American Journal of Civil Engineering and Architecture, 2024, Vol. 12, No. 4, 98-105
Available online at http://pubs.sciepub.com/ajcea/12/4/4
Published by Science and Education Publishing
DOI:10.12691/ajcea-12-4-4

Analyzing the Influence of Technology in Architecture: Computer Applications and Building Design

Abhishek Bangre[1], Rupesh Surwade[1], Mohammad Arif Kamal[2,*]

[1]Priyadarshini Institute of Architecture and Design Studies, Nagpur, India
[2]Architecture Section, Aligarh Muslim University, Aligarh, India
*Corresponding author: architectarif@gmail.com

Received November 06, 2024; Revised December 08, 2024; Accepted December 15, 2024

Abstract The development of information technology (IT) is one of the technologies that has had the biggest influence on architecture. The Computer-aided design software was developed to assist architects in the conceptualization of design concepts for architectural projects. Second, to produce any form or shape and realize the architects' distinctive design, better construction equipment and techniques were developed. Thirdly, the development of new materials has improved our understanding of architecture. This paper will examine the field of architecture, as well as the implications and effects of technology on the built environment. Architecture has been impacted by technology in a number of ways. This paper presents the three topics: information technology (IT), the influence of IT on architecture, and how Frank Gehry and Zaha Hadid had employed technology to create their distinctive architectural forms during the building design and construction phases.

Keywords: *architecture, technology, building design, computer applications, CAD, Frank Gehry, Zaha Hadid*

Cite This Article: Abhishek Bangre, Rupesh Surwade, and Mohammad Arif Kamal, "Analyzing the Influence of Technology in Architecture: Computer Applications and Building Design." *American Journal of Civil Engineering and Architecture*, vol. 12, no. 4 (2024): 98-105. doi: 10.12691/ajcea-12-4-4.

1. Introduction

Technology is a category of instruments, methods, frameworks, and apparatus used to assist individuals in resolving issues and accomplishing objectives. The advancement of technology has made life easier and more convenient for individuals. It also helps people achieve their goals while saving time and money, and it even raises the caliber of their output. In the twenty-first century, technology permeates practically every aspect of life. "Technology has existed as long as there have been people." This quotation makes the implication that individuals use technology everywhere they go and in practically everything they do. People find it difficult to avoid using technology; one example is a cell phone.

Other than that, the invention of the internet by technology has directly changed the way on which the people live today compared to the previous generations. Almost everything can be done online in anywhere and at any time as long as they have a device that can access the internet. Modern society is characterized by the fact that most people carry around a mobile phone in every place they go. This is because mobile phones are equipped with advanced technology that allows them to do more than just make calls. Additionally, the advancement of technology has had an impact on a number of industry sectors, including business, the automotive, and healthcare, cinema, and architectural industries, among others. Many problems that were intractable in the past have been resolved thanks to technological advancements over the years. Numerous pieces of knowledge and information, machines, and devices have been improved and introduced into various industries, making the seemingly impossible feasible.

Human life has depended heavily on architecture; without it, humans would not now be able to survive on Earth. Buildings used to be meant to provide shelter or places for people to live, but in the twenty-first century, people seem to be more concerned with and demanding of a building's beauty than its functionality. What is causing this problem? Does technology impact how a facility operates?

This paper shall analyses the three topics: information technology (IT), the influence of IT on architecture, and information technology itself. How Frank Gehry and Zaha Hadid employ technology to create their distinctive architectural forms during the design and construction phases. There will be multiple case studies of their constructions covered in these subjects.

2. Background Study

"The change in architecture was modern. It overthrew the preexisting Beaux-Arts system and instituted a new one in its stead. Earth's surface would never be the same [1]. A particular architectural style known as Beaux Arts persisted in the field for 2.5 centuries prior to the

emergence of the modern architectural style. Because Beaux-Arts architecture relied on sculptural embellishment whereas contemporary architecture relied on simpler shapes, the appearance of Beaux-Arts architecture appears far more sophisticated than that of modern architecture.

