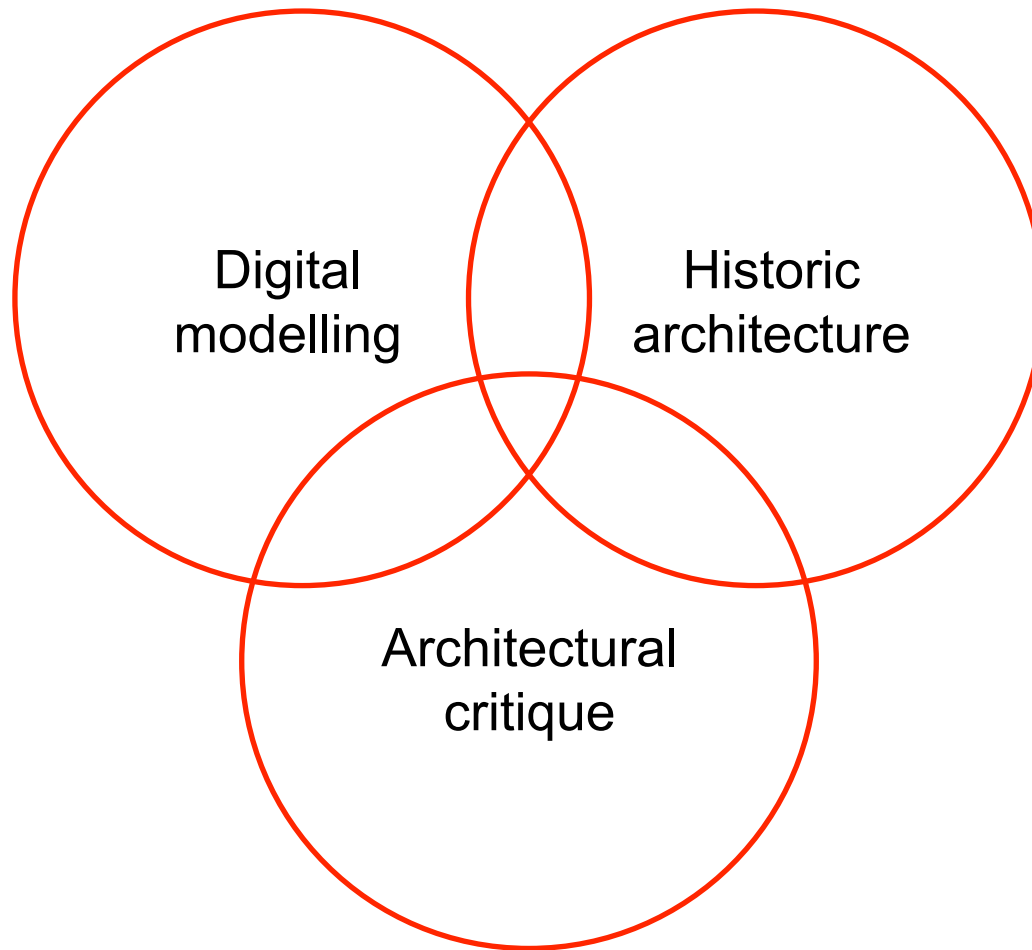


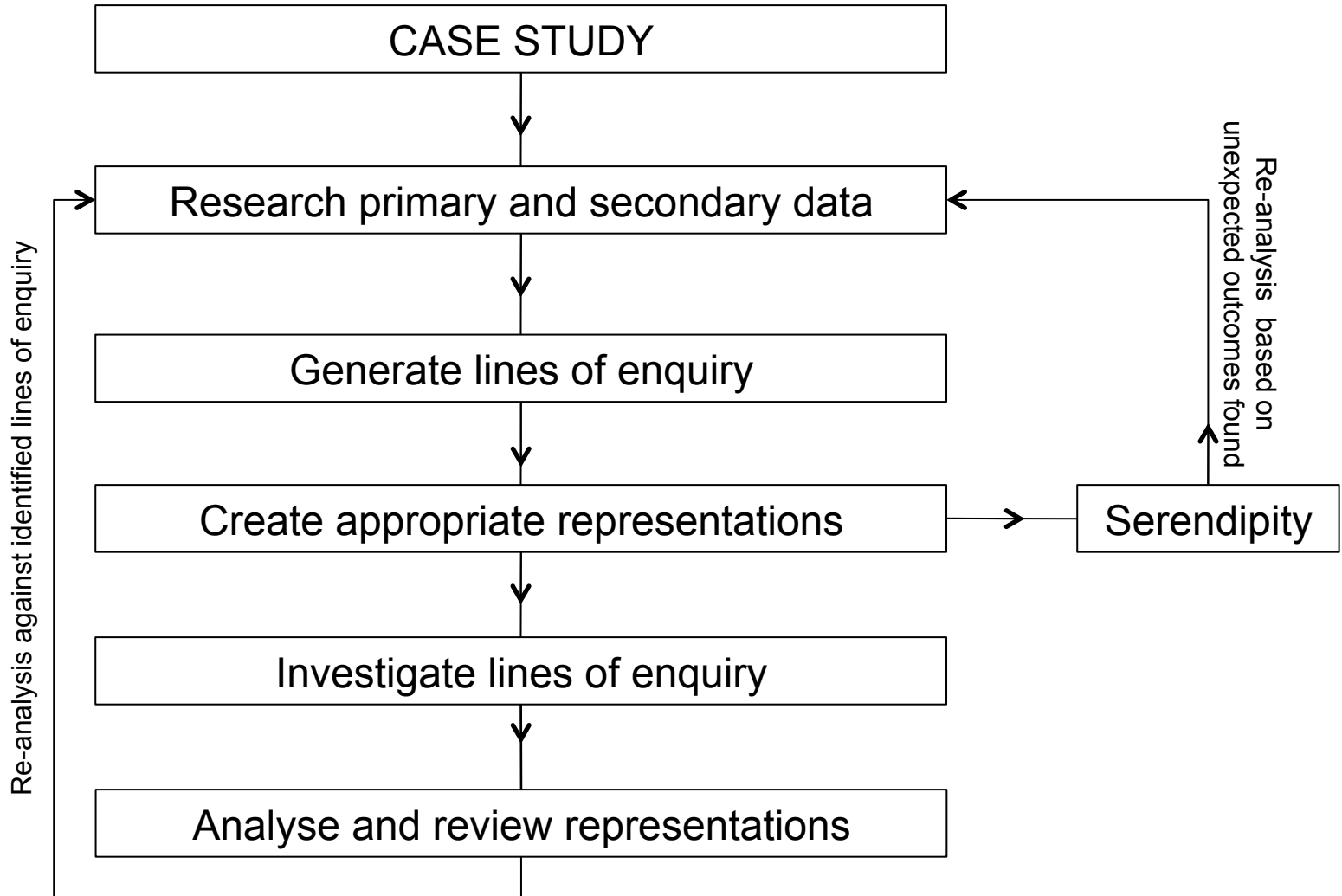
DIGITAL RE-ANALYSIS OF HISTORIC WORKS OF ARCHITECTURE

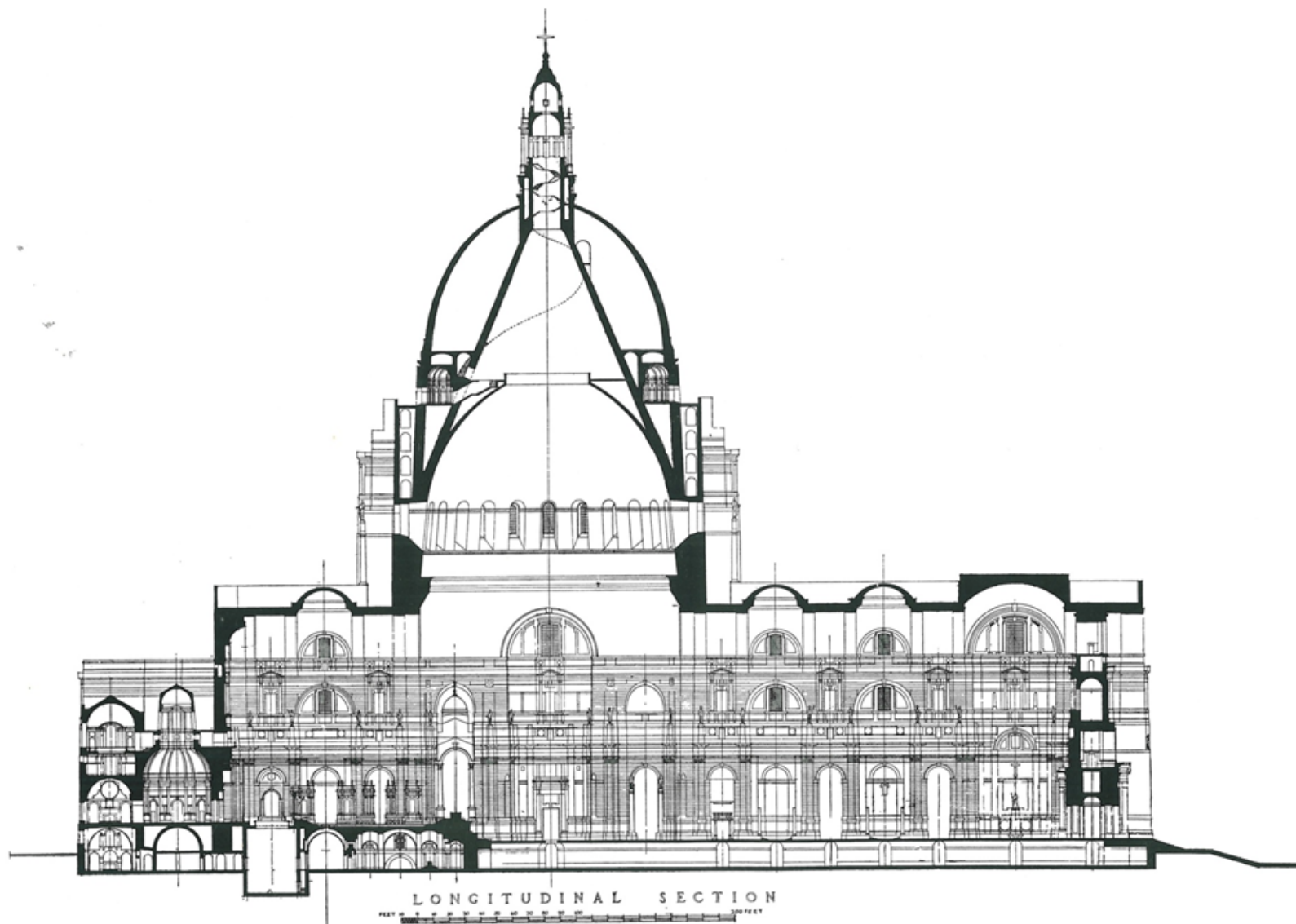
Dr Nick Webb
University of Liverpool
School of Architecture

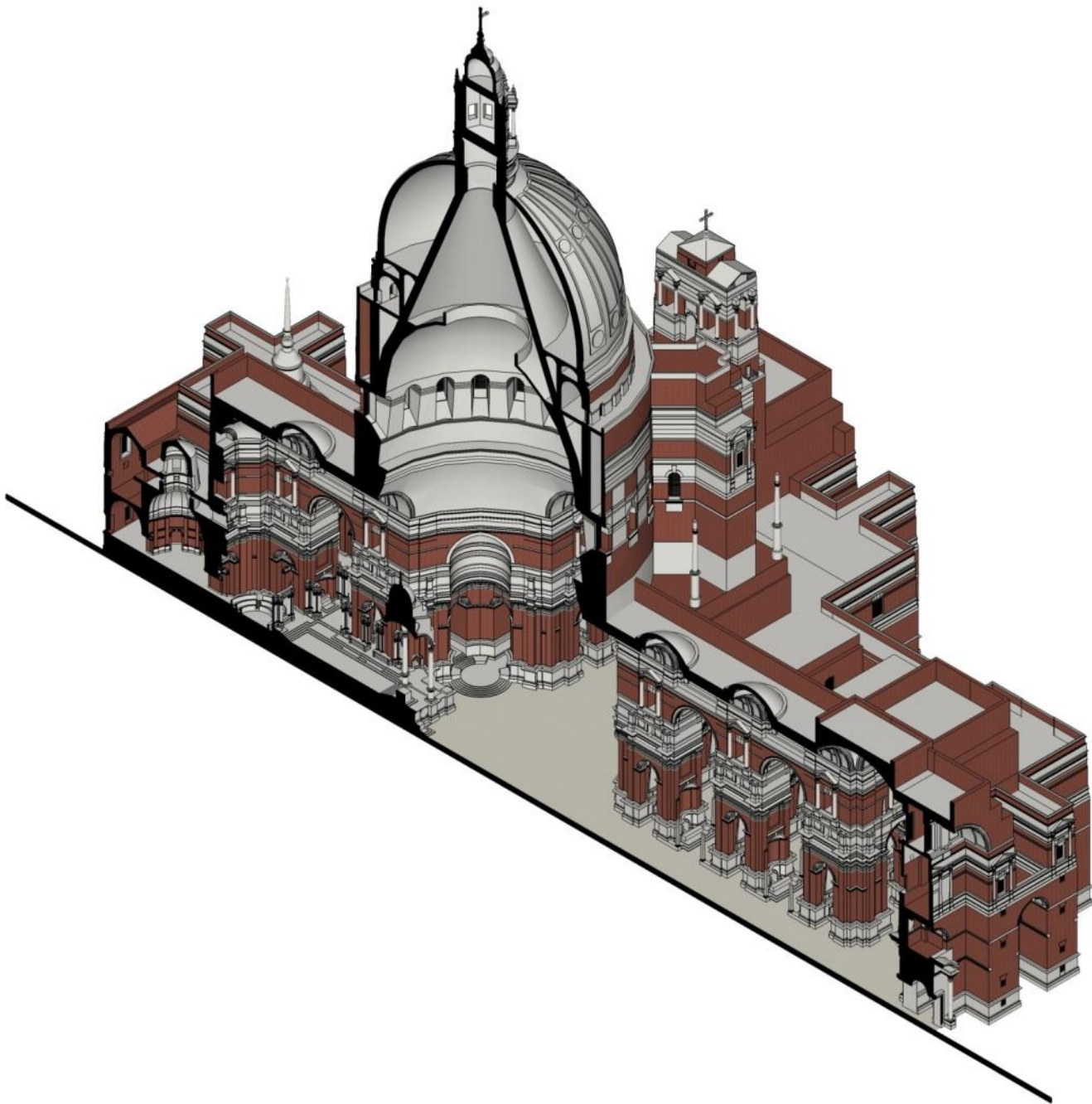


Digital re-analysis of historic works of architecture

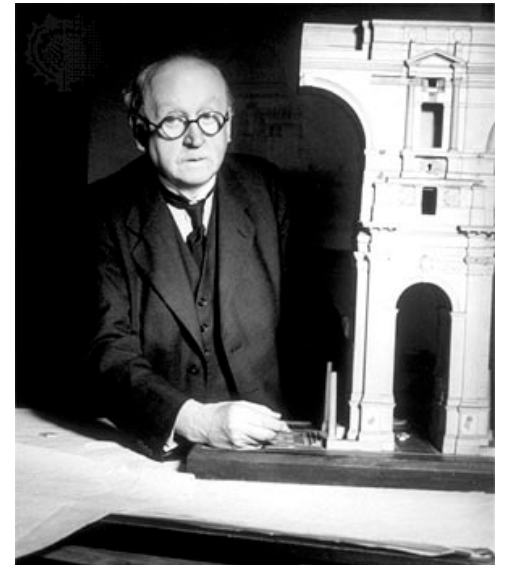
Methodology







Liverpool Metropolitan Cathedral (Sir Edwin Lutyens)

