BALÁZS SZŐKE
BALÁZS SZAKONYI
GERGELY BUZÁS

ROLE OF THE "HORIZONTAL RIBS" IN LATE GOTHIC VAULT CONSTRUCTIONS IN HUNGARY.

A „VÍZSZINTES BORDÁK" SZEREPE A MAGYARORSZÁGI KÉSŐGÓTIKUS BOLTOZATOK SZERKEZETÉBEN.

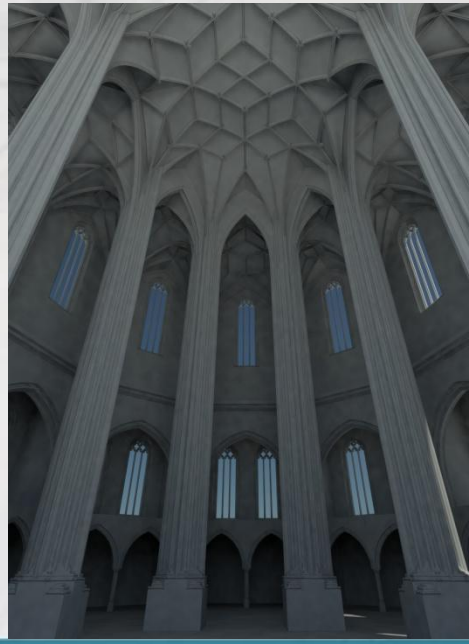
MODELLING MEDIEVAL VAULTS SYMPOSIUM

PAZIRIK INFORMATIKAI KFT

AR SZIME3D

UOL IN LONDON, 14 JULY
THE UNIVERSITY OF LIVERPOOL IN LONDON,
FINSBURY SQUARE—SEMINAR ROOM 4

In this presentation we would like to introduce our research done in the past decades regarding a typical late mediaeval vault rib type. Numerous theoretical reconstructions of perished structures are included in the presentation along still existing architectural monuments. Previously the theoretical reconstructions were created as drawings and paper models based on manual surveys. CAD modelling of the structures of vaults gave us possibility for advancement. In the recent years scanner surveying of vault intersections and ribs made it possible for us to immediately verify the CAD models, and also to have the digital models of the stone elements directly appear in the visualization of the theoretical reconstructions. The models created of the vaults may visualize the perished structures as some kind of digital anastylosis. Models can be technically verified and may provide a basis for scientific discussions.



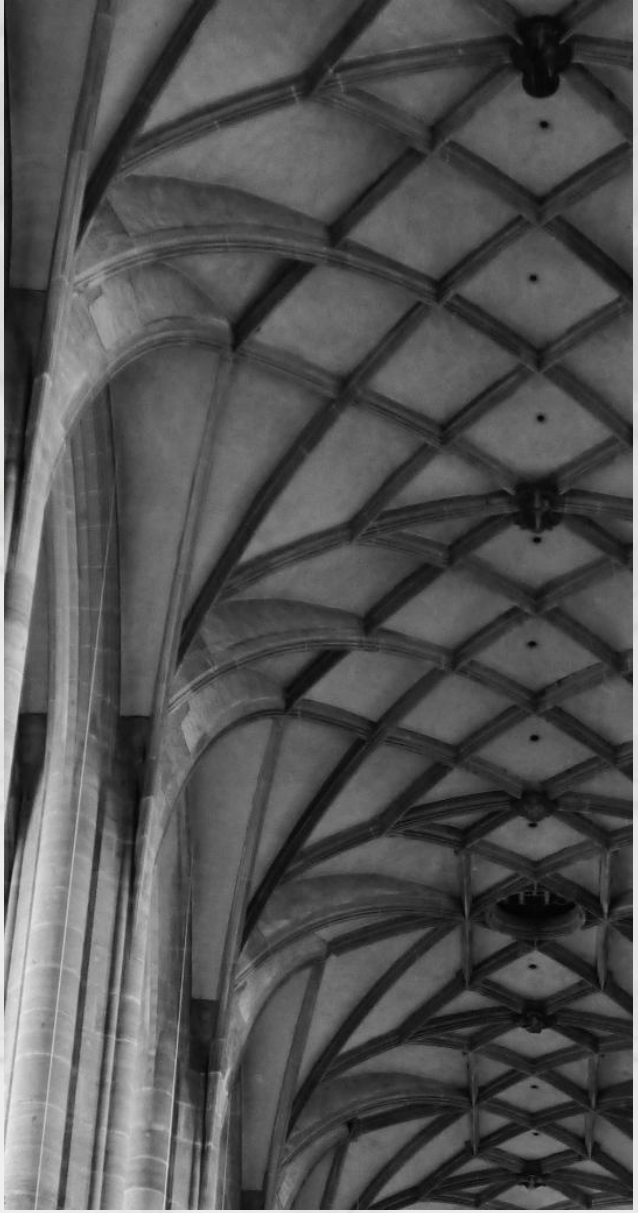
The most significant such still existing structure in Hungary is the nave vault of the Franciscan observantist church of Szeged lower town, a single nave hall space with a width of 42 feet which is outstanding with its dimensions as well.

Earlier the monument was listed as a baroque era gothicized barrel vault with lunette. We had already brought up earlier that the vault is a real gothic ribbed structure, which has been clarified in 2004 by a wall inspection executed in the church. Several periods of mediaeval paintings on the vault could be revealed. The construction of the vault can definitely be dated by the inscriptions from 1503 that survived on the side walls of the nave. The structure has been built from rib junctions carved from limestone and large sized radius-brick ribs.

Archaeological research in Szeged 2004

Imre Bodor
István Harsányi
Kornélia Forray
Ildikó Jeszeniczky
Balázs Szőke

The sort radius-brick rib elements have no curves. The vault has the same age as the buttresses, though the arches of the vault visible in the attic that are taller than the standing vault, give evidence that there had to be a change of plan throughout the construction.

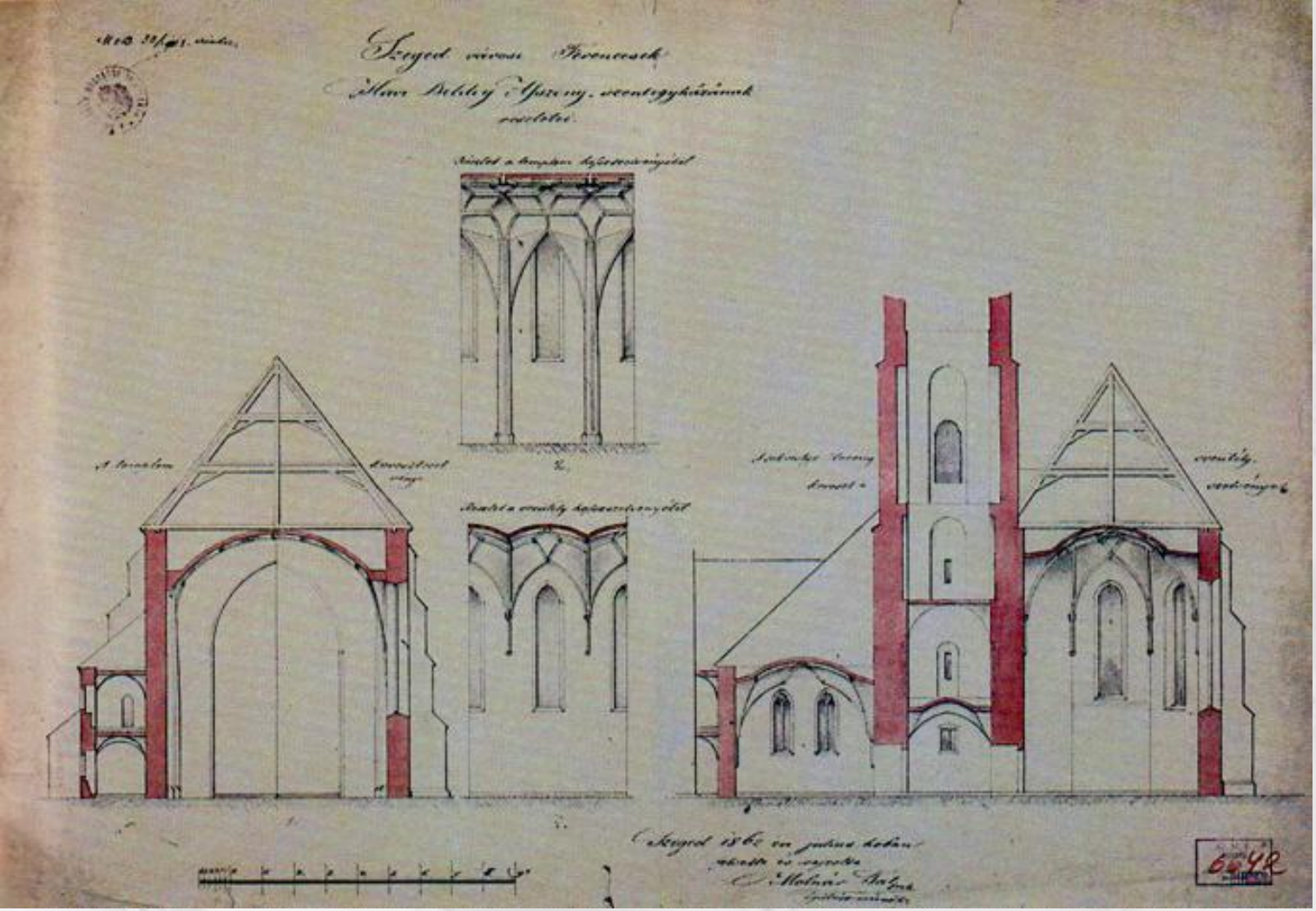


The vault of Szeged and the springer stones from the vault of Dinkelsbühl (Germany)

The peculiarity of the structure is that there are horizontal ribs between the rhomb rows perpendicular to the ridge of the vault.
These horizontal ribs according to the research function as real arching between the intersections.

The horizontal ribs however are not in direct connection with the infilling. Between the rib and the infilling, brickwork can be found.

The infillings lean on the other parts of the framework. The rib grid of the net vault creates the geometry of the brick infillings. This geometry adapting to the rib grid is especially visible at the spring-bases of the vault.



