Article

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A Digital Preservation for the Indonesian First Terminus

Abstract: The presence of modernization in Indonesia is supported by several factors, one of which is the railway network. Unfortunately, despite its importance in Indonesian history, the first terminus in Indonesia – namely, Semarang Station – has almost been forgotten. Conservation efforts are needed to describe the architectural evolution of Semarang Station, which can provide a lens to see the adaptation efforts in the development process and the global impact of the establishment of a railway network in the colony. Moreover, digital reconstruction as architectural preservation is necessary to convey the station's historical value. Given the limited access and scarcity of architectural drawings for Semarang Station, textual sources were used to validate the information from the visual sources. The digitalization of visual data produced 2D objects that were used as the basis for making 3D models; these 2D objects were identified using textual data to see the relationship between their architectural transformation and the events related to the building. The findings of the architectural morphology analysis were then used as data to produce the 3D models, which were the main target of the digital reconstruction. The result of this process is a reconstruction of the morphology of the Semarang Station that demonstrates its historical value.

Keywords: colonial; Semarang; heritage; reconstruction; history

1 Introduction

Semarang Station was the first terminus station in Indonesia and was established at the beginning of the development of the Java railway network. Unfortunately, information about the main station, which served as the starting point for opening the interior of Java, is currently not widely known to the public. The remains of the station building located in the swampy area of Kampung Sporland in Kemijen Kelurahan Semarang, with only a portion of the south wings still standing, do not show the appearance of the main station (OpenStreetMap Foundation n.d.). Indeed, the existence of the first terminus in Indonesia has been nearly forgotten, even though it is undeniable that trains, railways, and stations are the vehicles that ushered in the arrival of modernization to Indonesia.

Information about the architectural transformation of the stations in Indonesia, especially the first terminus, is an important illustration of the application of engineering education from Europe to the tropics. Moreover, efforts to describe the transformation of station architecture can serve as a magnifying glass to see the adaptation efforts and the global impact of railway construction in colonies. This has the potential to contribute to the creation of more inclusive and sustainable societies, and will also facilitate discussions of shared heritage to support partnerships and achieve the Sustainable Development Goals (SDGs). Preserving Semarang Station with its local problems is part of a global effort to link cultural heritage and the SDGs. Connecting local to global will open up opportunities for cultural heritage to be inclusive, accessible, and changeable over time (Mladenovic 2023).

In Indonesia, some buildings built during the Dutch colonial period have been declared as cultural heritage objects by Cultural Heritage Preservation Centre (*Balai Pelestarian Cagar Budaya* – BPCB). Fortunately, Indonesian Government Regulation No. 1 of 2022 provides that all parties can participate in national heritage registration (Presiden Republik Indonesia 2022). Colonial buildings in big cities like Jakarta, Surabaya, Bandung, and Semarang are thus now starting to receive attention and protection for preservation. Moreover, the conservation efforts are not only carried out by the government; private institutions and non-profit foundations are also involved. Several actions to conserve the colonial heritage in Indonesia in turn applied new applications and digital media, which provided a broader context of heritage digitalization in the New Heritage Paradigm. In order to resolve problems on

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heritage conservation, the New Heritage Paradigm places a strong emphasis on community interaction and digital technologies (Wiktor-Mach 2019). One example is the virtual reconstruction of the shipping office building in the Kota Tua area of Jakarta, with augmented reality (AR) used to document and visualize the building of Samudera Indonesia Limited, which was built in 1920 and was once the shipping office of Office Premises, Maintz & Co (Prabawasari 2022). The second example was the project to rebuild history to build the environment around the Surabaya Kota Station, which was one of the projects originating from the Shared Cultural Heritage program in the Netherlands (Meurs 2014).

Unfortunately, however, there are many obstacles to preserving cultural heritage buildings in Indonesia. In Semarang, the conditions of the location, which is often hit by floods, as well as unclear or disputed ownership status, have caused several buildings to be neglected and damaged (Darmawan and Enis 2016). This is what happened with Semarang Station, as the building's type and historical origin place it in a category that is very susceptible to damage, either due to natural factors or age. Unluckily, despite being the first railway station in Indonesia and qualifying as a cultural heritage building, Semarang Station has not received much attention.

