



APPLICATION OF BUILDING INFORMATION MODEL (BIM) IN THE CONSTRUCTION AND USING IN WATER SUPPLY SYSTEM

Nguyen Minh Ngoc*, Bui Hai Phong, Luong Thi Bich Phuong, Mai Vu

Hanoi Architectural University, Hanoi, Vietnam

*Email address: ngocnm@hau.edu.vn

DOI: 10.51453/2354-1431/2023/956

Article info

Received: 05/12/2022

Revised: 12/03/2023

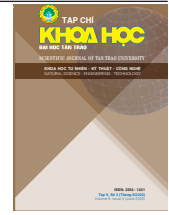
Accepted: 16/5/2023

Keywords:

Building
Information
Modeling
Revit
Water supply

Abstract:

Building Information Modeling (BIM) applied in the construction industry, especially the water supply and drainage field, plays an important role in economic development and project management. At present times, the legal documents have been initially completed for the application of BIM technology. The implementation processes to apply BIM (Revit/MEP) for the water supply system have been completed, and the data system of the water field for BIM is very plentiful. Besides the advantages of using BIM technology, there are also difficulties when implementing BIM technology comprehensively, so the application of BIM from the training process in universities plays an important role in BIM development in Vietnam.



ÁP DỤNG MÔ HÌNH THÔNG TIN CÔNG TRÌNH (BIM) TRONG NGÀNH XÂY DỰNG VÀ SỬ DỤNG TRONG CẤP NƯỚC CÔNG TRÌNH

Nguyễn Minh Ngọc*, Bùi Hải Phong, Lương Thị Bích Phương, Vũ Mai

Đại học Kiến trúc Hà Nội, Hà Nội, Việt Nam

*Địa chỉ email: ngocnm@hau.edu.vn

DOI: 10.51453/2354-1431/2023/956

Thông tin bài viết	Tóm tắt
<p>Ngày nhận bài: 05/12/2022</p> <p>Ngày sửa bài: 12/03/2023</p> <p>Ngày duyệt đăng: 16/5/2023</p>	<p>Mô hình thông tin công trình (BIM) ứng dụng trong ngành xây dựng, đặc biệt ngành cấp thoát nước đóng vai trò quan trọng trong phát triển kinh tế và quản lý công trình. Hiện tại, các văn bản pháp luật đã bước đầu hoàn thiện cho việc ứng dụng công nghệ BIM. Các quy trình triển khai áp dụng BIM (Revit/MEP) cho các công trình cấp nước, thoát nước đã hoàn chỉnh, hệ thống dữ liệu ngành nước cho BIM cũng rất phong phú. Bên cạnh các thuận lợi về sử dụng công nghệ BIM, còn có các khó khăn khi triển khai công nghệ BIM toàn diện, nên việc áp dụng BIM từ quá trình đào tạo trong trường đại học đóng vai trò quan trọng trong phát triển BIM ở Việt Nam.</p>
<p>Từ khóa:</p> <p>BIM</p> <p>Revit</p> <p>Water supply</p>	

1. Introduction

Teaching and learning is a process of transferring scientific knowledge, technology and working skills to students. The application of an information technology in teaching is currently an active tool in teaching and learning, which is emphasized by Resolution 29-NQ/TW (November 4, 2013) in the application of the information technology (IT) and communication in teaching and learning [1] Recently, Decisions 1282/QĐ-BGDĐT (May 10, 2022) of the Ministry of Education and Training on Promulgating a Plan to strengthen the application of information technology and digital transformation in education and training the period 2022-2025; Decision 131/QĐ-TTg (January 25, 2022) on digital transformation of the Prime Minister [5]; Then, Decision 4740/QĐ-BGDĐT (December 6, 2022) on the set of indicators and evaluation criteria for digital transformation in higher education institutions

