BESt: Journal of Built Environment Studies
P-ISSN: 2086-2636 E-ISSN: 2356-4644
Journal Home Page: jurnal.ugm.ac.id/v3/BEST

IN-FILL DESIGN IDENTIFICATION AS PRELIMINARY STUDY OF HERITAGE SITE CONSERVATION IN BOROBUDUR TEMPLE COMPOUNDS AREA

Pusparini Dharma Putri[1*], Laretna Trisnantari Adishakti[2]
Department of Architecture and Planning, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia

ABSTRACT

Borobudur Temple Compounds has a rural architectural atmosphere as an attribute. The compounds now face urbanized impacts by massive development, threatening social, political, and economic sectors, including architecture as a regional layout. And it is a threat to architectural preservation. This research tries to identify the kind of In-fill design of traditional architectural objects in surroundings. By using several parameters and virtual reconstruction as an identification tool, this research stands as an effort to preserve in the form of documentation. The process was done by visiting several villages and conducting digital modeling and drawing. This paper will be driven into three main outcomes: categorization of observed objects by their roof typologies, types of the wider setting, and their periodization. This research final aimed to be positioned as a prelude to the data documentation stage in the Heritage Impact Assessment (HIA) process and a critique of government regulation regarding the documentation of local architecture.

[*]Corresponding Author
Pusparini Dharma Putri

Universitas Gadjah Mada
+628139231934
Email:
pusparini.dharma.p@mail.ugm.ac.id

Keywords: in-fill design; rural architecture; virtual reconstruction; traditional building component

1. Introduction

Since the declaration of the Borobudur temple compound area as a National Tourism Strategic Area / KSPN1, several impacts have occurred on the area, from socioeconomic issues to "urbanized" architectural problems. Where it is the result of "top-down" projects that are not developed based on in-depth studies, the Borobudur Temple Compounds itself has been listed on the World Heritage list since 1995, which indicates that the development of the area needs to prioritize layers of development (Prabowo et al., 2020) and needs in-depth studies for each development occur in that area. But, before the development/construction begins in heritage areas, the government, with the help of a third party sector, must previously conduct a Heritage Impact Assessment2 (HIA) (ICOMOS, n.d.).

Being included in the World Heritage list shows the significant heritage value along with the diversity of the Borobudur temple compound, as it is also known as an open-air museum (Taylor, 2019). The initial use of Borobudur Temple Compounds as a Buddhist worship area also played a role in influencing the development of relevant Javanese community settlements. The settlements that developed were an extension and became a representation of earlier settlements. The toponym of the area around also represents the development of settlements from time to time and the geographical condition of the area (Anshari, 2017). One of the regional toponyms in the region Bhumi (earth) Segoro (sea/lake/water) stands as a historical sign of this area was once the former ancient lake of Borobudur Temple (Yunanda et al., 2018).

The level of development of human life is characterized by the existence of physical buildings that have an intrinsic value of local wisdom, as manifested in the architecture of traditional Javanese buildings (Ahimsa-Putra, 2019). The embodiment of value in this traditional Javanese building is the equivalent of the value of trust, knowledge, social ethics, and aesthetic sense (Afriyanto et al., 2021). These values are also reflected in the development of architecture and the arrangement of residential areas for Javanese people. The embodiment of the form of architectural objects itself is a form of development of community governance (Sultan, 2021), which is influenced by aspects of culture and customs or daily activities, as well as the local climate. In general, the buildings and settlement patterns of the Javanese people are influenced by the existence of Hindus and Buddhists.

Figure 1. (1) House that gets KSPN Improvement Fund; (2) Traditional House that is still in good condition

1.1. Community Heritage

Figure 2. Tangible and intangible heritage of Candirejo Village
Source: candirejo.com

Even though people living in the Borobudur Temple Compounds area no longer carry out all activities traditionally, the local wisdom principle is still applied daily. The community still applies social systems, customs, and local wisdom that are passed down, and it is shown in their everyday life (Fatmawati & Nurhayati, 2020).This culture is still preserved as a hereditary concept influenced by people's daily activities. Most residents in the area, until 2021, are still doing agriculture activities and other professions, such as small/ medium-scale household industry craftsmen, regional public/private office employees, or working in the tourism sector as the owner of lodging and/or restaurants. This combined pattern of agricultural and other economic activities has characterized the local culture today and is a form of appreciation for citizens preservingthe noble culture.

