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Metrology and proportion in the window tracery of medieval Ireland:

An empirical study of Ormond and Connaught

In 3 Volumes
Volume 2: Text, Chapters 5-9

A Thesis submitted to Trinity College Dublin for the degree of PhD

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5 Metrology and proportion in medieval Connaught

Despite a varied political history in the mid- to late-medieval era, Connaught includes a relatively homogeneous group of buildings within which to look for patterns in the execution of tracery design. The region also offers the advantage of containing a significant number of sites, many of which contain intact or well-preserved tracery, resulting in the examination of 242 lights in 82 windows at 28 sites during this research. As in the other study regions, the buildings included parish and collegiate churches as well as monasteries of the Augustinian (Canons and Friars), Cistercian, Dominican, and Franciscan orders.

Retaining the same format as for the Ormond dataset, this chapter will firstly set out the general patterns and some anomalies revealed by a province-wide study of metrology and proportion. A sample of windows will be presented which demonstrate use of the most popular proportions and metrology in the region. A further sample of windows will then be taken in order to examine the potential of this empirical methodology in addressing questions of chronology. Following this a case study will be described for Athenry Dominican priory, to evaluate any alignments which can be found between the results of the tracery analysis and a comprehensive architectural and historical evaluation of an entire building.

The conclusions of this chapter will be further analysed in conjunction with the results of the analysis chapters for Ormond and, to a lesser extent, Desmond, in a comparative analysis in chapter 6.

5.1 Connaught metrology results

Figure 5.1 charts the number of times that each unit in the range 0.212m to 0.372m was counted as being either the most likely unit or a highly probable candidate unit used in the execution of tracery in the Connaught data set.[1] The processing of the Connaught data was identical to that used for Ormond as has previously been described in detail (see appendix 6 and the accompanying DVD for a more detailed view).[2]

[1] 0.212m to 0.372m cover the most likely units anticipated for this study.

[2] Recap: to also allow for random errors within the measurement processes units which achieved high probability, within 10-20% of the most likely candidate, were included within the frequency count with lower weightings of 0.9 and 0.5, respectively. Before creating the graph shown in Figure 5.1 all frequencies were normalised to ensure the validity of comparisons made between the regions.

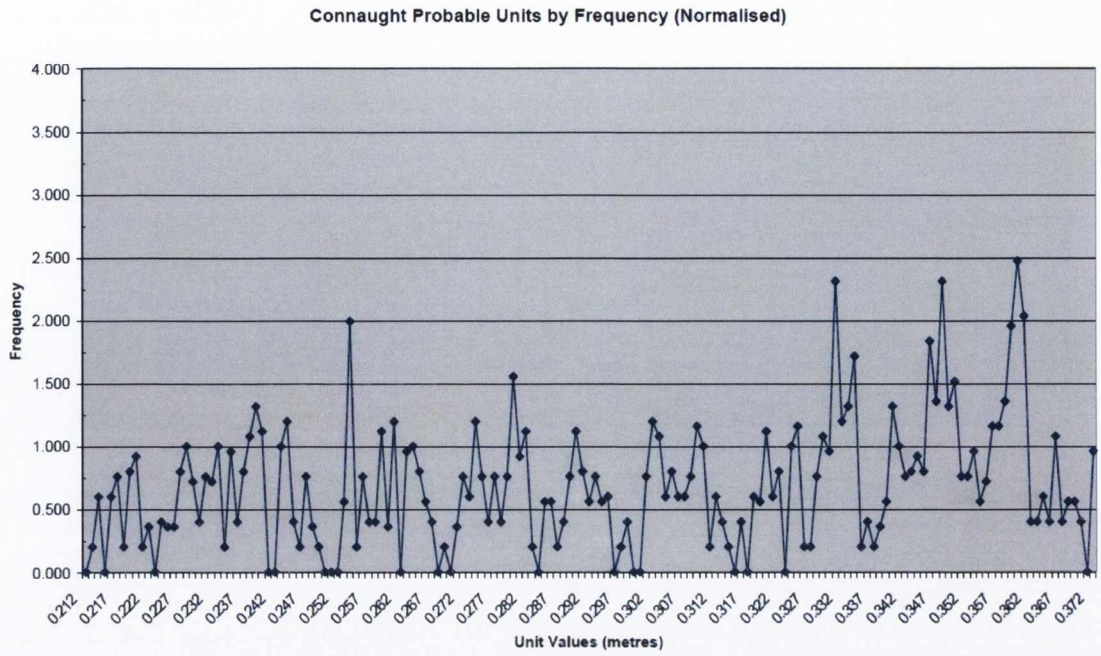

Figure 5.1 Connaught: frequency of occurrence of all units between 0.212m and 0.372m

The data for Connaught, as displayed in Figure 5.1, clearly shows 5 frequency peaks centred about 0.257m, 0.278m, 0.332m, 0.347m, and 0.357m. However, unique values are not as important as groupings of high frequencies within a specified range. Since the tolerance for this study is ~1cm, groups of high frequencies within 1cm of each other have been identified in the frequency data. Figure 5.2 depicts such groupings as totalled frequency bars. The lower portion of each bar (in blue where the total count was within 25% of the maximum count for the region and in yellow when within 50%) represents the normalised, grouped frequency of one most probable candidate unit, while the smaller red portion on top of each frequency bar represents a measure of the difference between the probable unit as calculated from the tracery data and the closest known or documented unit as evidenced from the literature.[3]

[3] Since the values that resulted from the difference calculation were very small relative to the frequency counts they were multiplied by 500 in order to make them visible on the graph.

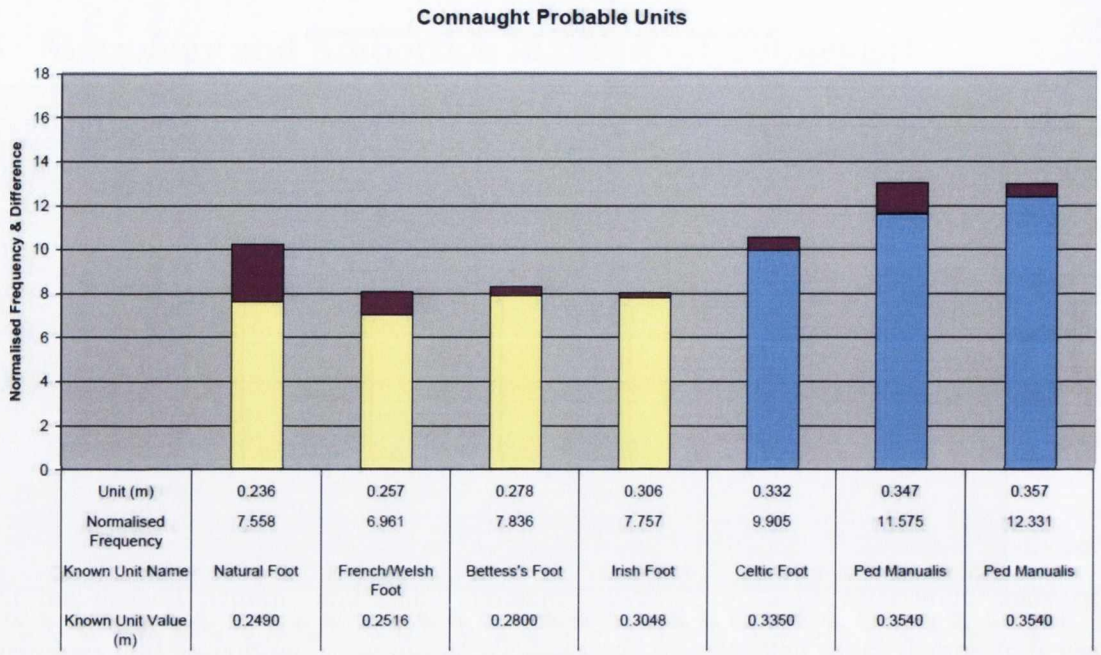

Figure 5.2 Connaught: probable candidate units: frequency of occurrence (blue where frequency is within 25% of the maximum value and yellow within 50%) and similarity to known units (red)

In the site catalogue the outcomes of the metrological investigation for each window within the Connaught data set are presented. However, in the following, only those measured items which relate to the most probable units will be described since this provides the most reliable source upon which to build an argument for an intended unit. This is not to say that individual sites may not have utilised metrology independent of their region, but this restriction guards against drawing conclusions based on limited evidence.[4] The differences between calculated and known values for each of the probable units are, in millimetres, 3, 7, and 3 for the units 0.332m, 0.347m, and 0.357m, respectively. For the lower probability groupings, the differences in millimetres were 13, 5, 2 and 1 for 0.236m, 0.257m, 0.278m, and 0.306m, respectively. With the exception of 0.347m and 0.236m, the deviations between calculated and documented units are below 5mm, making it likely that the documented units were used.

Table 5.1 details how each unit's total (9mm Total) was the sum of its own normalised frequency count added to the counts for the preceding four units and the following four units (sequentially shown as Contributing Normalised Counts). Table 5.1 also includes the value and name of the closest medieval unit found in the literature.

[4] As advised by exponents of the study of metrology such as Eric Fernie, Fred Bettess and Harry Sunley, and as described in chapter 2.

Table 5.1 Connaught: probable units with totalled frequencies

Unit	Contributing Normalised Counts					9mm Total	Closest Medieval Unit Value & Name	
Units within 25% of the maximum count								
0.332	0.756	1.074	0.995	2.307	1.193	9.905	0.332	Celtic Foot
	1.313	1.710	0.199	0.398				
0.347	0.796	0.915	0.796	1.830	1.352	11.575	0.354	*Ped Manualis*
	2.307	1.313	1.512	0.756				
0.357	0.955	0.557	0.716	1.154	1.154	12.331	0.354	*Ped Manualis*
	1.352	1.949	2.466	2.029				
Units within 50% of the maximum count								
0.236	0.716	0.994	0.199	0.955	0.398	7.558	0.249	Natural Foot
	0.796	1.074	1.313	1.114				
0.257	0.557	1.989	0.199	0.756	0.398	6.691	0.2516	French/Welsh Foot
	0.398	1.114	0.358	1.193				
0.278	1.193	0.756	0.398	0.756	0.398	7.836	0.280	Bettess's Anglo-Saxon Foot
	0.756	1.551	0.915	1.114				
0.306	1.193	1.074	0.597	0.796	0.597	7.757	0.3048	English/Irish Foot[5]
	0.597	0.756	1.154	0.994				

Before attempting to analyse these metrological outcomes, the findings will be combined with the results of the proportion investigation.

5.2 Connaught proportion results

In Connaught the sample size was large, 242 lights in 82 windows from 28 sites, thus providing a very reliable basis for analysis. Table 5.2 shows a list of the amalgamated and ranked results from the Connaught sites. The most frequently occurring ratios are the easily-executed, 1:2, 1:4, and 1:3, and, with the 4:5 ratio, these are used with similar frequencies.[6] Less frequently used but still possibly significant are the ratios 3:4, 13:23 and 1:1. Of the four most commonly occurring ratios in the Connaught data, three of these, 1:2, 1:3, and 4:5, are also popular in Ormond. For a full breakdown of which windows and which elements contributed to each ratio count see the site catalogue, appendix 8, and the Site_Measurements_Units_Proportions folder on the accompanying DVD.

[5] As has been discussed in an earlier chapter, the legally defined Irish and English foot were both set at a metric value of 0.3048m.

[6] Similarity is based on the totals of the 1%+2% columns rather than the All column.

Table 5.2 Connaught: ratios from normalised data - ranked by occurrence

Ratios	Numeric Value	All	1%	2%
1:2	0.500	44.6	24.0	20.7
1:4	0.250	38.4	18.6	19.8
1:3	0.333	37.6	23.1	14.5
4:5	0.800	35.5	13.6	21.9
3:4	0.750	27.7	16.1	11.6
13:23	0.565	23.6	9.9	13.6
1:1	1.000	22.3	11.2	11.2
377:610	0.618	18.6	7.0	11.6
1:√5	0.447	17.8	9.5	8.3
1: √2	0.707	17.8	9.1	8.7
5:6	0.833	17.8	7.0	10.7
1: √3	0.577	17.4	9.9	7.4
2:3	0.667	16.9	8.7	8.3
3:5	0.600	9.5	9.5	0.0
2:5	0.400	7.9	5.0	2.9

5.3 Site analysis

As with the Ormond data, two main groups of samples will be presented in the following. The first grouping is based on the empirical evidence from this study for the most popular proportions and units found in the region. Following this, as an *a priori* sample, two buildings which are well-documented, by Irish medieval standards, are located within the region, St. Nicholas' collegiate church, Galway and the Dominican priory, Athenry. Alignment of this documentation with the results of this investigation will assess whether empirical methods have the potential to assist in debates about chronology. The analysis of Athenry will continue as a full case study of the building to investigate correspondence between empirical results for window tracery and other architectural elements.

5.3.1 Empirical Investigation

The groups presented here represent the most popular ratios and units in this region. In the discussion that follows, an attempt will be made to give meaning to these groupings.

Metrology

1:2 Ratio

As with Ormond this ratio was the most frequently encountered ratio in Connaught, although without as much discrimination from the other popular ratios. Its use was common throughout the region and it was applied to a range of relationships within different windows (Table 5.3). Only in St. Nicholas' church was it used twice in the same window and that only occurred with a single design (the three-light nave south windows).

Table 5.3 Occurrences of 1:2 ratio in Connaught[7]

St. Nicholas nave south western	Light width to light height (at arch peak)
Athenry Dominican north aisle east	Overall window width to light height (at arch peak)
Kilmacduagh cathedral south transept east	Overall window width to light height (at arch peak)
Killursa chancel east	Overall window width to light height (at arch peak)
Moyne nave south	Overall window width to light height (at arch peak)
St. Nicholas nave north western **and** mid	Overall window width to light height (at arch peak)
St. Nicholas nave south western **and** mid	Overall window width to light height (at arch peak)
Rosserk south transept south	Overall window width to light height (at arch peak)
Rosserk nave west	Overall window width to light height (at springing point)
Claregalway chancel east	Overall window width to overall window height
Moyne chancel east	Overall window width to overall window height
St. Nicholas south transept east	Overall window width to overall window height
Portumna chancel east	Overall window width to overall window height
Strade north transept east	Overall window width to overall window height
Athenry Dominican nave north eastern	Tracery field height to light height (at arch peak)
Athenry Dominican north transept west	Tracery field height to light height (at arch peak)
Moyne nave south	Tracery field height to light height (at arch peak)
Sligo chancel east	Tracery field height to light height (at springing point)
Roscommon nave west	Tracery field height to overall window height
Ross Errilly south transept south western	Tracery field height to overall window height
Ross Errilly south transept west	Tracery field height to overall window height

[7] This list excludes any occasions where two-light windows measured half of the overall window width.

1:4 Ratio

Similar to the 1:2 ratio, this was only used twice in the same window on two occasions, in Ballindoon's chancel east window and Rosserk's nave west windows (**Table 5.4**). On every occasion but one, this ratio represented the relationship between the light width and some other parameter related to the light or to the mullion between adjacent lights. Even if windows were tall enough to allow it, the tracery field height was never one quarter of the overall window height.

Table 5.4 Occurrences of 1:4 ratio in Connaught[8]

Athenry Dominican north aisle east	Light width to light height (at arch peak)
Kilconnell south transept south	Light width to light height (at arch peak)
Kilmacduagh south transept east	Light width to light height (at arch peak)
Kilmacduagh south transept south	Light width to light height (at arch peak)
Killursa chancel east	Light width to light height (at arch peak)
St. Nicholas south transept east	Light width to light height (at arch peak)
St. Nicholas chancel south eastern **and** western	Light width to light height (at arch peak)
Portumna chancel east	Light width to light height (at arch peak)
Athenry Dominican chancel east	Light width to light height (at springing point)
Ballindoon chancel east	Light width to light height (at springing point)
Burriscarra south aisle east	Light width to light height (at springing point)
Kilconnell chancel east	Light width to light height (at springing point)
Meelick chancel east	Light width to light height (at springing point)
St. Nicholas south aisle west	Light width to light height (at springing point)
Rosserk nave west	Light width to light height (at springing point)
Ross Errilly south transept south eastern	Light width to light height (at springing point)
Ross Errilly south transept south western	Light width to light height (at springing point)
Strade north transept east	Light width to overall window height
Ballindoon chancel east	Mullion width to light width
Claregalway chancel east	Mullion width to light width
Moyne chancel east	Mullion width to light width
Moyne south extension south	Mullion width to light width
Moyne south transept south	Mullion width to light width
Murrisk chancel east	Mullion width to light width
Rosserk chancel east	Mullion width to light width
Rosserk nave west	Mullion width to light width
Ross Errilly south transept chapel east	Mullion width to light width

[8] This list excludes any occasions where four-light windows measured one quarter of the overall window width.

1:3 Ratio

Little pattern is discernible for the use of this ratio since it was applied to a range of relationships at sites throughout the region (**Table 5.5**). The collegiate church of St. Nicholas has a high representation in this group and, although the significant number of windows in that building might suggest that it would occur frequently, the reduced use of this ratio at other sites make this fact noteworthy.

Table 5.5 Occurrences of 1:3 ratio in Connaught[9]

St. Nicholas north chapel north	Light width to light height (at arch peak)
Ross Errilly south transept chapel east	Light width to light height (at arch peak)
Athenry Dominican north transept north	Light width to light height (at springing point)
Clontuskert Augustinian priory north transept north	Light width to light height (at springing point)
Agahower chancel east	Mullion width to light width
Sligo chancel east	Mullion width to light width
Feenagh parish church chancel east	Overall window width to overall window height
Moyne west	Overall window width to overall window height
St. Nicholas chancel south eastern	Overall window width to overall window height
St. Nicholas nave north western	Overall window width to overall window height
Rosserk nave west	Overall window width to overall window height
Rosserk south transept south	Overall window width to overall window height
Burriscarra Augustinian friary south aisle east	Tracery field height to overall window height
St. Nicholas north transept north eastern	Tracery field height to overall window height
Ross Errilly south transept east northern	Tracery field height to overall window height

[9] This list excludes any occasions where three-light windows measured one third of the overall window width.

4:5 Ratio

Although well used throughout the region, in 41% of the windows, the two buildings in Athenry dominate the list of occurrences of this ratio in Connaught (Table 5.6). It has mostly been used to relate the overall width of the window to the light or overall window height, or to divide the window vertically between the tracery field and the lights. On a few occasions it has been used to proportion the entire window by linking tracery field height to light height to overall window width, making its use seem very deliberate.

Table 5.6 Occurrences of 4:5 ratio in Connaught

Burriscarra south aisle east	Overall window width to arch span
St. Nicholas nave south western **and** mid	Overall window width to arch span
Athenry collegiate church north transept north	Overall window width to light height (at arch peak)
Claregalway north transept north	Overall window width to light height (at arch peak)
Kilmacduagh south transept south	Overall window width to light height (at arch peak)
Kilnalahan east northern	Overall window width to light height (at arch peak)
Athenry collegiate church south transept south	Overall window width to light height (springing)
Athenry collegiate church south transept east	Overall window width to light height (springing)
Athenry collegiate church nave south western	Overall window width to light height (springing)
Athenry Dominican nave north western	Overall window width to light height (springing)
Kilconnell nave south eastern	Overall window width to light height (springing)
Moyne chancel east	Overall window width to light height (springing)
St. Nicholas south aisle west	Overall window width to light height (springing)
Urlaur chancel east	Overall window width to light height (springing)
Loughrea nave north	Overall window width to overall window height
Athenry collegiate church nave south western	Overall window width to window height to spring
Athenry collegiate church south transept south	Overall window width to window height to spring
Athenry collegiate church south transept east	Overall window width to window height to spring
Athenry Dominican nave north eastern	Overall window width to window height to spring
Athenry Dominican north transept north	Overall window width to window height to spring
Claregalway chancel east	Overall window width to window height to spring
Kilconnell nave south eastern	Overall window width to window height to spring
Moyne chancel east	Overall window width to window height to spring
St. Nicholas north chapel north	Overall window width to window height to spring
Rosserk south transept east	Overall window width to window height to spring
Athenry collegiate church nave south eastern	Tracery field height to light height (at arch peak)
Athenry collegiate church nave south western	Tracery field height to light height (at arch peak)
Athenry Dominican chancel east	Tracery field height to light height (at arch peak)
Clontuskert north transept north	Tracery field height to light height (at arch peak)
Creevelea chancel east	Tracery field height to light height (at arch peak)
Kilconnell chancel east	Tracery field height to light height (at arch peak)
Ross Errilly south transept west	Tracery field height to light height (at arch peak)
Athenry collegiate church north transept north	Tracery field height to light height (springing)
Athenry collegiate church south transept south	Tracery field height to light height (springing)
Burrishoole chancel east	Tracery field height to light height (springing)
Claregalway north transept north	Tracery field height to light height (springing)
Creevelea west	Tracery field height to light height (springing)
Kilmacduagh south transept south	Tracery field height to light height (springing)
Kilnalahan east northern	Tracery field height to light height (springing)
Kilnalahan east southern	Tracery field height to light height (springing)
Moyne south extension south	Tracery field height to light height (springing)
St. Nicholas nave west	Tracery field height to light height (springing)
St. Nicholas chancel south east, mid **and** western	Tracery field height to light height (springing)
Portumna chancel east	Tracery field height to light height (springing)
Urlaur chancel east	Tracery field height to light height (springing)

Proportion

0.332m unit

Full list of contributing windows[10]: Athenry collegiate church south transept east and south transept south; Burriscarra south aisle east; Burrishoole east; Clontuskert east and north transept north; Kilcorban north transept north; St. Nicholas chancel east and south transept east; Rosserk east; Ross Errilly south transept east southern; Sligo east.

