

MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF CONSTRUCTION

**HANOI ARCHITECTURAL UNIVERSITY**

**LE DUY THANH**

**CONSERVATION OF ARCHITECTONIC  
STRUCTURE OF THE FRENCH COLONIAL  
BUILDINGS IN HISTORIC INNER CITY OF  
HANOI**

MAJOR: ARCHITECTURE

CODE: 9580101

**SUMMARY OF DISSERTATION**

**Hanoi - 2023**

This dissertation has been completed at:  
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at.....o'clock, date.....month .....year 2023

The dissertation can be found at the National Library and The  
Library of Hanoi Architectural University

## INTRODUCTION

### 1) **The necessity of the dissertation topic:**

The legal documents outline the preservation requirements for French colonial-era buildings in Hanoi. To ensure the conservation of these buildings, it is crucial to identify their characteristics, roles, and values of their architectonic structure.

However, in reality, French colonial buildings are increasingly deteriorating due to the lack of a conservation procedure and method for their architectonic structures. The conservation efforts often focus on ensuring the external appearance without addressing the core issue, which is preserving the intrinsic value of each component of the architectonic structure constituting the French colonial buildings.

Therefore, this dissertation concentrates on studying the characteristics, value identification, and proposes conservation procedures and solutions for the conservation of Architectonic Structure of the French Colonial Buildings in the Historic Inner Hanoi City.

### 2) **Research purpose**

- a. *Research Aims:* Conserving Architectonic Structure (AS) of the French colonial buildings (FCB) in historic inner city of Hanoi (HICoH).
- b. *Research Objectives:*
  - *Identifying and Assessing values* of AS of the FCB in HICoH.
  - *Proposing Procedures of Conservation Survey and Design* for AS of the FCB in HICoH.
  - *Proposing Conservation Solutions* for AS of the FCB in HICoH.

### 3) **Research subject and research scope**

- a. *Objects of the study:* Architectonic Structure of the French Colonial Buildings.
- b. *Research Scope:*
  - In terms of space: Historic Inner Hanoi City.
  - Regarding time: from 1873 to present.

#### 4) Research methodology

Collecting documents;  
Historical study;  
Surveying and assessing the current situation;  
Modeling; Social study;  
Expert survey; Analysis and Assessment.

#### 5) New contributions:

(1) Synthesize and categorize the 4 components in the Architectonic Structure of French colonial buildings; (2) Clarify the characteristics of the Architectonic Structure of French colonial buildings in the historic inner city of Hanoi; (3) Identify the 4 values (4) Create an assessment criteria set and assess the conservation potentials of the Architectonic Structure of French colonial buildings in the historic inner city of Hanoi; (5) Create a 3-step Survey Procedure and a 3-step Conservation Design Procedure suitable for the context of historic inner city of Hanoi; (6) Propose 3 perspectives, 4 principles and conservation solutions for the Architectonic Structure of French colonial buildings in the historic inner city of Hanoi.

#### 6) Scientific and practical significance:

*Theoretical value:* Providing scientific data for studies related to French colonial architecture; *Practical value:* Serving as reference material for the preservation of French colonial architecture and educational instruction.

7) **The structure of the dissertation:** Besides the introduction and conclusion, the thesis content includes 3 chapters;

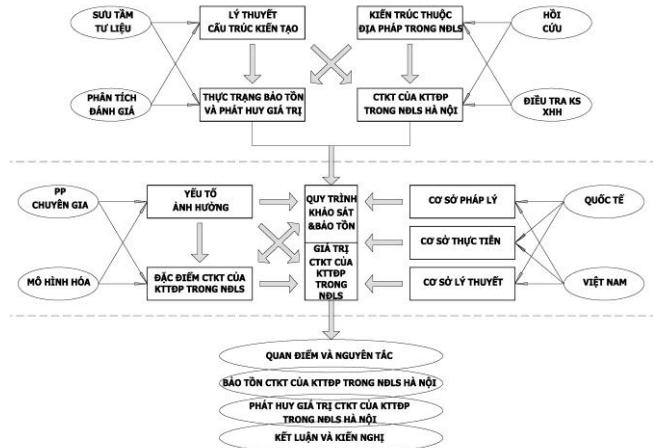


Figure 1 1 Research methodology of dissertation

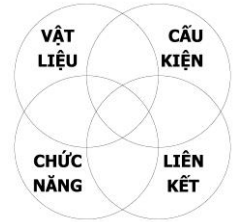
## CONTENT

### Chapter 1: OVERVIEW OF RESEARCH AIMS

#### 1.1 Overview of Architectonic structure

##### 1.1.1 Elements of Architectonic structure

The AS comprises four elements: *Material*; *Component*; *Space*; and *Connection*. AS throughout history: Karl Botticher have emphasized the importance of components, Gottfried Semper has highlighted the significance of connections, and Frampton has explored cultural aspect within material, component, connection.



Hình 1. 1 CTKT của kiến trúc

##### 1.1.2 Characteristic of AS throughout different historical periods of architecture

The AS has two main characteristics: *logicality* and *cultural aestheticism*, which are manifested through architecture history:

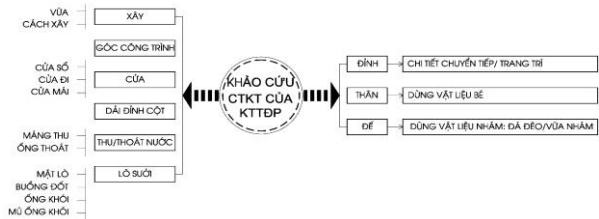
- Worldwide. In *Egypt*, the components hold paramount importance, columns symbolizing spiritual; *Greece* associates the component with the representation of beauty; *Rome* utilizes concrete material and incorporates arches; *Roman* architecture emphasizes the vitality of columns and connections; *Gothic* architecture features pointed vaults, spaces, and connections; *Renaissance architecture* expresses aesthetics through space, components and connections; *Modern Architecture* era, Le Corbusier employs simple components to serve the function, while De Stijl emphasizes artistic.
- Vietnam. *Traditional architecture*: Materials, authentic components, and culturally rich connections; *During the socialist countries' era*, there is a preference for minimally decorated modular elements, well-defined connections, and uniformity in the materials.