This indicates the development of human activity types (intangible), which will produce various objects of activity (tangible) (Karma, 2017). The relationship between the intangible and tangible is the form of architecture itself. In the form of residents' residences (whether traditional or contemporary style), new architectural objects form in restaurants, homestays, hotels, and shops that develop along the area's main road (Balaputradewa Street).

2. Literature Review

2.1. The Heritage In-fill Design

The Heritage In-fill Design, defined in the Bumi Pelestari Pusaka Indonesia, is a design intervention effortcarried out on ordinary heritage buildings or heritage sites, adaptive reuse, or in-fill design. In the context of preservation with the application of ODAP, all aspectsshould be considered, and this is also stated in the Heritage CityPreservation indicator compiled by BPPI. The process of heritage in-fill design, commonly referred to as adaptive reuse / adaptive design, stands as a milestone in sustainablearchitecture (Abdulameer & Abbas, 2020), either in terms of carbon footprint or the historical layer of an heirloom. Adaptive design in heritage buildings will strengthen the sense of belonging or attachment of an object orarchitectural area to the past and future. In an effort to build attachment to an object or area, heritage in-fill designshould pay attention to various aspects, such as social, economic, and cultural.

2.2. Traditional Javanese Buildings

Traditional Javanese buildings are grouped into five basic forms based on its roof; *panggang pe, kampung, limasan, tajug*, and *joglo*. Related to the social community hierarchy, joglo is the highest form and is considered the most picturesque. For Javanese people, the joglo building was considered not to be owned by laypersons, and it was exclusively intended to be owned by *priyayi*/nobles. It is also related to the complexity of the structure and the number of building components in the building setting (joglo), indicating the homeowner's status (economic and social). The limasan typology shows theowner's status as one level below the joglo building typology. The Limasan building has a medium level of structural complexity. In addition, the material used is not as much as that of the Joglo building. The building typology also accompanies the joglo building in one building complex. The village typology building has the most straightforward structural complexity, and the material needs in the roof frame structure are few. It is an empirical justification that the buildings in the Borobudur Temple Compounds area are mostly village-type with the availability of ornaments.

The community's residential area around the Borobudur temple compound area forms a settlementpattern, categorized as a rural settlement. Rural settlements are not much different in area structure from urban settlements, which distinguishes only in the geographical area (location) (Mulyana, 2013) as well as the pattern of citizen activity. The concept of rural settlements(physical aspects) has the characteristics of green land usethat dominate and the boundaries of land ownership parcels that are limited by vegetation. The characteristics of the arrangement of residential areas that present real boundaries between building parcels in the countryside arestrongly found throughout the observed area. In terms of non-physicality, it is still upheld that the cooperation of residents has succeeded in becoming a barrier to resilience to develop further (referring to the individualism of urban residents).

2.3. Historic Urban Landscape and Heritage Impact Assessment

Historic Urban Landscape (HUL) is a new perspective as a form of conservation efforts for highly valued historical areas, thoroughly carried out and involving all relevant elements of the area, namely community engagement, knowledge, and good planning (knowledge and planning), regulatory system, and financing (financial tools) (Ginzarly, Houbart, et al., 2019). However, as stated by Satander and Arana (2018), it should be noted that this phrase is not much different from the previously known concepts of conservation; this concept still needs to be strengthened in actions that must be carried out effectively. Meanwhile, the Heritage Impact Assessment (HIA) studies the impact of a phenomenon/event (directly or indirectly) planned on the object of the Heritage or Heritage Area. The purpose of HIA is to determine the potential and significance of potential impacts that have the potential to occur in the future (ICOMOS, n.d.) tag. This assessment process should involve various social layers in the community around the object or heritage area.

According to UNESCO (2011), the historic urban landscape contains layers of historical, interrelated (tangible and intangible), and local valuesthat blend and grow in a city. This makes an urbanarea as it is today, the complexity of layers of history and the rich development of civilization. Interrelated values, physical and non-physical, will be the starting point in the future management and development of cities. Thisis a form of appreciation for UNESCO's efforts to achieve the SDGs

(Sustainable Development Goals) with the 11th, 12th, and 13th targets. The holistic- interdisciplinary HUL aims to improve the quality of life oflocal communities, manage change, and create wise management of urban conservation.

