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TEACHING ARCHITECTURAL STRUCTURES WITH THE AID OF VIRTUAL TOURS

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Abstract. *Architectural structures are one of the main components of architecture. This is the reason why they are taught at every architectural study programme. The Faculty of Civil Engineering and Architecture of the University of Niš is no exception to this. With its strong background in civil engineering, this faculty gives even more attention to the architectural structures than most, and this has proven in practice to be a great advantage for its students. With the rise and development of new technologies, architectural structures are also being innovated and upgraded. However, new methods for teaching architectural structures are still being explored and there has not yet been an established direction for innovations in teaching architectural structures. This paper aims to analyze possible techniques and tools that could be used in enhancing teaching methodologies of architectural structures with respect to modern technologies.*
The paper will first present the need for innovation in teaching of architectural structures in the context of digitalization. Then, virtual tours as one of the means of digitalization will be analyzed and discussed. Next, architectural structures as a topic will concisely be introduced and systematized. In addition to this, teaching of architectural structures at the Faculty of Civil Engineering and Architecture in Niš will be briefly displayed. Finally, the possibilities for using virtual tours in teaching architectural structures will be investigated. Special attention will be paid to analyzing benefits, as well as limitations and possible problems of such an approach. Based on this, conclusions about the use of virtual tours in teaching architectural structures will be drawn and presented.

Key words: *virtual tours, architectural structures, education, architecture, digitalization, teaching method*

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1. INTRODUCTION

We live in the times of unprecedented technological development. This development is so fast and powerful that it is affecting all areas of our lives. Everyday life has changed significantly even compared to what it was a couple of decades ago. Two areas that are the focus of this research have, however, not changed as dramatically as some others. These are construction and education. It seems obvious that the developments in these fields will continue to happen, which is necessary in order to keep up with the speed the world is evolving. The research field of this paper is the one of education about architectural structures, with the specific interest in application of new technologies to this subject.

"Everything that can be digitalized will be digitalized" is an idea that has been gaining momentum in the past decade. Today it seems much more realistic and plausible than a few years ago. For example, the government of the Republic of Serbia has recently made digitalization one of its top priorities[1] and sees it as the most important catalyst of innovation. Recent events in the world, more specifically the pandemic of COVID-19, have worked in favor of the digitalization. There are numerous ways in which digitalization can happen and is happening. Today, it is quite common to have digital meetings, work and collaborate digitally, to have fun or learn digitally. While it is still too soon to evaluate the effects and results of these changes to education, it is certain that some positive aspects have been recognized and that it would be beneficial to continue to use them even if, or when, the classes are restored to classrooms.

Virtual reality is one of the important means of digitalization. It is one of the ways of representing space. Spaces represented in virtual reality can exist in reality or can be virtually created. Physically existent spaces can be presented in virtual reality in real time, in a period from the past or in one frozen moment in time. Usually, devices for creation or recording and devices for viewing virtual reality are necessary. For recording or creating virtual reality special expertize is needed, while no knowledge is needed for viewing it. Application of virtual reality can range between many different areas. In tourism, nothing can replace the physical presence at the site, but virtual reality is the next best alternative. In entertainment, virtual reality is widely spread, and video games are one of the most used forms of virtual reality. In culture, the form of art tourism was especially popular during the lock-downs caused by the pandemic. In retail, this form of digitalization is gaining significance and market share. In education, virtual reality has a great potential, especially in particular fields, such as for training surgeons or pilots. One of the means of virtual reality are virtual tours and they will be discussed in the next chapter in more detail.

This paper explores the possible connection between the virtual tours and the teaching of architectural structures. Architectural structure is an integral part of any building. Thus, they are thought at all architectural study programmes. The main purpose of architectural structures is to provide stability for the buildings and resist loads. This is the area in which architects and structural engineers cooperate, since the structures need to be analyzed and their dimensions must be calculated, whilst their appearance, position and form can be very important for the overall quality of the building. Technological advancements have significantly helped in analysis and design of architectural structures. The design and analysis of complex architectural structures built in the world today would have been impossible without the use of computers and specially created software. To some extent,

[1] Programme of the Government of the Republic of Serbia, 2020, https://rsjp.gov.rs/wp-content/uploads/Ekspoze-2020.pdf *(visited 17 April 2022)*

the construction of architectural structures has also been modernized, especially through automation, and work is being done in the field of printing structures and research on new structural materials. However, not much progress has been done in innovating the teaching methods in this area. This finding motivated the research on updating the approach to teaching architectural structures, as part of architecture very different in nature from architectural design. This paper will provide information on virtual tours as one of the means of digitalization, and on architectural structures. It will then explore the connection between teaching architectural structures and virtual tours. Based on this, conclusions will be drawn and presented about possibilities and limitations on using virtual tours as an aid in teaching architectural structures.