#### 1.2 Researching the AS of FCB in HICoH

The characteristics of the AS of FCB are typically divided into 3 parts: *the Base with rough materials*, *the Body using various small materials/ decorations*, *the Top featuring transitional patterns*.

### 1.2.1 Period 1875-1888

Utilizing *local materials* (brick, stone, wood), *lightweight assembled components* emerge (steel trusses). The



Hình 1. 2 Khảo cứu CTKT điển hình của KTTĐP

space is a simple, spacious, and well-ventilated single-story military camp. As of now, most have lost their original integrity, with the *level of expressional generally being moderate*.

### 1.2.2 Period 1888-1920

Designed by the French, the AS bear distinct French characteristics: *large spatial volumes, multiple stories, symmetrical facades, robust materials, decorative details, reflecting a sense of grandeur and magnificence*. Most served functions specific to the colonial government, *held historical significance, and exhibited a high level of expression*. However, their current accessibility is low due to: Restricted access; Obstruction by newer architecture.

### 1.2.3 Period 1920-1954

Prominent in this period is the feature of architectural components with distinct *Indochinese decorative* forms. Due to being constructed with more modern technologies, most of these structures are still in *good condition*, with minimal damage. However, their *historical significance is relatively low*, and their accessibility is also limited.

## 1.3 Classification of AS of FCB in HICoH

Based on the four components in the AS of FCB, the dissertation has classified and conducted a survey and evaluation as follows:

### 1.3.1 Material

Survey and evaluation *Brick/Stone; Mortar; Metal; Wood; Glass; Reinforced concrete* based on three criteria: *Good condition; Average condition; Poor condition or replaced*.

### 1.3.2 Component

Various types: *Foundation; Wall; Floor/Ceiling; Roof; Column; Door*. Most are still in good condition but are facing the risk of damage due to changes from the usage process.

### 1.3.3 Connection

There are five types: *Foundation Connection; Wall – Door Connection; Wall – Floor/Ceiling Connection; Wall – Roof Connection; Column – Floor/Ceiling Connection*.

### 1.3.4 Space

- 3 types of urban landscape structure: *Structures located at street corners; Structures aligned along the road axis; Structures serving as focal points of the road axis*.
- Meanwhile, the interior space of the structure is divided into 4 types: *Basement retail space, main functional space, corridor space, and rooftop space..*

## 1.4 Current situation of Conservation of AS of FCB in HICoH

### 1.4.1 Management situation

The Cultural Heritage Laws no.10/VBHN-VPQH, the Regulations on the Management of Old Quarters in Hanoi, Decree No. 92/2002/NĐ-CP, and Decision No. 1259 do not yet address the *value and role* of AS in conservation project.

### 1.4.2 Procedure of Site survey and Conservaion design

The Institute of Monument Conservation provides a site survey process with four contents. Decision 05/2003/QĐ-BVHTT lists the components of conservation projects. These processes lack *specific guidelines, especially regarding AS* to ensure the quality of the work

### 1.4.3 Conservation solution

Due to the focus primarily on *historical value*, only historical monuments of FCB receive conservation attention. The common approach is to ensure the *form during the historical event*, neglecting ongoing degradation. The main causes include space expansion, addition of technical systems (air conditioning, communication systems,

etc.), and the simplest yet most damaging activities, such as plastering/painting for the sake of 'renewal'.

## **1.5 Relevant Studies and Issues Addressed in the Dissertation**

### 1.5.1 Studies on AS

Inheriting studies on AS: *"The Tectonic of the Hellenes 1843-1852"* by Karl Botticher; *"Four Elements of Architecture"* by Gottfried Semper; *"Tectonics in Architecture"* by Robert Maulden; *"Studies in Tectonic Culture"* by Kenneth Frampton.

### 1.5.2 Studies on FCB

*"Natural and Cultural Indigenous Factors in French Colonial Architecture in Vietnam"* by Nguyen Dinh Toan; *'The Symbiosis Phenomenon between Tradition and Modernity in Vietnamese Architecture'* by Le Thanh Son; *'Thang Long - Hanoi, a Millennium of Urbanization'* by Nguyen Quoc Thong & Tran Hung; *'Architecture and Planning in Hanoi during the French Colonial Period'* by Tran Quoc Bao & Nguyen Van Dinh; *'Hanoi through Documents and Archives 1873-1954'* by Dao Thi Dien; *'Architecture of Construction Projects in Hanoi during the French Colonial Period'* by the National Archives Center I

### 1.5.3 Studies on Conservation of FCB

*"Conservation and Enhancement of Architectural Heritage - French Urban Areas in Hai Phong City"* by Nguyen Quoc Tuan; *"Identification of French Colonial Architectural Heritage in Hanoi and Sustainable Conservation Solutions"* by Tran Quoc Bao.