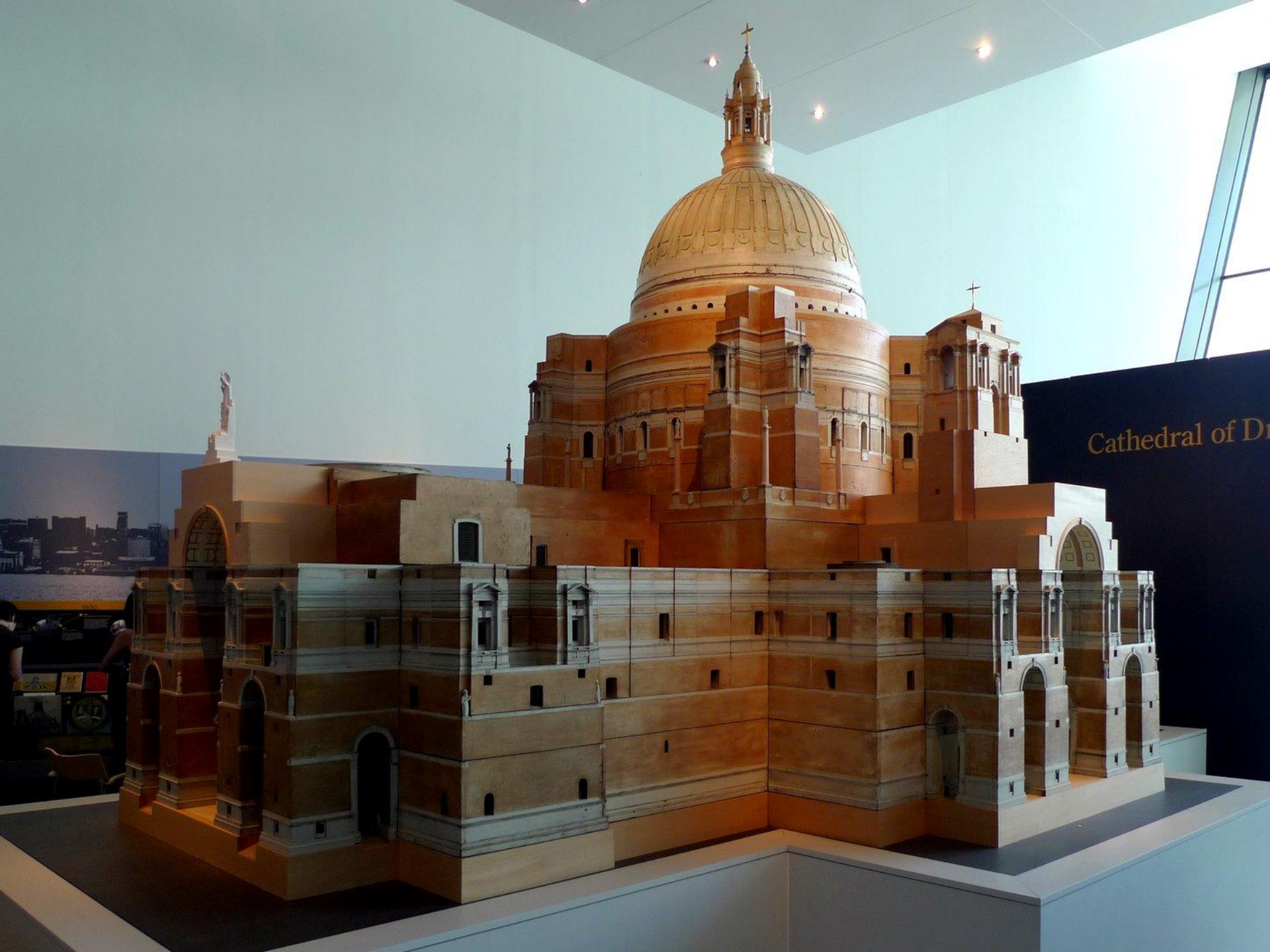


Liverpool Metropolitan Cathedral

Designed by Sir Edwin Lutyens; the cathedral would have been one of the largest places of worship in the world.

Construction began in 1933 but was suspended in 1941 due to wartime restrictions.

In 1959 an architectural competition was announced to design a cathedral incorporating the crypt; won by Sir Frederick Gibberd.





Why Liverpool Cathedral?

A large amount of literature has been written about the design therefore generating of lines of enquiry is possible.

The cathedral design is significant to the history of Liverpool.

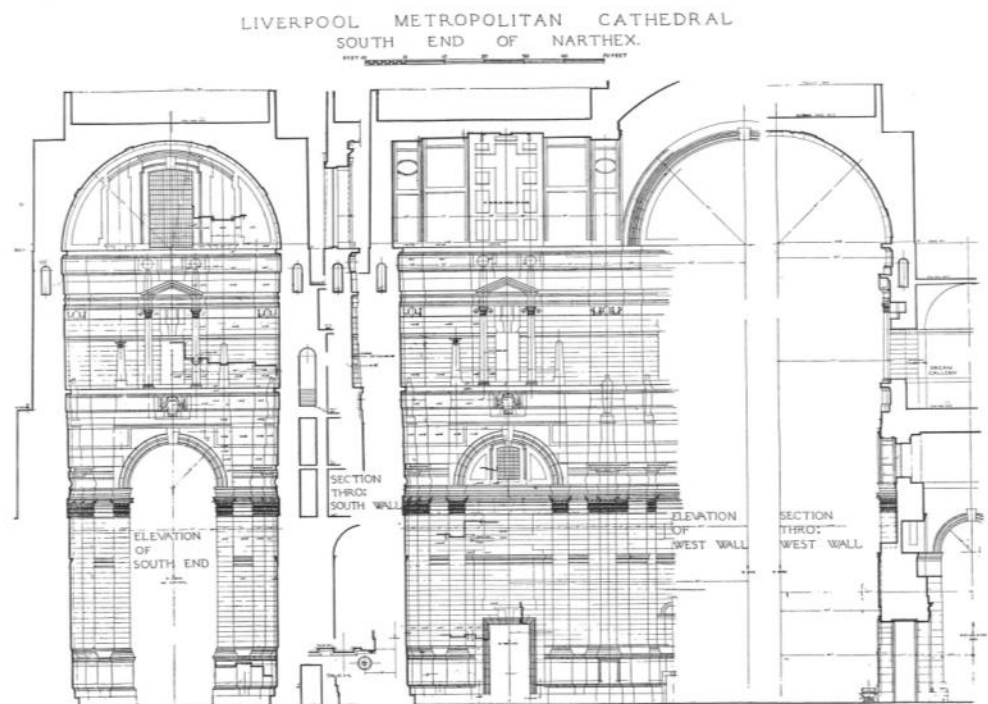
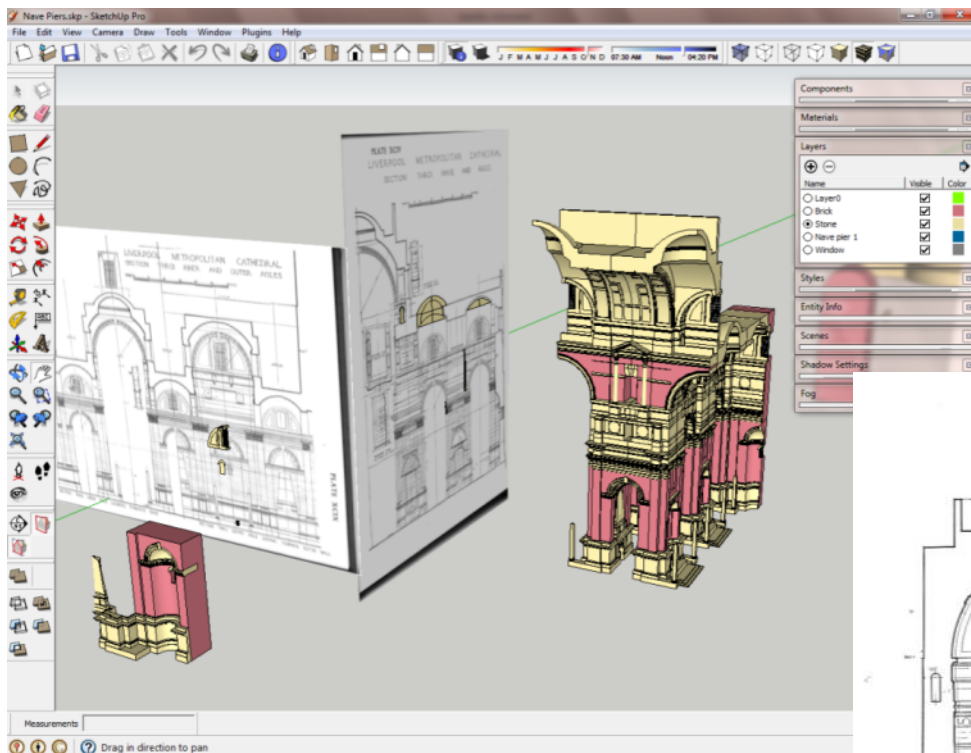
Ease of access to archive
information and other
primary data.



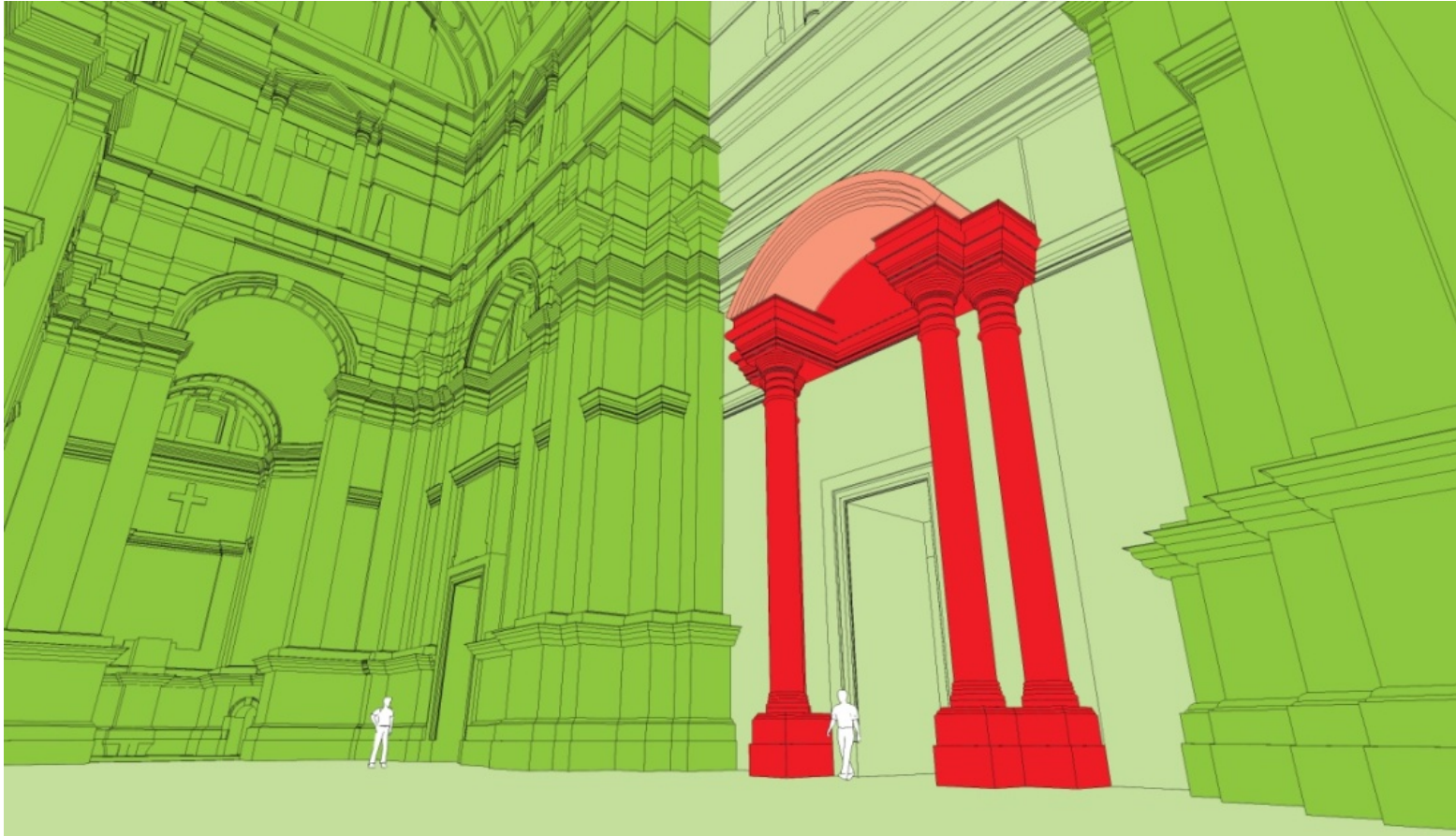
Generating lines of enquiry

- 1) Development of design from 1929 to 1934.
- 2) Internal geometry of the cathedral.
- 3) Lighting of the cathedral.
- 4) Geometric comparisons to the Thiepval Memorial.
- 5) Lutyens' original crypt design compared to Scott's version.
- 6) Counterfactual history.
- 7) Auralisation of the cathedral organ.

Create appropriate representations



Ambiguity and uncertainty



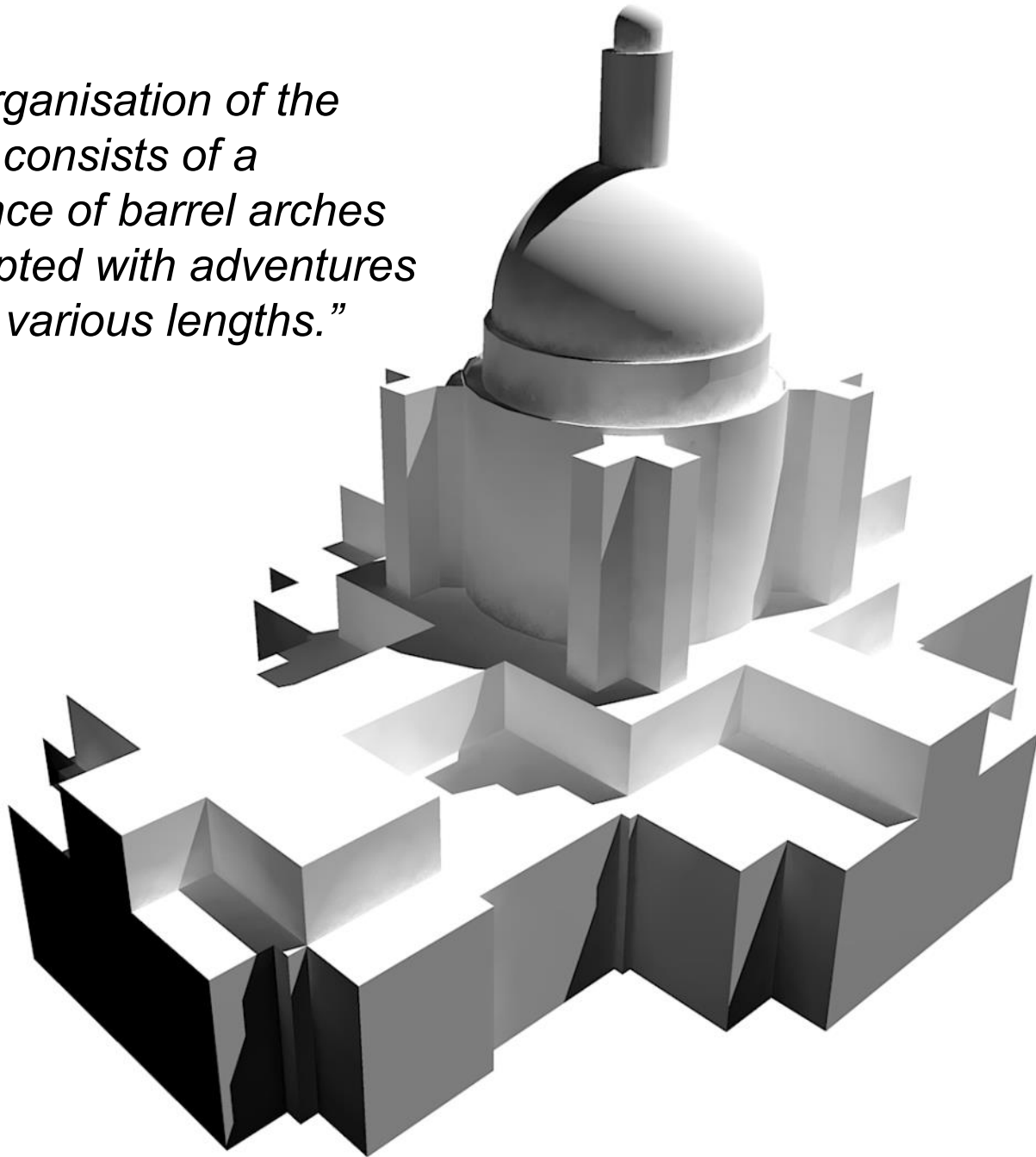
Line of enquiry: geometry

Design is based on a series of interlocking arches that increase in size and interlock. The interior has a cavernous feel that suggests the arches have been *subtracted* from an overall form. Butler (1950) states:

