

Investigating a narrative architecture

Mackintosh's Glasgow School of Art

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In this paper a theoretical approach and a methodology to investigate and document a narrative architecture will be presented. In the architecture field the word narrative is often used in reference to ways of representing or telling the story of a project. Within the context of this research with the expression "narrative architecture" the authors mean an architecture that, like a book, tells a story through its material and immaterial characteristics. In order to analyze the selected characteristics of a narrative architecture, a possible approach is represented by a digital 3D reconstruction and a critical analysis of the digital model produced. The digital reconstruction process and the theoretical background have been applied to a case study, a masterpiece in the history of architecture: Mackintosh's Glasgow School of Art. Several graphic works have been created to communicate the main characteristics of this narrative architecture. The research project attempts to explore ways to study and explain existing buildings from new and innovative points of view, but at the same time it can trigger important reflections in architectural design and education.

Keywords: *Digital reconstruction, narrative architecture, representation and visualization, critical analysis, 3D modeling*

MOTIVATION

In any good work of architecture (including vernacular architecture, hence not only works designed by professional architects) the aesthetic, constructive, functional and cultural aspects should always be balanced. Superficial implementation of the theories elaborated during the modern movement by many architects after the Second World War and the recent focus on only a few sustainability issues (such as en-

ergy savings) at the expense of other considerations, have caused a gradual aesthetic and cultural impoverishment of many new buildings. A building can be functionally efficient but at the same time uninhabitable because it may create discomfort to its inhabitants. The aesthetic-cultural aspects of a building are certainly more difficult to evaluate compared to computable parameters such as energy consumption because they require a holistic approach and do not

present well defined boundaries, therefore a unique interpretation and solution does not exist. Following Bernard Tschumi, we believe that even if architecture has to do with the building activity, it can't be reduced to it; it is instead a series of concepts added to the building (De Michelis 2003). The best architecture designed and built throughout the course of history on any continent, in addition to responding to specific functional requirements, bears aesthetic-cultural qualities that communicate meanings and ideas that make the architectural experience meaningful, exciting and pleasant. A possible way to comprehend these qualities, in order to reproduce them in new buildings, is through an in-depth study of architectural precedents. This research path should avoid the pitfalls of approaches mainly focused on architectural styles and shapes. In this paper a different way of reading buildings is proposed, focusing on their narrative qualities.

NARRATIVE ARCHITECTURE

The word "narrative" is usually used within fields such as literature and cinema and it has been diffused in the architecture field since the mid-1980s (Coates 2011). Recent research and publications have explored its connections with architecture (Psarra 2009; Coates 2011), with slightly different interpretations. In the architecture field the word "narrative" is often used in reference to ways of representing or discussing a project. Within the context of this research project, with the expression "narrative architecture" the authors mean an architecture that, like a book, tells a story through its material and immaterial characteristics such as the morphology, the constructive choices, the materials, the arrangement of spaces, the lighting system, the colours, the decorations and so on. The story can be intentionally told by a piece of architecture, namely the architect through the architecture gives hints of his/her intention for the story. All the elements chosen by the architect should be functional and coherent to the story that he/she wants to tell. However, the visitor can interpret the building, and hence the story, with a cer-

tain degree of freedom, because the building can also tell something that wasn't originally planned by the architect and the same elements can be interpreted in slightly different ways. Moreover, over time, a building may be subjected to interventions that can slightly change the original design of the architect, alterations that can also influence the narrative of the piece of architecture. Many similarities exist between a book and a building, in effect both have an author and a visitor/reader. Furthermore, an architecture, like a tale, is also realized to provoke reactions and emotions.

OBJECTIVES OF THE RESEARCH

The main objectives of the research are the followings:

- to define a theoretical framework, methods and tools to investigate a narrative architecture;
- to test the theoretical approach and the methodology previously elaborated on a case study and document its narrative characteristics.

The investigation, documentation and communication of narrative architecture is interesting for several reasons:

- to improve and deepen our understanding of aesthetic, constructive, functional and cultural values of architecture;
- to represent, communicate and disseminate the aforementioned values and increase popular awareness of this approach to architecture. The understanding and appreciation of these aspects can help to make people aware of the importance of safeguarding architecture for present and future generations.