This structural feature is already visible on the survey of Pál Molnár from 1861. Recently a laser scanner survey has been made of the building in the framework of the SziMe 3D AR programme, which has confirmed the outcome of the previous research and provided help to the analysis of static flaws created by the sagging of the building's walls.

Pukanec
Slovak Republic

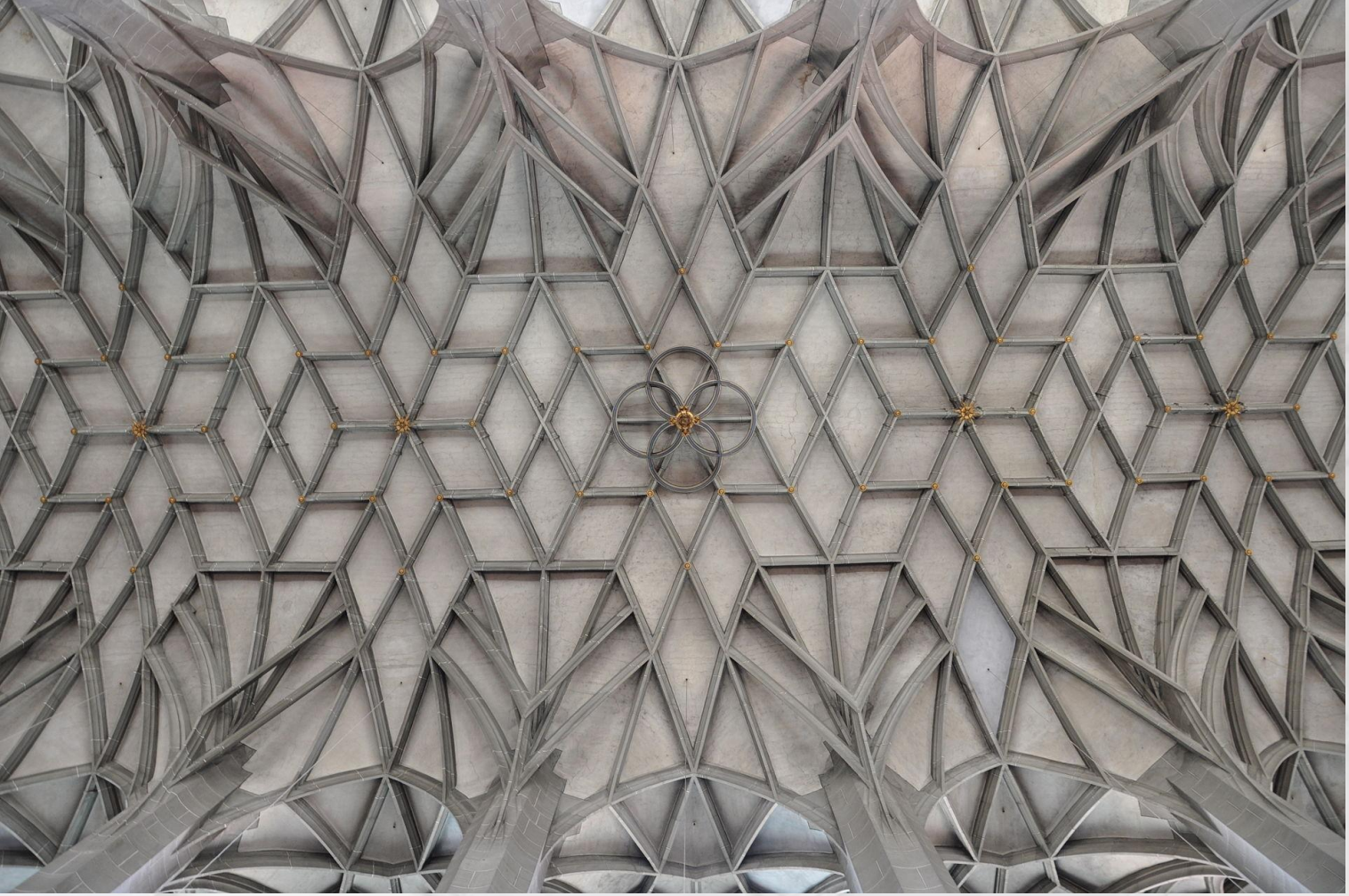
Hun: Bakabánya
Ger: Pukantz

The other existing analogy of the vault type in Szeged within the borders of historic Hungary is the nave vault of the church in Bakabánya. Besides similar vault systems have been built in the Saint Barbara chapel of the Roman Catholic Church in Besztercebánya, and also in the archway of the gate tower in Selmecbánya castle.

Banská Štiavnica Slovak Republic

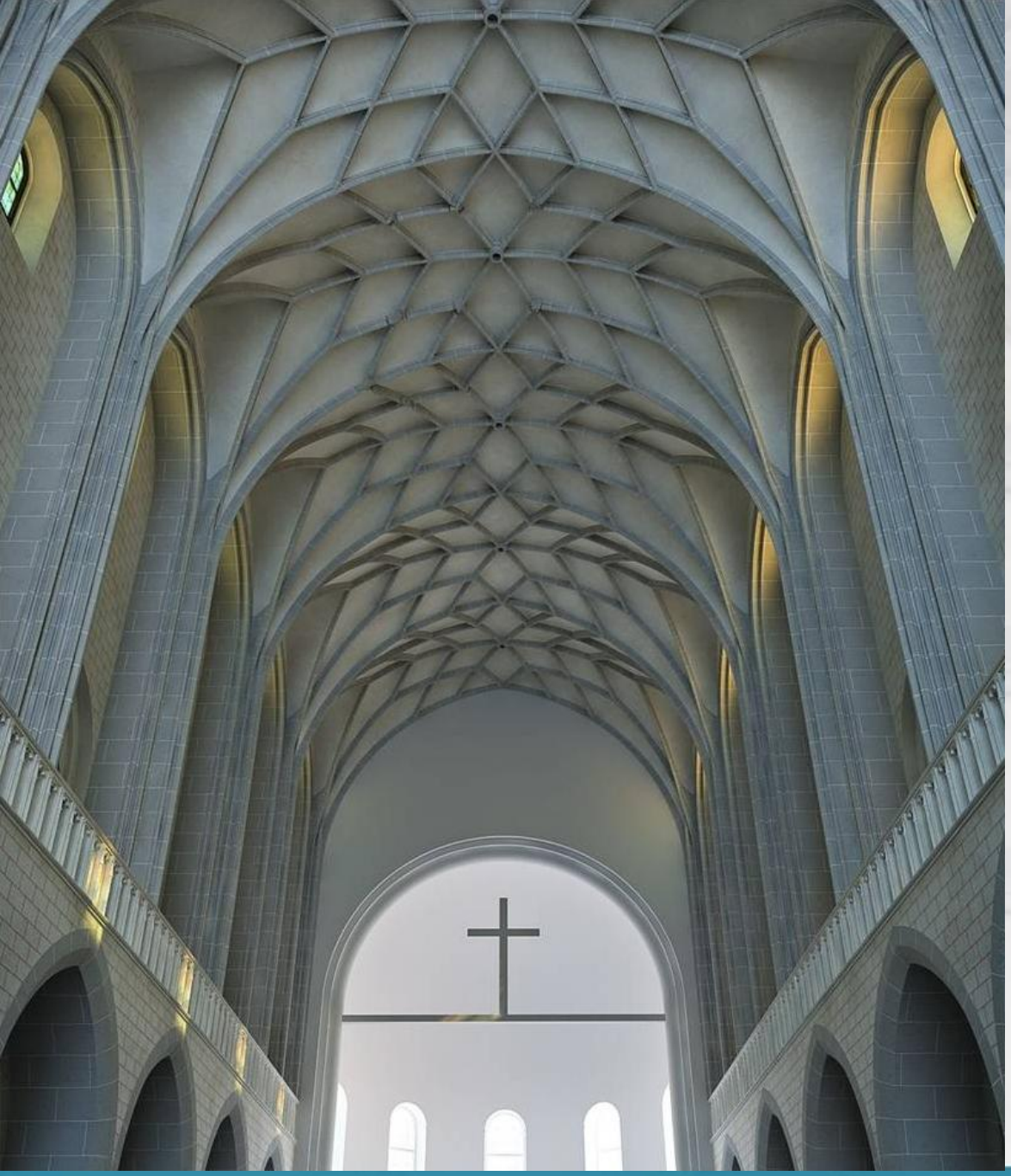
Hun: Selmecbánya

Ger: Schemnitz



https://commons.wikimedia.org/wiki/Category:Interior_of_Marktkirche_Halle_(Saale)#/media/File:Halle_Marktkirche_Gew%C3%B6lbe.jpg

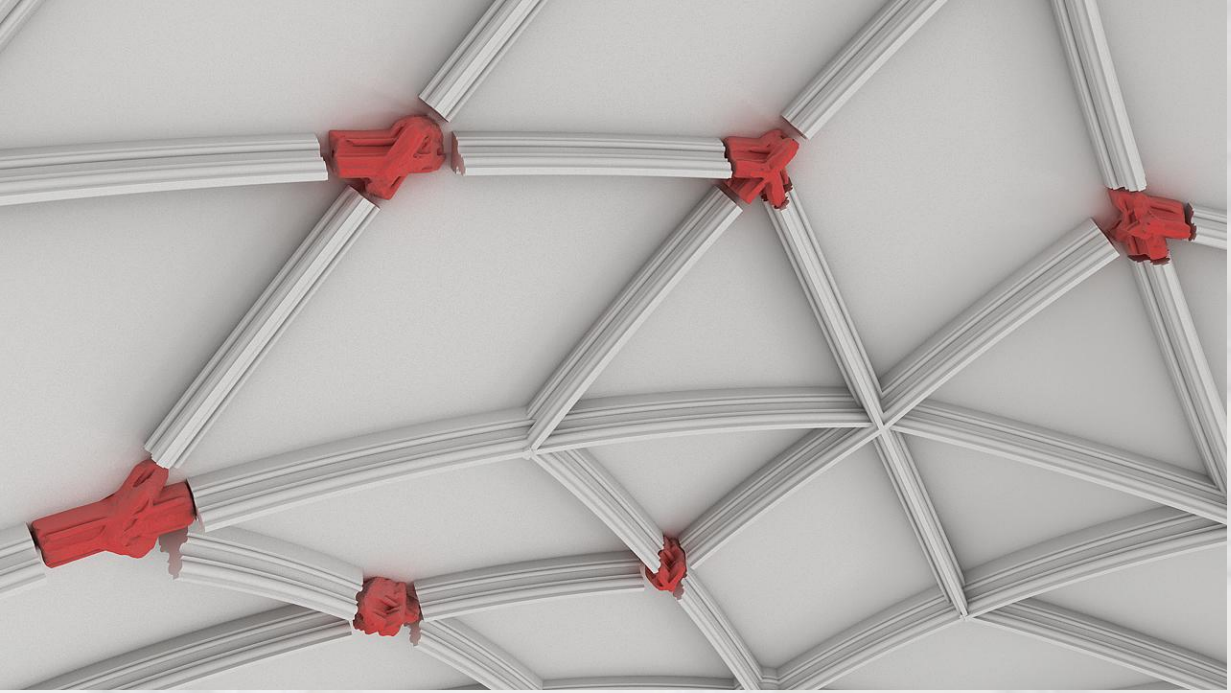
We come across this vault type in German speech area in numerous places. Most significant example of this is the vault of Marktkirche standing in Halle an der Saale, but we could mention numerous other examples, such as the sanctuary of the Lutheran church in Schorndorf or the sanctuary of Backnang Lutheran church and the cloister of Bebenhausen Abbey.



