

The Construction of Knowledge Through Virtual Photography of Abstract Geometry

Lengyel, Dominik; Toulouse, Catherine

Source / Izvornik: **Formats of (Non)Seeing, 2024, 334 - 347**

Conference paper / Rad u zborniku

Publication status / Verzija rada: **Published version / Objavljena verzija rada (izdavačev PDF)**

<https://doi.org/10.31664/9789533730530.16>

Permanent link / Trajna poveznica: <https://um.nsk.hr/um:nbn:hr:254:851635>

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Download date / Datum preuzimanja: **2025-02-22**



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INTRODUCTION

Photography is a position. It is the conscious composition of images in interaction with the scene in front of the camera and the technical options of its projection. The underlying relationship to photography in this paper is precisely this ideal one, since it is the same attitude, though under technically quite different conditions, namely the application of the methods of classical photography in virtual space. This method, called “virtual photography” by the authors, treats virtual space just as if it were physical reality. The aim of this self-restriction is the referentiality of the images thus created, trusting that their reception will thereby follow in the tradition of the reception of classical photography and that the images will thus be received as naturally as possible. This, in turn, is intended to ensure that the content of the images is the focus of perception. For the pictures are about complex spatial facts, not about imitating physical reality. This will be explained in the following.

The method presented here, the visualisation of uncertainty, was developed by the authors to address the need in archaeology and building research to adequately reflect the uncertainty inherent in the sciences. Although there have already been attempts to depict this uncertainty with the help of diagrams or explicit markings, for example, of the degree of uncertainty through the use of colour encoding, this increase in information inevitably leads to a dilemma, namely the loss of the original intention of the architecture. The aim is not to reproduce the original appearance, as the computer games and film industries do, for here the share of the purely speculative, the complete freedom of the imagination, is unlimited, but to make the uncertainty visible. This uncertainty is not to be confused with the unknown, for often there are fragmentary indications of, for example, the rough cubature. Depending on the reference that cannot be chosen unambiguously or due to an ambiguity, scientifically equivalent but mutually contradictory alternatives can also characterise the uncertain knowledge. Almost constant is the indeterminacy of the details, such as that of the surface of each single, lost stone.

The central dilemma in the visualisation of uncertainty lies in the need to make a fundamental decision. For while the diagram or explicit representation of the degree of uncertainty provides more objective information, just as a marker would in physical reality, it is often a particularly prominent element in its visibility. There are many examples of the integration of metadata in a representation of a so-called reconstruction, a well-known and very common one being the marking of the finds, i.e. those fragments of components that have been found and are preserved, versus those pieces that can be reliably complemented, fragments of column shafts, for example. The reliable completion leads to practically no differentiation in the geometry, so that a graphic differentiation is often applied, for example in the form of different shading, in order to represent the boundaries of the finds. Now, however, the objective information of the fragment boundaries is unquestionably part of research communication and should therefore be both recorded and communicated, but the visualisation of the hypothesis of architectural appearance is not suitable for this. This is because the form of the find fragments, their spatial delimitation, was in no case part of the original appearance or even the planning intention. Their visual presence with its irregularity almost completely contradicts the architecture and sometimes seems like a layer of camouflage. For an architectural interpretation, this information is not at all helpful, but rather obstructive; the intention of a colonnade, for example, can no longer be considered together with its core characteristic of being regular.

In this context, it is an important basic requirement for the interpretation of architecture not to provide any distorting content. The challenge, then, is to provide an image as an architectural vision, in addition to the objective information of all available content. And this is where the direct relationship with photography begins. Because here, too, there is a clear influence on perception depending on the composition. While classical photography essentially directs the recipient's gaze by means of location, viewing direction and framing, and can thus limit and partially direct their perception, the visualisation of uncertainty is more like studio photography, which can also redefine the object itself. But apart from this option of manipulating the depicted, the possibilities and the modes of action are quite similar. The essential factor in architectural perception is the interpretation of what is perceived primarily as an architectural vision. While, for example, the aforementioned find markings refer, if not primarily, then at least essentially to the historically coincidental fragmenting, a representation that wants to refer to the architectural structure should not be overshadowed by other aspects. The focus on architectural structure, however, has a clearly defined origin and at least one clear purpose. The origin lies in the articulation of hypotheses about the original appearance, which usually refer to the spatial structure, though often also to the material, but here rather to the materiality per se, not to the materials in detail. The purpose, in turn, lies in the clear communication of these very hypotheses on the one hand and in the transferability of the architectural idea on the other. The importance