2. VIRTUAL TOURS

Virtual tours are a type of virtual reality that is most commonly dedicated to showcasing places that exist in reality[2]. These places can be both interiors and outside spaces, including exteriors of buildings. These spaces are recorded at one moment in time, and can be viewed an infinite number of times at any given location. Devices for recording virtual tours can have different properties. Today, virtual tours can even be recorded with relatively simple smart phones. The next level recording devices, that also provide better quality of the tour, are omnidirectional cameras. These cameras have 360° field of view, and can be of different capabilities. The highest level of recording devices are cameras that also measure distance to objects. In this category, there are cameras that use infrared technology for determining distance, and the ones that have laser technology that provides higher precision. The devices for viewing virtual tours can also be divided into three categories: small screens, large screens and VR glasses. The first two categories are widely available and are mainly already in use for other purposes. "Small screens" used for viewing virtual tours are smart phones and tablets. Their biggest downside is the size of their screen, but on the other hand they are very easily transportable. Large screens provide better sense of immersion into the virtual reality, but are relatively fixed in position. Virtual reality glasses provide total immersion, but are not yet widely available and for small number of people they can cause discomfort while using them. Therefore, it is important to find the appropriate equipment for both recording and viewing virtual tours.

Recording and viewing are the first and the last step in creating virtual tours. There is an important segment in-between in which the virtual reality is actually made, for which software for creating virtual reality is needed. There are many available software packages for this purpose today. Some of the most popular are Cupix[3], Pano2VR[4], 3DVista[5], Kuula[6], Matterport[7] and Orbix 360[8]. Capabilities of these software packages are very different. While some of them only provide basic features, others are much more sophisticated. The elementary level of the capability is to connect the recordings of the space and allow for moving of the viewpoint from one point in space to another. The next

[2] Virtual tour of the Housing Exhibition in Niš, https://bit.ly/3r0Kvw1*(visited 17 April 2022)*
[3] https://www.cupix.com/ *(visited 10 April 2022)*
[4] https://ggnome.com/pano2vr/ *(visited 10 April 2022)*
[5] https://www.3dvista.com/en/ *(visited 10 April 2022)*
[6] https://kuula.co/ *(visited 10 April 2022)*
[7] https://matterport.com/ *(visited 10 April 2022)*
[8] https://orbix360.com/ *(visited 10 April 2022)*

level is to analyze the recorded data and create the floor plan of the recorded space. An even higher level is the ability to use the recoded data to create a 3D model of the recorded space. When using the top quality cameras with distance meters, this possibility seems natural, but in some software it is even possible to get 3D models from the data recorded with simple smart phones. This feature is enabled by using advanced artificial intelligence, and despite its lower accuracy compared to state-of-the-art cameras, it is truly remarkable. The possibility of creating 3D models of spaces generates completely new perspectives for development. This opens a space for data analytics, also a critical element in the field of digitalization. For example, the spaces do not have to be measured in reality, since they can be measured digitally in virtual reality. Additionally, spaces can be analyzed according to the objects they contain, their size, position or interrelations. On top of this, there is a possibility to digitally modify spaces in virtual reality. This is potentially the largest segment for using virtual reality in architecture. Starting from simple adding of objects or their deletion, this can be a quick way of producing new architectural designs. Other features are alteration of colors, materialization and textures. This can be perfectly connected with existing architectural tools for digital design of spaces. Such potentials are still not in use, but it is expected that they will be available in very near future.

3. ARCHITECTURAL STRUCTURES

It is considered today that there are three main components of architecture, and these are function, structure and form. This points to the importance of structure for architecture. The most traditional view of the relation between these components is that the function is most important. The structure serves the building by not interfering with the function and providing stability, while the form follows the function thus also making the form of secondary priority. However, it is now most commonly believed that the relation between these three components is not fixed and can vary for each analyzed building. Based on the type of the building and the architect's vision, one of the components can have the dominant role. This is usually easily noticeable. The structure is frequently the primary component in buildings with larger sizes and relatively simple function. Perfect examples of this are sport stadia. In such cases the form follows structure, or if the primary role is given to the form, than the structure will follow form. However, in order for the building to be completely successful, the function, the structure and the form need to be perfectly harmonized.

