

## The construction of the wooden roof: the case study of the reconstruction of the Old Castle in Stuttgart by P. Schmitthenner. Elements, language, form.

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### ABSTRACT

In 1931 a fire destroyed the old Castle of Stuttgart. Following a series of debates on the restoration of the castle and in particular on the tall sloping roof, a poor reconstruction of which would have rendered the image of the city “gray and expressionless”. In 1932 Paul Schmitthenner (1884-1972) published one of his projects for the reconstruction the castle. After the fire only the external walls where left intact, their ability to support a load, however, was compromised. In his project Schmitthenner decided to demolish the external walls and to rebuild them with the old stones and supporting pillars from the inside part. Also the tall roof was to be freed from the additions made without planning over the centuries. In the regional competition Schmitthenner proposed his project and won.

The compositional principle was the reconstruction of a basilical space with three aisles. This room was realized as a complex construction in wood. The walls of the room, set all under a single great trussed roof, were realized in half-timber structure with unplastered brick infill. To capture light from the sides, he built three of his signature high wall-dormers. Masterly handcrafted, the raw materiality of the wood and the brick, the light that penetrates the room, all the elements underlined the sacredness proper to this internal space. The reconstruction was finished in 1937, but did not last for a long because in 1944 the castle was destroyed by bombing. The intention of this research is to produce the three-dimensional reconstruction of the wooden roof, in order to understand the structural rules of the elements and the measure of the parts which compose the section, and finally to investigate the language of the traditional half-timber system developed in modern solutions and the meaning of *form* or, in Schmitthenner's words, the ‘constructed form’ (*Gebaute Form*).

### INTRODUCTION

“Long before being beautiful, art is ‘making’, and yet it is true and great art, indeed often truer and greater than beautiful art. For man has the nature of a maker who [...] seeks to gather around himself materials into which to mold his spirit” J.W. Goethe

Carl Schäfer was a professor of medieval architecture at the Technische Hochschule of Karlsruhe from 1894 till 1907. In his lectures Schäfer meticulously studied the buildings and the

development of the forms within the *Holzbauskunst*, i.e. the art of building with wood. An art of construction philologically founded on the central European construction of the domestic space, based on the ancient craft of the carpenter. The de-composing of the architectonic object, in this case of the *Bauernhaus*, into its constitutive parts, a clarity of the fundamental principles of construction in wood, distilled into simple forms, the systematic description of every node, articulation, joints between the various elements and what results from them defined by what is necessary for a *Holzbauskunst*, and became a rigorous method past down to his students for understanding the sense of the buildings. Architecture expressed by means of a craftsman's construction technique, a child of a people's culture of its needs of a fully developed craft and the inseparable unity with the landscape [1].

Theodor Fischer in his essay *Über das Restaurieren* (1903) expressed an opinion of condemnation for the reconstruction of historical buildings according to a stylistic approach that destroyed the characteristic configuration of the work in favor of its functional and aesthetic modernization. This practice, labelled as romantic by Fischer, revealed itself indifferent to the true nature of a work, to the meaning of its space and construction technique, to its entire genesis that allowed the building to bend to the transformations of time. And even worse this caused the loss of the memory of the unity that area had in as much as architecture is like a synthesis of the form of a piazza, a city, or of a landscape. Fischer individuates two possible paths for *Rekonstruktion*: *imitative*, as in the case of the campanile of piazza S. Marco for which the reuse of the remains and of the parts of the building still standing was inevitable; and *interpretative Rekonstruktion* as in the case of the Castle of Heidelberg where, with no significant remains still standing, the capacity of the artist to “not try to apply the forms of the preceding epoch [...] but rather to build in a clear and good manner using the forms that are understood” [2] in this way the master builder brings to life ‘the ancient spirit’.

## PAPER FORMAT

In December of 1931 a fire partially destroyed the renaissance Castle of Stuttgart, the most serious damage was done to the east wing facing the Karlsplatz and flanked by two imposing circular towers. The ruined remains still standing above the hall on the ground floor, the so called Türnitz, consisted only in the external walls, the load bearing ability of which was gravely compromised by the fire (fig. 1).

In the debate that quite soon became heated about what kind of reconstruction was to be carried out, P. Schmitthenner (1884-1972), a professor of construction at the Technische Hochschule of Stuttgart, joined forces with those who refused to carry out a restoration faithful to the old part of the building, rather in 1932 he published plans for a project of reconstruction that interpreted the character of the monument, the redefinition of the entire form and of the profile – the inviolable memory of the landscape of the city.