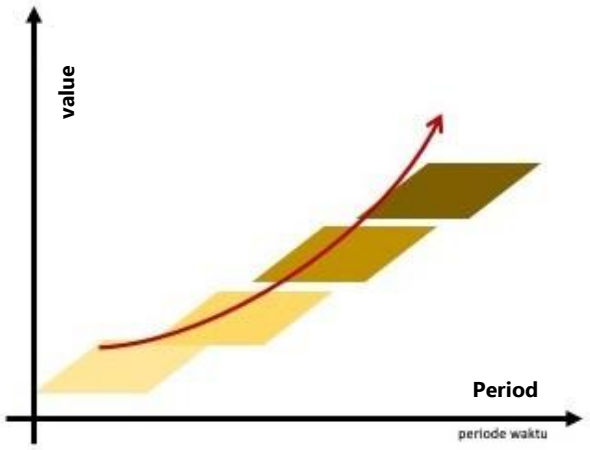


Figure 3. Value-added graph of the area in the lens of Historic Urban Landscape

Figure 4. The concept of the building period of the Pawon Temple Area
Source: RTBL Pawon (KSPN 2019)

The impact of applying this concept to an area is that it will improve services from the business sector, strengthen the sense of place in the area, high land, and property values, increase income, become a restoration and rehabilitation step, revive the tourism sector, and improve planning and design (UNESCO, 2016).

2.4. The Regional Building Layout and Langgam Rules

The Regional Building Layout and *Langgam* Rules, the Magelang Regency Spatial and Regional Plan document (2010 – 2030) (RTBL Pawon Area (2017) and RBTL MendutArea (2013)) do not have precise regulations regarding regional 'langgam' or architectural styles and spatial planning that must be applied in the area. However, another document, the Pawon Temple Area Building and Protection Plan, states that thesurrounding area must implement a traditional Javanese building style. The document that regulates and oversees the region's development does not clearly state howthe area should be developed, although the images that have been raised can be a reference; what about escorting the development of the area?

3. Research Method

3.1. Methods and Approaches

This research uses a direct field observation method with desk analysis, a literature study, and a discussion with experts about the observed objects. Field data collection is carried out by walking through the village along the main road in the observed area. If traditional building objects arefound, the researcher will collect further data.Further referring to smaller observed objects (buildings), data retrieval focuses on documenting the building's facades, components, and settings. Documentation of the façade of the building may simultaneously indicate the typology of the building and the development already experienced by the building. Theinterior of the building was not used as part of the main object of observation in the study to limit the research conducted by the authors.

3.1.1. Observation Area

Borobudur temple compound, consisting of three temple structures, Mendhut Temple, Pawon Temple, and Borobudur Temple, is located in Magelang Regency, Central Java Province, Indonesia. Borobudur temple compound area consists of sub-urban rural areas and stretches of agricultural land. The research focused on the observed area in some places in the coverage areas of Sub-Penunjang 1 (SP 1) and Sub-Penunjang 2 (SP 2).

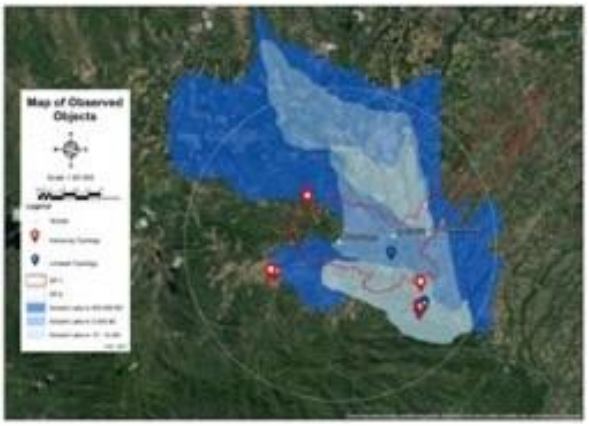


Figure 5. Map of the distribution of observed Object Village

The objects observed are found in six areas: parts of Candirejo, Wanurejo, Klipoh, Maitan, and the area around the imaginary line of the Borobudur temple compound (Bojong and Bejeng). In addition to observing traditional buildings in the village, observations were made on the first layer of Balaputradewa Road. Documentation is carried out by taking photos and videosand taking measurements of the object in the residential area. The measurement process is carried out on one side of the building, which is continued with building proportions in the re-imagining process.