There are different ways to systematize structures in architecture. One of the recently popular criteria is the self-weight of the structure. In general, it is beneficial if the self-weight is lower, provided the load bearing capacity is not impaired [10]. According to this criterion, the properties of structures differ extremely. One of the heaviest types are flat concrete slabs that can have self-weight of about 5 kN/m^2. At the other end of the spectrum, modern tensile structures have self-weight in the range of 0.01 kN/m^2 [17,18]. This enormous difference results in completely different structural requirements, behavior of the structures and dominant forces [8]. Another criterion for differentiating between structures is that of the types of used structural elements. Simple structural elements are linear and planar, and can be further developed either by combining or bending in space. Hence, the structural systems made out of these elements can be divided to linear and space-surface systems. One more possible criterion is the construction technique. In this sense, structures

can be divided into those made on site, partially prefabricated and prefabricated. With the increase of automation, more and more structures are now being prefabricated at least to some degree and fully prefabricated where this is possible and economical.

The role of architectural structures has developed significantly and needs to be elaborated here. The main functions of architectural structures are listed and discussed in the following paragraphs:

- Load bearing. This is the primary role of architectural structures and their first reason of being. Architectural structures provide stability of buildings under different external loads [2]. Most common loads are wind, snow seismic and dead loads. Expected loads are analyzed and based on the analysis appropriate structures are chosen. The loads are transferred through different structural elements to the ground [5].
- Partitioning. In addition to resisting external loads, architectural structures also provide partitioning. Partitioning can be horizontal, where vertical structural elements, usually walls, divide space, and vertical where horizontal elements such as slabs or roof divide space. Another type of partitioning is done according to position, so there is external partitioning where structure provides a limit to the interior space, and internal partitioning where interior is divided into smaller spaces.
- Protecting. Architectural structures provide protection from the sun, rain, temperature, moisture and sound. Although it is usually believed that exterior skin of the building provides all the protection, this is not always the case. For example, the interior partitioning structure should provide acoustical protection. In addition, some parts of the building could have different designed temperatures from the others and rely on interior structure to provide thermal resistance. This segment is very important in the context of energy efficiency and much work has been done in this area. Some of the measures for reduction of energy consumption include implementing Trombe wall [15], double skin [7] or improvement of building envelope characteristics [12] and can result in reduction of CO_2 emission [13].
- Esthetical. This role of the structure is the least utilized among the listed functions. There are cases when the structure is so well fitted into the building that it perfectly completes its three previously mentioned roles, but is not visually attractive. Opposed to visually neglecting the architectural structures is the example of using them as works of art. For such structures the first three mentioned roles are of no importance and they exist only for their attractiveness. Between these two extremes there are many examples where architectural structures, in addition to fulfilling their other roles, also add important esthetical value to the buildings [3,4].

While all architects have understanding and knowledge about architectural structures, what remains unresolved is how detailed this knowledge should be. One thing is certain, the better the architect's knowledge in architectural structure is, the easier his collaboration with the structural engineers will be [11] and more value will be extracted from architectural structures as a necessary component of any building.

4. Teaching Architectural Structures at the Faculty of Civil Engineering and Architecture

The Faculty of Civil Engineering and Architecture has a relatively long history of more than 60 years of teaching architectural structures. Up to date, more than 5000 engineers earned their degrees in Architecture and Civil Engineering in Niš. Many

architecturally important buildings projects included students from this faculty in their project teams, confirming that students received high quality level of conventional education in architectural structures. Some courses at the faculty already applied advanced teaching methods in their classes [14]. So far, novel educational methodologies including virtual tours are not implemented for teaching architectural structures at the Faculty of Civil Engineering and Architecture in Niš.

4.1. Faculty of Civil Engineering and Architecture, University of Niš

What is now the Faculty of Civil Engineering and Architecture in Niš was first founded in 1960 as the Faculty of Technical Sciences, even before the University of Niš was established in 1965. The Faculty changed its name in 1970, into the Faculty of Civil Engineering. In 1998 it got the name it still has today – Faculty of Civil Engineering and Architecture at the University of Niš. From its very beginning the faculty had a study programme in Architectural Structures. Unfortunately, this study programme was ended in 1968 and eventually replaced with the new, similar programme, Structural Engineering. This study programme was superseded with Architecture programme in 1995 [1]. For several years the faculty also offered a Master's programme in Architectural Structures, but it has eventually been canceled. Right now subjects related to architectural structures are being taught mostly as a part of the Architectural study programme throughout the five-year studies.