Schmitthenner proposed the demolition of the external walls of the building, and to rebuild the walls “with the necessary number of windows, maintaining the essential character of the exterior and giving the interior the correct distribution of spaces and the right illumination” along with the internal buttresses using the old stones. Furthermore the “massively imposing” high roof needed to be freed from the continues architectonic superfluities added over the course of time without any planning [3]. In the competition issued by the regional government of

Württemberg in 1933 – for which T. Fischer, R. Döcker, P. Bonatz, E. Fiechter acted as judges – Schmitthenner presented a project that was based on his earlier publication and that earned him one of the two second prizes and the responsibility of directing the reconstruction (fig. 2).

Schmitthenner's work was given form by two guide lines: on the one hand *to configure* the organically attach of the great roof to the body of the monument and to the skyline of the city, on the other hand *to construct* a meaningful space materialized as the structure of the wooden roof. In brief, to generate that which the German architect had theorized to be the *constructed form (Gebaute Form)*: “the original shape of every *constructed form* is in its configuration and in the elaboration of the work congruent with the materials. The configuration obtained by the use of a single material is the most pure. A *constructed form* is produced when, understanding the essence of the materials and not bypassing its needs, by a configuration” [4].

Schmitthenner's project did not concentrate only on the east wing but sought to redefine the entire attic floor – on the south east, south, and south west sides – of the Castle's roof, confirming the unified character of the spaces between the old and new ones, and the value of the preexisting structure by the autonomous profile of the roof on top of the mass of the Castle.

Under the unifying covering of the two slopes of the roof are found three long and narrow hall-like spaces, onto which face the rooms of the Castle (the circular towers, the octagonal hall of the knights' chapel, the stone stairs etc). On the south west and on the south, the halls are covered with ceilings made with exposed wooden beams, with lateral walls in half-timber. In some places the filling is in exposed brick, in other points at opportune moments it is protected by a layer of whitewash to accent the luminosity of the rooms, as one can see near the windows. On the other hand, the great hall on the east side is a complex wooden structure covered by the slopes of the roof that neatly covers off the part of the Castle between the two corner towers.

The concatenation of the public spaces is marked by narrow and thin thresholds, and doors with a domestic character that articulate the passage from one place to the next. The gable ends on the short sides of the first hall and of the last great hall are opened toward the outside by large windows whose addition of light give a sense of directionality to the space. The intermediary hall, on the other hand, on the side facing outward presents a thick wall with inhabitable rooms in it, the side facing the courtyard is made up of four symmetrically placed rooms lit by splayed dormer windows that capture direct light from the courtyard.

Not present in the internal distribution of the Castle before the fire of 1931, the great hall in the east is Schmitthenner's greatest contribution: an *interpretative reconstruction* attentive to the physiognomy of the object and to its possible new uses.

The roof is an element proper to German architectural culture. It is inseparably bound to the form of the house from its very origins. The archetype of the German house, the *Bauernhaus*, is a construction entirely in wood: on the outside the clean and continuous profile of the cabin roof and the box-like basement, on the inside the space is tripartite, one can recognize in the succession of vertical posts the *Deele* – the communal space in the central nave – and the *Fleet* – the final room at right angles to the *Deele* rather like a transept as wide as the entire width of the house; finally the presence along the axis of this room of the hearth to mark the more domestic character of this part of the building.

The east hall of the Castle makes reference to the same compositional *configuration* showing, essentially, a possible variation on this theme. It is a three aisled basilical space. The

proportion of height between the side aisles and the central one is 2:3, the proportion of width is 1:2. The side aisles are closed by half-timber walls in wood and polished bricks. On the south façade Schmitthenner placed three tall wall-dormer windows measuring 400x700 cm, the stone walls of the windows create rooms for controlling the light that in this way enters indirectly into the space of the hall. On the north façade, on the other hand, are placed 5 small dormer windows measuring 150x250 cm. distributed symmetrically with respect to the entire roof.

The wooden framework, that extends for about 60 m. with a width of 25 m. is defined by two rows of 24 three-pronged vertical supports (*Ständern*) with a square section of 25x25 cm. that support the coffered ceilings (*Steckgebälke*) over the lateral aisles. The principle beams of these ceilings have a section of 15x20 cm., while the elements placed lengthwise for giving rigidity to the structure are 10x20 cm. Corresponding with the meeting point of these ceilings with the three pronged vertical supports, the elements placed lengthwise (*Schwellen*) are doubled up taking on a section of 20x20 cm. Above the *Schwellen* the ceiling boards have a section of 20x5 and then of 20x3 cm. On the north side the beams laid lengthwise and the ceiling boards are interrupted to allow direct light to penetrate into the hall from the five dormers (fig. 3).