Hungary is in such a special situation, that the vast majority of the mediaeval building stock has been destroyed in the conditions of war lasting 150 years related to the Ottoman conquest between 1541 and 1686.

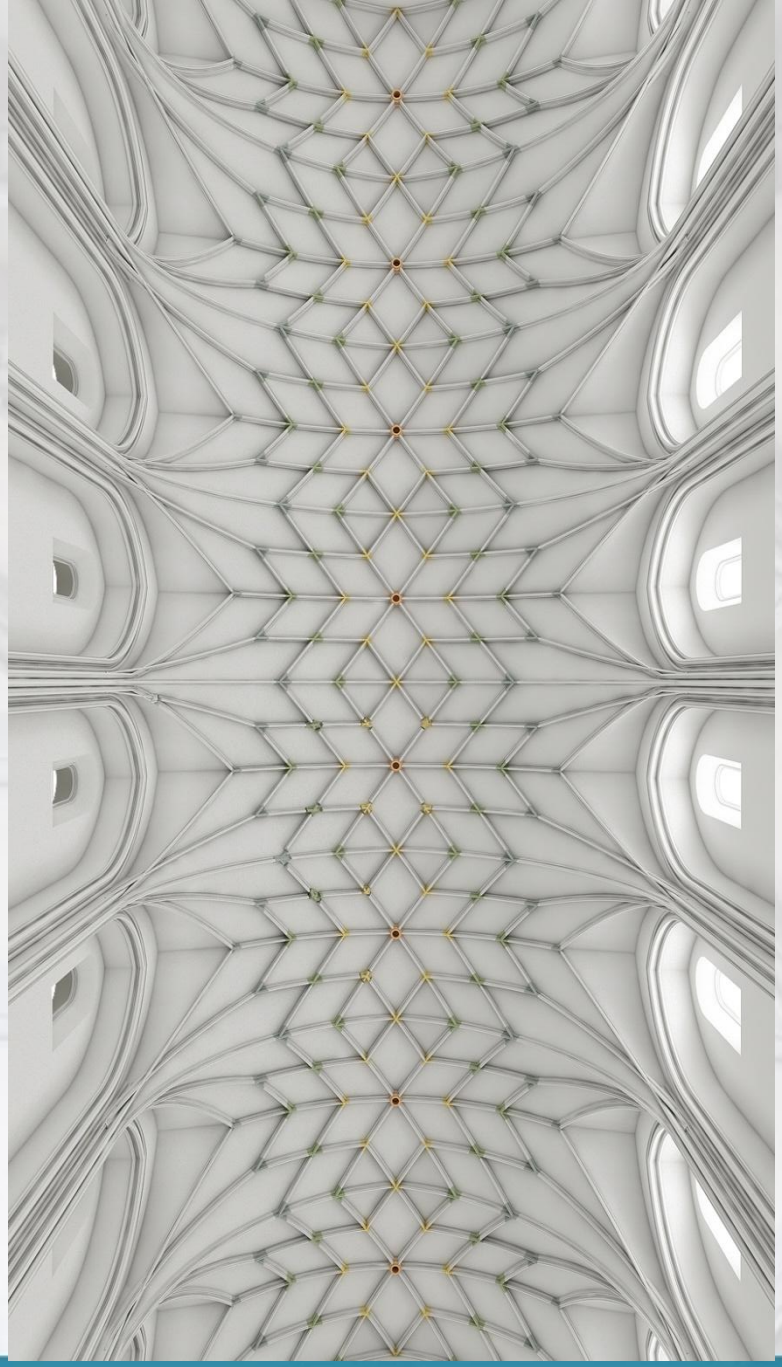
Thus the remains of many late gothic vaults from Hungary are only known thanks to archaeological digs.

Along the SziMe 3D Ar project we've had the opportunity to digitally record the stone sculptures from one of the most important buildings, Hungary's former coronation church, the Virgin Mary Provostry of Székesfehérvár, with the utilization of an laser object scanner.



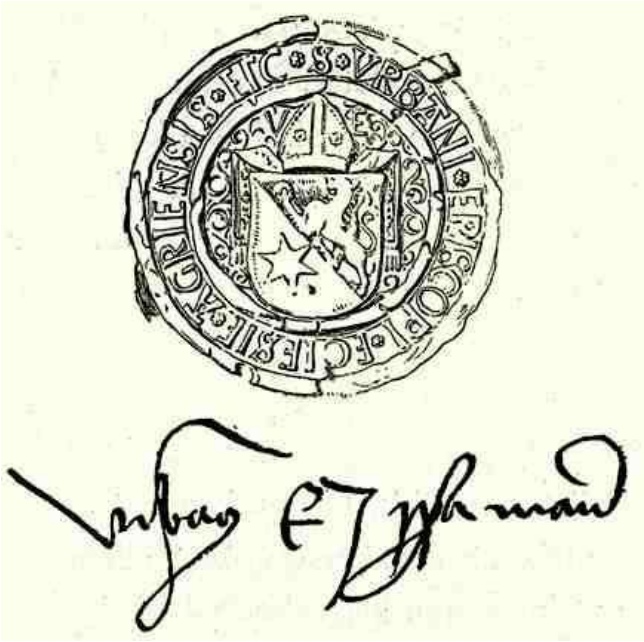
The theoretical reconstruction of the former net vault has been created in 2010 still based on manual surveying, and later the whole computer reconstruction was done as well based on the digital stone surveys. According to the surveys it can be proved that horizontal ribs have been used in the structure as well.

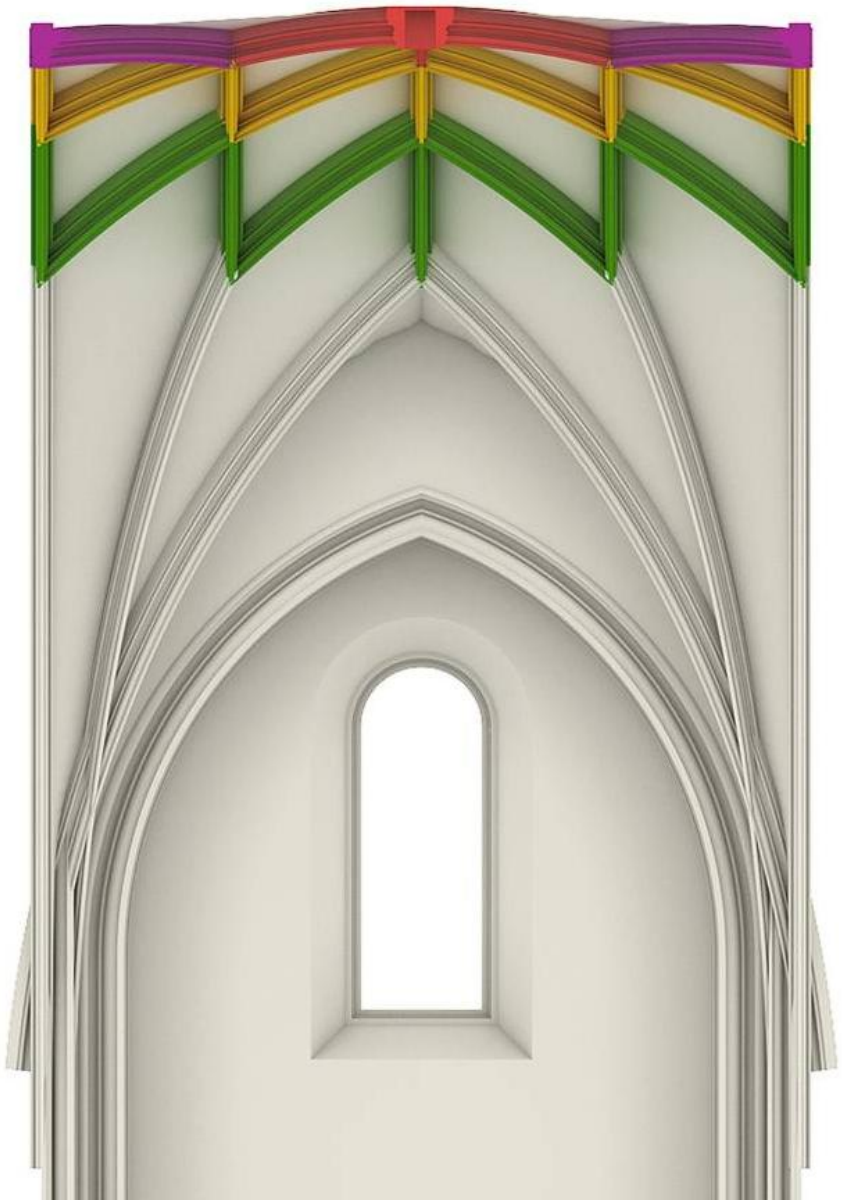
Theoretical reconstruction
and CAD model: Balázs Szőke



The construction of the vault in the basilica of Székesfehérvár is relatively well documented: The work was started in the second half of the rule of King Mathias Corvinus, in 1483 the roof of the church was rebuilt, this could be followed by the arching of the central nave which was already done in 1490 when the king was laid to rest in the church.