4.2. Chair for Architectural Structures

All the courses related to architectural structures at the University of Niš are under the jurisdiction of the Chair for Designing Architectural Structures at the Faculty of Civil Engineering and Architecture. At first, this chair was a part of the Chair for Architecture at the Faculty of Technical Sciences until 1968. From 1968 to 1972 this chair was named Chair for Architectural Structures. After this, a few chairs were merged to form Chair for Designing, Urban Planning and Architectural Structures. Since 2005 this chair again becomes independent under the official name Chair for Structures and Structural Systems of Architectural Buildings. Many reputable professors served as the Head of this chair including professor Desimir Dančević, professor Zoran Radović and professor Milisav Damnjanović. Current Head of the chair is full professor Veliborka Bogdanović, and professors of the chair teaching courses in Architectural Structures are full professor Dragan Kostić, associate professor Miomir Vasov and assistant professor Vuk Milošević, with assistants including doctors, doctoral candidates and student fellows.

Since architectural structures are closely related to engineering and the Faculty of Civil Engineering and Architecture had study programmes in engineering and very eminent teaching staff in this field, more than usual emphasis was given to architectural structures. This is usually not the case at faculties that are specifically oriented only towards architecture, because in these cases architectural design or urban planning are paid the greatest attention. However, the approach applied by the Faculty of Civil Engineering and Architecture has proven extremely efficient in practice. Students graduated from this faculty showed remarkable practical skills and were able to work effortlessly with structural engineers around the world. The method of investing more attention to engineering logic than the artistic talent has so far provided architecture students with important competitive advantage at various construction projects.

4.3. Architectural Structures Courses

The Chair for Architectural Structures is in charge of over 30 courses offered at the Faculty of Civil Engineering and Architecture. The courses are mostly part of the five-year Architectural Study programme, but also part of the Bachelor's programme in Civil Engineering, Master's programme in Civil Engineering, Bachelors programme in Construction Project Management and Doctoral programme in Architecture. In these courses video materials are used as teaching aid. Some of the courses are mandatory, while others provide deeper exploration into the topics and are elective. The chair's courses are divided in four large groups:

- Macro designing of Architectural Structures – includes courses Structural Systems 1 [9], Structural Systems 2 [6], Prefabricated Structures 1, Prefabricated Structures 2, Structural Systems and Assemblies, Architectural Structures 3 and others.
- Micro designing of Architectural Structures – includes courses Introduction to Architectural Structures, Architectural Structures 1, Architectural Structures 2, Civil Engineering Structures 1, Civil Engineering Structures 2, Façade Structures and Forms, Finishing in Construction and others.
- Energy Efficiency of Buildings – includes courses Building Physics [16], Energy Efficiency of Buildings, Bioclimatic Architecture 1, Bioclimatic Architecture 2, Green Building and others.
- Other courses – including Real Estate Management, Architectural Design, Sacral Architecture and others.

The courses of the first two groups are directly related to architectural structures. The aim of the courses from the first group is to teach students how to arrange the disposition of structural elements in order to form architectural buildings, most commonly with medium and large spans. The students study the approximate dimensions of the structural elements based on their function and placement within the building, possible connection types between the structural elements and different systems, and forms these elements can create. Structural analysis of these buildings is not a part of these courses, although it is expected that students understand how different loads are transferred through structural elements, and how these elements react to loads.

The courses from the second group are dedicated to smaller buildings or specific parts of architectural structures. The focus is on designing foundations, walls, slabs and roofs with smaller spans. Students are introduced to different construction techniques. Particular parts of the buildings, such as doors and windows, are discussed in detail. Students are taught to design different types of staircases. Layers of walls and slabs are thoroughly discussed and measures for protection against ground water and moisture are explored, along with some measures for providing acoustical comfort. Additional acoustical and thermal protection measures, including teaching of related calculations are a part of the courses from the third group.