Windows where 0.332m was probably used: Athenry collegiate church south transept east and south transept south; Clontuskert east and north transept north; Kilcorban north transept north; Sligo east.

0.347m unit

Full list of contributing windows: Athenry Dominican north aisle east; Burriscarra south aisle east; Burrishoole east; Clontuskert north transept north; Creevelea east; Kilconnell west; Killursa east; Moyne east, south transept south and west; St. Nicholas east, south aisle west, nave north western, north transept north eastern and south transept east; Roscommon east; Ross Errilly south transept east; Urlaur east.

Windows where 0.347m was probably used: Burriscarra south aisle east; Burrishoole east; Killursa east; Moyne south transept south; St. Nicholas east (not certain), nave north western, north transept north eastern and south transept east; Ross Errilly south transept east.

0.357m unit

Full list of contributing windows: Athenry collegiate church nave south western; Claregalway east; Kilnalahan east northern; Moyne east; St. Nicholas nave south eastern, nave south mid, chancel south mid and chancel south western; Roscommon west; Ross Errilly east, south transept south eastern, west, and south transept east northern; Strade north transept east; Urlaur east.

Windows where 0.357m was probably used: Athenry collegiate church nave south western; Kilnalahan east northern; St. Nicholas nave south mid and chancel south western; Ross Errilly east, south transept south eastern, west, and south transept east northern; Strade north transept east; Urlaur east.

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[10] A full explanation was given in the Ormond chapter on why all of the contributing windows for a particular unit are not actually windows where the value was probably used. The full list is, however, given here to explain the popularity of certain units and because the unit has an outside possibility of having been used for all of the windows in the list.

The possible origin of each of these units is examined in the discussion that follows and the windows within these groupings will be re-examined in that context.

5.3.2 Questions of Chronology

One of the major questions in Irish medieval architecture relates to the dating of both architectural features and structures. As discussed in the literature review, documentary evidence which could resolve such questions is rare. This leads the architectural historian to try to address chronology by aligning limited written evidence with other methods such as stylistic comparison, moulding profile analysis, and examination of the building fabric and architectural details.[11] The literature review has shown that the potential of metrology and/or proportion analysis as complimentary methodologies has not yet been considered. Therefore, in this section, documentary sources will be pooled with the evidence from previous architectural and historical investigations, and compared against the results from metrological and proportional examinations of St. Nicholas collegiate church, Galway and Athenry Dominican priory to assess the contribution that these methods might be able to make to chronological debates.

St. Nicholas collegiate church, Galway city

The collegiate church of St. Nicholas is among the largest medieval parish churches in Ireland.[12] It is also one of the best-documented and its medieval history, both architectural and ecclesiastical, has been recorded in a number of key documents which will be referenced in this investigation. Two of these texts are the TCD manuscript "*Account of*

[11] Many works of stylistic analysis abound in Ireland including Canice Mooney on the Franciscan's, Roger Stalley on the Cistercians and Harold Leask on almost the entire medieval record: C. Mooney, *Irish Franciscans and France*, Dublin: Clonmore and Reynolds Ltd, 1964 and C. Mooney, 'Franciscan Architecture in Pre-Reformation Ireland', *Journal of the Royal Society of Antiquaries of Ireland*, 1955, 85, 133-73; 1956, 86, 125-69 and 1957, 87, 102-24; R. Stalley, *The Cistercian Monasteries of Ireland*. London & New Haven: Yale University Press, 1987; and H.G. Leask, *Irish Churches & Monastic Buildings*. Vol. I-III. Dundalk, Ireland: Dundalgan Press Ltd., 1955 & 1960 (hereafter *Irish Churches I-III*). Danielle O'Donovan has been the main proponent of the use of moulding profile analysis although Roger Stalley's book on the Cistercians, among others, has also used the technique in a more selective context: D. O'Donovan, 'Building the Butler Lordship 1405–c. 1552', Ph.D. Trinity College, Dublin, 2007 (hereafter 'Building Butler'. Jim McKeon and Tomás Ó'Carragáin are among the researchers using detailed analysis of masonry techniques to examine a range of Irish buildings: J. McKeon, 'The Dominican Priory of Saints Peter and Paul, Athenry: high-medieval history and architecture', *Journal of the Galway Archæological And Historical Society,* 2009, 61, 24-56 (hereafter 'The Dominican Priory'); J. McKeon, 'St. Nicholas's parish church, Galway: structural and architectural evidence for the high medieval period', *The Journal of Irish Archaeology,* 2009, 18, 95-114 (hereafter 'St. Nicholas'); T. Ó'Carragáin, 'Habitual masonry styles and the local organisation of church building in early medieval Ireland', *Proceedings of the Royal Irish Academy,* 2005, 105C (3), 99-149; and T. Ó'Carragáin, *Churches in early medieval Ireland: architecture, ritual, and memory*. London & New Haven: Yale University Press, 2010.

[12] Tadhg O'Keeffe lists it as worthy of consideration with the large parish churches of New Ross, Fethard, Youghal and Kinsale: T. O'Keeffe, *Medieval Ireland: an archaeology*. Stroud: Tempus, 2000, pp. 156-7.

the Town of Galway" dated 1508, henceforth TCD MSS. Another manuscript held at TCD is attributed to John, son of Alexander Lynch. It dates from 1815, but is based on earlier documentation, and describes the activities of the Lynch family from an early medieval date, including reference to endowments to the collegiate church. It is described henceforth as Lynch MSS.[13] Specifically relating to architectural history, the main texts used in this work are Harold Leask's 1936 study of the structure of the church, which made significant reference to dating information from James Hardiman's *History of the Town and county of the Town of Galway*, and Jim McKeon's 2009 analysis of the high medieval structural and architectural elements of the church.[14] Issues relating to the sources used for Hardiman's account and to the completeness and veracity of the two manuscripts raise some doubts over the documentary references.[15] However, notwithstanding, they still provide better information than is available for the majority of Irish medieval sites.

The church has been in continuous use since its foundation and, although most sources attribute a date of 1320 to this event, the church is referred to in the 1302-06 taxation records.[16] Over its long history a significant number of alterations have been made to the structure and detailing of the building; including some necessitated by changes in the liturgy as a result of promotion to collegiate status in 1485. These phases of alteration will now be aligned with the metrological and proportional results and discussed in relation to documentary sources and previous analyses. First windows with little dating ambiguity will be discussed in order of their approximate construction sequence. Then windows of more uncertain chronology will be examined. These discussions are assisted by inclusion of a ground plan of the building, after Leask, but with the addition of the metrology results from this study (Figure 5.3). In this plan, where more than one unit is included this indicates that values within 10%, or on a small number of occasions within 20%, of the minimum unit might be significant and are discussed in the following.

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[13] M.J. Blake, 'An Old Lynch Manuscript (1508)', *Journal of the Galway Archæological And Historical Society,* 1915, IX (II), 79-107 (hereafter 'Lynch 1508'); J. Lynch, 'Lynch MSS: Letter and Account written by John, son of Alexander Lynch, 1815', *Journal of the Galway Archæological And Historical Society,* 1912, VIII (II), 88ff (hereafter 'Lynch MSS').

[14] H.G. Leask, 'The Collegiate Church of St. Nicholas, Galway. A Study of the Structure', *Journal of the Galway Archæological And Historical Society,* 1936, 17 (hereafter 'St. Nicholas'), J. Hardiman, *History of the Town and county of the Town of Galway.* Online <http://www.galway.net/galwayguide/history/hardiman/> Dublin: Folds, 1820 (hereafter *History of Galway*), and J. McKeon, 'St. Nicholas'.

[15] P. Walsh, 'An Account of the Town of Galway', *Journal of the Galway Archaeological and Historical Society,* 1992, 44, 47-118 and J. McKeon, 'St. Nicholas', p. 96 who suggested that the Lynch MS was at least in part a promotional document for the Lynch family.

[16] H.S. Sweetman, ed. *Calendar of documents relating to Ireland, 1302-7.* Vol. 5. 5 vols. Dublin, 1877, pp. 226, 235.

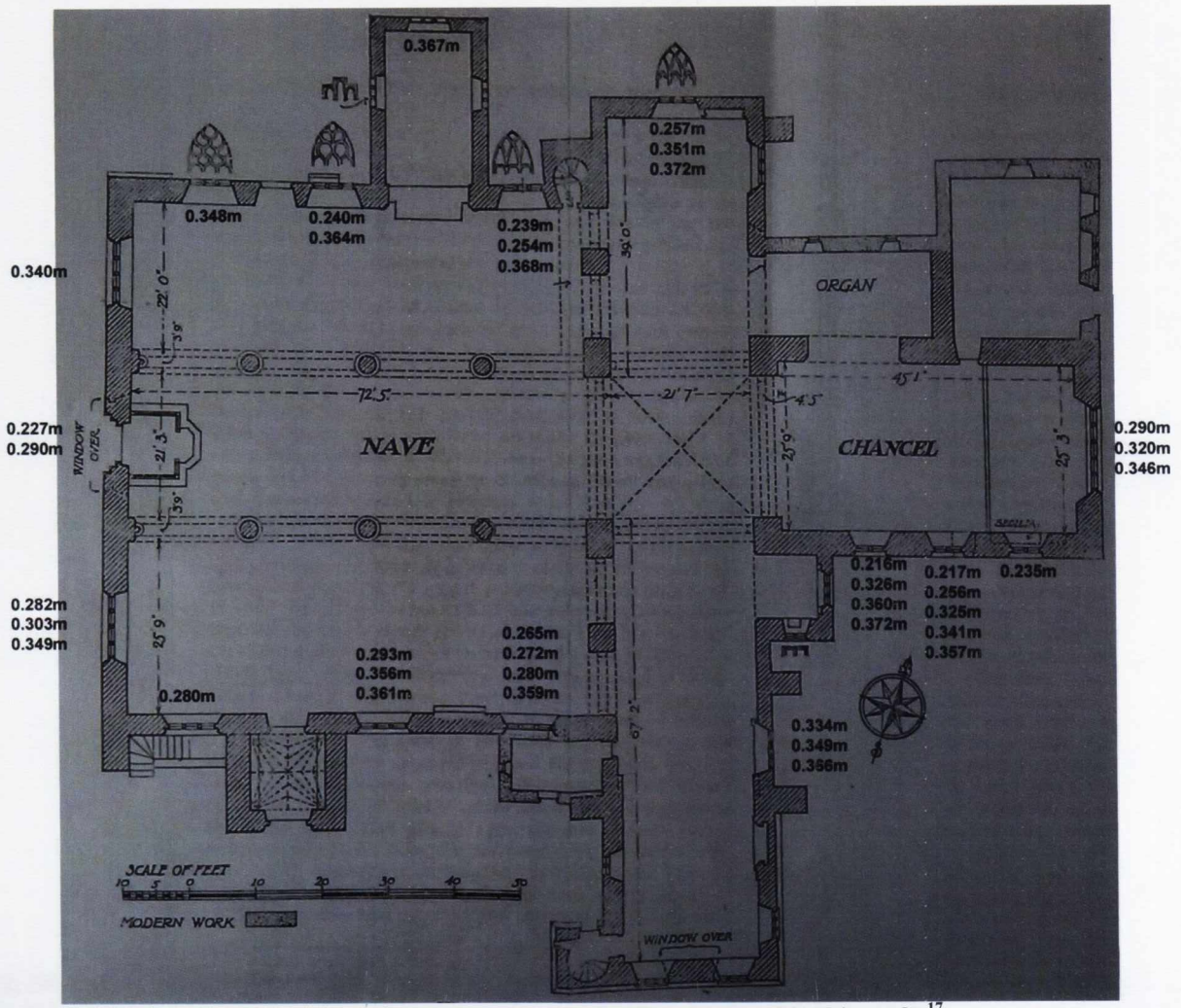

Figure 5.3 St. Nicholas' collegiate church, Galway: ground plan after Leask, annotated with units found in this study.[17]

[17] The figure contains some distortion due to copying from a folded original plan. H.G. Leask, 'St. Nicholas'.

Chancel

Harold Leask attributed a date of "*circa* 1320" to all three south windows of the chancel (Figure 5.4), listing them as contemporary with the beginnings of the Lynch-sponsored building works, possibly replacing an older church building on the same site.[18] Jim McKeon agreed that these windows dated to the fourteenth century because they were located in 'phase 2' of construction and because of the presence of rebates for glazing bars.[19] The results of the proportional investigation in this study indicate that all three windows were identical in design, with the most definitive ratio being 4:5 between tracery field height and light height (to springing point), the overall window width to overall window height was 1:3, or very close to it, while the light width was approximately 1:4 the light height (at arch peak). These three ratios occur within the top four frequencies in Connaught. The preferred unit is unclear with the analysis suggesting ~0.217m, 0.325m or ~0.360m.[20] As will be seen in the following, units close to 0.360m were widely used throughout the works of the fifteenth and sixteenth centuries in this building.

Figure 5.4 St. Nicholas collegiate church, Galway: south chancel south windows, western to eastern (left to right)

[18] H.G. Leask, 'St. Nicholas', p. 5.

[19] J. McKeon, 'St. Nicholas', p. 98 and p. 105. McKeon's phasing was as follows: Phase 1 was dated to the thirteenth century and was said to consist of the "same fabric (amphibolite, amphibolitic gneiss, granite)" as "the surviving town wall and New tower, and the foundations of the de Burgh hall and castle, all of which date from the earliest period of the Anglo-Norman town" (p. 97) while phase 3 was "safely" assigned "a construction spanning the fifteenth and sixteenth centuries, and perhaps, in the case of some alterations, even later" (p. 99). Therefore, phase 2 masonry, which physically sits between phases 1 and 2, "would appear to date from the fourteenth century" (p. 98).

[20] The value of 0.235m for the eastern window is notable because of its distinction from the other two windows despite their similarity in design. The extracted measurements from which this value was obtained were obviously different to those taken for the other two windows. However, when the proportional analysis is examined many of the same proportions occur demonstrating that this could be an occasion where

While Leask and McKeon may be right in asserting that these windows date to c. 1320 it is worth looking at the slightly later history of the building before committing absolutely to this date. As Galway expanded the civic authorities sought to increase their influence in the administration of the church, and in 1485 this was achieved by the transformation of the vicarage to a college of eight vicars and a warden, elected directly by the mayor and council of the town.[21] The regular and elaborate liturgy practiced by the members of the college would have necessitated some alterations to the church. It is also likely that the mayor and citizens would also have been keen to create a show piece at the centre of the town.[22] Liturgical change would have had a particular impact on the east end, and in 1493 the then mayor, James Lynch fitzStephen is noted in both the TCD MSS and Lynch MSS as having "on his own cost and charges put up all the painted glasses in the Church of St. Nicholas." The extent to which new tracery accompanied the reglazing of a church is a moot point in Ireland, although a kinsman of the Galway mayor, Edmund Lynch, was explicitly credited with replacing the windows at nearby Athenry 'sculpture and glass' earlier in the century (for which see below). It is therefore possible that this may have been the case at St Nicholas for all of the windows of the chancel.

Jim McKeon suggested that, although the chancel east window was located in fourteenth-century phase 2 masonry (Figure 5.5), the gable shape was significantly heightened in the fifteenth century or early sixteenth century (phase 3) and at this time the window could have been erected. He also found that this east window, unlike others in the fourteenth-century fabric, did not include rebates for glazing bars, which he suggested made it more likely to date from the fifteenth.[23] While this may be the case, there is little evidence of disturbance to the fourteenth-century fabric of the east gable suggestive of an insertion. Equally, McKeon's stylistic argument for such divergent dates for the southern and eastern windows simply does not ring true, as the four windows are really quite close in style, especially when compared with other windows in the church. His argument about glazing rebates is also problematic, not least because such features cannot be securely dated in a church that has remained in continuous use since its foundation.

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proportional design took precedence over measurement. See the appendices and site catalogue for all of the relevant figures.

[21] W.H. Bliss and J.A. Twemlow, *Calendar of entries in the papal registers relating to Great Britain and Ireland : Papal letters. Vol.5*. London: HMSO, 1904, p. 189.

[22] At this time, census was paid to Pope Innocent to guarantee the exemption from the jurisdiction of the archbishop of Tuam and this may have made some funds available for building work since the diocese could no longer demand the payment of certain fees. M.D. O'Sullivan, *Italian merchant bankers in Ireland in the thirteenth century: (a study in the social and economic history of medieval Ireland)*. Dublin: Allen Figgis, 1962, p.29 referring to content in TCD, MS 1.4.11.

[23] J. McKeon, 'St. Nicholas', p. 105 using a dating technique supported by examination of the presence or absence of rebates from H.G. Leask, *Irish Churches III*, 117-8.

The analysis results for the east window of the chancel do not align with the results from any other window of the church but evidence is strong for the ratio 5:6 for tracery field height to light height (at springing point) and 3:4 for overall window width to the same element. The study also found it possible that the overall window width related to its height by 377:610, a ratio more frequently used in Connaught than in the other study regions. The unit of measurement used was most likely 0.346m although 0.290m and 0.320m were also suggested by the analysis. This aligns most closely with the unit used in the windows of the north and south transepts.

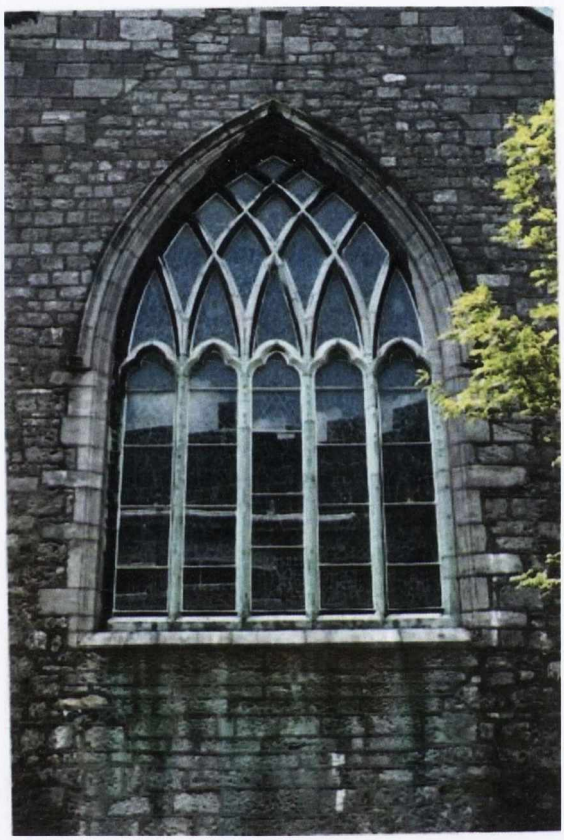

Figure 5.5 St. Nicholas collegiate church, Galway: chancel east window

Nave south aisle

The design of the three nave south aisle windows (Figure 5.6) is the same. It seems likely that they are contemporaneous, and all date to between 1486 and 1510 when this aisle was widened (TCD MSS). The proportional investigation was hampered by the presence of a stairs and an entrance porch but, in as far as they could be considered, the results shown in Table 5.8 confirm this similarity.[24] The metrological investigation found a probable unit

[24] The variation that occurs in some of the compared features is as a result of the inaccessibility of some parts of the window; both the eastern and western windows were obscured by unavoidable features when photogrammetrically measured. However, the tracery field of all windows could be assessed and these match to within the accuracy expectations of the project. Also, from the unmeasured interior the heights of these windows were approximately the same.

for the middle window of 0.356m, which was also a possibility for the eastern window. For the western window the unit suggested was 0.280m, and this was also suggested for the eastern window, and this unit is very close to 4/5 of 0.356m. In the analysis of the west window of this aisle below a choice is made between these two units.