The modern architectural style gradually supplanted the Beaux Arts architectural style throughout time. In the twentieth century, Beaux Arts architecture was hard to come by. The modernist architects created the majority of the buildings in a modern style. "It was obvious that architecture needed to evolve as the twentieth century got underway. The Beaux-Arts style of the nineteenth century was out of step with the times." [1]. Throughout the 20th century, architects' perspectives on the architectural design process evolved. The appearance of the structures was first designed mainly on their unique functions rather than as a means of commemorating history.

"Whether it be the sweeping eagle in his flight or the open apple-blossom, the toiling work-horse, the blithe swan, the branching oak, the winding stream at its base, the drifting clouds, over all the coursing sun, form ever follows function, and this is the law." The famous architect Louis Henry Sullivan said this in his 1896 essay, "The Tall Office Building Artistically Considered." According to Louis Henry Sullivan's phrase, "Every building has its own function," which refers to how the structure's owner used it? Each building should have a unique facade and form based on its particular function. For example, a hospital ought to be constructed similarly to a building that serves patients seeking medical care, and people ought to be able to tell a hospital apart from a library or school where they can obtain research materials and books to borrow.

Louis Henry Sullivan's law—form follows function—had both advantages and disadvantages in the field of architecture. Although it might be simple for visitors to locate the specific building they are looking for, this restriction on design concepts prevented architects from creating a structure with a distinctive shape that would elicit a distinct visual experience. In the past, technical limitations extended beyond legal constraints to include design concepts. Even though some architects may have had design concepts with distinct architectural styles, their use of antiquated technologies prevented them from moving forward with the construction phase. The twentieth century saw a shift in the understanding of architectural form and functions as a result of advances in technology and the rise of the phrase "function defies form" in architectural design. In the next century, Louis Henry Sullivan's law—that "form follows function"—will no longer apply. The architecture of the buildings was not based on their intended uses; for example, a library's exterior might resemble that of a museum, or visitors might not realize what it is until they enter."Renowned architect and transgressive thinker on architectural concerns Bernard Tschumi proposed that form does not follow function and function does not follow form.

The new technology, defined as industrial or applied science, produced a multiplying array of new machines and materials [1]. The development of technology has led to the invention of numerous novel materials for the architectural sector. These new building materials were versatile and reasonably priced, and their development allowed architects to produce a variety of distinctive architectural designs. Other than that, employing contemporary technologies can address the constraints imposed by earlier construction methods.

The manner that buildings were designed and constructed was altered by the new technology's steel beams and cables, reinforced concrete, and plastic. Time and money are saved when units are mass-produced in factories and assembled on-site using state-of-the-art equipment. Most significantly, they reduce labour costs. Even if our buildings now have cutting-edge technology for lighting, heating, cooling, communications, and security that were unheard of in the past, all of this is still true today [1]. Humans have benefited greatly from technological advancements over time. In order to develop high-quality works, aesthetic architectures were designed to both enhance the surrounding area and provide comfortable living and working environments for people. People can experience a beautiful sense of sight through architecture that uses innovative materials. The Berlin Turbine Factory, designed by German architect Peter Behrens at the start of the 1800s, was built for the Allgemeine Elektronikats-Gesellshaft, an electrical company. Its massive glass side walls and reinforced concrete structure announced the arrival of a new architectural style. In his office were Walter Gropius, Mies van der Rohe, and Le Corbusier [1].

In order to create an attractive and distinctive appearance, numerous architectural styles and building designs were developed in the twenty-first century. High-tech construction techniques can be used to create architecture with irregular shapes. It depends on what the architects want; with today's sophisticated technology, they can create a structure in whatever shape they like. Thanks to technological advancements, architects are now able to build in a virtual setting and produce concepts digitally. It can be accomplished by utilizing computer-aided software, another innovation of technology. With the help of all these technology, architects were able to design buildings that were both highly beneficial and creative.

