BIM Model for Railway Intermediate Station: Transportation Perspective

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Abstract

As a result of the imposed war on Syria since 2011 until now, most Syrian cities have been completely or partly devastated on multiple levels. This urge the needs for developing a comprehensive, balance and sustainable reconstruction strategy. Transportation sector in Syria was subjected to vandalism and systematic destruction. Therefore, the reconstruction strategy should take into account the need to rehabilitate, restore or create vital axes to connect all Syrian cities. Maintaining existed railway lines or constructing new lines require expanding railway stations to meet the expected traffic flow for both passengers and cargo. On the other hand, Building Information Modeling (BIM) has been crystallized as a new technological concept in the construction industry. It is considered a revolution that has transformed the way in which engineering facilities and infrastructures are designed, analyzed, constructed and managed. In such context, the author has applied BIM technology for modeling a real case of railway intermediate station called XiaMen railway station, China. When the modeling process was finished, the station model allows the author to have the needed documentation of station simultaneously. Besides, this model highlights any possible conflicts or design mistakes before the real construction starts. This study makes a novel contribution by providing a new method for 3D digital railway station that motivates designers and contractors to carry out BIM in this vital sector. It paves the way to support the reconstruction phase with modern technologies and its applications.

Keywords: Reconstruction Phase; Building Information Modeling; Transportation; Railway Intermediate Station

1.Introduction

In front of the great challenge facing Syria to wipe out the dust of war and rebuild a unique civilization linked to the roots of history and launched the meteors of science and knowledge, its scientists and researchers were ambassadors of the progress and modernity around the world. The Syrian Government is initiating the establishment of integrated scientific platforms aimed at exchanging the latest and most important researches and tools in the various sciences that related to the reconstruction phase. The distinguished national scientific and research competencies stand today in front of their responsibilities to contribute in advancing the wheel of reconstruction and overcoming the challenges of rapid scientific and technological development witnessed by the world, in order to the return of Syria once again as the east beacon and the gate of peace. The systematic devastation of Syrian cities because of the terrorist acts since 2011 until now has affected all components of the society, whether physical or human, or natural and cultural resources. Therefore, the optimal strategy for the reconstruction phase in Syria must be carried out

DOI: https://doi.org/10.54216/IJBES.040202

Received: March, 10,2021 Accepted: Dec. 28, 2021

through two parallel approaches. On one hand, it must consider the historical and spatial value of the cities, and restore the cultural and social structure of the Syrian society. On the other, it must catch up with the latest technological developments for achieving a strong foundation for a balanced and sustainable development in various social, economic, environmental, planning, legislative and administrative fields.

Recently, the great scientific progress in the construction industry has led to the crystallization of a technological concept called "Building Information Modeling" or what is known shortly “BIM”. The term “BIM” has been intentionally and consistently used to describe an activity (meaning building information modeling), rather than an object (building information model) (Eastman et al [1]), which reflects the belief that BIM is not a software but a human activity that ultimately involves broad process changes in construction. BIM is a shareable collection of building data, including a three-dimensional (3D) computer model of the entire project. This model includes data about each of the physical building elements that make up the project, including the location, number, and size of those elements. This fact makes of the building information models a shared knowledge resource to support decision-making about a facility from planning to demolition, it is the present and the future of the construction sector (Di Giuda et al [2]; Zhao [3]). The BIM model allows analyzing the current situation, solving the problems with information management using team-based collaboration between project participants and integrated project delivery, establishing common data environment, and initiating use of BIM-based procurement (Ustinovichius et al [4]).

The transportation sector like other service sectors in Syria has suffered a lot during the war period. It was subjected to vandalism and systematic destruction. Many highways, that consider the main arteries for connecting the Syrian governorates such as Aleppo-Hama-Homs highway, had stopped working. Furthermore, many railway lines and railway stations have been out of service due terrorist acts. Thus, the Syrian body was partially or totally ripped. Hence, a reconstruction strategy that consider the need to rehabilitate or construct vital hubs to connect all cities with each other should be adopted. Which will in turn contribute to the transfer of labor and raw materials involved in the renovation of various cities and towns. Maintaining existed railway lines or constructing new ones requires expanding railway stations to meet the expected traffic flow for both passengers and cargo. As BIM provides an opportunity for superposing the multidisciplinary information within one model powerfully, the importance of data addition of civil engineering projects into the BIM model has been discussed recently. However, the number and content of studies related to the construction phase in the area of civil engineering indicated that there is still a gap for integrated solutions, in particular, studies intended for the construction stage of railway intermediate stations (Abdal Noor and Yi [5]).

In such context, the paper as its first objective is trying to focus the light on BIM and on its promising role in to the reconstruction phase in Syria, and to explore the implementation of BIM in railway projects. Then, it investigates a few examples of the application of BIM in transportation research areas. Finally, it delineates the modeling processes of railway station, and verifies the significance of BIM in modeling railway intermediate station of real case study, XiaMen railway intermediate station. The results show that the previous problems coming from relying on traditional 2D CAD drawings have been overcome by the parametric modeling technology BIM has. This research contribute to the body of knowledge by providing a stunning opportunity to improve the design approach of railway intermediate station. In addition, it motivates designers and contractors to reap the benefits of implementing BIM into this vital sector.