3.1.2. Data Grouping

The grouping categories used in this study will becarried out based on the location of the observed objects, the typology of the building, the structure of the building construction, and the type of design process applied. Also, those categories are carried out after a study that has beendone before, where we documented all the traditional buildings and also who got an in-fill design touch, such as what we have described in the research background. Thisstudy also stated intangible factors that follow the existence of observed objects.

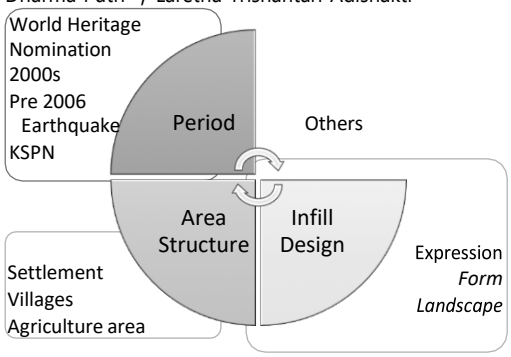


Figure 6. Classification of data collection

These groupings form a codification system. Thus, the data can be easily read and understood by the commoner. The groupings in the group will also be divided, referring to the division of the body of the building: legs, torso, and head (Wardiningsih, 2015). This division of the body represents how Indonesian Vernacular Architecture is developed. So, it was hoped that this classification or grouping could continue with another study that analyzes the red line between Indonesian Traditional Buildings to know the DNA of Indonesian Vernacular Architecture.

4. Results and Discussions

4.1. In-fill Design Types

Figure 7. The majority of typologies of traditional building types are based on shape

The most common variety of in-fill design found in thearea around the Borobudur temple compound is the overall village typology building functioning as a residential house, where one parcel of land ownership consists of the main house (village typology) and pawon (attached to the main house or separate). Buildings and settings likewise also have vertical boundaries that are nothigher than those of humans between neighbors. This form of design is a form of the concept of getting along well (*guyub*) with rural communities, which is the advantage of the value of rural settlements. Although the layout of the building in a set like this has developed further (the increase in the area of the building due to the increase in the number of family members), efforts in maintaining the form of land parcels are still carried out in each parcel.

Entering into smaller objects, building time, and generally the design process in traditional langgam is the replacement of timber structure materials (vertical elements) into reinforced brick/concrete materials. Material replacement is driven by an improvement in the economic qualities of building owners and is also caused by the degradation of the quality of vertical structures (timber).

Figure 8. Kinds of Façade design intervention

Another visible in-fill design is a change in the terrace of the building in the shape of theroof or a change in the function of the terrace. It should beunderstood that in preserving heritage areas, the harmony of buildings in one area becomes an important value. The alignment is intended to maintain and preserve the image of the region. Maintaining the image of the region does not mean completely rejecting new development, but new development needs to adapt to the existing image so that the area remains in harmony, especially maintaining the perspective of the human eye. Some of the potentials of in-fill design that are in accordance with the regional style are the addition of buildings that are not attached to the existing building so as to create a unit of building components in one parcel. Inaddition, it can also be the use of similar materials, in the form of gedheg (bamboo walls) or wood as a wall cement.It would be wrong to do the same thing the Ministry of PUPR implemented with the

"*batanization*" of settlementsalong the protocol road of the Borobudur templecompound area.

Figure 9. Variety of materials as a form of building expression(*gedheg* / bamboo