Mathias has also taken up building a late gothic hall choir with ambulatory and radiating chapels following South German design, but this has probably never been finished, the walls were pulled up most certainly only to the level of the radiating chapels. According to some data from 1483 the economic management of the construction financed by the king, was the task of chamberlain Orbán Nagylucsei.





The vault of Székesfehérvár also belongs to the rhomb net vaults mentioned before, in which it is not typically necessary to use horizontal ribs. This solution appears frequently in such vaults of Burkhart Engelberg and his world where triangular arch bays have been built into the rib grid.

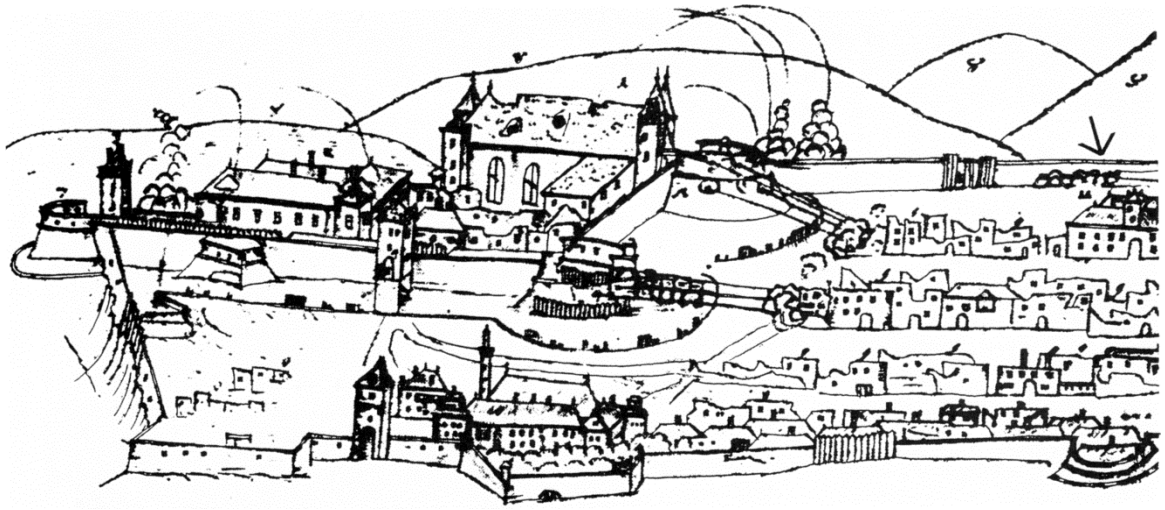
These structures are typical transitions between stellar vaults with separated vault segments and homogeneous net vaults. Or similarly to the design used in Schwäbisch Hall, where these were constructed with a rib grid not symmetrical to any of the axis.

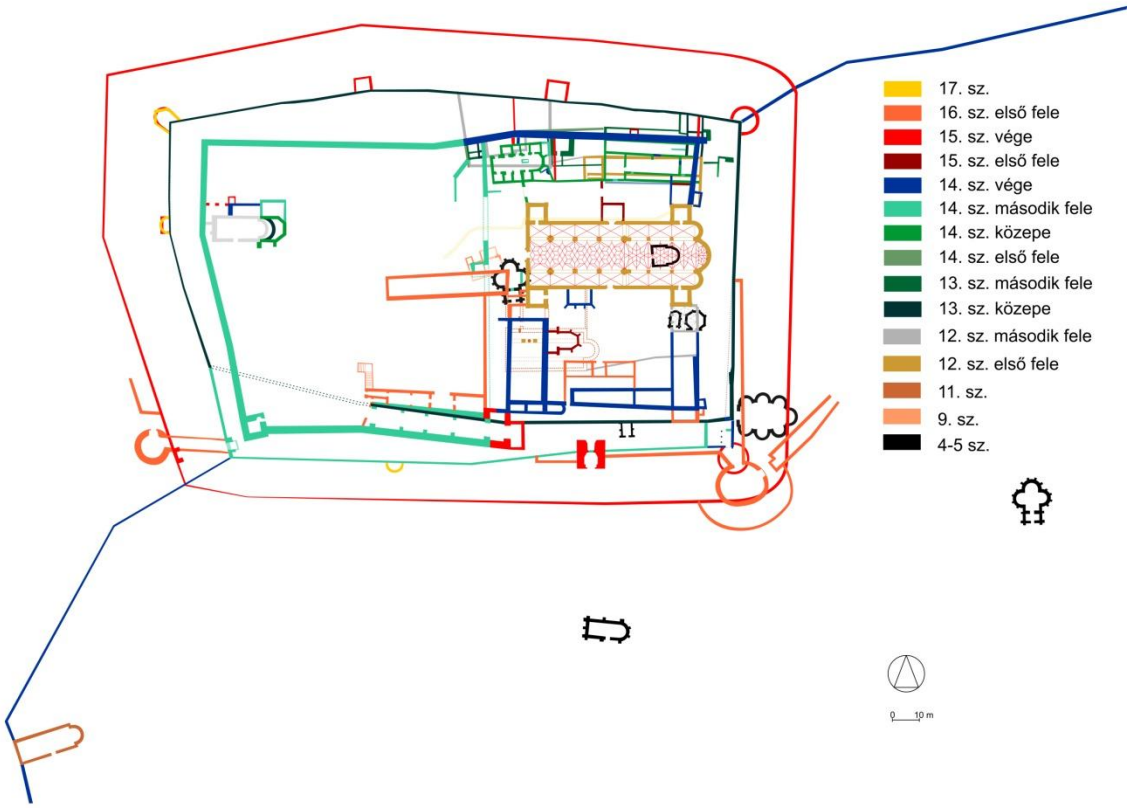
Burkhart Engelberg
1447- 1512

Pécs episcopal castle, Theoretical reconstruction and CAD model: Gergely Buzás

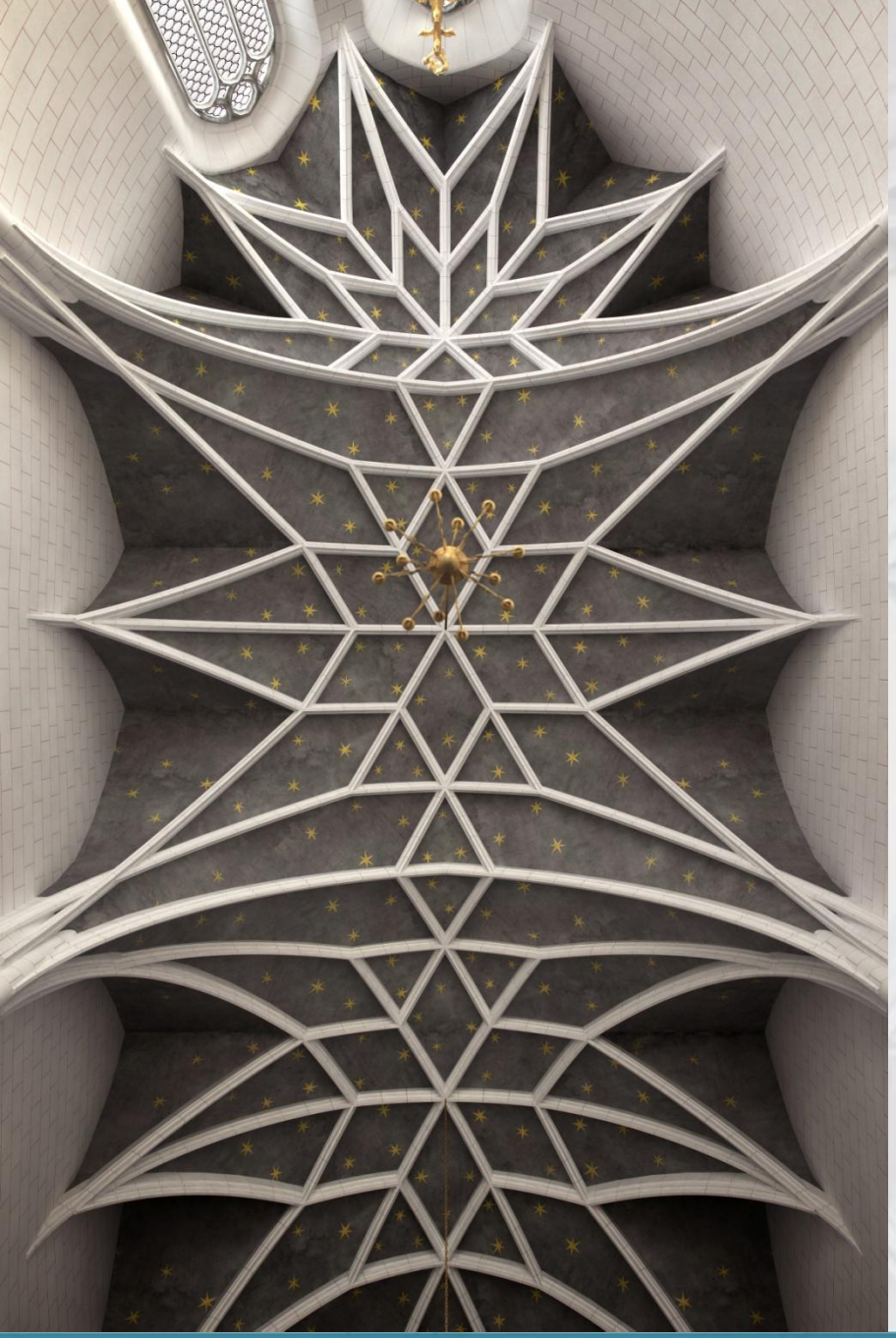
3D reconstruction: Pazirik Ltd.

Such vault structures were built once in Pécs, in the cathedral and the former Dominican monastery church.
The orderer of these constructions was Bishop Sigismund Ernuszt.