2. Literature review

There have been different attempts within the AEC (Architecture, Engineering and Construction) industry to define BIM. According to the National Building Information Modeling Standards, it is a digital representation of physical

DOI: https://doi.org/10.54216/IJBES.040202
Received: March, 10,2021 Accepted: Dec. 28, 2021

and functional characteristics of a facility and its related project/lifecycle information, and it is intended to be a repository of information for the facility owner/operator to use and maintain throughout the lifetime of the structure (National Institute of Building Sciences [6]). A fundamental premise of BIM is collaboration by different stakeholders at different phases of the lifecycle of a project to insert, extract, update or modify data in the BIM process to support and reflect the roles of that stakeholder. Thus, it is a shared digital representation of a facility founded on open standards for practical interoperability, Figure 1 (Nawari and Kuenstle [7]).

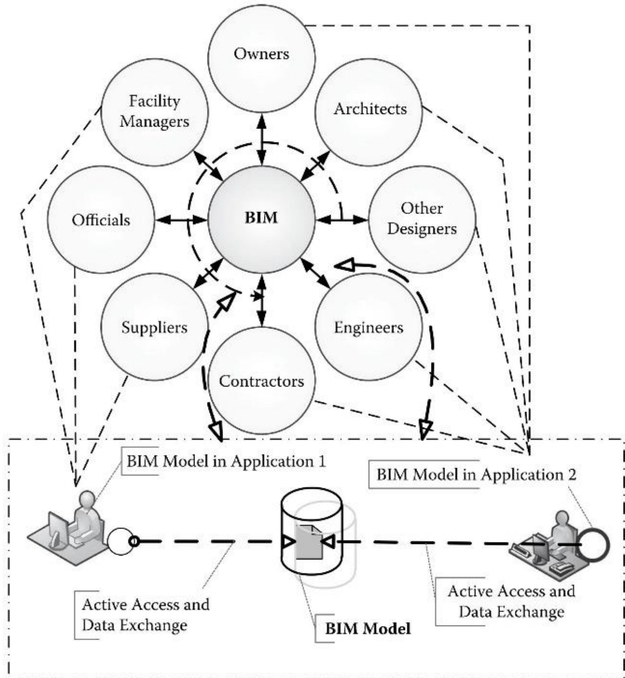

Fig. 1 BIM concept and process (Nawari, N.O. and Kuenstle, M., 2015)

The AEC demand for more efficient management of the construction projects during its different phases was a driving force in the development of BIM. The AEC industries have long sought techniques to decrease project cost, increase productivity and quality, and reduce project delivery time (Al Ahbabi and Alshawi [8]). BIM offers the potential to achieve these objectives. It represents the development and use of computer-generated n-dimensional (n-D) models to simulate the planning, design, construction and operation of a facility. In addition, it can be used by different parties for different ends in different phases, as follows:

- the owner to understand project needs;
- the design team to analyze, design and develop the project;
- the contractor to manage the construction of the project; and
- the facility manager during operation and decommissioning phases (Grilo and Jardim-Goncalves [9]).

The needs of the AEC industries the BIM met are reflected in the academic literature. BIM means both using three-dimensional intelligent models and making significant changes in the workflow and project delivery processes (Hardin [10]). BIM not only represents a new paradigm within AEC, one that encourages the integration of the roles of all stakeholders on a project, but it also has the potential to promote greater efficiency and harmony among players who, in the past, saw themselves as adversaries (Azhar et al [11]). It also supports the concept of integrated project delivery (Rowlinson [12]), which is a novel project delivery approach to integrate people, systems, business structures and practices into a collaborative process to reduce waste and optimize efficiency through all phases of the project lifecycle.

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Received: March, 10,2021 Accepted: Dec. 28, 2021

The increased use of BIM in the industry is mirrored in academic literature. Becerik-Gerber and Rice [13] identified innovative research topics and trends in the area of BIM in AEC through interdisciplinary endeavors. They found that theoretical developments in BIM indicate that it might be useful not only for geometric modeling of a building's performance (McGraw-Hill [14]), but also in the management of construction projects (BuildingSMART [15]). Jung and Joo [16] introduced a BIM framework that consists of three dimensions and six categories and addresses the variables for theory and implementation. They defined the proposed framework as the one that "practical BIM implementation effectively incorporates BIM technologies in terms of property, relation, standards, and utilization across different construction business functions throughout project, organization, and industry perspectives".