4.2. Regional Structure and Rural Settlement

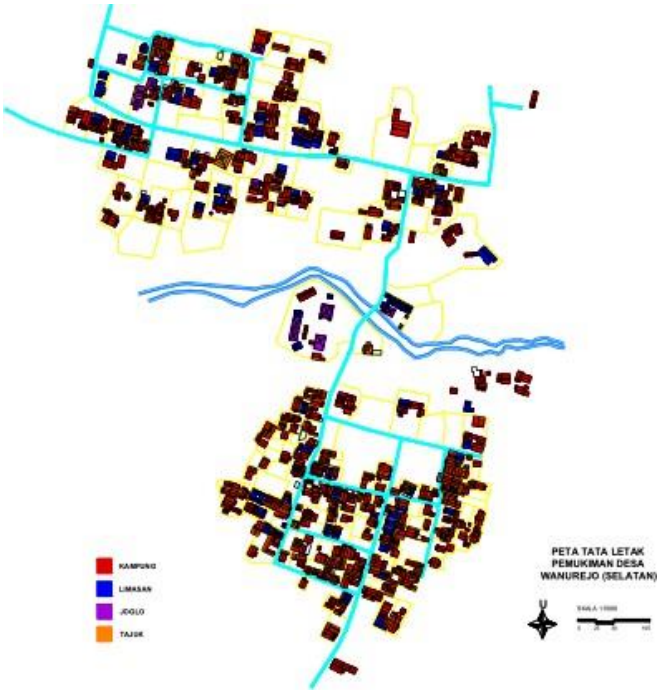
There are three characteristics of rural settlements thatare seen in each observed village, namely:

1. The majority of land use is used for agricultural land(corn, rice, tobacco, etc.)
2. Simplicity of simple architectural expression in all buildings in one area that is in harmony with nature (setting)
3. Landscapes (gardens, forests, rivers) as village or territory boundaries at the micro level parcels of land ownership) vegetation that functions as land boundaries.

Figure 10. Expression of the rural settlement area of theBorobudur temple compound area

In accordance with reference to the regional design direction document at the 2020 RTBL Pawon KSPN, the majority of building typologies found in the field are buildings (traditional and modern) with a typology of village roofs, limasan, but it is very rare to find original (local) buildings with joglo roof typologies. Joglo buildings are commonly found with commercial functions such as homestays, restaurants, café, or complementary buildings in one building complex outside the Borobudur temple compound area (ex-situ). Traditional buildings (in-situ) based on the results of direct observation in the field are buildings with the function of residential houses. Some houses also have an additional function as a workshop for the owner (for example, a pottery workshop). If analyzed further in traditional buildings in situ, the design interventions carried out did not change the shape of the building because the design process usually consisted of building new rooms on the side or back of the original building.

Figure 11. Distribution of buildings in the Wanurejo observed area,



Borobudur Temple compound

It is also interesting to find that the majority of buildings in the observed area of Candirejo, Klipoh, and Wringinputih are mostly village typologies. In contrast, the buildings in Wanurejo and Maitan are mostly limasan typologies. Furthermore, in the Tuksongo observed area, the number of buildings compared with the typology of the village and limasan is almost comparable.

The pattern of street space and residential areas also forms a grid pattern, not applying a centrist pattern. This isbecause there is no activity center in the middle ofsettlements in the observed area, which is a reference for activity / vocal points. Apart from being due to the pattern of citizen activity, this spatial layout is a form of adaptation to the contours, simultaneously forming a pattern of regional protection. On a micro-scale (home parcel), this Grid patterns also appear during the development of the buildingperiod (Santosa, 2016).

Interestingly, many buildings with a typology of limasan roofs but no longer with wooden vertical structures have been replaced with reinforced brick / concrete structures. This phenomenon was identified to occur in the 1990s – 2000s. This identification is based on the type of glass window used (*nako*) and additional components on the terrace using a fence with a grate model that was widely used in the 1990s. The replacement of wooden structures with reinforced concrete structures also shows an improvement in the community's economy so that the community is increasingly able to keep up with architectural developments (Gowa, 2016).

4.3. Periodization

Grouping based on the time layer (periodization) of various building designs in the area to facilitate research in curating field findings data. Each finding will be identified as the object of the design occurring at the time layer andwhat new interventions occur. In addition, carrying out an area conservation study with a Historic Urban Landscape (HUL) approach (Asriana & Sesotyaningtyas, 2018) must have a period/time layer of the observed area (Ginzarly et al., 2019). After the field warning is carried out, a period of various design processes is compiled; this is useful for showing the time layer of the observed object that stands as an indicator of the success of the community and the government in implementing the Architectural Design Process. This periodization is made based on events/time that have occurred until now in the process of structuring the area/architecture, such as the designation of Borobudur Temple as a World Heritagein 1995, the Jogja earthquake in 2006 and when CSR (Corporate Social Responsibility) funds of various SOEs entered the villages around the area. It is visible to the naked eye that the addition/modification of buildings occurs and complements each other directly.