of the reception of the photo of architecture for the reception of the photographed architecture is expressed by Julius Shulman in an overview of his entire oeuvre as follows: "As I myself know from decades of experience, photographs become part of history, and therefore the documentation of a building must be done in such a way that the viewer is first attracted by the visual expression of the image. Only then does the quality of the architecture become visible and capable of appealing to the viewer."¹ Transferring this into virtual space is the content of the method of the visualisation of uncertainty presented in the following.

VISUALISATION OF UNCERTAINTY — DESIGN IN MODELLING AND PHOTOGRAPHY

The method of the visualisation of uncertainty essentially consists of the two traditional architectural sub-disciplines of model making and photography, specifically model making of the early design phase, in which all possible degrees of detail can be combined, from rough cubature to set pieces, and photography, which is consciously composed but primarily documentary in the sense of an imaginary user of architecture.

Model making is the element that has the greatest affinity with competence as an architect, since it is about giving complex spatial matters an appropriate, new form. Even though it is conceptually about abstraction, the literal translation of the Latin word is misleading. For the abstraction that can be used to represent facts is not achieved by pulling away what is already there. On the contrary, the same basic idea is contained in the components that have been preserved, but not their generalisation, that which is common to all members of a type.

This commonality is described in the orders of ancient architecture. Thus, the orders do not allow any alternative to a certain type of capital in the corresponding context. If the base and shaft of a column and the other existing fragments of a building clearly suggest the Corinthian column order, there is no way around having a Corinthian capital. Its perceived visual volume, however, consists largely of its acanthus leaves. If the leaves were removed, the volume would be considerably smaller and the recognisability as a Corinthian capital would be lost. So, nothing is achieved by pulling away. It is therefore necessary to develop a new form that expresses both that it is a Corinthian capital and that it is not an individual find. This new form is therefore an originally designed, new object for which there is no image in physical reality. There is only its verbal counterpart. A description of Corinthian capitals could begin with precisely those characteristics that are common to all Corinthian capitals. But what is daily practice in verbal form is not familiar as a plastic form in everyday life; but very much so in architectural design.

1 Shulman, "Architektur und Fotografie", 16.

As in the scale of ornamentation, abstraction also applies to the scale of urban planning. Here, too, the verbal hypotheses do not speak of individual buildings, but rather of building structures or –

as in the case of classical antiquity—even of entire blocks of buildings, *insulae*, whose outer boundaries can be derived solely from fragmentarily preserved sewage pipes. And yet a verbally largely secure description of these buildings can be made, usually on the basis of better-preserved sites. It is the principle according to which they were built that can be described. And here, too, the discipline of architecture is in a position to give precisely this description a suitable visible form that follows the structural principle, but at the same time conveys just as clearly that the buildings are a type and that their concrete appearance is not known.

Both forms of abstraction are therefore by no means images of physical reality, yet they are representations. They focus the viewer's attention on the geometry of the structure, i.e., the elements that define the space. Through their form, they indirectly suggest familiar buildings without pretending to actually depict them, as if they were part of physical reality. With this explicit as well as intuitive distance, they again operate in two directions. They convey the knowledge of science and at the same time, through the uncertainty, scientificity in itself, with all its ambiguity and, of course, uncertainty. This second feature is not to be neglected, as it strengthens the perception of science and the reflection on science in society. It becomes clear to the viewer, who confronts an abstract suggestion, that in the end it is the viewer's own imagination that translates the seen into architecture. And even then, if the viewer is not immediately aware of this process, a certain irritation causes reflection. Thus, scientific visualisation pursues a certain educational mission at the same time.