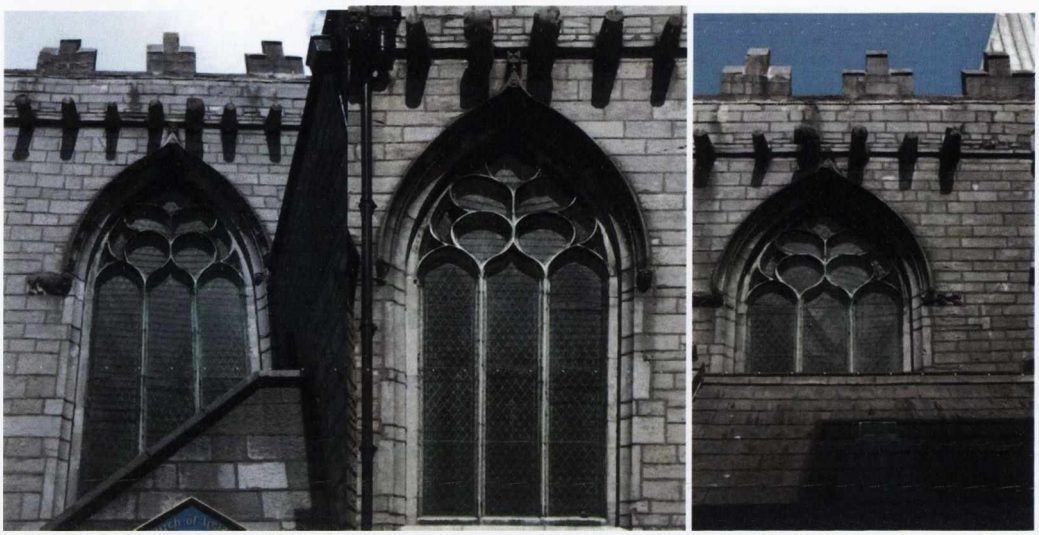

Figure 5.6 St. Nicholas collegiate church, Galway: nave south windows western, mid and eastern (left to right)

Due to issues of access the south window of the south transept was not measured, but its design could be described as a cusped version of south nave windows (Figure 5.7 left). Leask attributed a date of *c.*1500 to this window, based on the description of a donation by Dominick Duff Lynch in the TCD MSS. It is of note that this window is very similar in design, although more finely wrought, than the south transept south window at Rosserk Franciscan friary (Figure 5.7 right). The Rosserk window displays use of 1:3 between the overall window width and overall window height and between the light width and the overall window width, while the overall window width is also 1:2 of the light height (at arch peak). The preferred unit for this window was found to be 0.267m. That these values cannot be compared with the Nicholas window is unfortunate, but from a visual inspection it is clear that there is a difference in the profile of the mullions and the design of the tracery field at least varied though the use of different foliation of the tracery loops. While there is possibly a link between these two windows, its exact nature cannot be defined.

Figure 5.7 St. Nicholas collegiate church, Galway: south transept south window (left) and Rosserk Franciscan friary south transept south (right)

Harold Leask also suggested that the current east window of the south transept was actually the original fourteenth-century window, removed from the south of the south transept prior to its extension *c.*1500 as described above. This window is similar in design to the south chancel windows and also to the north window of the north transept (Figure 5.8 left). However, despite the similar switchline tracery design with trefoil-headed triple lights the exact shaping of the diamonds and the height of the foils at the light heads are not the same. Neither the north transept north or south transept east (formerly south) window share any proportional connection.

The reason that no proportions were shared may be because when the window was moved from the south wall of the south transept to its east wall, the overall height of the window was significantly reduced to allow for the difference in height between the gable and side walls. The measurements of the mullions for these windows agree to within a few millimetres, while the widths of the lights agree at centimetre level. Consequently, the analysis shows that the metrological unit used for both original north and south transept gable windows was 0.351m and 0.349m, respectively; a value very similar to that used for the chancel east window and which has been found in a number of locations in Connaught.

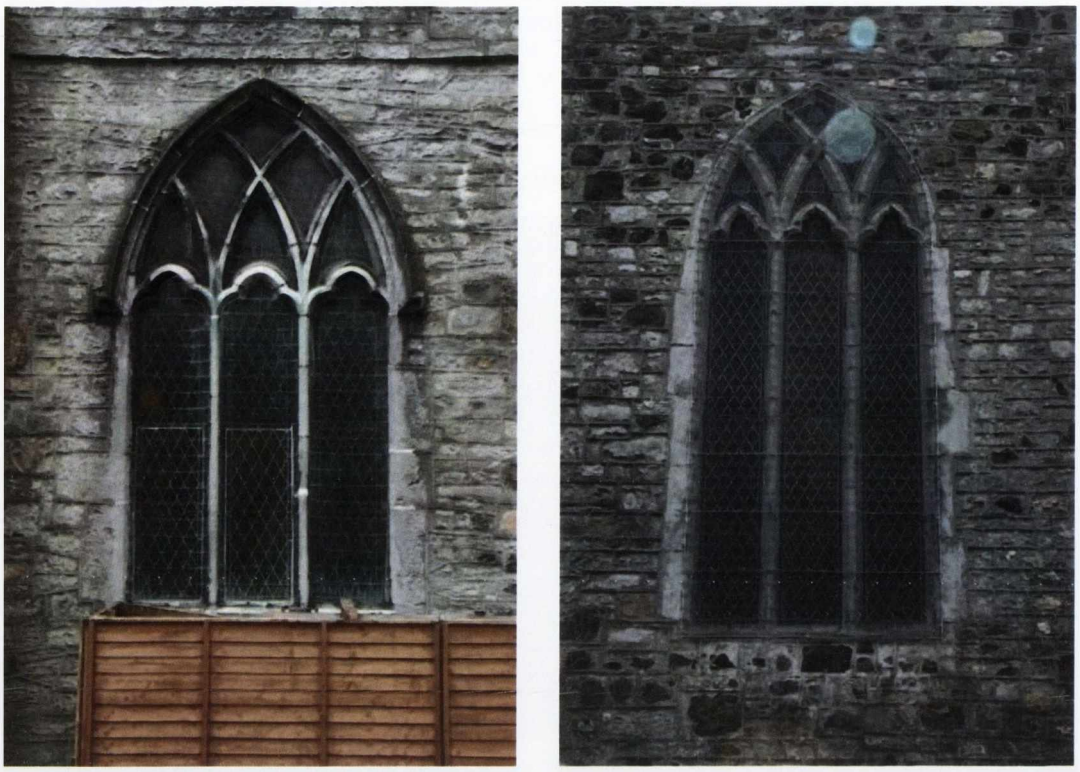

Figure 5.8 St. Nicholas collegiate church, Galway: south transept east (left) and north transept north windows (right)

Jim McKeon made a different interpretation of architectural developments in the north and south transepts based on his broad masonry phase dates of: 1, thirteenth century; 2, fourteenth century; 3 fifteenth/sixteenth century. He agreed that the south transept east window probably dated from the fourteenth century, based on stylistic considerations, but suggested that it was now set in thirteenth-century, phase 1 masonry because the original lancet windows were damaged when the phase 1 wall was destroyed (Figure 5.9). He gave no date or reason for the destruction of the wall but his dating for the phase 2 masonry on site is that it "would appear to date from the fourteenth century".[25] Documentary sources suggest that Dominic Duff Lynch's donation of the south window occurred *c.* 1500, probably corresponding to works required after the elevation of the church (McKeon's phase 3), so the fourteenth-century phase 2 works in the south transept must have occurred prior to 1485.

[25] J. McKeon, 'St. Nicholas', p. 98.

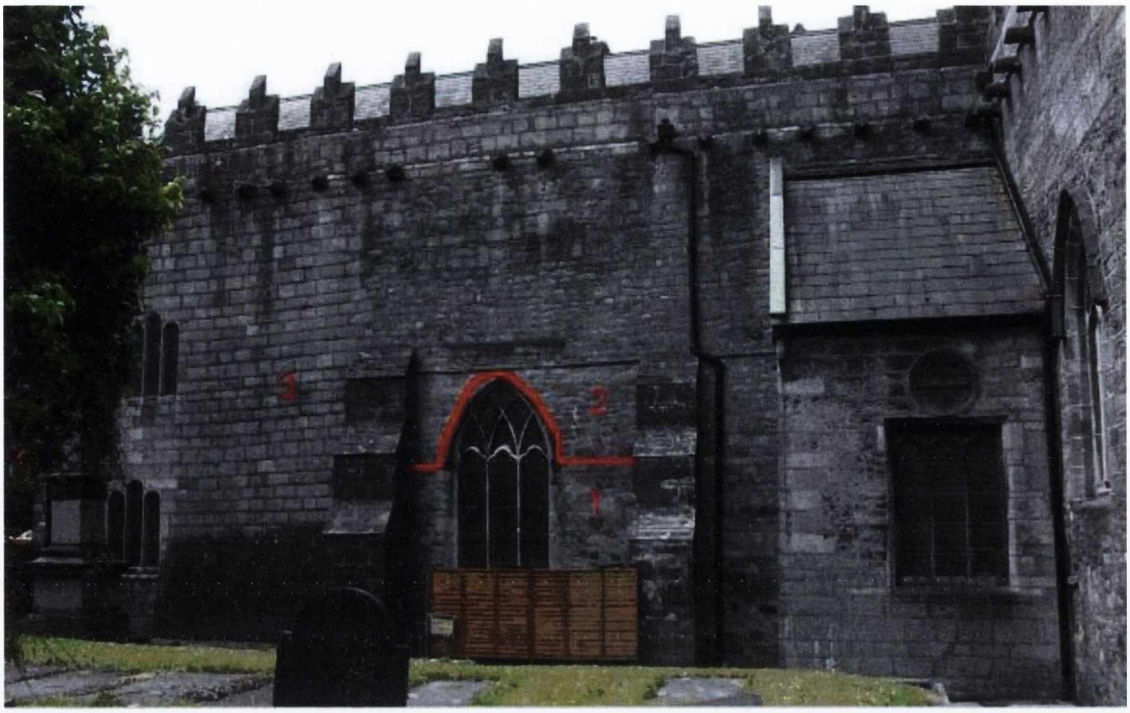

Figure 5.9 St. Nicholas collegiate church: south transept external east façade with masonry phases after Jim McKeon

McKeon then argued that this "may have prompted the unnecessary insertion of the similarly styled window in the north transept for aesthetic reasons, even though the phase 1 masonry in that gable remained undamaged". I do not think that this window looks to have disturbed the masonry in any way and is, therefore, unlikely to have been a later insertion (Figure 5.8 right).

Although McKeon describes his phase 1 masonry as thirteenth century, suggesting that it may have come from an earlier building on the site, he does not identify which part of the thirteenth century was involved. This means that the phase 1 work might be from the very end of the century. If works proceeded slowly on certain sections of the church, and the north transept had less liturgical importance than the south meaning that it may have been a later build, the phase 1 masonry in the north transept may not have been so temporally-distinct from the early phase 2 masonry in the south chancel and south transept. Therefore, the undisturbed north transept east window set in thirteenth-century phase 1 masonry and the south transept east window of fourteenth-century date also set in thirteenth-century phase 1 masonry may actually have been contemporary to within a decade or so, a suggestion in agreement with the identical mullion sizes and probable unit of measurement.

The problem with this theory, though, is that if the south transept east window was formerly located in the south of the transept, its replacement was not donated by Dominic Duff Lynch until *c.*1500. This could mean that Duff Lynch's window actually took the place of a replacement for the window now visible in the transept east or it could signal a problem with the McKeon's masonry dating. It might be more appropriate to suggest that the phase 1 masonry dates from the late-thirteenth to early-fourteenth centuries and the phase 2 materials from the mid-fourteenth to as late as the mid-fifteenth centuries with the phase 3 fabric beginning with works undertaken for conversion of the church to a collegiate church after 1485.

Nave north aisle and west end of the church

The main element of confusion arises with the dating of the windows of the north aisle of the nave and the entire west end of the building.[26] The north chapel, known as the Chapel of the Blessed Sacrament, is dated by Leask to between 1538 and 1561, despite the evidence from the TCD MSS cited below.[27] The only window in the chapel containing tracery is the north window, and this three-light elliptical-headed switchwork window is very similar in design to the nave north aisle north (eastern) window (Figure 5.10). The building of the chapel and the widening of the north aisle as far west as the chapel, including these two windows, is dated to 1538 by the TCD MSS; that is, to the time while John French was mayor of Galway: "John French alias Shane Itallen, soe called on account of the abundance of salt that he brought into the country, built the north side of the church".[28] While the north chapel window and the nave north eastern window share a common unit of measurement of between 0.367/8m, the proportions are entirely different, a result probably caused by the difference in the available wall heights. The width of the mullions is common between the two windows, as are the ratios between the widths of the side lights and the central light. These combined analyses support the view that these windows were inserted by the same masons.

[26] None of these windows were considered in Jim McKeon's study as they were deemed "late medieval".
[27] H.G. Leask, 'St. Nicholas, Galway', p. 18.
[28] Trinity MS, Account of the Town of Galway. MS. Trinity College Dublin (TCD) Collection, Dublin, p. 10.

Figure 5.10 St. Nicholas collegiate church, Galway: nave north aisle north eastern (left) and north chapel north (right) windows

The second grouping of windows in the north aisle area consists of the north aisle north windows, to the west of the Chapel of the Blessed Sacrament (Figure 5.11).

Figure 5.11 St. Nicholas collegiate church, Galway: nave north aisle north mid (left) and western windows (right)

Harold Leask suggested that these were built in 1583, about 50 years after the completion of the chapel, and that the point where the two building phases meet on the north aisle wall is marked by "a very slight obliquity" (Figure 5.12).[29] However, I would attribute this small change in direction more to an attempt to link the north aisle with the turret on the north transept than to a different phase of building, and that the windows should therefore be placed c. 1538.

Figure 5.12 St. Nicholas collegiate church, Galway: north aisle of the nave. The arrow marks the approximate position of Leask's 'very slight obliquity'

The tracery of the westernmost of this pair of windows is very similar in style to the west window at Creevelea Dominican friary. J.E. Mac Kenna and W.A. Scott wrote that the entire structure of Creevelea friary was constructed in a relatively short period after 1508 due to the "magnificent generosity of its founders" and that the short time between building and suppression "prevented its architectural unity [from] being marred by additions and alterations".[30] However, an exact date for the windows is difficult to ascertain because it is unclear whether a fire in 1536 damaged an existing stone church building or an earlier wooden church.[31] Both the St. Nicholas and Creevelea windows

[29] H.G. Leask, 'St. Nicholas, Galway', p. 17.

[30] J.E. MacKenna and W.A. Scott, 'The Franciscan Friary of Creevelea, in the Barony of Breffny, Co. Leitrim', *Ulster Journal of Archaeology,* 1899, 5 (4), 190-201, p. 193.

[31] 'The Annals of Ulster.' Corpus of Electronic Texts Edition: T100001C. Eds. M. Balé and E. Purcell: CELT online at University College, Cork, Ireland, 2003, sub 1512: "Margaret, daughter of Concobur O'Briain, queen of Lower Connacht, from the Mountain down, first and wife of O'Ruairc after—the unique woman who, of what were in Ireland in her time, was of best fame and hospitality and housekeeping and was richest

have mullions of ~0.128m in width and the simple moulding profiles are very similar. The proportions and metrology used, however, are very different. The unit used at St. Nicholas was 0.348m and at Creevelea was 0.256m. It would, of course, be possible to reuse a template for a mullion without applying either the same overall window design, in terms of ratios, or the same unit of measurement. The insertion dates of the windows at both sites will be reconsidered in conjunction with the discussion of the west end which follows.

Figure 5.13 Creevelea Franciscan friary: nave west (left) and St. Nicholas' collegiate church, Galway: nave north western

The tracery design of the eastern of these two windows of the north aisle at St. Nicholas is similar in style to the windows of the south aisle dated c.1486, although narrower and therefore missing some elements. (Figure 5.14).

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in gold and silver and in every other valuable—died and was buried in a wooden church she built herself for the Friars Minor close by Druim-da-ethiar." and sub 1536: "The monastery of the Friars of the town of O'Ruairc was burned and two friars, namely, Ereman Ua Domnaill and Mael-Sechlainn Mag Samradhain, were burned in it and much damage to the whole country was done in it." The question of dating is also addressed by R. Stalley, 'The End of the Middle Ages: Gothic Survival in Sixteenth-Century Connacht', *The Journal of the Royal Society of Antiquaries of Ireland,* 2003, 133, 5-23, p. 6.

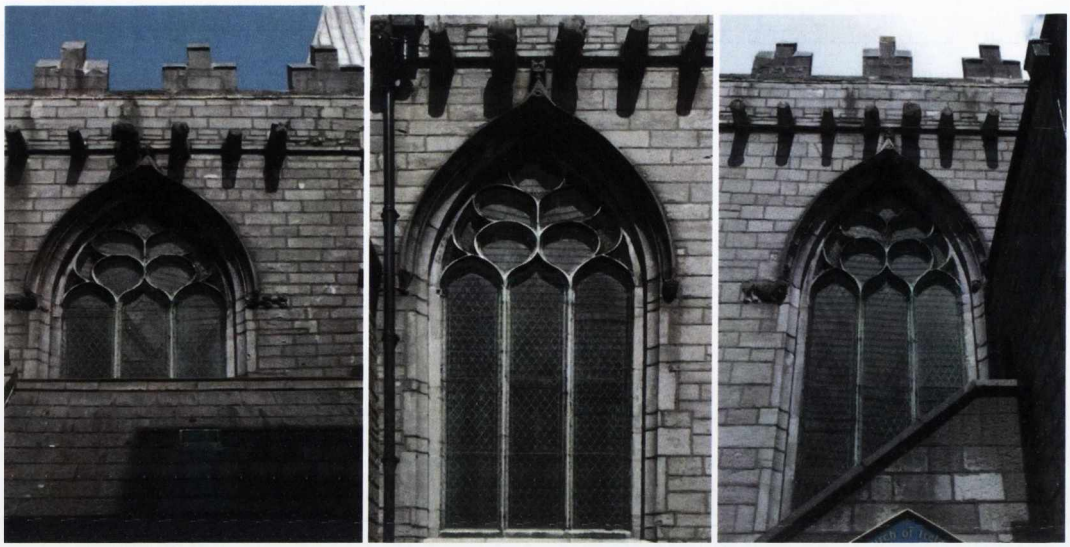

Figure 5.14 St. Nicholas collegiate church, Galway: south aisle south windows eastern, mid and western (left to right)

While certain designs are known to have perpetuated for much longer in Ireland than they did in England, it is difficult to believe that masons working in the middle of the sixteenth century would have copied a design from 100 years earlier, unless they were requested to do just that, as in English contracts discussed in the literature review. The variation in design between the south aisle windows and the one similar north aisle window is within the previously-described definition of medieval copying. The ratios of the nave north aisle north mid and the nave south aisle south mid windows are very similar and the metrology suggests units of 0.280/0.356m and 0.364m, respectively – less than a centimetre different. As previously identified, the relationship between 0.280 and 0.356 is 4:5 so even if the south aisle windows had a unit of 0.280m then the similarity between north and south aisle windows would still be of importance.

Part of the confusion about dating of the north aisle of the church is caused by the difficulty in dating the windows of the west end, which have three distinctive designs, and according to this study, three separate metrological and proportional systems (Figure 5.15).

Figure 5.15 St. Nicholas collegiate church, Galway: west windows of the north aisle, nave and south aisle (left to right)

Beginning with the west window of the south aisle (Figure 5.15 right), this has been dated by Harold Leask to approximately 1510 as it probably marked the culmination of Dominick Lynch's endowment to the church through work carried on by his son Stephen as required by his will.[32] The similar timing of installation of all windows of the south aisle is confirmed by the metrological study if we take the 0.280m/0.282m values as being the unit of preference. Although the study did not find the same unit for the middle south window of the aisle, a unit of 0.274m was just outside the criteria for the metrological analysis. These are the only windows in the building with this unit therefore a distinctive erection date could reasonably be assigned, as done by Harold Leask, plus there is precedent in other parts of Connaught for this unit's use throughout the middle ages.

The date given by Harold Leask to the window on the west end of the north aisle is 1583, the same date as attributed to the two windows on the north side of this aisle and undoubtedly assigned because of the inscription within the tracery (Figure 5.16).

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[32] M.J. Blake, 'Lynch 1508', p. 102: "I order my son Stephen Lynch to finish and complete the new works begun by me in the Collegiate Church, and also to erect an Altar to St. James the Apostle, adjoining the nearest column in the chapel of Blessed Mary in the said Church."