The Indonesian Railway Preservation Society (IRPS) has attempted to prove that the first terminus site in Indonesia was in Kampung Sporland (CNN Indonesia and S 2015). Nevertheless, no one has produced a reconstruction of the architectural transformation of Semarang Station since it was built in 1864 until now. The Semarang Station has changed four times between 1864 and the present (Sulistyani 2022).

Even though the station location is flooded at every high tide, the remaining buildings of Semarang Station are currently inhabited by the descendants of PT. KAI (*Kereta Api Indonesia* – Indonesian Railways) employees. The physical reconstruction of buildings will be difficult because it has the potential to cause social conflict. Based on these conditions, the research problem is how to carry out architectural reconstruction that would not trigger social conflict.

The only railway operator in Indonesia, PT. KAI, has not made many conservation efforts for the former Semarang Station; the government company's only effort to claim the site and the remains has been to place a sign stating that the building and area of the former Semarang Station are their property. Given the conditions described above, conservation efforts must be carried out through digital reconstruction. The novelty presented in this work lies in digital reconstruction using computer-aided design (CAD) technology in chronological order based on the architectural history of Semarang Station.

The function of Semarang Station has completely disappeared. The remains of the building include only a part of the south wings and a few building elements that can connect with the glories of the past. Copeland stated that cultural heritage sites are defined as having a past (Copeland 2004); moreover, historical or cultural heritage sites were characterized by their emphasis on the past (Cheshmehzangi 2020). Interpretation of the past is necessary to understand the importance of heritage sites and their intangible values in the context of the New Heritage Paradigm (Araoz 2011). Meanwhile, by recognizing the diverse ways in which cultural groups connect with their ancestral past and understanding heritage as something dynamic and constantly evolving, the New Heritage Paradigm highlights the need for a more inclusive and holistic approach to heritage conservation (Araoz 2011).

Nevertheless, the remains of Semarang Station are legacies that become data for digital reconstruction. Because the conditions on the ground did not provide opportunities for physical reconstruction, the buildings' remains needed to be digitally reconstructed as a preservation effort in order to convey their historical value. In the case of historic cities and their urban networks, images of the past play an important role and therefore have the potential to continuously update information and emphasize multiculturality and the plurality of historical developments without overloading the physical space (Mladenovic 2023).

However, the architecture of the Semarang Station building has not been widely discussed by researchers because of its relatively unknown history. The details of the genesis and evolution of the station have not been coherently told, and the available information remains confusing. Therefore, the data for digital reconstruction – namely, the architectural history of Semarang Station – was collected from various sources and triangulated to produce valid data. Based on the validity of Semarang Station's historical data, digital reconstruction can serve as the first step in conserving the first Indonesian terminus.

2 Method

Due to the incomplete Semarang Station architectural drawings and limited access to study the blueprints, various sources were used to reconstruct the story of the first terminus in Java. These included engineer journals, railway company reports, and almanacs, as well as photographs and other visual documents, while monthly progress reports published in newspapers and travel diaries

were also consulted to verify the chronology of events. Finally, tourist travel diaries were used to re-examine the data from a different perspective – namely, that of railway users.

The first step to making a digital reconstruction of the station architecture was to examine the visual evidence in the form of photographs (Figure 1). Photographs have limits given that they are two-dimensional images, however, an image can frame something that text cannot. The visual analysis theory is used to explain the event behind the scene; by analyzing who was there and their positions in front of and behind the camera, it is possible to reconstitute the colonial identity through photographs (Supartono 2015). Art can provide evidence for the aspects of social reality through which a text passes, at least in some places and times: "Images often reveal details of material culture that people of the time would have taken for granted and thus failed to mention in the text" (Burke 2001).

Visual evidence was converted into digital format, through the perspective restitution method, and used to identify the architectural morphology of the Semarang Station. Perspective restitution is needed to help better understand architectural illustrations by utilizing perspective procedures (Sdegno, Masserano, and Riavis 2018). Digital representation has overcome many of the limitations that affected the restitution of perspective in the pre-digital era (Agnello, Milone, and Barrale 2022).

