidelines, along with the factors threatening or mistreating the shophouse architecture.

Other studies by Ismail (2012), and Ariffin & Alias (2016) are investigating the relationship between the shophouse building and its occupants or users, in the aspect of the building's heritage value, comfort, building circulation, and any other value related to the residential and commercial function of the shophouse. The main findings of these studies are; elaborating the importance of the shophouse as the most visited building type, the place users can have both positive or adverse impact and perception of it, and the role of the stakeholders in the shophouse conservation.

Descriptive studies of the shophouse architectural characteristics like studies by Wooi (2015), and AJM (2013) have overviewed the shophouse design and elements, historical background, its architectural styles and the chronological development of each, along with these styles unique building materials and visual features. Primary results of such studies are the enabling of visual recognition of each style. Also, conservation guidelines of the George Town shophouse have elaborated regarding the heritage building category II that the shophouse is involving under it.

Finally, studies of the shophouse reviving in George Town such as Ling (2014), Mydin & Keling (2014), Jasme & Sani (2014), and Prihatmanti & Bahauddin (2014) are focusing on the adaptive reuse of the shophouse building. Some of them are investigating the environmental aspects of reusing heritage buildings, while others are

more pointing to the architectural features like elements or building materials in the process of adaptive reuse. The main results of these studies are the multiple types of assessment according to the nature and aims of each study. Table 1.1 summarize the previous studies about the shophouse in George Town, Penang according to their criteria.

Table 1.1 Previous studies about the shophouse in George Town, Penang.

Author	Overview of The Study	Main Findings
(Omar & Fadzil, 2011)	The importance of reducing energy consumption in the commercial and residential buildings by passive methods. This research has taken the heritage shophouse in George Town and its environmental key elements as an efficient tool to reduce cooling loads in buildings.	<ul style="list-style-type: none"> • The thermal difference made by the passive shophouse design between indoor and outdoor. • Generating some recommendations for improving the thermal performance of the general shophouse design.
(Ismail & Shamsuddin, 2005), (Ismail & Mohd Ali, 2011), (Baroldin & Din, 2012)	Focusing on the negative role of the urban development of the heritage state of the historical building and the shophouse in particular. Also spot the light on the conservation problems on the aesthetic, environmental, and also building structural and finishing material state.	<ul style="list-style-type: none"> • Producing comprehensive planning of conservation processes, more detailed conservation guidelines. • Elaborating the factors threatening or mistreating the shophouse architecture.
(Ismail W. H., 2012) (Ariffin, Ahmad, & Alias, 2016)	Investigating the relationship between the shophouse building and its occupants or users, in the aspect of the building's heritage value, comfort, building circulation, and any other value.	<ul style="list-style-type: none"> • Focusing on the importance of the shophouse as the most visited building type, the place users can have both positive or adverse impact and perception of it. • Clarifying the role of the stakeholders in the shophouse conservation.
(AJM, 2013), (Wooi, 2015)	Overviewed the shophouse design and elements, historical background, its architectural styles and the chronological development of each, along with these styles different building materials and visual features.	<ul style="list-style-type: none"> • Enabling visual recognition of each style. • Conservation guidelines of shophouse elaborated regarding the heritage building category II that the shophouse is involving under it.
(Ling, 2014), (Mydin & Keling, 2014), (Jasme & Sani, 2014), and (Prihatmantia & Bahauddin, 2014)	Focusing on the adaptive reuse of the shophouse building. Some of them are investigating the environmental aspects when reusing heritage buildings, while others are more pointing to the architectural features like elements or building materials in the process of adaptive reuse.	<ul style="list-style-type: none"> • Multiple types of assessment according to the nature and aims of each study.

1.4 Problem Statement

The architectural heritage of George Town, Penang (especially for shophouse facade) is facing transformations on its visual characteristics for many reasons, which are defining problem statement of the research. These are:

- Insufficient analytic studies about its visual features and characteristics of the shophouse facade, while other uncharted installations of building services on the facade impact the heritage architecture, causing a lot of damage to the heritage value of George Town. That impairment occurs in different architectural levels: the functions of the architectural elements, building structure and materials, and what is the most important to the research, is how it affects the shophouse facade's visual characteristics. Additionally, shortage in the methods of inserting modern building services' installations into the heritage buildings generally and facades in particular, in a way that can preserve them from modifying their visual characteristics.
- As a result of the evolving and increasing needs of people, in addition to the accelerating development of modern technologies, new installations have been inserted and fixed on the facade of the heritage buildings, in unplanned approaches. The harm caused by that on many heritage buildings is not reversible. On the contrary, many heritage buildings have been modernized (Nasution, 2008), as the occupants attempt to replace the original building or its architectural parts with new ones with different styles. Thus, traditional architectural style and building materials can be transformed in a way that caused heritage unsustainability (Coleman, 2004). Moreover, as can be noticed in George Town's streets, owners/ tenants of the shophouses are arbitrarily installing whatever they need of new services'

installations into their buildings without sufficient censorship or supervision to prevent them from changing the visual characteristics or any other architectural aspects of their buildings.