Furthermore, this research and its outcomes will be useful in education and practice, representing a

methodology to study different kinds of architecture and to design new buildings. To reach the intended objectives, digital technologies will be used because, as demonstrated in other research by the authors, they allow us to reveal aspects of the buildings impossible to perceive from traditional drawings and models alone.

OUTLINING A THEORETICAL FRAMEWORK TO STUDY A NARRATIVE ARCHITECTURE

A building is a complex system, a fusion of material and immaterial characteristics. Much like a book, a piece of architecture can be read and interpreted in many ways but, considering its complexity, it is necessary to use a holistic approach, a fusion of theories, methods and tools to properly analyze and document it. Hence, in this research paper the word "fusion" is interpreted in two different, but interrelated, ways. It should be noted that the aim is to read mainly those aspects that generally can be perceived through direct experience of a building. However, it is clear that the final result of a work of architecture is also influenced by many other aspects linked to society, politics, economics, religion, cultural movements and so on. Taking into account our objectives, which material and immaterial characteristics of an artifact should be analyzed? Considering the definition of narrative architecture that we have previously stated, in which way and through which elements can an architect tell a story and communicate specific meanings? According to what has been stated and written by various scholars, including Bruno Zevi (1957), space has been considered as the main characteristic of architecture. It is possible to experience a building's space by moving through the various spatial units that constitute it. This sequence of spaces can be explored using various trajectories. Everything looks very much like the concept of narrative path. In fact, a narration is characterized by the exposition of an event and its temporal sequence that can be chronological or not. In our case the event is represented by the piece of architecture (in all its aspects) while its temporal sequence

is constituted by the spatial arrangement of the various rooms. The spaces are discovered and experienced in sequence, then the architecture is revealed like the plot of a story and conveys emotions while it discloses itself. But unlike a written story, a narrative architecture usually has an open structure that does not require a specific sequence to be followed in order to read it. The same concept of narrative architecture suggests an operational methodology to analyze it. The first analyses should affect all the aspects strictly linked to space and movement, namely:

- Spaces: dimension and shape of the various spatial units, this characteristic directly affects the shape of the envelope and of its inner partitions (for example, walls);
- Connectivity: connections between the various spatial units;
- Functional arrangement: organization and placement of the various spaces;
- Movements: dynamic of movement that uses horizontal and vertical paths to connect the various spaces.

To these characteristics linked to the spaces, other elements that help to highlight, strengthen or enrich the story that the designer wants to tell and suggest are added. All these new aspects can be observed and/or experienced through direct knowledge of the piece of architecture. The characteristics considered most relevant in this case are the following:

- Constructive system: the constructive technology used (the assembling system and so on);
- Materials: the materials used, their position and their surface treatment;
- Light: the natural and artificial lighting sources, shadows;
- Decorations: the various decorative elements used;

- Colours: the kind of colours used and where they are employed.

The selected characteristics represent the main aesthetic, constructive, functional and cultural aspects that contribute to telling the building's story. The importance during an architectural experience of some of the previously mentioned characteristics (together with solids and cavities, scale and proportion, rhythm, and other architectural aspects) have been described in Rasmussen (1962). To study a narrative architecture hence it is necessary to also study its structure, the elements that constitute it, as both aspects (narrative and structure) are strictly connected to each other. Generally the constructive solutions should be used to translate an idea in a spatial conception. Taking into consideration the quantity and the variety of the required analysis to study a narrative architecture, which approach should be adopted?

DIGITAL RECONSTRUCTION

In order to analyse the selected characteristics of a narrative architecture, a solution is represented by a digital 3D reconstruction and a critical analysis of the digital model produced. The validity of this approach and methodology for comprehending various aspects of buildings has already been proven by one of the authors in different case studies (Di Mascio 2013). The objective of the digital reconstruction is the realization of a 3D model, that offers the possibility of analyzing a high number of aspects of the piece of architecture. But the digital reconstruction is a process that has autonomous value, independent from further analysis. As Frischer (2008, available at [1]) states: <<Models not only illustrate what we knew when we started creating them, they also have the potential of revealing new knowledge that was always lurking below the surface of the facts but which, to emerge and be grasped, needed to be visualized in 3D.>> Hence, the same reconstruction process contributes to deepening and broadening knowledge of the artifact. This is an interactive process, because, after the analysis and interpretation of the available

documentation related to an artifact and during the digital reconstruction phase, the scholar can verify the correctness of his interpretations: hence he receives feedback from the model and reacts accordingly. During the realization of a digital 3D model it is essential to select a particular level of abstraction useful to achieve the selected objectives. A synthetic model allows us to exclude unnecessary information in order to focus only on the narrative characteristics. The digital reconstruction process and the theoretical background previously described have been applied to a case study: Mackintosh's Glasgow School of Art.