3. Research Methodology

In this paper qualitative research method has been used. The systematic literature review explores the basic concepts and backgrounds of parametric architecture through books, internet and secondary data from relevant published academic literature from journals articles and research papers. In order to analyze the theoretical study data, this research paper aims to elucidate the key elements of parametric architecture. The data collection in the qualitative research are the data that comes from a number of case studies and examples that are described descriptively and are supported by illustrations and photographs to reinforce the arguments put forward.

4. Role of Information Technology in Contemporary Architecture

The use of computers and telecommunications

equipment for data processing, transfer, storage, and manipulation is known as information technology, or IT. Typically, IT is used as a synonym for computers by people. Nonetheless, it includes a wide range of technology, including networks, computers, mobile phones, printers, scanners, fax machines, and telephones.

The development of IT did alter how people worked, but not how they lived. Compared to working manually, it helps users save time and money while producing even better work. The majority of tasks can be completed electronically and without paper. Other than that, it has the ability for people to produce mass production in a short time.

To improve group procedures, electronic mail, groupware, telecommuting, and videoconferencing have all become comparatively commonplace technology. Teams now have the ability to interact anywhere, at any time, thanks to technological advancements [2]. Technology helps those who collaborate in groups by facilitating communication and enabling debates among team members at any time to generate higher-quality work. "Information technology can significantly improve work group productivity by increasing the speed and decreasing the cost of communication and coordination [2]. By utilizing email or various programs like Virtualbox, Dropbox, and others, users can also share or exchange data and information utilizing internet technology at the same time. When speaking with a specific individual, they can obtain a variety of data and information in electronic form instantaneously. People are able to save money and time by travelling around in order to obtain all the documentation they require in this way. "The top three organizational effects were: allowed business to be done at greater distances, shortened work cycle time, and reduced the need for clerical support staff [2]. With all these sophisticated technology at their disposal, architects are now creating buildings with a different mindset. Architecture design will be judged based on its conceptualization, aesthetics, and utility. One reason for this is that as technology has advanced, fundamental building functions have been lost.

In the past, individuals had to shop at malls, supermarkets and retail stores, mail letters by placing them in the postbox, conduct research and check out books from the library. All of these tasks can be completed with the help of modern technology, including email, online purchasing, and information searching, and downloading e-books from the internet. People these days rely too much on technology to get things done; they can use the internet to finish a chore or reach their objective without getting up from their chair. Because there is less demand for physical space, architects must build with aesthetics in mind rather than functionality. Consequently, information technology assisted in the construction of numerous curved buildings: IT has freed the architect to create heretofore unaccomplished curvaceous form, and new service areas are emerging in the "information age" frontier marketplace [3].

Apart from that, IT has affected more than just the form of architecture during the design process. Towards the end of the 20th century, computers are being used by architects to create and develop concepts. The complex and unique design of architecture can be done with computerized and the invention of computer aided software such as AutoCAD, InteriCAD, Adobe software, Rhinoceros, 3D Studio Max, CATIA (Computer Aided Three-dimensional Interactive Application) and many more.

With the use of all this computer-aided software, architects can produce distinctive designs that are impossible to accomplish by hand while also saving time. Apart from that, it made it possible for architects to calculate space accurately and produce realistic renderings of the planned project. "Computerization and the advancement of design technology and practice are two of the most important technologies in the architecture industry in the twenty-first century." The advancement of design technology entails the creation of new tools that allow designers to focus more on issue solving and less time and effort on gathering data, computing, and creating design documentation [4]. It is apparent that computer aided software has already become one of the design instruments in the designing process in the architectural industry.

The primary product of the architectural design process is drawings, which can be classified into two categories: two-dimensional drawings and three-dimensional drawings. A two-dimensional drawing is one that has every element on a flat surface and typically has just two dimensions—length and width or width and height—without any thickness or depth. Furthermore, a three-dimensional drawing is any graphic or picture that contains things in all three dimensions—height, breadth, and length.

Additionally, virtual reality (VR) is applied in conjunction with computer-aided software to make drawings. "Virtual reality (VR) is a computer-generated environment that involves one or more human senses and is created in real time by the activities of the users. VR differs from previous types of computer-generated simulations in that the computer responds to the participant's actions in real-time. In a universe where the object of perception is formed by activities, a participant in a virtual reality environment is both a perceiver and a creator at the same time [5].

