

READING ABBEY
A STUDY IN GEOMETRY AND SPIRITUALITY

John Mullaney
Spring 2024

CONTENTS

INTRODUCTION	THE MEETING OF THE PHYSICAL AND THE SPIRITUAL	3
PART ONE.	THE DIVINE PLAN - DIVINING THE DIVINE	6
	CREATING THE <i>GOLDEN RATIO</i>	7
	READING ABBEY - GEOMETRIC ANALYSIS	8
	THE GROUND PENETRATING RADAR SURVEY (GPRS) 2016	10
	THE MEASUREMENTS	11
	GEOMETRIC ANALYSIS OF THE EAST END OF THE CHURCH	12
	THE CHANCEL - ARCHITECTURAL AND SPIRITUAL BACKGROUND	13
	THE PROPORTIONS OF CLUNY III	14
	READING - THE HIGH ALTAR	15
	THE NAVE AND ITS DIMENSIONS	16
	OVERALL PLAN AND DIMENSIONS OF READING ABBEY	17
	PART ONE SUMMARY	
PART TWO	THE HIGH ALTAR AND THE BURIAL PLACE OF KING HENRY I	18
	THE LOCATION OF THE HIGH ALTAR	21
	THE LOCATION OF KING HENRY I's TOMB CHEST	22
	PART TWO SUMMARY	24
THE READING ABBEY ILLUSTRATION		25
PART THREE	CLUNY, READING AND ROUEN COMPARED	26
	CLUNY III	27
	ROUEN II	28
	CLUNY III AND READING	29
	PART THREE SUMMARY	30
CONCLUSION		31
REFERENCES		32

ACKNOWLEDGEMENTS

My thanks to Professor Anne Curry and John Painter for checking the draft, and making some suggestions.

I am dedicating this work to the *Friends of Reading Abbey*.

COPYRIGHT

1. This work, including diagrams, is for the benefit of all who wish to use the information. Please acknowledge the source as follows, *Reading Abbey, a study in geometry and spirituality* © John Mullaney 2024
2. Where Google Maps are the bases of diagrams, please also credit their use as follows
Google, Imagery ©2024 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The Geoinformation Group, Map data ©2024 Google
3. To obtain permission for the reproduction of John R Mullaney's illustration of Reading Abbey on page 25, please credit *Reading Abbey* © John R Mullaney FSAI and before use, send details to jgmullaney@aol.com. For non-commercial use permission is required, but will be granted free of charge. Any other use will be subject to consideration.

The following pdf is best viewed as a double page spread.

INTRODUCTION

THE MEETING OF THE PHYSICAL AND THE SPIRITUAL

The foundation charter of Reading Abbey states that it was built as a place of prayer. Henry wished it to be a monastery where prayers would be offered not just for his eternal salvation, but also for that of his family, both antecedents and descendants.

The very first words of the charter establish the connection between King and God. The charter uses the formula 'Henry by the grace of God king of the English'. (*Henricus gratia Dei rex Anglorum*) These words demonstrate the abbey's primary purpose: its spiritual purpose. It was built as a space where heaven and earth meet.

It has been claimed that the words 'by the grace of God', attributing a divine blessing on Henry's kingship, and so authority, are a later addition. As such, it has been said that the charter, if not a forgery, was at least an amended version, written some time after the abbey's foundation.

However, there are numerous occasions when the words *gratia Dei* ('by the grace of God') were used by English royalty before the foundation of the abbey.

1. 10th century

The phrase was used by Aethelstan, grandson of Alfred the Great and arguably the first King of all England.

In 935 we read *ego Athelstanus nodante Dei Gracia basileos Anglorum*

"I Athelstan by the grace of God, king of the English

In 936 Aethelstan granted land to Aethelhelm at Marksbury, Somerset.

Quapropter ego Athelstanus nodante Dei gratia basileos Anglorum et eque totius Britanniae orbis gubernatur...

"On account of this, I Aethelstan, by the grace of God, king of the English and also governor of the whole realm of Britain"

The same phrase is used on many occasions by Athelstan.

2. In 1071 William I used the phrase in affirming a grant in Freckenham (Suffolk) to Lanfranc, Archbishop of Canterbury

Willelmus gratia dei rex anglorum, episcopo erfasti, Balduino abbati, picoto et rotberto malet uicecomitibus, et ceteris fidelibus meis salutem.

"William, by the grace of God, King of the English, greetings to the bishop (of) Erfast, abbot Baldwin, the sheriffs Picot and Robert Mallet and the rest of my faithful (subjects)".

file:///C:/Users/John/Desktop/Downloads/dokumen.pub_the-anglo-saxon-chancery-the-history-language-and-production-of-anglo-saxon-charters-from-alfred-to-edgar.pdf and <http://www.anglo-saxons.net/hwaet/?do=get&type=charter&id=431>

3. William II (Rufus) likewise used this formula in a grant of land in connection with the church of St Mary, Lambeth.

QVISQVIS deo seu pro deo aliquid prestat, non hoc ipsum a se alienat, sed Melius sibi ipsi in posterum reseruat. Qua spe ductus ego Willelmus dei gratia rex anglorum trado de iure meo ecclesie rofensi sancti andree apostoli ecclesiam sancte marię de lamhytha.

"Whoever does anything in God or for God, does not alienate himself from Him, reserves the best for himself for the future Led by this hope I, William, by the grace of God king of the English, hand over my rights to the church at Rochester, the Church of Saint Andrew the Apostle, the church of Saint Mary at Lambeth".

4. "Henry I's Coronation Charter is a notification to all the shires of England that King Henry has been crowned.

The new king promises to make a number of improvements to English law, removing unjust exactions and restoring the standard set by the law of King Edward (i.e. Edward the Confessor, who reigned 1042-1066). Henry I therefore used the formula *dei gratia rex* at the very beginning of his reign:

Anno incarnationis domini circę MCI [mille, centum, unum] Henricus filius Willelmi regis, post obitum fratris sui Willelmi, dei gracia rex Anglorum, omnibus fidelibus salute.

"In the year of the incarnation of the Lord circa 1101, Henry son of King William, king of the English after the death of his brother William [i.e. William II, also known as William 'Rufus'] and by the grace of God, to all the faithful, greetings)"

There are several versions of Henry I's Coronation Charter. The copy found in *Textus Roffensis* is the oldest surviving of these. Interestingly, the introduction to the Rochester copy, which differs from other versions, gives the date of Henry's charter as 'circa 1101', though we know it was in fact produced on 5th August, 1100. At the end of the charter the names of the witnesses include 'Bishop Gundulf', who was bishop of Rochester at the time. However, Gundulf does not appear as a witness on later surviving copies. One scholar suggests that the scribe, when copying from his exemplar, erroneously expanded the initial 'G' for Bishop Gerard (bishop of Hereford) who is recorded in other versions of the charter as a witness. This seems the most likely reason for Gundulf being included as a witness in *Textus Roffensis*, though we should note that there are other differences between the various versions' lists of witnesses, and so the possibility that Rochester's bishop witnessed the signing of Henry's Coronation charter still remains. (<https://www.rochestercathedral.org/research/textus/96r-97v>)

1. Henry I's daughter Matilda used the same formula in 1114 on her marriage to the Holy Roman Emperor Henry V. Her seal states *SIGILLVM MATHILDIS DEI GRATIA ROMANORVM REGINA*. (The seal of Matilda by the grace of God Queen of the Romans).

<https://www.nationalarchives.gov.uk/education/resources/platinum-jubilee/role-of-a-queen-matilda-and-elizabeth-i/queen-matildas-seal/>



Seal of Matilda, Queen of the Romans Courtesy National Archives

READING ABBEY - ITS PRIMARY PURPOSE

Reading Abbey was, therefore, conceived as a spiritual space. Whatever the exact wording, or timing, of its Foundation Charter, its primary purpose was clearly defined and understood as such at the time.

Henry was no saint, and he knew it. But he was a deeply religious man, in so far as he believed that, whatever his earthly rank, he would have eternal salvation, or eternal damnation, depending on his 'state of soul' at death. He also adhered to the Catholic church's teaching, then as now, that prayers after his death could help lessen any partial punishment still due for his sins at the time of death.

Just how seriously the monks of the abbey adhered to Henry's wishes, and continued to 'pray for the salvation of his soul', is witnessed by the detailed description of the yearly commemoration services on the anniversary of his death. (*Reading Abbey Records a new miscellany*, B. Kemp and *Reading Abbey – a pilgrim church*, J. Mullaney).

The abbey, and especially its church, was understood to be a representation of the New Jerusalem, the place prepared by God for those who loved Him, in other words 'heaven'. The images, the sculptures, the music, all existed to focus the mind and soul on the Divine. Even more, they did not merely represent the Divine. They were symbols of the Divine; every aspect of the church was an earthly expression of eternity, of the choice between 'heaven' and 'hell'. The symbol was so powerful that it was seen as participating in that which it represented.

An example of this belief may be found in such works such as the *Physiologus*, which both reflected this medieval belief system and helped shape it. Its origins can be traced to the folk legends and animal lore common to a number of early eastern Mediterranean cultures and to Greek philosophers such as Plato and Aristotle. As one commentator, Mary Allyson Armistead, writes, "written in Greek, the original *Physiologus* (Greek for "The Naturalist") described the characteristics of animals and birds—both real and fantastical—and provided allegorical interpretations of the characteristics enumerated". But, unlike the works of the pre-Christian philosophers, in the *Physiologus* nature was seen and studied for how it revealed God's plan and as providing a template for how to conduct one's life.

One example is that of the eagle. This bird becomes a symbol and allegory of baptism when it is represented as plunging from the sky into a cooling water. Yet again, when the lion descends from its hilltop lair to the valley below, it is an allegory for Christ's descent to Earth.

The visible world was understood as revealing the unseen. *Visibilia* (such as animals and objects) reflected the *invisibilia* (the Divine). Moreover, as a 'reflection', the image represented a reality. There can no reflection without its reality.

It is possible to identify two major differing approaches to understanding the nature of reality in the medieval church.

Aristotle's philosophy was the basis of Thomas Aquinas' 13th century theology. This 'scholastic' tradition, was a theory of knowledge that stated that everything that could be known had to be based on observation. As Thomas writes in *De Veritate* (Concerning Truth): *nihil est in intellectu quod non sit prius in sensu*, ("there is nothing in the mind that has not first passed through the senses").

Plato's approach was different. He believed that there are model 'forms' or 'ideals' and that what we see are mere reflections and distortions, of these.

Leaving aside this millennia-old philosophical debate, both schools of thought could unite in seeing God's handiwork and His plan for mankind in the natural world.

This symbolism extended to the abbey church, to its decoration and to its architecture. The building was an allegory for Christian belief. As such, the very design participated in the Divine. But what determined this? How could the builders be sure that their structure was true and good: that it was in accordance with the great Divine plan, was a reflection of Divine reality?

PART ONE
THE DIVINE PLAN

Numerus est qui cuncta disponit
“Number rules all things”
(Cassiodorus *Institutiones* 2:4)

Today we would talk about the ‘architect’ of a building. For the 12th century monks there was only one architect: God. Those who designed and built the churches and abbeys were referred to in other terms, such as *caementarii* (builders) or *imaginatori* (designers)

Cluniac abbeys were built according to a master plan, which was more of a concept than a prescriptive ordered pattern or an obligatory blueprint. The Cistercians, on the other hand, followed a much stricter rule, and their monasteries were much more cohesive in design. Builders of other churches, likewise, would have followed different ideas.

But what united all was the belief that the church was a divine space and that this should be reflected in its appearance. Just as ‘nature’ reflected the Divine, so this sacred space should, as far as possible, reflect God’s plan. So how could the architects of these buildings ensure they were following God’s design?

The 6th century polymath Cassiodorus was much respected in the 12th century, and indeed throughout medieval Christendom. He wrote extensively about mathematics. His aphorism *numerus est qui cuncta disponit*, is just one of his many observations. It helps us understand where the medieval philosopher and theologian believed he could find a definitive and eternal truth in an ever changing and uncertain world. He would also have been familiar with Book of Wisdom 20:11 “(God), you have ordered all things according size, number and weight” (*omnia in mensura et numero et pondere disposuisti*).

Today we may look at such mathematical uncertainties as the chaos theory, but to the medieval mind mathematics, (number) offered certainty. As such, it was seen as being symbolic of the Divine: sharing many of the attributes of God. These truths, like God, were eternal and infinite in time and space, irrespective and independent of existence. The properties of a triangle, for instance, would be true, even if there were no triangles, indeed even if there were no material existence to which they could be applied.

It is no wonder, therefore, that one such mathematical device became known as the *Divine ratio*.

DIVINING THE DIVINE

The divine ratio, the divine section, ‘ratio Divina’, the golden section

In drawing up the plan for Reading Abbey, the monks would have had several mathematical tools at their disposal. Geometry, literally *the measurement of the Earth*, is the branch of mathematics which is most relevant to drawing up a plan for a building.

There are several ways this could have been used in planning Reading Abbey. The most common method, and one used since classical Greek times, was founded on what are known as *ad Quadratum* and *ad Triangulum*.

In these cases the plan and elevation calculations were based on the square and/or triangle. The golden ratio (the *golden* or *divine section*) was worked out to produce the adjacent proportion.

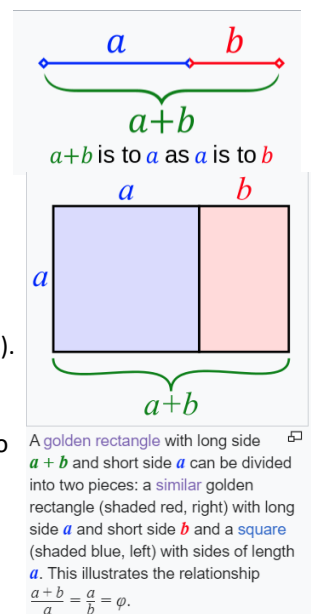
The golden ratio is where the ratio between one line, or rectangle, is equal to the ratio between another formed from the first, as shown in the equation $a : b = a + b : a$.