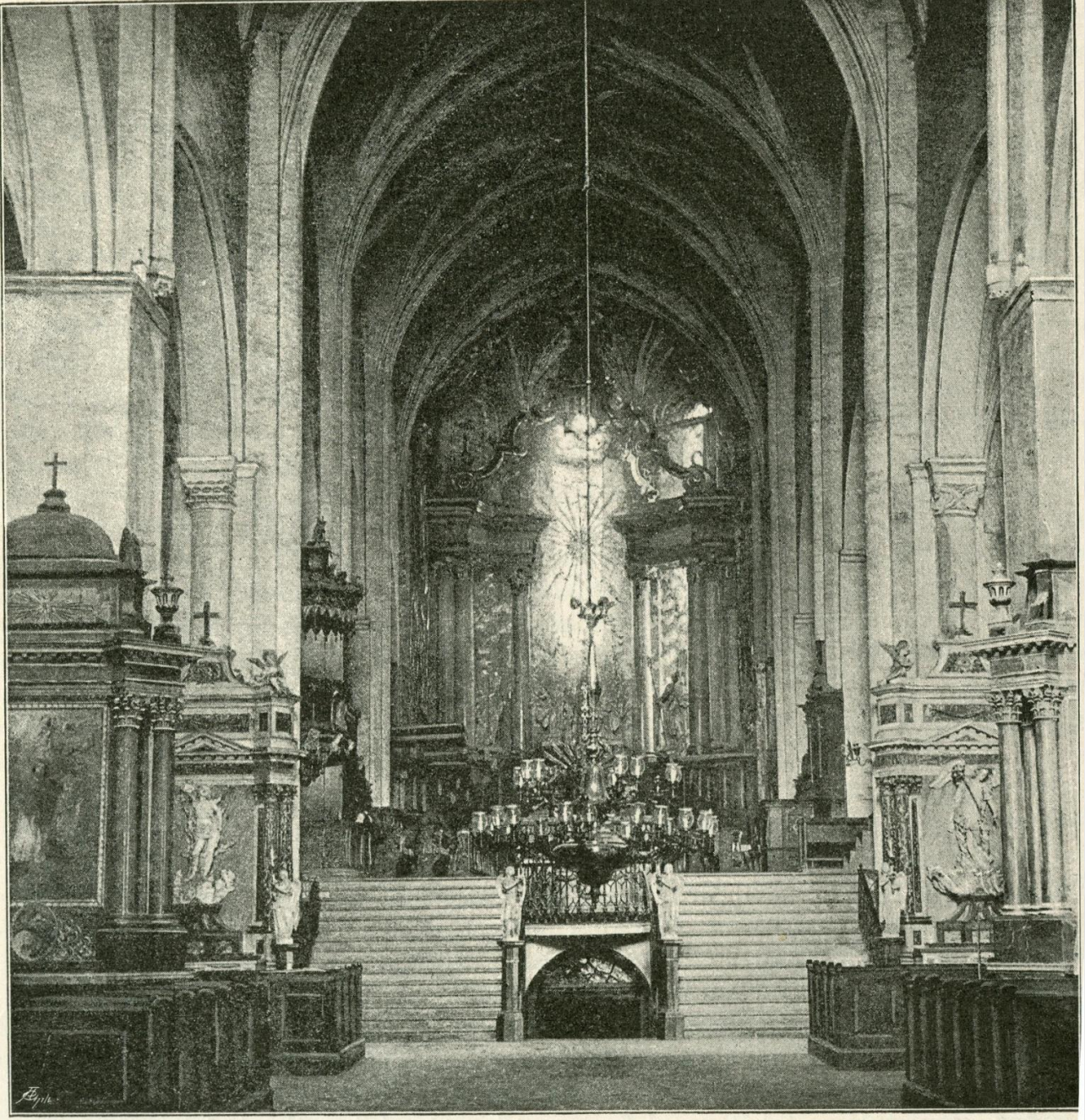


The construction of the episcopal castle in Pécs was already under way in 1498 according to a dated crest sculpture, the central nave vault of the cathedral was said to be ready in 1500.



This was followed by the construction of the sanctuary vault: we know from 19th century copies the painted inscriptions once visible below the vault, on the sanctuary wall raised during the construction, recording the date 1505, the finishing of the construction and the name of master mason Demeter.
The builder bishop became the victim of homicide in this same year also.

Pécs Chatedral choir vault
Theoretical reconstruction and CAD model: Balázs Szőke
3D reconstruction: Pazirik Ltd.



Zelemy K. udv, fényk.

The vaults of the choir in the cathedral existed till 1882. It has been demolished during the Neo-Romanesque style, purist minded restoration of the cathedral. We are in possession of photographs of it and also the surveys of the structure remain by an architect from Vienna, Friedrich Schmidt.

The stone sculpture material of the nave vault in the Dominican monastery similar in structure with the choir vault of the cathedral is known from archaeological excavations. György Szekér who reconstructed the vault related both vaults to the world of Burkhart Engelberg.

Burkhart Engelberg: Saint Ulrich and Afra in Augsburg

https://en.wikipedia.org/wiki/St._Ulrich%27s_and_St._Afra%27s_Abbey#/media/File:Augsburg_Afra.jpg

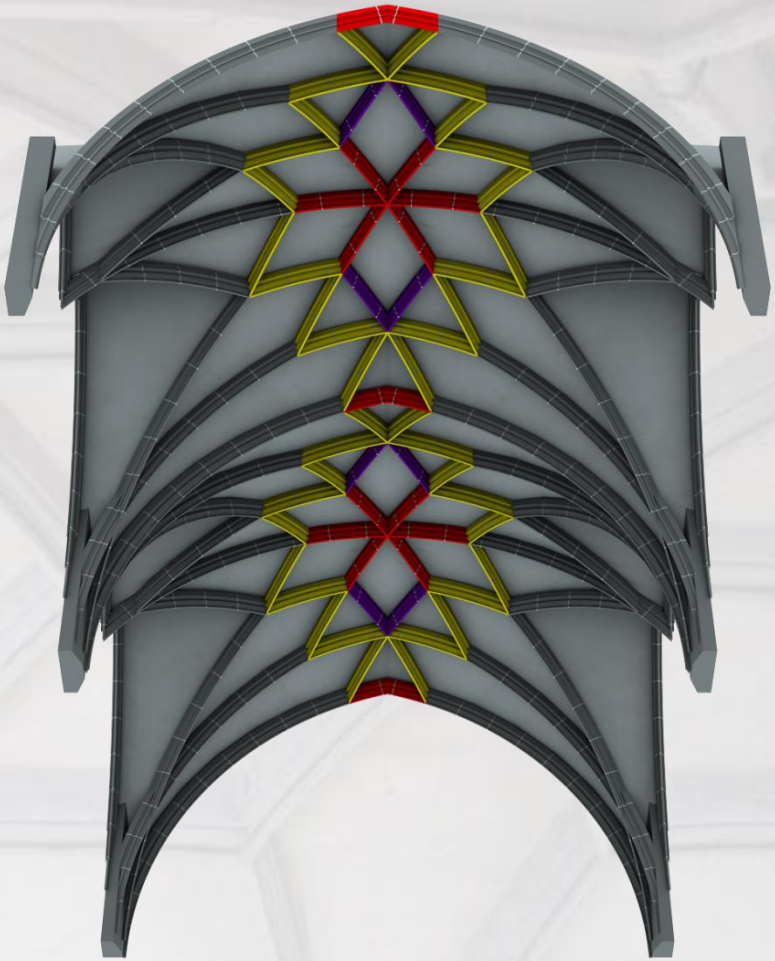
Dominican Church in Pécs
Theoretical reconstruction: György Szekér
CAD modell: Balázs Szőke
3D reconstruction: Pazirik Ltd.

Augsburg

Pécs

The vaults from Pécs are squarely related to the structural solutions of the nave vault in the basilica of Saint Ulrich and Afra in Augsburg: they represent a richer variant of these.
The horizontal ribs appear in the structure with exactly the same function, like the ones in Augsburg.