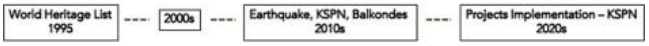


Figure 12. Periodization of Observed Objects

4.4. Improve Identification Data and System

Overall research and conclusions drawn from similar studies regarding the identification of local architecture expression increasingly open the possibility that contributions in the data collection stage (taking images of observed objects) to produce virtual documentation of objects based on real data (high accuracy) / measurements (relatively low accuracy) and according to real conditions is very wide open. In line with the great concept of a Historic Urban Landscape (Ginzarly et al., 2019), which puts forward the role of the wider community (participatory public), a single data portal must be established as a pooling data site. Big data that is echoed today will show its usefulness in preserving architectural heritage expression, such as the traditional building. It also stated that the steps that must be taken in the implementation of Historic Urban Landscape and Heritage Impact Assessment require that data be collectedand well organized (by one gate data system). This effort will strengthen the objective, measurable, and real data-based analysis. For instance, the accuratedigital data in the area shows very objective data, sothe assessment in the Heritage Impact Assessment will minimize the subjectivity of the assessor/assessor. This is important to avoid the same mistakes that have occurredduring the implementation of the HIA Borobudur 2021.

4.5. Virtual Reconstruction

To document and preserve heritage objects digitally, virtual reconstruction still needs to be implemented in Indonesia, such as for this kind of research. The ease ofdoing simple documentation (in the form of 2D photos) with various quality devices will assist in documentation by reconstructing the observed object digitally. With two approaches to data collection (Reality Based Modelling and Source Based Modelling) and the accompanying tools, it should have been able to become an initial guide in carrying out a simple virtual reconstruction.

Determination of the object of observation for the method of photogrammetry and ordinary field measurements based on conditions: (1) there are not many obstructions to the view of the building (Pardamean & Tolle, 2021), (2) the entire envelope of the building can be surrounded/photographed (at least two sides of the building are next to each other), (3) the object of the observation is an old building or a building that represents the character majority of the surrounding buildings (UNESCO, 2021). With the provisions of the observed objects, six observable objects that meet these criteria have been successfully curated for further virtual reconstruction using photogrammetry. In addition to the photogrammetry method (hereinafter referred to as ClosedRange Photogrammetry/CRP), the six selected observed objects will also be reconstructed using the redrawing method based on the measurement results (hereinafter referred to as Source Modeling/SBM).