Another attempet to provide a new and novel companies' BIM performance improvement framework has been carried out by Ahmed et al [17], which consisted of three fields: policy, process, and technology. the aim of their study is to improve the BIM performance in Syrian AEC companies which are already in the BIM zero level and to provide strategies to the companies which do not use BIM for BIM adoption in their projects. The problems of BIM Adoption are defined in many studies across borders, but their impacts varied with countries [18,49]. Where, their study analyses barriers and drivers to BIM adoption in the Nigerian construction industry from adopters and non-adopters perspectives as to allow an informed decision in developing a strategy for macro BIM adoption. They recommend proper consideration of the established barriers and drivers while developing any strategy for effective BIM adoption.

Furthermore, BIM is seldom adopted on the government level, especially in the developing countries [19, 45, 46, 47, 48]. have explored the stakeholders' perceptions on the benefits of BIM and the barriers that hindered its adoption, and proposed the practical solutions to motivate BIM non-users to adopt BIM. Abdal Noor and Yi [5] have identified the research topics and trends in the area of BIM through interdisciplinary endeavors, as well as the gaps for potential directions, which could advance the state of the art in BIM technology. Furthermore, one of their main goals is to explore the adoption of BIM in civil engineering construction projects, in particular the construction of railway intermediate stations. However, the results showed that there is a weakness for applying BIM technology in transportation sector, where a few researches have discussed its necessity and importance in transportation-related infrastructure.

3. Application of BIM in transportation research areas

BIM has become a proven technology in other industry fields including architecture, mechanics, etc. Nevertheless, it is a revolutionary technology and process that has transformed the way transportation-related infrastructure are designed, analyzed, constructed and managed. The first buildingSMART IFC (Industry Foundation Class) for infrastructure extension project is the P6 "IFC Alignment" project (Buildingsmart-tech [20]), which acts as a baseline for further projects, such as IFC-Bridge and IFC-Road, and provides the data model for 3D and 2D alignment information for spatial location of infrastructure assets. In other words, as the first IFC extension project to address infrastructure works, it is a common resource for road and rail construction, bridges, tunnels, etc. This section presents a few researches for applying BIM technology in different transportation projects.

3.1 High-speed railways

Two examples of articles that examine the use of BIM in the construction of high-speed railways are discussed here. The first article, (Lee et al [21]), investigated a case study of the Taiwan High Speed Rail Corporation, in which BIM technology was used in the construction of the Changhua Station. They found that the application of BIM coordination technology reduces the information gap, enhances construction quality and helps in meeting the schedule. The other article, (Cho et al [22]), introduced the application of the construction management integrated

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system by using BIM on a case study of the Honam High-Speed Railway Lot No.4-2, Korea. The achieved results showed a well-integrated on-site management, particularly in the best cost adjustment, construction management and safety conditions.

However, the application of the BIM process in railway infrastructure requires constant improvement. This concerns the development of libraries and the models available to all users in order to encourage the development of this methodology and, consequently, its use of information throughout the life cycle of an infrastructure work. Bensalah et al [23] have verified that the BIM can provide the railway with the tools to face some of its challenges and improve its productivity. Where the integration of BIM with the railway, through a theoretical and practical study, has shown positive impacts. Other researchers, Kaewunruen and Xu [24], have discussed a specific BIM application within the context of railway station buildings using a Revit-based simulation of construction work for King's Cross station in London. Their outcome can provide construction participants with reasonable guidance of BIM adoption on railway station projects that can be used for planning, designing, and operating an economic and environmental efficient construction project.

3.2 Tunnel construction

Here, three articles addressed BIM use in tunnel construction. When viewing from the information interoperability prospective during the lifecycle of the structure, producing an IFC data schema-based information model is essential. However, as is generally known, the current IFC data schema is intended for buildings. In this context, the first article, (Lee et al [25]), examined the applicability of the existing IFC data schema to NATM (New Austrian Tunneling Method) road tunnels and used the results to expand the existing IFC to allow efficient exchange and management of the tunnel's design information between different computer environments. The other, (Ghaznavi and Abourizk [26]), proposed a step-by-step framework to achieve an IFC data model extension for tunneling projects to form a tunnel information modeling system, which intends to form a data model structure for tunneling construction projects. Last one, (Ryu et al [27]), developed a methodology to predict multiple sets of ground conditions by using simulated annealing, which is a geo-statistical method, and then evaluate excavation costs and durations of a tunneling schedule via BIM.

3.3 Urban deep excavation projects

Two articles that addressed BIM use in urban deep excavation projects have been highlighted. The first, (Wu et al [28]), developed a BIM-based monitoring system to integrate and visualize monitoring data for risk assessments during urban deep excavation projects. This system assists construction project teams in identifying and understanding possible blind spots when attempting to achieve risk assessments during urban deep excavation projects and further enables the adoption of measures to reduce risk levels. The other, (Lu et al [29]), used a real-world case study to integrate the 3D building model, excavation model, environmental conditions, results of ground surface settlement analysis, measurement and monitoring data into one system for assisting construction project teams in executing environmental impact assessments accurately.