For example, if line ‘a’ is 5 units and line ‘b’ is 3 then line ‘b’ has a ratio of 1.6 to line ‘a’ (divide 5 by 3). When line ‘a’ is added to line ‘b’ the length of ‘a’+‘b’ is 8. Divide this by line ‘a’ (5), so when 8 is divided by 5, the ratio is again 1.6. In other words the two sets share the same ratio.

When a four sided figure is formed on these lines a ‘golden ratio’ exists between the areas of the two quadrangles.

This formula may be applied consistently to churches throughout Europe from the 11th century, and before.

<https://babel.hathitrust.org/cgi/pt?id=uc1.c037553620&seq=11>

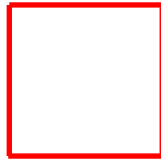


CREATING THE GOLDEN RATIO

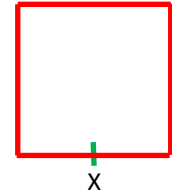
It will be shown later that it is likely that at Reading Abbey various parts of the church building were based on the *golden ratio*. To understand how this was calculated it is useful to see how the proportions were worked out.

STEPS

1. Make a square or *quadratum*



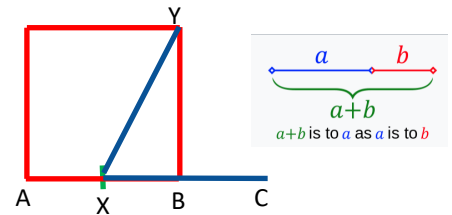
2. Find the half way point on one of the sides, the green line, marked with an X



3. Draw line from X to one of the corners on the opposite line, Y

4. Rotate the line XY, with X as its pivotal point, to lie on line AB to make line XC

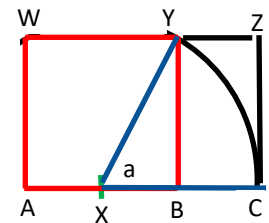
5. The ratio between line AB : BC = the ratio between AB + BC : AB. This is 1.6...



6. The same is true of rectangles formed on the lines AB and BC.

The ratio of rectangle (square) ABYW to rectangle BCZY = ACWZ : ABYW

It also forms the arc YC of a circle. This circle or part of it, could then be used as a basis for other geometric based proportions, such as apses and arches,

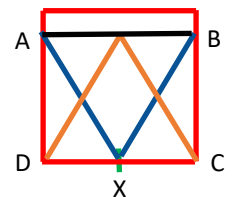


NOTE

The angle of BXY at 'a' is 61.8° . This is usually rounded-up to 62° and is referred to as such throughout this paper.

CREATING AN EQUILATERAL TRIANGLE

To make an equilateral triangle two lines are drawn at angles of 60° , either from point X (blue lines) or from the corners of the square, C and D (orange lines). This creates equilateral triangles within a new rectangle ABCD.



NOTE

By using geometry alone, without recourse to arithmetic, it was possible to calculate the most complex building designs utilising various proportions.

READING ABBEY
GEOMETRIC ANALYSIS

Methodology

1. The following work is based on combining several sources: a late 19th century OS map, excavations of the abbey site by Dr Slade in the 1960s and 1970s, the Ground Penetrating Radar Survey (GPRS) of 2016, an aerial view from *Google Maps*, using the measurement tool provided, and on site measurements. All these will differ slightly one from another in different accounts, depending on the exact points the measurements are taken. It should be remembered that the standing remains are stripped of their ashlar blocks and that the flint core has also been 'robbed' at certain points. Consequently, the measurements are only approximate to those planned by the architects and as would have been seen before the abbey was reduced to a ruin.

There have been several measurements made of the abbey and these are listed in *The Royal Abbey of Reading* by Ron Baxter. In the following account a tolerance of up to a metre, and sometimes more, should be allowed.

2. Application of *ad Quadratum*, *ad Triangulum* and the 'golden ratio'.

The danger in any study such as this, is the temptation to make the data of the investigation fit into the proposed explanation, rather than identifying the mathematical scheme that was used.

Since the 19th century, there has been an ebb and flow of opinion as to whether medieval builders adhered to a geometry of proportion, and, if so, to what extent. Much of this work was dismissed as unreliable, especially in the influential work of Konrad Hecht. However some, such as Viollet-le-Duc, K J Conant, F M Lund, R Bork, and many others, argue to the contrary. It is generally accepted that, to a greater rather than a lesser degree, medieval builders followed a geometric rule of proportion when designing their churches. Moreover, it is accepted that this mathematical basis was the application of *ad Quadratum*, *ad Triangulum*, and the *golden ratio*.

3. Alternative systems of using *ad quadratum etc.* could have been used at the same time, or at different times. It will be seen if, and where, it can be shown any of these were used at Reading.

1. READING ABBEY MEASUREMENTS

Before it is possible to apply any proposed geometric scheme, it is necessary to obtain as accurate measurements as possible, within the limitations explained above.

First, with the benefit of *Google Earth*, it is possible to propose very accurate measurements of the standing remains. For the reasons given above, this does not mean that these are those of the finished abbey, nor that they will match earlier records. Nevertheless, they are probably the most accurate that are available.

Secondly, for the hidden elements, below ground, there are the three main sources mentioned above: the 1879 OS map, previous excavations and the 2016 GPRS .

Starting with the earliest of these, the OS map shows the standing ruins, and what was known or surmised, regarding the abbey's footings. Some of information on the OS map used previous surveys and evidence from excavations when making the foundations for the second gaol in the mid 19th century.

The main sources used in this work are:

1. Englefield. 1779 and updated in Coates *The History and Antiquities of Reading* 1802)
2. Buckler. 1823/4
3. Board of Health survey. 1853
4. OS Map. 1879 which incorporated Albury's plan.
5. Hurry. Late 18th / early 20th century
6. Slade. Late 1960s and early 1970s
7. Baxter. 21st century
8. GPRS 2016
9. *Google Maps* and its distance-measuring tool.

The accuracy of the apse area, as shown on the OS map, was confirmed in the 1960s and 1970s when Dr Slade, of the University of Reading, undertook some archaeological excavations.

The full report may found in 'Berkshire Archaeology', vol 68.

Fig 1. The 1879 OS map shows the standing ruins and existing buildings, without differentiation, as shaded areas. These include the 19th century priest's house and 'School (*Boys and Girls*)'.

Abbey-related features are identified in gothic script.

The proposed outline of the outer apse, along with pillar bases and even the site of the altar, are included and shown with faint lines. The other faint lines are the walls of the gaol and its west tower and garden

The proposed site of the altar is speculative, but based on comparison with similarly dated abbeys.

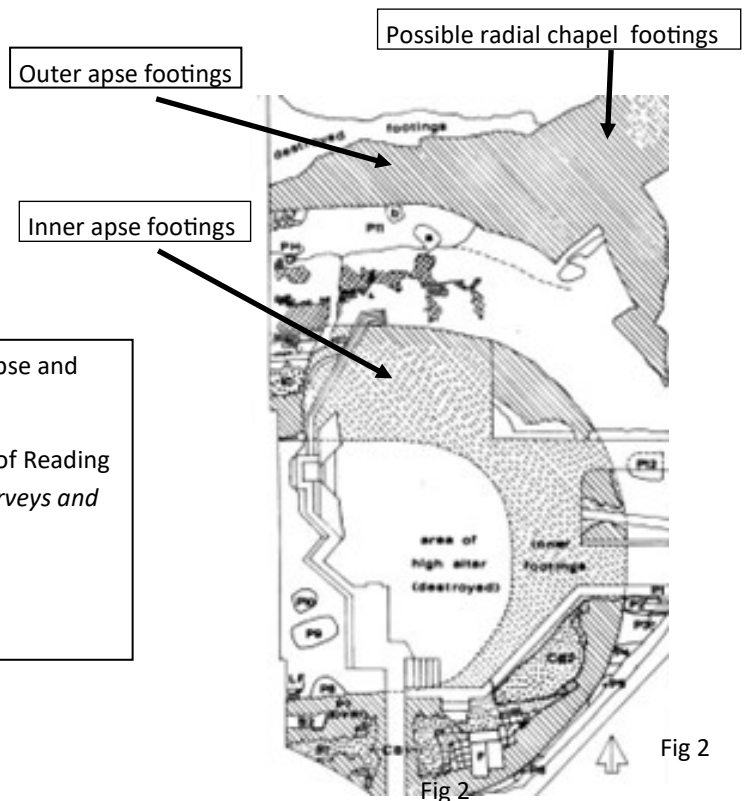
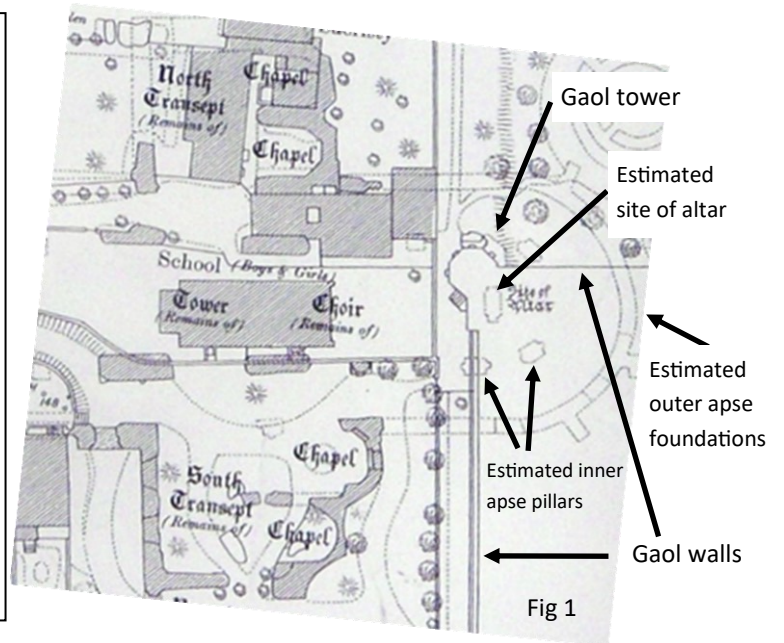


Fig 2. The shaded areas are of the inner apse, the outer apse and possibly of one of the radial chapels.

(For fuller commentary on these sources see the 'Friends of Reading Abbey' website *Reading Abbey and the Forbury, Maps, Surveys and Excavations*)

THE GROUND PENETRATING RADAR SURVEY (GPRS) 2016

The 2016 GPRS by Stratascan provided its most useful information at the east end of the abbey.

Fig 1. In the area which had been the gaol's car park, there were very clear results showing what Stratascan called features that 'probably related to the abbey', and which corresponded to the archaeology of the 1960s and 1970s.

The deep blue area shows the footings of the inner apse of the abbey church. The light blue markings likewise matched the archaeology of the outer apse. An unresolved anomaly is the extension of the light blue area northwards.

Stratascan believed the light blue markings were 'probably' abbey related, especially as they match the 1960s archaeology. If so, the question remains: to what does the northward extension refer? It seems to extend too far to be the footings of a radial chapel, though Slade's excavations indicate that such chapels existed.

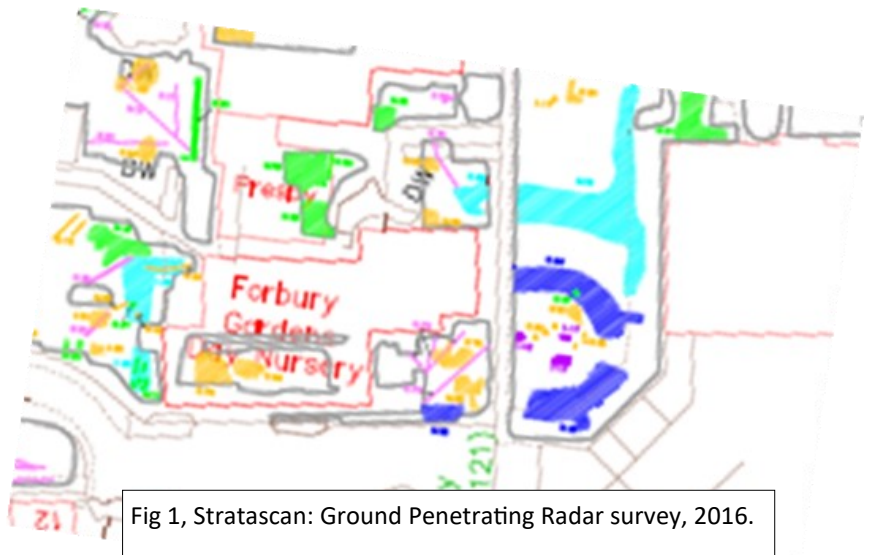


Fig 1, Stratascan: Ground Penetrating Radar survey, 2016.

KEY	
	Feature probably related to the abbey
	Probable archaeological feature, possible related to the abbey
	Probably modern obstruction
	Possible archaeological feature

Fig 2. Slade's drawing of the 1960s –70s archaeology is superimposed on the 1879 OS map, showing remarkable alignment between the GPRS and Slade's archaeology.

The purple marks within the inner apse were interpreted by Stratascan as possible graves. These lie within the arc of the apse, with one or two on the edge of the surveyed area where a modern wall separates the car park from the school playground.