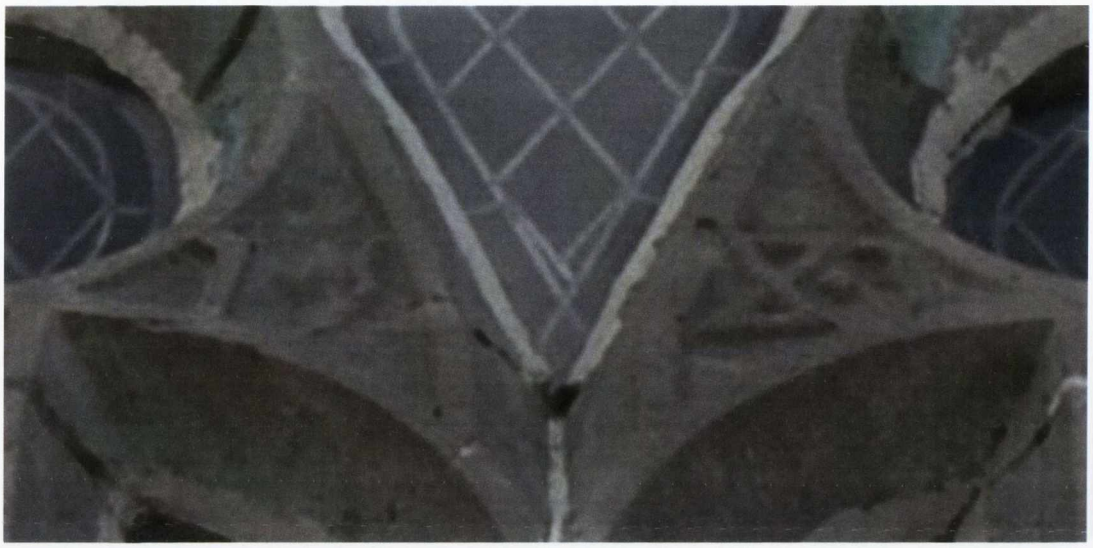

Figure 5.16 St. Nicholas collegiate church, Galway: 1583 date inscribed on the tracery of the north aisle west window

This inscription is curious since it is the only one in the building and because of the difficulties that it causes for both stylistic and, more importantly for this study, metrological considerations. Therefore, we must examine what the presence and contents of this inscription implies. One idea to be considered, and is that the north aisle west window originated from another location, perhaps the priory at Annaghdown, some 19 km away. The priory was granted to the college of St. Nicholas in 1578 by Nicholas Lynch [fitz Stephen fitzArthur] who had himself gained possession of the "abbey of Annadown" on May 20, 1576 by the second earl of Clanrickard after its original post-suppression grant in 1570.[33]

Funds for church-building were in short supply towards the end of the sixteenth century, and the remains of a newly-dissolved priory could have been seen as an appropriate source for materials for the collegiate church in Galway, particular because of the easy transport options provided by the Corrib lough and river. Rachel Moss has suggested that the reader's desk, now forming the entrance to the Blessed Sacrament chapel, was salvaged from a recently suppressed monastic foundation for use as a pulpit. As the footprint of such a feature still survives at Annaghdown, she has suggested this as the ultimate source.[34] It is, therefore, possible that the same source was used to acquire the

[33] K. Nicholls, 'A List of the Monasteries in Connacht 1577', *Journal of the Galway Archaeological and Historical Society,* 1972, 33, 28-43, p.33: "The 'abbey of Annadown' was granted to the second earl of Clanrickard in 1570 (F.E., 1581) and was conveyed by him to Nicholas Lynch [fitz Stephen fitzArthur] of Galway on May 20, 1576 (original deed in possession of Mrs. R. A. Milne)".

[34] R. Moss, 'The forgotten century: the survival and revival of the Irish monastery 1540-1640', *Reconstructions of the Gothic Past*, Trinity College, Dublin, June 2009.

tracery for the west window of the north aisle of St. Nicholas, particularly given that the east window at Annaghdown has been reduced to sill level (Figure 5.17).[35]

Figure 5.17 Annaghdown priory, Galway: view of the east end of the church with all tracery removed

Then, as was quite typical of restoration works, two sections of tracery could have been replaced by the pieces upon which the 1583 inscription was added (Figure 5.16).[36] This insertion, whatever its origin, was, I suspect, probably the only work undertaken at this date and the north aisle section into which the window was inserted was more likely to have been completed contemporaneously with the work on the Chapel of the Blessed Sacrament, in approximately 1538. This theory would certainly explain why the same window design and approximately the same metrology were used in windows on both the north and south aisles of the nave. Also, given the stylistic similarity between the western window on the north side of the north aisle and the nave west window at Creevelea, the 1538 date would suggest that the window at Creevelea was not inserted at foundation in 1508 but rather later after the fire of 1536. The unit of measurement used for these two windows is not the same, but the style appears so similar that it could very likely have been produced by the same mason. This either means that metrology was not important or the damage from the fire at Creevelea may have required replacement of the tracery but

[35] No meaningful measurements could be made at Annaghdown priory in support of this argument.
[36] Examples of dates on restored architectural works and reliquary shrines are frequent such as Henry Sidney's 1570 restoration of Strongbow's tomb and other details in Christchurch cathedral, Dublin.

without changing the opening in the wall, thus forcing the mason to work within a space that appeared to change the unit of preference.

The metrological analysis found that the unit for the north aisle west window was 0.340m. The next most likely unit for this window, although just outside the thresholds set for this study, was ~0.257m. 0.340m is not a typical Connaught unit but the closest frequently used unit, in fact the second most common unit in the region, is only 7mm different at 0.347m. At St. Nicholas versions of this unit were used in the north and south transept windows, suggested as fourteenth century by Leask, and the western north aisle window. 0.257m was also in common usage in Connaught, particularly in a number of Dominican and Franciscan monasteries, but the only other similar unit at St. Nicholas, 0.254m for the north eastern window of the north aisle, was discounted in favour of 0.368m.[37] If we were to base our interpretation on metrology alone and if 0.340m, as a contributor to the 0.347m group, was the preferred unit for the north aisle west window, then it is possible that was made for St. Nicholas church and that it was, perhaps, inserted during the fourteenth century with a number of other windows as discussed. However, stylistically this window is completely different from the other windows which used this unit and it more typical of windows from the late fifteenth or early sixteenth centuries. If 0.340m was independent of the 0.347m group, or if the preferred unit was actually the second choice of 0.257m, then this window may not have been designed for use at St. Nicholas church but rather it could have been reused from another site within Connaught, such as Annaghdown priory.

The final ambiguity in relation to the dating of window tracery at St. Nicholas relates to the nave west window (Figure 5.15 middle). Leask suggested that this window was a later insertion from the seventeenth century. However, in his account of the history of Galway, James Hardiman gives a date of 1578 to the enlargement of the western windows, while Archdeacon Berry attributes a date of 1583 to the event.[38] The 1583 date is assigned because of the inscribed date on the west window of the north aisle (Figure 5.16) but this is probably not contemporary with the nave west window, given the nature of the stonework in both sections. The nave window is probably the latest of the three west windows and, independent of whether inserted in the late sixteenth or seventeenth centuries, the idea of a late date for the window is supported by the metrological investigation which attributed a unit of 0.227m. Establishing that this value aligned with a variant of the *dodrans* of 0.225m would not be feasible without some definitive

[37] Which agreed with the north chapel north, north aisle mid, and south aisle windows.

documentary support. However, applying the meaning of *dodrans* as three-quarters to 0.227m produces 0.303m, the Irish legal standard foot. This unit is not used elsewhere in the medieval fabric of the church and, as has been previously discussed, administrative efforts at standardisation of Irish metrology to the legally approved measures had gained significant momentum by the middle of the sixteenth century suggesting an approximate insertion date for the nave west window.

Summary

Although St Nicholas is a relatively well-documented building, in some cases documentation has served to confuse as much as clarify the various building phases of this complex structure.

The windows of the south wall of the chancel, and the west and east of the south aisle of the nave clearly belong to the same phase, probably late fifteenth or early sixteenth century. The east window of the chancel, although thought by McKeon to be 50-100 years later than the south chancel windows, appears to tally more closely with the north transept north window and south transept east window, suggesting that these too may all belong to a similar phase, probably around the same period as the south chancel windows. Comparison between the two transept windows was further enlightening as it highlighted the probability that the southern transept window had been moved and probably shortened when the transept was extended in the sixteenth century.

Perhaps most significant though was the analysis of the northern nave aisle windows, which appears to demonstrate that it was most likely erected or extended within 40 years of the work on the south aisle. The west window of the north aisle was shown by the metrology to possibly have originated at another location. While a date for the central nave west window could not be confirmed, it was certainly not contemporary with the other windows on site and may date to the seventeenth century, as suggested by Leask, due to a preferred unit of ¾ of the legal standard foot of 0.3048m.

For most of the late-fourteenth to late-fifteenth centuries the unit of preference for St. Nicholas' masons was a 'long' foot of ~0.350m. There seems to have been a transition to a foot of 0.280m for the installation of the nave south aisle windows, even though probably contemporary with the chancel south, and, in agreement with differences in style, this suggests that a different group of masons worked on the chancel and aisle. Later work on the north aisle utilised a different 'long' foot of ~0.365. Thus, some statements about

[38] J. Hardiman, *History of Galway* and Archdeacon Berry, *The Story of St. Nicholas Collegiate Church,*

absolute dating can be made in the context of this building. However, application of this information to other sites must still be done cautiously owing to the longevity of certain standards in medieval Ireland.

The evidence from proportional analysis provides useful support to the results of the metrological studies, but I would suggest that by itself it is incapable of providing definitive chronology or dating indicators. All results for the proportional investigation on this site have been amalgamated into Table 5.7- Table 5.9.

Ratio	Numeric Value	1%		2%	
1 : 4	0.250	0.253	0.248	0.255	0.245
1 : 3	0.333	0.337	0.330	0.340	0.327
2 : 5	0.400	0.404	0.396	0.408	0.392
1 : root 5	0.447	0.452	0.443	0.456	0.438
1 : 2	0.500	0.505	0.495	0.510	0.490
13 : 23	0.565	0.571	0.560	0.577	0.554
1 : root 3	0.577	0.583	0.572	0.589	0.566
3 : 5	0.600	0.606	0.594		
377 : 610	0.618	0.624	0.612	0.630	0.606
2 : 3	0.667	0.673	0.660	0.680	0.653
1 : root 2	0.707	0.714	0.700	0.721	0.693
3 : 4	0.750	0.758	0.743	0.765	0.735
4 : 5	0.800	0.808	0.792	0.816	0.784
5 : 6	0.833	0.842	0.825	0.850	0.817
1 : 1	1.000	1.010	0.990	1.020	0.980

Galway. Galway: O'Gorman, 1912.

Table 5.7 St. Nicholas collegiate church, Galway: proportional investigation part 1

Connaught	Chancel east					
St. Nicholas, Galway		Light/	Light/	Light/	Light/	Light/
Proportions	Single	Mullion1	Mullion2	Mullion3	Mullion4	Mullion5
Tracery field height to light height (at springing point)		0.841	0.844	0.839	0.839	0.841
Tracery field height to light height (at arch peak)		0.958	0.960	0.955	0.957	0.961
Tracery field height to overall window height	0.542					
Overall window width to overall window height	0.607					
Overall window width to window height to spring	0.460					
Overall window width to arch span	0.886					
Light width to light height (at springing point)		0.270	0.267	0.265	0.272	0.262
Light width to light height (at arch peak)		0.237	0.235	0.232	0.238	0.229
Light width to overall window width		0.202	0.201	0.198	0.204	0.197
Light width to overall window height		0.123	0.122	0.120	0.124	0.120
Light width to arch span		0.179	0.179	0.176	0.181	0.175
Overall window width to light height (at springing point)		0.751	0.754	0.749	0.749	0.752
Overall window width to light height (at arch peak)		0.856	0.858	0.853	0.855	0.859
Mullion width to overall window width		0.011	0.013	0.012	0.012	
Mullion width to light width		0.056	0.056	0.063	0.064	
Mullion width to light width		0.062	0.061	0.059	0.061	

North aisle west				
	Light/	Light/	Light/	Light/
Single	Mullion1	Mullion2	Mullion3	Mullion4
	0.741	0.741	0.745	0.744
	0.670	0.671	0.671	0.671
0.430				
0.366				
0.641				
0.822				
	0.156	0.159	0.162	0.156
	0.141	0.144	0.146	0.141
	0.247	0.252	0.255	0.246
	0.091	0.092	0.093	0.090
	0.203	0.207	0.209	0.203
	0.632	0.632	0.635	0.635
	0.571	0.572	0.572	0.572
	0.045	0.044	0.045	
	0.182	0.178	0.175	
	0.173	0.175	0.181	

Connaught	South aisle west				
St. Nicholas, Galway		Light/	Light/	Light/	Light/
Proportions	Single	Mullion1	Mullion2	Mullion3	Mullion4
Tracery field height to light height (at springing point)		0.973	0.979	0.978	0.974
Tracery field height to light height (at arch peak)		0.847	0.848	0.847	0.845
Tracery field height to overall window height	0.522				
Overall window width to overall window height	0.433				
Overall window width to window height to spring	0.694				
Overall window width to arch span	0.598				
Light width to light height (at springing point)		0.259	0.176	0.178	0.248
Light width to light height (at arch peak)		0.226	0.152	0.154	0.215
Light width to overall window width		0.321	0.217	0.219	0.308
Light width to overall window height		0.139	0.094	0.095	0.133
Light width to arch span		0.192	0.130	0.131	0.184
Overall window width to light height (at springing point)		0.807	0.807	0.810	0.807
Overall window width to light height (at arch peak)		0.702	0.703	0.702	0.700
Mullion width to overall window width		0.007	0.006	0.006	
Mullion width to light width		0.021	0.031	0.026	
Mullion width to light width		0.026	0.029	0.021	

Nave west					
	Light/	Light/	Light/	Light/	Light/
Single	Mullion1	Mullion2	Mullion3	Mullion4	Mullion5
	0.811	0.813	0.811	0.807	0.803
	0.715	0.715	0.716	0.715	0.711
0.453					
0.562					
0.548					
0.882					
	0.194	0.202	0.204	0.202	0.202
	0.171	0.177	0.180	0.179	0.179
	0.193	0.200	0.203	0.202	0.202
	0.109	0.112	0.114	0.113	0.114
	0.170	0.176	0.179	0.178	0.179
	0.994	0.992	0.995	0.999	0.995
	0.887	0.887	0.888	0.887	0.882
	0.037	0.035	0.036	0.037	
	0.190	0.183	0.177	0.175	
	0.180	0.181	0.183	0.182	

Table 5.8 St. Nicholas collegiate church, Galway: proportional investigation part 2

Connaught	Nave south western			
St. Nicholas, Galway		Light/	Light/	Light/
Proportions	Single	Mullion1	Mullion2	Mullion3
Tracery field height to light height (at springing point)		0.408	0.405	0.440
Tracery field height to light height (at arch peak)		0.600	0.626	0.622
Tracery field height to overall window height	0.713			
Overall window width to overall window height	0.642			
Overall window width to window height to spring	0.462			
Overall window width to arch span	0.811			
Light width to light height (at springing point)		0.732	0.746	0.682
Light width to light height (at arch peak)		0.498	0.483	0.482
Light width to overall window width		0.332	0.336	0.333
Light width to overall window height		0.213	0.215	0.214
Light width to arch span		0.269	0.272	0.270
Overall window width to light height (at springing point)		0.454	0.450	0.489
Overall window width to light height (at arch peak)		0.666	0.696	0.691
Mullion width to overall window width		0.007	0.042	
Mullion width to light width		0.022	0.022	0.022
Mullion width to light width		0.128	0.127	0.127

	Nave south mid			
		Light/	Light/	Light/
Single		Mullion1	Mullion2	Mullion3
		0.627	0.629	0.620
		0.560	0.553	0.559
0.390				
0.355				
0.581				
0.814				
		0.187	0.193	0.189
		0.167	0.170	0.170
		0.328	0.337	0.335
		0.116	0.120	0.119
		0.267	0.274	0.272
		0.570	0.572	0.564
		0.509	0.503	0.508
		0.015	0.009	
		0.044	0.043	0.044
		0.028	0.027	0.027

	Nave south eastern			
		Light/	Light/	Light/
Single		Mullion1	Mullion2	Mullion3
		0.421	0.426	0.462
		0.613	0.644	0.658
0.988				
		0.693	0.702	0.636
		0.476	0.465	0.446
		0.288	0.296	0.290
		0.264	0.271	0.265
		0.020	0.019	0.020
		0.130	0.126	0.129

Connaught	Nave north western			
St. Nicholas, Galway		Light/	Light/	Light/
Proportions	Single	Mullion1	Mullion2	Mullion3
Tracery field height to light height (at springing point)		0.610	0.611	0.614
Tracery field height to light height (at arch peak)		0.557	0.562	0.561
Tracery field height to overall window height	0.382			
Overall window width to overall window height	0.336			
Overall window width to window height to spring	0.543			
Overall window width to arch span	0.891			
Light width to light height (at springing point)		0.174	0.184	0.179
Light width to light height (at arch peak)		0.159	0.169	0.164
Light width to overall window width		0.325	0.343	0.332
Light width to overall window height		0.109	0.115	0.112
Light width to arch span		0.289	0.306	0.296
Overall window width to light height (at springing point)		0.536	0.537	0.539
Overall window width to light height (at arch peak)		0.490	0.494	0.494
Mullion width to overall window width		0.072	0.194	
Mullion width to light width		0.222	0.210	0.217
Mullion width to light width		0.597	0.566	0.584

	Nave north mid			
		Light/	Light/	Light/
Single		Mullion1	Mullion2	Mullion3
		0.625	0.624	0.623
		0.546	0.542	0.544
0.387				
0.350				
0.571				
0.921				
		0.188	0.194	0.183
		0.165	0.168	0.160
		0.333	0.343	0.325
		0.116	0.120	0.114
		0.306	0.315	0.299
		0.566	0.565	0.565
		0.495	0.491	0.493
		0.064	0.065	
		0.193	0.187	0.197
		0.195	0.190	0.200

	Nave north eastern			
		Light/	Light/	Light/
Single		Mullion1	Mullion2	Mullion3
		0.619	0.619	0.617
		0.580	0.581	0.579
0.386				
0.358				
0.584				
0.908				
		0.195	0.194	0.185
		0.183	0.182	0.174
		0.339	0.337	0.324
		0.122	0.121	0.116
		0.308	0.306	0.294
		0.575	0.575	0.573
		0.539	0.540	0.538
		0.064	0.069	
		0.187	0.188	0.196
		0.202	0.204	0.212

Table 5.9 St. Nicholas collegiate church, Galway: proportional investigation part 3

Connaught	North chapel north			
St. Nicholas, Galway		Light/	Light/	Light/
Proportions	Single	Mullion1	Mullion2	Mullion3
Tracery field height to light height (at springing point)		0.759	0.752	0.749
Tracery field height to light height (at arch peak)		0.900	0.896	0.897
Tracery field height to overall window height	0.579			
Overall window width to overall window height	0.525			
Overall window width to window height to spring	0.802			
Overall window width to arch span	0.923			
Light width to light height (at springing point)		0.398	0.404	0.401
Light width to light height (at arch peak)		0.336	0.340	0.335
Light width to overall window width		0.334	0.336	0.332
Light width to overall window height		0.175	0.176	0.174
Light width to arch span		0.308	0.310	0.306
Overall window width to light height (at springing point)		0.838	0.831	0.827
Overall window width to light height (at arch peak)		0.994	0.989	0.990
Mullion width to overall window width		0.073	0.074	
Mullion width to light width		0.220	0.218	0.221
Mullion width to light width		0.223	0.222	0.225

	North transept north eastern		
	Light/	Light/	Light/
Single	Mullion1	Mullion2	Mullion3
	0.485	0.489	0.488
	0.433	0.434	0.434
0.332			
0.402			
0.601			
0.988			
	0.195	0.197	0.199
	0.174	0.175	0.177
	0.333	0.333	0.337
	0.134	0.134	0.135
	0.337	0.337	0.341
	0.588	0.592	0.590
	0.524	0.526	0.525
	0.019	0.022	
	0.057	0.057	0.056
	0.067	0.067	0.067

	South transept east		
	Light/	Light/	Light/
Single	Mullion1	Mullion2	Mullion3
	0.776	0.775	0.776
	0.670	0.673	0.670
0.443			
0.500			
0.898			
0.957			
	0.293	0.294	0.290
	0.253	0.255	0.250
	0.334	0.336	0.331
	0.167	0.168	0.165
	0.319	0.321	0.316
	0.877	0.876	0.876
	0.757	0.760	0.757
	0.016	0.017	
	0.049	0.049	0.050
	0.050	0.049	0.050

Connaught	Chancel south eastern		
St. Nicholas, Galway		Light/	Light/
Proportions	Single	Mullion1	Mullion2
Tracery field height to light height (at springing point)		0.793	0.795
Tracery field height to light height (at arch peak)		0.675	0.678
Tracery field height to overall window height	0.447		
Overall window width to overall window height	0.339		
Overall window width to window height to spring	0.609		
Overall window width to arch span	0.687		
Light width to light height (at springing point)		0.310	0.293
Light width to light height (at arch peak)		0.264	0.250
Light width to overall window width		0.514	0.486
Light width to overall window height		0.175	0.175
Light width to arch span		0.354	0.334
Overall window width to light height (at springing point)		0.602	0.604
Overall window width to light height (at arch peak)		0.513	0.515
Mullion width to overall window width		0.048	
Mullion width to light width		0.092	0.098
Mullion width to light width			

	Chancel south mid	
	Light/	Light/
Single	Mullion1	Mullion2
	0.798	0.798
	0.683	0.680
0.442		
0.346		
0.617		
0.678		
	0.317	0.308
	0.271	0.263
	0.507	0.493
	0.176	0.176
	0.344	0.334
	0.625	0.625
	0.535	0.533
	0.044	
	0.086	0.089

	Chancel south western	
	Light/	Light/
Single	Mullion1	Mullion2
	0.802	0.801
	0.683	0.687
0.451		
0.325		
0.589		
0.696		
	0.286	0.291
	0.243	0.249
	0.495	0.505
	0.161	0.161
	0.345	0.351
	0.577	0.576
	0.491	0.494
	0.024	
	0.048	0.048

Athenry Dominican priory, county Galway

Founded in 1241 by Meiler de Bermingham, 2nd Baron of Athenry, the Dominican priory of SS Peter and Paul, Athenry is among the best documented medieval houses because of the existence of a copy of the medieval friary register (hereafter known as Register).[39] The Register is of particular value as it records various benefactions made to the friars over a period of some 300 years and includes a number of significant donations to the fabric. The Latin Register was published in full in 1912 by Ambrose Coleman and an earlier work by Martin J. Blake on the friary, published in 1902, also contained much of the contents of the Register but in translation.[40] The church building at Athenry has also been the subject of some detailed architectural and stylistic analysis. In 1913 R.A.S. Macalister published a comprehensive analysis of the structure, some of its monuments, and its grave slabs. This publication is an important record of the building prior to modern conservation work and some unfortunate acts of twentieth- and twenty-first-century vandalism.[41] More recently, Etienne Rynne assessed the building in the context of medieval Athenry and in 2009 Jim McKeon produced another architectural analysis of the building involving examination of masonry, architectural detailing, and grave slabs.[42]

In common with St Nicholas collegiate church in Galway, even with the survival of documentation recording benefactions, some ambiguity remains about the phases of building and the insertion dates for many of the windows. This investigation seeks to determine whether metrology and/or proportional analysis, considered in conjunction with architectural and stylistic analysis, can assist in resolving these ambiguities.