Using virtual reality (VR) with computer-aided modeling tools, a virtual model simulating a three-dimensional image can be produced. To meet the requirements of realism, this model helped architects plan in great detail and anticipate any technological problems. In addition, it enables architects to accurately represent a building and efficiently visualize spaces. Furthermore, before the structure is constructed, the actual image can be viewed on a computer or printed out. Because of this, architects have the ability to alter designs if they feel uncomfortable or don't look good.

5. Role of Virtual Reality (VR) in Architectural Design

The preceding materials provide a clear introduction to virtual reality (VR). According to the research, VR applications have also been employed in a number of other sectors, including astronomy, medical, entertainment, sports, and the arts. Additionally, it has been applied to the design of architecture as a tool. It is simple to see how VR

features like interaction, immersion, and three-dimensionality impact the architectural industry. Rendering technologies have been made available for the observation, assessment, and aesthetic view of an architecture setting prior to construction through the use of virtual reality. This material will pose the topic, "How does virtual reality work as a design tool in architecture design?"

According to research on design-related challenges conducted over the course of the year, the use of virtual reality (VR) in the architectural profession has enhanced and made the design process more engaging. Out of all the VR applications, employing VR as a design tool has the least potential. The process of entering concept ideas used to be done by hand, using tools like pencil, paint, or ink on paper to create two-dimensional drawings. However, with the help of computer-assisted technology, this process can now be transformed into an immersive method of creating preliminary sketches or three-dimensional visuals. All the credit goes to the VR implementation. The University of North Carolina's three-dimensional modeler, 3DM, produced the three-dimensional models during the VR architectural design implementation by utilizing a hand-held pointing device and head-mounted display (HMD). This application allows models to be edited and transformed, including the ability to copy, paste, cut, move, scale, and even manipulate them in immersive ways [6].

5.1. Design Process from Sketches to Models

The design process consists of numerous steps, including mapping, schematics, sketching, building drawings, and more. While they can be distinguished by the accuracy, detail, and quantity of representative information, sketches and working drawings incorporating concept ideas are crucial. When the concept ideas on the sketches are sufficient to be expressive and evolve into a workable drawing, the computer may program and carry out the drawing. In modeling, computer-aided design (CAD) is helpful and convenient since it offers beneficial tools. As an illustration, a distinctive curved wall design for a façade can be extruded with a round opening, and its model can be implemented with precise wall and opening proportions. Additionally, the CAD program can be used to implement recurring operations. On the other hand, the speed at which a drawing may be instantly converted into a working model can improve both the creative process and the comprehension of three-dimensional space [7].

5.2. Two-Dimensional Media and Scale Models

Two-dimensional media, like paper, are constantly used in architectural design to convey concept ideas into the creation of the design. Aside from that, two-dimensional media are used to depict three-dimensional items in presentation drawings such as building, detailing, and three-dimensional perspective drawings [8]. Every single computerized output, including CAD, needs to be present in two dimensions, either via printing on paper or displaying on a screen. Scale models represent an additional option for architectural design that can both define and realize the use of unbuilt three-dimensional space. Nevertheless, because the model cannot be occupied and the viewer cannot see inside, the quality of the place has been diminished [9].

5.3. Virtual Environment

Different notions will be brought to the act of creativity by this technique, which is known as immersive design and involves the designer operating within the product of his design in a virtual world. In an immersive design environment, form can be created by manipulating elements through rotation, subtraction, and rising of walls. Stairs and floors can be constructed and altered in response to perceptual cues. For the design that is based on volumes, Boolean operations of addition and subtraction can be employed to enable the moulding and carving motion. As the application of conventional compositional rules transitioned from two-dimensional representations to three-dimensional immersive environments, several values were assumed. You can confirm the proportions of different architectural features by living in the area. Even Nevertheless, virtual reality applications should make immersive design a reality, revolutionizing the field of architecture. In order for the architect to become accustomed to the idea of drawing in space, being inside, and having a firsthand experience of three-dimensional space, the conversation about the traditional act of designing should be conducted.