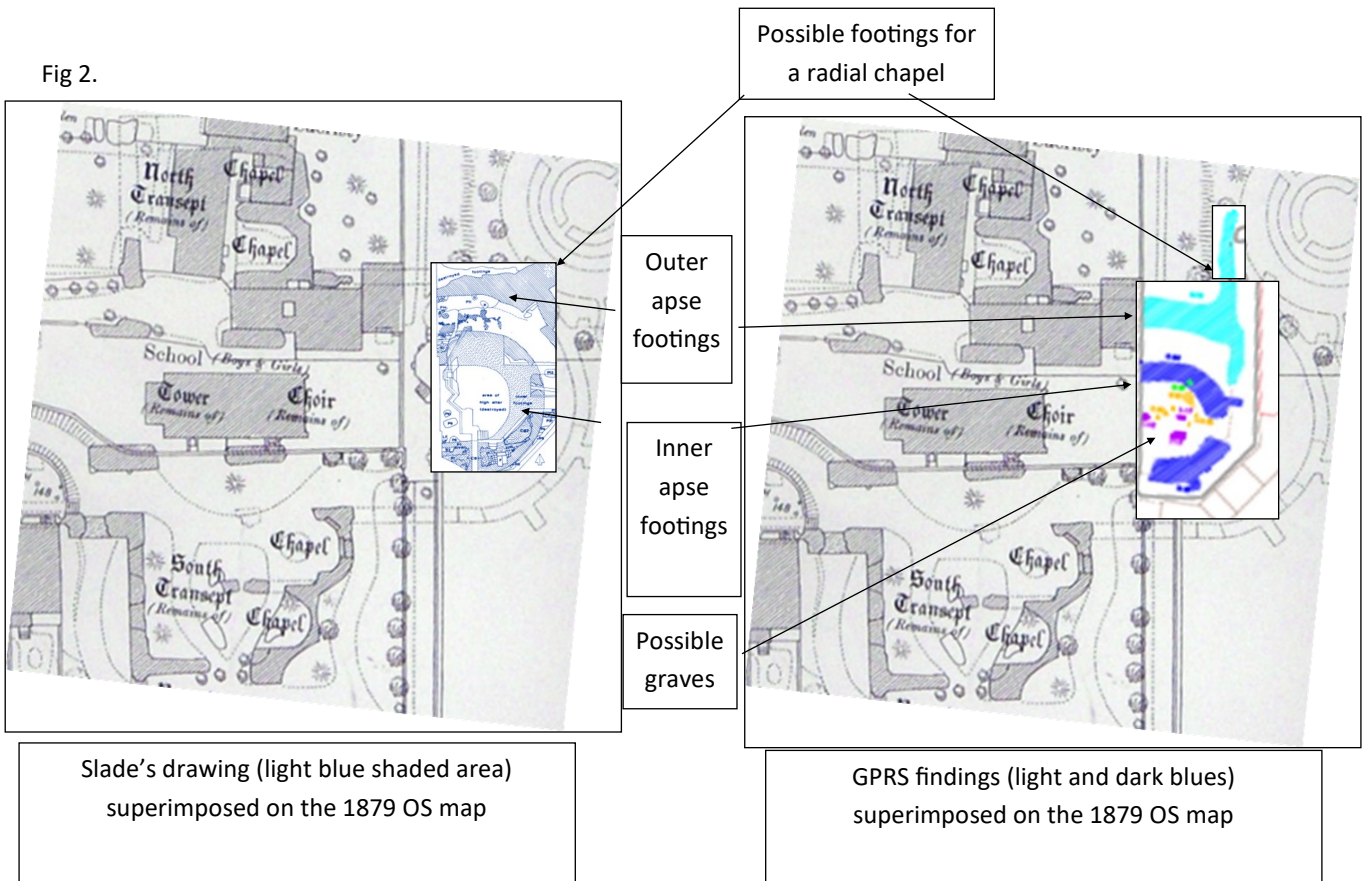


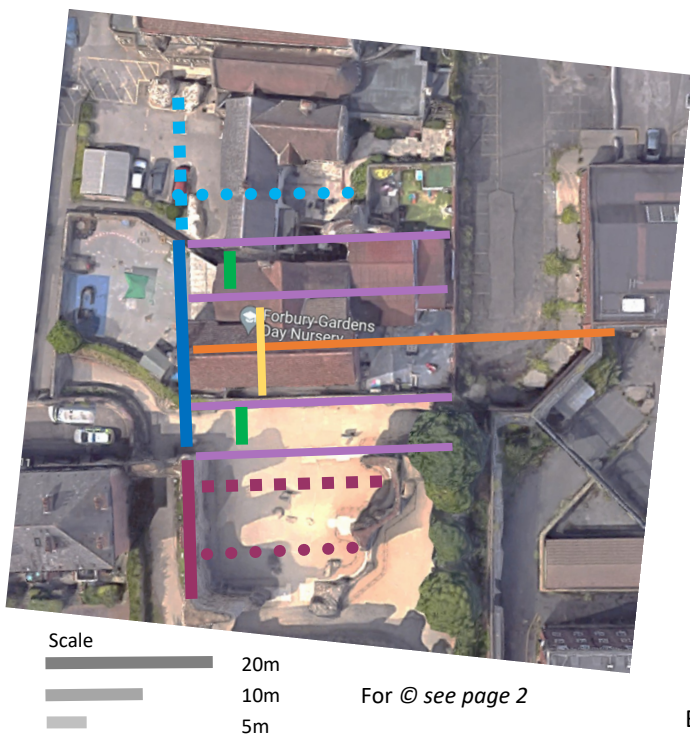
Fig 2.

Slade's drawing (light blue shaded area) superimposed on the 1879 OS map

GPRS findings (light and dark blues) superimposed on the 1879 OS map

THE MEASUREMENTS

Before proposing any hypothesis regarding the use of a mathematical or geometric methodology in the building of the abbey, it is necessary to know the measurements of the key points in the chancel and transept areas. The various distances are colour-coded to match the lines on the maps. The distances are taken from Google Maps' measuring tool.



THE CHANCEL and CHANCEL AISLES

Overall length — c48m.

It should be noted that there are no standing ruins at either the west or east end of the chancel. The west terminus is based on its alignment with two pillar bases to the north and south and the possible footings shown in the GPR survey. These all give the likely demarcation line between the chancel and the nave. The east terminus is based on Slade's excavations and the GPRS.

Overall width — c25m

AISLES to north and south length — c30m

“ “ width — c6m each

CHANCEL width — c12.5m

(The chancel consisted of the choir, presbytery and sanctuary)

Caution must be taken with these measurements, as they depend on the exact points taken, and differences of the thickness of the standing ruins. Nevertheless, they coincide reasonably well with Baxter's measurements and those in *Reading Abbey—a pilgrim church*, which are based on several sources.

SOUTH TRANSEPT

There are two apsidal chapels in the south transept, one larger than the other. They are also offset, an arrangement referred to as 'chevron apsidal style'.

Width (at widest point) — c16m

Length of north chapel ■ ■ ■ ■ ■ c24m

Length of south chapel ● ● ● ● ● c18m

NORTH TRANSEPT

Width ■ ■ ■ ■ ■ 16.5 m ?

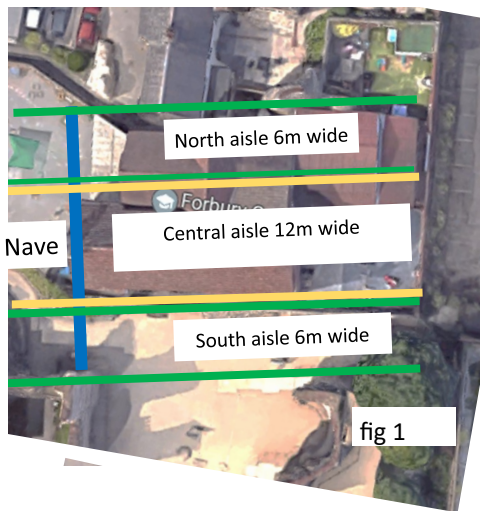
Length ● ● ● ● ● 16 to 18m?

Like the south transept, the north transept consisted of two chapels. Only part of the more southerly wall of its south chapel still stands. There are some indications, alongside the wall of the modern house, of possible remains of a wall demarking the north and south chapels. The footprint of this transept is not certain, but there are ruins, in front of the 19th century house, which may indicate its north wall.

Dotted lines show estimated distances only, as there are insufficient standing remains for accurate measurements.

COMMENT. The lengths of the transept chapels are uncertain. It is possible that the chapels themselves were separated from the rest of the transept, with an area to their west for pilgrims and visitors to pass by, or wait, until there was sufficient room in the chapels proper. As noted, there have been various measurements made and as much as 10% tolerance, if not more for certain areas, needs to be allowed in all these measurements, including those from Google Maps.

GEOMETRIC ANALYSIS OF THE EAST END OF THE CHURCH



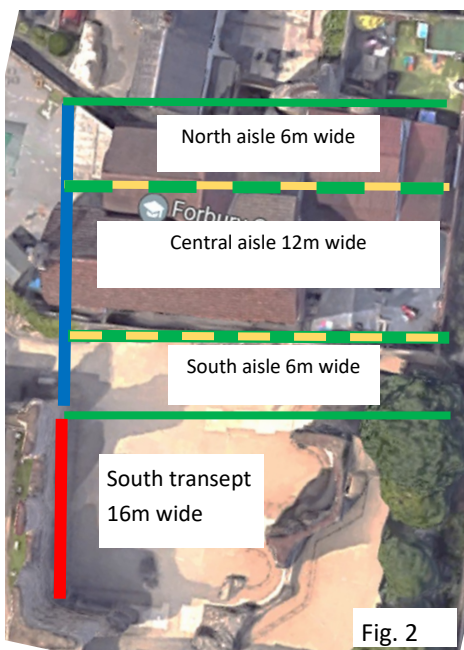
THE CHANCEL AND SIDE AISLES (Fig. 1.)

The eastern section of the abbey church consisted of the north and south transepts, north and south side aisles, and the chancel. The east end terminated in an inner apse and an outer apse. This latter formed the outside wall of the church until the Lady Chapel was added in 1314. An ambulatory, or walkway, between the apses, allowed movement round the chancel.

In many medieval churches the width of the chancel, and therefore the nave which continued along the same lines, had a proportion of 1:2:1. That is: the width of the central aisle was equal to the sum of the widths of the two side aisles.

At Reading, the side aisles (between the green lines) are about 6m each. The central aisle in both the nave and chancel (between the yellow lines) is about 12m.

It can be seen, therefore, that there was a proportion of 1:2:1 at Reading.



THE SOUTH TRANSEPT (Fig. 2)

The south transept measures about 16m at its widest point (red line). It consists of two chapels, the north chapel being larger than the south chapel.

Does this distance relate to any of the numeric formulae that have been proposed as relating to 'divine perfection'?

The calculation for the golden ratio was seen on page 4.

Is this applicable to the south transept of Reading Abbey?

First it is necessary to create a square (*quadratum*) based on the dimensions of the chancel.

The blue line (Fig. 2) shows the width of the chancel at its west end. This is where the chancel met the nave.

This forms the base on which to create the *quadratum* (Fig. 3, purple lines).

Following the formula to create the *golden ratio*, a line (yellow) is drawn from the half-way point, X, on the base purple line, to angle Y.

The extent of this line, from X to Z, coincides with the southerly wall of the transept at Z.

The south transept therefore has a *golden ratio* proportion to this section of the chancel and its aisles.

COMMENT: The North Transept:

The standing ruins of the north transept, especially its north wall, are not visible as they are under the modern buildings. There are some standing ruins. From these it is reasonable to estimate that the north transept was likewise based on the same calculations. However, this is a speculative assessment.



For © see page 2

THE CHANCEL

ARCHITECTURAL AND SPIRITUAL BACKGROUND

By the 12th century, most churches were built on a west-east orientation, with the chancel area to the east, and the public space, the nave, to the west.

The chancel of an abbey church was its most sacred space. There are several theories as to the etymology of the term 'chancel', one of the most commonly accepted being that the name can be traced back to the Latin *cancellum* (barrier, lattice work, doorway or entrance) demonstrating that this part was distinct from the body of the church and that it was reserved for special religious purposes.

The chancel was separated from the nave by at least one screen. This reached across the width of the chancel area. One such screen was known as a *pulpitum*. Another was a rood screen, so called from the Old English for the 'Cross' or 'rod'. Unlike the *pulpitum* this would have had two doors, on either side of an altar, surmounted by a depiction of Calvary: Christ crucified, flanked by his mother Mary and the apostle John. The altar between the doors was for the general public gathered in the nave attending Mass. There would not been any pews or chairs.

Beyond the *pulpitum* lay the chancel. This was divided into three sections

The first of these was the choir.

Processions were a feature of Cluniac Benedictines. As part of their ceremonial, either processing from the chapter house, or on more important feast days from the public body of the church, the nave, the choir monks would enter the chancel through the central doorway, as in the illustration of the *pulpitum* in Ripon. They would then pair off to the choir stalls, one set to the right, the other to the left, facing each other, as in the photograph of Winchester Cathedral choir.

Second, to the east of the choir stalls, would have been the 'presbytery', or priests' area. This was usually raised slightly above the level of the choir. It was a large open space to allow for the lavish ceremonial associated with Cluniac monasticism. At Reading we are fortunate to have a detailed account of one such ceremony: the instructions given for the commemoration of the death of Henry I, held on the first of each month and, each year, even more lavish services on the 1st December, the anniversary of his death. (*Reading Abbey Records a new miscellany* –ed Brian Kemp). Here we read of the numbers of monks dressed in copes and accompanied by others carrying thuribles and candles, offering prayers for the founder's soul.