### 1.5.4 Research Contents of the dissertation

- *Comprehensive study of the AS characteristics of FCB.*
- *Identification of the formative factors and influences on the AS of FCB in HICoH.*
- *Value recognition of the AS of FCB in HICoH.*
- *Development procedures of site survey and conservation design.*
- *Formulation of conservation solutions.*



## **Chapter 2: SCIENTIFIC BASIS FOR CONSERVATION OF ARCHITECTONIC STRUCTURE OF THE FRENCH COLONIAL BUILDINGS IN HISTORIC INNER CITY OF HANOI**

### **2.1 Characteristic of AS of FCB in HICoH**

#### 2.1.1 Material characteristics

*Imported materials* were used in the early period such as cement, reinforced concrete, I-beams, slate tiles, glass floor tiles. *Traditional materials and techniques* have also modified: Traditional fired clay bricks were produced in factories, Perforated bricks have emerged with several advantages (material-saving, lightweight, easy to work with). French machine-made tiles, cast iron and ceramics drainpipes.

#### 2.1.2 Component characteristics

Foundation, Wall, Floor, Roof, and Door adhere to the *standards of classical European architecture*. However, alongside this, they are combined with elements of the *indigenous East*. Each component is carefully studied and designed with precision in proportion, from the overall layout to the smallest decorative details, marking the first appearance of such features in Vietnam at that time.

#### 2.1.3 Connection characteristics

The common feature of connections is *simplicity*, such as stones or bricks stacked on top of each other and bonded by mortar. Jerky wall supports floor with a brick arches resting on I-beams. This design has the disadvantage of its *large weight and low tensile strength*. Mechanically, connection types are: *Bearing connections; Fixed joint connections; Rigid frame connections; Bar connections*.

#### 2.1.4 Space characteristics

- Regarding landscape space: there is a close relationship with the structure of urban landscape space. External landscape structures can be categorized into *6 types*: *U-shaped* with an expanded angle; *I-shaped* parallel to the access road; *H-shaped*, located at the end of a main axis road; *L-shaped* at a street corner; *C-shaped* along the axis of the road; *C-shaped* with access from a garden space in the middle, situated at the

end of the road axis.

- Main utility space: relatively small, with a *linear spatial structure* along the traffic corridor. The width of each bay inside is typically 7.5-10m, and the height of each floor is not more than 5m.
- Basement: It maintains a *stable temperature*, protected from external weather changes, and is cool in the summer (20 - 25°C). *The humidity* is generally *higher* than other floors, ranging from 70% to 90% (can reach 100% in spring). Basements are often designed with relatively good ventilation through *small ventilation doors* running around the retaining walls of the structure.
- Corridors: typically wide from 1.5-2.5m. In pre-colonial structures, corridors often *opened directly* to the outside, but in later periods, this space was gradually *enclosed by layers of doors*, progressing from a single-layered door to double-layered doors with an outer layer of glass.
- Roof space: formed by the *sloping roof* system and the *flat ceiling* of the lower floor. In some structures, this space is only about 1.8m high but can reach 2.5 – over 3m in large-scale and renovated structures used as primary spaces. Due to direct contact with the roof of the building, this space has the following characteristics: *Higher temperatures* in the summer; Lower temperatures in the winter with *significant daily fluctuations*; *Good ventilation*.

## **2.2 Factors forming Characteristics and Values of AS of FCB in HICoH**

### 2.2.1 Technical and Material Factors

- Context of scientific and technical progress in France and the world: France introduced Vietnam to distinctive *traditional construction techniques* (15th-16th-century classical architecture) as well as *advanced technology* inherited from Europe
- Domestic scientific innovation: Thanks to advanced production technology imported from France, *domestic material and construction production technology rapidly developed*. Cement/steel factories (Dap Cau), brick, and tile factories (SATIC, Dai La, Hung Ky) were

established, changed the construction technology in Hanoi.

### 2.2.2 Natural and Cultural Factors

- Climate characteristics: The climate in Hanoi is *harsh*, with many *sudden changes* throughout the year, reflected in the actual climate values that often do not match the averages. Therefore, people in Hanoi pay significant attention to *climate issues* in architecture.
- General awareness of colonial culture: The French brought *advanced philosophy and ideas*, helping to *enrich and expand* the scope of Vietnamese culture in *many aspects*, including writing, and cultural arts (literature, painting, performing arts)
- Society's perception of military construction projects: After many historical events, they have been *accepted and become an integral part* of Vietnamese culture, manifested through various aspects such as art, cinema, media, and construction management.

### 2.2.3 Economic and Social Factors

- Economic: a *significant transformation* from the colonial period to the era of opening up to a market economy. New consumer trends with *imported goods* have become *symbols of luxury/extravagance*.
- Societal transformation in Vietnam: The period of opening up easily reveals strong development, with increased demand for material and spiritual products. Establishing an individual style has become necessary for *self-expression*, as people today seek expressions of *personal identity*.

### 2.2.4 Political and Epochal Factors

- The structure of the colonial government, with *ambitious Governors-General*, influenced society through architectural and urban planning imprints.
- Relations between the two government: In the eyes of the Vietnamese people, the image of France has transformed from an *invading nation* to a *reliable partner/friend*.

## 2.3 Factors causing the deterioration of AS of FCB in HICoH

### 2.3.1 Internal factors

The internal factors within the AS of HICoH are manifested through stress originating from *three main causes: Self-weight; Loads; and Deformation* due to the elasticity of materials. Stress is not evenly distributed in the structure; Some points/ areas experience higher stress, and this place is where damage is most likely to occur.

2.3.2 Natural environment factors

*Weak geological conditions, temperature, humidity, pollution, and biological organisms.*

2.3.3 Social environment factors

Factors such as *regulation changes, ownership, overloading* (human and equipment), and the AS modifications.