The sections of the Register that refer to the building fabric are as follows:[43]

1241: The abbey was founded by Meyler de Bermingham for the Dominican friars.[44]

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[39] The comment "remarkably good" is relative to other Irish buildings and not English or continental European works. A. Coleman, 'Regestum monasterii fratum praedicatorum de Athenry', *Archivium Hibernicum,* 1912, 1, 201-21 (hereafter 'Regestum').

[40] M.J. Blake, 'The Abbey of Athenry', *Journal of the Galway Archæological And Historical Society,* 1902, 2, 65-90 (hereafter 'Athenry').

[41] R.A.S. Macalister, 'The Dominican Church at Athenry', *Journal of the Royal Society of Antiquaries of Ireland,* 1913, 43 (1913), 198-222 (hereafter 'Athenry').

[42] E. Rynne, 'Dominican Priory History - Athenry.' 2000. Athenry Heritage Centre. Viewed May 2009. <http://www.athenryheritagecentre.com/history_dominican.htm> (hereafter 'Dominican Priory') and J. McKeon, 'The Dominican Priory'.

[43] Some details have been added from associated texts.

[44] A. Coleman, 'Regestum', p. 204: "Dominus Bremigham nomine Mylerus elegit et vocavit fratres prasdicatores prae ceteris ordinibus mendicantium et aliis religiosis ad villam suam de Athnary, et contulit eis pulchram aream et dedit eis copiam pecunias ad fabricam Monasterii.".

1324: William Canus de Burgh and his wife Fionnula O'Brien donated 100 marks towards the building and glazing of the west front for the church.[45] They also paid for the choir to be extended by 20 feet and designated a space there for their burial.[46]

Before 1343: Work on the north transept took place, or was certainly funded, in two phases; the first up to the bases of the windows funded by Mac a Wallayd de Bermigham and the second phase continuing, we assume, to roof height and funded by William Wallys, who also built the belfry up to the height of the gable of the church some time prior to his death in 1343. At his death Wallys bequeathed two pipes of wine towards the repair of the windows in the Chapel of the Blessed Virgin Mary, i.e. the north transept.[47]

1400: Pope Boniface IX granted Indulgences to those who contributed to the upkeep of the priory.[48]

After 1408: Some time after the death of her husband, David Wydyr in 1408, Joanna de Ruffur "put up the great window in the front of the high altar, and all the windows of the choir".[49]

1423: A Papal Bull was issued by Pope Martin V. requesting that visitors should make donations to fund rebuilding works after a fire that consumed the monastery.[50]

1445: Papal Bull from Eugene IV. "enforced" the bull of Pope Martin.[51]

Pre 1462: Edmund Lynch (d. 1462) funded the "carving and glazing" of all of the windows of the north of the church. It is unclear whether this was just the north aisle of the nave of the church, or included the transept too.[52]

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[45] A. Coleman, 'Regestum', p. 212: "Item Willelmus Canus et Fymiola iuyn ybrisen ruais sua uxor. Fuerunt isti conventui magni amici et dederunt fratribus plusquam centum marcas ad fabricam frontis Ecclesiae et ad vitrum".

[46] A. Coleman, 'Regestum', p. 212: "Sic Dominus am [blank] Athassel [am] pliavit chorum nostrum spacio viginti pedum et sepulti sunt in presbiterio in gradu diaconi." The translation from M.J. Blake, 'Notes on the Persons named in the Obituary Book of the Franciscan Abbey at Galway', *Journal of the Galway Archæological And Historical Society,* 1911-12, VII (I), 1-28, p. 9 is: "This lord [William de Burgh of Athassel] enlarged our choir by the space of 20 feet and they are buried in the presbytery in the rank of Deacon [Deacon's step]."

[47] "Item Mac a Wallayd de Bermigham fecit Capellam beatae Virginis usque ad bases fenestrae. Postea Wllyn Walys reliquam partem praedictae capellae complevit." and "Item reliquit fratribus duo pipa vini pro reparatione fenestrarum. Item fecit capellam beatae virginis.": A. Coleman, 'Regestum', p. 206.

[48] A. Coleman, 'Regestum', p. 214.

[49] A. Coleman, 'Regestum', p. 207: "Et fecit vitriare magnam fenestram frontis magni altaris et omnes fenestras chori et in vitro et in omnibus expensis ad vitrum pertinentibus expendebat plusquam centum marcas ut asseritur." Partially translated by M.J. Blake, 'Athenry', p. 78.

[50] T. Walsh, *History of the Irish Hierarchy, with the Monasteries of each county, biographical notices of the Irish saints, prelates, and religious*. New York: D. & J. Sadlier & Co., 1854, pp. 450 (hereafter *Monasteries*): "AD 1423, Pope Martin V., the monastery being consumed by fire granted indulgences to all persons visiting it on the feasts of Saint Patrick and Saint Peter ad vincula, and contributing to its repairs".

[51] T. Walsh, *Monasteries*, pp. 450: "AD 1445, Pope Eugene IV. enforced the bull of Pope Martin the V.; and it appears from his bull, that there were thirty friars in Athenry".

[52] A. Coleman, 'Regestum', p. 211: "Item fecit fabricari nova reparatione aram muralem existentem ex opposito columnarum dicti monasterii ex parte Boreali cum omnibus fenestris ibidem sculptis et vitratis in suis propriis expensis."

Each portion of the church will now be examined to cross-reference the evidence from the Register with the results of this metrological and proportional investigation, and in reference to previous examinations of the building.

The east end of the church

R.A.S. Macalister, Harold Leask, and Etienne Rynne all interpreted the entry in the Register relating to the extension of the choir by 20' to mean that the east gable was knocked in 1324 and that the chancel was extended 20' eastwards.[53] Jim McKeon, however, argued that such work would have made "no practical or financial sense" and suggested that the extension of the choir was actually achieved by the internal movement of the ("probably timber") rood screen westwards.[54] He supported his argument with evidence that a string course of "no later than the thirteenth century" runs along the internal north chancel wall under the lancet windows and "returns into the east gable"; a corbel table to support the roof "spans the length of the wall"; an external rectangular string course "runs along the external face of the north chancel wall"; and there is an "absence of any noticeable break in the masonry fabric of the wall".[55]

The corbel table (seen internally in Figure 5.18) is the weakest piece of evidence here. When the priory was destroyed by fire in 1423 this almost certainly necessitated the installation of a new roof. This, in turn, could have required the building of the corbel table which would have spanned both the original chancel and any extensions to it. The exterior string course, which is part of the corbel table, is so uneven, both at the purported masonry junction and above the section containing the lancets, that its absolute continuity must be questioned (Figure 5.19). The stonework above this corbel table/course also looks to be of somewhat different fabric to that below. In relation to the interior string course, there is a significant gap from just before the sedila and tomb on the north wall of the chancel to the east wall (Figure 5.18). I suggest that the string course on the east gable end could have been reused from the wall that existed prior to extension to create a sense of unity and continuity. Examples in England have shown that masons were required to blend new works with existing fabric creating a relevant precedent.

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[53] R.A.S. Macalister, 'Athenry', pp. 200-1; H.G. Leask, *Irish Churches II*, pp. 126-7; E. Rynne, 'Dominican Priory'.
[54] J. McKeon, 'The Dominican Priory', p. 27.
[55] J. McKeon, 'The Dominican Priory', p. 30.

Figure 5.18 Athenry Dominican priory: internal view of the chancel from the crossing. Note the different lean of the wall above the arches surrounding the lancets and the presbytery windows.

Figure 5.19 Athenry Dominican priory: chancel north wall details

Although the masonry is very similar along the entire north wall of the chancel, the scarring of the wall between the chancel lancets and easternmost windows caused by the destroyed buttress makes this difficult to interpret (Figure 5.19). The location of the destroyed buttress would also be appropriate for the supposed original east end. From an angled view along the north wall there appears to be a slight bend at approximately the right place for the 20' extension. Such a bend would have been very unlikely if the entire wall was built as a single construction (see Figure 5.18 and Figure 5.20). R.A.S. Macalister's plan of the building also shows a small but perceptible change in the width of the chancel wall after the end of the nave lancets (Figure 5.35). Typical Irish Dominican buildings of the thirteenth century, such as Cashel (Figure 5.21), Roscommon (Figure 5.22) and Sligo (Figure 5.23), featured groups of adjacent lancets on the walls of the chancel and/or nave, without any variation in style or spacing. This would make Athenry's lancets contemporary with the building of the monastery in 1241 and adds to the suggestion that the window closest to the east end is part of a different phase.

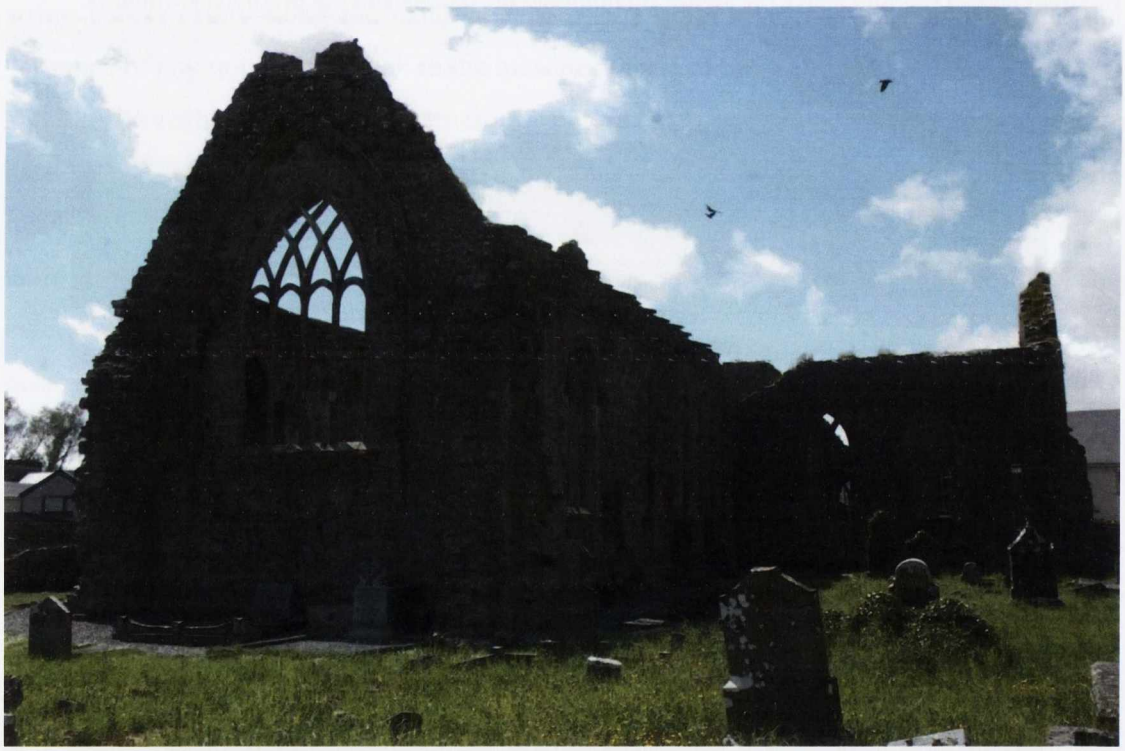

Figure 5.20 Athenry Dominican priory: external view from the north-east. Note the 'curve' in the chancel north wall between the presbytery and lancet windows

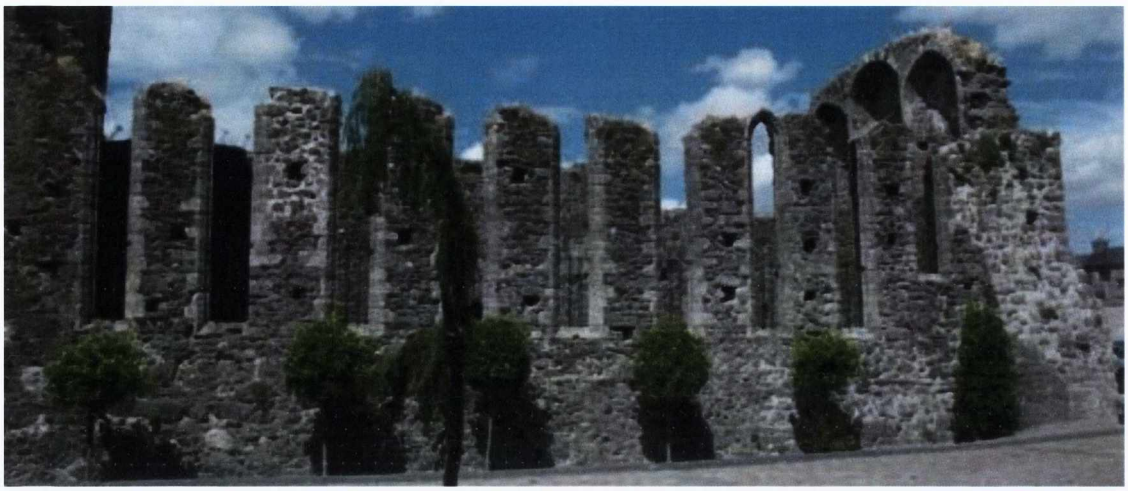

Figure 5.21 Chancel lancets, south wall, Cashel Dominican

Figure 5.22 Nave lancets, south wall, Roscommon Dominican

Figure 5.23 Chancel lancets, south wall, Sligo Dominican

The masonry around the arch of the north chancel window does not look in any way scarred, making the insertion of the window seem contemporary with the building of the wall. Scarring might be particularly expected at the base of the chancel window because it is not on a level with the bases of the lancets and it is unlikely that the original window would not have been inserted on the same course (Figure 5.19). This would make both the wall and the window fourteenth-century rather being a fourteenth-century window in a thirteenth-century wall. The treatment of the chancel arch (Figure 5.24) is also very different from that around the lancets (Figure 5.25) with the stones arranged radially around the arch in the former and the arch shape created through the use of spalls in the latter. Although the narrower width of the lancets would make arching support less important, I suspect that had these been built by the same mason, he would have used the same technique irrespective of width. Thus, I think that the architectural evidence alone refutes McKeon's theories.

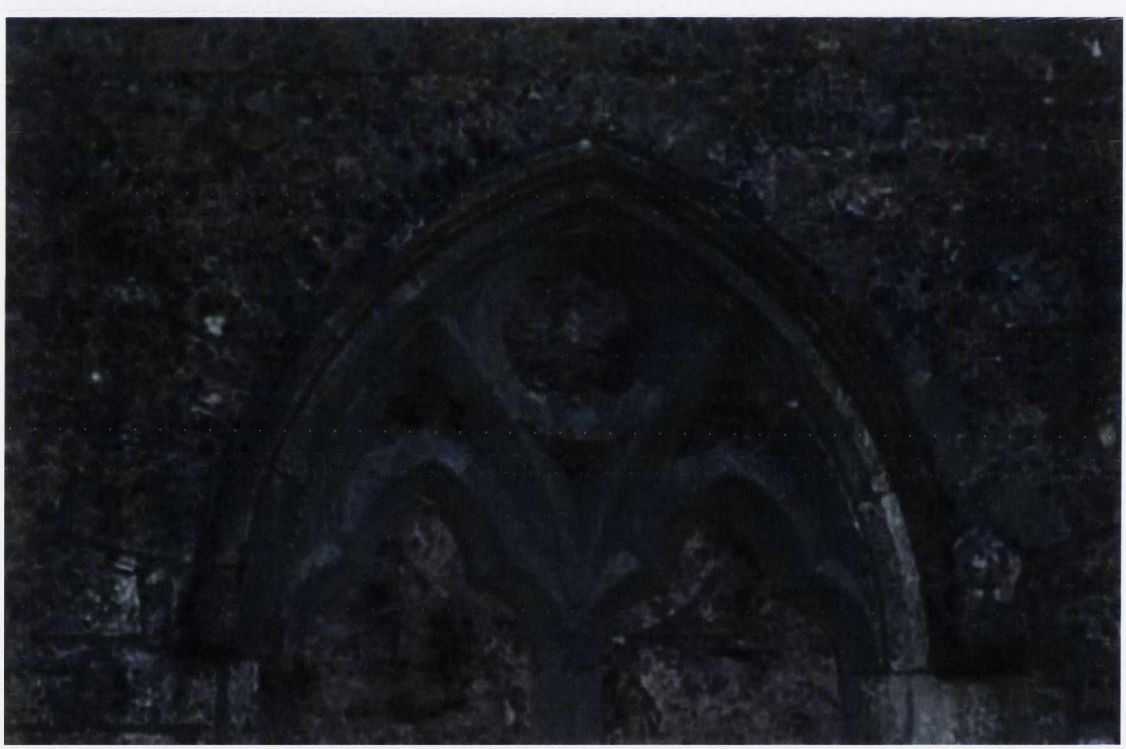

Figure 5.24 Athenry Dominican priory: chancel north window arch external

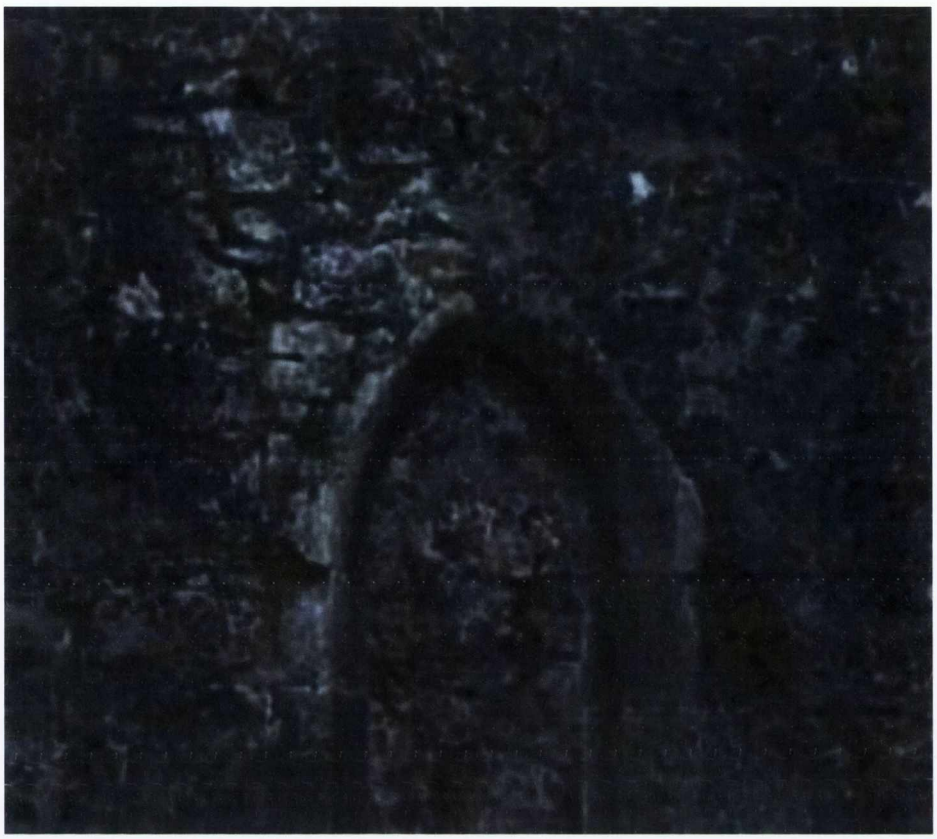

Figure 5.25 Athenry Dominican priory: chancel north window arch external

Returning to the Register, Joanna de Ruffer's donation after 1408 for all the windows of the choir is vague enough that it could mean that she only paid for replacement glass, a supposition that appears to be confirmed by the survival of the original thirteenth century lancets in the north wall. The question for the empirical investigation is whether a distinction can be made between thirteenth-, fourteenth- or fifteenth-century, or possibly later, windows in the chancel.

The windows of this complex east end are the chancel east as well as a north and south chancel windows. The current chancel east window (Figure 5.26 left) is a simple switchline design which replaced a much larger decorated window (Figure 5.26 right is a conjectural reconstruction). Etienne Rynne suggested that the switchline tracery was inserted after the fire of 1423 and subsequent Papal Bulls although no record of its funding is included in the Register.[56] R.A.S. Macalister, however, dated the switchwork window to the Jacobean period, some two hundred years later.[57]

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[56] E. Rynne, 'Dominican Priory'.