Beyond the presbytery was the sanctuary or 'holy space'. It was accessed by steps, usually three, (a symbolic mystical number) raising it above the level of both the presbytery and the choir. This was where the high altar would have been placed and where Mass would have been said for the community. It is not possible to overestimate the spiritual importance of this area and of the liturgy of the Mass. Every Mass was seen not just a re-enactment of Christ's suffering, death and resurrection. It was believed that Christ's act of salvation was repeated at each Mass and that Jesus came amongst the community, 'body, blood, soul and divinity'. In short Jesus as God was believed to be really present at this very point in the church. It may be argued that the architecture reflected, and was even an essential part of, this belief.

ARCHITECTURAL ANALYSIS OF THE CHANCEL AT READING ABBEY

To what extent is it possible to determine the architectural features at Reading? Is it possible to determine which, if any, of the proposed geometric devices mentioned above, were employed at Reading?

The first challenge, in any such analysis, is to avoid the error of making the facts fit a theory.

The facts, as exist at Reading, are that there are a few standing ruins of the transepts and the bases of some pillars for the chancel. There is the tangible evidence from some archaeology and the GRP survey. There are also written records such as the account of the ceremonial commemorating Henry's death, and a few references to the chancel in the late 12th document known as the 'Miracles of the Hand of St James'. In the annals that have survived, there are references to Henry's tomb, written at various dates, such as those at the time of Richard II, and, towards the end of the abbey's existence, the report of the official 'visitation' by Thomas Benolt in 1532.



Ripon pulpitum with its central doorway



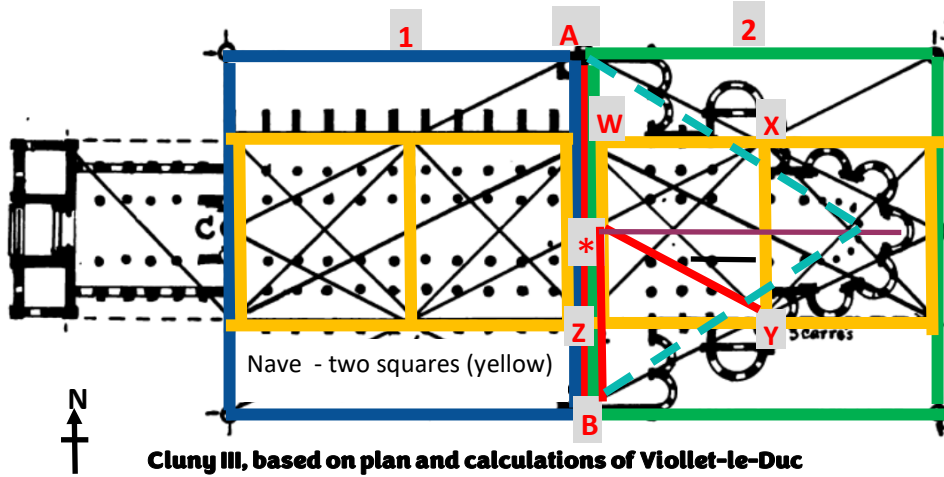
St Albans. Rood screen and altar



The choir, Winchester Cathedral

THE PROPORTIONS OF CLUNY III

The monastery in Reading was founded in 1121. It was a Cluniac church and its construction dates to about the same time as when Cluny III was being built (1089-1131). The monastery at Reading began as a priory and was founded by Cluniac monks from Lewes and from Cluny itself. By 1121 the construction of Cluny III was nearing completion. Henry I was a significant benefactor to its costs. To what extent did the design of Reading follow that of Cluny?



Cluny III, based on plan and calculations of Viollet-le-Duc

and 2, the chancel, aisles and transepts to the east (green lines), which together form a rectangle, where the line A-B lies at the west end of the transepts and chancel, dividing this area from the nave.

Furthermore, the chancel is divided into two equal smaller squares (yellow borders), as is the nave.

To create the transepts, a golden ratio distance is formed. Without the need for arithmetic calculations, a line (red) is drawn from the half way point (*) on the square or *quadratum* (WXYZ), to the opposite corner (Y). The length of this line (*Y) is the radius of a circle, whose arc at 62° creates a line *B. The ratio between WZ and ZB is the same as the ratio between WB and WZ: a *golden ratio*. (See pages 6 and 7)

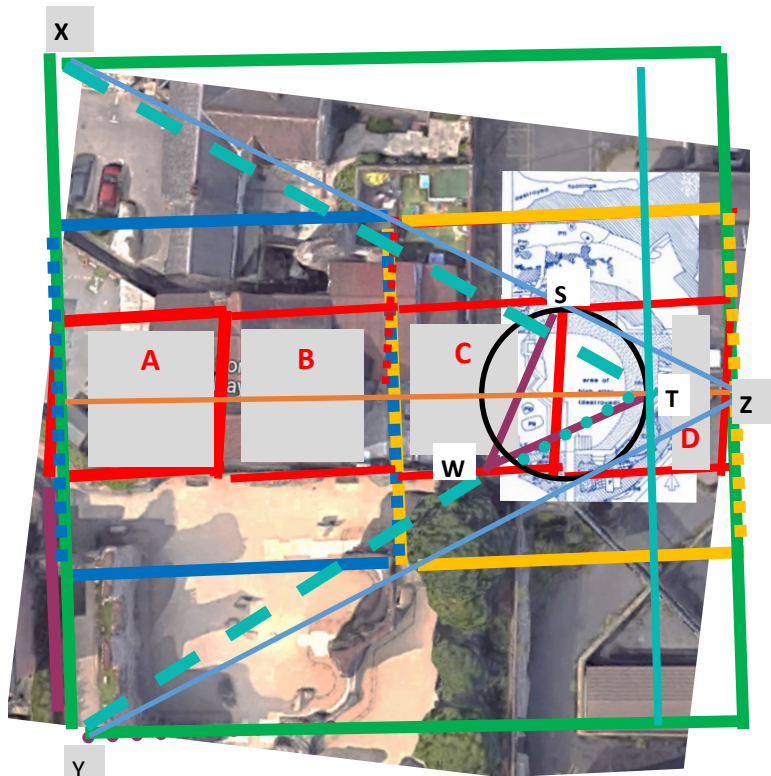
As Viollet-le-Duc showed, it is possible that Cluny was built *ad Quadratum*. That is, its proportions were based on the square and its derivatives, such as the circle and the triangle. Where the latter's proportions are used, this is referred to as *ad Triangulum*.

Viollet-le-Duc claimed that Cluny III's overall plan lies within two large squares, marked 1, the nave and aisles to the west (blue lines)

READING and CLUNY: EAST ENDS COMPARED

(Where two or more lines overlap, the lines are dotted)

1. Reading Abbey chancel and aisles can be divided into two equal squares (blue and yellow). As at Cluny, the outer *quadratum* (green) encloses the whole site.
2. The chancel area can be divided into four equal squares A, B, C, D (red). The circle (black), coincides with the footings of the inner apse. This circle is formed by the golden section, lines WS and WT from W on square C (deep purple lines). Similarly, Viollet-le-Duc divided the chancel at Cluny into two *quadrata*, in which he included the double aisles.
3. The furthest easterly point of the outer apse lies on the triangle XYZ (*ad Triangulum* - light blue lines) based on the outer *quadratum* (green). According to Viollet-le-Duc's plan, Cluny was similarly designed
4. As at Cluny, the terminus of the chancel is formed by an equilateral triangle (dotted turquoise lines), created from the outer green *quadratum* at points X and Y. (Cf p17 for the symbolic meaning of the equilateral triangle)
5. The GPRS and Slade's excavation both suggest that the outer apse had radial chapels, similar to those at Cluny.



For © see page 2

READING - THE HIGH ALTAR

There is no archaeological or historical evidence to pinpoint the exact location of the high altar. The 1879 OS map placed it within the arc of the inner apse. This is probably correct, although its precise position is open to various possibilities.

One method, to determine its positioning, is to make a comparison with other high altars and see if there is any relationship that may be applied to Reading.

Many studies of medieval churches have been made using various methods of geometric proportion.

The following applies some of these schemes to Reading.

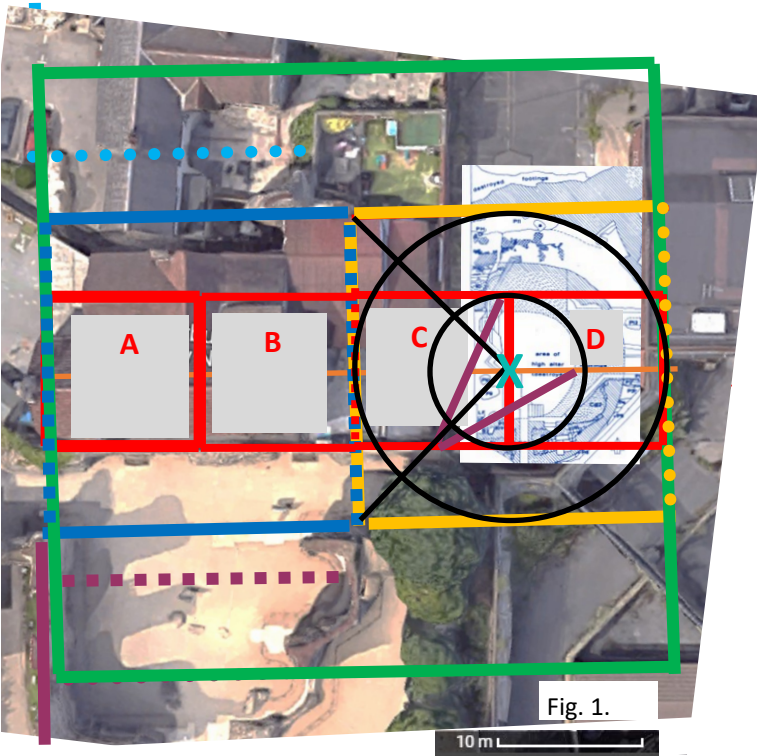


Fig. 1.

Geometric scheme 1: The altar was placed on the centre point, **X**, of the radius of the circle formed by the inner apse. This coincides with the central point where squares C and D meet (Fig. 1).

Geometric scheme 2: An alternative calculation locates the altar on the central point of the yellow quadratum which enclosed the easterly part of the chancel, the aisles and the ambulatory. This quadratum also encloses the two concentric circles which coincide with the abbey footings. This central point is also at **X**. The concept of the circle as representing the 'divine' was well-established by the 12th century, representing either Christ or heaven, the larger circle possibly being symbolic of God, and the inner circle representing Christ within the Trinity.

It has also been suggested that concentric circles served as an apotropaic device, having the power to avert evil.

Such symbols would have been represented in different ways for different occasions. Whatever their symbolism, they appear frequently in churches, for example on tiles. This is an example of the deeper invisible

symbolism found in ecclesiastical architecture.

In attempting a modern analysis, it is necessary to remember that we should include the mystical, or divine, element which would have been of paramount importance to the medieval architects. In their minds, the main factor determining the location of the altar would have been its spiritual significance.

As described earlier, the monks of Reading Abbey believed that 'number' or 'proportion' was the closest humankind could come to comprehending and reflecting the 'divine'. It is, therefore, very likely that some form of conjunction of angles/circles would have determined the location of the high altar.

However, this is informed speculation. All we do know is that the altar would have been situated within the arc of the apse, that it would have been on a raised platform, and that this would have been sufficiently large for the great number of clerics, dressed in sumptuous vestments to



Fig. 2.

For © see page 2

perform their most sacred rituals in this area.

The green arc (Fig. 2) represents the inner apse, with its radius also green. The approximate footprint of the altar (1m x 2m approx) is shown by a white rectangle. If this proportion scheme was followed, the high altar would have been about 5m from the boundary of the current school playground.

THE NAVE AND ITS DIMENSIONS

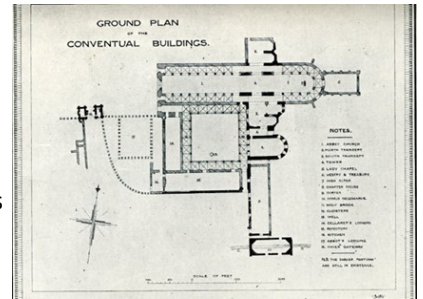
There is little reliable historical or archaeological evidence regarding the dimensions of the nave. This is certainly true of the length of the nave, whereas its width most probably followed that of the chancel, of which there are some remnants.

One of the main sources is the Ordnance Survey (OS) map of 1879. This gives us a detailed picture of the area. Much of the evidence for the map relies on the work of Englefield, Buckler, but most of all of Albury. Some of the information may be speculative, or the cartographers may have had information, based on Albury's plan, which has been lost to us. Albury claimed that the outline plan of the Abbey was inserted following the results of his survey.

It is possible that Albury had in fact discovered the foundations of the missing nave pillars. He said that he had made a detailed plan, marking in red the positioning of these Abbey remains and that they were then incorporated into the OS map. It was at this time that the eastern section of the Forbury, the part east of the Hill and the Inner Gateway, was being converted into a botanical garden, and extensive work was taking place in that area.