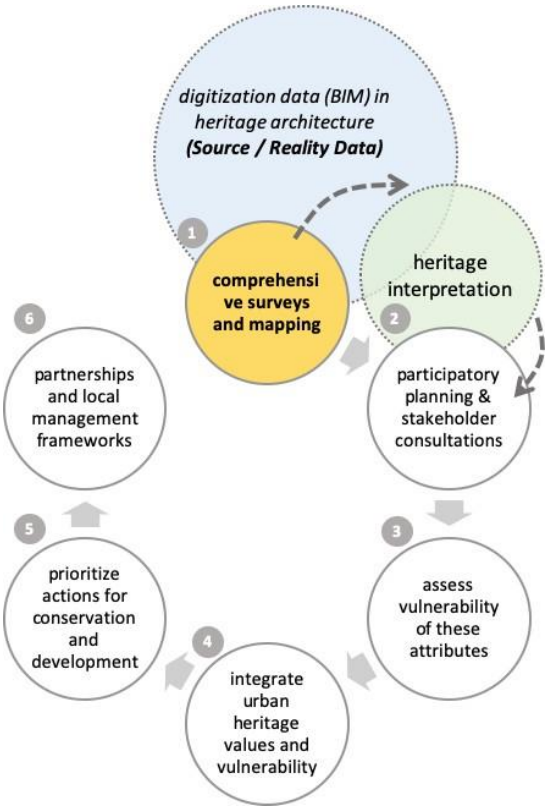


Figure 13. Post-Occupancy Evaluation Phase
Source: Praiser, 2012

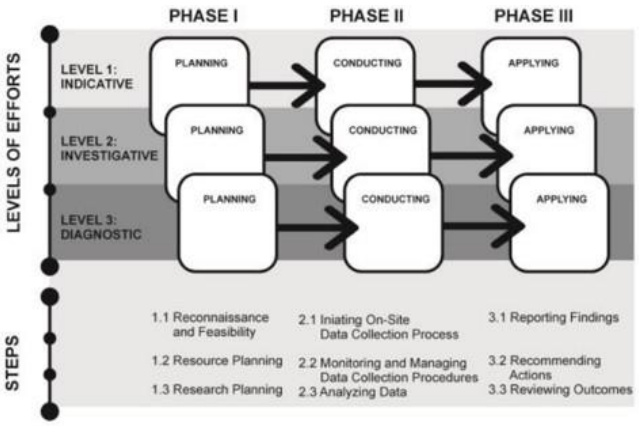


Figure 14. Steps in Implementing Historic Urban Landscape
Source: The HUL Guide Book, UNESCO 2016 with improvemen

4.6. Post-Occupancy Evaluation

Evaluation of built objects after various interventions (Jiafeng et al., 2020) becomes a recommendation urgently being carried out in the Borobudur Temple Complex area and surrounding hamlets. Understanding the stages in the implementation of Post Occupancy Evaluation (POE), this research stands at the identification stage (phase 1) (Nimpuno, 2017).

5. Conclusion

Identification of various heritage in-fill designs in the Borobudur temple compound area has shown similarities within the building's layout as well as the building's form. This will be the fundamental base for developing the area design guidelines. The main issues found as the conclusion of the identification in the Borobudur temple compound area are;

a. Characteristics of Rural Area Planning.
   An area with a rural atmosphere that dominates the residential area. The combination of human-made and nature-made is neatly intertwined. Neighbors and large parcels of land are characteristic of rural settlements.
b. Characteristics and expression of buildings.
   Javanese people, as the majority of the population in the area, produce the character of traditional Javanese buildings with a down-to-earth, simple expression. Ornamentation and various structures and materials are minimally implemented in building architecture.
c. The influence of the community's role in thedevelopment of the region.
   Cooperation as the social identity of the people in the region is still felt when carrying out architectural interventions. Renovating or building traditional buildings still involves residents, and the maintenance of residential areas also uses the principle of cooperation.
d. Imminent natural elements in the architecture of buildings and regions.
   Plants and mountainous/agricultural landscapes are strong elements in the Regional in-fill design. Different types of plants are present in thelandscape of the yard and *kebon*. This element can be found in almost the entire area of the observed.

In addition to the four findings points, communityefforts were also identified in neatly presenting traditional architectural expressions in modern buildings. One good example is building design processing to show still the image of the building with traditional materials (gedheg) in the house owned by Manto (Dusun Bejeng).

Presenting digital data space in the form of photos from various layers of time and weather that highlight observed objects can be a good source of data to be processed into 3D object data. In an enormous scope (regional example), these data can present a digital diorama (Nakayaet al., 2010) that can be accessed from various places and times. Such virtual tourism has begun tobe widely used in Indonesia, such as on the pages of the Indonesian National Museum and Borobudur Temple.

Figure 15. Concrete wall "wrap with *gedheg*" to maintain imagery

6. References

Abdulameer, Z. A., & Abbas, S. S. (2020). Adaptive reuse as anapproach to sustainability. IOP Conference Series: Materials Science and Engineering, 881(1). https://doi.org/10.1088/1757-899X/881/1/012010

Afriyanto, D. S., Putri, P. D., & Pradipto, E. (2021). PADA PENDOPO DALEM KABUPATEN REMBANG The Tectonics of Javanese and Europe Elements in Pendopo DalemKabupaten Rembang. 19(2), 239–248.

Anshari, I. B. (2017). Kajian Etnosemantik Dalam Toponimi. Jurnal Laboratorium Leksikologi Dan Leksikografi, ISSN: 2407(May), 64.

Asriana, N., & Sesotyaningtyas, M. (2018). Pendekatan Historic Urban Landscape Untuk Pelestarian.

Demetrescu, E. (2018). Virtual reconstruction as a scientific tool: The extended matrix and source-based modelling approach. Communications in Computer and Information Science, 817, 102–116. https://doi.org/10.1007/978-3-319-76992-9_7

Fatmawati, A., & Nurhayati, E. (2020). Kearifan Lokal Jawa dalamSerat Manguharja. Jurnal Penelitian Humaniora, 25.