[6] This shows that the application of the information technology in teaching at the university level is a necessary trend [14] and requirement for education and training development and integration in the 4.0 revolution [4]. At Hanoi Architectural University, in the training program for Engineers specializing in water supply and drainage, the subject of construction water supply and drainage (in the 4th year) requires students to apply the knowledge they have learned to the design of the water supply and drainage network in the building [12, 4]

Meanwhile, the drawings and equipment structures are mainly presented in 2D, making it difficult for students to visualize the structure's characteristics. Especially the arrangement of water supply and drainage pipes passing through obstacles is not clearly shown in the drawings, leading to the attractiveness

and accessibility of the subject to actual construction, construction management is reduced [8, 12,3] Besides, the technology of Building Information Modeling (BIM) helps the design and construction of works visually, the equipment structure, pipeline location is clearly shown in the building construction.

Currently, the BIM technology has many different types of software for the design of indoor water supply and drainage (Table 1). In Vietnam, Autodesk's Revit model is often used to serve project design. Currently, students majoring in the water supply and drainage from Hanoi Architectural University have been instructed to apply the Revit/MEP model to the design of indoor water supply and drainage works in the subjects and graduation thesis.

2. Applying BIM for drainage and water supply projects

2.1. Legal documents for using BIM

Legal documents for using BIM can be listed as follows:

Decision No. 2500/QĐ-TTg (December 22, 2016) of the Prime Minister approving the Scheme on application of Building Information Model (BIM) in construction and operation management.

Resolution No. 17/NQ-CP (March 7, 2019) of the Government on a number of key tasks and solutions for the development of e-Government in the period of 2019 - 2020, with a vision to 2025[7]

Decision No. 1004/QĐ-BXD (July 31, 2020) approving the "Plan for digital transformation of the construction industry for the period 2020-2025, with orientation to 2030"[9]

On July 5, 2018, the Ministry of Construction of Vietnam and the Ministry of Foreign Affairs of the United Kingdom of Great Britain and Northern Ireland held a signing ceremony of a memorandum of understanding on cooperation in building information modeling (BIM). This is part of the Global Technical Infrastructure Program (GIP), which is part of the UK Government's Prosperity Fund.

Decree No. 15/2021/ND-CP (March 3, 2021) of the Government detailing a number of contents on construction investment project management

Decision No. 348/QĐ-BXD (April 2, 2021) of the Ministry of Construction on "Publishing General Guidelines for Application of Building Information Model (BIM)"[10]

2.2. Reality factors of applying BIM at universities

Apply BIM technology in construction projects in line with current development trends, especially the 4.0 technology revolution in the construction industry. BIM technology makes the project clearly show the structure and equipment for the design, construction and operation, management [11,12,2,3]

Minimize errors/conflicts between design and construction work, reduce investment costs and be clear in project management [12,4]

Common recruitment criteria in companies for water supply and sewerage engineers is whether they have the ability to use BIM software or not?

Trend between training and approach to real work of fresh graduates.

3. Properties of BIM/MEP

MEP is part of Autodesk's Revit software system. This is a software developed by Autodesk with the desire to integrate into the effective design and construction management system according to BIM technology.

In the Revit software system, including Revit / Architecture for architectural design, Revit /Structure for structural design, Revit /Mep is a tool for designing electrical, water supply, drainage systems, ventilation etc in construction works.

This is an innovative design solution of Autodesk, Inc. to meet the needs of design, construction and project management in a comprehensive way.

In Revit/MEP modeling, each 2D, 3D drawing and material bills represents information from a basic building model database.

Working in drawings and lists, Revit/MEP collects information about the construction project and coordinates this information with all other project presentations.

Changing Revit/MEP parameters automatically coordinate changes made anywhere, like in models, drawings, lists, sections, and diagrams.