5. Virtual Tours in Teaching Architectural Structures

With the topic of virtual tours and topic of architectural structures presented independently, the possibilities for their connection can be explored in the following sections. The written form of this paper presents an important obstacle in showing all the possibilities of this synergy, since it does not allow for showing all the qualities virtual tours have. Due to

the dynamic and interactive nature of virtual tours it is not possible to represent their value by showing pictures in this paper instead of the virtual reality, as pictures are a much more rudimentary form of representation. Therefore, the potential for using virtual tours in teaching architectural structures will be elaborated in textual form. First the benefits and opportunities of such an approach will be discussed. The authors find it very important to also investigate the possible downsides of such an approach, because without knowing them, it would not be possible to use this approach appropriately and successfully. Therefore, the problems and limitations will also be investigated and presented.

5.1. Benefits and Opportunities

In teaching architectural structures, visits to construction sites are even more important than they are in teaching architectural design. This is mostly due to the fact that architectural design is a form of art, while design of construction requires application of established rules and processes. However, there are many difficulties in organizing such visits, especially for larger groups of students and during the times of pandemic. Virtual tours solve many of these difficulties. The basic idea is that virtual tours should be used in order to show important architectural structures or their parts to students. The students would then have the possibility to walk around through virtual reality and explore the details and individual parts or the whole structure. Ideally, not only the finished complete structure would be available, but also the possibility to browse through different construction stages of the same structure. This would necessitate having several virtual tours or combining them into one tour.

Today the level of detail and the quality of representation virtual tours offer are excellent and can fully be a replacement for visiting the site physically. Furthermore, visiting of construction site by students is possibly an issue for the construction process or the construction workers. The time and duration of the visit should be carefully planned. In case the virtual tour is used instead of the physical visit, the site can be visited at any time, the duration of the visit can be infinite and the visit can be repeated an infinite number of times. Also, there are no safety risks that exist at the construction site. All of these are huge advantages for the students. Additionally, construction stages only last for certain periods of time, and cannot be repeated on the same site. Contrary to this, if these phases are recorded in virtual reality, they can be accessed at any time in the future.

When organizing physical tours there is inevitably also the factor of costs. The construction site can be far away, which also requires additional time for travel. In some cases, the construction site can be totally unavailable for visits, for several reasons, such as short construction time, huge popularity, or inaccessible places or countries of construction. Other difficulties could also be related to the fact that the construction does not exist anymore, for any of the possible reasons, that the structure of the building is not visible, for example when it is covered with other elements, or that the phase that is of interest for the lecture is already completed in the past. Once again, virtual tours provide solutions to all of these problems. Most virtual tours are web based, so they are only a few clicks away, thus saving travel time and costs. Virtual tours can be created with no obstruction to the construction process. Once created, the tour can be always available to show the specific time point and stage of the construction, and if several tours are made at different times, than a timeline can be created and specific elements can be viewed at different construction stages.

Finally, it is important to point out how easy to use virtual tours are and what their benefits compared to other means of representation are. As previously stated in the introduction, no knowledge in virtual reality is necessary for viewing virtual tours. It will come completely naturally to students that already have skills in creating digital models of their architectural projects. In addition, it can be viewed on devices that architecture students already have, such as smart phone devices and computers. The important question is: why not make a photographic record of everything previously stated? Virtual tours are not just a more modern form of representing spaces compared to photographs or even videos, they are also much more advanced. While photographs are still, virtual tours enable moving through the space, focusing on different parts or the whole. Videos can provide great insight if the information about conducting a construction process is important, but they do not give the viewer any freedom to select her focus, move or view the wider picture. It is not just that virtual tours provide much more data, they can also be used for much more broader purposes, as explained in the section about virtual tours. Lastly, virtual tours allow for creation of 3D models which are of great importance in understanding architectural structures.

5.2. Problems and Limitations

One of the important limitations of virtual tours is that they do not allow for recording of time flow. This limits the possibility to record how certain construction operations are undertaken in real time. Such a possibility would be of greater importance when training construction workers, then when educating engineers and architects. However, it is important to acknowledge this limitation. There are ways to mitigate this by creating virtual tours at the beginning and the end of each phase. Nevertheless, for this specific purpose, it would be better to create videos instead of virtual tours.

Benefits of the virtual tours compared to physical visits are elaborated in the previous section, however, creation of such virtual tours also needs careful planning. It is important to mention that creating virtual tours during construction stages of already built structures is not possible. In order to have such tours, plans must be made to record virtual tours during the construction of new buildings and structures. This requires permits from the construction companies and hiring of experts in recording and production of virtual tours. Creation of such tours also incurs costs for personnel and software licenses, but on the other side, most of the software packages provide free viewing of tours.