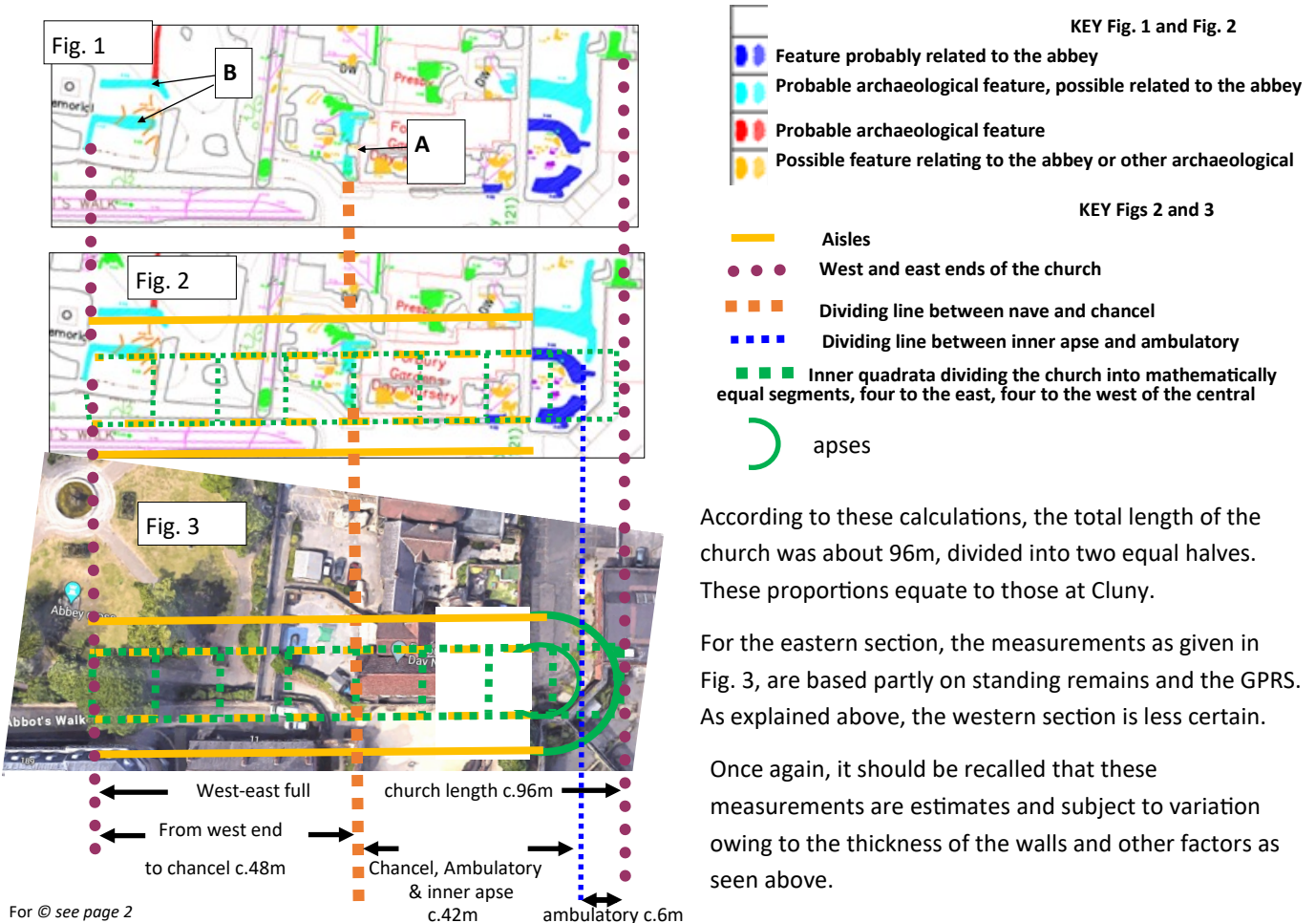
Subsequent maps and plans, showing the westward extent of the Abbey, have been based on this information. Dr Hurry's plan (alongside) followed Albury's work. Baxter, in *The Royal Abbey of Reading*, analyses and compares the various sources.

All these plans show the westerly extent of the abbey, comprising the nave, with eight sets of pillars and two side aisles, as matching the easterly extent of the chancel and ambulatory, excluding the 14th century Lady Chapel. If this is accurate, the proportions at Reading replicate those of Cluny.



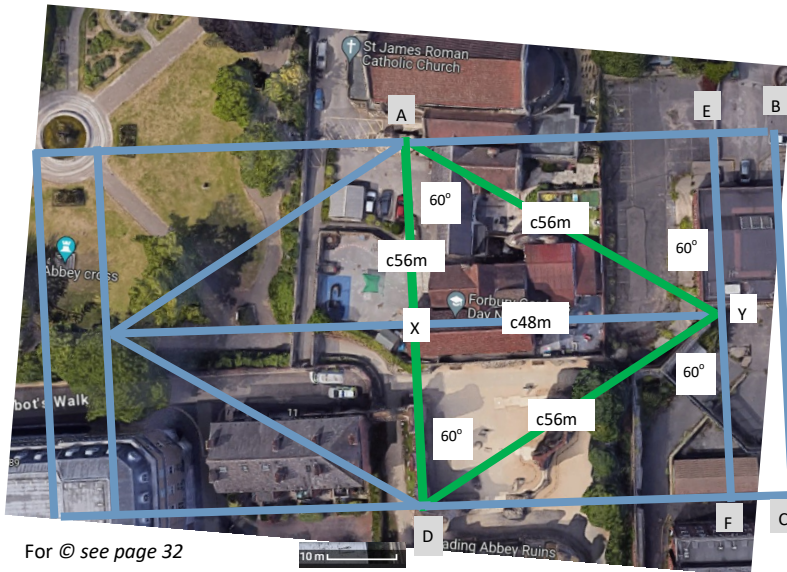
In addition to the information available to previous researchers, the GPRS produced possible, though not conclusive, evidence of a *pulpitum* between the chancel and the nave, and of the westerly extent of the nave.

One of the few historical records, *The Miracles of the Hand of St James*, mentions the existence of a *pulpitum* (Miracle 18). The GPRS shows possible medieval footings at the entrance to the chancel (Fig. 1, A). The scan also showed these with a gap in the centre, which would be consistent with the foundations of a *pulpitum*. To the west, two more blue markings were interpreted by Stratascan as being possibly related to the abbey (Fig. 1, B).



OVERALL PLAN AND DIMENSIONS OF READING ABBEY

There is sufficient evidence above to propose that Reading was designed using the *ad Triangulum* scheme, which in turn was based on *ad quadratum* principles. Unlike Cluny, where the triangles are at 62° , (the basis for the golden ratio), at Reading the triangles are at 60° thereby creating two equilateral triangles. Both schemes had mystical symbolism.



For © see page 32

The version of *ad Triangulum*, creating equilateral triangles, was widely used to determine architectural features and in designs representing the divine.

The equilateral triangle is one of Christianity's earliest symbols, representing the equality of the Holy Trinity: the Father, Son and Holy Spirit in one God.

It is formed from a *Quadratum*, ABCD, by drawing two lines from its base, AD, at 60° to point Y, which bisect line EF. This forms an equilateral triangle (green lines) within a new rectangle, AEFD.

At Reading, each side of this triangle is c.56m. It was shown above that the overall length of the chancel is about 48m, from point X to point Y.

When looking at the GPRS, if the westerly traces are the footings for the west end, the probably length of the whole church was c96m.

By applying the above *ad Triangulum* scheme, it can be seen that the position of the west end of the church corresponds both to the GPRS possible footings in the Forbury Gardens and to the claims made on the 1879 OS map.

The overall scheme of proportions is similar to Cluny III as described on page 12.

PART 1 SUMMARY

1. There is sufficient consistency and frequency in the application of schemes of proportion to believe that Reading was built according to the principles of *ad Quadratum* and its derivatives.
2. The founding community of monks came from Cluny, and there are close similarities between the overall designs of Reading and Cluny.
3. Although there is no conclusive evidence for the westerly extent of the church, the theoretical application of the *ad Quadratum* scheme, together with the GPRS and reported 19th archaeology, indicate its possible position.

PART TWO

THE HIGH ALTAR AND THE BURIAL PLACE OF KING HENRY I.

Since the discovery of Richard III's grave in Leicester, Reading, as the burial place of Henry I, has received a great deal of attention in the national press. That he was buried in Reading, and that his grave was in the abbey church, is well known. But the exact location is unknown. It is possible that his remains are still interred in the area of the abbey church, and there have been several proposals to see if they can be found. On the other hand, the area has been so comprehensively developed and built over that all traces of Henry's skeleton may have been lost.

References to Henry's tomb appear throughout the four centuries of the abbey's existence. Various accounts have been made of these, most comprehensively by Baxter in *The Royal Abbey of Reading*, and by Mullaney in *Reading Abbey, a pilgrim church*.

By applying the information outlined in this work, it may be possible to identify more precisely whereabouts in the church Henry was buried. The following is a summary of the main primary historical sources which mention Henry's tomb.

HENRY'S TOMB: PRIMARY SOURCES

With the publication of the *Reading Abbey Records*, (Kemp 2018) it became clear that there was a close connection between the location of Henry's tomb and that of the abbot's seat in the choir, or maybe one of his places in the chancel.

According to Kemp, the document concerning the ceremonial surrounding the annual commemoration of Henry's death on the 1st December 1135, is to be found in "a small gathering of additional folios, bound at the end of a 13th century manuscript of the *Summa de Dictamine* or *Summa Dictaminis* by Guido Fava". Originally from Westminster Abbey, it is now in the British Library — (Additional Ms 8167, fo. 200r-v). The ceremonial covers both the day itself and the day before, or vigil. That it was a solemn commemoration, liturgically speaking, is demonstrated by the fact that the *Office of the Dead* was sung with full ceremony. It was, however, also a time of celebration, with extra food and distribution of charity. Thirteen poor people from the town were fed in the monastery's *aula* (hall).

Another manuscript containing the third set of the Annals of Reading Abbey, which is also reproduced in the *Reading Abbey Records*, has a list of feast days and anniversaries observed annually at Reading. It enumerates these special days and how they were to be celebrated, according to their liturgical category. The most lavish, such as Christmas, were known as 'doubles'. Henry's commemoration day is ranked among these.

The two documents provide us with invaluable information. Not only do they tell us that the liturgy was to be performed in the most solemn way, but we read that the church was to be lavishly decorated, and that the services were to be accompanied by clergy in what we have to assume to be the best copes. Bells were to be rung both inside and outside the church, and generous portions of special food were to be provided to both the monks and the poor of the town.

The manuscript concerning the ceremonial around Henry's commemoration is not a complete rubric or liturgical text, but rather it consists of specific instructions which read more as clarifications to the full ritual. At times it is written in what can best be described as 'note form'. It comprises instructions for the performance of the liturgy for both the Mass and the Office of the day. Unfortunately, it has suffered from some damage where a hole in the folio makes the meaning of the text uncertain.

Whilst describing, in some detail, the actions and dress of the clergy, the manuscript also gives what we might call 'stage directions'. We read about the roles of certain participants, their number, and where they should stand or sit. Consequently, we also get something of a description of the chancel, and how it was used.

Regarding Henry's tomb, the most significant piece of evidence is an explicit reference to its location in the chancel.

The relevant text reads *ingrediatur abbas ad sedile suum iuxta tumbam super pavimentum ex parte australi*, ("the abbot is to proceed to his seat by the tomb upon the pavement to the south side"). This makes it clear that there was a close connection between the location of the tomb and that of the abbot's seat. The text categorically states that his seat was 'by the tomb'. The Latin word used is *iuxta* which means 'next to' or 'alongside'.

Another important phrase is that the tomb is 'upon the pavement', *super pavimentum*. This presents us with the possibility that this refers to the area beyond the choir. However, it may also merely be a reference to the open space of the choir, as is the case of William II's original tomb at Winchester, though more recently this tomb is attributed to Henry of Blois. With regard to the siting of the tomb at Reading, it is not possible, therefore, to come to a definitive answer.

Apart from those in the *Abbey Records*, there are only a few references to Henry's tomb. However, these do give us clues as to its location.

In chronological order they are:

1. For the year 1135:

Anno tertio Henrici secundi regis, obiit Willelmus peror. primogenitus filius Henrici regis, et sepultus est Radingis ad pedes Henrici regis proavi sui.

"In the third year (of the reign) of King Henry II, William of Poitiers, first son of King Henry, died and was buried at Reading at the feet of his grandfather, King Henry (the First)".

2. Late 12th, very early 13th century. Gervase of Canterbury (d. circa 1210) - *Opera historica* Rolls series Vol I, page 95 (Quoted in Hurry p 6).

ante altare sepultum est. ('He is buried in front of the altar') This is often translated as 'the high altar'. Strictly speaking the technical term used for the 'high altar' ought to be *maior altaris* ('greater altar'), the term used in the Cluny 'customaries'.

3. 13th century. Lambeth Palace Library ms 371. (For full reference and explanation of this archive follow link below *)

The tomb is *in medio presbiteri ante altare.* ("In the centre of the presbytery in front of the altar")

The latter is a categorical reference to Henry's tomb being in the centre of the presbytery. It is uncertain whether this means in the centre of the area known as the 'presbytery' or just in a central position and not to the side (east or west) of the presbytery. When we read such descriptions, it is necessary to question whether the writer is employing terms as they would be used today, in a strictly architectural sense. Nevertheless, taken together with other sources, such descriptions do help build an overall picture.

The Lambeth Palace reference occurs in an account of how and where Henry's second wife, Adeliza, came to be buried in Reading Abbey. Following Henry's death, Adeliza married William d'Albini, Earl of Lincoln and Earl of Arundel. It is worth quoting the account in full in translation, and in the original

"William earl of Lincoln married Queen Adeliza, wife of the founder as is evident in a charter and confirmation of the same William. Accordingly the king's council would not permit her to lie with him (Henry) in the middle of the presbytery before the altar. She lies buried, however, on the north side of the choir between the columns, apart from King Henry I, our founder and her husband, on whose souls may God have mercy. Amen"

Willelmus comes lincolnie desponsavit Adelizam Reginam fundatoris nostri uxorem ut patet in carta et confirmacione eiusd. Willelmi. Et ideo consilium regium noluit permittere eam iacere cum eo in medio presbiterii ante altare. Illa tamen jacet sepulta in boreali parte chori inter duas columnas seorsum a rege henrico primo fundatore nostro et marito eiusdem. quorum animabus propicietur deus. Amen.