Beyond this fundamental engagement with science, however, this form of representation of architectural structure also makes an influential contribution to architecture. The abstraction of the common visual characteristics of the representation of historical architecture, first and foremost the texture of the surfaces, furnishings or even out of use of the acting persons and their clothing as well as other attributes such as insignia or weapons, shifts the perception away from the specifically historical characteristics towards the concept of space here as well. The aim of this is not to deny the historicity of what is depicted, but to direct the visual focus to characteristics that are otherwise superimposed. Focusing on the structure, then, allows it to appear in a way that might not only have affected the user of its time. The structure can furthermore operate as an intellectual spatial composition and thus, liberated from its historicity, become part of the experiential vocabulary of current design activity. Not the building with its use at the time, but its spatial structure can thus be an additional reference for today's planners.

Here again it is photography that connects the different manifestations of architecture. If the hypothetical ancient, abstract architecture is photographed virtually as if it were part of physical reality, as if it were actually built in this abstract form, then it requires all the less imagination to picture this architecture as part of physical reality. Virtual photography thus helps the imagination as much as possible, it compensates for the abstraction of geometry, to a certain extent, and establishes a reference to photographs of physical reality. It creates an idea of a potential physical reality in the viewer. The intended impression of the photograph of an almost casual view is to have the photographer's role move into the background so that the spatial impression of the imaginary architecture can be the centre of attention, as Gilles Mora describes the photographer's role in a review of Walker Evans: "Le photographe n'est plus là pour travailler la composition, mais cadrer le pré-composé, l'ordre et la configuration préexistante des surfaces visuelles s'offrant au regard".²

Photography is not a limitation here, but acts as a familiar mediator of architecture. Of course, architecture can only be perceived authentically on site in space and in person, at best still as a user fulfilling the original purpose, an authentic experience therefore, like entering a place of worship as a participant in a religious service or a railway station as a train traveller. This is not possible in the case of ancient architecture, if only because the cultural background as visitor and user is completely different. The intention of the visit alone finally distorts the impression. Both, however, are irrelevant in photographic reproductions. The static photographic image already bears the distance within itself. This circumstance gives photography a special role in the mediation of architecture, as does the fact that a large part of architectural reference is limited to images. The most significant examples of architecture, even when they are still standing, are typically communicated through the image, especially in view of the global scene of architectural production. The photograph is thus one of the most vital carriers of architectural messages. The image of hypothetical ancient architecture is placed in this context, making it feasible to compare virtually photographed abstract geometry with photographs of architecture in physical reality.

The method of limiting the liberties of the projection of virtual models in such a way that an impression of space is created that is as relevant as possible in terms of the interpretation of architecture is based on a number of conventions taken from traditional architectural photography. Both arise from the need to convey the abstract geometry as unambiguously as possible. The first aspect is always the point of view, but of this especially the natural eye level. Reliability is important here, because unlike physical

2 "The photographer is no longer there to work on the composition, but to frame the pre-composed, the order and the pre-existing configuration of the visual surfaces offered to the gaze". See in: Mora, "Introduction", 12.

reality, abstraction lacks visual indicators that allow a conclusion to be drawn about the height of the viewer, such as handrails, furniture, street furniture or also vegetation. This absence makes it much more difficult to estimate the dimension. A constant and reliable eye level over a series of images, on the other hand, restores the ability to make this assessment. Elevated viewpoints, on the other hand, distort the spatial impression, and bird's-eye views can be mistaken for views from actual elevated viewpoints such as mountains or towers. This misunderstanding is most easily countered by parallel projections, which do not have a viewpoint because the projection is only of a direction, not of an imaginary viewer who would be in a specific location. The second aspect is the orientation of the architecture. This is related to the sense of balance in physical reality and allows a clear idea of where is up and where is down. From this, in turn, it can be determined, among other things, which surfaces are horizontal and which are vertical. In a static perspective, this is much more difficult. Due to this reason, perception and interpretation depend on whether or not the orientation of the depicted objects is distorted. This is because visual perception conditions spatial perception as a whole, i.e., including the mental processing of what is seen into the spatial model that is constructed from spatial perception.