6. Zaha Hadid: Deconstructivism and Fluid Forms

Iraqi-British architect Zaha Mohammad Hadid was born in Baghdad, Iraq, on October 31, 1950. She was the first female Muslim recipient of the 2004 Prizker Architecture Prize. Additionally, she was consistently awarded the Sterling Prize in 2010 and 2011. After graduating from the American University of Beirut's mathematics program, Zaha Hadid went on to study architecture at the Architectural Association (AA) School of Architecture in London. She then worked for Rem Koolhaas and Elia Zenghelis, her former lecturers. In the 1980s, she continued to serve as an AA lecturer after joining Koolhass as a partner in 1977. After that, she founded "ZahaHadid Architects," a London, United Kingdom-based architecture and design firm that employs over 300 people.

The buildings built by Zaha Hadid consistently have a complicated form and a distinctively futuristic aesthetic. She is able to create curved architectural designs using cutting-edge technologies and novel materials in her modern and inventive designs. The Contemporary Arts Centre, the Guangzhou Opera House, the Vitra Fire Station, the BMW Central Building, the London Aquatics Centre, Galaxy Soho, and other projects were among her finished and ongoing projects (Figure 1 & Figure 2). In addition, she designs cars and furniture with a fluid aesthetic and works on interior design projects.

By utilizing the advantages of cutting-edge technologies in her architectural designs, Zaha Hadid has emerged as one of the most well-known modern architects. She is curious about how technology is affecting building design and construction since it makes construction more

feasible. She was awarded the Jane Drew Prize in 2012, and in an interview with "Architects Journal," she suggested that architects spend money on digital technologies and take trips; both activities foster inspiration and inventiveness in design.

Figure 1. The Galaxy Soho at Beijing, China

Figure 2. The Guangzhou Opera House at Guangzhou, China

6.1. Case Study 1: BMW Central Building at Leipzeg, Germany

Zaha Hadid's winning entry for the 2004 Pritzker Architecture Prize was the BMW Central Building. Situated in Leipzeg, Germany, the complex's construction costed approximately 1.55 billion dollars (Figure 3). It is employed in the production of BMW 3 Series automobiles. The building's owner, BMW AG, Munich, Germany, paid 60 million dollars for its development. Arge Rohbau, OBAG, and Wolf & Mueller GmbH built it, assisted by AGP Arge Gesamtplanung, IFB Stuttgart, the structural engineer.

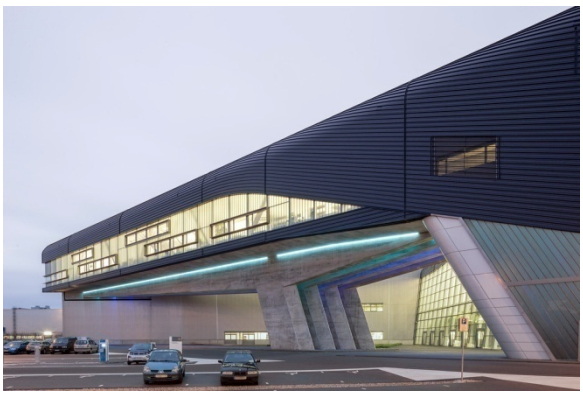

Figure 3. The BMW Central Building at Leipzeg, Germany

Three distinct structures that were created by the BMW estate and management group comprise the original construction of the factory. The three distinct structures serve as the production facilities for the BMW 3 Series of cars. They are working on the process of creating car bodies, painting them, and assembling the pieces together individually. An architectural competition is being organized to develop and connect all three structures. Zaha Hadid integrated the idea of connectivity—the process of overlapping and connecting the spaces and levels—into the design. The concept application resulted in a complicated interior design and a blurring of the boundaries between the three buildings. Zaha Hadid has made full use of the most cutting-edge design tools, construction equipment, and novel materials during the project's design and construction phases. Todd Gannon, the series editor of Source Books in Architecture, spoke with Lars Teichmann, the project architect and Patrik Schumacher, a partner of Zaha Hadid, about the construction methods and design approach of this project.