THE CASE STUDY: THE GLASGOW SCHOOL OF ART

General description

The art school is located in Glasgow, Scotland, and it was designed in two different phases. Even if a visitor is unaware that the building was designed and built in two different periods, the reading/observation of the exterior can trigger his/her interest and curiosity, as the building tells something about this aspect: each of the four façades are completely different from one another. For the design of many architectural elements (windows, doors, etc.), Mackintosh took inspiration from Scottish vernacular houses and castles, but he also got design ideas from other sources such as Japanese architecture. The building represents both a school of art and the Glasgow School of Art, namely a specific building, located in a particular place in a certain city, in a particular culture at a given period of time (MacMillan 1988). The building is considerable in size and it is composed of five main floors (from the sub-basement up to the second floor), plus mezzanines. From the outside it appears as a mysterious fortress and inside it presents a magical atmosphere, suited to a place where art is produced. The variety of constructive solutions, spaces, decorations and types of light, make the GSA a building rich in moments of experience (Figure 1) and worth an in-depth analysis with new methods and tools. Even if the overall atmosphere and characteristics of the

Figure 1
Pictures of the
Glasgow School of
Art (from left to
right): the West
Facade, the
Museum and the
East Facade (Source:
personal archive of
the author).



building remain close to what they were when it was built, there are a few differences that influence the experience of the art school, for instance non-original doors inserted at the beginning and at the end of the corridors (Buchanan 2012) that interrupt spatial and visual continuity.

In this paper, the first step of the research project will be presented, namely the digital reconstruction (still ongoing) of the building's spaces, paths and technical elements. Unfortunately, because of an unlucky event (the explosion of a projector in the basement of the building) that caused a ferocious fire on the 23rd of May 2014, the west wing of the School has been heavily damaged. During the fire, particularly important rooms were destroyed, such as the famous library (an art-nouveau jewel), the lecture theatre and Studio 51. Therefore work on this case study will be even more valuable. The authors had the opportunity to directly experience the whole building throughout many inspections during one of the co-authors' period as Visiting Researcher at the Mackintosh School of Architecture (MSA) in 2013, looking at key areas and details, including many that were lost in the fire, in a critical way and documenting them with sketches and pictures.

Methodology

The methodological process can be synthesized in the following main phases:

- Collection of documentation;
- Analysis of the collected documentation;
- Digital reconstructions (interpretation, modeling and organization of the elements);
- Representation and organization of the information.

Collection and analysis of documents

One of the main issues that arose at the beginning of the research was in regards to which version of the building should be modelled: as designed, or as built, and at what date. Taking into account the main objective of the research (that also requires a physical experience to understand and document the perceptual characteristics), we decided to model the GSA as close as possible to its current state. The absence of either CAD drawings or a complete set of traditional drawings reflecting the current status of the building, led the authors to use and match various sets of drawings collected from different sources, namely: plans, elevations and sections of the design proposal, dating back to 1910; a new set of 2D drawings made for

a publication in 1993 (Macaulay 1993), three longitudinal sections (hand drawn) created for a dissertation at the Mackintosh School of Architecture, and a physical 3D model currently located in the GSA shop and described in Robertson (1995). This documentation has been complemented by continuous on-site inspections. To organize and manage the collected documents a metafile has been created.