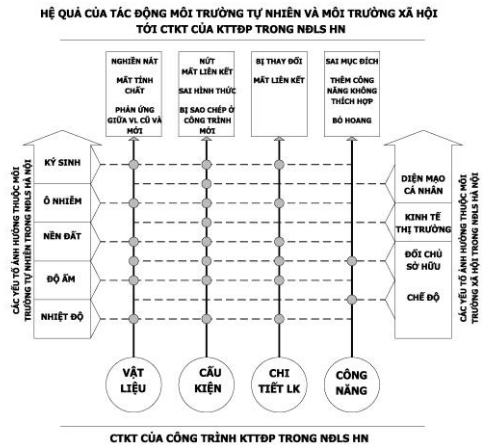
2.4 Theoretical Basis for the Conservation of AS

2.4.1 International Documents on Conservation

The Athens Charter (1931), Venice Charter (1964), Burra Charter (1979), Washington Charter (1987), Hoi An Charter (2003) and Nara Document are the *basis for conservation procedure and solutions*.

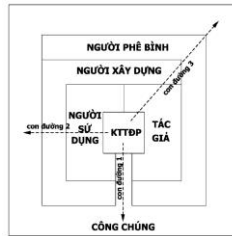
2.4.2 Theoretical Basis for Determining the Value of AS

- Likert scales to identify the value of AS of FCB through social study and expert survey
- The method of *assessing the value and conservation potential* by *Nahoum Cohen* indicates criteria and an evaluation scale for the urban architectural heritage in general.



Hình 2. 1 Tác động của môi trường tự nhiên và môi trường xã hội

- The relationship between spirit and expression: 'Cultural Field' of AS; the relationship between *human beings and cultural arts; Vietnamese philosophy in architecture*



Hình 2. 2 Trường Văn  
hóa của CTKT của  
KTĐP



Hình 2. 3 Bánh xe cảm  
xúc của Pluchik

## 2.5 Practical Basis for the Conservation of AS

- 3 steps of *The CIB architectural heritage assessment procedures*: Approach Request, Survey and Preliminary Evaluation, Diagnosis

- *The CIB conservation design procedure*: Output requirement: reports, construction drawings

### 2.5.1 Methods and Techniques for conservation of AS

- ISCARSAH Conservation Guidelines by *ICOSMOS*
- *TPS USA Conservation Guidelines*
- *Conservation Handbook* by *J. Kirk Irwin*

### 2.5.2 French and Global Experiences

- Europe: Professor *Paulo Lourenco* in the field of conservation, he advocates for *advanced structural analyses*.

- Asia: Professor *Abu Sayeed*, with extensive projects in conservation *utilizing lime-based materials*.

- *Lessons on Authenticity in the Conservation of Chu Quyen communication house and My Son Sanctuary*.

### 2.5.3 Conservation Experience of FCB in Vietnam

- *Site assessment method* in the conservation project of *Vo Van Tan Villa*, Ho Chi Minh City

- Conservation solutions and *integration of interior spaces with urban activities* in the conservation project of the *People's Court building in Ho Chi Minh City*.

## Chapter 3: CONSERVATION SOLUTION FOR ARCHITECTONIC STRUCTURE OF THE FRENCH COLONIAL BUILDINGS IN HISTORICAL INNER CITY OF HANOI

### 3.1 Research perspective and principle

#### 3.1.1 Research perspective

1. Conservation aims for *the authenticity* of 4 characteristics of AS: Material Characteristics, Components Characteristics, Connection Characteristics, and Spatial Characteristics.
2. Conservation work needs to adhere to a *rigorous procedure*.
3. Conservation integrates AS with the activities of HICoH

#### 3.1.2 Research principle

The 4 conservation principles are: Principles of Strengthening; Adaptive conservation to the historical context of HICoH; Replication/recreation in relation to the environment of the HICoH; Replacement/integration

### 3.2 Conservation Values and Potential of AS of FCB in HICoH

#### 3.2.1 The

#### Evaluation Criteria

The dissertation proposes 4 values with 8 evaluation criteria as follows:

- (1.) *Scientific and Technical Value* with 2 criteria: (1.1) Uniqueness of construction material

techniques; (1.2) Adaptation to the natural conditions of HICoH.

- (2.) *Aesthetic Expression Value* with 2 criteria: (2.1) Alignment with societal aesthetic trends; (2.2) “Government representative”.

- (3.) *Identity Establishment Value of the HICoH* with 2 criteria: (3.1) Harmonious connection, enhancing the beauty of HICoH; (3.2)



Hình 3.1 Phương pháp luận để xây dựng bộ tiêu chí đánh giá giá trị và tiềm năng bảo tồn CTKT của KTTĐP trong NDLS HN

Historical significance.

- (4.) *Utilization and Promotion Value* with 2 criteria: (4.1) Uniqueness techniques with high applicability; (4.2) Heritage tourism

### 3.2.2 Criteria and evaluation scale for conservation values

The criteria based on principles of *Scientific, Feasibility, Rigor, Transparency, and Directionality*. 20 criteria and 5 points score /each. The maximum score for each value is 25 points, with a total maximum score of 100 for each AS. The evaluation scale:  $> 80$  is considered to have high value and high conservation potential; 50 to 80 is considered to have value and conservation potential;  $< 50$  is considered to have low value.