[57] R.A.S. Macalister, 'Athenry', p. 207. Jim McKeon suggested that this window was "probably inserted into the gable in the fifteenth or sixteenth century" on the basis of "almost identical windows" in Scotland from the mid-fifteenth century. The style of this window is so generic and so widely used throughout Ireland and over time, as will be discussed in chapter 6, that to make comparisons with datable windows in Scotland makes no sense. J. McKeon, 'The Dominican Priory', p. 35.

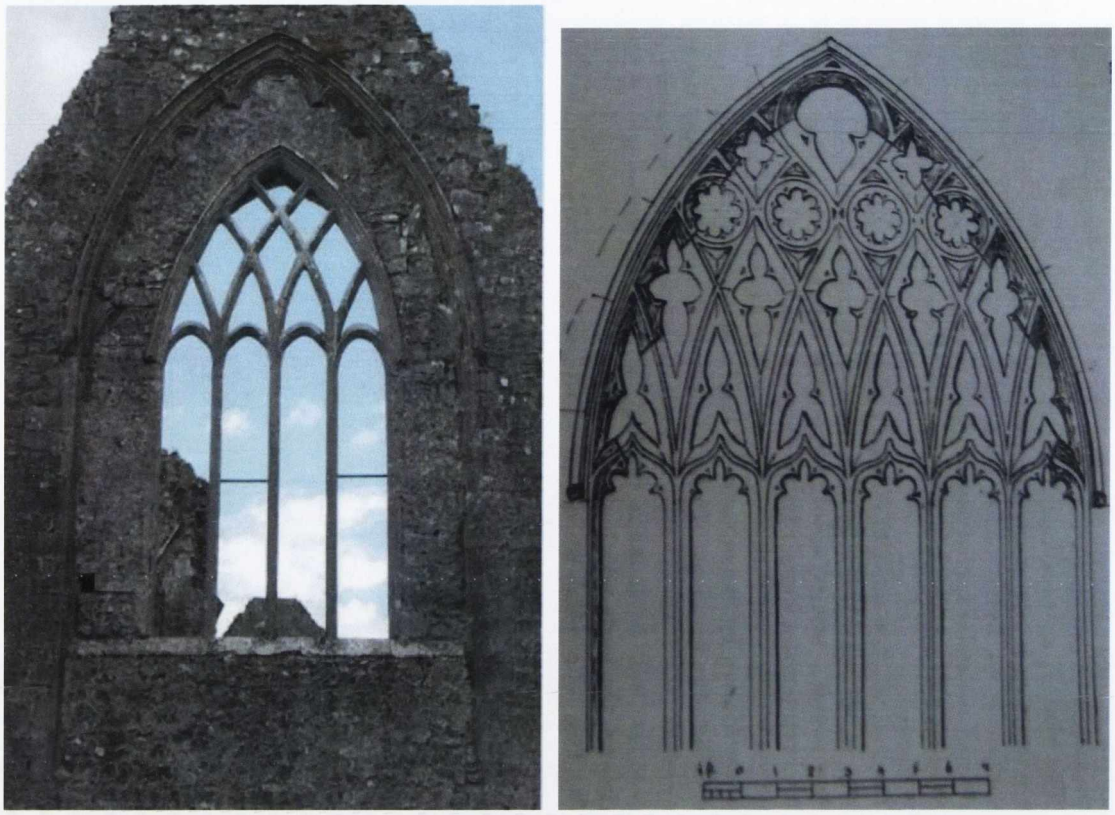

Figure 5.26 Athenry Dominican priory: current chancel east window and R.A.S. Macalister's conjectural reconstruction of the original window [58]

The unit derived for the chancel east window was 0.279m which aligns well with a unit popular throughout Connaught and the other regions of study. In Connaught the windows where ~0.279m occurs are Claregalway Franciscan north transept north; Kilconnell Franciscan east; Kilmacduagh cathedral south; Portumna Dominican east; and the south aisle south and west windows at St. Nicholas collegiate, Galway. Neither the Claregalway window, with heavy-set switchline design with trefoil headed lights, nor the Kilmacduagh window, with plate-like tracery, are obviously datable. Kilconnell east's tracery includes loops that are not unlike the south aisle windows at St. Nicholas. Although Kilconnell was founded in 1414 or 1353, depending on the source used, its conversion to Observantine rule in 1467 could have provided a reason for the updating of the building fabric.[59] The style of the east window at Portumna also suggests that it was inserted in the fifteenth century (see below for further discussion). Most informatively, the windows at St. Nicholas have been securely dated to between the end of the fifteenth and the beginning of the sixteenth centuries. This evidence suggests that Etienne Rynne's post-fire date is more correct than Macalister's Jacobean idea.

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[58] R.A.S. Macalister, 'Athenry', p. 201.

[59] A. Gwynn and R.N. Hadcock, *Medieval Religious Houses: Ireland.* 2nd ed. Blackrock, Co. Dublin: Irish Academic Press, 1988, p. 251 (hereafter *Medieval Religious Houses*).

In relation to proportions, the overall window width is 13/23 the overall window height, while the tracery field height is 4/5 the light height at arch peak (Table 5.14). The proportions of the lights are very close to 1:4 between width and height to springing point. The 4:5 ratio is particularly popular at the collegiate churches of Athenry and St. Nicholas, Galway, which were made collegiate in *c.*1484 and 1485, respectively.[60] 1:4 was frequently used at St. Nicholas, Kilconnell, Portumna, and Ross Errilly Franciscan (which became Observant in 1470), while use of 13:23 was prominent at St. Nicholas, Kilconnell, and Moyne Franciscan, another Observantine foundation from 1460.[61] That these windows are all of later fifteenth century date supports the theory that Athenry Dominican priory's east window was inserted in the mid to late fifteenth century. The similar metrology and proportions suggests some consistent practices by a mason or group of masons, for this set of buildings at this time at least. The other connection between these buildings at this time is patronage by the Lynches and other Galway merchants, or links to the de Burgo family. It is unlikely that this is coincidental and will be further discussed in chapter 6.

Since only the outline of the earlier decorated chancel east window remains it was not possible to obtain sufficient measurements to reliably calculate the probable unit of measurement. However, the major proportions could be calculated and are given in Table 5.10. 4:5 was typically used in tracery throughout the late middle ages and is, therefore, not informative in relation to dating. Neither of the other two ratios is common in Connaught and occasions where they are used cannot be linked to the Athenry window by more than coincidence.

Table 5.10 Athenry Dominican priory: chance east old window proportions

Element	Value	Ratio
Tracery field height to overall window height	0.794	4:5
Tracery field height to overall window width	0.831	5:6
Overall window width to overall window height	0.661	2:3

The metrological investigation returned a unit of 0.228m for the chancel north window (Figure 5.27 left). The south window could not be accessed to facilitate measurement (Figure 5.27 right). 0.228m is within 1cm (the tolerance set for this study) of the Connaught unit of 0.236m which was used for the north transept north window at Athenry's collegiate church, for the west windows at Kilconnell and St. Nicholas, the east windows at Kilteevan and Meelick. None of these windows bear any stylistic similarity to

[60] A. Gwynn and R.N. Hadcock, *Medieval Religious Houses*, p. 358.
[61] A. Gwynn and R.N. Hadcock, *Medieval Religious Houses*, p. 255.

the chancel window. Athenry collegiate church's windows probably date from at least the mid-fifteenth century, but Kilconnell's window could have been inserted as early as the 1353 possible foundation date. Kilteevan's window was dated to late fifteenth or early sixteenth century by H.G. Leask, while the continuity of use of Meelick church makes interpretation of its original dating difficult.[62] As has been discussed, the dating of the west window at St. Nicholas is uncertain but it was possibly inserted in the early sixteenth century. This selection of dates for windows with the same unit makes it unlikely that they are logically connected.

The tracery field height to light height at springing point ratio for the chancel north window is 13:23, which has the connections described above, but the other ratios found, golden section and $1:\sqrt{5}$, do not align with these possible links. Thus, no dating suggestions can be made on the basis of proportional analysis either.

Figure 5.27 Athenry Dominican priory chancel east end windows: north (left) and south (right)

Thus, the accepted position that the chancel north window was probably inserted in the fourteenth century during the extension works of 1324 can neither be confirmed nor denied by the empirical investigation. Leask dated this window as fourteenth-century based on stylistic analysis while Jim McKeon identified the similarity between the head capitals on the external hood and ones at St. Canice's cathedral, Kilkenny and St. Mary's

[62] H.G. Leask, *Irish Churches III*, p. 130.

collegiate church, Gowran, Kilkenny which are dated to the late thirteenth or early fourteenth century.[63]

Figure 5.28 Athenry Dominican priory: chancel north window head capitals on external hood

Nave west

The Register suggests that the window of the west end of the nave was replaced as part of the major works of 1324. Unfortunately, the damage sustained as a result of the building of the ball alley in the nineteenth century means that the only the tracery field is still measurable (Figure 5.29).

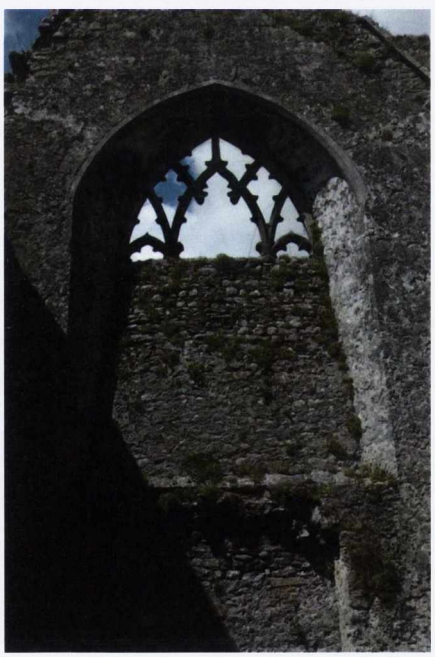

Figure 5.29 Athenry Dominican priory west: current (left) and R.A.S. Macalister's reconstruction [64]

[63] J. McKeon, 'The Dominican Priory', pp. 33-5 citing J. Hunt, P. Harbison and D.H. Davison, *Irish medieval figure sculpture, 1200-1600: a study of Irish tombs with notes on costume and armour*. Dublin: Irish University Press, 1974. McKeon also noted the presence of diagonal tooling, a method which he claimed was used between the twelfth and fourteenth centuries but, as has been discussed, this is not a reliable indicator of dates.

[64] R.A.S. Macalister, 'Athenry', p. 201.

Insufficient measurements could thus be taken to derive a probable unit of measurement. Dimensions could be extracted for a small number of elements and relationships between these were compared against the ratios used in the rest of this study (Table 5.11). While the light width was close to ¼ the overall window width none of the other relationships matched the typical proportions.

Table 5.11 Athenry Dominican priory: Nave west window proportional relationships from laser scanning

Element	Value
Tracery field height to overall window width	0.888
Light width to overall window width	0.257
Mullion width to overall window width	0.047
Mullion width to light width	0.183

The window which most closely resembles Athenry's nave west window is at the east end of the chancel at Portumna Dominican friary, 50km away (Figure 5.30). Danielle O'Donovan's investigation of the mouldings of the mullions and tracery lead her to conclude that these windows must have been created by the same mason and date from after the fire at Athenry Dominican priory.[65]

Figure 5.30 Portumna Dominican friary: chancel east window

[65] D. O'Donovan, 'Building Butler', p. 140.

The unit used at Portumna was 0.274m which, when used at St. Nicholas' collegiate church, occurred in the context of late-fifteenth or very early sixteenth-century works. However, in Ormond, this unit was used at St. Mary's collegiate church, Gowran which dates to the late thirteenth century. This unit seems to have great longevity and, therefore, cannot discover whether the tracery remains now evident date to William and Fionnula's donation of 1324 or to after the fire of 1423. Stylistically, and vaguely based on metrological evidence from St. Nicholas' Galway, I would suggest that the latter date is more likely.

Although very limited in scope, a comparison of the proportional relationships and extracted measurements at Athenry and Portumna (Table 5.12 and Table 5.13) indicates that although the tracery of the two windows were very similar they were not set out according to the same designs, even though templates for the mullions may have been shared. This evidence suggests that the two windows were installed within a close timespan of each other but neither the metrology nor the proportions can confirm when that time was.

Table 5.12 Comparison of proportional relationships for Athenry nave west and Portumna chancel east

Element	Athenry	Portumna	% Difference
Tracery field height to overall window width	0.888	0.920	4
Light width to overall window width	0.257	0.250	3
Mullion width to overall window width	0.047	0.053	13
Mullion width to light width	0.183	0.210	15

Table 5.13 Comparison of measurements for Athenry nave west and Portumna chancel east

Element	Athenry	Portumna
Tracery field height	2.592	2.871
Overall window width	2.918	2.641
Light width	0.749	0.660
Mullion width	0.137	0.139

North aisle and north transept

There is no record in the Register of when the north aisle of the nave was built. R.A.S. Macalister dates this and the erection of the north transept as contemporary with the extension works on the chancel (1324). Since the Register records that the transept was built prior to the death of William Wallys in 1343, this hypothesis is plausible. The windows in the aisle were probably those of the north part of the church which were replaced "carving and glazing" by Edmund Lynch pre-1462.

The metrology recorded for the north sections of the building is as follows:

North aisle north western:	0.247m
North aisle north eastern:	0.254m
North transept west:	0.298m
North transept east southern:	0.350m or 0.220m
North transept north:	0.302m

The measurements of the two north aisle north windows (Figure 5.31) are the same to within the tolerance of this study.[66] Their metrology does not align with any other windows on site but it does align with the documented unit of the Natural/French or Welsh foot of 0.249/0.251m. In Connaught, other windows which share this preferred unit were Aghagower parish church east, Creevelea Franciscan east and west, Kilconnell Franciscan south transept south western, and, possibly, Burrishoole Dominican east and south transept south. As discussed above, the Creevelea windows possibly date to post 1536 and Kilconnell's to post 1467. Burrishoole was built *c.* 1469, by Richard de Burgo of Turlough, making its windows at least mid- to late-fifteenth century.[67] Aghagower lost its status as a station on the pilgrimage between Ballintubber Abbey and Croagh Patrick in 1457 so it is unlikely that major window installations took place after this date.[68] With the exception of Creevelea, the unit used at these windows aligns with a mid- to late-fifteenth century date for the installation of Athenry's north aisle windows by Edmund Lynch.

[66] All of the dimensions of the north aisle west window were extracted from a laser scan, since it could not be measured photogrammetrically due to space restrictions, and these agreed with the measurements of the north aisle windows to within the tolerance of the study. Due to the different origin of the data this window was not processed with the rest of the photogrammetric results.
[67] A. Gwynn and R.N. Hadcock, *Medieval Religious Houses*, p. 222.
[68] On site plaque.

Figure 5.31 Athenry Dominican priory: nave north aisle north eastern (left) and western (right)

Although the measurements of the lights and mullions of the west window of the north transept (Figure 5.32 right) indicate that it was designed to be the same as the north windows of the north aisle, the metrological analysis suggested that the unit of measure for the west window was 0.298m while for the nave north aisle the suggestions were 0.247m/0.254m. The north window of the transept (Figure 5.32 left) has a unit of 0.302m, similar to the west unit. The closest know standard to these two is the Irish foot of 0.3048m and this can be explained because both of these windows were restored by the Office of Public works in the early twentieth century. The restoration was based on stone fragments found on site but not *in-situ* because when R.A.S. Macalister studied the site prior to 1913 he described the north transept north window thus: "The tracery of this has entirely disappeared, and not even such small fragments as are left of the east window are to be seen."[69]

[69] R.A.S. Macalister, 'Athenry', p. 203.

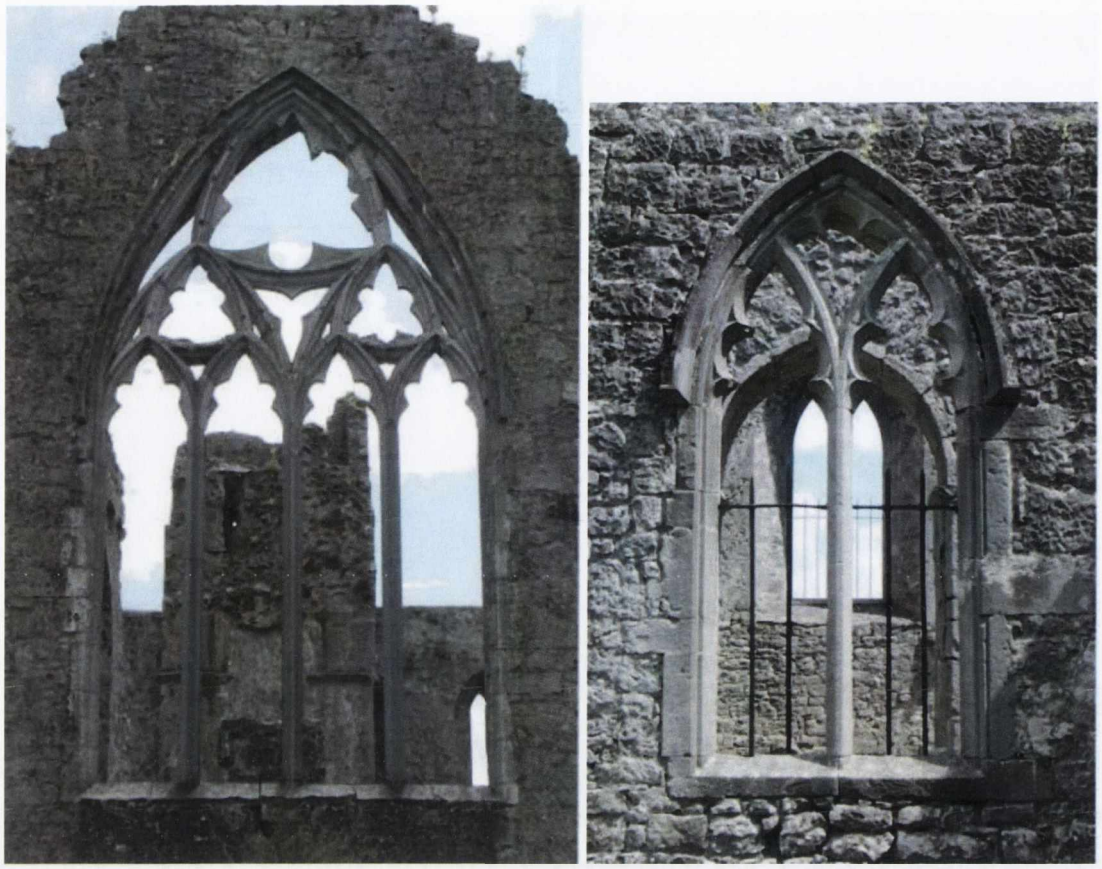

Figure 5.32 Athenry Dominican priory: north transept north (left) and west (right)

Thus, even though pieces of, possibly fourteenth-century, fallen stone were reused this study detected that the window had been set out using the modern foot. A number of other cases of reconstructed windows were found to use the modern foot: the chancel east window at Claregalway Franciscan friary, the chancel and north aisle east window at Jerpoint Cistercian abbey and the chancel east window at Holycross Cistercian abbey. Thus this study presents a method by which some later restorations can be detected.

In reference to the east side of the transept, the northern window contained so much newly-cut stone that it was not measured in the study (Figure 5.33). Some ambiguity exists about the style of tracery in the southern window. Angelo Maria Bigari's 1779 drawing of the priory (Figure 5.34) shows the north transept east windows as having similar tracery to the chancel north window (Figure 5.27 left). H.G. Leask's plan of the priory from 1960 suggests another possibility, showing the east windows as having the same tracery as the north aisle north and west windows, switchline but with the addition of foliation at the heads of the lights and in the central kite shape.[70] Bigari's drawing may be untrustworthy because he has depicted the wrong number of lights in the chancel east

[70] H.G. Leask, *Irish Churches II*, p. 127.

window and showed switchline tracery in the north transept north window when pieces of geometric tracery were found in the church in the nineteenth century. He probably created a sketch on-site but without sufficient attention to detail.

Irrespective of style (current plain switchline, Leask's foliated switchline, or Bigari's geometric), the key measurements used in this study are based on the overall window, the tracery field, and the lights, and these would probably have been the same since there is no evidence of reinsertion of the window. The preferred units calculated for this window were 0.350m or 0.220m. Neither unit aggress with the windows of the north aisle making Leask's drawing of the tracery style questionable. If 0.220m is the correct unit for the north transept window then this suggests that it might be contemporary with the chancel north window with a unit of 0.228m, making it possible that Bigari's drawing was indeed correct. As previously discussed, this unit could not be aligned with windows from any particular era but it would confirm Macalister's theory of contemporary building of the north transept and chancel east end, probably at in the second quarter of the fourteenth century. The option of a unit of 0.350m would place this window in a group with the transept windows of St. Nicholas, Galway which date to somewhere between the mid-fourteenth and mid-fifteenth centuries. While this is compatible with the pre-1343 record of funding for the transept in the Register, I would suggest that the 0.220m unit was the more likely candidate.