As a working tool, perspective or dimensional restitution from a photograph is frequently used by architects whose area of expertise is historic centre restoration (Constantí and Gómez-gil 2020), and it could be necessary to restore a lost historical environment as part of these efforts. The photographs and image sources related to Semarang Station were arranged in chronological order to identify and

Figure 1: The Semarang Station platform, seen from the south east (c. 1905). Utrecht Spoorwegmuseum.

read the context both synchronically and diachronically. This step creates a bridge to understanding the relationship between morphology, engineers or architects, dates, and accompanying evets to the architecture of the Semarang Station.

The results were then cross-checked with information from textual archives, with the resulting visual and textual analysis providing the architectural morphology of Semarang Station. Moreover, morphological findings are used as data visualization by utilizing computer software to generate 3D modeling, with the production of 3D models the final stage as a form of digital reconstruction activity. Figure 2 shows the process of the digital reconstruction of Semarang Station.

3 Literature Review

The phrase "digital reconstruction" consists of two words: reconstruction and digital. The word reconstruction means "the process of putting something back into the state it was in before" (Oxford University Press 2022c). In other words, reconstruction is the action of restoring something to its original state. Meanwhile, the word digital refers to the use of computer technology (Oxford University Press 2022a). Hence, digital reconstruction can be interpreted as the act of bringing things back to their original state using computer technology.

The use of digital technology developed rapidly in the early twenty-first century, with these new tools providing a fresh perspective on how techniques for cultural value conservation and preservation are being developed and improved (Khalid 2021). Digital 3D reconstruction has also become part of humanities research (Friedrichs, Münster, and Hegel 2018). Furthermore, according to Friedrichs, Münster, and Hegel (2018), the main goal of digital reconstruction is to create a virtual spatial, temporal, and semantic model. Although digital reconstruction also has limitations, the use of digital technology provides several advantages when *in-situ* conditions do not allow physical reconstruction.

By combining digital technology with heritage preservation, it is possible to improve the destinations for cultural tourism as well as public engagement in the study and maintenance of the past's physical remnants (Aburamadan et al. 2021). Digital reconstruction does not solve conflicts or social problems that arise on the ground, however, it can provide a chronological overview of building transformations without disturbing the conditions in the field. Accordingly, digital reconstruction has been applied in various fields of science, including architectural preservation. Digital media
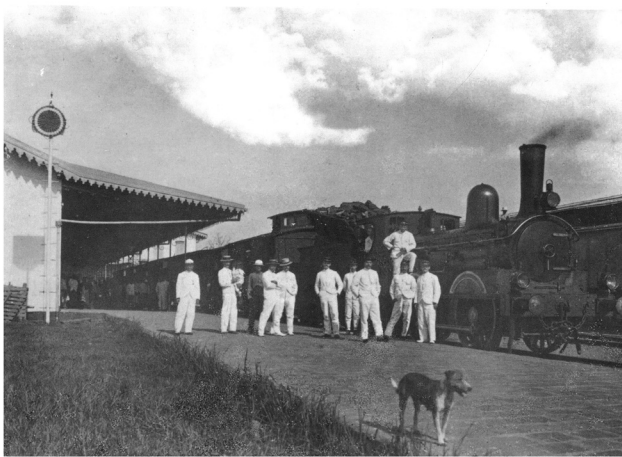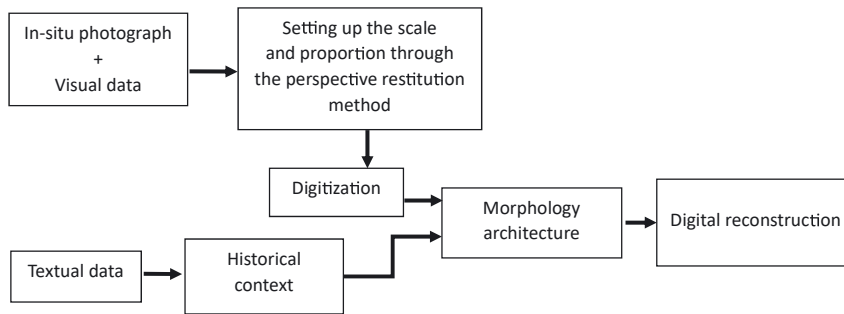
Figure 2: Semarang Station digital reconstruction.

are essential for involving stakeholders and communities in heritage preservation initiatives (Wiktor-Mach 2019).