It is therefore necessary to compensate for the lack of movement in space. Because spatial perception in physical reality is not static, but dynamic in several ways. Not only the body moves through space, but also the head and, additionally, the gaze. Furthermore, the visual perception is dual, stereoscopic. The innumerable impressions perceived through the movements construct a spatial model in the imagination that contains, among other things, unambiguous orientation; ambiguities arise—if at all—through optical illusions. A static perspective representation corresponds most closely to this mental model when it takes over the orientation. As in the case of eye level, in physical reality it is often minor details that facilitate orientation. But in abstract geometry, the lack of unambiguity can lead to considerable misunderstandings. Yet here it is not the value that is at issue, but the deviation itself. It is a critical, digital distinction of an either-or. Very subtle inclinations are not accidentally found on certain components. It is the deliberate deviation from the perpendicular that underlines the defensibility of fortress walls, it is in a sense the main geometric characteristic of a fortress wall to be defensible, and this is precisely what a slight inclination expresses. But if geometry makes a central statement about architecture, its proper interpretation is determined particularly by its orientation in space. Traditional architectural photography, which usually works with vertical image planes, has set the standard at this point.

No less important are the other aspects of photographic composition, such as angle of view or lighting. But here, too, the reference to traditional photography is helpful. Focal lengths in virtual space that correspond exactly to those of traditional photography again create a comparability with clas-

sical photographs. Lighting, on the other hand, is an inexhaustible subject, but one that is shaped by two main variables. The first is the plausibility of natural light, i.e., the correct geographical position in sunlight; the second is the quality of the light, i.e., the portion of indirect light as well as the colour temperature. In virtual space, the liberties are comparable to those of studio photography. The aim of the lighting, however, is not brightness, but how the different brightness influence the perception and hierarchisation of space. But this, too, belongs to the realm of complex design and usually only succeeds in a convincing way after long experience. For it is not the technique that decides a photograph, but the experienced eye, the trained observation, the experience in photographic image composition. When asked by Joseph Rosa what aperture to set for a particular shot, Julius Shulman replied, "That's not important. You can learn that anywhere. Learning to see is the important thing."³ Learning to see is the prerequisite for designing photographs, for constructing a composition, in summary, for the "constructed view."⁴ Shulman gladly adopts this term created by Rosa for himself: "The title he chose opened up a whole new view of my life's work."⁵

CASE STUDIES

For the Cologne Cathedral Administration, the construction phases of Cologne Cathedral and its predecessor buildings were partly updated and partly reinterpreted. From then on, all construction phases have been visualised in their urban context. Through the process of visualisation from an architectural point of view, some weightings could be shifted in the case of ambivalences. The project was exhibited in the 2010 NRW State Exhibition in the Roman-Germanic Museum of the City of Cologne. In addition, it has been exhibited since 2010 as a permanent installation in the access area to the Archaeological Zone of the Cologne Cathedral and the tower ascent. (Fig. 1, 2)

For the Istanbul department and the excavation project in Bergama of the German Archaeological Institute, the entire ancient metropolis of Pergamon has been visualised as a permanent cooperation since 2009. The visualisation is constantly changing along with the research. The first milestone was the first monographic exhibition on Pergamon at the Pergamon Museum Berlin in 2011, in the context of the Excellence Cluster TOPOI of the Berlin Universities, Freie University and Humboldt University. Since then, the latest research on the city has resulted in numerous updates, especially on the western slope. Numerous requests for visualisations of specific sections by a wide variety of researchers continuously enrich the image repertoire. Currently, several sanctuaries in the surrounding area as well as the Roman city in the lower part of the complex are being completed. (Fig. 3, 4)