Digital reconstruction of the Glasgow School of Art

The collected and scanned drawings were imported into AutoCAD to redraw them and create a vector basis for the digital 3D reconstruction. In the 2D CAD environment, after placing the drawings in correspondence between them, thanks to the support of vertical and horizontal axes, it was realized that many discrepancies were presented. Taking into consideration these issues and the different selected elements that compose a narrative architecture, instead of drawing the architectural/technical elements, the authors first chose to draw the volumes of all the spaces. This choice was made in order to obtain a first general idea of the morphology of the whole building, and an overview of the volumes of the spatial units and their relationships and hierarchy. This process was accomplished creating a sort of virtual paper model of the building, putting together a set of 2D planes, each one with a cut off scanned draw-

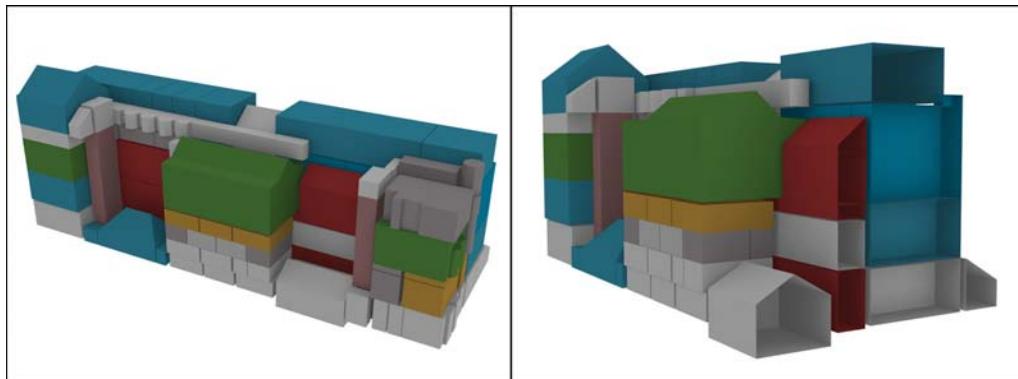
ing (plans, elevations and sections), arranged in the proper position. The completed paper model was used as a basis to create the volumetric model (Figure 2). During the next step, different colours were assigned to each individual spatial unit to highlight the different functions of the spaces (Figure 3).

The modeling process then focused on the individual spatial units and precisely on those elements that due to their shapes, materials, and constructive characteristics can catch visitors' attention and hence attract their interests during the path. These elements can be defined as 'narrative episodes'. The CAD drawings produced and prepared in AutoCAD, specifically the first floor plan and one section, were imported into Rhino and used as a reference during the modeling phase. A 2D-3D drafting software package like Rhino was used instead of a 3D modeler like 3DSMax, because more precision was needed as well as better control of the geometric shapes during the redrawing process and because during the digital reconstruction phase, the 2D drawings in the same working environment are being continually updated. During the digital reconstruction process, because of the complexity of the building, it has been essential to undertake many inspections of technical elements and diverse unclear details and to document them with pictures, sketches and metrical surveys. Hence the authors decided to concentrate on



Figure 2
(left) the digital model realized with the scanned drawings; (right) the volumetric model under construction.

Figure 3
(left) the volumetric model with the colours that highlight the different functions of each single spatial unit; (right) a section of the volumetric model that shows the different shapes of some spatial units.



the core space of the GSA building, namely the Museum located on the first floor. The Museum in addition to being a connection node is a spatial and narrative episode. The visitor goes into the entrance hall that is a narrow space, a bit oppressive with its vaults, and relatively dark, but immediately his/her attention is caught by the light that floods down the central stairwell. This light is an invitation to come up and discover a huge space that the visitor could never imagine before. The main element that characterizes this huge exhibition space is its ceiling, and in particular its roof timber trusses. This distinctive element, like all the other roof trusses presented in the other places in the school, present a specific design solution; Mackintosh, in fact, avoided standard engineering iron components. The precision tools in Rhino were very useful to model the different timber components, 37 in total, that constitute each roof truss. The elegant shape of the roof trusses does not represent a simple reply to structural needs but it is evident that they also have an aesthetic quality expressed through their details (hearts cut into them), shape, materials and constructive technique. With the latter aspect we specify how the single pieces are connected together, because this aspect also affects the aesthetic quality of the technical element and hence of the space and of the narrative experience. These details are like the sentences in a novel, the quality of writing affects the quality of the narration. The

same approach has been used to model and investigate the paths, the other spaces and their characteristics.