The ceiling of the main aisle the (*Zwischendecke*) with its span of about 6 m., is made of transverse beams with a section of 10x20 cm. that give rigidity to the entire structure. At the points corresponding with the top of the central stem of the three-pronged vertical elements the transverse beams are duplicated and at the centre are firmly fixed to the each other and to the beam above them by blocks of wood. The structure is completed by beams 20x10 cm. running lengthwise. The entire structure lies on three large beams 15x20 cm. laid lengthwise one of them placed at the centre the other two along the slopes of the roof as arcade plates or purlin plates (*Längsunterzügen*) directing the load of the roof onto the vertical structure and to the ground.

The syntax of the construction refers to a very definite grammar; every element comes from the well-known type of roof: the *Kehlbalkendach* (any kind of truss with a straining beam or collar beam). In fact the 10x20 beams in the ceiling of the central aisle act as straining beams tying together the arcade plates, the vertical supports and the 15x15 rafters (*Sparren*) of the roof. Near the summit are placed 10x20 cm. coupled collar tie beams on which rest the 20x20 cm. ridge beam. The coupled collar beams are fixed to the principle rafters (*Dachsparren*) which rest on a wooden plate placed on top of the stone wall.

The rafters are continued by sprockets (*Aufschieblinge*) of a constant section 15x15 to ensure that the slope of the roof creates an eave. These continuations of the rafters protrude by 20 cm. and create a line of shadow between the solid masonry wall and the continuous profile of the roof covered with slate tiles.

On the inside the half-timber wall is made with a wooden structural frame (*Riegel*) with 15x15 cm. elements. These are doubled up at the points corresponding with the vertical supports and at these points it is also topped off by brackets (*Kopfbänder*) supporting the coffered ceilings of the side aisles.

The wooden framing is made of 70x120 cm. modules. The filling (*Gefachschluss*) is made of exposed polished roman bricks 5x14x28 cm., arranged completely according to a fishbone pattern or with only the diagonals in the fish bone pattern the rest according to normal bond patterns, thus the resistance to traction of the entire structure is increased (fig. 4). It is possible to see two different structural spans between the vertical supports: first a span A of on average 440 cm. made up of four modules of the half-timber frame then a span B measuring

on average 300 cm made up of 3 modules. The doors with their stone doorposts and the square windows above them leading to the rooms created by the tall wall-dormers take up an A span that is filled with a simple brick wall without the timber framing. These A spans in correspondence with the wall-dormers alternate with B spans. The B spans have windows taking up a single module.

The working of the wood in its innumerable parts enriches the sense of this collective space by means of its magnificence. The main beams of the ceilings of the side aisles protrude 15 cm. into the central aisle and their tips are finished with a simple curve (*Fasen*). These beams along with the blocks of wood that act as joints for the straining beams, mark a constant processional rhythm toward the great bow windows located at the extremities of the hall, in some ways the two poles of the axis. The protruding beams of the coffered ceilings seem also to take on the task that the molding marking the height of the ceilings (*Brustgesims*) in traditional domestic architecture has.

The expressiveness of the wooden frame in the accenting of every node, joint, support, iron rings around the supports, show *pure ornament* that underline the construction. Proof of this are found in the cusped profile (*Wulst*) of the inclined parts of the vertical supports, in the gola moldings (*Kehle*) of the wooden framing above the high bow windows, in the wooden block joints of the straining beams with their gola molding, and in the brackets joining the half-timber walls to the top plates on top of them.

The disposition of the elements in the wall and of the patterns of the brick bonds, the butt ends of the horizontal beams that protrude rhythmically into the central space express, on the contrary, a use of the materials with technical mastery and in keeping with the laws of the trilithic wooden skeleton, that itself become *decoration*.

Schmitthenner uses both ornament “that is on the surface or that identifies itself with some plastic detail, as a symbol recalling another, higher meaning”, and decoration that “must always take its force from the living form of construction” [5] as tools to accent the immaterial: the measure, and proportions between the parts of the hall, the relations between the surface and depth, finally the rhythm of light and shadow.