This indicates that the words *in medio* mean 'centrally' rather than 'laterally' when referring to the tomb's place.

* <https://archives.lambethpalacelibrary.org.uk/CalmView/Record.aspx?src=CalmView.Catalog&id=MSS%2F371>

4. 13th century. Death and Burial of the infant William of Poitiers. Two chronicles reference this event.

A. *Flores historiarum* - Roger of Wendover, with additions by Matthew Paris.

This concerns the death and burial of William of Poitiers, son of Henry II (grandson of Henry I).

AD 1156 Willelmus quoque primogenitus regis Henrici obiit, et sepultus est apud Radingum

"... also William, firstborn son of King Henry, died and was buried at Reading"

B. *Annales de Waverleia* (II p237)

<https://archive.org/details/annalesmonastici02luar/page/236/mode/2up>

MCLVI. Anno tertio Henrici secundi regis, obiit Willelmus primogenitus filius Henrici regis, et sepultus est Radingis ad pedes Henrici regis proavi sui.

"1136. In the third year of King Henry II's reign, William, King Henry's eldest son, died and is buried at Reading at the feet of his grandfather, King Henry" (Henry I).

5. 1398 Richard II - Confirmation of the Abbey's Liberties - Cartularies 1, 116 (ed. Kemp)

Tumbam et imaginem Henrici quondam regis Anglie ... et fundatoris abbacie predictae (Reading) in eadem humati ... honeste facerunt reparari.

"They (the monks), must ensure that the tomb and effigy of Henry, sometime king of England, ... founder of the aforesaid monastery who is buried in that same place ... are properly repaired".

6. 1532 Thomas Benolt Clarenceux King of Arms

In 1532 Thomas Benolt made an heraldic visitation when he reported that Henry's tomb was:

in the myddest of the high Quyer

(Kemp *Abbey Records* p 102 quoting 'Visitations of Berkshire' ed W H Rylands).


The full record reads:


Clarenceux King of Arms, is the senior of the two provincial kings of arms, and has jurisdiction south of the River Trent. The office almost certainly existed in 1420, and there is a fair degree of probability that there was a *Claroncell rex heraldus armorum* in 1334. The title of Clarenceux is supposedly derived either from the Honour (or estates of dominion) of the Clare family or from the Dukedom of Clarence. (*Source Wikipedia*).

**King Henry the first iij^d Sonne to w^m Conquerour and first founder
of the Abbaye of Redding ys buried in the myddest of the high
Quyer w^tin the sayde place afore rehercyd
On the right hand of him liethe buryed Ranawd Le fitz parys
Before our Lady Chappell lyeth buryed Thomas Wood Knight some-
tyme Justice of the Co^mune place
In the bodye of the Church in our Ladye Chappell lyeth buryed
Thomas Prowt**

THE LOCATION OF THE HIGH ALTAR

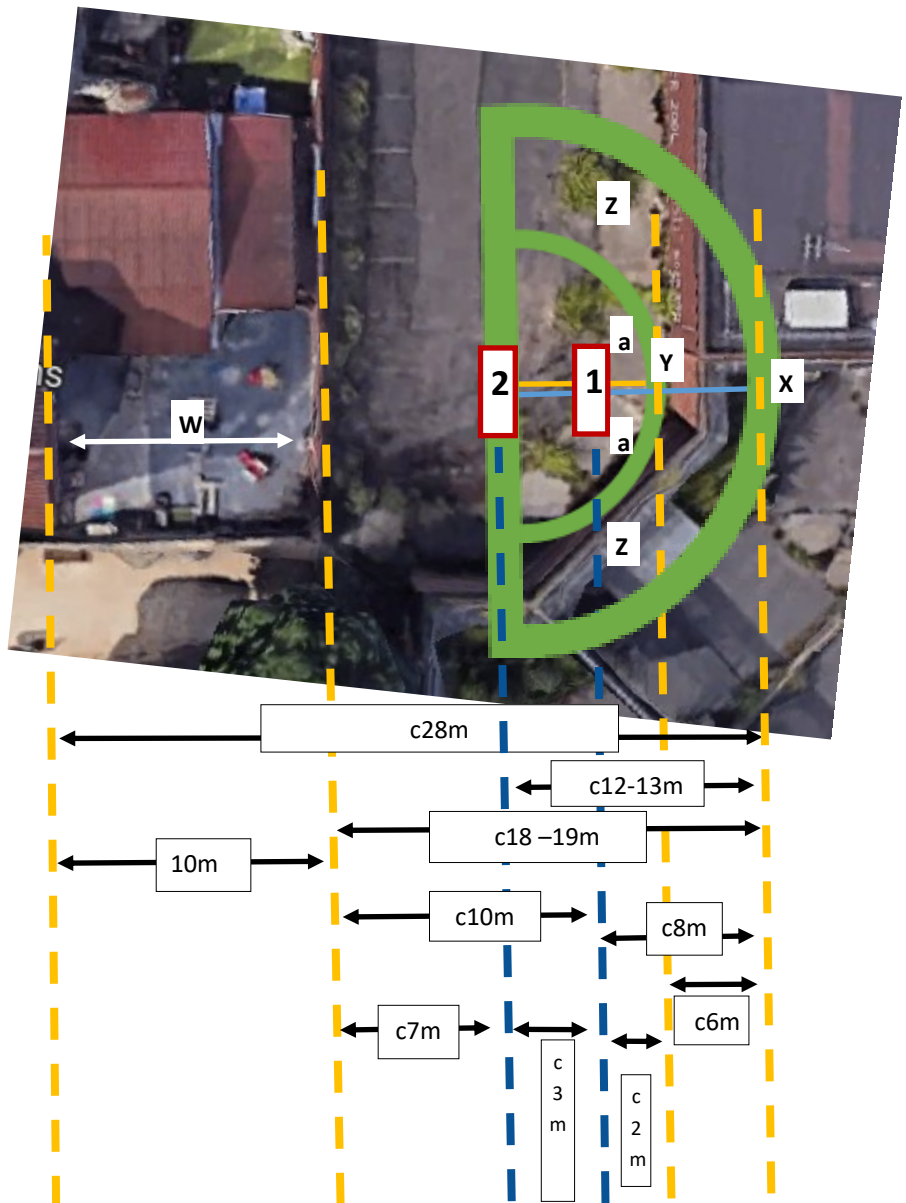
KEY

 Apses and the centre point of the circles formed by the arcs at point marked "2"

 Possible positions of the high altar

 10 m

For © see page 2



Allowing for variables, such as wall thicknesses, the radius of the outer apse was c.10-12m (light blue line from 2 to X). The radius of the inner apse was 4-5m (thin yellow line from 2 to Y). The ambulatory (Z), between the outer and inner apses, was about c.6m (8m inc. footings). The distance from the modern wall of the former gaol car park to St James' school building is about 10m, marked with a white line and W.

The high altar could have been placed anywhere within the arc of the inner apse. Allowing for movement around it to access the back, the altar would have had to stand at least one metre from the apse pillars, and probably a screen, at its narrowest points, marked 'a'. The altar, therefore, would have stood at least 1.25m from the apse wall/pillars at its centre.

The altar table (1) would have been at least 1m deep. The altar would have stood on a raised area. The steps, usually three, down from the altar would have taken up another metre or so of width. On these reckonings, the maximum distance between the altar and the modern school wall is c.8.5m - 3.25m = 5.25m.

If, however, as has been shown above, the altar was placed according to a divine proportion scheme, corresponding to the most sacred space within the abbey, then it is likely to have been positioned at the centre point of the circles formed by the arcs of the inner and outer apses (2). This lies about 7m from the school wall. After taking into account the size of the altar from front to back of c.1m, the celebrant's area of about 1m and the steps down to the presbytery, another metre, the distance remaining to the school wall would be c.7m minus 3m = 4m

In summary the furthest distance between the altar area and the modern school wall would have been about 5.25 m, whereas its most likely spot would have been about 2m from the wall.

THE LOCATION OF KING HENRY I's TOMB CHEST

The written records tell us that the tomb was:

1. in front of the high altar. There has been a comment that Henry's tomb could have been behind the high altar at Reading, like that of Edward the Confessor at Westminster Abbey. Not only does this run contrary to all historical records for Reading, but Edward was originally buried in front of the altar and his tomb was moved in 1269.
2. alongside, or next to, (*iuxta*) the abbot's place in choir
3. in the centre of the presbytery (which probably means somewhere on a central axis, rather than to the side).
4. a substantial chest with an effigy
5. in the 'midst of the high choir'

Comparison with other tomb chests shows that they varied in size from about 2.5m to 3m in length, many being about 2.9m.

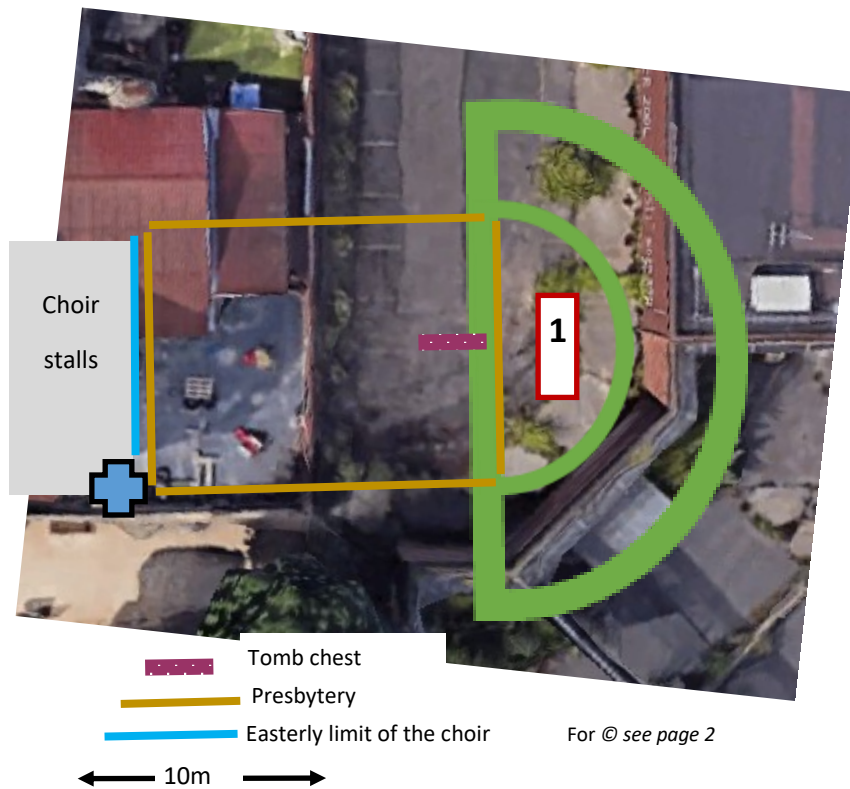
THE EXACT LOCATION OF THE TOMB CHEST

THEORY 1

If the high altar was placed as far east in the chancel as possible (near to the inner apse wall), the tomb chest could have been situated anywhere in the presbytery area. The placement in the illustration below, would be its furthest possible position to the east.

However, being so near the altar is difficult to reconcile with the historical records given above. The abbot's seat, which was 'next to' the tomb, would have been in the choir, most probably at the end of the choir stalls, where they met the raised pavement of the presbytery, as marked with the blue cross.

The presbytery area extended from the end of the choir to the altar steps. The choir stalls would have started at the entrance through the *pulpitum*. By allotting a typical 750cm for each monk's stall, it is possible to estimate the length of the choir area. Allowing for 100 places on both the north and south sides, with three rows of stalls on each side, the overall length of the choir stalls would have been about 25 metres.



THEORY 2 (Fig. 1)

This places the altar (2) at the centre of the circles formed from the arcs of the inner and outer apses.

As discussed above, this position conforms with a design scheme adhering to the principles of divine proportion, representing the most sacred space within the church.

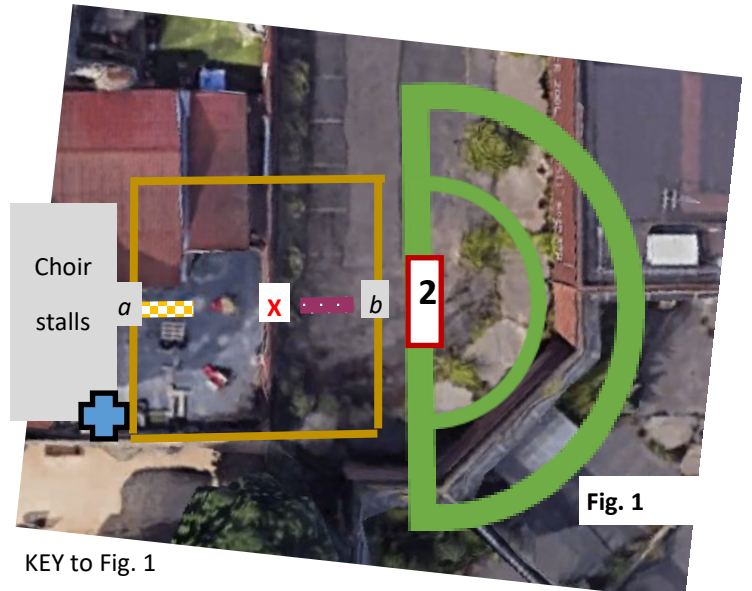
In this case, the furthest east the tomb chest could have been is about 2m from the boundary between the former gaol car park and the school wall.

As in the case of the previous theory, and as seen on page 19, the tomb chest could have been placed anywhere on the line between *a* and *b*, in the 'middle' of the presbytery.

By examining the historical records, this was its most likely position, and not to the side of the presbytery, as many lesser tombs were placed.