3.4 Highway projects

Here are three articles that discuss the application of BIM for highway projects. The first, (Sibert [30]), explained how BIM can provide a structured approach to design data storage and sharing for design teams, contractors and operators. BIM has improved coordination and holistic design for multidisciplinary teams and has been helpful in communicating construction sequences and applications. The second, (Teall [31]), identified the current challenges relating to the link between major project BIM tools and highways asset management to improve the whole-life management of highways assets. By using another major transport infrastructure project in Scotland (M8/M73/M74 motorway improvements project on the outskirts of Glasgow), Kumar et al [32] suggested a significant increase in

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value creation and savings by using BIM technologies in the project by streamlining the information exchange between stakeholders through the use of BIM-driven common data exchange platforms.

3.5 Metro transit systems

Metro transit systems have gained importance because of the large number of passengers depending on this vital mode of intercity transportation. Most metro transit systems contain subways that need to be efficiently ventilated to maintain the health and comfort of workers and passengers. Therefore, it is necessary to monitor the thermal comfort inside subways. In such context, Marzouk and Abdelaty [33] presented an application that uses wireless sensor network and BIM to monitor thermal conditions within a subway during construction and operation phases. Furthermore, other examples such as the Westside subway extension project in the USA (Clark [34]) and the Hallandsås Railway project in Sweden (Päiviö and Wallentinus [35]) have also used BIM in railway infrastructure construction.

Although building information modeling (BIM) has demonstrated to be an effective tool for the construction of urban rail transit worldwide, it has not gained the same popularity in the facility management (FM) of urban rail transit. Xu et al [36] have investigated the BIM application areas for FM in urban rail transit from an innovation diffusion theory perspective, in order to gain efficient operation and maintenance in urban rail transit. The limited availability of infrastructure components libraries and the difficulty in assigning parameters to the geometries of the objects (many of them with unique characteristics) have been frequently quoted as main obstacles to the BIM use for the transport infrastructures. In this context, Pasettoa et al [37] have focused on the study of the Infrastructure Building Information Modeling (I-BIM) methodologies for the transport infrastructures (in particular railway infrastructures), analyzing a case study related to the port of Venice.

3.6 Bridges projects

Here are two examples of articles that contribute on building a bridge model. The first, (Marzouk and Hisham [38]), presented a BIM-based cost estimation application that is capable of carrying out approximate cost estimation and detailed cost estimation. This application integrates BIM with the earned value concept to determine the project status at a specific reporting date. As an initial stage study to effectively apply BIM to railway infrastructure, Lee et al [39] proposed measures of IFC-based information modeling of a railway bridge, which is a representative structure of railway infrastructure, and provided conceptual methods to use this measure.

3.7 Track-alignment

Huang et al [40] demonstrated that BIM can simplify the design and construction of track alignment, increasing the abilities of computer-aided design and automation, which greatly shortens the design period and increases construction efficiency. Schiavinato et al [41] described the BIM-oriented design of the underground railway extension in the metropolitan area of Catania. They highlighted the design process and the selected BIM tools considering the boundary conditions characterizing the project, i.e. basic information missing in the final design project, need of coordination between different design disciplines and designer companies, and, finally, need for a flexible design approach which is able to adapt to changes occurring during design development.

The application of the BIM methodology to a rail track rehabilitation case study has analyzed by Neves et al [42] through using a geotextile and geogrid in the ballast layer base. They described the procedures applied in achieving the BIM models, the limitations involved, and the interoperability between the BIM tools. It was concluded that the BIM methodology was viable and could be implemented with benefits, despite certain difficulties and limitations, which emphasize the need for further developments. Other research work conducted by (Biancardo et al [43]) offered an insight into the possibilities offered by different BIM-based tools for parametric modeling applied in the railway sector whereby an example of a railway section model has presented. Indeed, the focus will be on the

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Received: March, 10,2021 Accepted: Dec. 28, 2021

creation of parametric objects representing railway components, as existing BIM object libraries lack them in the IFC2× 3 standard format.

4. Modeling process of the railway station

Railway stations are places where trains make scheduled stops. Because the number of railway intermediate stations account for the majority of stations in the Chinese railway system (Yi and He [44]), therefore designing an intermediate station properly has important implication to fulfill the railway transport task and to strengthen the rural-urban linkages. For making well-designed intermediate station, planners must have a clear and comprehensive understanding about its task, work, and equipment requirements. The modeling process is explained in the following sub-sections.

4.1 3D modeling of station elements

This research has used Autodesk Revit for modeling all elements of the railway intermediate station separately and stored them as Revit family file (.RFA) which is a loadable content in the project. The production of an example of a portfolio, housing unit, or other product used to indicate the pattern, configuration, and/or form of future products of the same nature is called the basic element model. Thus, the basic element model of railway intermediate station structure refers to the basic structural unit of the station components such as rail, sleeper, turnout, platform …etc. It is realized by adding the information of whole lifecycle to the basic structural unit.