- Many researchers studied the topic of a shophouse in many ways. Some of them took the shophouse reviving and its adaptive reuse, others looked for the relation between building and its users or the surrounding environment, while other studies focused on architectural styles, material and details of the shophouse and its facade. Lack of adequate studies about these aspects can still be noticed: Visual analysis (regarding design principles) of heritage shophouse facade in George Town. The negative visual impact of the modern building services' installations on the shophouse facade. The traditional methods of achieving building services in the original state of the shophouse, and their transformation into the current situation. Additionally, the visual relation types and integration levels between the shophouse facade and building services on the shophouse, in both its original and present states, in addition to the potentials of the shophouse building to absorb any new equipment building services. These aspects mentioned are the primary goals of the current study.

1.5 Research Questions

The study asks several questions related to its topics such as:

1. What are the main visual characteristics of the heritage shophouse facade in George Town, Penang, Malaysia?
2. How do modern services' installations impact the facade's visual characteristics of

- the heritage shophouse in George Town?
3. How do traditional techniques of achieving building services in George Town's heritage shophouse transform from their original state into the current one regarding their relation to the building generally, and facade in particular?
 4. How do modern building services' installations and appliances integrate visually with the characteristics of heritage shophouse facade in George Town?

1.6 Research Objectives

The primary aims of the study are to answer the research's questions, and in other words, they are:

1. To identify visual characteristics of the shophouse facade in George Town, Penang based on principles of design analysis.
2. To evaluate the visual impact of the modern building services' installation on the facade of the heritage shophouse in George Town.
3. To analyze the transformation in the relation and integration between building services system and the shophouse facade in its original and current state.
4. To provide a review of guidelines and recommendations for the shophouse facade, with the modern services' installations.

1.7 Research Framework

Research background has motivated its problem statement, which in its turn determines research questions and related objectives. The literature review is divided into three parts; the main two are the sides of study equation. The first one focused on the

shophouse facade, its background, architectural characteristics, and styles. The second part is the building services generally, and in the shophouse specifically. The other important part forms the linking between these two sides, which is the visual analysis aspect.

Selection of research framework type is inspired mainly by the nature of research questions. A qualitative approach is usually adopted to answer these kinds of questions, especially when the research is designed for exploratory purposes, as the study investigates all the aspects of the other sub-inquiries with the sufficient types of data and proper analysis approach.

The study explores phenomena within their contexts, by utilizing variety sources of data, which can be facilitated correctly by the case-study research method. Due to the variety of implications in the current research, methods used for the data collection are also wide-ranged by documentation, visual, observation, and interviews data. Selecting samples have to be made by using two types of strategies: The theoretical sampling strategy is used for finding the examples of shophouse facade styles in George Town, which are suitable to apply the visual analysis. The second strategy is the purposeful sampling, which is involved to border the observation area to study the current state and the causes of visual problems on the shophouse facade.

Research involves two primary analysis techniques; the first one is the framework analysis, which has the stages of familiarization, identifying a thematic framework, indexing, charting, and finally, mapping and interpretation. This technique is used to analyze visual and observation data. The other technique is the content analysis, which is

utilized to analyze document and interview data. After that, direct results are combined to achieve more findings regarding research objectives.

Figure 1.1 shows the research summary and development according to the research methods and framework.