Over time, there are always new things, e.g. new buildings and new digital reconstruction techniques, that appear related to digital reconstruction. Given the physical condition of the building and the social conditions of the community around the Semarang Station, digital reconstruction activities are an appropriate choice. The 3D model of the artifact can be used for display, educational, and commercial reasons, as well as to communicate with the public and promote the conservation process and encourage the preservation of cultural heritage (Makris, Sakellariou, and Karampinis 2021). In particular, the digital reconstruction process does not have to be carried out on-site, avoiding the social conflicts that are common due to physical reconstruction efforts. Reconstruction can be classified into three levels: the reconstruction of the visual representation of an object, its historical context, and the object used (Stiller and Wintergrün 2016). All three stages face a major challenge – namely, the completeness of the details needed to triangulate historical reconstruction data. According to Stiller and Wintergrün, the reconstruction process can be traced and repeated so that problems can be well understood, even if they are not completely solved. Moreover, the reconstruction process must be transparent by disclosing the parameters of the various stages that produce the reconstructed product (Stiller and Wintergrün 2016).

4 Results and Discussion

The Semarang Station building no longer represents the terminus, with the appearance of the central station when it was built in 1864 no longer present (Figure 3). The remains include only the south wing of the station building, which is buried 3 m below street level. In other words, part of the building's physique is currently underground, which is an effort to deal with the water due to rob (the rising of the sea level). The first terminus in Indonesia has been forgotten; the site, which is currently a slum settlement, is slowly turning back into a swamp.

Figure 3: The Semarang Station remains.

Limited data on dimensions, materials, and space-forming elements can be obtained from the station building's remains. Facts about the station building from informants are also very limited, as the only occupants of the station remains are the children and grandchildren of PT. KAI employees. The information they provide must be validated with information from other sources; as the station building has undergone several changes, data from the field must be triangulated with data from archives and visual illustrations to be valid.

4.1 Digitization of Photos of Semarang Station

Digitizing the Semarang Station photo object into a 2D object using computer software is one step in the reconstruction of the object's visual representation. The design stage for the digital reconstruction of the Semarang Station began with setting up the scale and proportion of objects from the data. Then, a 2D model is created using computer software.

The process at this stage is data digitization, which involves redrawing elements of the photographs using computer software. Digitization or digitalization is "the process of changing data into a digital form that can be easily read and processed by a computer" (Oxford University Press 2022b).

Ideally, the data is obtained from architectural shop drawings. However, due to the scarcity of architectural drawings, the reconstruction of Semarang Station was carried out with information from photographs and maps. A photograph (Figure 4) with the title *Het perron van eerste station van de Nederlands-Indische Spoorweg Maatschappij te Semarang (The platform of the first station of the Netherlands Indies Railway Company in Semarang)* provides a one-point perspective, which is the point of convergence. In Figure 4, the point of view or angle is referred to as the normal view perspective. Tracing parallel lines to the point of convergence is used to create a perspective grid for the illustration seen in the photograph, with all of the primary vanishing points for the structures in Figure 4's foreground converging at a single point on the horizon line. The proportion shown in a photo becomes a reference point for measurements in the re-imaging process. Data triangulation for material analysis refers to project progress reports or newspaper reports since the photos used as data are black and white.

4.2 Historical Context

The description of the historical context of Semarang Station is carried out through reading the building's architectural past. Referring to Copeland, the activity is significant with "expert interpretation," which aims to present dialogue translating experiences into a strong system for understanding archeology, thereby increasing visitors' connections to the site. Expert interpretation in presenting archeology to the public involves expert construction of sites or interpretation of artifacts. This is important as it shapes the information and assistance provided to visitors to facilitate their understanding and engagement with the archaeological heritage (Copeland 2004).

Semarang Station was the station owned by the first private railway company in Java, NISM – *Netherlandsche Indische Spoorweg Maatschappij* (Netherlands Railway Company). As supervisor of the construction of the Semarang-*Vorstenlanden* (the Principalities) railway line, J.P. de Bordes gave an overview of the architecture of the stations in Java in general, however, this included limited detail about the architecture of the Semarang Station. Most of the railway buildings in Java are built of bricks but also, as an effort to adapt to the tropical climate, all the brick walls were plastered (De Bordes 1871). The description in this work is based on the explanation in the article by De Bordes (1871). The station building is very simple, with straightforward interior decoration and almost no ornamentation at all, with all the doors and windows in the waiting room only having shutters. The walls were not only plastered but also whitewashed, while the floors were made of tiles and inlaid stones. Since locals walked barefoot, some of the station floors were also covered with Portland cement, a local product. Ceilings were usually made of wood. A separate room with barred doors and wooden benches, resembling a warehouse in the freight area, was reserved for third-class passengers.