Augsburg

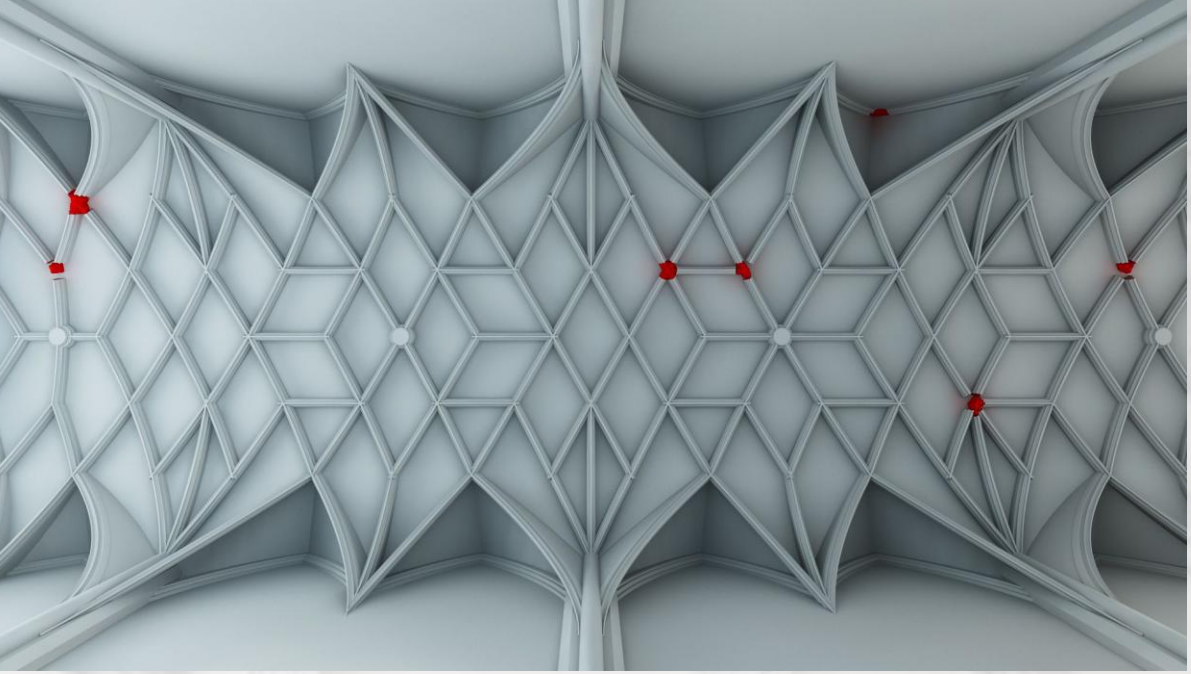


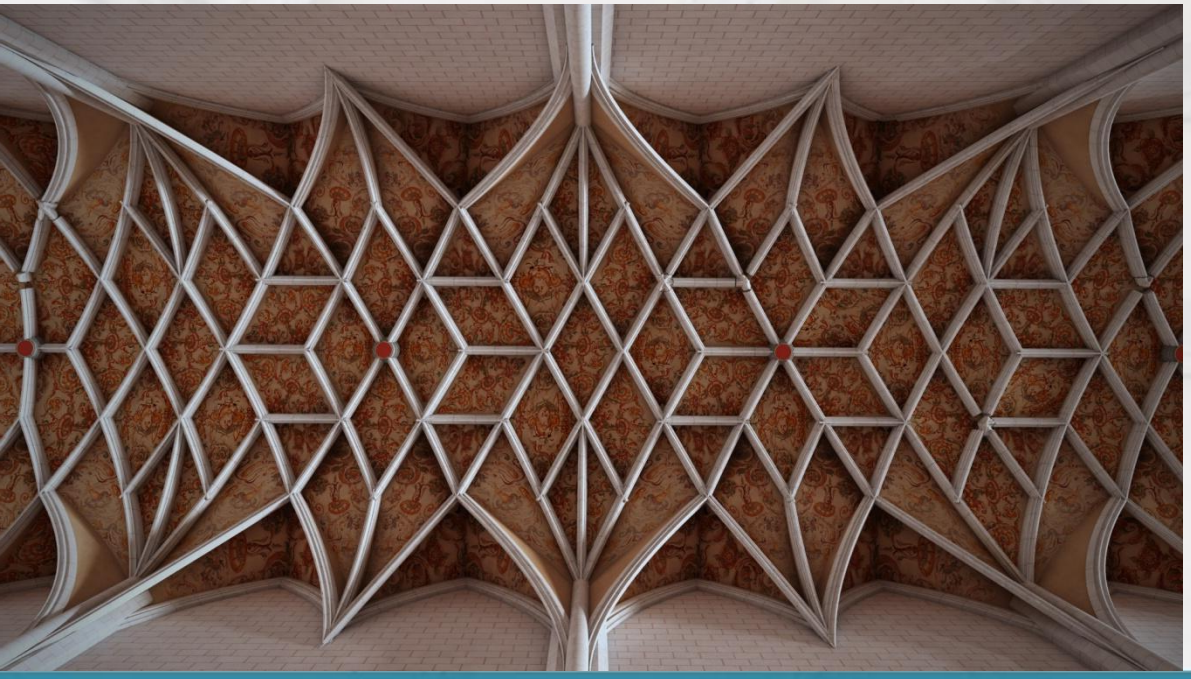
Pécs

Archaeological research in Pécs 2011

Gergely Buzás

Numerous carved stones from the former nave vault of the cathedral have been found in 2011 in Pécs. In many cases we can see the connection spot of the horizontal rib on the intersection elements.





The theoretical reconstruction of the former nave vault has been created based on the scanner surveys of the carved stones.

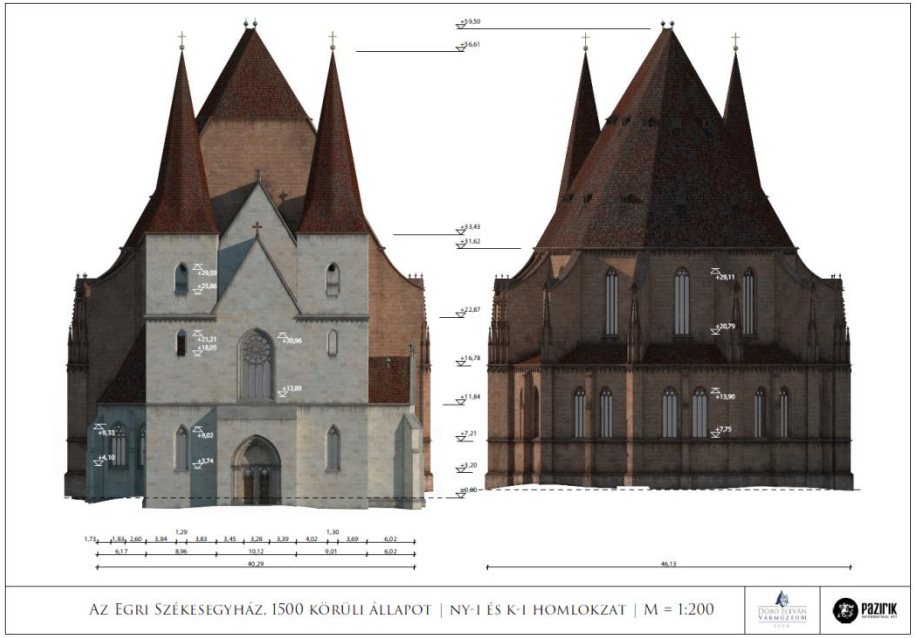
Pécs Chatedral nave vault
Theoretical reconstruction and CAD model: Balázs Szőke
3D reconstruction: Pazirik Ltd.

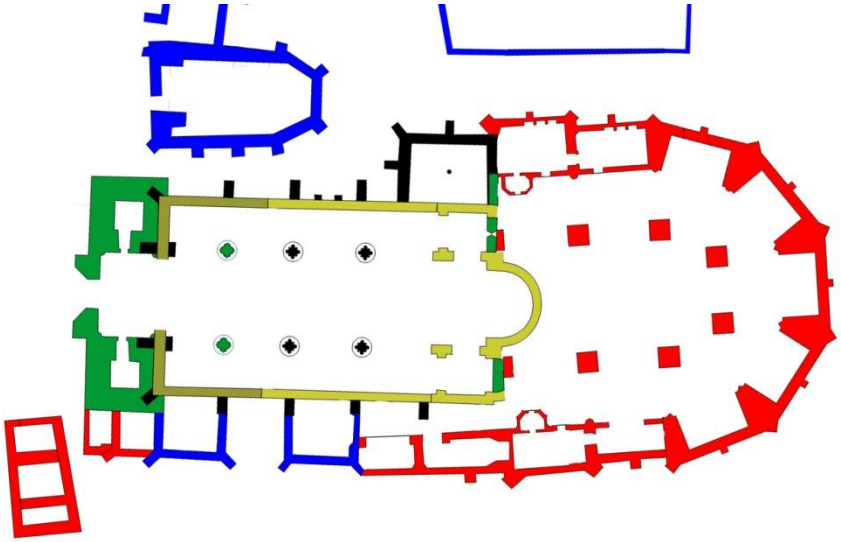
The nave vault did not belong in the type of choir vaults, but rather into such a vault system, like the vault of the church in Szeged lower town built in 1503.

Chamberlain Orbán Nagylucsei playing an important role in managing the late gothic construction works in Székesfehérvár, gained the bishopric of Eger in 1486 and following this he started rebuilding the cathedral of Eger. He built a hall choir with ambulatory and radiating chapels behind the old church similarly to the one in Székesfehérvár.

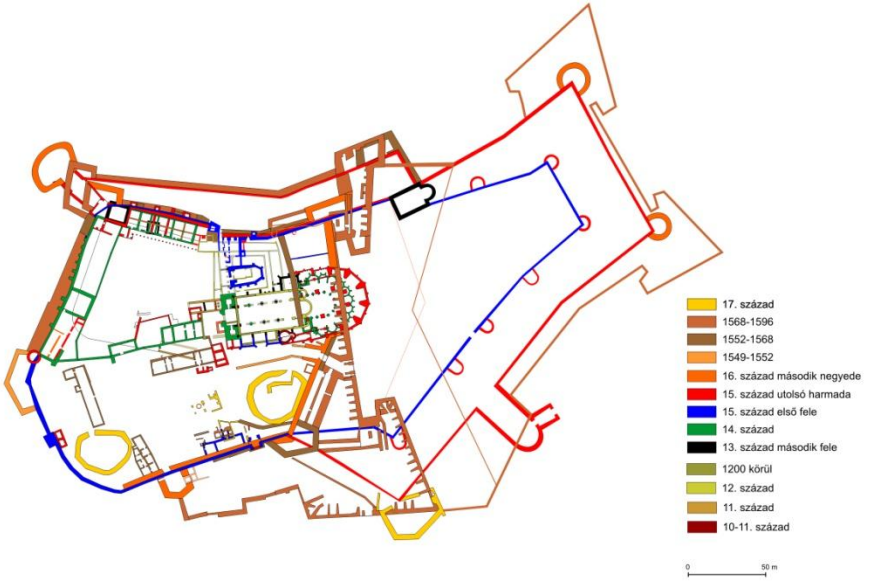
Eger Chatedral
Theoretical reconstruction and CAD model: Gergely Buzás
3D reconstruction: Pazirik Ltd.

The construction was continued by Tamás Bakócz after the death of Orbán in 1491, but the work slowed down after he left and only ended in 1508, after a firestorm in 1506. The construction of the vault probably ended at the same time as well.





A certain part of the wall from the hall choir and the buttresses separating the naves, demolished in the decades following 1542, after the hall choir burnt down, survived in the earth fill of the fortifications built in its place.
The stone sculptures of it have been built into the castle walls.



During the archaeological research numerous intersection elements of the sanctuary vault appeared, so the former building can be reconstructed in a great part. We are currently working on this.

The model created based on the manual surveys of the carved stones from the vault in Eger will be refined in the near future based on the Photogrammetric surveys done by Pazirik Informatics Ltd. Previously in the Székesfehérvár, Pécs and Visegrád projects we used laser scanners, and we created DWG-DXF files from the received data, these files can be directly used along CAD modelling.

We've used photogrammetry earlier at many archaeological excavations. As an outcome of the research currently being carried out, it seems that photogrammetric surveys will be accurate enough in the case of carved stones for adequate measurements.