It is the ability of the author to render all the complexity of the *Holzbaukunst*, at once a handed down knowledge of the carpenters craft and the clarity of the spatial idea of the great roof; but also the formal memory of the pitched roof (*Satteldach*) that leitmotif of the urban landscapes of German cities. This architecture, in its representation of the characteristics proper to construction in wood, shows itself in all its purity and clarity and affirms the truth of its content in the rational dialectic established between construction and form.

## CONCLUSION

Although far from any interpretation of the *Bekleidungsprinzip* (principle of the covering) this work by Schmitthenner unveils all the force of the two paradigms of Semper: “the tectonic in the framework in which light linear components are assembled to enclose a spatial grid, and the stereotomic in the basement, where mass and volume are formed together by multiple layers and repetitions of heavy elements” [6].

The wooden framing of the roof with its double essence, constructive and symbolic, is contrasted with the stereotomical mass of the Castle. The distinction between the light and the heavy allows for a further classification of the paradigms and of the structural properties of the

materials: to the lightness of the frame is coupled wood with its capacity to sustain tensile stresses; to the heaviness of the basement is coupled stone and brick with their ability to sustain compressive stresses. These in their turn declare themselves members of precise formal families that must be respected, in the order of the composition, the laws of construction that govern them: wood is used in serial discrete elements that do not create thrust; stone and brick on the contrary form continuous organic elements that produce thrust (fig. 5).

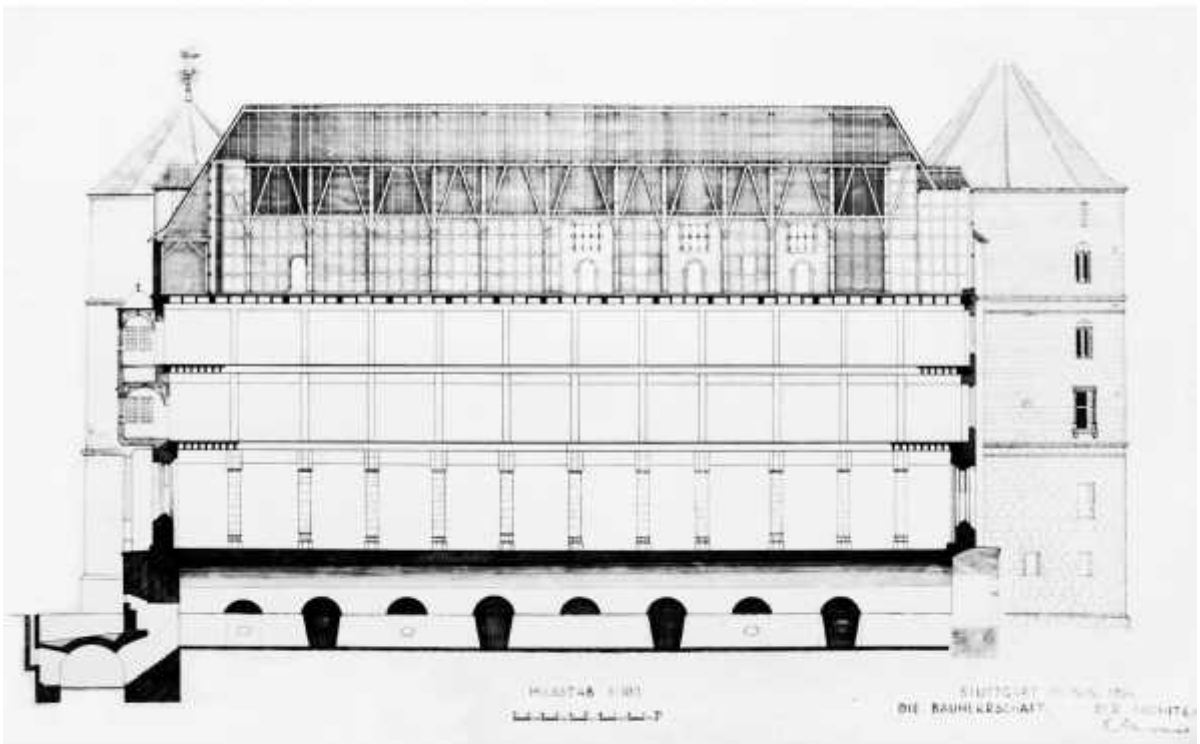
For the reconstruction of the Castle of Stuttgart on the one hand Schmitthenner inherited, in his conservation of the close relationship between form and construction, the teachings of Schäfer his Professor in Karlsruhe. He made the order of the construction legible showing its nature, accenting the figurative power of the elements in the unadorned frame; this work is a testimony of Schmitthenner's research on the expressivity of the *Gebaute Form*, celebrated in the sacrality of the hall. On the other hand he inherited the teachings of Fischer his master of election, because he builds 'forms that he knows well', respecting the rigorous grammar of the wooden frame system that becomes the shape demanded for by a space, the great roof covering the collective hall gives precisely the condition of being 'inside' of the great roof (fig. 6).