Semarang Station was a terminus that served as the starting point of the Semarang-*Vorstenlanden* Line. On a map of Semarang city drawn in 1866, it can be seen that the station complex had a symmetrical appearance, and the main entrance was oriented to the west (Cronenburg 1866). The station had four tracks: two lanes on the north side used for goods and two on the opposite side used for the carriage of passengers via the platform. In terms of style, Semarang Station exhibits neo-classical idioms, but in a very simple
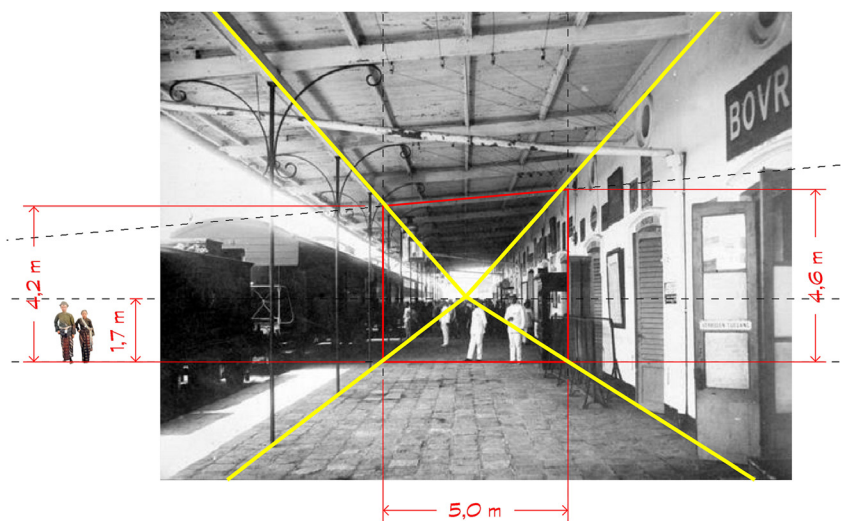

Figure 4: Digitization of the Semarang Station visual data, 2022. Tropenmuseum Collection, *Het perron van eerste station van de Nederlands-Indische Spoorweg Maatschappij te Semarang,* TMnr 10013983.

form (Sulistyani 2023). The façade bears some resemblance to Dutch railway station architecture (Figure 5), particularly the style known as *waterstaat* (public works; Figure 6). There is a clear explanation for this aesthetic relationship: the earliest railway stations in Java were built concurrently with the reorganization of the railways in the Netherlands, so some of the rules applied in the Netherlands were also used in Java. The U-shaped Semarang Station building consisted of a central section with a symmetrical façade flanked by two wings, with the central part consisting of two floors. The main entrance was located in the center, and the balcony on the top floor emphasized the symmetry of the façade and the axis of the building (Figure 5). The south wing of the station building was used for passengers and goods, while the room used for official purposes was placed in the center part of the building. The drawing room for producing the Semarang Station design was on the second floor under a roof and had

Figure 5: Semarang Station (c. 1880) seen from the northwest. University Library Leiden, Digital Collections, Inv. No. KITLV 19212, *Station te Semarang*, http://hdl.handle.net/1887.1/item:739291.

Figure 6: Zwolle Station (1866), The Netherlands, https://www. spoorbeeld.nl/zoeken?term=zwolle.

no ceiling. The roof was a thin clapboard from Singapore, with its surface protected by a layer of bitumen to ensure that the room stayed cool.

The station façade was equipped with a clock (Figure 5), which seems to have been planned from the start, as the station design blueprints show a clock on the building façade. Despite their ornamental qualities, clocks are a testament to the arrival of a new concept of time based on train schedules. This new concept encouraged a broader breakthrough of modern concepts that had to be followed by the people of Java.