Different from the conventional family types such as beam, column, wall, and so on, the structure of sleeper, rail, signal and other components involved in the railway station is complex, and it cannot directly use the software family components. In Revit, It needs to use the family editor for development and creation. The basic process for creating the basic element models of the railway intermediate station is as follows:
(1). Select the appropriate template to edit the template group.
(2). Then draw the outer boundary of the component in the family member template.
(3). Add control reference plane and reference line.
(4). Draw the outline boundary of a component according to its standard size, and establish the control constraint parameters with reference planes and reference lines.
(5). Finally, the spatial structure of the component is created by setting out, merging and shearing functions.

The elements of railway intermediate station are turnout, rail, fouling post, signal, sleeper, fastening device, passenger platform, passageway, canopy, passenger building, and freight yard.
1. Turnout: usually, it is divided into three shapes, line-joint turnout, line-crossing turnout, and line-joint and crossing turnout. Fig.2(6) show Revit model for line-joint turnout#9.
2. Rail: At present, the main types of Chinese rail are 75kg/m, 60kg/m, 50kg/m, 43kg/M and UIC60kg/m. This research has modeled the type 60 kg/m as shown in Fig.2(1).
3. Fouling post: When the rolling stock stop inside of a fouling post of a track, other train can safely travel on the adjacent track. Fig.2(5) shows fouling post model.
4. Communication signals: They are classified into different types according to the signal function, such as a warning signal in Fig.2(4).
5. Sleepers: There are two kinds of sleepers: wooden sleepers and concrete sleepers. A concrete sleeper has modeled as a Revit family, Fig.2(3).
6. Fastening devices: Chinese fastening devices are divided into different types according to the used material. Two kinds of concrete fastener have modeled as shown in Fig.2(2).

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Received: March, 10,2021 Accepted: Dec. 28, 2021

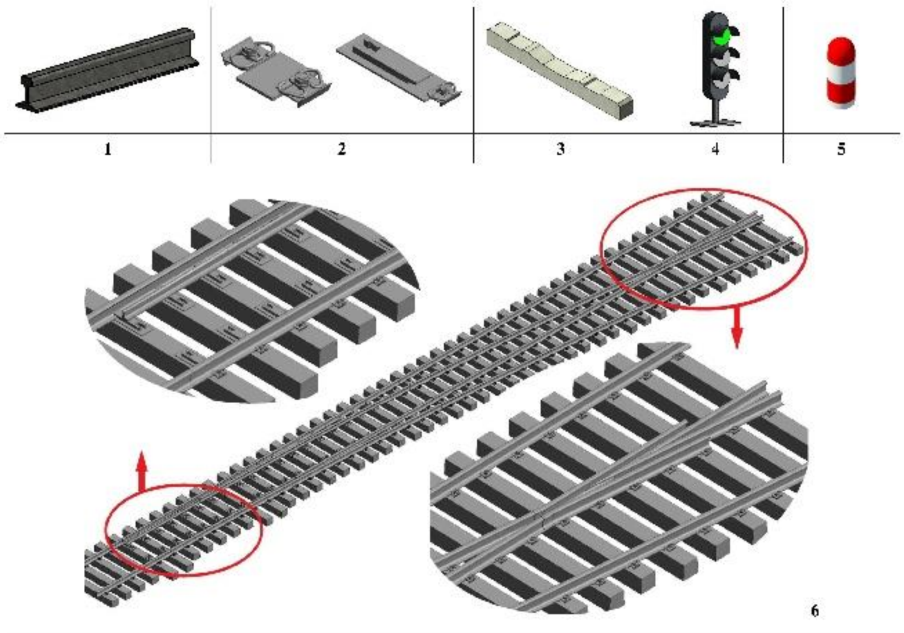

Fig.2 Revit models of (1) Rail, (2) Fastening devices, (3) Sleeper, (4) Signal, (5) Fouling post, and (6) Turn-out

7. Passenger platform: It is usually divided into basic and intermediate platform, and also has been modeled separately as shown in Fig.3.
8. Passageway: Between basic and intermediate platform, there should set-up one or two passageway with a width not less than 2.5 m (Yi and He [44]). Fig.3 shows Revit model of a passageway.
9. Canopy: Clearly it is desirable that some protection should be provided for waiting passengers. A one type of canopies has modeled as shown in Fig.3.
10. Passenger Building: The location of the passenger building should be coordinated with the city, and convenient for tourists passing in and out of the station. Fig.3 shows Revit model of the passenger building.