This is the principle that governs the three halls understood as public spaces. The wall is articulated in a series of rooms, the rooms with doors and windows face the 'street'. The halls are 'streets' whose sky is represented by the great roof. The three collective spaces finally bring the monument into the city understood to the sense of community that it symbolically represents.

For this reason Schmitthenner does not celebrate the ruins but protects the spirit of an ancient truth in a new architecture, by which "every process of structuring, as in the use of any material, is moved by the tension of the unfinished toward the finished" [7].

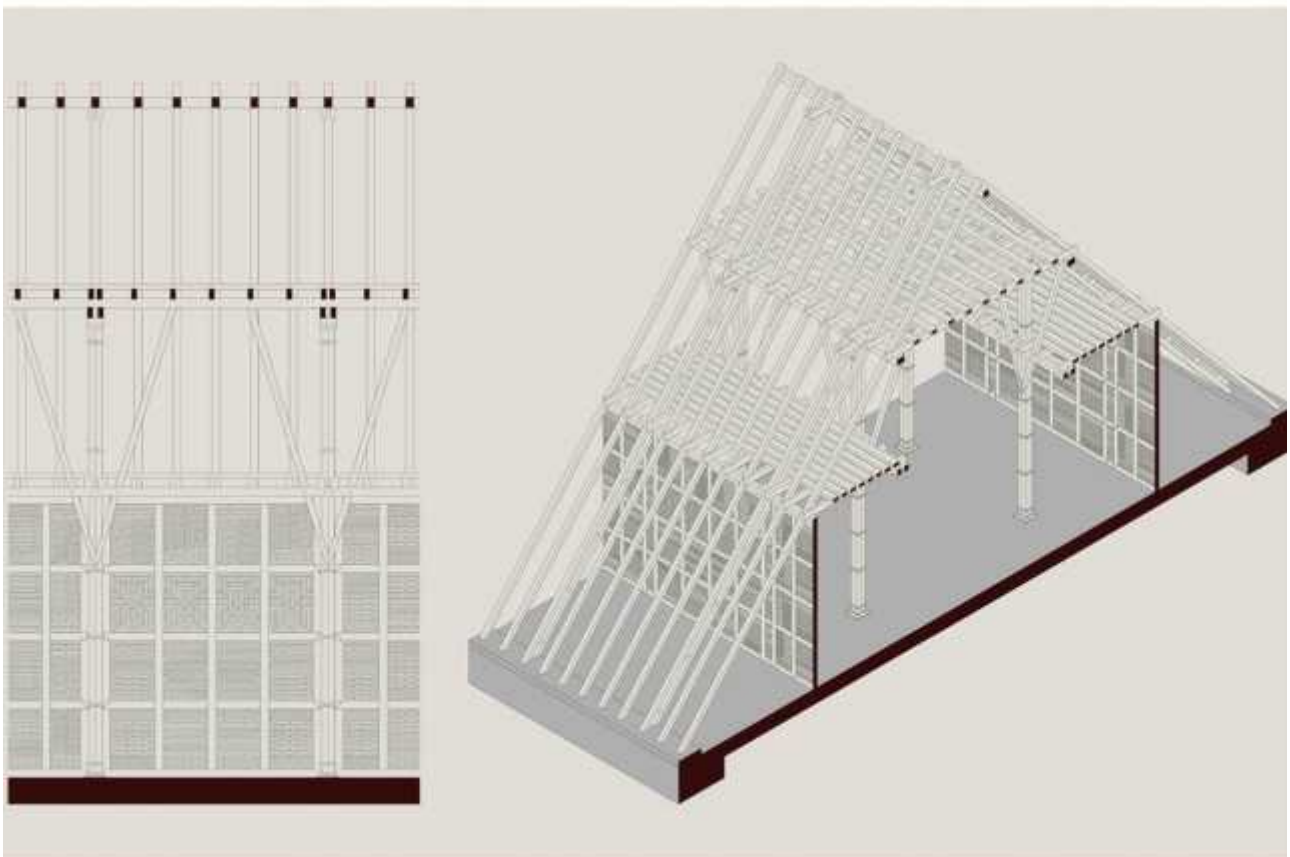
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1. Above: the Castle after the fire 1931 (Schmitthenner Archive, Munich)