Figure 5.33 Athenry Dominican priory: north transept east southern (left) and north transept east northern (right)

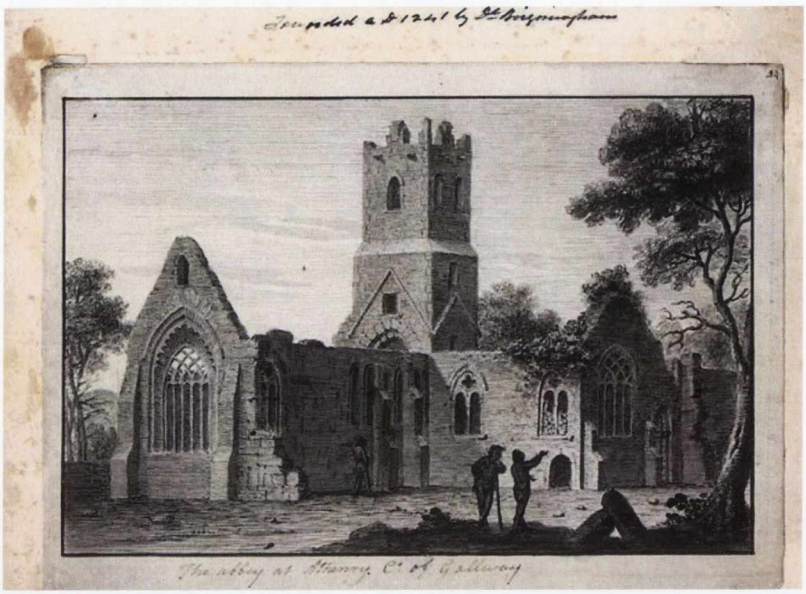

Figure 5.34 Athenry Dominican priory: drawing by Angelo Maria Bigari from 1779 [71]

The full results of the metrological study are shown on a plan of the building after Macalister in Figure 5.35 while the results for the proportional investigation are given in Table 5.14.

Ratio	Numeric Value	1%		2%	
1 : 4	0.250	0.253	0.248	0.255	0.245
1 : 3	0.333	0.337	0.330	0.340	0.327
2 : 5	0.400	0.404	0.396	0.408	0.392
1 : root 5	0.447	0.452	0.443	0.456	0.438
1 : 2	0.500	0.505	0.495	0.510	0.490
13 : 23	0.565	0.571	0.560	0.577	0.554
1 : root 3	0.577	0.583	0.572	0.589	0.566
3 : 5	0.600	0.606	0.594		
377 : 610	0.618	0.624	0.612	0.630	0.606
2 : 3	0.667	0.673	0.660	0.680	0.653
1 : root 2	0.707	0.714	0.700	0.721	0.693
3 : 4	0.750	0.758	0.743	0.765	0.735
4 : 5	0.800	0.808	0.792	0.816	0.784
5 : 6	0.833	0.842	0.825	0.850	0.817
1 : 1	1.000	1.010	0.990	1.020	0.980

[71] A.M. Bigari, 1779, The Abbey of Athenry, Co. of Gallway [sic]. Dublin, National Library of Ireland. http://catalogue.nli.ie/Record/vtls000051659

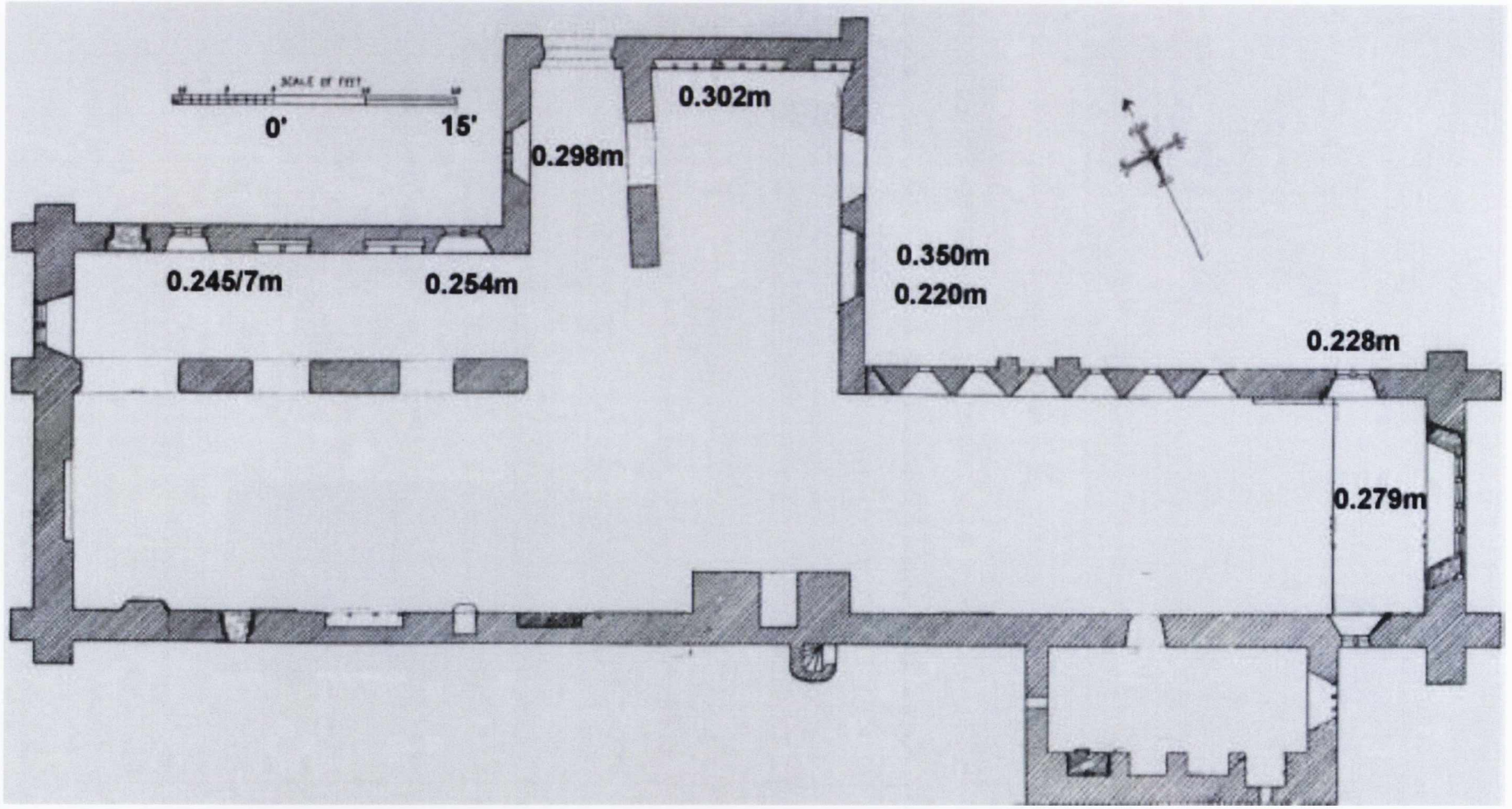

Figure 5.35 Athenry Dominican priory: ground plan after R.A.S. Macalister annotated with metrological findings from this study

Table 5.14 Athenry Dominican priory: proportional investigation

Connaught	Chancel east				
Athenry Dominican		Light/	Light/	Light/	Light/
Proportions	Single	Mullion1	Mullion2	Mullion3	Mullion4
Tracery field height to light height (at springing point)		0.893	0.897	0.894	0.895
Tracery field height to light height (at arch peak)		0.785	0.790	0.788	0.794
Tracery field height to overall window height	0.472				
Overall window width to overall window height	0.555				
Overall window width to window height to spring	0.953				
Overall window width to arch span	0.989				
Light width to light height (at springing point)		0.265	0.266	0.252	0.271
Light width to light height (at arch peak)		0.232	0.234	0.223	0.240
Light width to overall window width		0.252	0.252	0.240	0.257
Light width to overall window height		0.140	0.140	0.133	0.143
Light width to arch span		0.249	0.249	0.237	**0.254**
Overall window width to light height (at springing point)		0.951	0.951	0.951	0.950
Overall window width to light height (at arch peak)		0.924	0.930	0.928	0.935
Mullion width to overall window width		0.051	0.048	0.045	
Mullion width to light width		0.205	0.204	0.189	
Mullion width to light width		0.198	0.189	0.176	

	Nave north western		
		Light/	Light/
	Single	Mullion1	Mullion2
		0.714	0.713
		0.489	0.489
	0.405		
	0.461		
	0.774		
	0.948		
		0.422	0.397
		0.289	0.272
		0.520	0.489
		0.239	0.239
		0.493	0.464
		0.812	0.811
		0.556	0.556
		0.097	
		0.188	0.199

	Nave north eastern		
		Light/	Light/
	Single	Mullion1	Mullion2
		0.730	0.736
		0.497	0.500
	0.410		
	0.467		
	0.792		
	0.964		
		0.422	0.419
		0.287	0.285
		0.508	0.500
		0.237	0.237
		0.490	0.482
		0.831	0.837
		0.566	0.569
		0.089	
		0.175	0.178

	Chancel north		
		Light/	Light/
	Single	Mullion1	Mullion2
		0.565	0.567
		0.472	0.472
	0.349		
	0.448		
	0.688		
	0.939		
		0.373	0.366
		0.311	0.305
		0.513	0.502
		0.230	0.230
		0.482	0.472
		0.726	0.729
		0.607	0.606
		0.094	
		0.183	0.187

Connaught	North aisle east		
Athenry Dominican		Light/	Light/
Proportions	Single	Mullion1	Mullion2
Tracery field height to light height (at springing point)		0.591	0.591
Tracery field height to light height (at arch peak)		0.427	0.426
Tracery field height to overall window height	0.359		
Overall window width to overall window height	0.425		
Overall window width to window height to spring	0.662		
Overall window width to arch span	0.984		
Light width to light height (at springing point)		0.367	0.341
Light width to light height (at arch peak)		0.265	**0.246**
Light width to overall window width		0.525	0.487
Light width to overall window height		0.223	0.223
Light width to arch span		0.516	0.479
Overall window width to light height (at springing point)		0.700	0.701
Overall window width to light height (at arch peak)		0.506	0.505
Mullion width to overall window width		0.134	
Mullion width to light width		0.255	0.275
Mullion width to light width			

	North transept west		
		Light/	Light/
	Single	Mullion1	Mullion2
		0.727	0.727
		0.498	0.497
	0.409		
	0.460		
	0.778		
	0.959		
		0.412	0.414
		0.282	0.283
		0.504	0.506
		0.232	0.232
		0.483	0.485
		0.818	0.818
		0.560	0.559
		0.093	
		0.185	0.184

	North transept north			
	Light/	Light/	Light/	Light/
Single	Mullion1	Mullion2	Mullion3	Mullion4
	0.881	0.881	0.876	0.884
	0.908	0.906	0.906	0.901
0.519				
0.607				
0.792				
0.963				
	0.343	0.326	0.332	0.333
	0.274	0.260	0.263	0.266
	0.258	**0.246**	0.248	0.252
	0.157	0.149	0.151	0.153
	0.249	0.237	0.239	0.243
	0.753	0.753	0.749	0.756
	0.942	0.944	0.944	0.949
	0.049	0.053	0.050	
	0.189	0.199	0.215	
	0.213	0.200	0.197	

Chronology summary

Using St. Nicholas collegiate church and Athenry Dominican priory, an analysis of alignment between dating evidence from documentary sources, and from metrological and proportional evidence derived from window tracery was presented. The dates from these sources are presented in Table 5.15. 4 possible cases of corresponding units occur between the two sites:

0.280: Athenry chancel east (1423-end 15th C), and St. Nicholas nave south aisle south and west (1486-1510). **Approximate agreement**.

~0.227: Athenry chancel north and north transept south eastern (1324-mid 14th C), and St. Nicholas nave west (possibly 17th C). The style of the nave west window at St. Nicholas makes it unlikely that it could have been installed as early as the mid-fourteenth century, just as the style of the chancel and transept windows at Athenry make it unlikely that they were seventeenth-century installations. This could suggest great longevity for a unit or, as proposed previously, the St. Nicholas unit could actually be ¾ of the legal standard foot of 0.3048m. **Disagreement**.

0.350: Athenry north transept south eastern (mid 14th C-mid 15th C), and St. Nicholas chancel east (1493), north and south transepts (mid-late 14th C). **Approximate agreement**.

~0.254: Athenry north aisle north western (mid-late 15th C) and St. Nicholas nave north aisle west (inserted in 1583 but possibly originally designed mid-late 15th C[72]). **Approximate agreement**.

[72] This possible date is made on a stylistic basis. Quite speculatively, if the source of the window was Annaghdown Augustinian priory, then in the late fifteenth century a number of her abbots hailed from the de Burgo family, which may have prompted patronage of window tracery. A. Gwynn and R. N. Hadcock, *Medieval Religious Houses*, pp. 156-7.

Table 5.15 Chronology of window tracery at Athenry Dominican priory and St. Nicholas collegiate church from documentary and empirical evidence

Window	Unit	Documentary/ Literature Date	Empirically Suggested Date	Datable by metrology	Datable by proportions
Athenry					
Chancel east (switchline)	0.279	1408/1423/ 17thC	1423- end 15thC	Yes	Yes: 1:4, 13:23
Chancel north	0.228	1324/1408	1324- mid 14thC	No	No
Nave west	? Maybe 0.274	1324	1423- end 15thC	Possibly, through metrology link to Portumna & St. Nicholas	No
North transept east southern	Option 1: 0.220	pre 1343/ pre 1462	1324- mid 14thC	Possibly	No
	Option 2: 0.350	pre 1343/ pre 1462	mid 14th- mid 15th	Possibly	No
North transept north	0.302	pre 1343/ pre 1462	?	modern restoration	No
North transept west	0.298	pre 1343/ pre 1462	?	modern restoration	No
North aisle north eastern	0.245	pre 1462	mid-late 15thC	Yes	Yes: 13:23
North aisle north western	0.254	pre 1462	mid-late 15thC	Yes	Yes: 13:23
St. Nicholas					
Chancel south	~0.360	*c.*1320	1493	Yes	No
Chancel east	0.346	1493	1493	Yes	No
South transept east	0.349	14th C	mid-late 14thC	Yes	No
North transept north	0.351		mid-late 14thC	Yes	No
Nave south aisle south	0.280 (4/5 of 0.356)	1486-1510	1486-1510	Yes	No
Nave south aisle west	0.282 (4/5 of 0.349)	1486-1510	1486-1510	Yes	No
Nave north chapel	0.367	1538-1561	1538-1561	Yes	No
Nave north aisle north	0.364	1538-1561	1538-1561	Yes	No
Nave north aisle west	0.257	1583	inserted in 1583 but possibly originally designed mid-late 15thC	Yes	No
Nave west	0.227 (3/4 of 0.303)	1583	possibly 17thC	Yes	No

The correspondences found between these two buildings verify the chronological findings made separately at each site. The discrepancy relative to the 0.227m unit emphasises the need for caution in the use of measured data. The findings of this section demonstrate that examination of metrology, supported in some cases by proportion, can identify, or confirm, groups of windows that are contemporary in an individual building where stylistic or other types of evaluation have failed.

Thus far, the sample of data is much too small, both temporally and spatially, to enable creation of a chronology of Irish medieval units. This study has, however, confirmed that numerous units were in simultaneous use and that the length of these units varied from a 'short' foot of ~.227m to a 'long' foot of ~0.356m, with a number of other values in between. This shows that despite significant legal intervention by the Anglo-Norman/English administration in relation to the short selling of measures in trade, this had little or no impact on the building industry in the west of Ireland. The range of measures used in Ormond and Desmond suggest a similar outcome there.

5.4 Connaught case study – Athenry Dominican priory, county Galway

Figure 5.36 Athenry Dominican priory: early twentieth century (Lawrence Collection, National Library of Ireland)

This case study focuses on the ground plan of the building and on other architectural features since the windows have been analysed in the previous section. Part of the architectural historical interest in this building is due to its location in a Gaelic province but within a town under Norman influence. This particular Gaelic/Norman blend is emphasised by the joint patronage of the monastery by Norman lords and Gaelic chiefs alike, sometimes contemporaneously. Although not suppressed at the Dissolution in 1539 the priory has suffered significant structural damage as a result of its use for military purposes in the seventeenth and eighteenth centuries and because of the collapse of the central tower in 1845.

Measurement of the internal ground plan and architectural features was executed using terrestrial laser scanning. This required three set-ups of the Mensi GS200 time-of-flight laser scanner: at the intersection of the chancel, nave and north transept (Figure 5.37); beside the door of the sacristy in the chancel; and in the north aisle adjacent to the western tomb niche. As described in the methodology chapter, the three scans were

aligned using spherical targets and the registration module of the Realworks V6.2 software.

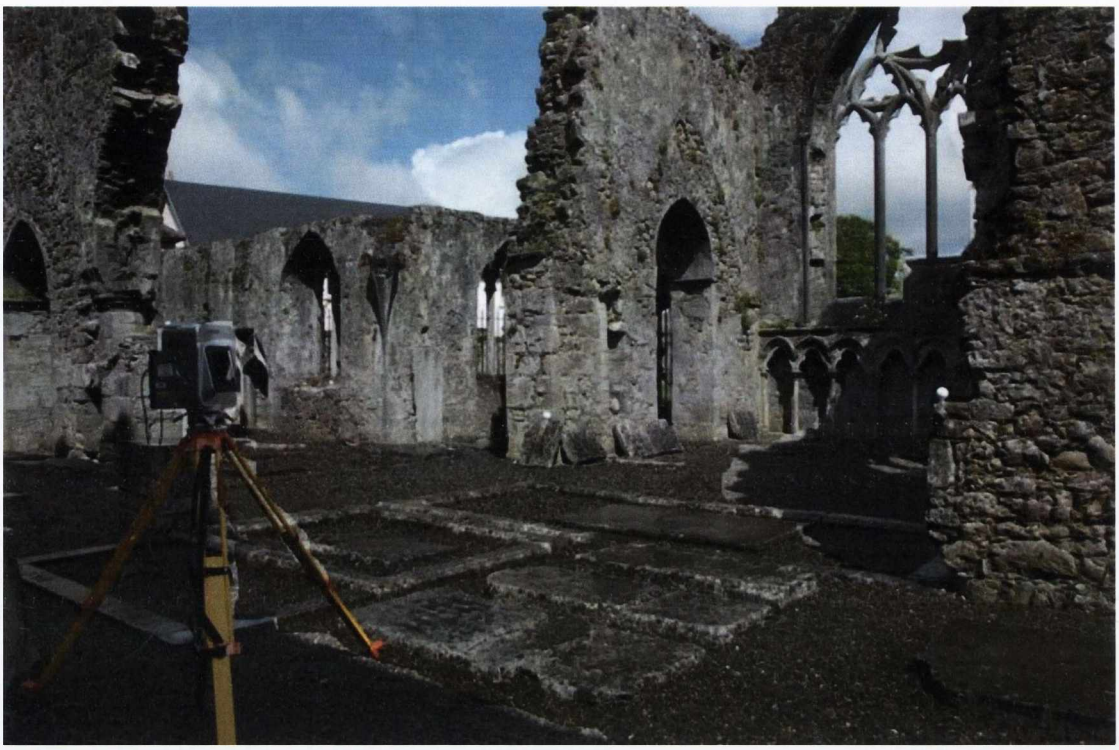

Figure 5.37 Athenry Dominican priory: laser scanner position

Table 5.16 shows that, with the exception of two targets, the scans registered to within 6mm and frequently to much better. Target 7 was located on the string course beside the southern-most east window of the north transept making it measurable in only two scans and for both scans the angle of incidence of the beam was very different. The end result was that it was extremely difficult for the digital matching software to align the same target in the two scans. Similarly target 10 was positioned on the window ledge of the west window of the north transept resulting in the same problems as for target 7. It is theoretically necessary to use only three targets to link the data from the different scanner positions and when more than three targets are used this provides redundancy in the result. When redundant data is available the lower quality results, such as from targets 7 and 10, are given lower priority in the matching solution thus causing a minimal effect on the overall alignment result. After matching, the measurements from the three scans were successfully merged into a single homogeneous point cloud from which any required measurements could be extracted.

Table 5.16 Athenry Dominican priory: scan registration results

Target Number	Residual Error (mm)	Delta X (mm)	Delta Y (mm)	Delta Z (mm)	Fitting Error[73] (mm)
1	3.06	-2.57	1.66	0.09	1.10
2	1.61	0.58	-1.46	0.34	0.71
3	1.21	0.95	-0.65	0.40	0.78
5	5.18	-0.87	-5.10	0.28	0.77
7	11.76	7.66	-8.79	1.52	0.87
9	5.76	2.34	4.80	2.14	1.10
10	12.89	-9.13	9.09	0.34	0.75
11	1.70	-1.57	-0.67	0.05	0.96

5.4.1 Ground plan

When initially erected the church building consisted of only a nave and chancel, the total length of which, ~39.3m, was very long relative to its width, ~7.1m. In the chancel, a ratio of approximately 1:2 existed between width and length, with the result being approximate partly because construction of the crossing tower and the north transept make it difficult to determine the exact point at which the chancel ended.[74] None of the other width to length relationships in the original ground plan matches the ratios in this study.