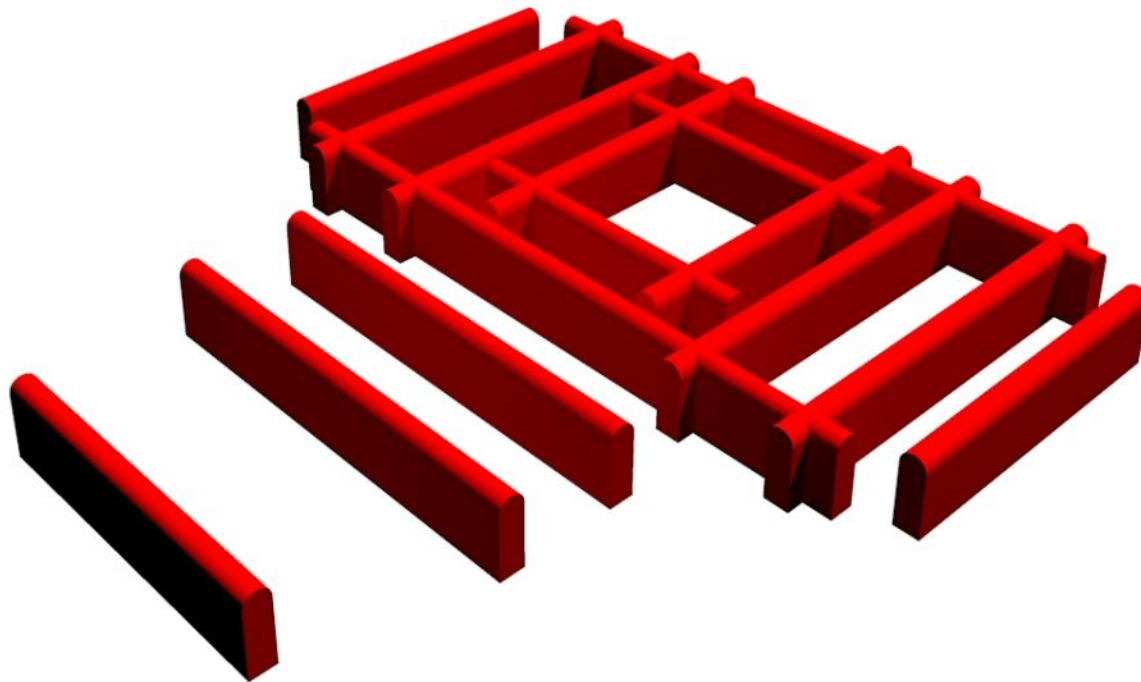
“Its lucidity is difficult to convey in words and really requires a model for its explanation – a model, that is, which can be taken to pieces and built up again.”

This will be demonstrated using Boolean operations

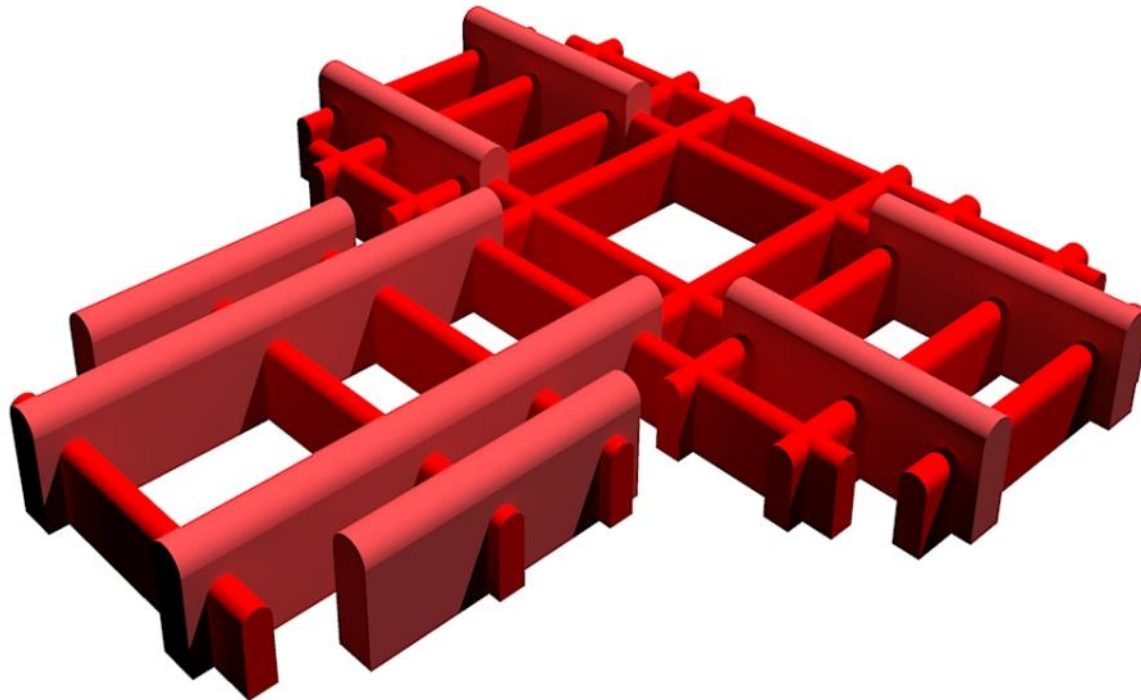
“The organisation of the design consists of a sequence of barrel arches intercepted with adventures in their various lengths.”



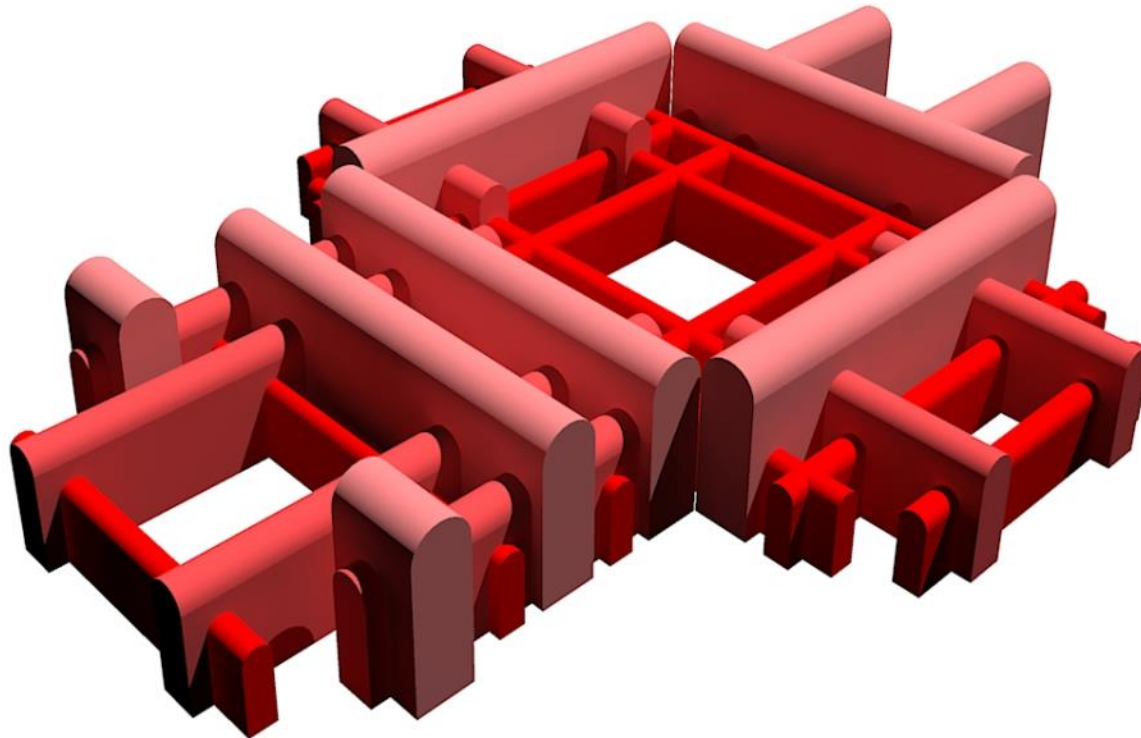
*“Arches 15 feet wide and
45 feet high carry at right
angles...”*



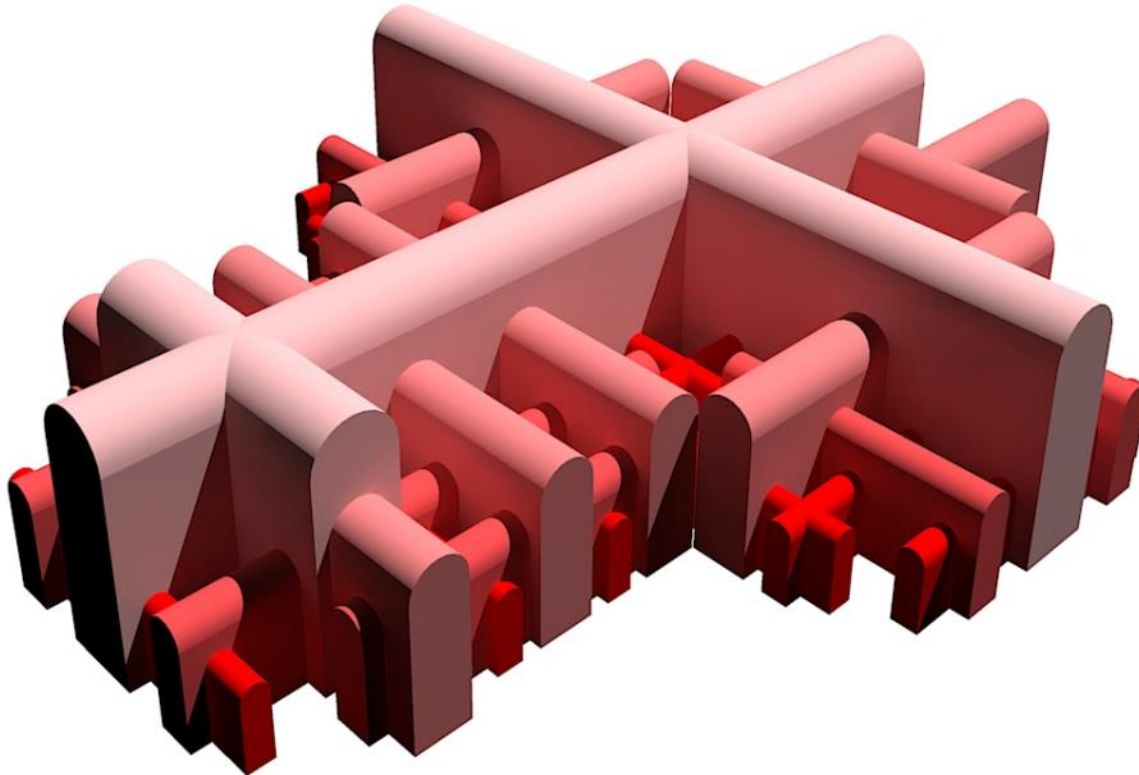
*“... arches 22 feet wide and
66 feet high...”*



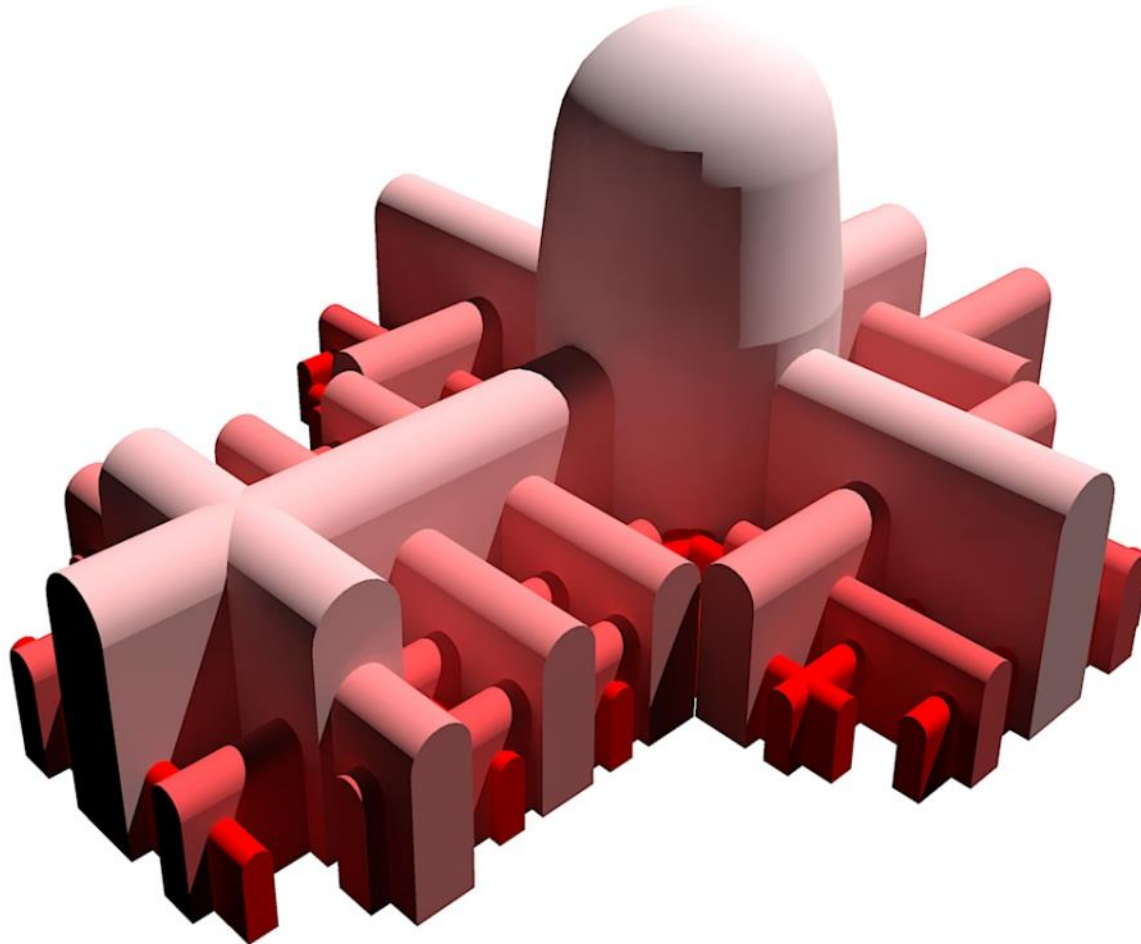
*“... which in turn carry
arches 32 feet wide and 96
feet high...”*