4. Process of using Revit/MEP

- Step 1: Study the design drawings and requirements of the investor
- Step 2: Unify the position, order of elevation of systems and collection of libraries to be used in the design
- Step 3: Restore architectural and structural drawings from drawings in Autocad software
- Step 4: Deploy the design for the systems: Electricity – Water supply and drainage – Air-conditioning – Ventilation – Fire protection
- Step 5: Analyze the building system, check for conflicts, can export 2D drawings, 3D simulation of the works and print

5. Usecase of indoor water supply using Revit/MEP

5.1. Computer configuration

Requirements of computers using Revit/MEP are shown in table 2.

5.2. Revit/MEP models

Opening Revit software, we have to select the project content to design, here is the water supply and drainage project. Select the Project item, select New → New Project → Plumbing-default_metric (Figure 1) → OK.

Simulation drawings of the indoor water supply works using BIM technology on Revit/MEP software are shown in Figures 2-7.

The actual water supply works shown in Revit/MEP software are shown in Figure 8.

6. Advantages and disadvantages using BIM

6.1. Advantages

The 4.0 technology revolution is taking place strongly in Vietnam, all industries have plans and visions to apply information technology to 2030.

The set of “General Guidelines for the application of Building Information Modeling (BIM)” was issued, which is a meaningful legal basis in formalizing the use of BIM for the construction industry[10]

The information technology standard of officials, engineers, experts and managers has been improved, qualified and able to access new technology to solve current works.

The investment of construction companies in BIM technology is very strong, and at the same time, the regulations on laws and policies are favorable for BIM technology application projects.

Universities have included BIM technology in training from the main course to external expansion. Competitions for students about BIM are also very exciting (most recently ARCHICAD BIM COMPETITION 2022), which has stimulated students' morale and interest in BIM research.

BIM technology is a preparation for fresh graduates to be admitted to specialized jobs with good salaries.

For Hanoi Architectural University, a roadmap to bring BIM technology into mainstream teaching has been proposed and plans for specialized development of BIM have been developed.

6.2. Disadvantages

The initial cost for BIM technology is very high, especially equipment and technology, the cost of training human resources, the change in the concept of design, appraisal and acceptance of works from the point of view by BIM technology.

The application and control processes according to BIM technology are still limited, especially the change in working methods, construction system management thinking and the synchronization in BIM process control from the construction company with the state management units has not really matched.

The mechanisms, policies and laws are only at the initial stage, there are still many items and issues that need to be completed.

For Hanoi Architectural University, the application of BIM technology is still limited, using BIM in the design of subject, teaching and new graduation projects at the encouragement step, there is no mandatory requirement, so the development of BIM in the majors is still limited.

Table 1. Some software in BIM technology used for the water supply and drainage works [4]

Number	Software	Company
1	Revit (MEP)	Autodesk Inc
2	CADMEP (CADduct / CADmech)	Autodesk Inc
3	4MSA FineHVAC+FineLIFT+FineELEC+FineSANI	4M
4	Bentley Hevacomp Mechanical Designer	BENTLEY SYSTEMS
5	Digital Project MEP Systems Routing	Digital Project, Inc

Table 2 High-performance PC configuration for Revit 2018

Operating system	Windows 7 SP1 64-bit
	Windows 8.1 64-bit
	Windows 10 64-bit
CPU	Intel Core i, Xeon, AMD
	Multi-Core processors are preferred
RAM	16GB RAM
	Revit with 700 MB
Monitor	Ultra high definition
HDD	5GB
	Support Point Cloud data
Web browser	Internet Explorer 7.0 (Or higher version)