Lars Teichmann mentioned in the chat that although some people are developing three-dimensional models and two-dimensional computer drawings, there is always someone testing ideas with real models in the workshop. Additionally, they are able to construct a variety of possible interpretations of their ideas thanks to this approach. In addition, the use of concrete for the walls' construction addressed the issue of loads passing through the structure. Because concrete walls are stronger and can support heavier loads, they were able to create gaps in the wall using cutting-edge technology when needed [10].

6.2. Case Study 2: London Aquatics Centre at London, UK

The London Aquatics Centre is a facility for swimming and diving, two indoor sports. It was built as a venue for the 2012 Olympic Games in London (Figure 4). The centre is situated at Olympic Park, Stratford, London, United Kingdom, and was constructed on July 27, 2011. The Olympic Delivery Authority is in charge of running it, and the building project came at a cost of roughly 269 million pounds. In addition, Ove Arup & Partners, a structural engineer, assisted contractor Balfour Beauty in the construction of the centre. Additionally, the centre has a capacity of 17,500 seats.

Figure 4. The London Aquatics Centre at London, United Kingdom

It is clear from the aquatic center's intricate and distinctive design that Zaha Hadid was responsible for its modern and avant-garde style. Zaha Hadid used the idea of water's fluidity in motion when designing the aquatics centre. The Olympic Park nature served as influence for the design of the areas and their surroundings. The primary building material employed in its construction was precast concrete. Apart from that, the building's face is made of glass and steel, forming the roof that resembles a wave. The building originally had wings on both sides that served as additional seats for Olympic Games spectators. However, as they weren't included in ZahaHadid's original design, they wouldn't remain there indefinitely. The games will be taken down after they are finished, and at the same time, the aquatics complex will be dismantled and reopened to the public in 2014.

The IOC President, Jacques Rogge, called the Centre a "masterpiece". He claimed to have experienced a "visual shock" during his visit to the centre in 2011 because, in contrast to other locations he observed, he thought this place was exceptional and state-of-the-art. (BBC Sport (2012) It's clear that Zaha Hadid used technology skillfully in her architectural designs. Because of her inventiveness and ability to construct distinctive buildings, she is able to enhance the surrounding landscape.

7. Frank Gehry: A Pioneer of Deconstructivism

Frank Owen Gehry was born Frank Owen Goldberg, but he now goes by Frank O. Gehry thanks to his wife Anita Snyder's suggestion. On February 28, 1929, Frank Gehry was born in Toronto, Ontario, Canada. He was a Canadian-American Pritzker Prize-winning architect living in Los Angeles. He has also received other honors, including the Order of Canada, the National Medal of Arts, and the AIA Gold Medal.

Being one of the most influential and significant architects of the 20th century, his works were included in the 2010 World Architecture Survey as examples of noteworthy contemporary architecture worldwide.

In the architecture industry, he is regarded as a modern architectural icon due to his well-known status as an architect. His structures are renowned for their sculptural forms and for their extraordinary architectural design, which never fails to astonish.

He completed his architecture studies at the University of Southern California in 1954 and was awarded a Bachelor of Architecture. After that, he worked for a few architectural firms while attending Harvard University's Graduate School of Design to study city planning. He began his work as an architect in 1962 when he founded Frank O. Gehry and Associates, Inc.

His handmade design technique was replaced with a computerized one in 1989. The computer systems specialist Jim Glymph joined Gehry's team with the intention of focusing more on curves in his designs. When he wished to incorporate a more intricate shape into his design, Glymph assisted him by obtaining a CATIA program from the aerospace sector [11].

Gehry began to reject the use of boxy shapes and straight lines in architectural design with the aid of computer tools. He was able to create designs for both public and private buildings in Europe, America, and Asia because to his well-rounded architectural career. When Gehry Partners, LLP was founded in 2002, it employed more than 175 people and offered comprehensive services for institutional, commercial, and residential clients. The majority of the employees at Gehry Partners is equipped to oversee challenging architectural projects and is capable of producing technical drawings and construction papers. The business operates by relying on the "Digital Project," a computer aided design (CAD) application based on CATIA software which was developed by one of the Frank Gehry's companies, Gehry Technologies.