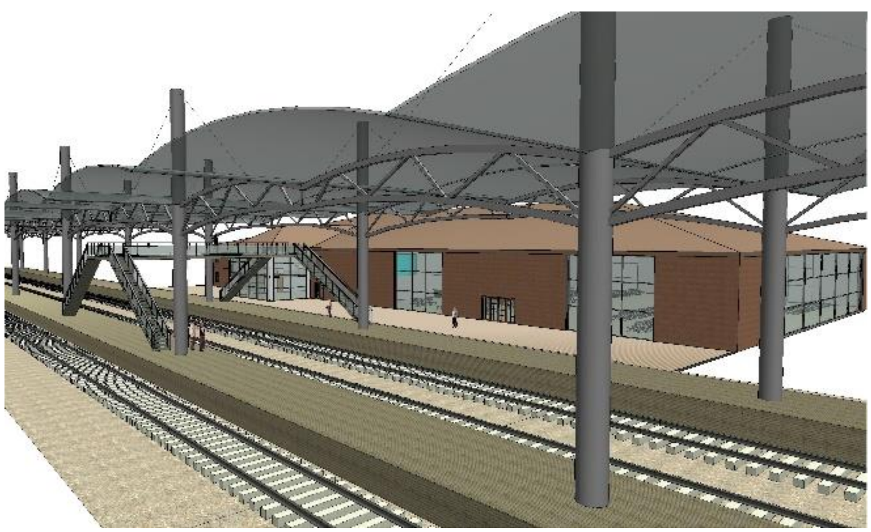

Fig.3 Assembling Revit models of passenger platform, passageway, canopy, and passenger building

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11. Freight yard: Usually the freight yard is set-up on the same side of passenger building equipped with all facilities for goods loading, unloading, delivery and storage. Freight yard has also modeled as shown in Fig.4.

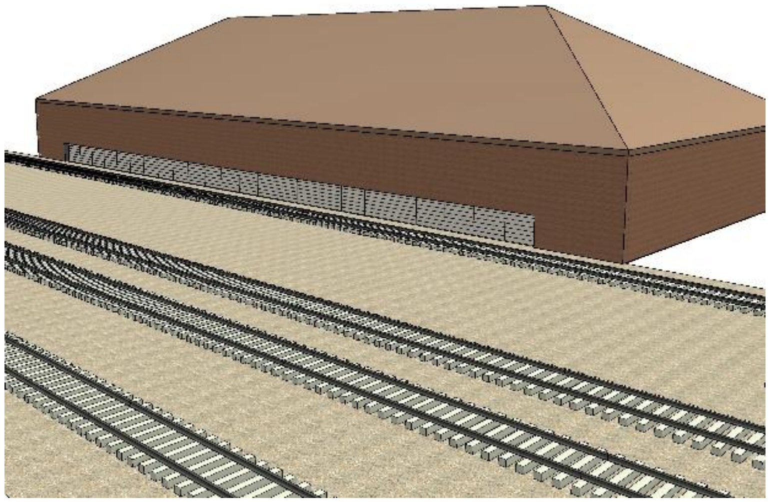

Fig.4 Revit-based model of freight yard

4.2. Performing design procedures

Revit provides a powerful .NET API that can be employed to automate repetitive tasks and extend its core functionality. For executing the design phase of a railway intermediate station intelligently, Revit Architecture has been supplied by an extension tool through the software developer toolkit (SDK). Moreover, the design procedures of different equipment at the railway intermediate station have been encoded in C# programing language by using Microsoft visual C# 2010 package. Then, this code has been uploaded to the Revit environment by using the function Add-in manager. Furthermore, standard layouts of the railway intermediate station have collected in a raw database. Fig.5 shows the logical design procedures executed by the extension tool.

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Received: March, 10,2021 Accepted: Dec. 28, 2021