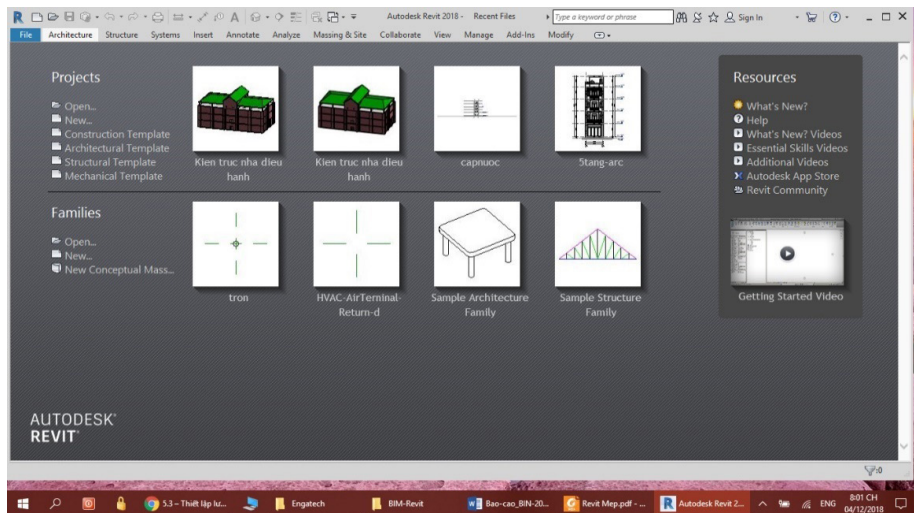


Figure 1 Figure 1 Revit interface (2018).

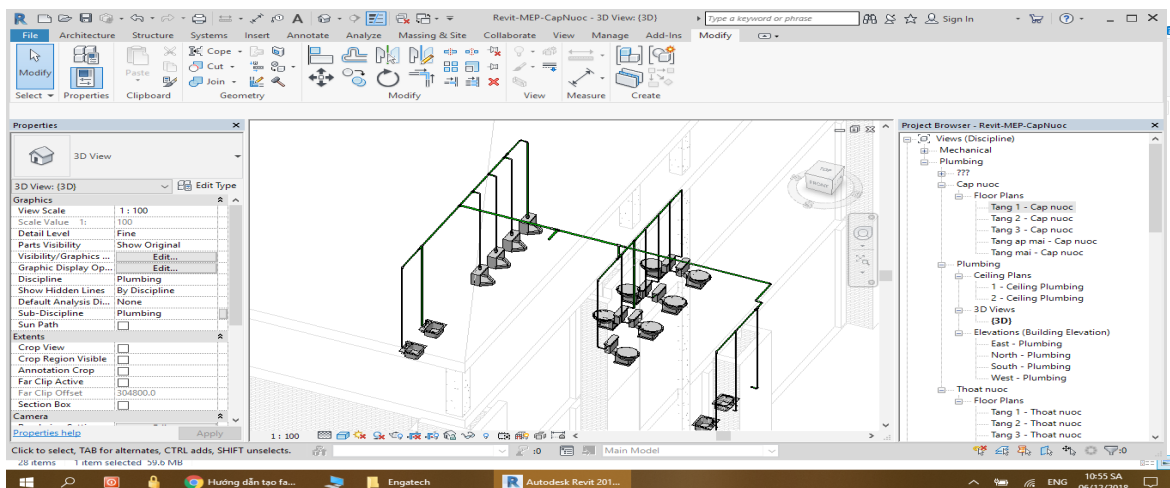


Figure 2 Layout of 3D water supply network for 1st floor (sanitary works).