At the end of the nineteenth century, Semarang Station was connected with the tram or light rail line of the SJS – S*amarang Joana Stoomtram Maatschappij* (Semarang Joana Steam tram Company). The tram stop is located on the south side of the station, which was part of the passenger side, with the placement appearing to have been planned from the start. Freight traffic was placed on the accessible part of the port or vice versa, which was in the north part of the station. The western section facing the street served as the main entrance for official purposes and also housed the NISM office.

The main considerations for station design are functionality and budget. Economic considerations are very important in first-line development and, accordingly, building aesthetics and monumentality do not seem to have been a priority early in the line's development (before 1870). Apparently, the corporate identity of the company was not considered important for shaping the station's architectural expression at that time – or perhaps there was no corporate identity in those early days. The building is relatively simple and was then gradually adapted to the changing demands and needs that arose over time. Economic considerations were the top priority (De Bordes 1871). However, as a terminus, Semarang Station was also expected to display luxury, although these efforts ultimately failed. At the station itself, the first- and second-class waiting area floors were covered with Bremer stone, a stone much used in the Netherlands for monumental interiors, instead of the Chinese tiles originally suggested (Nederlandsche Staatscourant 1867).

A combination of factors forced the first terminal to switch roles, which was the first step in the station's ultimate closure to passengers. The Semarang Station building had been used as a central station for more than 35 years when the idea to build a city station was proposed. It seems that NISM wanted to take the opportunity to dominate freight and passenger transportation by using the city of Semarang as its base, with the rough idea to build a new city station. As a city station, the location and service facilities of Semarang Station were inadequate (De Sumatra Post 1902). Moreover, the environment of Semarang Station was
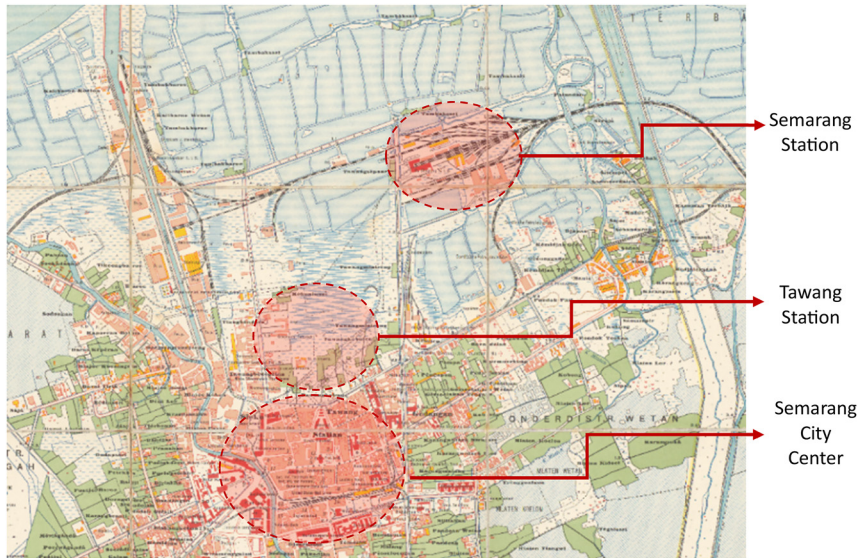
Figure 7: The Semarang Station and Tawang Station railway connection plan, 1909. University Library Leiden, Maps (KITLV), Inv. No D E 38,3 *Semarang en Omstreken*, http://hdl. handle.net/1887.1/item:55928.

not conducive for passenger transportation: during the dry season (East Season), it is filled with dust, and during the rainy season (West Season), it turns into puddles of mud and sometimes stagnates with water as high as half a meter above the road surface (van Ballegoijen de Jong 1993).