### 3.2.3 Technical scientific value

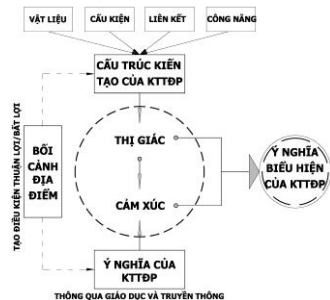
- The criteria for the uniqueness of the construction technique are determined through 3 indicators: *environmentally sustainable natural materials; Material adjustments to suit the construction technical characteristics of the locality; Unique construction techniques*
- The criteria for adapting to the natural conditions of HICoH are determined through 2 indicators: *insulation/humidity buffer space; Materials/components enhancing adaptability to the environment*

### 3.2.4 Expression of Aesthetic Value

- “Alignment with societal aesthetic trends” criteria is evaluated through 3 indicators: *evoking safety/protection emotions; evoking wealth/prosperity emotions; evoking permanence emotions.*
- “Government representative” criteria is evaluated through two indicators: *having significance within the colonial government; having significance within the contemporary Vietnam government.*

### 3.2.5 Identity Establishment Value of the HICoH

- “Harmonious connection with HICoH” criteria is evaluated through



Hình 3. 2 Cơ chế hình thành thẩm mỹ biểu hiện của CTCT của công trình KTTĐP trong NĐLS HN

2 indicators: *authentic and close-to-nature colors/materials; decorative patterns that align with Vietnamese culture.*

- “Historical significance” criteria is demonstrated through 3 indicators: *the proportion of impressive spatial volumes; strategically important locations - urban focal points; serving as the recognizable image of the HICoH.*

3.2.6 Utilization and Promotion value

- “Uniqueness techniques with high applicability “ criteria is expressed through 2 indicators: *resource-efficient construction techniques, spaces adaptable to the climate; aesthetically construction techniques suitable for contemporary architecture.*

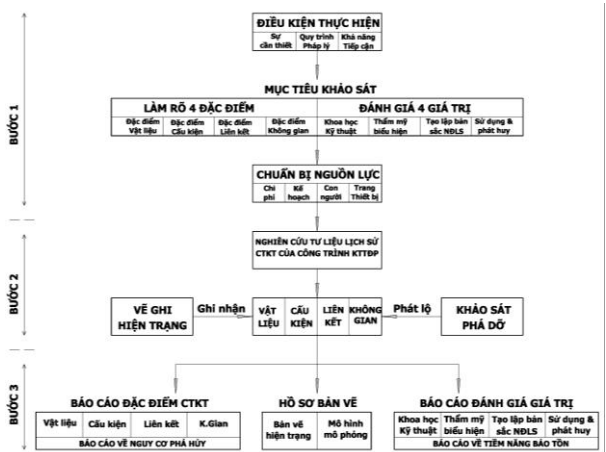
- The criteria for “Heritage tourism” criteria is determined by 3 indicators: *roofed/basement spaces adaptable to technical functions enhancing function; roofed/basement adaptable to public functions providing new experiences; adaptive suitability for community.*

**3.3 Conservation procedure of AS of FCB in HICoH**

3.3.1 Conservation survey and assessment procedure

Proposal for a 3-step survey and assessment procedure:

- Step 1 - Preparation: Legal procedures; Consent from all parties involved; Allocation of resources; Clearly define the objectives of the survey process:



Hình 3. 3 Quy trình điều tra khảo sát

emphasizing the need to clarify the 4 characteristics and evaluate the 4 values of the AS of FCB.

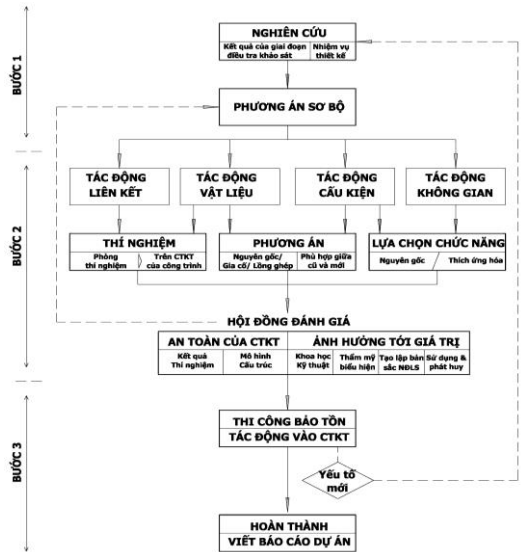


- Step 2 – Site drawing survey: Conduct at all locations to document the existing conditions and damages. Carry out partial or complete *demolition of elements* without value to *reveal* the characteristics of the AS of FCB.
- Step 3 - Evaluation and Reports: *3 types of reports*: Reports on the 4 characteristics of AS and risks of deterioration; Current situation drawings (2D and AS modeling); Reports (written and visual) evaluating the 4 values and conservation potential.

### 3.3.2 Procedure of conservation design

The dissertation proposes a design and construction procedure for the conservation project of the AS of FCB consisting of three steps:

- Step 1 - Design Proposal: Research the results of the survey and *assessment procedure* and the project brief
- Step 2 - Evaluate proposal: base on two main criteria “Safety” and “Values impacts”, overseen by the project's expert council. Impacts on interconnections/materials need to be verified through



Hình 1. 3 Quy trình thiết kế - bảo tồn

*laboratory models/on AS*. Impacts on components need to be verified through *3D model*. Impacts on space should *balance original integrity with new functional use*. If not achieved, return to Step 1.

- Step 3 - Construction: Conservation construction must adhere to *safety requirements*. A monitoring expert team will report on the construction process and project outcomes. During construction, new

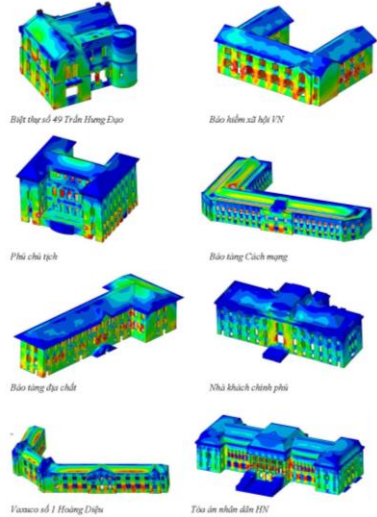
factors may arise requiring assessment of their impact on the project. If necessary, return to Step 1 for *design adjustments/ enhancements*.