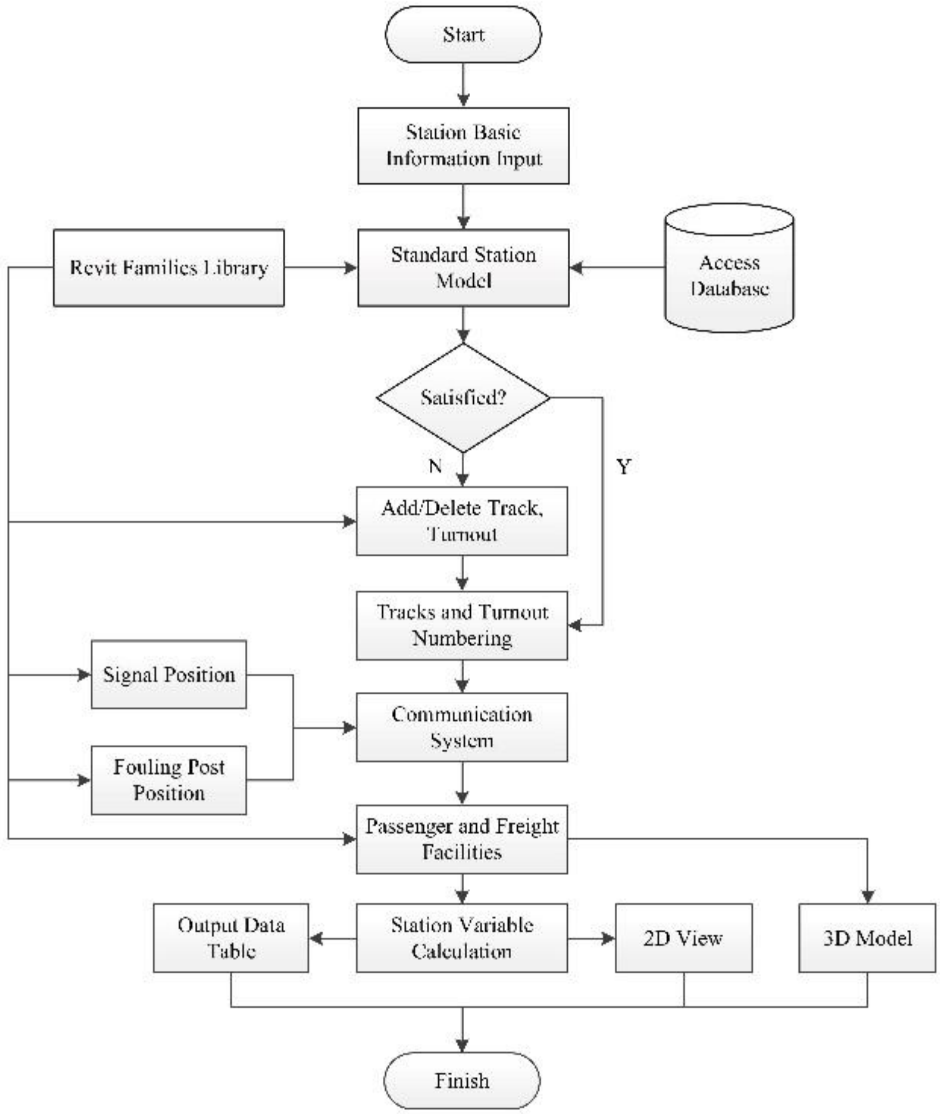

Fig.5 Design procedures flowchart

As seen in Fig.5, the execution starts with the input of all basic design information of the railway intermediate station. Then, the program by calling standard station layouts from the raw database and 3D basic element models, it will realize the standard station model. This model will be checked whether it meets the design requirements or not. In most cases, standard station layouts are not exactly the same layout as the designed case that results in changing and modifying the standard model by adding or deleting tracks and turnouts. Then, the program starts numbering the tracks and turnouts according to their rules. After that, it will call the 3D basic element model of each signal and fouling post, which together consist the communication system, and install them in their exact position. Later, it will install the passenger facilities such as station building, platform, passageway, and canopy, and the freight equipment. In the last step, the program will calculate all variables of the railway intermediate station. As a result of program execution, the user will get a 3D static model of the planned intermediate station layout in three types of formats: 3D model, 2D views and output data table.

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5. Case study

In order for a model to be acceptable, the model should be thoroughly verified and validated before use. Model validation provides assurance or confidence that the model is sufficiently adequate and appropriate for use according to its purpose. If a model has not been validated, it is unlikely that it will be used in a real-world setting. Therefore, the last step of this study is to verify the BIM model of railway intermediate station. Thus, the proposed extension tool has been used for modeling a railway intermediate station of real case study, XiaMen railway intermediate station. It is located in Xiamen city, Fujian province, China, on the Yingxia Railway which is operated by Nanchang Railway Bureau, China Railway Corporation. It is a sea channel bridge connecting Xiamen Island and the Chinese Mainland leads the railway to the city area. Currently, there are trains heading for Beijing, Xiamen, Shanghai, Nanjing, Hangzhou, Hefei, Nanchang, Yingtan, Xi'an, Chongqing and other major cities.

Only three tracks of XiaMen station have been modeled to meet the study scope. For establishing station building of the intermediate station, it can be directly implemented by the Revit software function. However, for the connection and placement of different families such as sleeper, rail, signal, it is necessary to be realized by the second development through Revit API. By analyzing the loading principle of family component, we should find the loading function based on point and line in the second development function of Revit, and use the traversal function to find the family component that has been loaded in the project. In addition, by accessing the component parameters, the location or position line of the family component is obtained. Signals and other devices can be loaded and replaced by calculating the three-dimensional coordinate points in the model and the constraints of adjacent components. It is necessary to draw the centerline of the track before laying the sleeper and rail group members. The adaptive point of the family component is attached to the centerline of the arrival-departure track through the line based loading method. The component can adapt to the change of the line, and adjust the parameters of the loading length and spacing. The sleeper and rail are loaded according to the length and spacing of the design requirements to ensure the authenticity and accuracy of the model. Finally, by assembling all the basic element models, the three-dimensional BIM model of the railway intermediate station is realized, as shown in Fig.3-10.