3 McCoy, "Persistence of Vision", 10.

4 Rosa, *A Constructed View*.

5 Shulman, *op.cit.*, 299.

For the architecture department in Berlin of the German Archaeological Institute, numerous palaces on the Palatine in Rome during the imperial period were visualised between 2010 and 2020. Exhibited in the first version in the final exhibition of the Excellence Cluster TOPOI in 2011, the representations include the Circus Maximus and the Septizonium Fountain in addition to the actual palaces. Of the palaces, only the representative terraces and courtyards were visualised in detail, including, in the later course of the cooperation, the impressive series of successive representative courtyards with water basins. (Fig. 5)

For the Madrid Department of the German Archaeological Institute, the orchards in the Caliphate city of Medina Azahara from the 9th century CE were visualised, in which the focus was on the representation of the landscape and the agriculture, the cultivated vegetation. The visualisations show the tension between architecture and the regular establishment of plantations for the purpose of fruit cultivation, which also gives the vegetation an architectural expression. (Fig. 6)

Funded by the Gerda Henkel Foundation for Historical Humanities, and together with the former head of the Rome Department of the German Archaeological Institute as well as the Archaeological Institute in Tirana, Albania, the unique principle of the construction and accessibility of the ancient Roman amphitheatre of Dyrrachium, today Durrës, was analysed through visualisations and for the first time completely worked through as a coherent three-dimensional model. The result, as well as the construction phases of the Cologne Cathedral and the ancient metropolis of Pergamon, can be viewed as a film on the knowledge portal L.I.S.A. of the Gerda Henkel Foundation. (Fig. 7, 8)

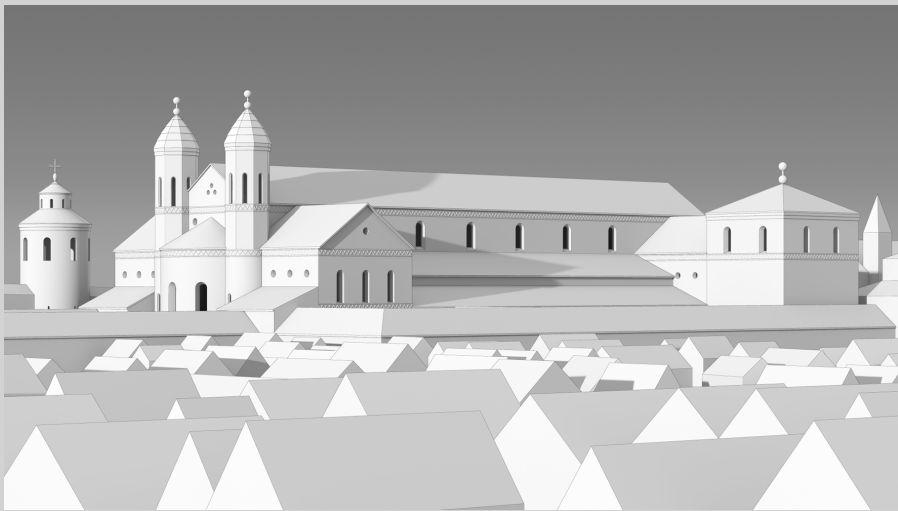
CONCLUSION

Photographic composition as part of the creative disciplines can neither be comprehended in simple recipes nor judged objectively. It is a complex process that often only manifests itself in the producing itself through the reflection of the author. Nevertheless, there are some principles in composition that can be at least clearly helpful for an intuitive spatial interpretation of what is depicted. Following these is the basis especially for the depiction of abstract geometry if it is to represent architectural content. Similarly, the design of abstraction is a creative process. In addition, the two are mutually dependent, which means that the creation of a scientific visualisation can probably best be compared to studio photography. Architecture as a site-specific subject is geographically bound to certain lighting conditions, but at the latest in the case of diffuse lighting or indoors, the lighting is also subject to the liberties of design and is thus part of the complex, interactive and reciprocal process of creativity. In the visualisation of uncertainty in the knowledge of the humanities, it is less the technique than the competence to design that decides whether the