### 3.4 Conservation solutions of AS of FCB in HICoH

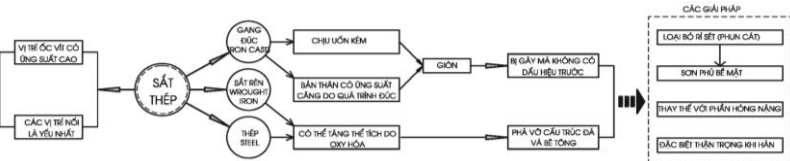
Overall, it is necessary to *model the stresses within the AS of FCB* to identify the *root causes of damage*.

#### 3.4.1 Conservation Solutions for Materials

- Bricks used for conservation have characteristics *similar to the original* (-5\*10.5\*21cm, compressive strength -50N/mm<sup>2</sup>)
- Mortar: use a mortar mix (lime, sand, water) to prevent the formation of a *salt corrosion* layer inside and allow the masonry to *breathe*.
- Metal: Must be coated with *anti-*



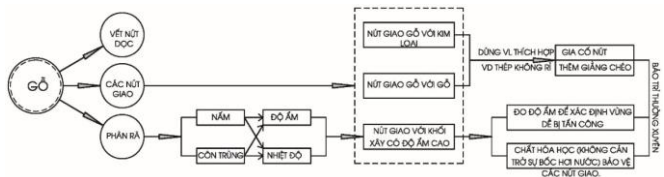
Hình 3. 4 Mô hình hóa ứng suất nội tại trong một số công trình KTTĐP ở HN



Hình 3. 5 Đặc điểm và các phương pháp bảo tồn vật liệu Kim loại *corrosion paint*. Regularly inspect the condition of *metal connections*. Preserve decorative steel or cast iron details with high aesthetic value.

- Wood: Choose the right type of wood/connection similar to the original. When replacement/reinforcement using metal materials, use *stainless steel*.

Reinforce joints/add additional cross braces when

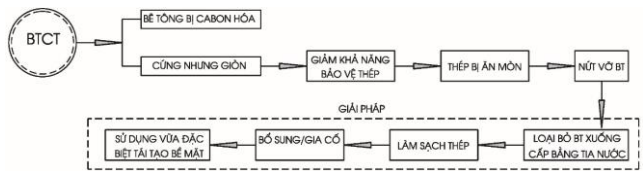


Hình 3. 6 Đặc điểm và các phương pháp bảo tồn với vật liệu Gỗ

needed. Utilize chemicals for surface coating to provide protection at contact points

- with the masonry, such as the ends of wood beams embedded in walls. However, it is advisable not to completely seal the surface, and avoid using oil-based paints.

- Reinforced Concrete: clean using water jet, use chemicals to clean rusted steel, insert new



Hình 3. 7 Đặc điểm và các phương pháp bảo tồn với vật liệu BTCT

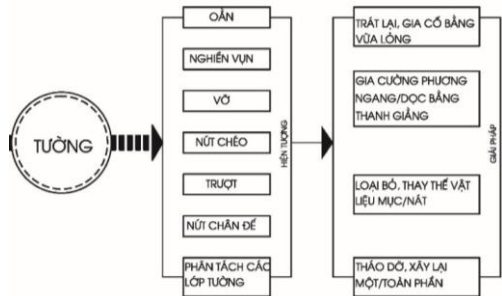
- steel for reinforcement, and repair using grout concrete.

### 3.4.2 Conservation solution for components

In addition to conservation methods for the materials constituting the component, other methods need to be applied to ensure functionality and aesthetic appeal.



Hình 3. 8 Gia cố cấu kiện Móng



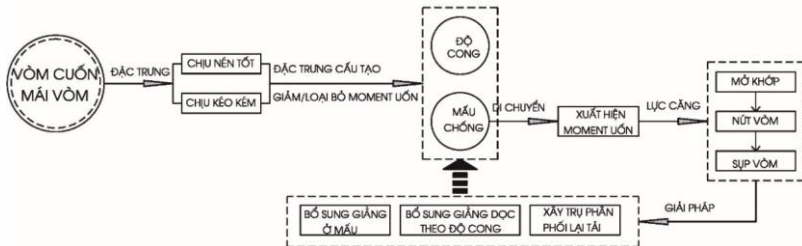
Hình 3. 9 bảo tồn cấu kiện Tường

- Foundation: Reinforce the existing foundation with a *supplementary foundation* system connected around it.

- Walls: For minor cracks, apply grout mortar. In the case of walls with a risk of collapsing due to significant cracks, metal straps with screw fastening can be used. Small voids inside the walls can be filled with a mortar mix combined with broken bricks.

- Arch: For small cracks in the middle of the arch, supplement with

connecting rods between two points (start and end of the arch). Connect these rods by drilling and using steel epoxy. If the arch begins to break when two cracks appear on either side of the symmetry axis, consider additional support beams using wood/steel, paying attention to aesthetic considerations.



Hình 3. 10 bảo tồn cầu kiện Vòm cuốn

- Floor: Prioritize the maintenance of I-beams with rust-resistant paint and ensuring protective mortar layer. With significant cracks, need adjusting columns to distribute the load. Additional steel beams should be added to support the vault when large cracks appear..
- Roof: dismantle the roof if necessary, preserving all original materials. Repair each element using conservation methods for materials. Clean and treat cracks on the water gutter. Supplement the top wall with a beam to increase the rigidity of the connection between the wall and the roof truss. Reinstall the roof system with a suitable slope, replacing corroded metal components.
- Door: Replace the decayed wooden parts that cannot be restored with equivalent materials/techniques. Apply protective paint, using traditional types of paint (vecni) to facilitate good moisture permeability for wood. Wooden components with structural roles that are damaged may need reinforcement with iron straps

### 3.4.3 Conservation Solutions for Connections

*Modeling the connections* within AS to identify vulnerable details. Require to describe as materials, and connection points *without protective layers*.