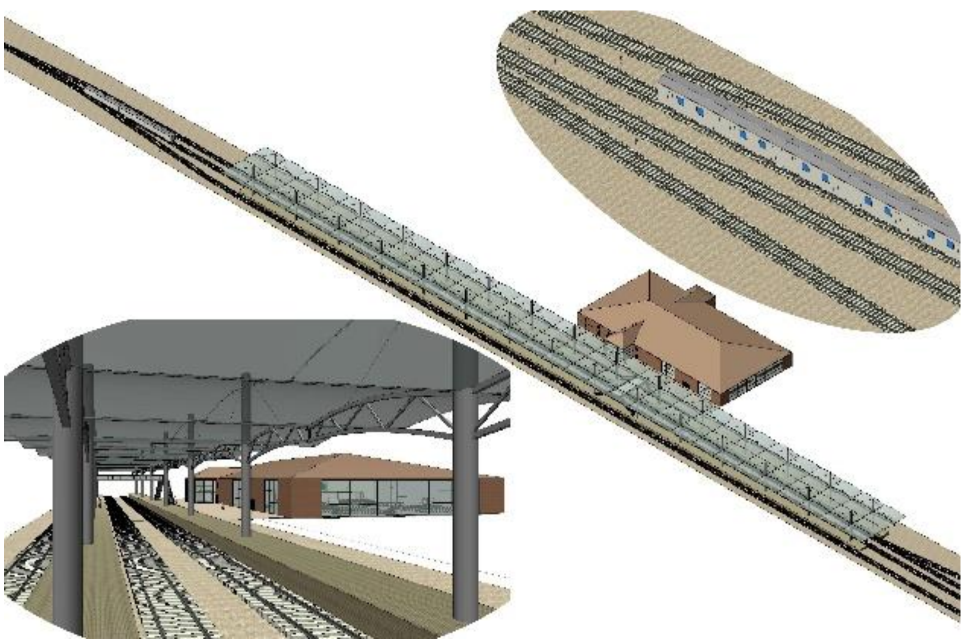

Fig.6 Revit-based model of XiaMen railway station

DOI: https://doi.org/10.54216/IJBES.040202
Received: March, 10,2021 Accepted: Dec. 28, 2021

6. Results discussion

As a summary of the study results, the authors highlight a few points that must keep in mind when applying BIM technology for modeling the railway intermediate station:

1. One of the main difficulties in establishing BIM model for the railway intermediate station is to create heterogeneous components in this field.
2. Revit provides a powerful .NET API that can be employed to automate repetitive tasks and extend its core functionality.
3. Different from the conventional family types such as beam, column, wall, and so on, the structure of sleeper, rail, signal and other components involved in the railway station is complex, and it cannot directly use the software family components.
4. The complete information model can be used to calculate the project quantities after establishing the standard 3D model. By creating the project schedule, the basic parameter information of the family component contained in the model can be clearly displayed.
5. For sharing the resulted BIM model of the intermediate station with different modeling tools and software, the station model could be exported into different types of format such CAD, FBX, IFC, etc.
6. The IFC (Industry Foundation Class) format of intermediate station model contains a structures combination of geometric and non-geometric data.
7. These data can be displayed, analyzed and modified in different ways by multiple software applications. The exchange format is open, free and well documented. Furthermore, data from design phase of the intermediate station lifecycle can be utilized in later stages without the need for data re-entry, custom import interfaces, or proprietary plugins.
8. The resulted model assists the station designer in realizing and visualizing the railway intermediate station in three type's formats, 2D drawing views, 3D station model, and output design data table,
9. The 3D station model is a static model realized from the 2D drawings by only one keystroke needed, and it facilitates the design work by visualizing the whole structural elements of intermediate station in three dimensional model.
10. For documenting the station design information, all the calculation results, such as main points coordinates, effective length and full length …etc. can be exported and saved into access database. These three formats are connected interactively where the change anywhere will be reflected directly everywhere.

7. Conclusion

In this paper, the author proposes a new thinking of 3D digital railway station. He build an information rich model for the railway intermediate station. Considering the shortages in information expression of the previous modeling methods, BIM modeling can support the detailed semantic of station elements. In addition to the building construction, a large number of urban projects such as integrated transportation hub like railways have been increased from day to day. These projects are dispersed in different sectors and areas, resulting in a lot of problems which can't be solved by only relying on the two-dimensional plane data. Therefore, the development of 3D railway station model is imperative. By getting the whole 3D model of the railway intermediate station, the following conclusions can be drown:

1. When it comes to the modeling, the design phase is handled properly. Using BIM helps to eliminate much of the repetitive and mundane tasks traditionally associated with the 2D drawings allowing more time for coordination and visualization of the station model.
2. As the design team works on familiar drawing views or in 3D views, adopting the new technique of BIM coordinates their design information across all other representations of the station project and conducts clash detection.

DOI: https://doi.org/10.54216/IJBES.040202
Received: March, 10,2021 Accepted: Dec. 28, 2021

3. 3D model views, 2D model drawings sheets, sections, plans, and information schedules and take-offs are all coordinated because they are all elements of the same underlying railway station model.
4. After the tedious, redundant, time-consuming, and error-prone world of 2D-CAD drafting, the parametric modeling technology with its automatic document generation and coordination capability will revitalize the layout process of railway intermediate station.

The author expects and has confident to believe that BIM for construction of railway station has great future potential for better utilization in line with the global trends. Looking to the future leads to speculation that BIM will eventually lead to a virtual railway station design and construction approach, with a railway station project being completely simulated before being undertaken for real. Such BIM will provide potential beneficial station project outcomes by enabling the rapid analysis of different scenarios related to the performance of a station through its lifecycle.

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