The idea of building a new station appeared in a 1902 publication that underlined the urgency of building a new city station (De Sumatra Post 1902). Apart from the advantage of getting land for free, the location of Semarang Station, though far from the city center, was likely selected to support connections to the port and warehouses; the location selection likely prioritized goods transportation. However, since the station's location was so far from the city center, travelers had to endure significant inconvenience. The idea of building a new station appeared in a 1902 publication that underlined the urgency of building a new city
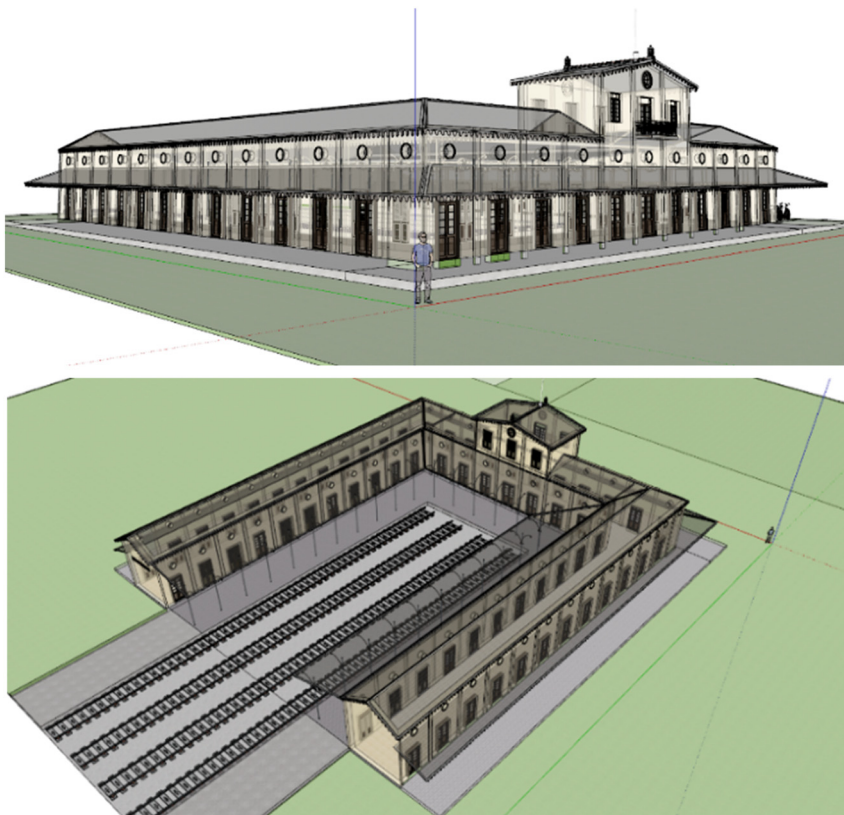

Figure 8: The process of creating the Semarang Station digital 3D model.

station (De Sumatra Post 1902). The new station was located in Tawang, which was near the city center, hence travelers could easily reach it. Tawang Station became the main station in the city, equipped with all adequate passenger facilities (Figure 7).

After Tawang Station opened as a central passenger station, NISM continued to use the old freight station and changed its name to Semarang *Goederenstation* (Semarang Freight Station). Due to the need to use this site for the loading and unloading of goods – or perhaps because the environmental conditions were not suitable for use – the northern part of the Semarang *Goederenstation*, which served as a goods depot, was also demolished (van Ballegoijen de Jong 1993). There is no information about exactly when the north wing was destroyed. Today, the last remaining section is the south wing.

4.3 Semarang Station 3D Model

Digital reconstruction begins by converting 2D objects into 3D models (Figure 8). As was done by Prabawasari (2022),

software with geolocating capabilities that can provide precise geographic location information and terrain conditions was used for 3D modeling. Based on historical analysis, the chronological architectural transformation of Semarang Station is known; even though it was a terminus and the first station in Java, the façade or appearance of the building shown is quite simple (Figure 9). As Java's existing resources were taken into consideration, functional and economic aspects were the main basis for architectural design, with the idea that the railroad would become the engine of change that would propel the colony toward modernity. Engineers with knowledge of civil engineering had to make the best decisions in situations that differed from those in Europe. These engineers provided knowledge for architectural design in an environment with challenging geographical conditions and a tropical climate.