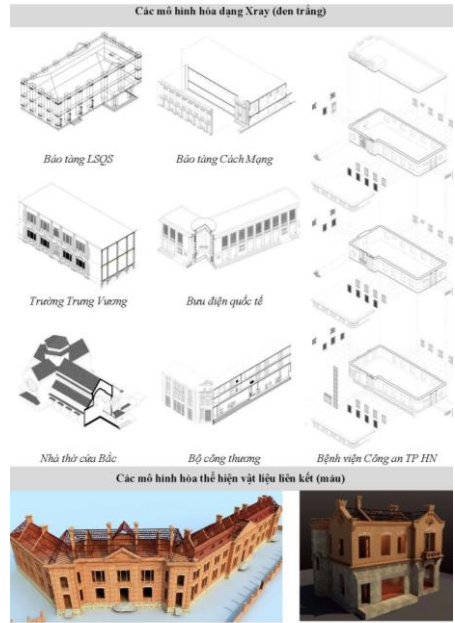
- Outer wall and floor connections: Reinforcement using steel cables in case of wall collapse,
- Internal wall and floor connections: At the corner of the wall and floor, steel brackets can be used to reinforce the three sides.
- Wall and roof connections: Reinforce with a top wall tie connection.
- Foundation and ground connections:

Depending on the variability of the ground, implement measures to stabilize groundwater levels or improve the stiffness of weak soil (using sand piles M75).

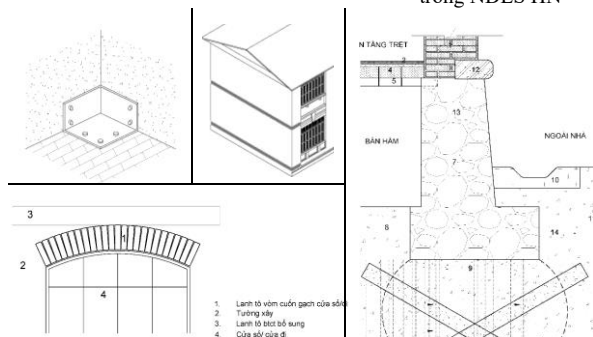
- Wall and door connections:

intergrating concrete beam above the arch to enhance load-bearing capacity

- Column and floor connections: Remove oxidized layers and apply



Hình 3. 11 Một số mô hình hóa chi tiết liên kết của CTKT của các công trình KTTĐP trong NĐLS HN



Hình 3. 12 Các phương pháp bảo tồn liên kết Sàn- Tường nội thất; Ngoại thất; Móng-Nền; Tường-Cửa (Từ trái qua phải, từ trên xuống)

anti-corrosion paint. If a steel column loses its load-bearing capacity due to damage, a new support column can be used for reinforcement, with clear differentiation with the original.

#### 3.4.4 Space Conservation Solutions

Solution for landscape conservation involves establishing protected areas for AS and eliminating intrusive factors. Factors to consider include natural landscapes (trees, water surfaces, etc.), streets, viewpoints, signage, and the form of surrounding structures.

- New constructions within the protected areas should *enhance/intergrate* to the overall aesthetics of the urban area with a focus on the central theme of the AS of FCB.

- For large open landscape areas (gardens, squares, and boulevards), it is necessary to add *complementary*



- elements* (walkways, signage, access

Hình 3. 13 Công trình 49 Trần Hưng Đạo hiện trạng và phương án Bảo tồn không gian cảnh quan

- paths, etc.) to provide a clearer *interpretation of the significance* of the AS of FCB in HICoH.

- In cases where the landscape of AS has already been affected, a plan for *relocating intrusive elements* is required to restore AS value and role in the urban environment.

Adaptive conservation solutions for interior functional spaces should be open in nature to allow not only those inside but also the local community and visitors to perceive the space from the outside. Design principles include *creating similarity, continuity between old and new, and incorporating contrasting elements*.

- Basement/underground: Prioritize functions such as *moisture control and natural ventilation*. When sufficient height is available, consider transforming into *open public exhibition areas*.

- Main use spaces: The ground floor is suitable for *small volume functions* (individual/group rooms, small display areas along routes). Upper floors can have interconnected pathways to create larger spaces like exhibition halls, seminar rooms, and meeting rooms. Pay attention to the placement of *technical elements* (outdoor unit, elevator shafts) on the attic/basement levels
- Rooftop spaces: Small and low spaces can be utilized for air conditioning units, elevator machine rooms. Or serve as multi-functional gathering spaces, including cafe/restaurant services if the space is large enough. Prioritize the use of *transparent materials* such as glass or acrylic to emphasize the *rhythm of the roof structure*.

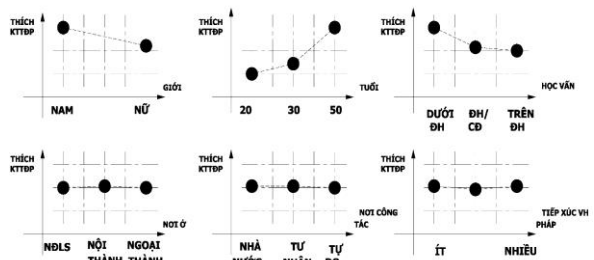
### 3.5 Discussion of dissertation contributions

#### 3.5.1 Consistency and Feasibility in Conservation of AS of FCB

- *Incorporate the terminology of AS of FCB into regulatory texts and architectural conservation and preservation training programs.*
- *Incorporate the regulations of procedure of survey/assessment and conservation design of AS of FCB.*
- Each AS Conservation project requires the involvement of a *multidisciplinary research team* comprising various experts.
- *Adaptive conservation is essential, but community involvement and feedback are crucial.*

#### 3.5.2 The Influence of French Colonial Architecture on Contemporary Architecture from an AS Perspective

- *Awareness for Builders:* Architects, engineers, and construction workers used to associate the luxurious and authoritative image of FCB in *every corner of urban areas, from*



Hình 3.14 Tổng hợp đặc điểm của mẫu khảo sát về sự yêu thích KTTDP

*interiors to exteriors.*

- *Investors:* by *replicating the images of FCB*, they aim to express their individuality. Up to 40% of those surveyed choose the FCB style. (Among them, more men than women, older individuals more than younger ones. However, those with higher education levels tend to choose the FCB style less frequently.