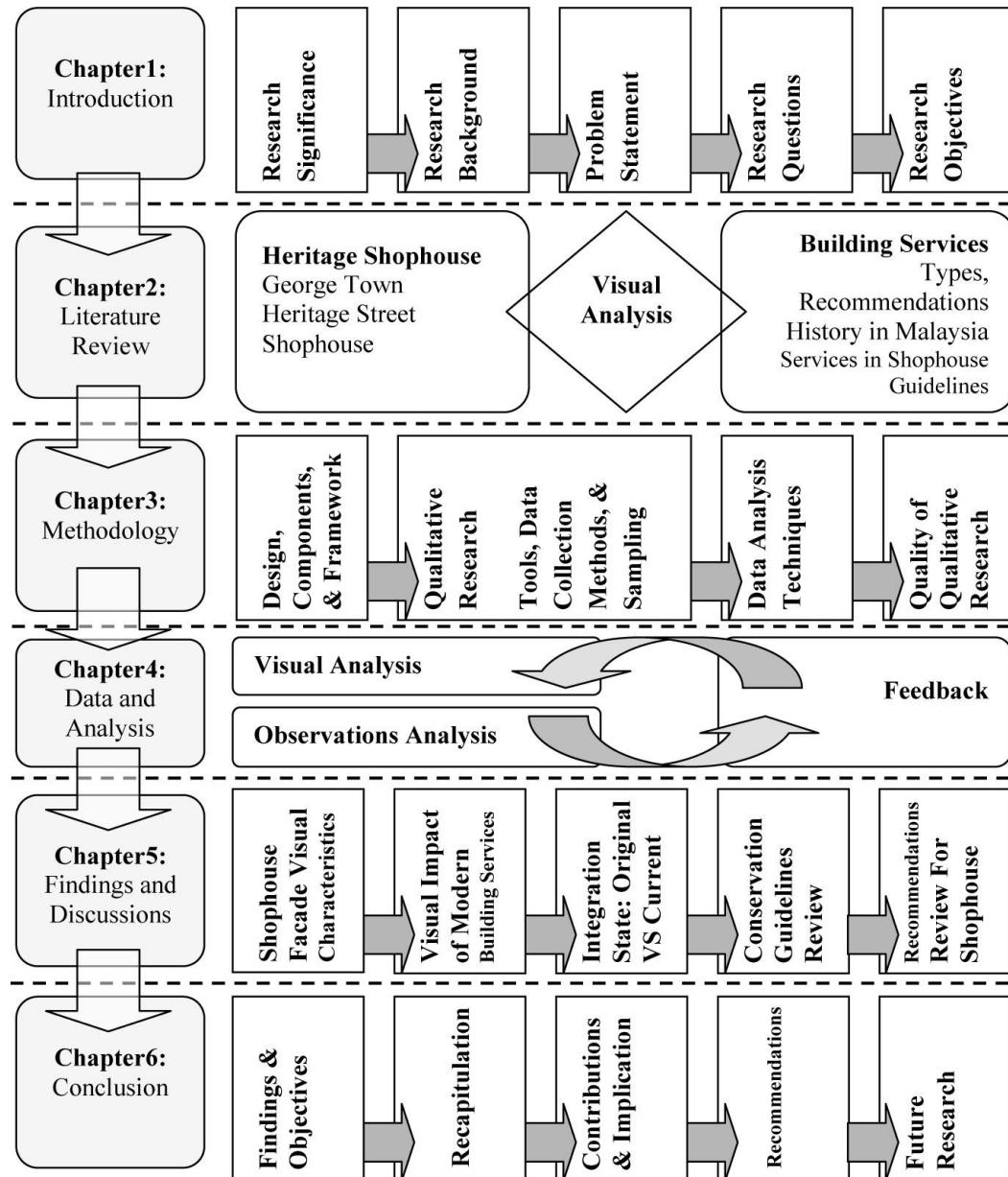


Figure 1.1 Research Summary and Development.

1.8 Research Limitations

The study is investigating two states of a heritage building type; the first one is the original state changed to the current situation with all emerged additions and recent installations. Hence, the original condition of the building is now missing for most of the cases, especially this one related to the original methods of building services. Because it is impossible to go back and observe the building in the past, thus, the information about the initial state is only explored through any available documentations and other visual or written resources. Also, the research adopts the visual analysis as an essential tool for major parts of the analysis process. However, visual documentations of the shophouse facade in the streets of George Town are very limited. Therefore, the researcher did all the necessary photography and field documentations for the study.

1.9 Arrangement of the Chapters

The research includes these six chapters:

Chapter 1 is the introduction to the study; it consists the proposed significance of the research. A discussion of the background behind the research is also contained to investigate the research statement of the problem. Moving to the central questions implied by the research, to conclude the core objectives and goals of it. Finally, an arrangement of the chapters has been clarified.

Chapter 2 is the literature review for the research. It mainly discusses the pivotal information about the topic of the study and divided into three basic parts; The first part of it basically dives into the historical background of the region the study subject is located in it, to understand the cultural, social, and other factors lead to the flourishing of

this unique type of architecture. The second part is an explanation of the basic life standards in the design of the shophouse. Starting with a discussion of the building services and their types, and reflect them to the mechanical system in the shophouse design, with the general background of the building services and their related infrastructure in the area of the study. The last part is mainly investigating the theories of architectural visual analysis, an overview of them generally, then the studies that specialized in the visual analysis of the facade. The reason behind this operation is to aggregate the variables and factors that are used later to analyze the visual characteristics of the shophouse facade.

Chapter 3 is the part of the study where the research methodology is explained, firstly by exploring research design and its qualitative methods, then the research framework suggested for it, study aspects and the relation among them. An exploration of the preliminary study and its stages have been mentioned, after that, the necessary qualitative tools, methods, and techniques are explained, then data collection methods, their types, sampling are investigated. Another important part of this chapter is the exploring of the data analysis techniques and tools. Finally, the quality of the research has been ensured through multiple mechanisms and from many aspects of the quality values.

Chapter 4 includes the results of the visual analysis of the shophouse facade in George Town, Penang, as well as the direct results of the field observations and their analysis. Also, the results that related to the data of the documentations and the interviews has been clarified in this chapter.