Representation of the information

A piece of architecture cannot be described through a single method and a single tool. Every representational method fills the gaps presented in the others. The 3D models have also been created taking into consideration which graphic works have to be prepared. All the spaces have been classified in a scheme with information about their dimensions and shapes. Through this representation it is made evident that the story told by the shape of the sections of the spaces is much more varied and exciting compared to the one told by the shape of the plans, mainly rectangles. Many diagrams and drawings were prepared to represent and communicate paths and movements inside the building. The main paths have been represented with both 2D plan view and 3D rendered views. For technological details such as the roof trusses, different analytical drawings have been prepared, including axonometric exploded views, to appreciate the formal and constructive characteristics inspired by the Japanese joints, and a rapid prototyping model has also been manufactured directly from the Rhino file (Figure 4). With all the graphic works produced, a visual narrative will be prepared.

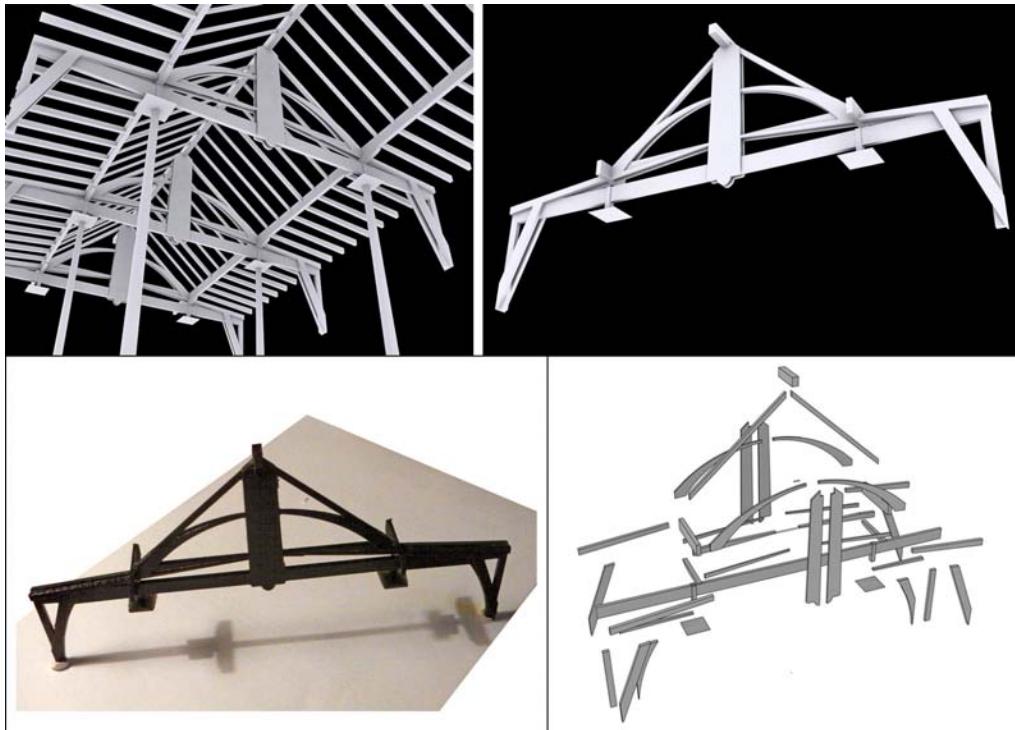


Figure 4
 (upper left) 3D digital model of the whole roof structure of the museum; (upper right) rendered view of the roof truss; (lower left) rapid prototyping model of the roof truss; (lower right) exploded view of the roof truss.

DISCUSSION OF THE RESULTS

The concept of narrative architecture, together with the methodological framework that has been elaborated to analyse it, has proven to be effective to comprehend in a proper way the main qualities of the Glasgow School of Art designed by C.R. Mackintosh. The direct experience of a piece of architecture is an invaluable moment because it allows one to comprehend the building through the senses, hence to enhance the understanding of many important aspects before and during the process of analysis. The digital reconstruction process of the GSA (still ongoing) and the digital 3D models produced thus far allowed for an in-depth study of some of the main aspects that characterize a narrative architecture, namely: spaces, functional arrangement, con-

nectivity, movements and constructive characteristics of a few important technical elements. The 3D model gives a comprehensive overview of the interior and the exterior of the whole building, which is impossible to have with direct experience alone; in fact through a 3D model, it is possible to have a visual overview of the entire piece of architecture. In this way, the model is confirmed as a precious interpretative tool and not a mere representation. The volumetric model that shows all of the spatial units, gives an immediate view of the shape, dimensions, position and function of each individual space and proves its usefulness in understanding the relationship between the various spaces located on different floors. During the digital reconstruction process it was possible to hypothesize and test constructive/technical