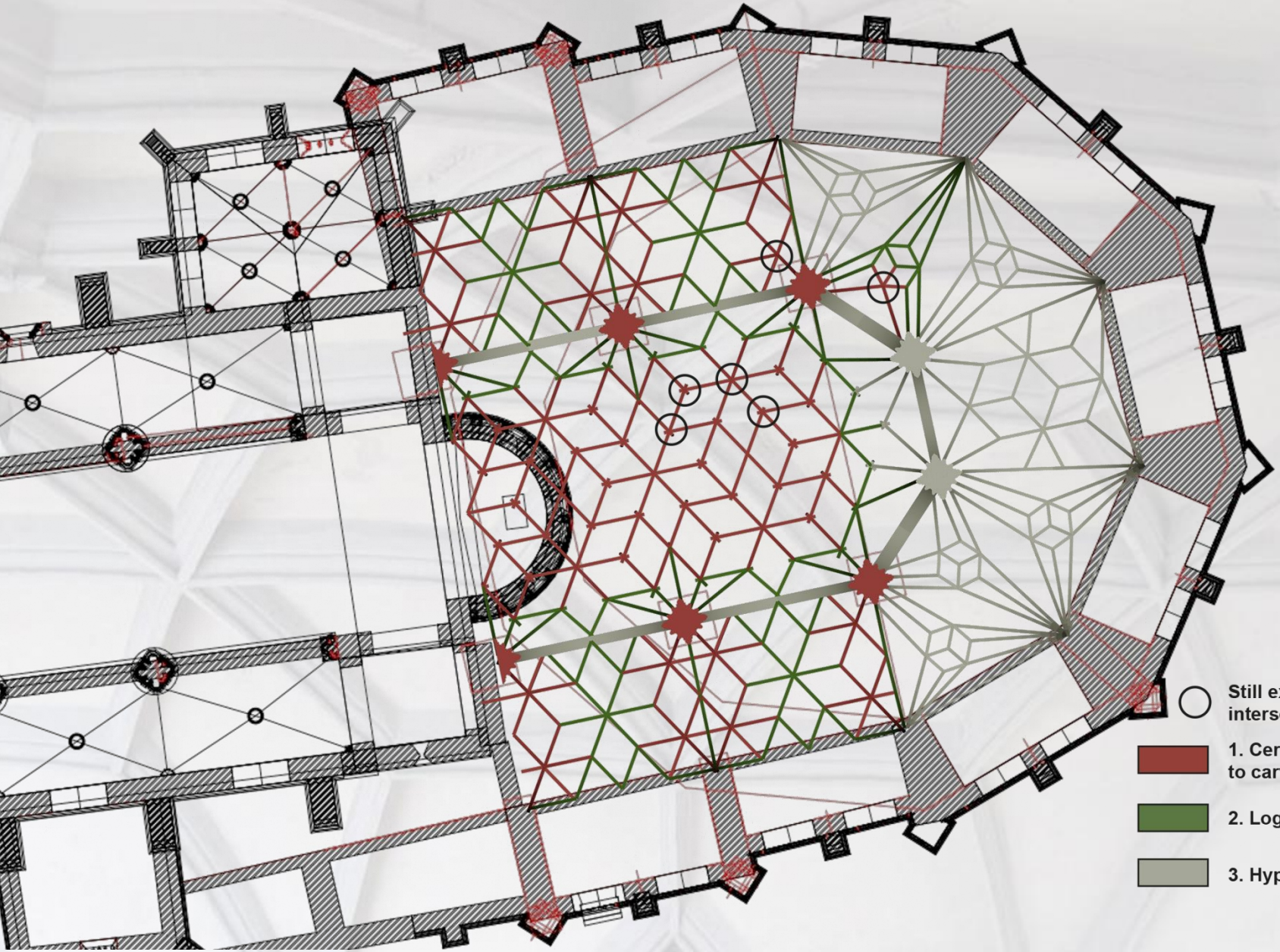


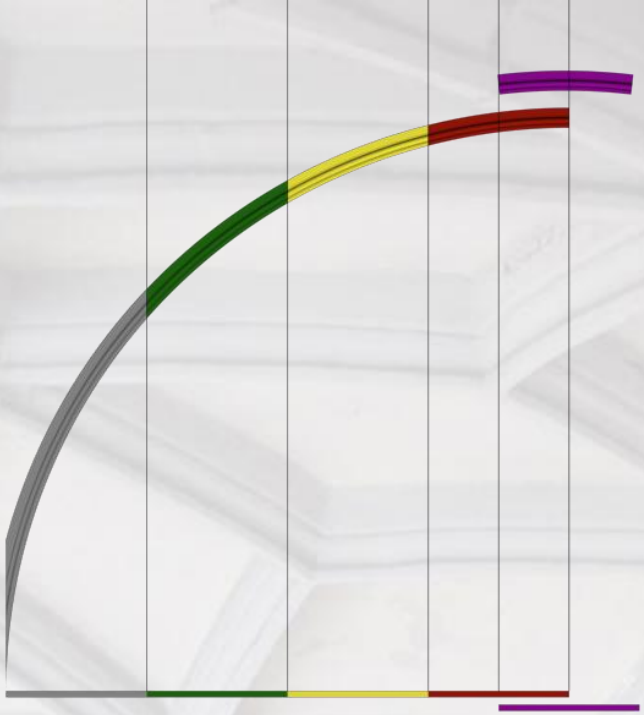








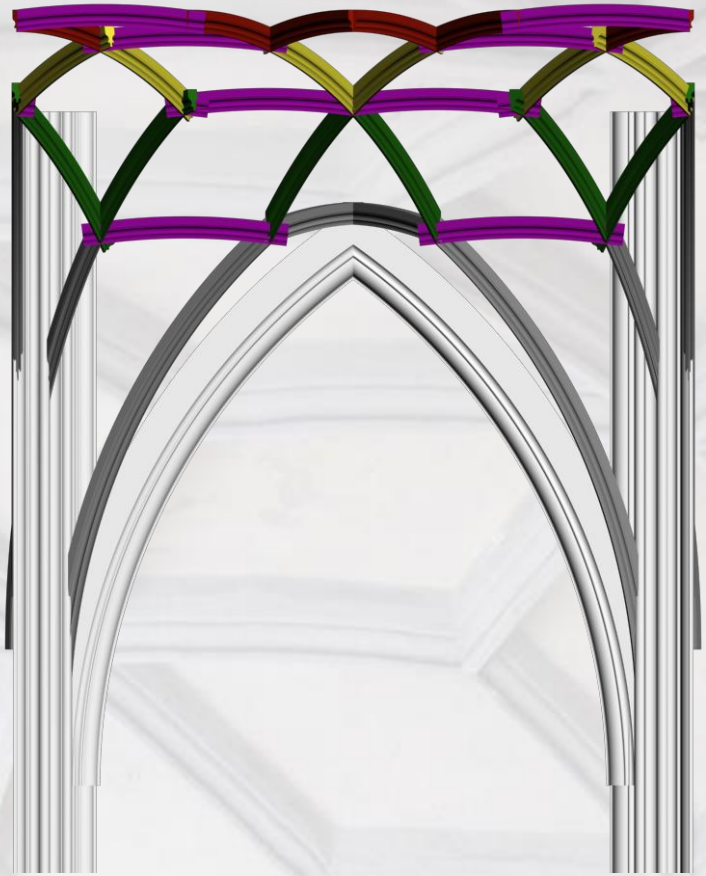

Still existing intersection types
1. Certifiable according to carved stones
2. Logical hypothesis
3. Hypothesis / perished

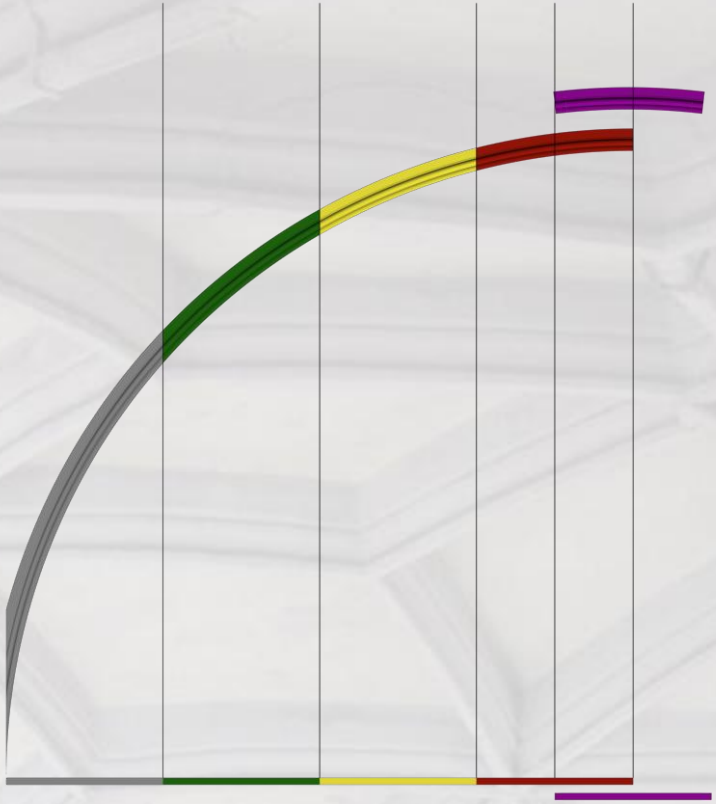


The construction curve of the vault in Eger with marking the construction of horizontal ribs

Cross section of the central nave vault from the Cathedral of Eger

According to the theoretical reconstruction editable based on the stone fragments