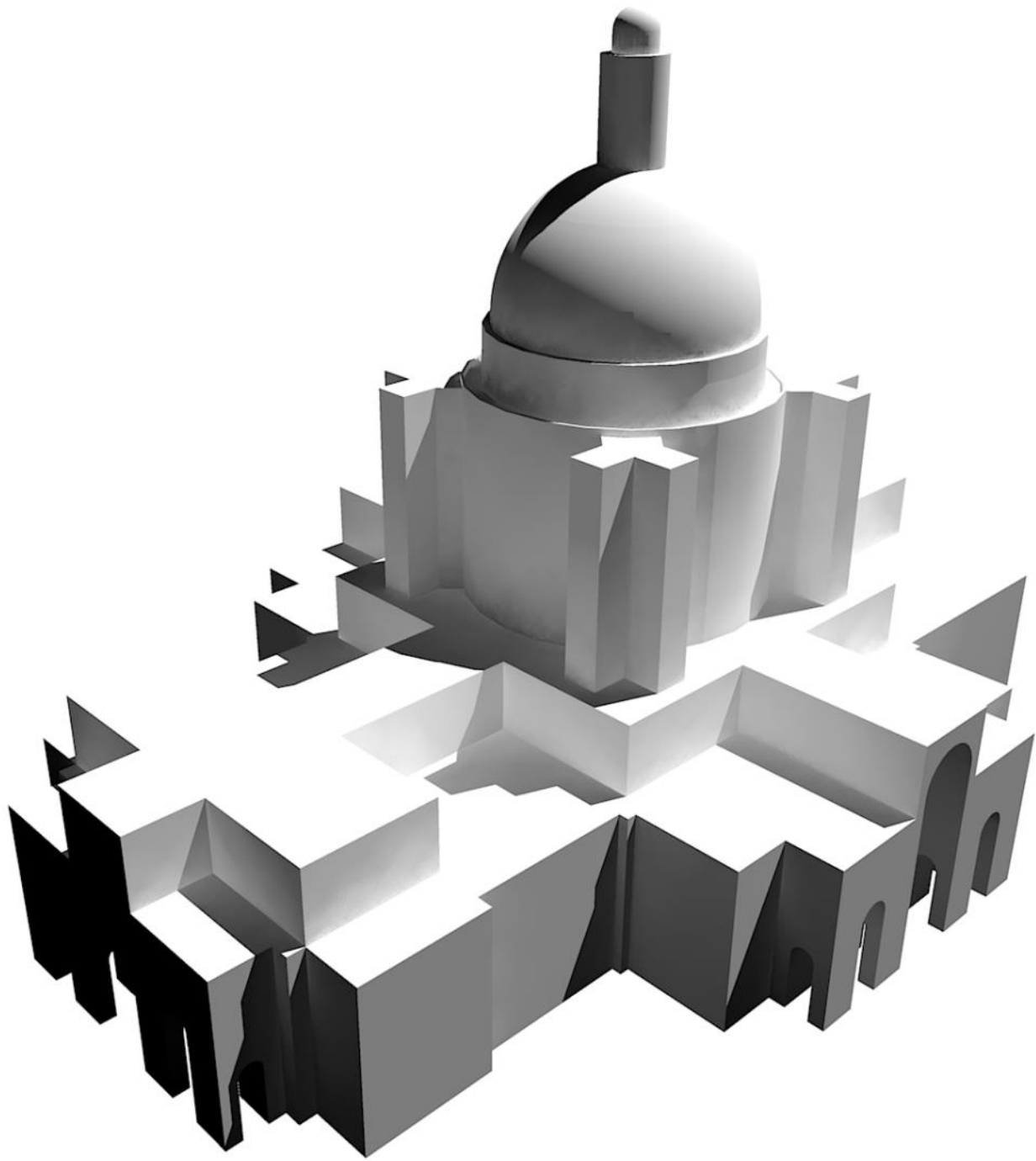


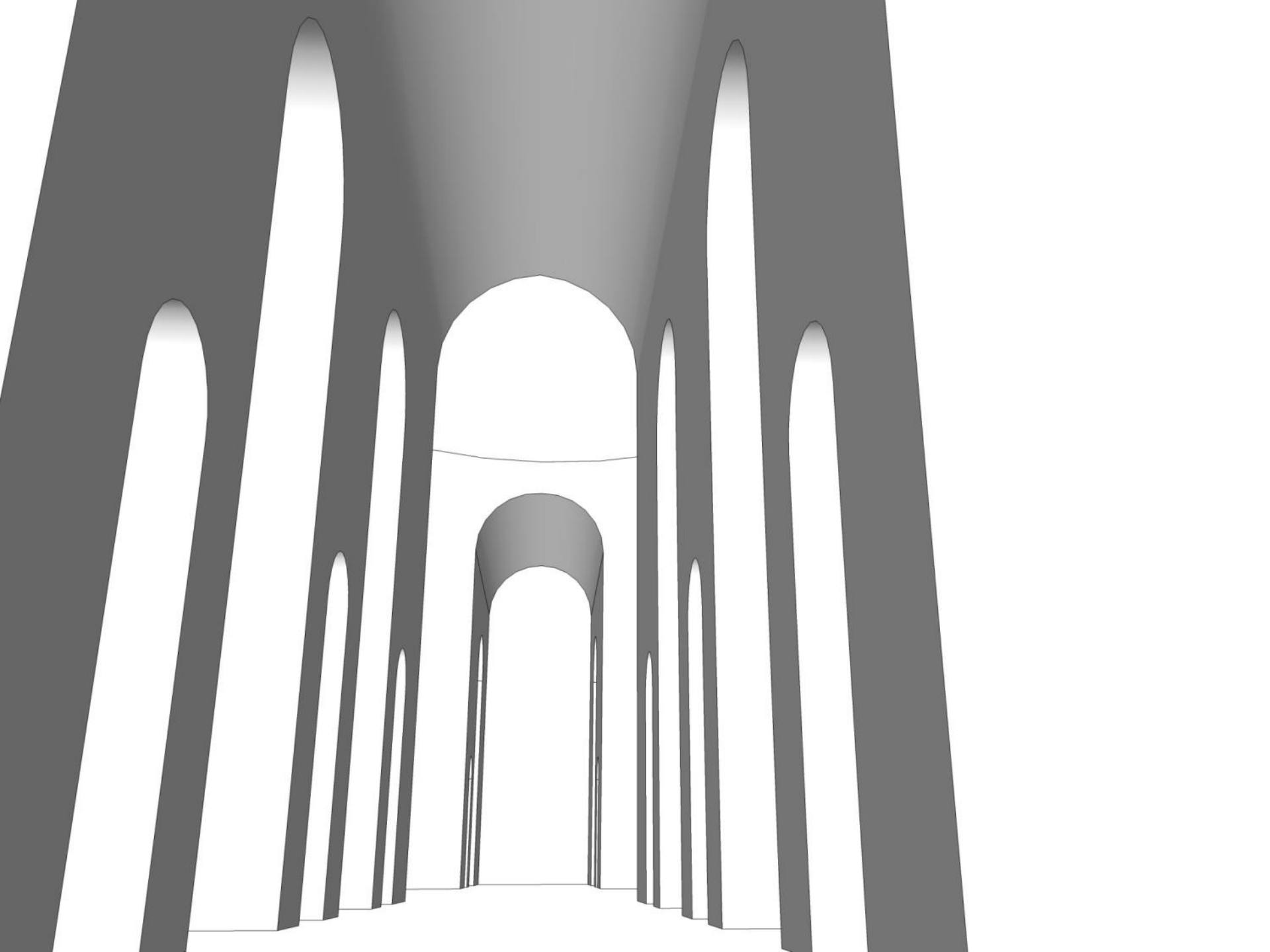
*“... and these carry the
main vaults 46 feet wide
and 138 feet high, rising
incidentally to 150 feet...”*



*“...the whole converging to
carry the great dome, 168
feet in diameter, covering a
height of some 300 feet.”*





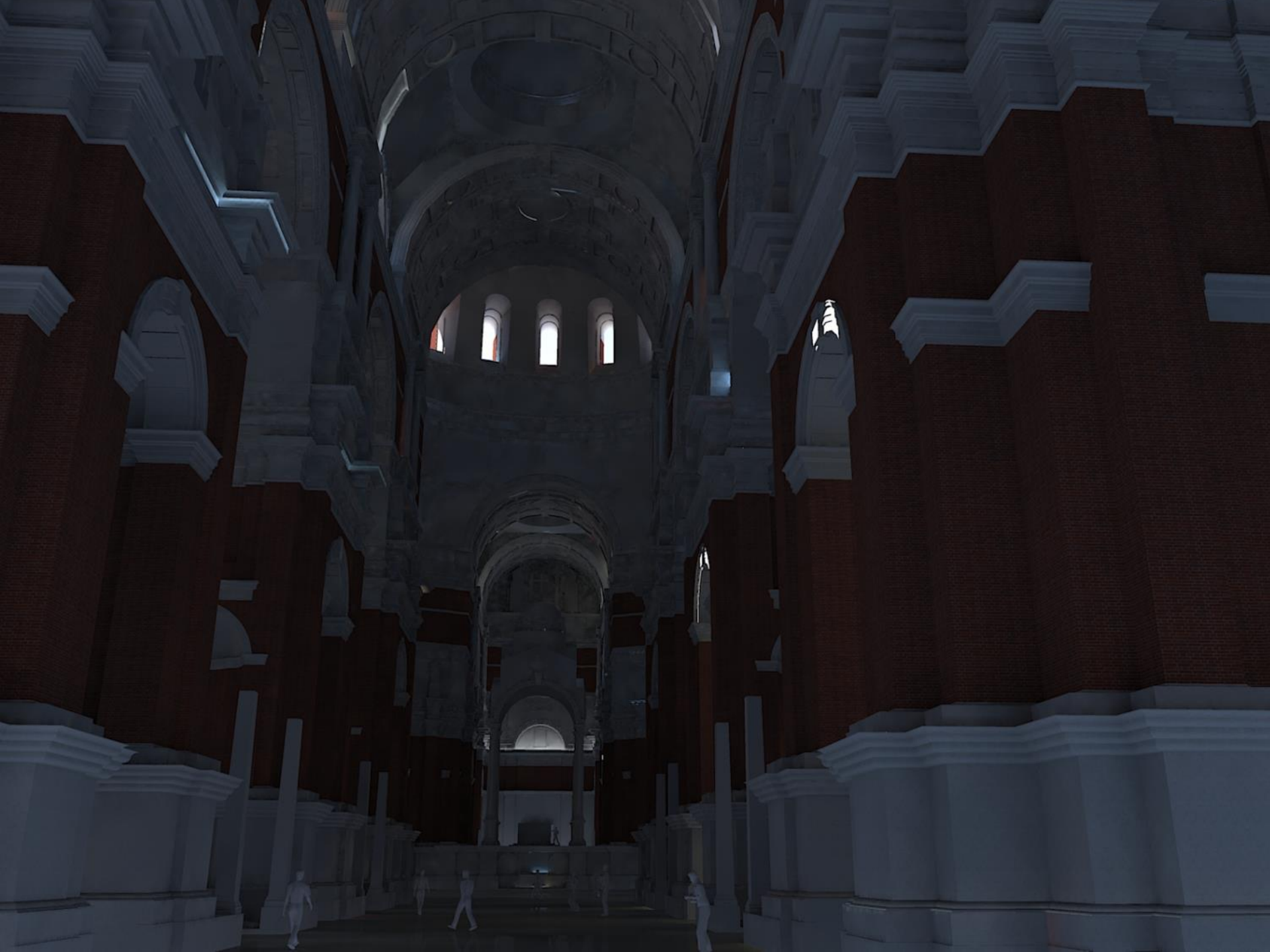


Line of enquiry: lighting

“I want my Cathedral to be lit entirely by candles. You need wondrous few. The big Nave at St. John’s College is lit by four candles and isn’t it glorious and mysterious! The choir is alone well lit in that every chorister has a candle.

But they want electric light, and flood-lighting at that.”

(Hussey 1950)







Line of enquiry: Scott's crypt vs Lutyens crypt

After Lutyens died Adrian Gilbert Scott acted as continuator to finish the crypt construction and detailed design.

“The Chapel should be plastered, otherwise it will look little better than a coal cellar. It will save your electric light bill, and apart from this, it is not fair to the Cathedral to present it to the public in that way.” (Lutyens 1937)

Digital representations of both designs were ray-traced to enhance understanding of the differences between them.







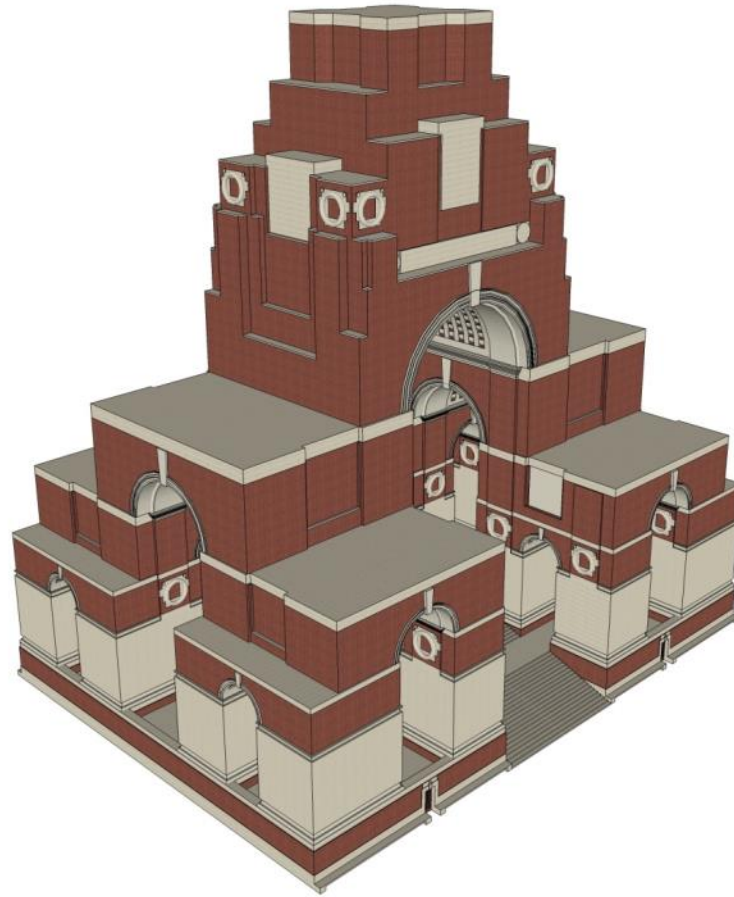
Line of enquiry: Thiepval

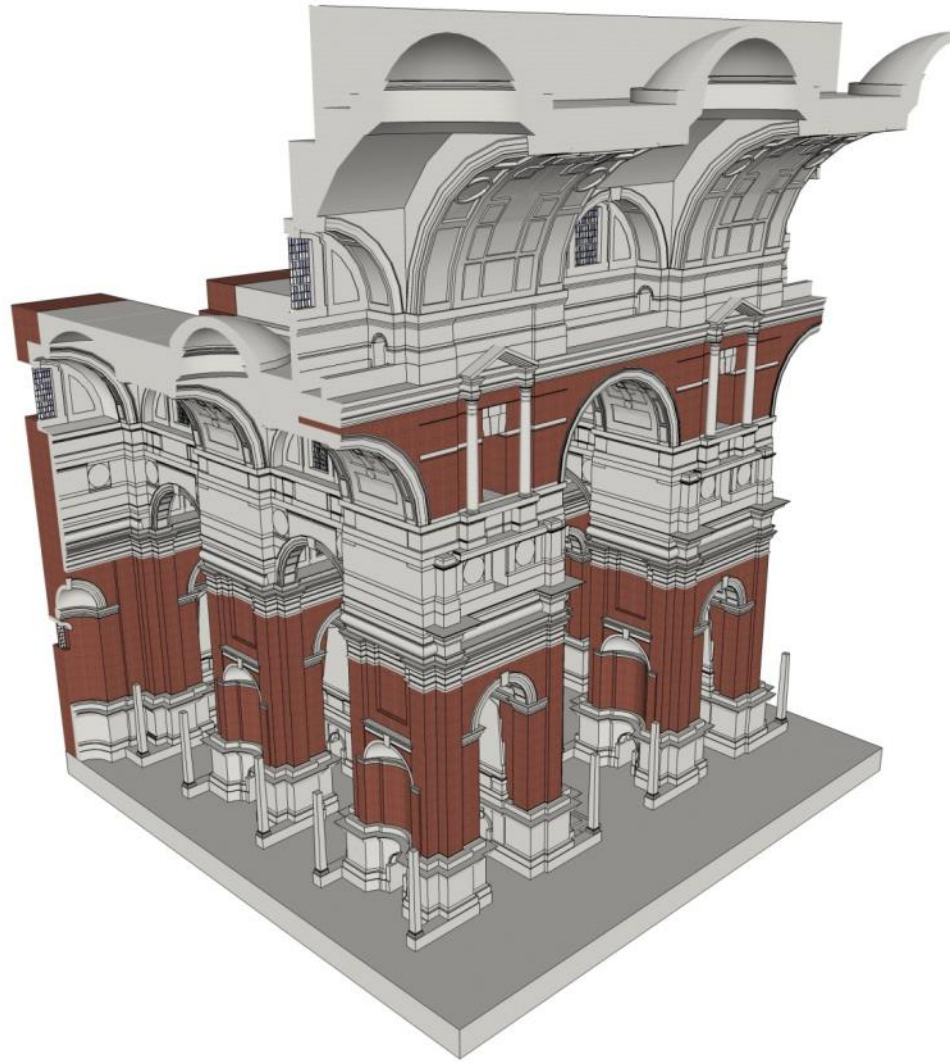
Geometry and materiality of Lutyens' Thiepval Memorial often compared to the cathedral design (Butler 1950, Summerson 1981).