The transformation of the Semarang Station from 1864 to the present has undergone four stages of change (Figure 10). The first began when it was completed in 1867, with an optimal function to serve the transportation of passengers and goods (Figure 9). The second began in 1913, when the central part of the building was torn down to
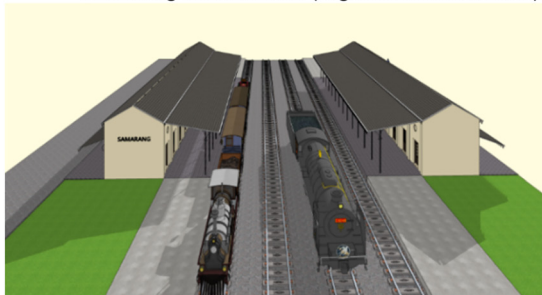

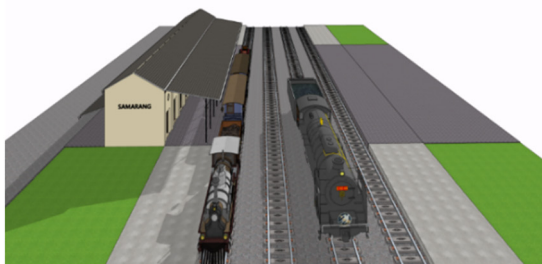**Figure 9:** The Semarang Station digital 3D model.
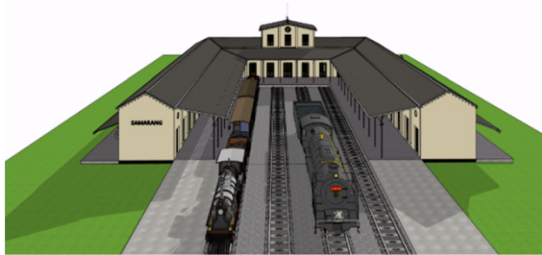
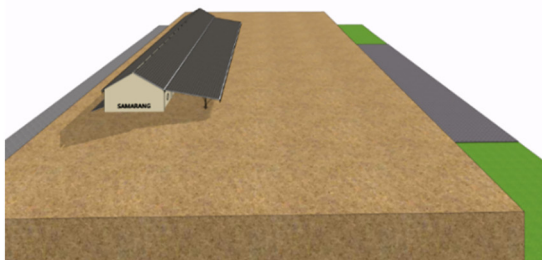Semarang Station 1867 (Digital Reconstruction)
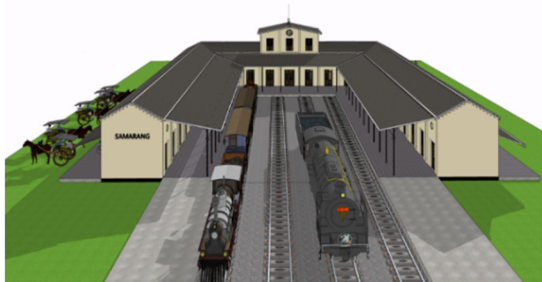
Semarang Station 1900 (Digital Reconstruction)

Semarang Station 1913 (Digital Reconstruction)

Semarang Station 1925 (Digital Reconstruction)

Semarang Station 2022 (Digital Reconstruction)

Figure 10: The Semarang Station architecture transformation.

connect the rail line to Semarang's Tawang Station; at this stage, the station only supported the transportation of goods. The third stage began in 1925, when the northern part of the station building was demolished so that only the southern part was left. Given its main function as a warehouse for goods, the southern part of the building has been referred to as the Warehouse Station. The last stage began when the condition of the station was covered with earth to deal with the floods and flood tide (*rob*) that frequently hit the Spor-land area, meaning the physical part of the building is currently 3 m below road level.

5 Conclusion

Digital reconstruction is the digital representation of a physical object. In the process, data transparency is essential, and scientific standards such as validity and reliability must be met. This is highly important to achieve data validity and optimal final results.

The digital reconstruction carried out in this study provides visual information about the transformation of Semarang Station over time. The building preservation efforts utilizing computer-aided design tools allowed the conservation work to be done more easily and efficiently; compared with physical conservation, this model is able to present a more innovative approach. Architectural conservation using digital technology can be a low-cost method of immediately recording such endangered architectural sites. In summary, preservation with a digital reconstruction model can save money, effort, and time.

The Semarang Station digital reconstruction presents the transformation of the architecture of the first Indonesian terminus in chronological order. Text and visual analog sources describing the history of the station were used as resources for the reconstruction. Conversely, the digital reconstruction now contributes evidence to clarify the station's relatively unknown history. The output of digital reconstruction based on historical context has the potential to contribute to achieving the Sustainable Development Goals, and particularly to creating more inclusive and sustainable societies. It will also contribute to addressing a shared heritage in order to support partnerships.

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