Lastly, everything necessary for creation and production of a virtual tour must be available. This means that there should be available experts for recording and production of virtual tours, the equipment and devices for recording and production need to be obtainable, and the software for recording and production should be at disposal. Only a few years ago all of this was very scarce or completely unavailable. However, today all of these are much more available and affordable. In the near future, it is expected that this problem will be completely eliminated.

6. CONCLUSION

This paper presents results of the research about the possibility of using virtual tours as a tool in teaching architectural structures. Architectural structures are a specific part of architecture that is very different from architectural design. Structures are necessary for

every building and they have several distinctive roles. Teaching of architectural structures has not changed significantly in the past decades. One of the important parts of teaching architectural structures that allows for better understanding of theory are visits to construction sites. In cases when this is not possible, photos or videos from construction sites are presented to students. With the development of new technologies, digitalization of spaces also became possible. Virtual tours are one of the ways to digitalize physically existing spaces. The idea of innovating teaching methods of architectural structures by utilization of virtual tours has been created and explored.

Advantages and disadvantages of using virtual tours in teaching architectural structures were examined. Particularly, a possibility of replacing physical visits to the construction sites with virtual tours was analyzed. It was concluded that this approach would bring many benefits. The site can be virtually accessed easily and fast at any time, and it can be viewed as many times as needed. There are no costs for viewing the virtual tour. Many sites can be viewed virtually during the same amount of time as needed for visiting the site physically. Virtual tours can show construction stages, as well as the structures that are no longer visible or do not exist anymore. They provide much more freedom to the viewer compared to photographs or video, while having excellent viewing quality, and are much more informative. Nowadays, 3D models of recorded spaces are also created and can be further edited. However, some limitations need to be taken into account. Recording and production of virtual tours may still be costly. They also need to be planned in advance, so that different phases of construction are recorded in different virtual tours. Finally, experts, equipment and software must be available for use.

With all the presented arguments in mind it can be concluded that virtual tours are a promising tool for easier understanding of architectural structures. The advantages of virtual tours as a teaching aid are numerous, and even more significantly, have a huge development potential. On the other hand, the disadvantages are few and expected to be reduced soon with the future development of technology and the expected reduction of costs. Based on such conclusions, it is proposed to include virtual tours, in addition to already used short videos and other novel educational methods, in teaching of architectural structures at the Faculty of Civil Engineering and Architecture of the University of Niš.

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NASTAVA ARHITEKTONSKIH KONSTRUKCIJA UZ POMOĆ VIRTUALNIH TURA

Arhitektonske konstrukcije su jedna od osnovnih komponenti arhitekture. Zbog toga se one izučavaju na svim studijama arhitekture. Građevinsko-arhitektonski fakultet Univerziteta u Nišu nije izuzetak od ovog pravila. Sa dugom istorijom i velikim znanjem u oblasti građevine, ovaj fakultet daje učenju konstrukcija na značaju čak i više nego drugi fakulteti, što se pokazalo kao velika prednost za njegove studente. Sa usponom i razvojem novih tehnologija, inoviraju se i arhitektonske konstrukcije. Međutim, nove metode u nastavi arhitektonskih konstrukcija se još uvek ispituju i za sada ne postoji jasno određen pravac u inoviranju pristupa izučavanja arhitektonskih konstrukcija. Ovaj rad je deo istraživanja o mogućim načinima i sredstvima koja bi bila korišćena za unapređenje nastavnih metoda u oblasti arhitektonskih konstrukcija, u skladu sa savremenim tehnologijama.

U ovom radu će najpre biti predstavljena motivacija za inoviranje učenja arhitektonskih konstrukcija u kontekstu digitalizacije. Zatim će biti analizirane i diskutovane virtualne ture, kao jedan od vidova digitalizacije. Potom će tema arhitektonskih konstrukcija biti ukratko predstavljena i sistematizovana. Uz to, biće prikazana i nastava iz oblasti arhitektonskih konstrukcija na Građevinsko-arhitektonskom fakultetu u Nišu. Na kraju će biti istražene mogućnosti za primenu virtualnih tura u podučavanju arhitektonskih konstrukcija. Posebna pažnja biće posvećena analizi prednosti, ograničenja i mogućih problema ovog pristupa. Na osnovu ovoga biće doneti i zaključci o mogućnosti korišćenja virtualnih tura u nastavi arhitektonskih konstrukcija.

Ključne reči: *virtualne ture, arhitektonske konstrukcije, edukacija, arhitektura, nastavni metod*