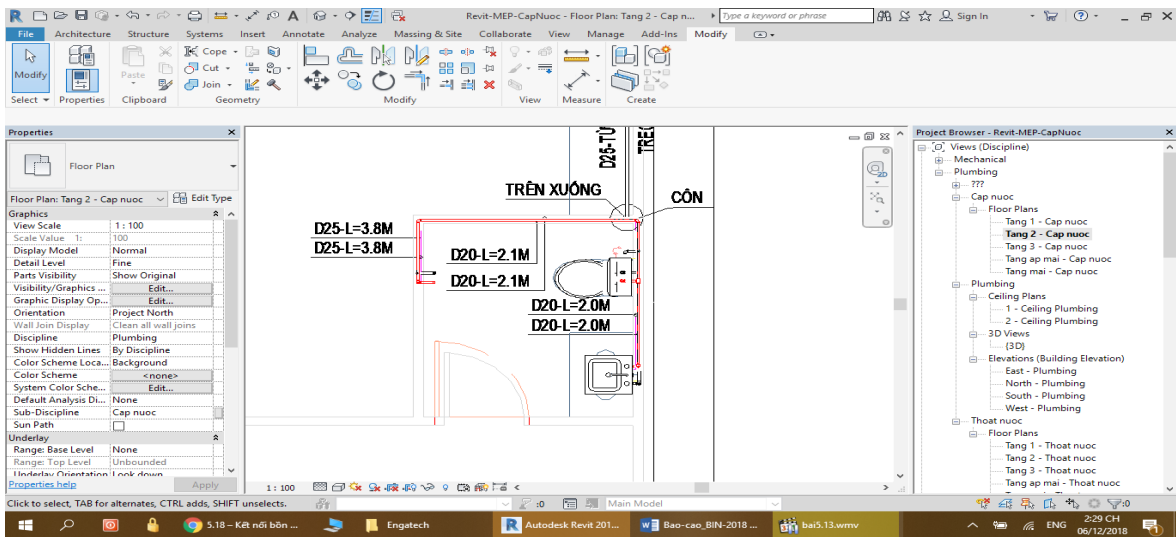


Figure 3 Design of a toilet with a connection to hot and cold water systems

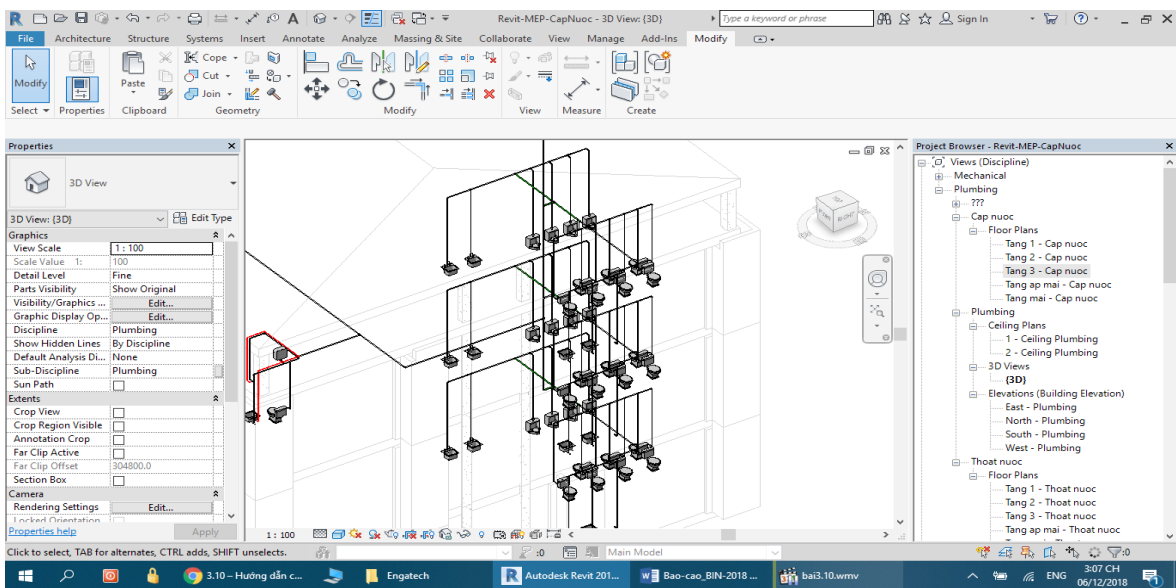


Figure 4 Layout of sanitary equipment and water supply of 1st, 2nd and 3rd floors.