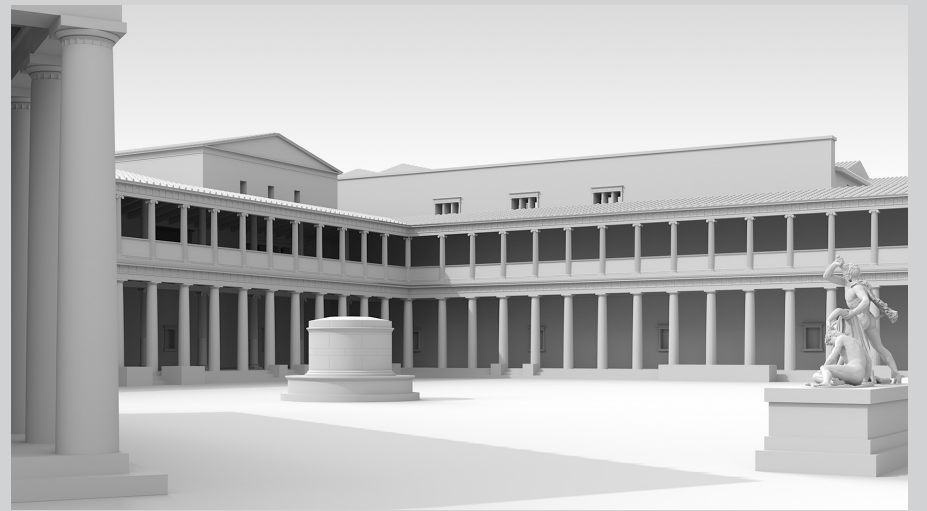
content is adequately represented, just as it is not the camera but the photographer who decides on the essential quality of a photograph. For then, when architecture appears self-evident despite abstraction, an architectural interpretation is a direct reflection of the hypothesis. And quite similar to the creative design process in architecture, the scientist is thus able to make the visible the basis of further reflection. New, transdisciplinary research questions emerge simply from looking at what was previously only verbally formulated, what was only theoretically conceived. The translation of the verbal into the visual form is thus a form of re-articulation that serves the evaluation and further development of the hypothesis. The discipline of architecture is the translator. The visualisation is the catalyst.