Stratascan identified a potential grave at point **X** (see page 10).

The white-yellow block would correspond to the report that the tomb was 'next to the abbot's seat in choir'.



KEY to Fig. 1

- Tomb chest, furthest easterly position within the presbytery
 - Tomb chest, furthest westerly position within the presbytery
 - Presbytery
 - Abbot's place in the choir, when presiding.
 - GPRS potential grave
- ← 10m →

THEORY 3 (Fig. 2)

Instead of hypothesising a position for the tomb chest based solely on the position of the altar, it is possible to introduce another geometric scheme based on the triangle (*ad triangulum*).

Using the yellow quadratum and drawing two lines at 60° on its base BC, an equilateral triangle is formed (light blue lines, triangle BCC) with its apex on a line AD (purple line) forming an unequal rectangle, ABCD.

Having seen the mystical significance of the equilateral triangle, it would be appropriate to hypothesise that in determining Henry's resting place, this 'divine' point **C** could be that of his tomb (black-white block).

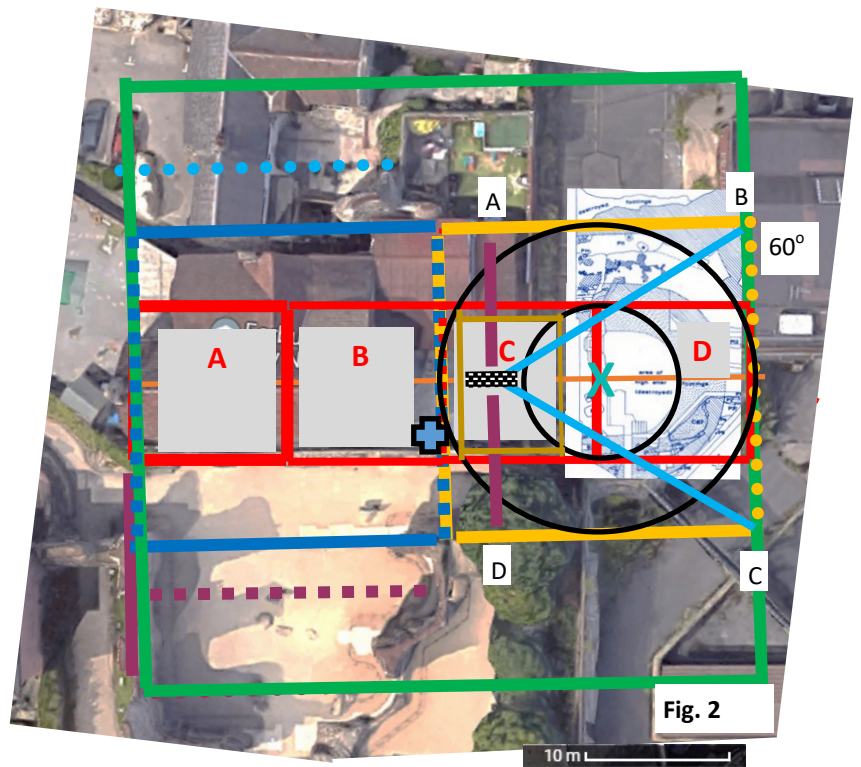


Fig. 2

KEY to Fig. 2

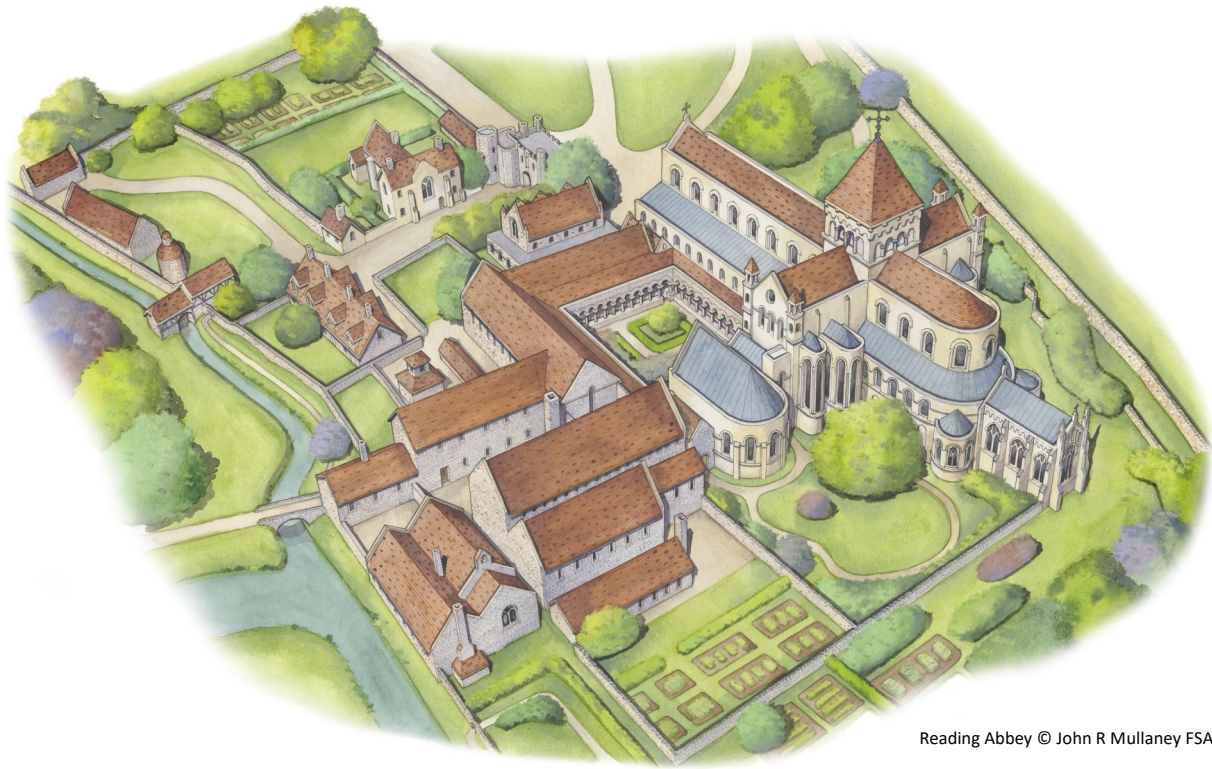
- Tomb chest, at apex of equilateral triangle (60° angles)
 - Presbytery
 - Abbot's place in the choir when presiding.
 - Altar
- ← 10m →

For © see page 2

PART TWO SUMMARY

1. Although little remains of Reading Abbey, and almost nothing of its church, there is sufficient evidence to identify the footprint of the chancel. Archaeology and the GPRS give a good outline of the eastern end of the church, before the Lady Chapel was added in 1314.
2. There are certain features which appear to have been planned according to geometric proportions. These are repeated throughout the chancel and transepts. They occur so consistently, and with sufficient frequency, to postulate the theory that a scheme of proportional geometry was used in building the church.
3. There is continuing debate about the location of Henry I's tomb. The above analysis provides options based on the position of the high altar and the medieval concept of 'number' as participating in the Divine.
4. All theories must take the historical evidence into account. There are several written records spanning four centuries that mention the positioning of the tomb.
5. It has been suggested that Henry may have been buried near or under the high altar and that the tomb chest was placed elsewhere in the chancel for ceremonial purposes. As in the cases of King John and Edward the Confessor, it is possible that the tomb and body were moved at some point. At Reading, there is no evidence one way or another for this. What is certain is that the 13th century instructions for the commemoration of Henry's death demonstrate the solemnity of the occasion, and show that the monks were convinced that the tomb chest was the location of Henry's body. The liturgy was not just a ceremonial act. It was a spiritual belief in the effectiveness of the prayers being offered at the tomb, with candles, incense, prayers and chanting over the body to pray for the salvation of the souls of Henry, his antecedents and descendants, as instructed in the Foundation Charter. These liturgical acts would not have been performed if the monks did not believe and know that this was the location of Henry's mortal remains which would rise again at doomsday.
6. The spiritual function of the abbey and its design are factors often overlooked, or at least downplayed, in our modern secular world. The Foundation Charter emphasised the spiritual reason for the abbey. Designed to be Henry's mausoleum, the abbey church was conceived as a mystical entity where prayers would be offered for his eternal salvation. Not just the fabric, the art, the music, but most importantly of all the very design of the abbey church itself were symbolic of its purpose. The exact siting of Henry's tomb, the *raison d'être* of the monastery, would have been the paramount consideration in its design.

THE READING ABBEY ILLUSTRATION



Reading Abbey © John R Mullaney FSAI

In collaboration with Brian Kemp, John R Mullaney, produced the above illustration of Reading Abbey, as it may have appeared by the early 14th century.

The representation is based on archaeological and historical sources. It shows the church without towers at its west end. These may have been built early on or added later. There may also have been towers at the ends of the transepts. The Lady Chapel, built in 1314, was in the 'decorated' gothic style.

The roof covering shows tiles in brown and leadwork in grey. There is no way of knowing which materials were used in which places, but there would have been lead on some roofs and clay tiles on others.

Two radial chapels are shown on the apse.

The proportions are approximate, but based on the information from the OS map, the GPRS, and the standing ruins.

PART 3

CLUNY, READING AND ROUEN COMPARED

Various applications of *ad Quadratum* have been used in the above analyses. The medieval mind would have been looking for patterns in nature that reflected God, and their churches would have been built to be symbolic of these patterns.

There are many variations of the *ad Quadratum* schematic, but whilst conducting this research, a recurrent pattern emerged of the close similarity between Cluny III and Reading.

This is not surprising. The first monks were from Cluny, led by a prior called Peter. This was at a time when Cluny III itself was nearing completion. Other monks, who comprised the founding community, were from Lewes Priory, a Cluniac monastery, whose prior was Hugh of Amiens, sometimes known as Hugh de Boves. Hugh was a Cluniac monk, theologian and scholar. He was briefly prior of St Martial, Limoges, renowned both as being on one of the pilgrim routes to Santiago de Compostela and as a centre of the arts. Hugh became the first abbot of Reading in 1125 and in 1130 was appointed Archbishop of Rouen.

Henry I was a major sponsor of the Cluniac order and of Cluny itself. Despite a rather tense relationship, at times, between Henry and Hugh, the two respected each other and Henry called for him on his deathbed in 1135.

The pattern of Cluniac architecture should be put within the wider context of how it reflected the specific spiritual values of the order. Among these the most salient was the emphasis Cluniacs put on prayer for the dead and the dying. It was the Cluniacs who were chiefly responsible for promulgating the commemorating the feast of All Souls. In addition to the full Divine Office, they sang daily the Office of the Dead.

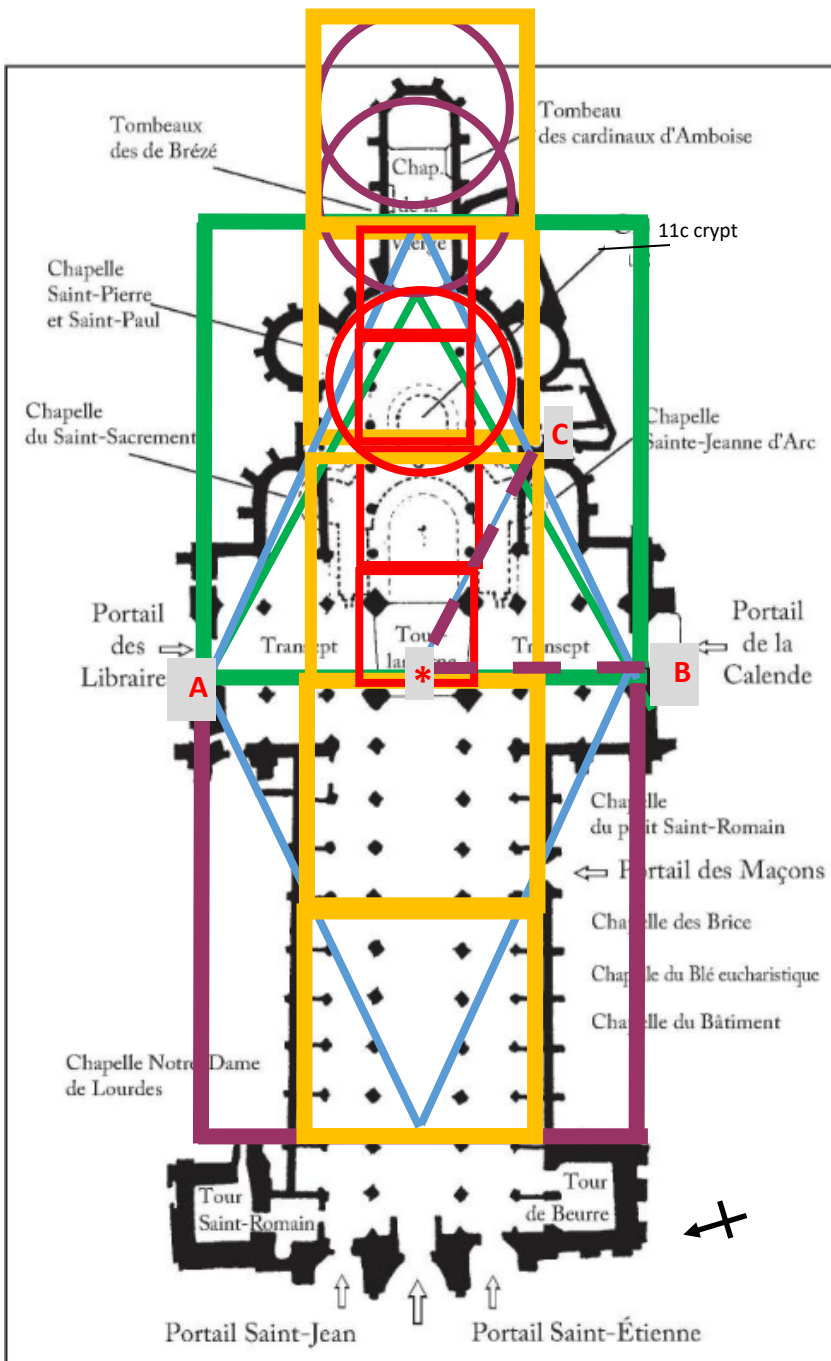
In the customaries of Cluny, the death rituals surrounding the last days of one of the community are precise and explicit in their detail. This was based on the fear of last minute weakness whereby the devil might tempt even the strongest soul into despair and eternal hellfire. Not only did continual prayers and sermons warn the community of the inevitability of death and eternal damnation, but all around were visual reminders in the form of stained glass, sculptures, tiles and paintings. As has been argued above, the very design and fabric of the church likewise carried this same message, though in a more subtle, hidden manner. This suited the medieval mind which believed in a divine plan underpinning all of God's creation. Paramount among these patterns was 'number' and the eternal truths number conveyed.