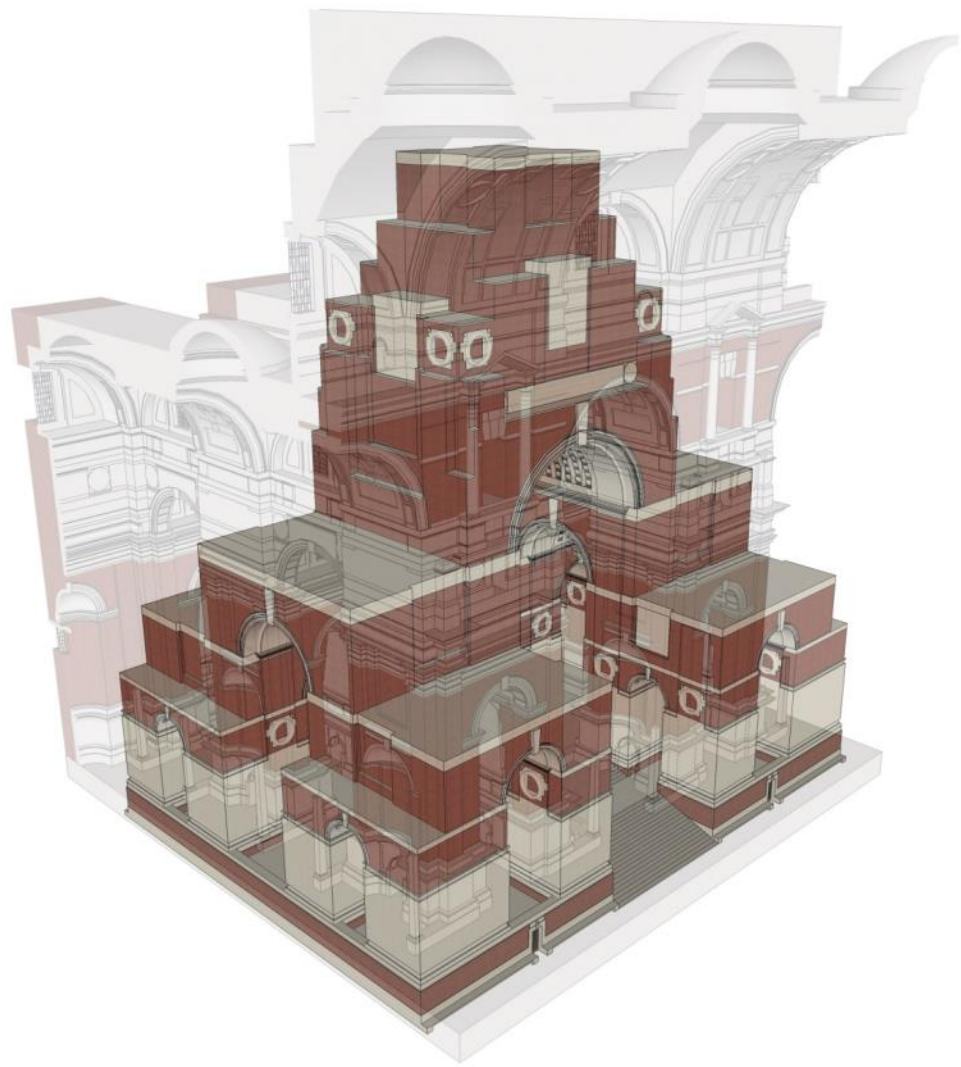
Designs both feature a series of interlocking arches that increase in size as they become taller.

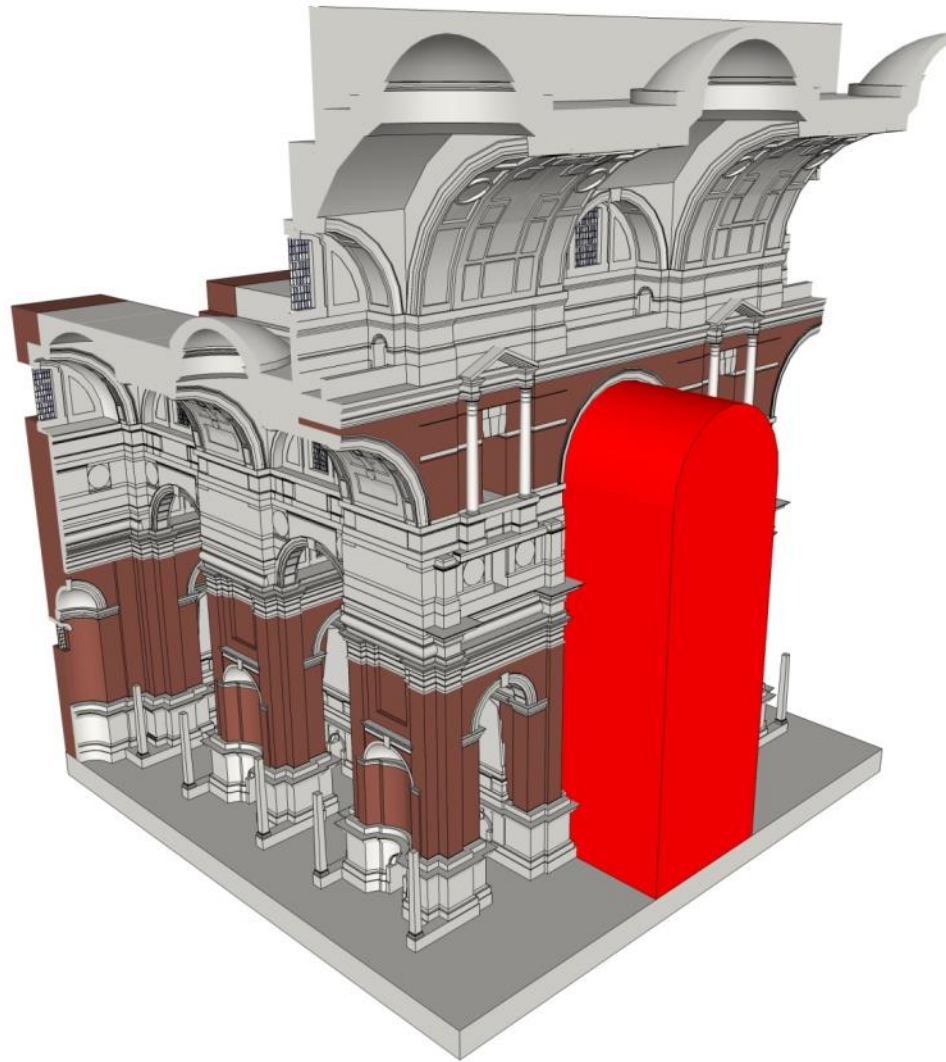
Digital representations of both designs are overlaid to test the extent of their geometric similarities.