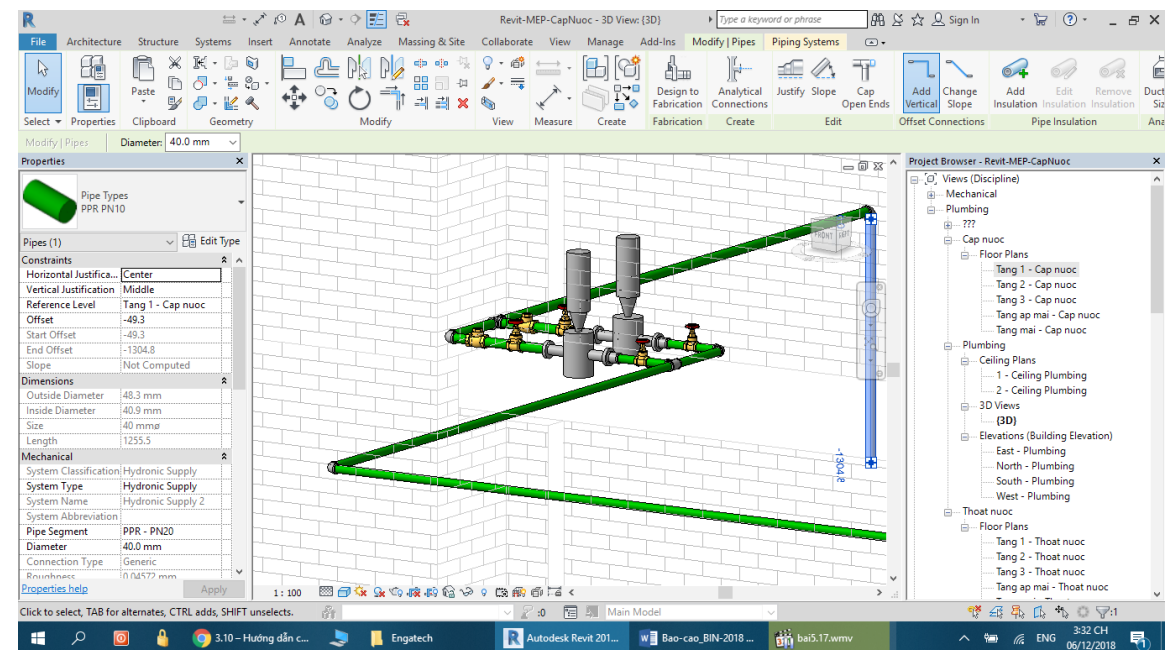


Figure 5 Layout of pump, check valve and gate valve.

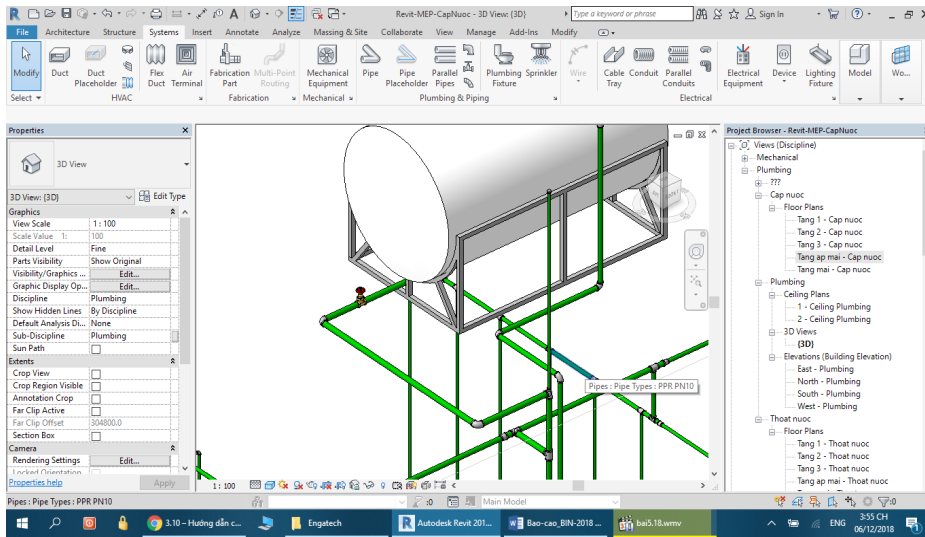


Figure 6 Installation of the water tank, the supply pipe to the tank and the supply to the sanitary system.