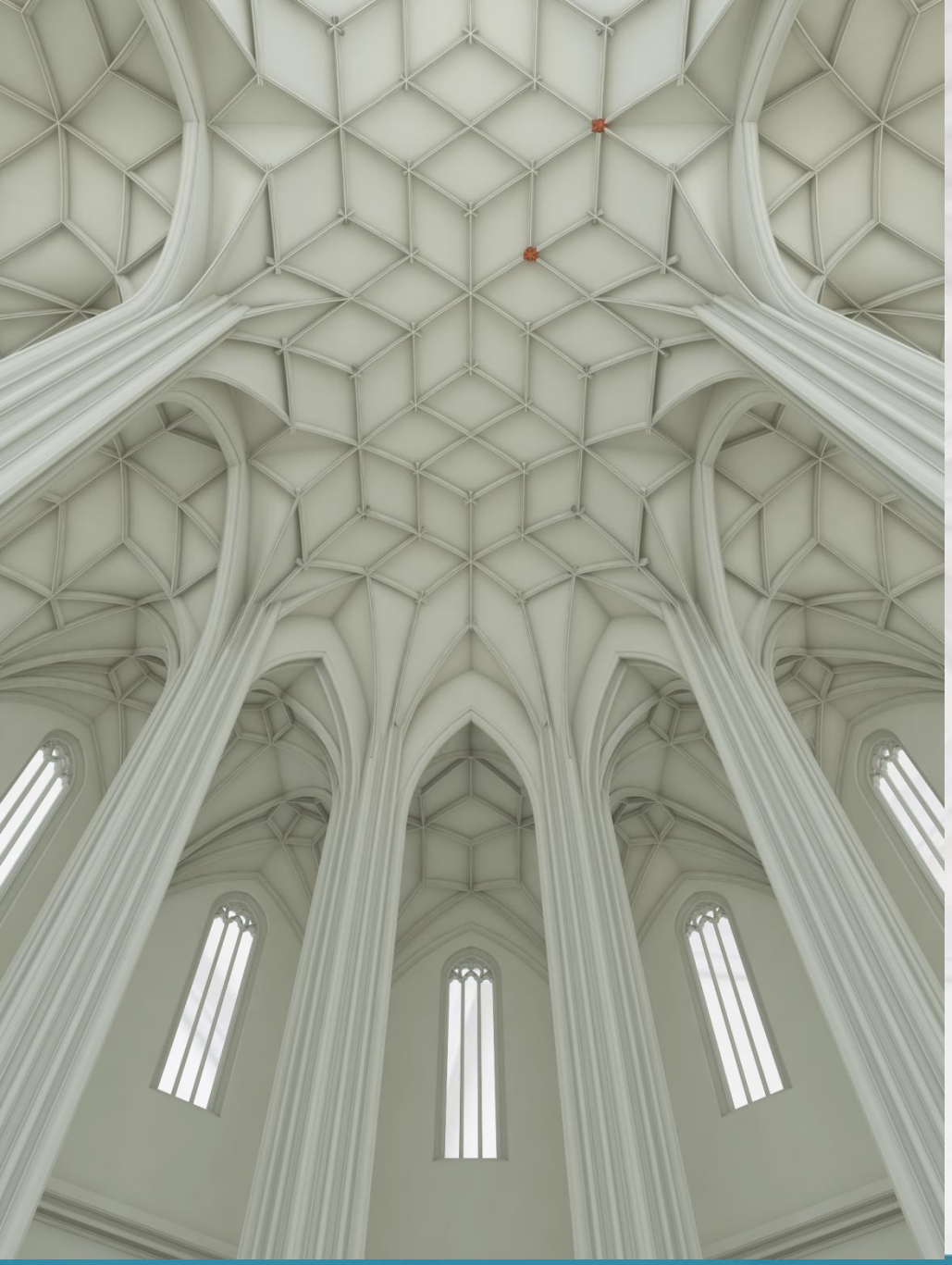




The construction curve of the vault in Eger with marking the construction of horizontal ribs

Longitudinal section of the central nave vault from the Cathedral of Eger

According to the theoretical reconstruction editable based on the stone fragments



Eger Chatedral interior

Theoretical reconstruction and CAD model: Balázs Szőke

In Eger a net vault system using horizontal ribs similarly to the one in Szeged can be reconstructed in the central nave of the choir of the cathedral.

According to written sources it seems that the construction can be related not only to the one in Székesfehérvár but also to the one in Pécs. In 1495 a foreman named Demeter appears in the episcopal account book among permanent employees of the diocese.

Eger episcopal castle
Theoretical reconstruction and CAD model: Balázs Szőke, Gergely Buzás, György Domokos
3D reconstruction: Pazirik Informatics Ltd.

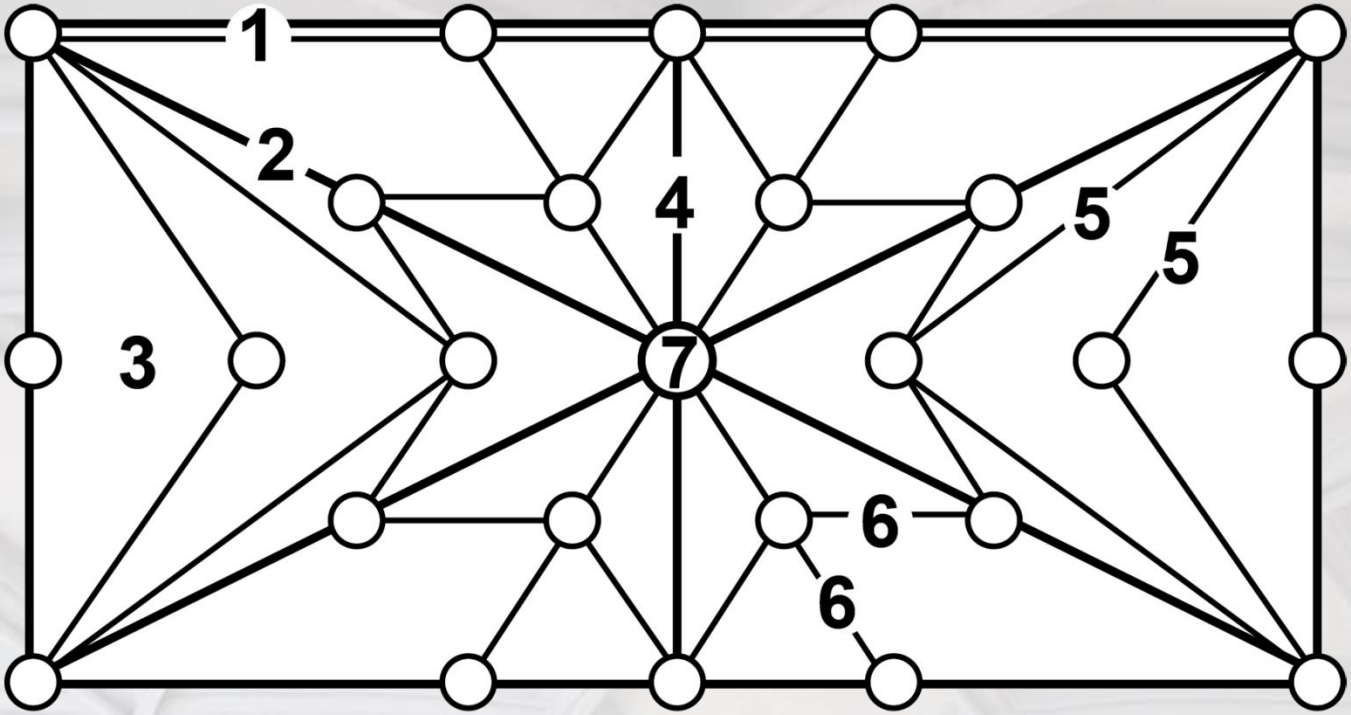
The relative rarity of the name and the traceable relation in form between the vault in Eger and the one in Pécs signed by a master mason called also Demeter brings up the possibility that in Eger in 1495 this master mason appeared who worked in Pécs 10 years later.
In this case we can assume that master mason Demeter's carrier started at the construction in Székesfehérvár in the first half of the 1480s.

Eger Chatedral

In this case we can assume that master mason Demeter's carrier started at the construction in Székesfehérvár in the first half of the 1480s. Maybe he got introduced to the newest achievements of South German vault building there, and he could have got to Eger via Bishop Orbán Nagylucsei in the second half of the decade, from where he could have left to Pécs after the slowing of work in 1497. There he has built up the nave vault of the cathedral till 1500, and the choir vault till 1505. His workshop arched the nave of the Dominican church too. We can't exclude that his workshop played some kind of role in building the nave vault of the Szeged lower town church in 1503, because the limestone material of the rib intersection elements of the vault in Szeged show a markable similarity with the fine limestone used for the vaults in Pécs.

An important trade rout connected these two cities in these times.
Maybe the peculiar material choice of the vault in Szeged can be explained in this way: the limestone intersection elements could have been ordered from the workshop in Pécs, while the simple ribs were created in Szeged from radius bricks.
Demeter or one of his apprentices could have returned to Eger from Pécs after the death of Bishop Sigismund in 1505, because of the restarting work in Eger in 1506 to finish the sanctuary vault in 1508.

In the late gothic architecture of the Hungarian Kingdom, beside other vault types those net vaults had an outstanding role, which also had horizontal ribs in their construction. These vaults can be classified in the „Maschennetz Gewölbe" type in the German technical literature.
Their construction is typical from the 1480s, but most of these structures were built in the beginning of the 16. century.



1. Traverse rib
2. Diagonal rib
3. Traverse ridge-rib
4. Longitudinal ridge-rib
5. Tiercerons
6. Liernes
7. Boss

The "horizontal rib" is similar structurally to the English ribs called "longitudinal ridge ribs", though the builders did not solely use such construction along the ridge of the vault.

"Schlingrippe" Siklós Castle

Thus we would like to suggest that this solution should get a separate label in the terminology, similarly to the "Schlingrippe" expression naming the twofold curving arc ribs in German terminology.

THANKS FOR THE ATTENTION

LECTURERS:

BALÁZS SZŐKE: historian - art historian - 3D graphic designer
/SziMe3DAR - Pazirik Informatics Ltd./

GERGELY BUZÁS: archaeologist - art historian
/Director of the King Mathias Museum in Visegrád of the Hungarian National Museum, SziMe 3DAR professional/

BALÁZS SZAKONYI: 3D graphic designer, graphic artist, translator
/Pazirik Informatics Ltd./

PARTICIPATED IN THE EXECUTION OF THE PROJECTS:

PAZIRIK INFORMATICS LTD.
ANDRÁS BALOGH / PROJEKT LEADER
MÁTYÁS VÉGH
GÁBOR MENYHÁRT
ANDRÁS PÁMER
MARTIN APPELSHOFFER
NORBERT SANDÓ

SZIME 3D PROJEKT SZIME 3D AR
ANDRÁS FEHÉR / PROJEKT LEADER
BOGLÁRKA LAKI
LÁSZLÓ PIPIS

PAZIRIK INFORMATIKAI KFT

AR SZIME3D

UOL IN LONDON, 14 JULY
THE UNIVERSITY OF LIVERPOOL IN LONDON,
FINSBURY SQUARE—SEMINAR ROOM 4