### 3.5.3 Promoting the values of AS of FCB in HICoH

- *In scientific research:* Establishing a *database* storing the characteristics of AS of FCB would contribute to urban development planning and the training of architects and construction engineers.

- *In high culturally urban design:* Creating a distinctive HICoH with focal points of culture through FCB that leverage their AS features.

### 3.5.4 Applicability of research distributions to other urban areas

Re-examinations of the following points is necessary: The factors formed characteristics and values; Factors influencing degradation; The context of architectural characteristics of FCB; The fundamental value assessment methods may be applicable but criteria require careful review and adjustment.

## **CONCLUSION - RECOMMENDATION**

### **1. CONCLUSION**

The importance of FCB in the HICoH has been acknowledged; however, it is not extensively addressed in legal documents. Approaching conservation through traditional methods, such as stylistic preservation, has yielded somewhat modest results, as the value of these projects extends beyond their external appearance. It encompasses the tangible (materials, structures) and intangible (construction technique as connections, spatial arrangements). A profound understanding of AS contributes to identifying authentic values and formulating appropriate conservation strategies. The dissertation has achieved four research outcomes:



1. Identify and clarify the 4 values in the AS of FCB in HICoH, including:

- *Technical Scientific Value*: demonstrated through the integration of Western materials/construction techniques with the local context to serve functional purposes and adapt harmoniously to the climate
- *Aesthetic Value Expression*: Determines the mechanisms forming the value. This value is manifested through conformity to the development trends of societal aesthetics while being a typical representation of the societal regime (government representative).
- *Value in Establishing Identity for HICoH*: In urban planning, they play as key nodes linking urban components, creating harmony for the urban landscape of Hanoi. In the subconscious of residents, they carry the historical significance of the transformation process from feudal urbanization to European-style urbanization
- *Utilization and Promotion Value*: Construction techniques with cost-effective advantages and expressive qualities can be used in the contemporary architecture suitable with the native architecture and sustainable architecture trends. In addition, with numbers of FCB in Hanoi, heritage tourism will bring economic benefits and promote the image of HICoH.

2. Proposing a set of 8 criteria along with 20 indicators to assess the value and conservation potential of the transportation infrastructure project in the Hanoi metropolitan area. The evaluation results also provide guidance for suggesting improvement/enhancement options

3. Establishing conservation procedures of AS of FCB in HICoH

- *3-step survey and assessment Procedure of AS of FCB in HICoH*. The focus is on elucidating the characteristics and values of AS of FCB in HICoH, so the output products of the process is very clear in terms of each element and value. Special attention is given to the demolition survey method to clarify the original value characteristics.

- *3-step design-conservation procedure for AS of FCB in HICoH*. The conservation design process is the subsequent stage following the

survey and investigation process. The design of conservation plans and construction measures must be assessed based on the impact on the 4 elements and 4 values of AS of FCB by an interdisciplinary expert group through specialized methods.

4. The dissertation has proposed specific conservation solutions for AS of FCB in HICoH.

- *Proposed material conservation solutions* based on the characteristics of materials and the contextual conditions of HICoH bricks, mortar, metals, wood, and reinforced concrete.
- *Suggested component conservation solutions* based on the principle of minimizing impact to preserve its external appearance. The focus is primarily on reinforcement to extend the lifespan of component such as foundation, wall, arch, floor, roof, and door.
- *Recommended conservation of connections solutions* are grounded in original techniques to ensure consistency and, most importantly, the authenticity of AS of FCB
- *Proposed conservation of space*: Adaptation of both external and internal landscape spaces to new functional uses, aiming to integrate with the HICoH while preserving the distinct features of AS of FCB and promoting their inherent values.

## **2. RECOMENDATION**

1. *Recommendations for future Research*: A more in-depth study on the impact of AS of FCB on the aesthetic aspects of Vietnamese architecture

2. Suggest to incorporate the procedures of survey/assessment and design-conservation into the legal framework

3. Recommend incorporating the content of AS of FCB into the curriculum of the conservation program in Vietnam.

4. Suggest applying the proposed conservation solutions outlined in the dissertation in a concrete project.

**List of published scientific works of the author  
related to the dissertation**

- Scientific papers

1. Le Duy Thanh (2021), *Identifying Architectonic Structure of the French Colonial Architecture and their Values contributing to the Historic Inner Hanoi city*, Architecture Journal - Vietnam Architects Association Journal (ISSN 0866-8617), Issue October 2023.
2. Le Duy Thanh (2023), *Preserving and promoting the aesthetic values expressed in the architectural heritage of French colonial structures in Hanoi*, Construction and Urban Journal - AMC (ISSN 1859-3119), Issue 90, August 2023.

- Scientific paper in scientific conference

3. Le Duy Thanh (2021), *The story of the approaching and evaluation process of the French Villa in Hanoi*, Polish-Vietnamese experience in preservation and conservation of achitecural heritage, Science and Technology Publisher, (ISBN 978-604-67-2106-2) , 2021, p. 251-255.