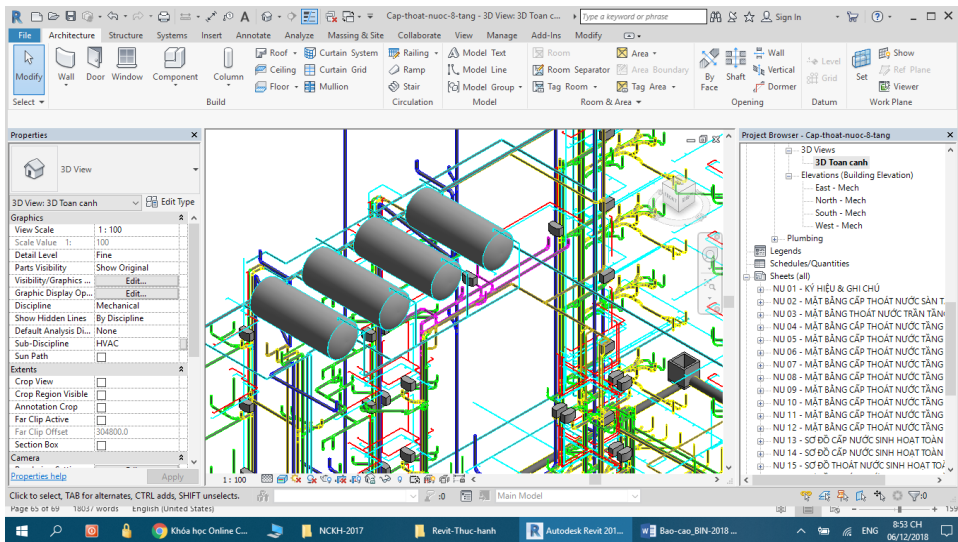


Figure 7: Overall 3D system of 3-storey indoor water supply network.

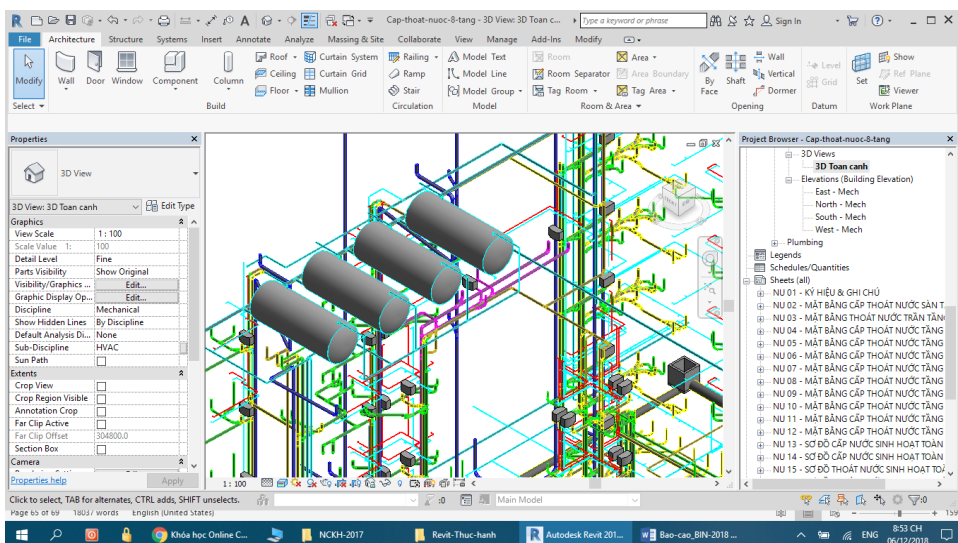


Figure 8 Water supply design model for an 8-storey building of Hue Central Hospital

Source: HMT company

7. Conclusions

BIM technology is an inevitable trend, is the integration of Vietnam's construction industry with the world, the application of BIM technology plays a big role in the development of Vietnam's construction industry.