solutions adopted in certain points, defined narrative episodes (for instance the roof timber trusses and the main window in the director's room), which could be difficult to analyze and document in other ways because of their difficult geometry and shape. During the digital reconstruction work, major technical and management issues have also been overcome, thanks to the high number of 3D elements in the model. The 3D models, together with the other analytical drawings, document and communicate new and in-depth information on the Art School that despite the vast number of publications on Mackintosh and his masterpiece, have never been analysed or shown before, therefore it is original content. It is impossible to make a single physical model that presents at the same time a high number of interior and exterior details. Furthermore, a physical model is difficult to modify and update and it limits the number of analyses that can be undertaken, except for the ones planned at the beginning of the work. In contrast, a digital 3D model does not present any limit, it is open to any new modification and update and it can be enriched with different kinds of information. The digital model representation can also serve as the base to produce other digital models and analytical drawings; in this way there will always be a metrical correspondence between all the graphic works, hence a higher precision and clarity in the documentation and communication of the different aspects. A 2D - 3D drafting software program like Rhino turned out to be a proper solution in this kind of digital reconstruction. This software presents a rich set of tools that are very useful for managing and creating every kind of shape; for this reason Rhino is very frequently used in fields such as industrial design and marine design. Various aided tools (such as a wide number and type of snaps), absent and not effective inside pure 3D modeling software packages, have been very useful to overcome the discrepancies between the different drawings and the geometric complexity of many technical elements in the Mackintosh building. Furthermore, Rhino allows the creation of rapid prototyping models directly from the

digital 3D model with the aim of exploring and communicating the building characteristics for a possible future exhibition. The set of models and graphic works (both those already produced and those yet to be produced) will be used to create a visual narrative to tell the narrative architectural story of this building. In past centuries, the model has always been the most understandable representation of a building for people outside the field of architecture, for this reason it also has its own inherent value as autonomous work. It is planned to use the same model within a game engine to investigate and document the experience of the space. As already stated and investigated by one of the authors, videogames with a first person viewpoint allow for movement inside a space and observation in real time, providing an experience and a freedom of movement much closer to reality (Di Mascio 2010). This aspect will be further developed in future papers.

CONCLUSIONS AND FUTURE DEVELOPMENTS

Within this research paper, theories, methods and tools to analyse narrative architectures have been investigated, elaborated and proposed. The whole methodological process requires objective and subjective interpretations. With this paper the authors aim to highlight the importance of understanding the narrative aspects of architecture, including perceptual aspects in addition to material ones, in order to improve the quality of the architectural experience and hence of our daily life. The cultural aspects will be explored in greater depth in future papers. The core idea is the re-reading of the architecture in our historical and contemporary built environment using a new angle, not limited to the functional aspects. The creation of a 3D digital model opens new opportunities in the analysis and communication of architecture. The digital reconstructions make evident the main elements of the narrative architecture namely: paths, spaces, the hierarchical relationship between the various spatial units, the aesthetic-constructive qualities of some elements and so on.

Traditional representational methods and tools alone are insufficient for analysing and communicating the characteristics of a narrative architecture appropriately, whereas when starting from the space, new tools made available by digital technologies allow various paths of analysis. As the case study, Mackintosh's famous Glasgow School of Art, demonstrates so well, masterpieces pertaining to the history of architecture are like the classics of literature: they always have something new to say (Calvino 2013). In fact during a re-reading of a masterpiece it's always possible to discover something meaningful. The research project attempts to explore ways to study and explain existing buildings from new and innovative points of view, but at the same time it can trigger important reflections in architectural design and education. The same methodology will be applied to two other buildings of the GSA campus, the Bourdon building (current home of the Mackintosh School of Architecture) and the new Reid Building designed by Steven Holl, officially inaugurated on the 9th of April 2014. A comparison between these three buildings is also part of the research schedule. During the next phases of the research endeavour a further in-depth analysis and development of the theoretical, methodological and experimental approaches will be considered. The theoretical and methodological approach that has been developed in this research is suitable to analyze the narrative of other architectural works around the world. The same approach can be also used to analyse damaged, unbuilt or lost buildings.

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