In comparing Cluny and Reading, it transpired that the Cluniac influence could also be seen in many other churches across Europe. One such is the cathedral church of Rouen. The first Romanesque building was consecrated by William of Normandy (the Conqueror). When Hugh left Reading to become Archbishop of Rouen, he began updating and rebuilding the cathedral in the new gothic style. He had been at the consecration of St Denis, and seen the work of Abbot Suger, and no doubt was influenced by what he saw there.

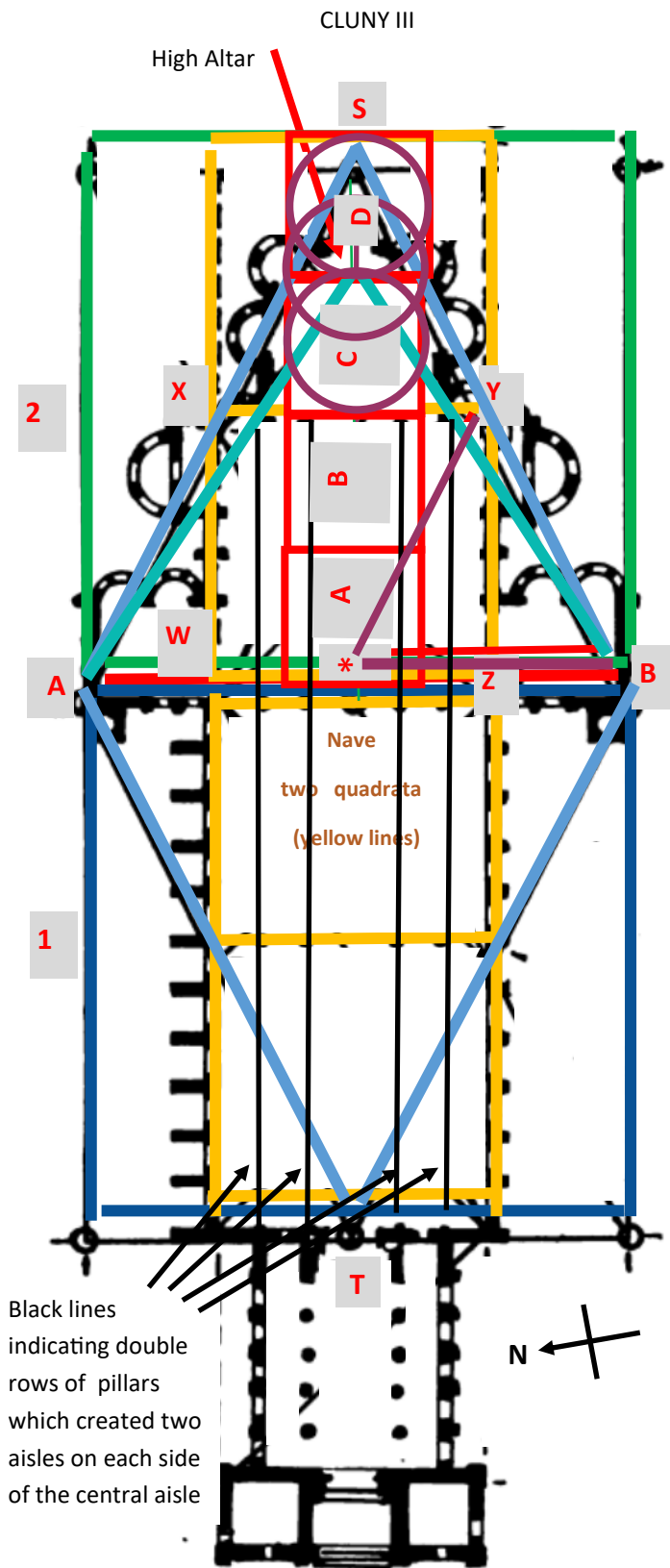
Although the cathedral was rebuilt in the gothic, pointed style, it retained many of the features of the previous church. The ground plan reflected the original building and the Lady Chapel appears to follow the same geometric scheme.

ROUEN II built c 1130 – c 1150

Hugh of Amiens was appointed Archbishop of Rouen in 1130. Having been present at the consecration of Abbot Suger's new style gothic cathedral of St Denis, Hugh set about modernising the Romanesque building in Rouen.

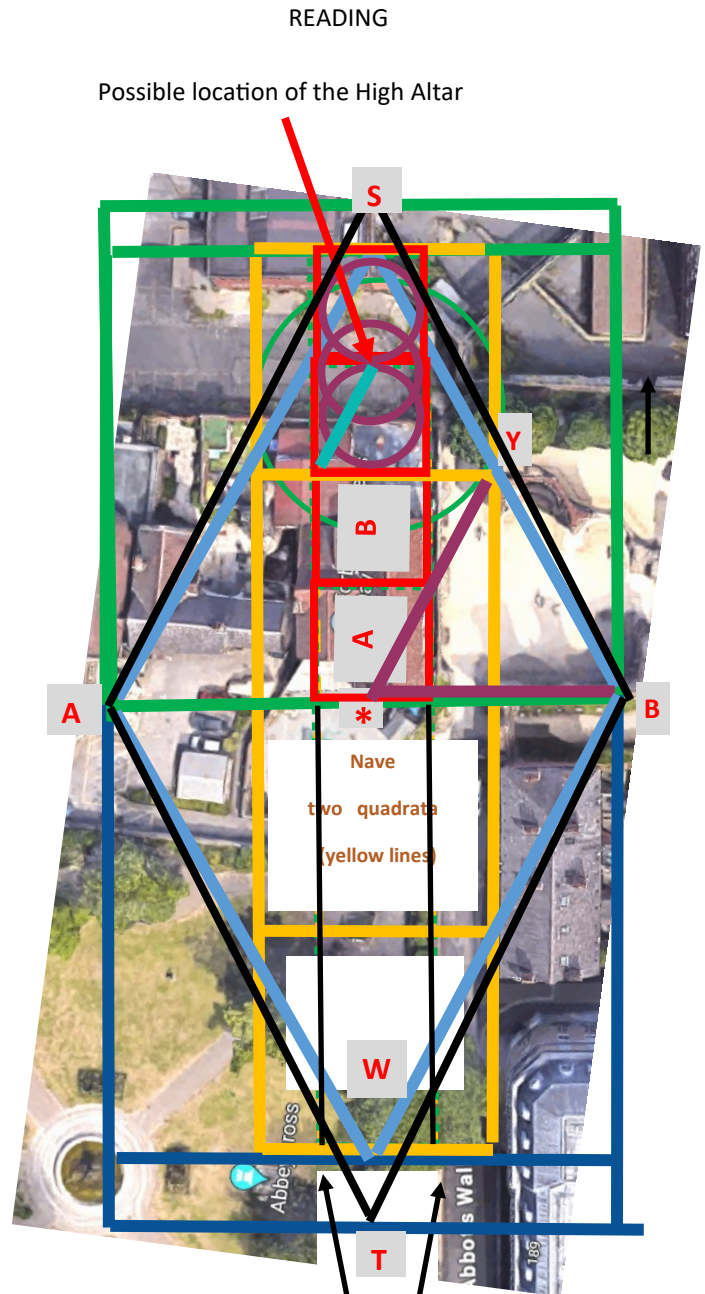


1. The footprint of the 11th century crypt possibly marks the outline of the Romanesque sanctuary. However, the overall proportions, and allowing for the addition of the Lady Chapel, are similar to other Romanesque churches, such as Cluny III.
2. There are many similarities between Cluny and Rouen. Both are based on the *quadrata* and the division of the chancel and nave into two equal parts (yellow lines).
3. The transepts are created with a golden ratio distance, in the same way as at Cluny, lines *C and *B (broken purple lines).
4. There are two side aisles, one each side of the main aisle. The ratio is 1:2:1
5. The east end consists of an inner apse and an outer apse. The space between them allows for an ambulatory and gives access to the Lady Chapel. This was added in 1302, and extended the previous smaller radial chapel dedicated to Mary. The proportions of the new chapel match the circles (purple) formed within the most easterly yellow *quadratum*. The outer apse is clearly based on this circle. The inner apse is formed on the circle created by the equilateral triangle (green). Both these proportions and devices are similar to those used at Cluny III
6. The two triangles (blue), formed at 62° on the half-way line AB, form the basis for the overall length of the church, to the east and west, with two equidistant halves. This is similar to Cluny III.



Narthex (black) added early 13th c

Cluny length (excluding narthex) 187m



Reading length 100m

For © see page 2

The two drawings are not to scale one to another.
The total length of Reading would have been just over half that Cluny III.

PART THREE SUMMARY

Cluny III and Reading compared.

SIMILARITIES

1. The dimensions of both Cluny and Reading appear to be founded on proportions based on *ad quadratum* principles.
2. Both have two outer quadrata, with two inner quadrata, themselves divided into two quadrata for the central aisles.
3. The widths of the transepts are based upon the *golden ratio* (lines *Y and *B)
4. The overall lengths are based on *ad Triangulum* calculations
5. The apse areas are formed on segments of circles within the innermost quadrata
6. Both have approximate West– East orientation, with chancels and apses to the east.

DIFFERENCES

1. Cluny had two aisles on each side of the main aisle. Reading had one aisle on each side of the main aisle.
2. Length: Though both Cluny and Reading are based on *ad quadrata* and *ad Triangulum* principles, the lengths use different schemes. At Cluny the overall length (the distance between S and T) is based on the two outer quadrata (green and blue) with triangles at 62° . At Reading there are two main possible ways by which the length was determined. If the same proportions as at Cluny were used, it would seem that the both the east and west ends would extend beyond what are believed to be their known limits (black lines AS, AT and BS, BT). However if equilateral triangles are formed at 60° on the dividing line AB, then the east end matches the archaeology and the presumed west end of Reading Abbey church (light blue lines AW and BW).
3. The altars are based upon different *ad quadrata* schemes. At Cluny the altar is at the apex of the equilateral triangle formed on the base line AB at 60° . At Reading the exact position of the altar is not known. Looking at the common position of altars in Romanesque churches, and using the theory of proportions, it is possible that the location of the altar was based on the innermost (red) quadratum and on the overlapping circles (purple) within the two most easterly quadrata.

CONCLUSION

When analysing the proportions in medieval churches, it is tempting to lose oneself in the increasing complexity of geometric patterns. This essay has looked only at ground plans. When raising the eye upwards, marvelling at the towering elevations of Romanesque and Gothic churches, a three dimensional world speaks of almost unfathomable, seemingly infinite, interrelationships in monumental sculpture.

Yet we should keep in mind the purpose of these buildings, and the very principles of architecture which guided their builders. Vitruvius is our master here, and we should recall his instructions that a building should possess a trinity of purpose. It should be well built, *firmitas*, it should be fit for purpose to facilitate that purpose, *utilitas*, and it should be beautiful, *venustas*.

In the Catholic church of the 12th century, there was only one entity that was perfect and that was God. We saw how Cassiodorus described 'number' as the paradigm of perfection. According to the thesis in this paper, churches as the symbol of the New Jerusalem, had to conform to the laws of number, that is, the laws of proportion.

Churches were created as holy spaces where God reached out to mankind, and mankind to God. Human knowledge of the Divine could come in many forms, but most of all through the senses. The churches were filled with sensations designed to bridge the transcendental chasm between the finite and the infinite. They were places of vibrant colours, sweet aromas, sounding bells, intricate sculptures and mysterious relics to feel, to kiss, and to lick. It was even possible to taste the food of eternal life in Holy Communion. Each symbol conveyed its own message. But most of all the churches echoed to heavenly sound. Almost every minute of the day, and for much of the night, the heavenly vaults were filled with the ethereal music of the monks' chanting.

And this was no accident, for if the church building could be said to have a primary purpose, it was as a monument of music.

Cassiodorus wrote *numerus est qui cuncta disponit*.

But he goes on to say that *musica est scientia quae de numero loquitur*:

A literal translation would be,

Number governs all things and music is the science which speaks of number.

To paraphrase the whole saying:

"God rules the universe through immutable laws and it is through the study of music that we learn these laws"

REFERENCES

In compiling this work I encountered many writers expressing various theories about the use, or otherwise, of schemes of proportion in medieval churches. The following is a list of just a few of those commentators and researchers.

Allen, J

Bork, R

Burkhardt, T

Connant, K

Crossley, P

Eliade

Fairey, C

Frampton, K

Frankl, P

Hecht, K

Jones, L

Macody Lund, F

Male, E

Pugin, A W N

Roriczwe, M

Von Simson, O

Shelby, L. R

Viollet-le-Duc, E

Weston, L

Wu, N