BIM technology brings clarity and transparency in the design, construction and management of water supply and drainage works.

The legal regulations on BIM application are gradually being completed and helping the application of BIM technology become more popular for construction projects.

For education and training, BIM technology has become a core technology to replace traditional techniques (technology, 2D drawings).

It is necessary to bring BIM technology into official teaching in universities with majors in architecture, construction, water supply and drainage and other infrastructure industries.

References

[1] Ban Chấp hành Trung ương (2013). Nghị quyết số 29-NQ/TW ngày 4/11/2013 về đổi mới căn bản, toàn diện giáo dục và đào tạo, đáp ứng yêu cầu công nghiệp hóa, hiện đại hóa trong điều kiện kinh tế thị trường định hướng xã hội chủ nghĩa và hội nhập quốc tế.

[2] Nguyễn Minh Ngọc (2018). Những thuận lợi và khó khăn khi áp dụng BIM trong ngành xây dựng Việt Nam. Tạp chí Xây Dựng Việt Nam. Số tháng 10, trang 115 – 118.

[3] Nguyễn Minh Ngọc (2019). Giải pháp BIM trong thiết kế, thi công và quản lý công trình cấp thoát nước trong nhà. Tạp chí khoa học kiến trúc và xây dựng, số 35 tháng 09 năm 2019, trang 58-63.

[4] Nguyễn Minh Ngọc (2018). Đề tài nghiên cứu khoa học cấp Trường “Nghiên cứu áp dụng mô hình

thông tin công trình trong (BIM) thiết kế hệ thống cấp nước trong nhà”. Trường ĐH Kiến trúc Hà Nội.

[5] Quyết định số 131/QĐ-TTg của Thủ tướng Chính phủ: Phê duyệt Đề án “Tăng cường ứng dụng công nghệ thông tin và chuyển đổi số trong giáo dục và đào tạo giai đoạn 2022 - 2025, định hướng đến năm 2030”.

[6] Quyết định số 4740/QĐ-BGDĐT ngày 30/12/2022 Ban hành Bộ chỉ số, tiêu chí đánh giá chuyển đổi số cơ sở giáo dục đại học

[7] Quyết số 17/NQ-CP về một số nhiệm vụ, giải pháp trọng tâm phát triển chính phủ điện tử giai đoạn 2019-2020, định hướng đến năm 2025.

[8] Quyết định số 749/QĐ-TTg về việc Phê duyệt “Chương trình chuyển đổi số quốc gia đến năm 2025, định hướng đến năm 2030”.

[9] Quyết định số 1004/QĐ-BXD ngày 31/07/2020 Về việc Phê duyệt “Kế hoạch Chuyển đổi số ngành Xây dựng giai đoạn 2020-2025, định hướng đến năm 2030”.

[10] Quyết định số 348/QĐ-BXD ngày 02/04/2021 về việc Công bố Hướng dẫn chung áp dụng Mô hình thông tin công trình (BIM).

[11] Quyết định số 749/QĐ-TTg về việc Phê duyệt “Chương trình chuyển đổi số quốc gia đến năm 2025, định hướng đến năm 2030”.

[12] Quyết định số 1004/QĐ-BXD ngày 31/07/2020 Về việc Phê duyệt “Kế hoạch Chuyển đổi số ngành Xây dựng giai đoạn 2020-2025, định hướng đến năm 2030”.

[13] Quyết định số 348/QĐ-BXD ngày 02/04/2021 về việc Công bố Hướng dẫn chung áp dụng Mô hình thông tin công trình (BIM).