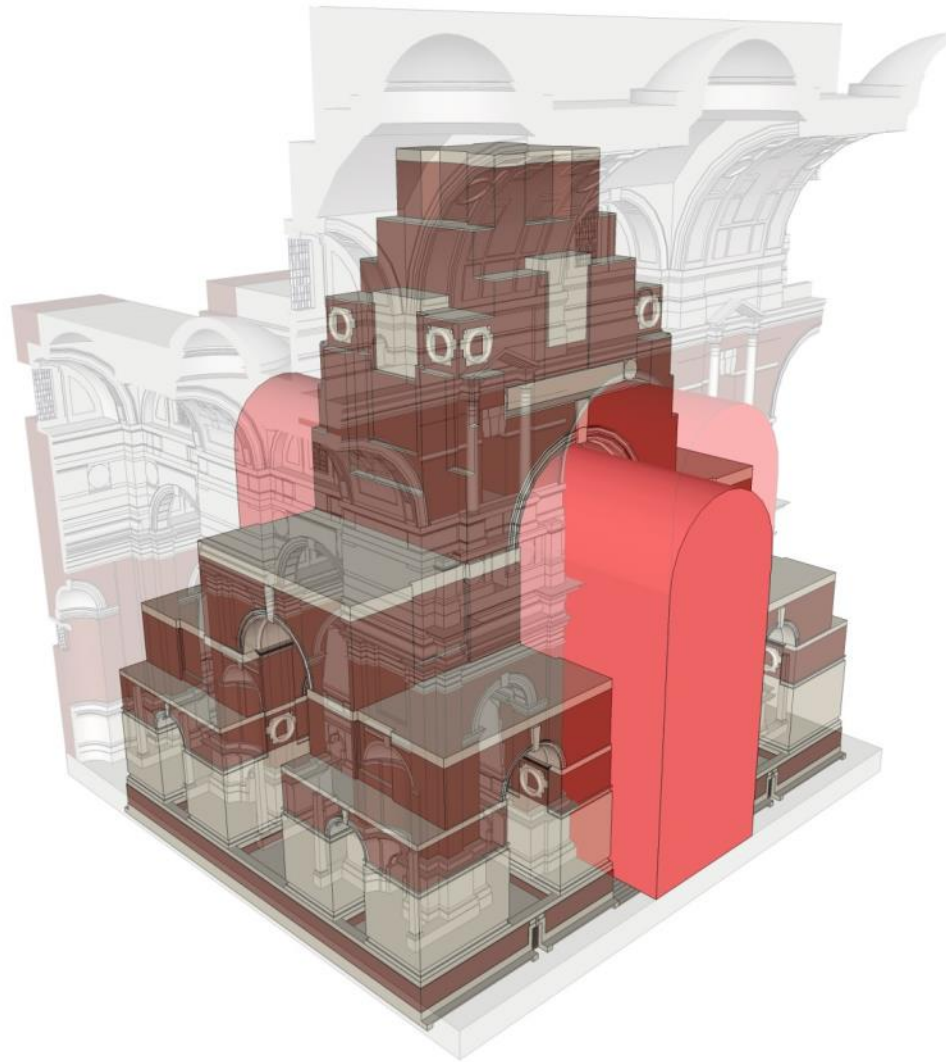






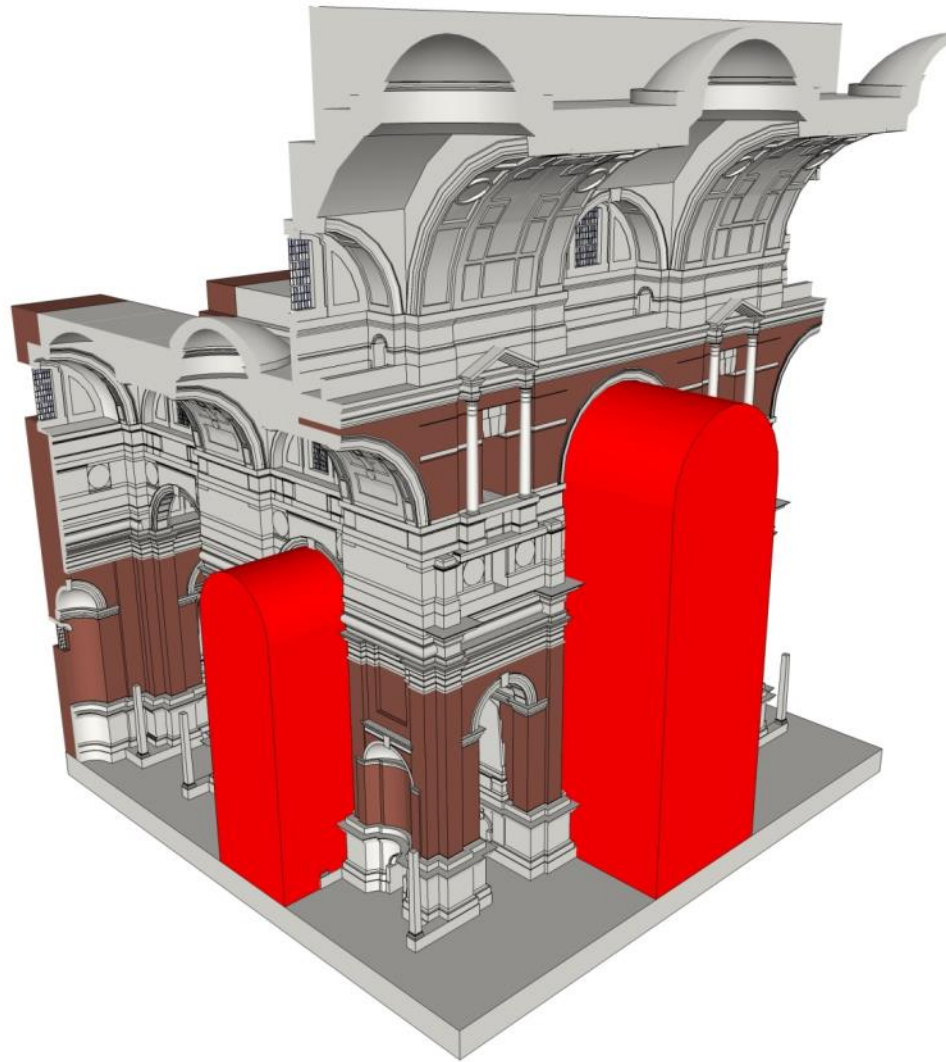
32 by 96 feet
1:3





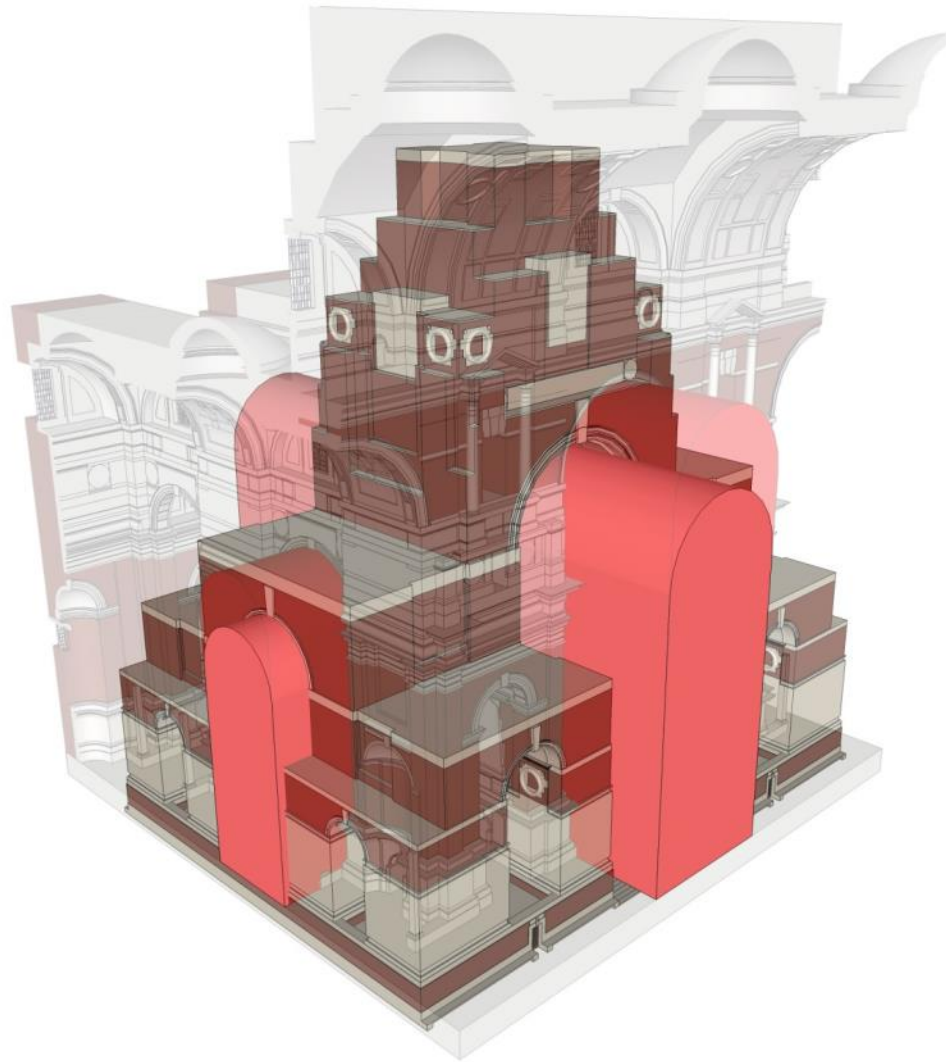
32 by 80 feet
2:5



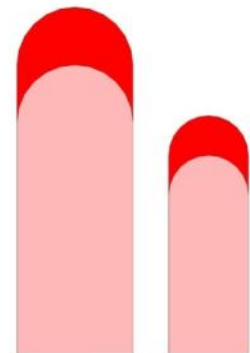


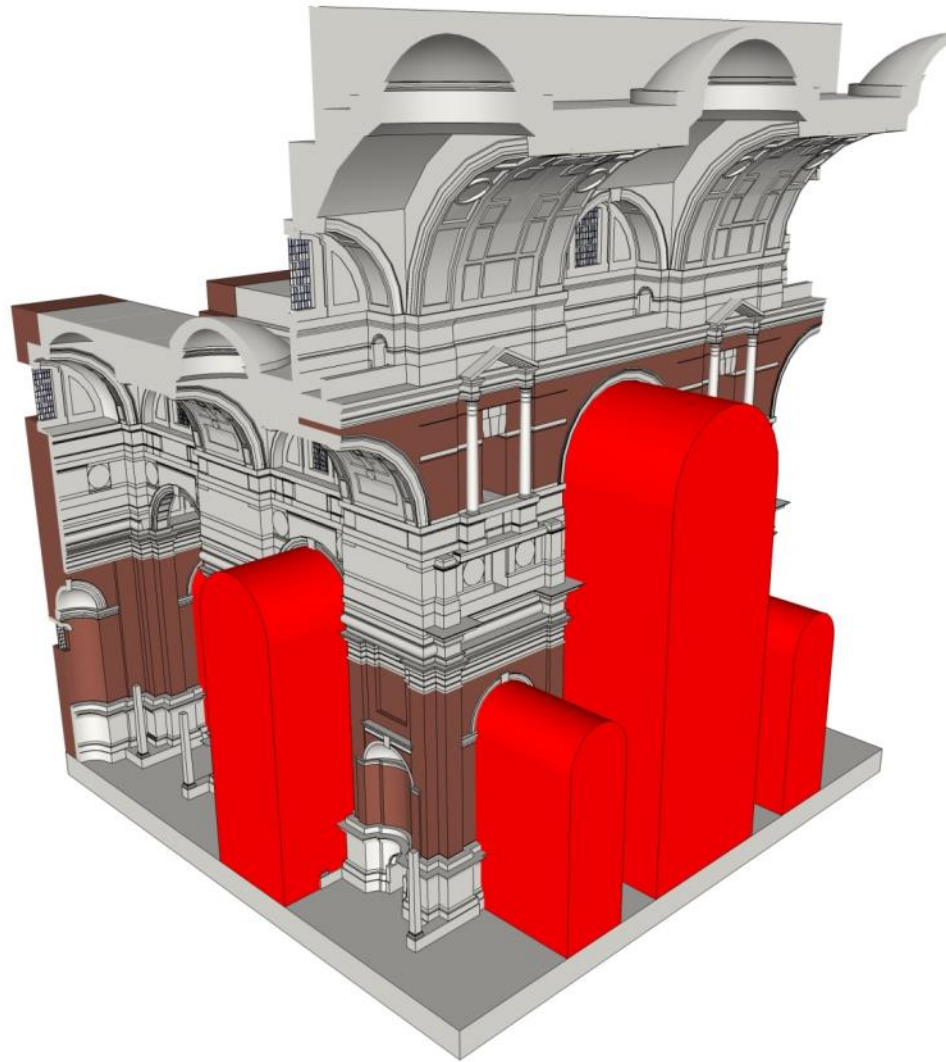
22 by 66 feet
1:3





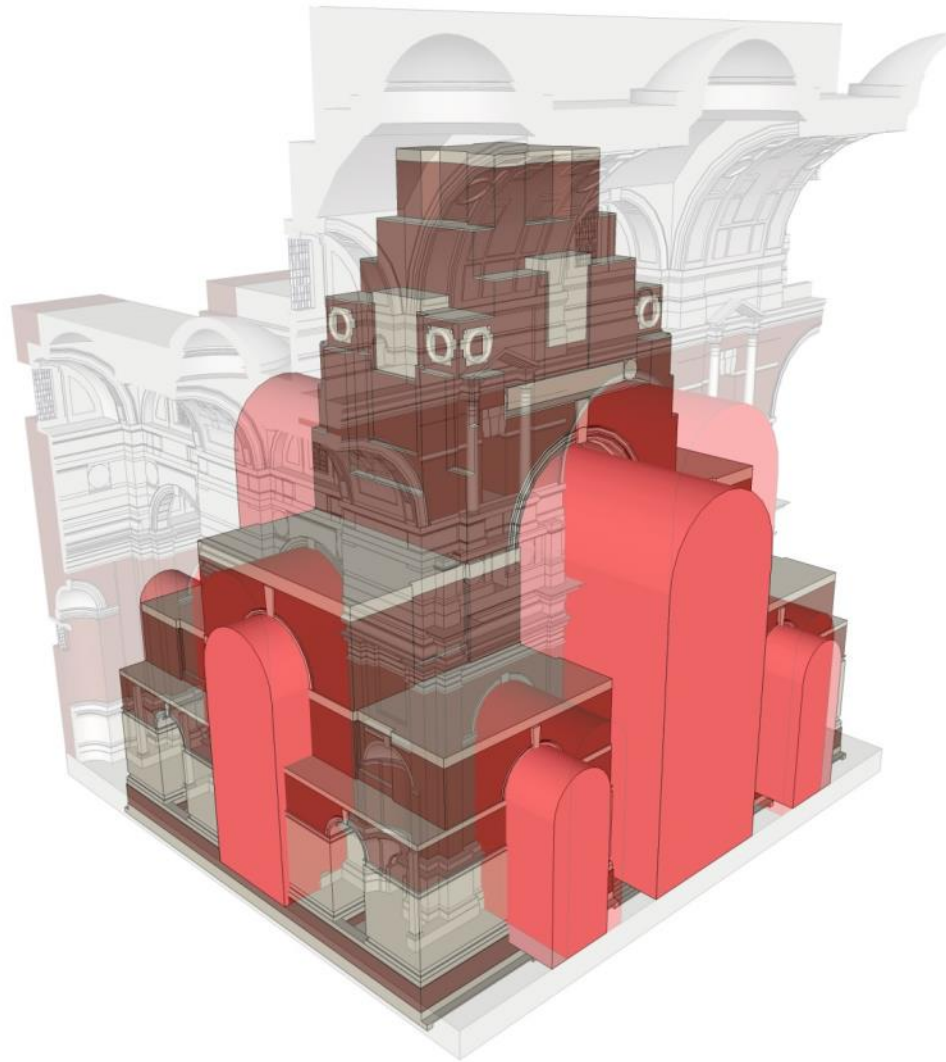
22 by 55 feet
2:5



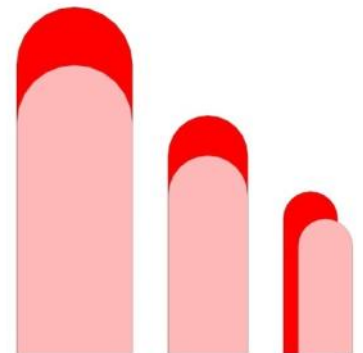


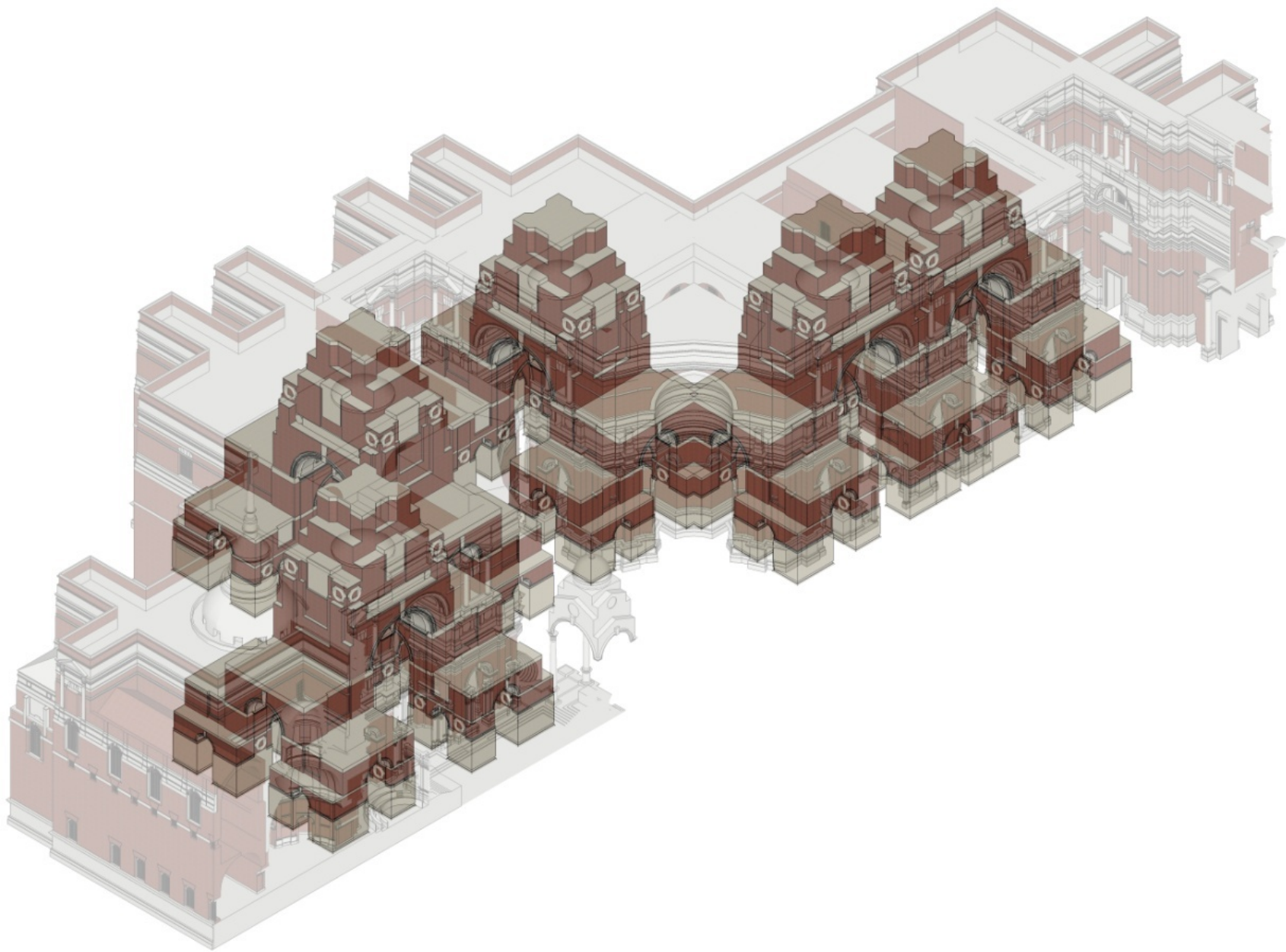
15 by 45 feet
1:3





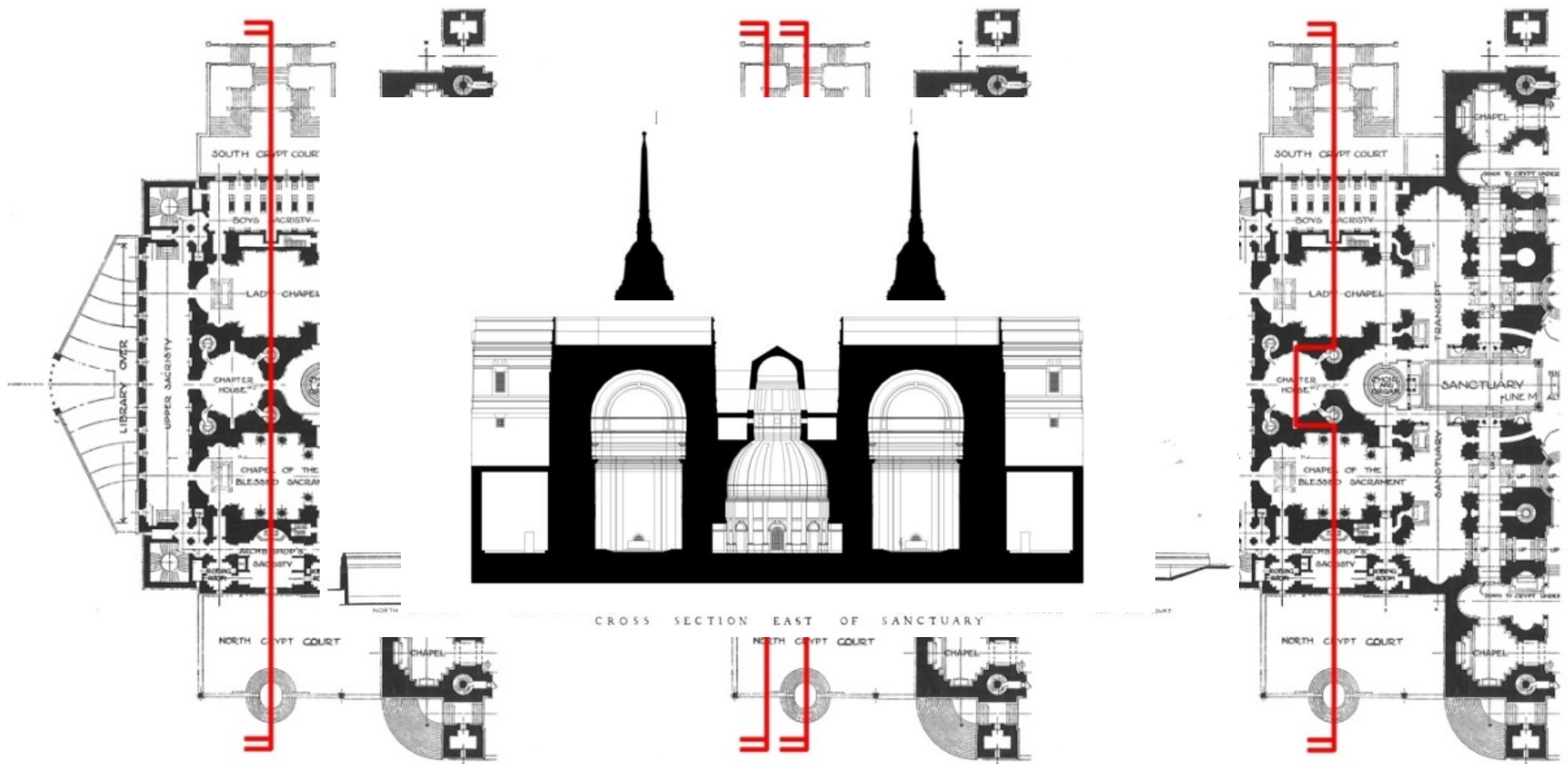
15 by 37.5 feet
2:5

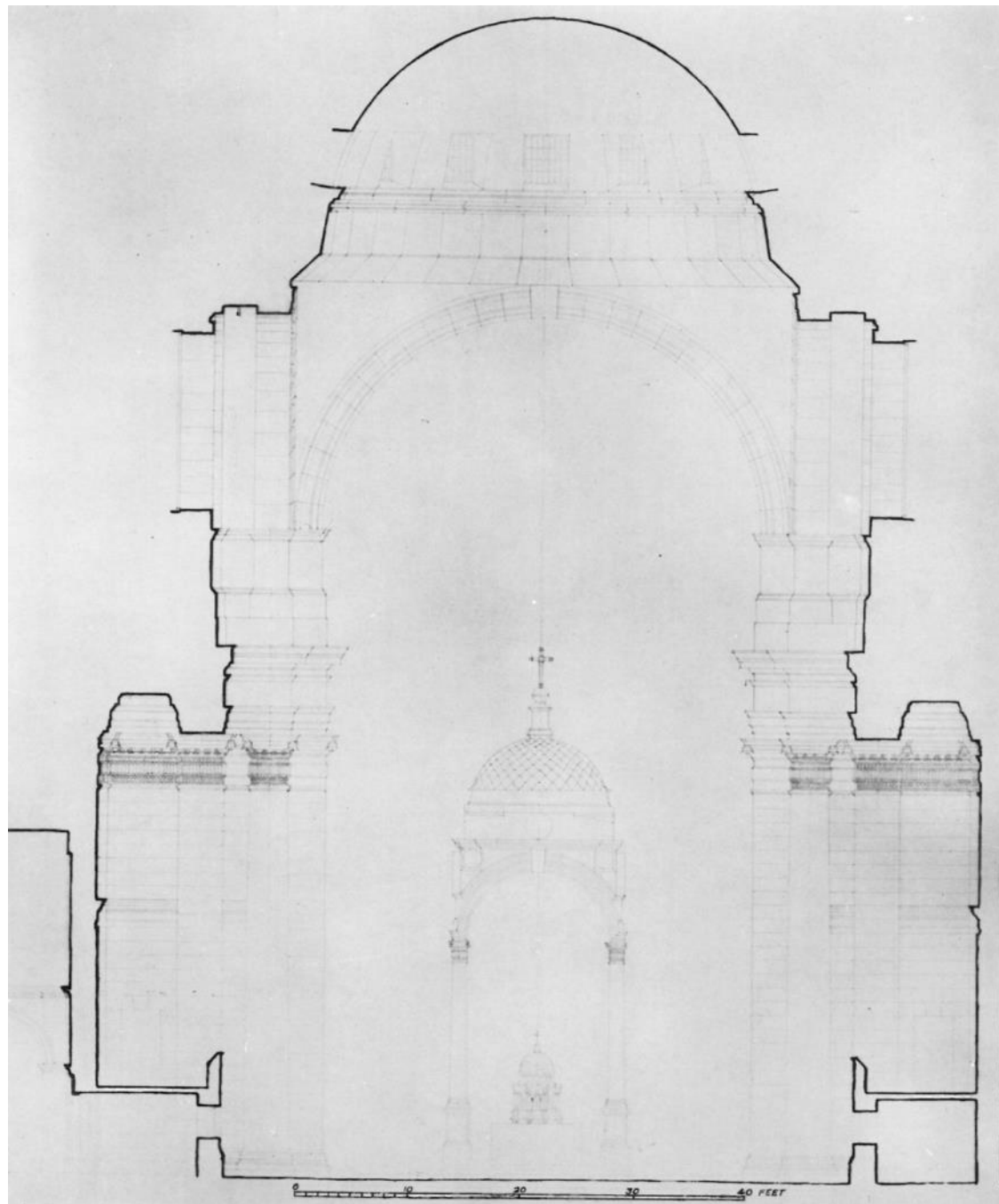




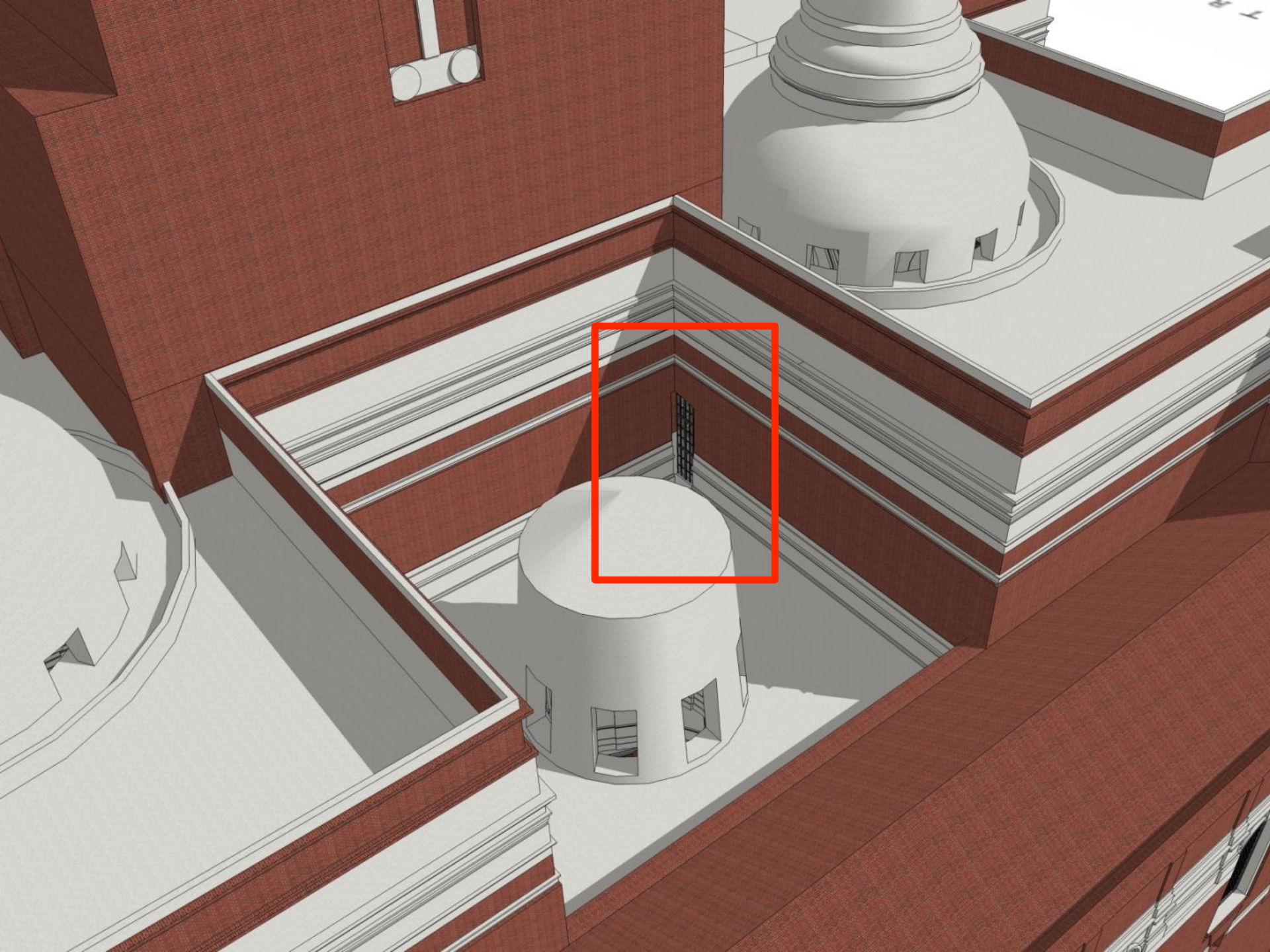


Serendipitous results

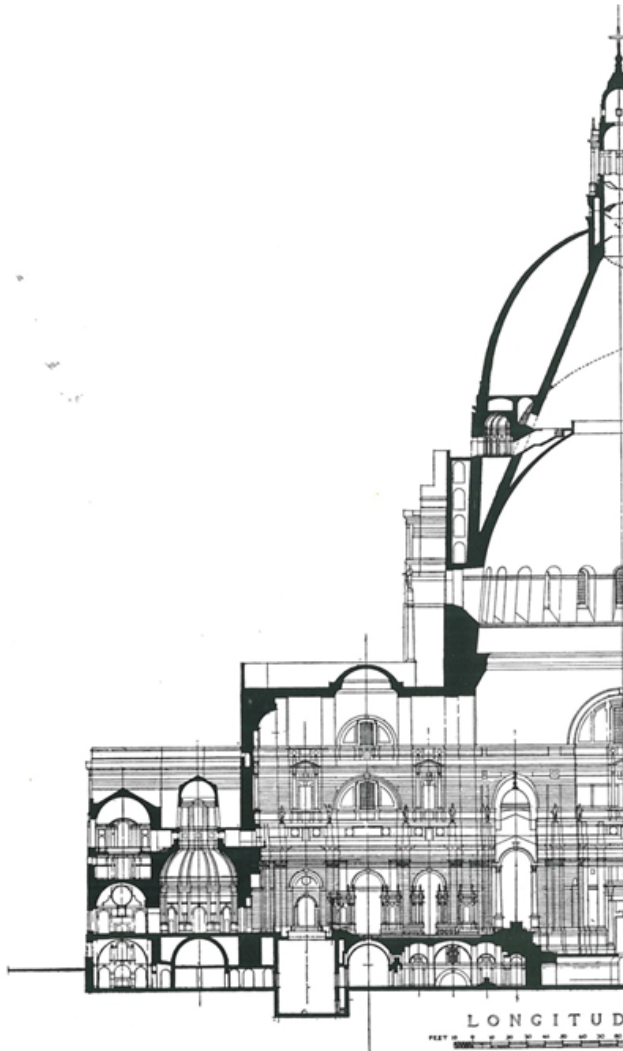




The Architecture of Sir Edwin Lutyens Volume III (Buter, 1950)



Auralisation



Organ placed in crypt with sound travelling upwards to sanctuary through a grill. Choir stands around grill so that 'sound and song could come out together'.

Potential use of auralisation techniques (ray-tracing).