Frank Gehry has created numerous structures with eye-catching and distinctive designs over the years. His own home, the Guggenheim Museum, the Walt Disney Concert Hall, the Experience Music Project, the Weisman Art Museum, Dancing House, the Art Gallery of Ontario, and other structures are among his constructions (Figure 5 & 6). Gehry was able to produce dismantled attractive buildings in the deconstructivism style with the help of computer technology and the use of unusual materials.

Figure 5. The dancing House at Prague, **Czech Republic**

Figure 6. The Art Gallery at Ontario, Canada

7.1. Role of CATIA in Architectural Design

The full name of this kind of computer-aided design software is Computer Aided Three-dimensional Interactive Application, or CATIA. Dassault Systems, a

French corporation, developed it using licensed proprietary software. CATIA was developed in 1977 by French aircraft maker Avions Marcel Dassault and has since been used in a variety of industries, including shipbuilding, the automotive and aerospace industries. It supports the conceptualization, three-dimensional modeling, visualization, and other stages of the design development process. Using CATIA, one may also construct intricate, novel forms.

7.2. Case Study 1: The Guggenheim Museum at Bilbao, Spain

The modern and contemporary art is showcased in the Guggenheim Museum. It is situated in Abando, Bilbao, Spain, and was founded on October 18, 1997. The Solomon R. Guggenheim Foundation is the owner of this modern structure, which cost 89 million US dollars to construct and was built by Ferrovial, S.A. Additionally, it was constructed against the Nervion River and is mostly used to display Spanish and foreign artists' works. In addition, it has been one of the most well-known structures, particularly in 1998 and 1999 when it was a hot topic among industry architects. In 2007, the number of visitors to the museum exceeded one million. According to the 2010 World Architecture Survey, it is among the most significant structures constructed since 1980. Aside from that, renowned architect Philip Johnson has referred to it as "the greatest building of our time." The building has even been called a miracle by the New York Times (Figure 7).

Although the Solomon R. Guggenheim Foundation, the museum's owner, selected Frank Gehry to design the building, Thomas Krens, the project director, pushed Gehry to produce something truly unique and audacious. Additionally, the design was creatively realized with the haphazardly appearing curving outside design. Glass, limestone, and titanium were used in the building of its asymmetrical design. Computer technology has been used in the process of conceptualization, design, and visualization as well as managing the cost of construction due to limitations during the development of the specific deconstructed design of the museum. The intricate architecture of the building was made possible by the use of sophisticated equipment technologies.

Figure 7. The Guggenheim Museum at Bilbao

7.3. Case Study 2: Walt Disney Concert Hall at Los Angeles, USA

Walt Disney Concert Hall is the fourth hall of Los Angeles Music Centre which is located at 111 South Grand Avenue, Los Angeles, California U.S.A (Figure 8). The music hall's development began in 1999 and was finished and opened on October 24, 2003. It took about 130 million dollars to build, and it can accommodate 2265 people in seats. Stainless steel was primarily used in the construction of the Concert Hall's exterior to produce a matte look. However, the installation of the material resulted in issues with solar reflection; the reflective properties of the material surfaces also increased the building's temperature and increased the likelihood of traffic accidents.

The owner of the Concert Hall approached Gehry Partners to provide a solution. It came up with a solution by dulling the surfaces with a method of gently sanding in order to lessen the undesirable glare with the use of computer analysis on the building's panels (Dimming Disney Hall - Los Angeles Downtown News - For Everything Downtown L.A., 2012) This dilemma suggests that computer technologies can aid in problem solving in addition to providing advantages for design, development, and construction.