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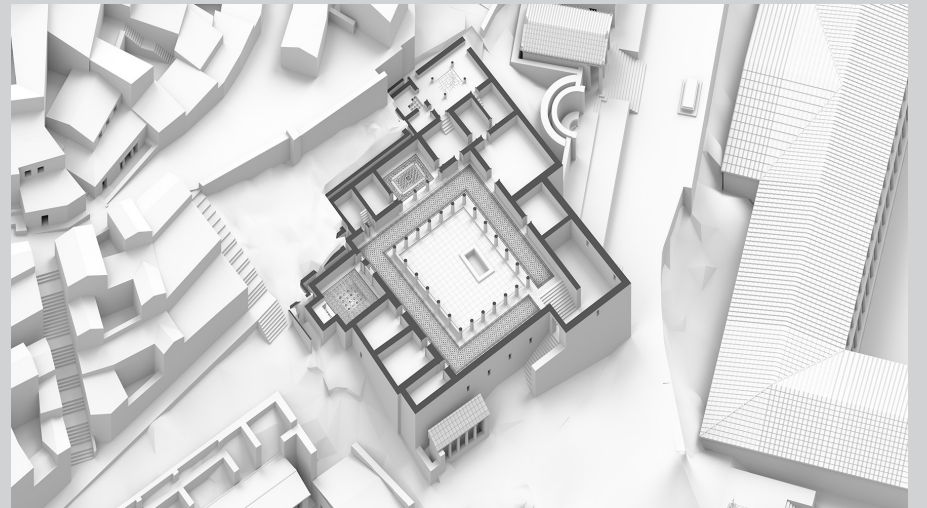
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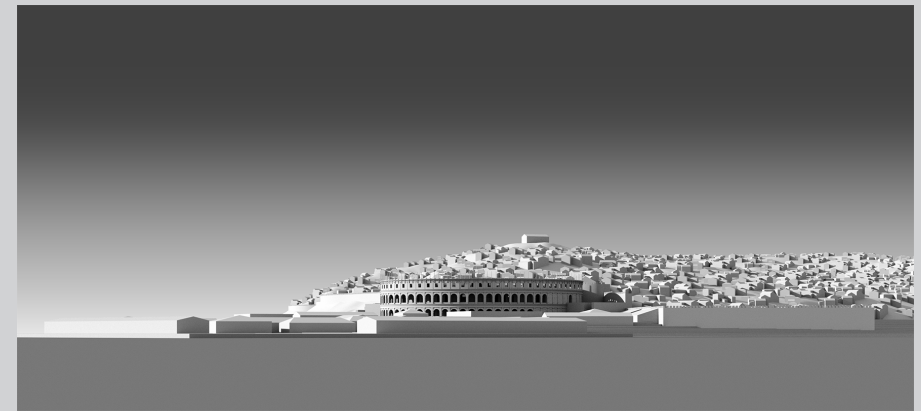
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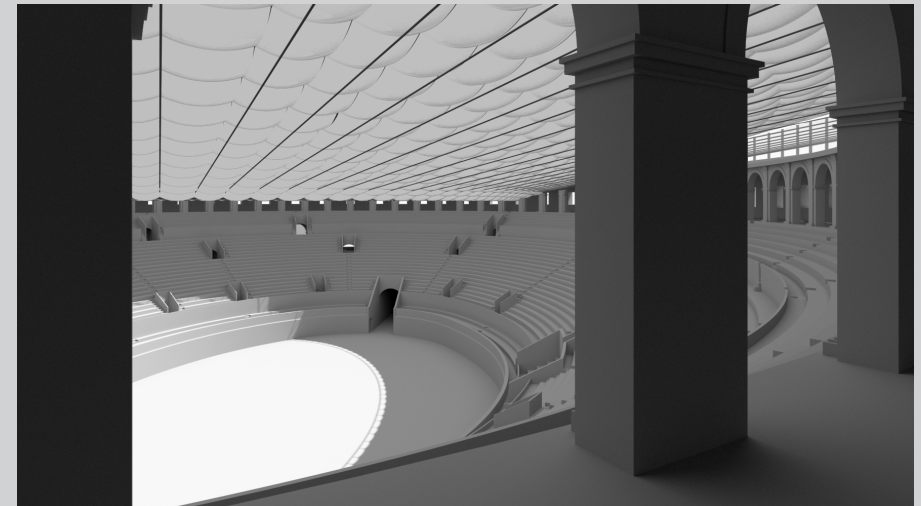
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- 1 Hildebold Cathedral, the last predecessor of Cologne Cathedral, around 1025 CE, for the Cathedral administration © Lengyel Toulouse Architects Berlin
- 2 Cologne Cathedral between in the 16th to 19th century CE, for the Cathedral administration © Lengyel Toulouse Architects Berlin
- 3 Sanctuary of Athena in ancient Pergamon around 300 CE with Gruppo Ludovisi and Dying Gaul sculptures, the library and the palaces at the back, in cooperation with the German Archaeological Institute DAI © Lengyel Toulouse BTU
- 4 Building Z in 3 in ancient Pergamon around 300 CE in a skewed axonometric projection showing both the undistorted plan and the elevation of the building, in cooperation with the German Archaeological Institute DAI © Lengyel Toulouse BTU

- 5 Imperial palaces on the Palatine hill in ancient Rome, in cooperation with the German Archaeological Institute DAI © Lengyel Toulouse Architects Berlin
- 6 Agricultural orchard in the Ummayyad fortified palace-city Medina Azahara near today's Córdoba in the 9th century CE, in cooperation with the German Archaeological Institute DAI © Lengyel Toulouse Architects Berlin
- 7 The Roman amphitheater of Dyrrachium, today Durrës in Albania, as a visible landmark for the sea route and bridge head between the Via Appia and Via Egnatia from Rome to Byzantium @ Lengyel Toulouse
- 8 The interior of the Roman amphitheatre of Dyrrachium with the drawn Vela, an important factor in attracting spectators in antiquity @ Lengyel Toulouse