Alternatively, immersive experience via oculus rift and headphones.

Wells Cathedral Choir Aisles



South Aisle



North Aisle

Built between 1326-1337 (approximately 10 years)

Dr Alex Buchanan

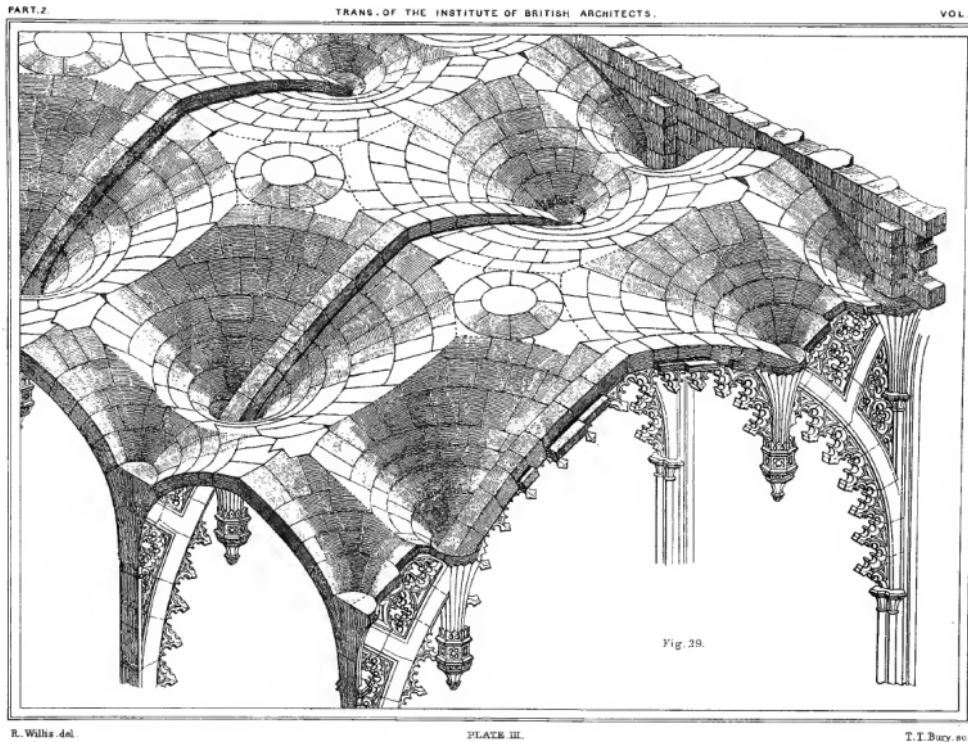
Medieval vaults

Prior to stereotomy (drawing out the design in plan, section, elevation, iso/axo).

Instead, tracing floor plan is projected up and down.

Ribs form the structure with lightweight panels in between.

Infill panels therefore a result of ribs.



VAULT OF HENRY THE SEVENTHS CHAPEL WESTMINSTER.

Robert Willis' call to the RIBA

‘On the construction of the vaults of the middle ages’
(1842).

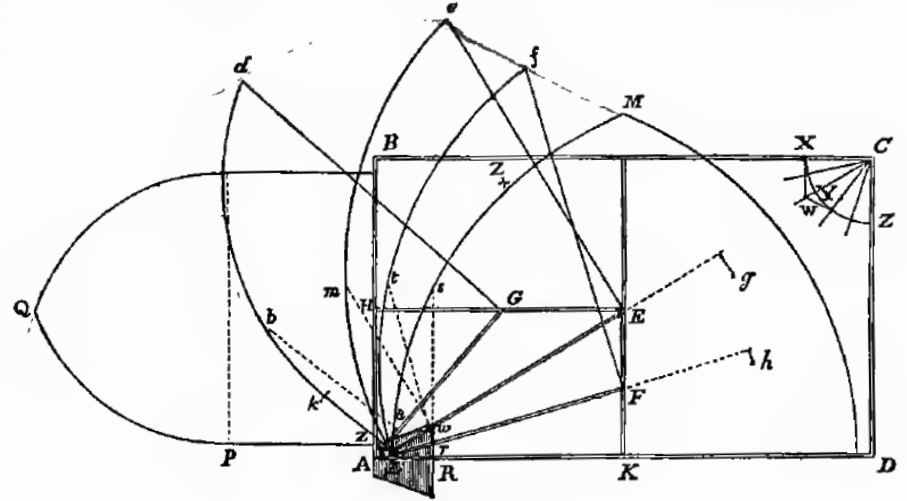


FIG. 10.

Hypothesises different methods of designing and constructing vaults.

Calls on RIBA members to survey vaults in order to test his theories fully.

Method

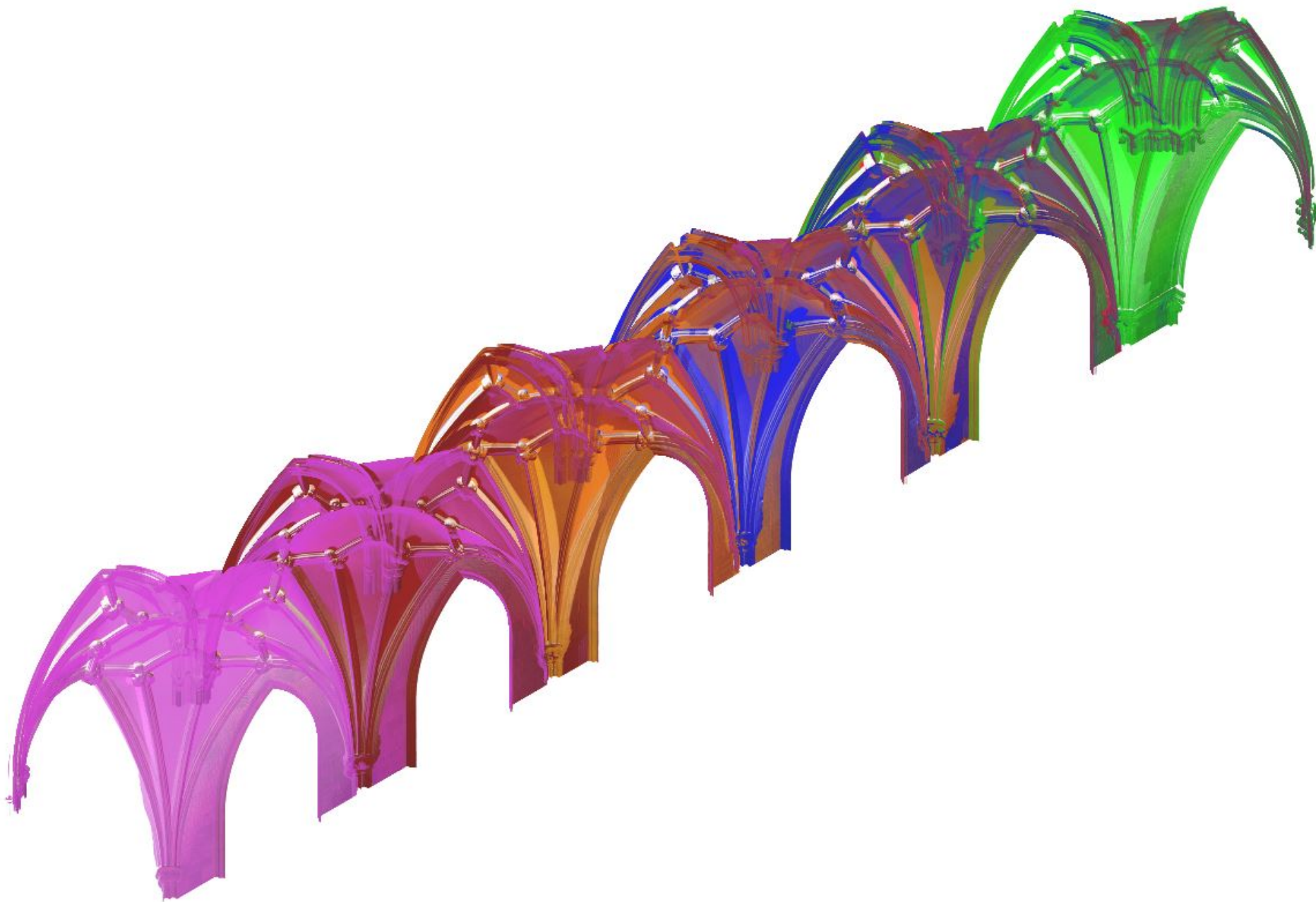
Digital laser scanning.