Figure 8. Walt Disney Concert Hall at Los Angeles, California U.S.A

8. Conclusions

People in the current era are unable to survive without technology. Every activity that people engage in, including sports, entertainment, and transportation, involves technology. Everywhere they go, we can see that everyone is carrying at least one electronic device. Since technology has already permeated every aspect of our lives, its growth has had a profound effect on us. It has affected many aspects of our lives, including how we interact, travel, and live. Technology usually serves us well, but as nothing is flawless, there are drawbacks as well as advantages. Our lives are becoming more convenient and luxurious thanks to technology. The two most important things in life are always money and time. Everyone benefits from time and money savings, which help us accomplish our goal with a higher-quality end

product. For example, we may obtain the facts and information we need on the internet without having to visit the library, which saves time. We may buy for food online and save money by not having to leave the house. On the other hand, because of the volume of data available online, we might obtain inaccurate or superfluous information and data. Additionally, when we shop online, we can receive spoilt or expired goods.

In addition, technology has had an impact on a wide range of industries, including the film, automotive, and architectural sectors. Both the design development of a project and the construction of buildings have been impacted by technology. As time goes on, technology continues to advance and has more positive effects on the architecture sector than negative ones. The development of information technology (IT) is one of the technologies that has had the biggest influence on architecture [12].

IT was covered in the first chapter and had an impact on how the building operated by using the internet. People are spending all of their time online and aren't leaving the house, which has led to a loss of building functionality. Apart from that, the development of computer-aided design (CAD) made it possible for architects to design digitally, produce intricate designs, and save time. Additionally, it gives architects precise measurements so they may create error-free designs. Nonetheless, architects are accustomed to designing for modern art, which has led to the decline of traditional architectural design. Additionally, technological issues with computer technology can arise and take time to resolve. Furthermore, modern construction technology can alleviate the shortcomings of earlier construction methods. With the use of sophisticated machinery, it facilitates the fabrication of intricate designs and reduces labour requirements. Projects by Frank Gehry and Zaha Hadid are instances of finished work made possible by cutting-edge technology.

References

[1] John P., The Oral History of Modern Architecture: Interviews with the Greatest Architects of the Twentieth Century, H.N. Abrams, New York, USA, 1994.

[2] Clayton, M. J., Johnson R. E., Song Y. and AlQawasmi J., The Information Content of As-Built Drawings. CRS Center, Texas A&M University, College Station, TX, USA, 1998.

[3] Barrow, L., Cybernetic Architecture – Process and Form – The Impact of Information Technology;" Dissertation, Harvard Design School, 2000.

[4] Rivard H., A Survey on the Impact of Information Technology in the Canadian Architecture, Engineering and Construction Industry, ITcon Vol. 5, pg. 37-56, 2000.

[5] Bertol D., Designing Digital Space: An Architect's Guide To Virtual Reality, John Wiley & Sons Inc., USA, 1997.

[6] UKEssays, Impact of Technology In Architecture Cultural Studies Essay. Available: https://www.ukessays.com/essays/cultural-studies/impact-of-technology-in-architecture-cultural-studies-essay.php?vref=1.

[7] Saquib M., Kamal Arif M., Effective Learning through Integrated Automation in Architectural Education: A Model Framework, Architecture Research, Scientific & Academic Publishing, 2015.

[8] Surwade R., Khas S. Kawaljit, Raghani S., Kamal Arif M., Model Making as a Creative Skill and Tool for Teaching-Learning Process in Architecture and Product Design, Civil Engineering and Architecture, 11(6), 3278-3284, 2023.

[9] Surwade R., Khas Kanwaljit S., Raghani S., Kamal Arif M. Exploring the Potential of Model Making as a Tool for Designing Sustainable Buildings. Civil Engineering and Architecture, 11(4), 2231 – 2239, 2023.

[10] Gannon T., Zaha Hadid: BMW Central Building, Princeton Architectural Press, USA, 2006.

[11] Friedman, M., Gehry *Talks: Architecture and Process*, Universe Publishers, New York, USA, 2002.

[12] Farooq S., Kamal Arif M., An Investigation into the Adoption of Digital Design Software in the Curriculum of Interior Design'. Universal Journal of Educational Research, 8(11B), 6256 – 6262, 2020.