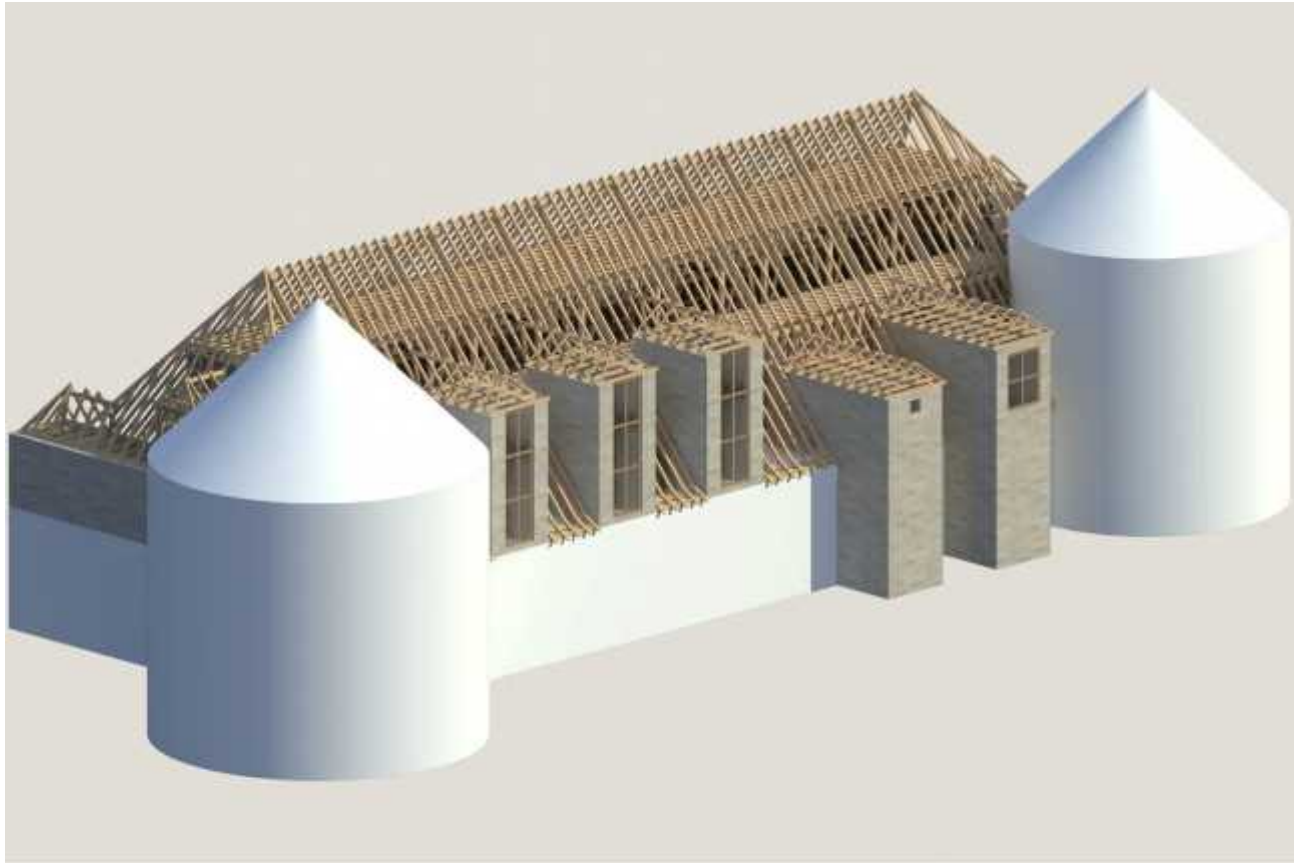
2. Below: the project of P. Schmitthenner, longitudinal section 1934 (Schmitthenner Archive, Munich)





3. Above: 3d model of the east hall of the Castle, transversal section

4. Below: 3d model of the east hall of the Castle, structural span



5. Above: 3d model of the east hall of the Castle, axonometric external view
6. Below: 3d model of the east hall of the Castle, perspective internal view