Ginzarly, M., Houbart, C., & Teller, J. (2019). The Historic Urban Landscape approach to urban management: a systematicreview. International Journal of Heritage Studies, 25(10), 999–1019. https://doi.org/10.1080/13527258.2018.1552615

Ginzarly, M., Pereira Roders, A., & Teller, J. (2019). Mapping historic urban landscape values through social media.Journal of Cultural Heritage, 36(October), 1–11. https://doi.org/10.1016/j.culher.2018.10.002

Gowa, P. (2016). Peranan Wujud Sosial Ekonomi Pada Akulturasi Arsitektur Tradisional Makassar Dalam Pengembangan Rumah Tinggal. Prosiding Temu Ilmiah IPLBI, 1–9. https://eng.unhas.ac.id/arsitektur/files/5821b5d204ea8.pdf

ICOMOS. (n.d.). Guidance on Heritage Impact Assessment forCultural World Heritage Propertise. 148, 148–162.

Jiafeng, S., Wei, H., & Yun, W. (2020). The Post-occupancy Evaluation over the Landscape of the Campus of Zhejiang Agriculture and Forestry University. IOP Conference Series:Materials Science and Engineering, 794(1). https://doi.org/10.1088/1757-899X/794/1/012052

Karma, M. P. (2017). Penelusuran Nilai Tangible dan Intangible Heritage dalam Tradisi Ngerebeg di Desa Tegallalang, Gianyar, Bali. B103–B110. https://doi.org/10.32315/sem.1.b103

Mulyana, D. (2013). Ilmu Komunikasi: Suatu Pengantar. Remaja Rosdakarya.

Nakaya, T., Yano, K., Isoda, Y., Kawasumi, T., Takase, Y., Kirimura,T.,

Tsukamoto, A., Matsumoto, A., Seto, T., & Iizuka, T. (2010). Virtual Kyoto project: Digital diorama of the past,present, and future of the `historical city of Kyoto. LectureNotes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 6259 LNCS, 173–187. https://doi.org/10.1007/978-3-642-17184-0_14

Nimpuno, W. B. (2017). Post-Occupancy Evaluation: the Application of Universal Design in Hayrettin Paşa Square,Istanbul. Sinergi, 21(1), 39. https://doi.org/10.22441/sinergi.2017.1.006

UNESCO, J. H. S. (2021). Documentation of The Traditional Building Character in Cultural Landscape of Borobudur Region.

Preiser, W. F. E. (2008). Universal Design: From Policy To Assessment Research and Practice. International Journal of Architectural Research: ArchNet-IJAR, 2(2), 78–93. https://doi.org/10.26687/archnet-ijar.v2i2.234

Pardamean, B. S., & Tolle, H. (2021). Pembuatan Objek 3D CandiBadut Menggunakan Metode Photogrammetry. Physics and Science Education Journal (PSEJ), 5(6), 1–2.

Prabowo, B. N., Pramesti, P. U., Ramandhika, M., & Sukawi, S. (2020). Historic urban landscape (HUL) approach in Kota Lama Semarang: Mapping the layer of physical development through the chronological history. IOP Conference Series: Earth and Environmental Science, 402(1). https://doi.org/10.1088/1755-1315/402/1/012020

Sultan, S. H. (2021). Kajian Tipologi Bola Soba Bangunan Tradisional Bugis Bone. Permukiman, Pusat Litbang Perumahan Dan, 178.

Taylor, K. (2019). Cultural landscape as open-air museum. Humanities Research, 10(2), 51–62. UNESCO. (2016). The HUL Guidebook. The HUL Guide, 59. http://historicurbanlandscape.com/themes/196/userfiles/download/2016/6/7/wirey5prpznidqx.pdf

Santosa, E. B. (2016). Ruang Permukiman Tradisional Jawa Berbasis Perlindungan. Journal of Regional and CityPlanning, 27(1), 16–24. https://doi.org/10.5614/jrcp.2016.27.1.2

Wardiningsih, S. (2015). Arsitektur Nusantara Mempengaruhi Bentuk Bangunan yang Berkembang di Indonesia. Scale,2(2), 274–283. http://repository.uki.ac.id/492/1/5. Sitti Wardiningsih.pdf