Also photogrammetry.

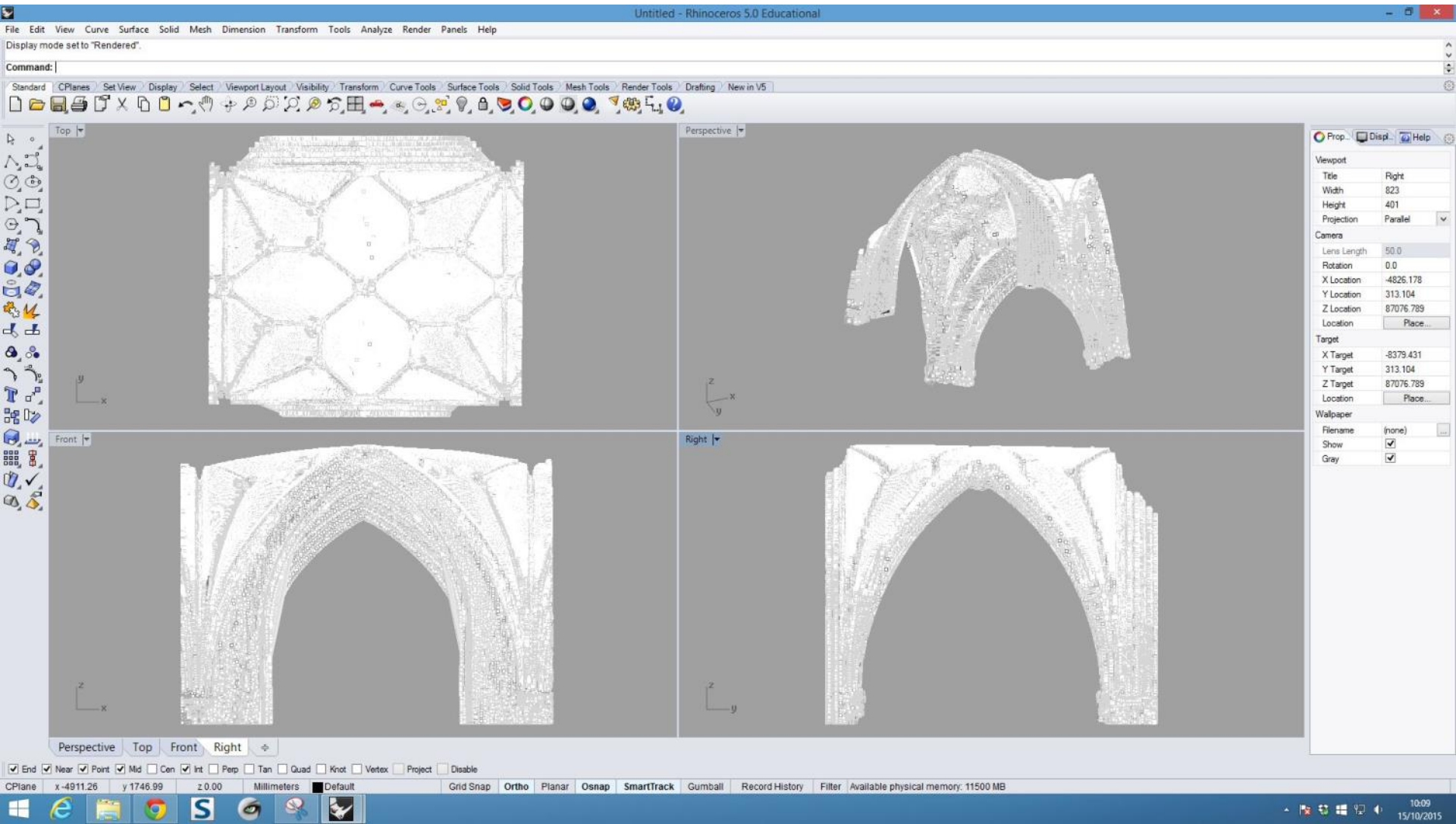
Laser scan provides highly accurate (3mm) survey data.

Also very quick compared to traditional methods.

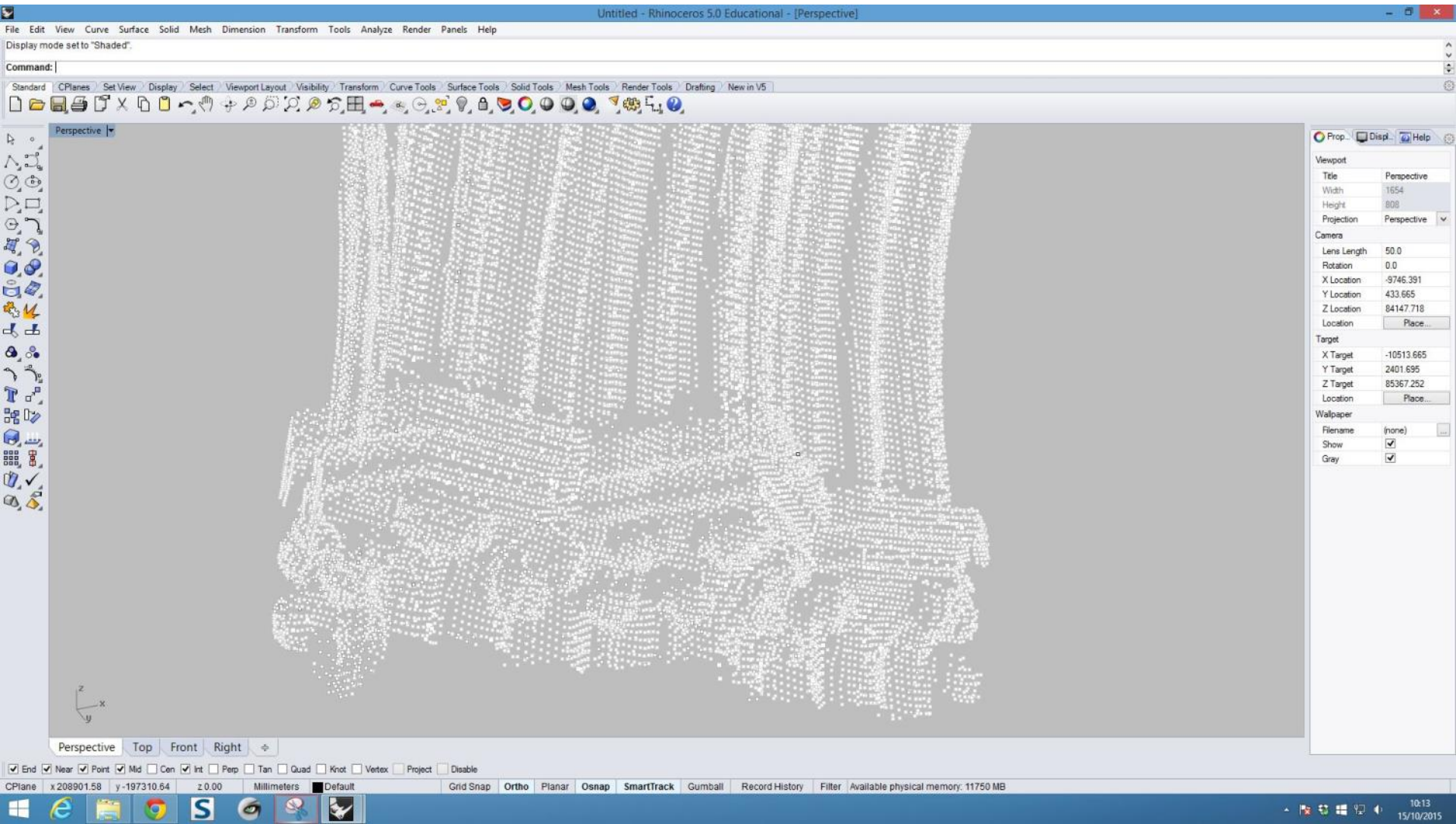




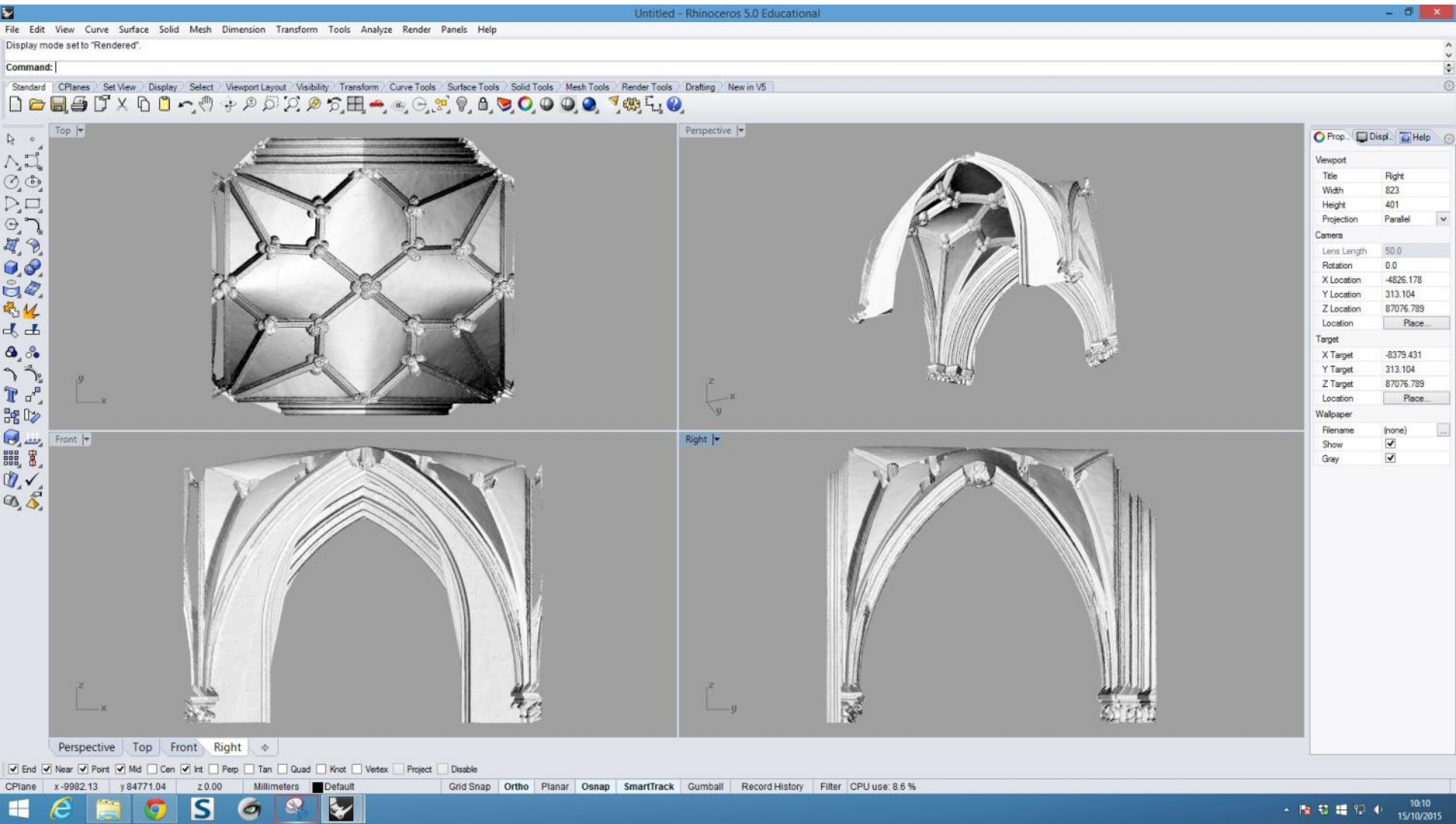
Point cloud model



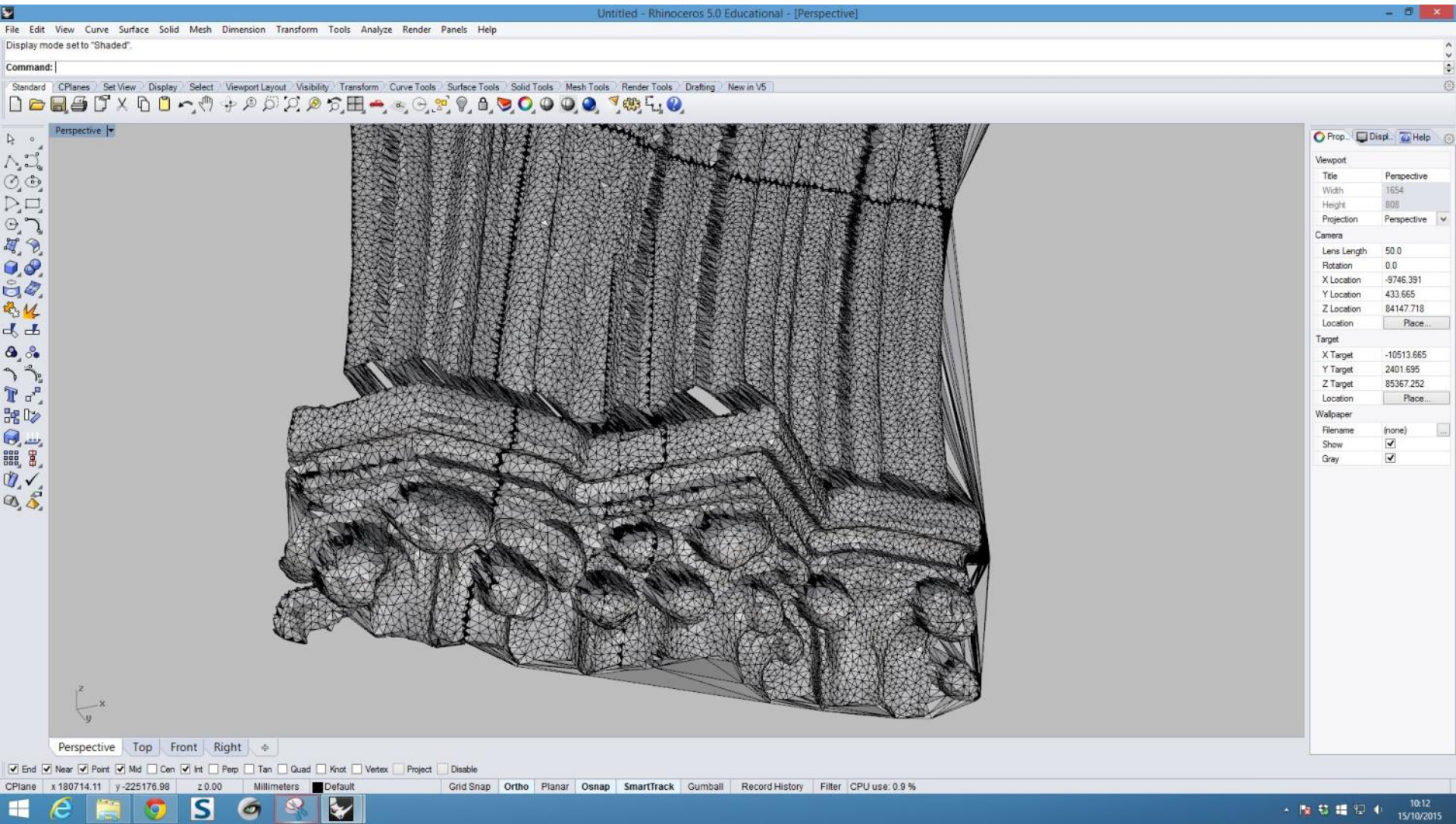
Point cloud model



Mesh model



Mesh model



Summary

Observations made by architectural historians can be enhanced or critiqued using digital tools.

Primary evidence can be re-presented to augment our understanding of an architect or work of architecture.

Constructing a model can lead to unexpected or serendipitous findings.