After the addition of 20' to the length of the chancel in 1324 the chancel width to length ratio no longer matched any set ratio. The other additions to the building from the early fourteenth century are the north aisle and transept. The shape of the north aisle appears not to have fixed proportions although the overall internal width of the north aisle plus nave is close to 4:5 the length of the aisle. The length of the north transept, taken from the intersection with the north aisle relates to the width of the transept by the golden section. I do not think that either of these ratios was deliberately set out. While the golden section has been found in late medieval church planning this mainly occurred in the east of the country.[75] 4:5 has been shown to have been very popular in the Connaught windows but the related items seem to be too random to be verifiable.

Thus the evidence of the proportions of the ground plan suggests that very little, if any, importance was attached to proportional planning at this site. No estimation could be

[73] This figure represents a measure of how well a spherical shape could be fitted into the point cloud which represented the scan of the spherical target. Where there is no mis-identification of the target spheres this value should be below 2mm, as is the case here.

[74] Since these dimensions were derived from the laser scan of the building they were measured between the internal faces of the walls which may not represent the original setting out by the mason. Setting out to centre-lines or external faces would have been just as likely and consistency is also not certain.

[75] See chapter 2, section 2.2.1.

made of the metrology of the original ground plan because so many alterations have been made to the fabric that it would be impossible to ascertain the initial setting out positions.

5.4.2 Architectural details

Originally the piers of the arcades between the north aisle and the nave were circular in shape but at some later point they were hidden and encompassed in rectangular stonework during works which also reduced the width and height of the arches (Figure 5.38).[76] Measurements of the current footprint of the arcade piers reveal little regard for rigorous measurement and insufficient information is available to enable extraction of a preferred standard unit. The style of the capitals which are still visible from the original piers reveals a very simple design which may reflect the availability of reduced funds and a preference for adornment instead of the timber screens that would have filled the arcades (Figure 5.38 left).

Figure 5.38 Athenry Dominican priory north aisle arcade: arch size reduction

The south wall of the nave (Figure 5.39) was also altered over time. For instance, the eastern tomb recess in the south nave wall (detail in Figure 5.42) is evidently later than the original lancet windows, because of the way in which the quatrefoils above the main arches encroach on the lancets.

[76] R.A.S. Macalister, 'Athenry', p. 207.

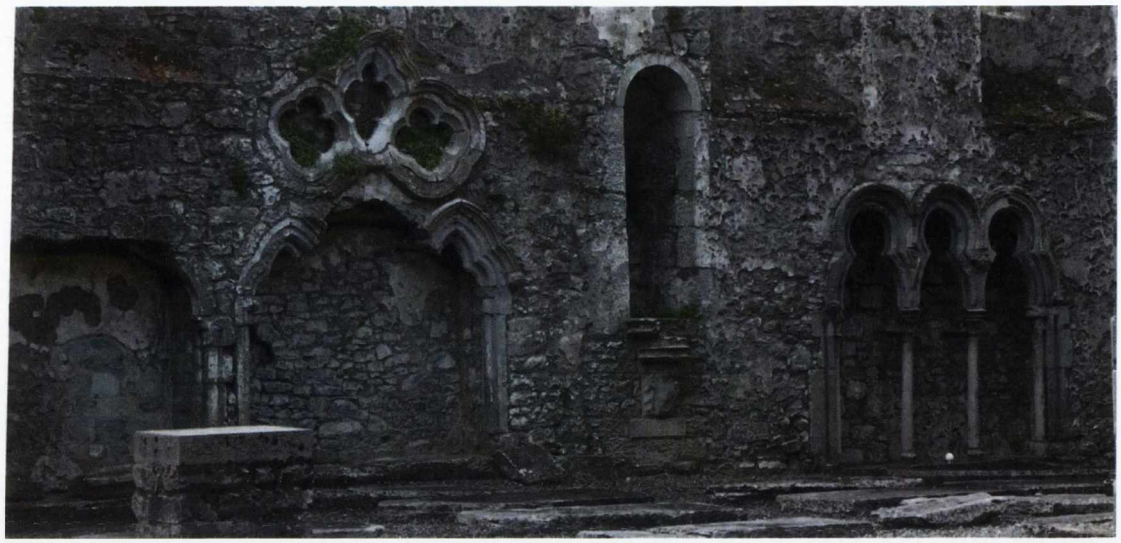

Figure 5.39 Athenry Dominican priory: nave south wall

The western slender triple-arched monument in the south wall of the nave (Figure 5.40) was attributed by Macalister to the first half of the fourteenth century, and he suggested that it accommodated graves, now hidden below the current ground level.[77]

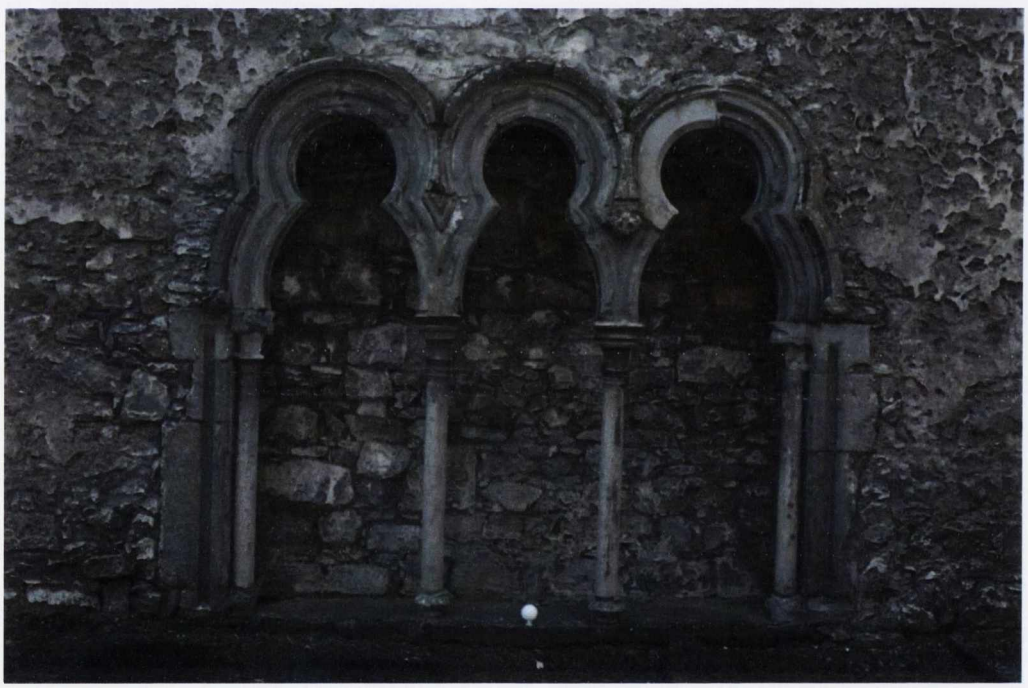

Figure 5.40 Athenry Dominican priory: south nave triple arch feature

Some reconstruction took place before 1913, as revealed by the presence of iron supports in Figure 5.36. Although the mouldings (Figure 5.41), the pillar capitals, and the bosses at the end of the arch hoods display some sculptural skill there is little evidence of geometrical ability. The sizes of the three sections of the niche are all different by

[77] R.A.S. Macalister, 'Athenry', p. 208.

approximately 5cm, and the shapes of the arches are non-symmetrical in all three cases. Although the width of the inter-columnar distance is 1/3 the height of the niche space, this is the only definitive occurrence of a known proportion that could be found within the design. Thus, on the evidence currently available to us, the conclusion which must be drawn is that this piece of tomb sculpture was created by someone with little regard for geometrical considerations.

Figure 5.41 Athenry Dominican priory: south nave triple arch feature; moulding detail of the eastern arch

The eastern niche in the south wall, although missing some elements of its lower portion, can be studied in relation to the symmetry of its design (Figure 5.42).

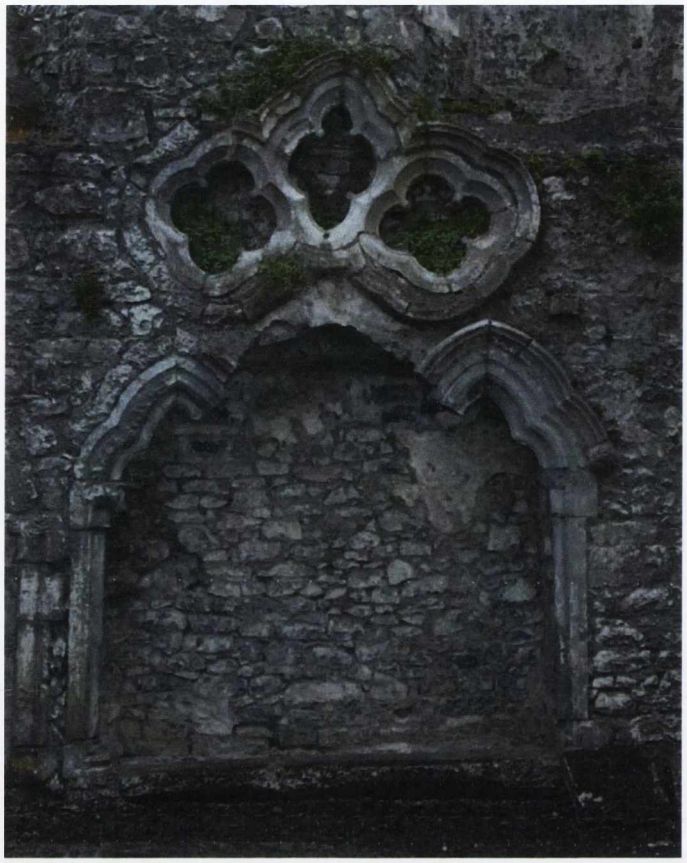

Figure 5.42 Athenry Dominican priory: south nave triple arch feature with additional quatrefoils

Visually, the quatrefoils above the arches are variable in size and this is confirmed by extracting the laser points specifically related to the edges and fitting arcs in AutoCAD (Figure 5.43 and Figure 5.44). Figure 5.43 clearly demonstrates that the mason of this piece was very capable of creating stonework designs involving curves of a particular radius. However, if the intention was to repeat the same sized curve over the four sections of each of the two lower quatrefoils the mason failed badly. Neither of these shapes is symmetrical about either a slanted vertical or horizontal axis, and the size of the radius of curvature varies over the two shapes from 148mm to 184mm, between 5.8 inches and 7.2 inches when converted to modern feet. This variation can hardly be regarded as errors in measurement or cutting, and must instead be indicative of a disregard for the relevance of geometry. Jim McKeon identified some of the motifs on this tomb as consistent with 'School of the West' architecture thus dating the tomb to the initial construction phase of the building and suggesting that the Gaelic benefactors were expressing their identities through the use of specific architectural details.[78] Most of the 'School of the West' buildings retained their lancet windows and so were not examined in this study, nor are they available for measured comparison.

[78] J. McKeon, 'The Dominican Priory', p. 38.

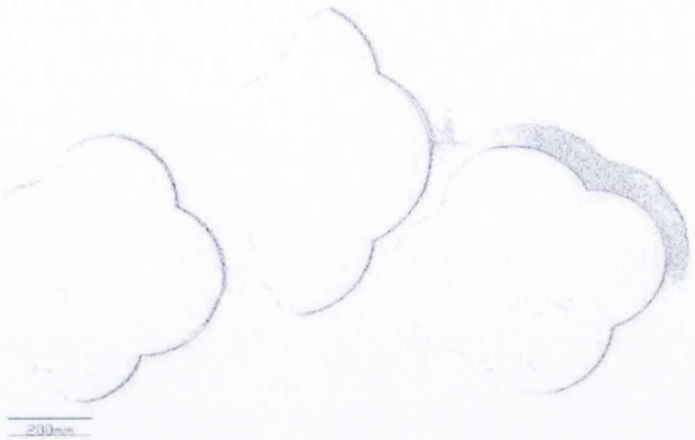

Figure 5.43 Athenry Dominican priory: quatrefoils above triple arch feature in the south nave; linework represents 3-point arcs fitted in AutoCAD over the terrestrial laser scanned points

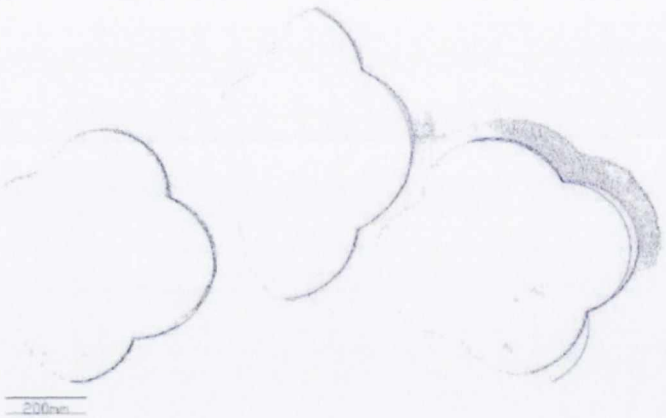

Figure 5.44 Athenry Dominican priory: quatrefoils above triple arch feature in the south nave; linework from the left quatrefoil has been superimposed on the right quatrefoil, in blue, to check for similarity.

Moving to the architectural features in the north transept, R.A.S. Macalister described the series of arcading features at its north end as actually being three adjacent tomb niches separated by double piers. His reasoning was based on the incompatibility of the full width of the combined arches with the available width of the transept. He felt that had this been an ornamental feature it would have been designed such that the entire feature would have fitted evenly within the allocated space without needing to cut into the east wall of the transept as appears to be the case (Figure 5.45). Jim McKeon agreed that the origins of the feature were in three separate elements and dated the entire arcade, with the exception of the earlier eastern capital, to contemporary insertion with the building of the transept.[79] Since the north transept was almost certainly contemporary with the north

[79] J. McKeon, 'The Dominican Priory', p. 46.

aisle, and since the building of the north aisle would have necessitated the destruction of the nave north wall, I would suggest that the eastern capital that McKeon dates to the mid-thirteenth century might have originated in that north wall.[80]

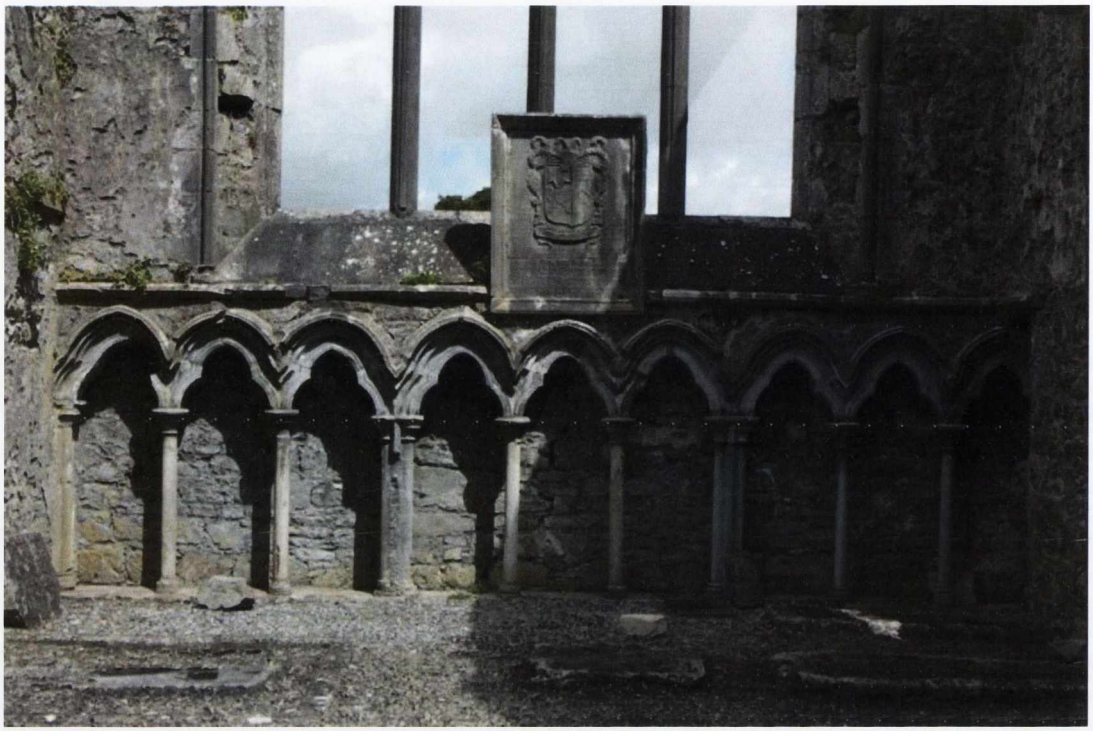

Figure 5.45 Athenry Dominican priory: north transept north arcading (2009)

I agree with Macalister and McKeon that the elements that make up this feature actually started life as three separate monuments because of the evidence provided by historical imagery from post-1930, after the reconstruction of the north window of the transept (Figure 5.46), and Macalister's own 1913 image before any modern conservation work was carried out (Figure 5.47). The older imagery suggests greater differentiation between the groups of arches with the set on the right actually consisting of only two arches rather than three, and this is the description given by Macalister.[81] The separating double pier on the right side is not discernable in the oldest image and could potentially be a misinterpretation during reconstruction. However, in Macalister's time the original double pier could have been covered over by debris from later works, such as the insertion of the memorial slab in 1652. Attempts to understand this feature are made even more difficult by the similarity between the design and mouldings of all of the piers; a similarity borne out by the measured evidence which shows that, for example, the dimensions of the double piers agree to within a couple of millimetres.[82] This suggests that all of the

[80] J. McKeon, 'The Dominican Priory', p. 46.
[81] R.A.S. Macalister, 'Athenry', p. 209.
[82] R.A.S. Macalister, 'Athenry', p. 209 and confirmed by the laser scan.

components of the tombs were manufactured at the same time, or certainly within a short time of each other.

Figure 5.46 Athenry Dominican priory: north transept north arcading – TRIARC Edwin Rae Collection 1930-1970

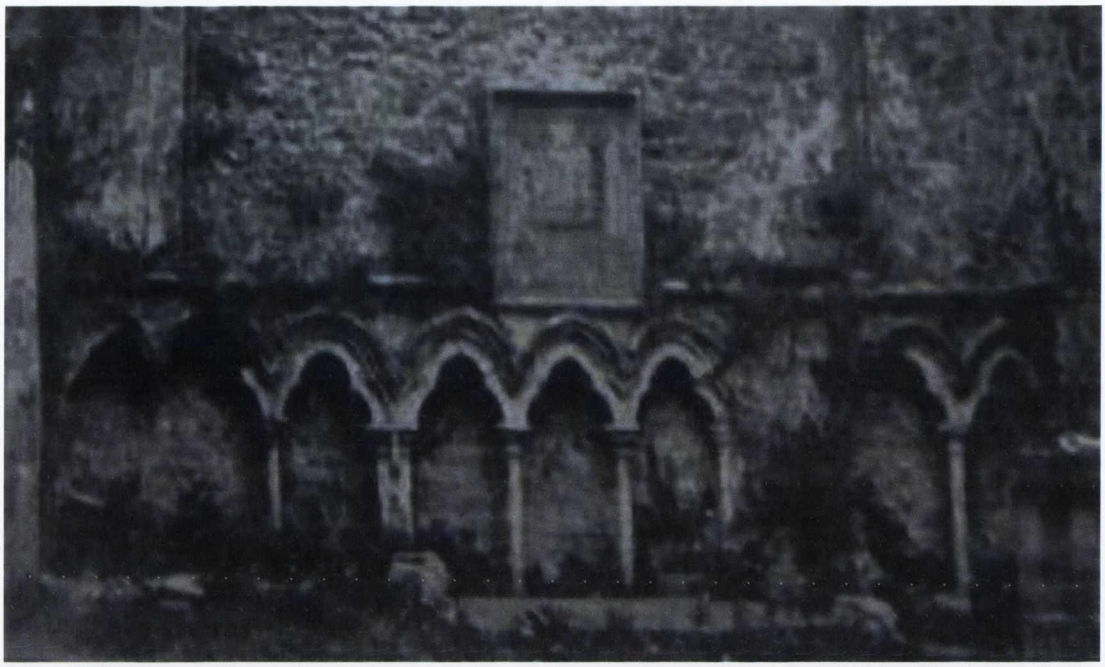

Figure 5.47 Athenry Dominican priory: north transept north arcading – R.A.S. Macalister pre 1913

I do not agree with Macalister and McKeon's ideas that the arcade was 'made to fit' onto the north wall by cutting into the east wall.[83] Just south of the "cut" on the east wall is a blocked doorway that is clearly visible externally. In modern photographs the level is so low that it might almost be missed (Figure 5.48) but in Angelo Maria Bigari's drawing it appeared to be almost full height (Figure 5.49).

[83] Due to the nature of this study an examination was made of whether a measurement error could have caused the arcade to be too long for the transept wall, as was also suggested by Jim McKeon ("an error of judgement either in the planning or construction stage": 'The Dominican Priory', p. 42). One possible scenario where such an error could have occurred would have been if one mason, who used a 'short' foot, took the dimensions of the space and another mason, who preferred a 'longer' foot, actually cut the stone, off site, using these dimensions. The feature would then have been too long necessitating the cut in the wall. This could have occurred if masons from different traditions were working together on this project. However, I think that the degree of conjecture in this option is too much while the explanation for the strangeness of the north east corner given in the main text is entirely plausible, and more logical.

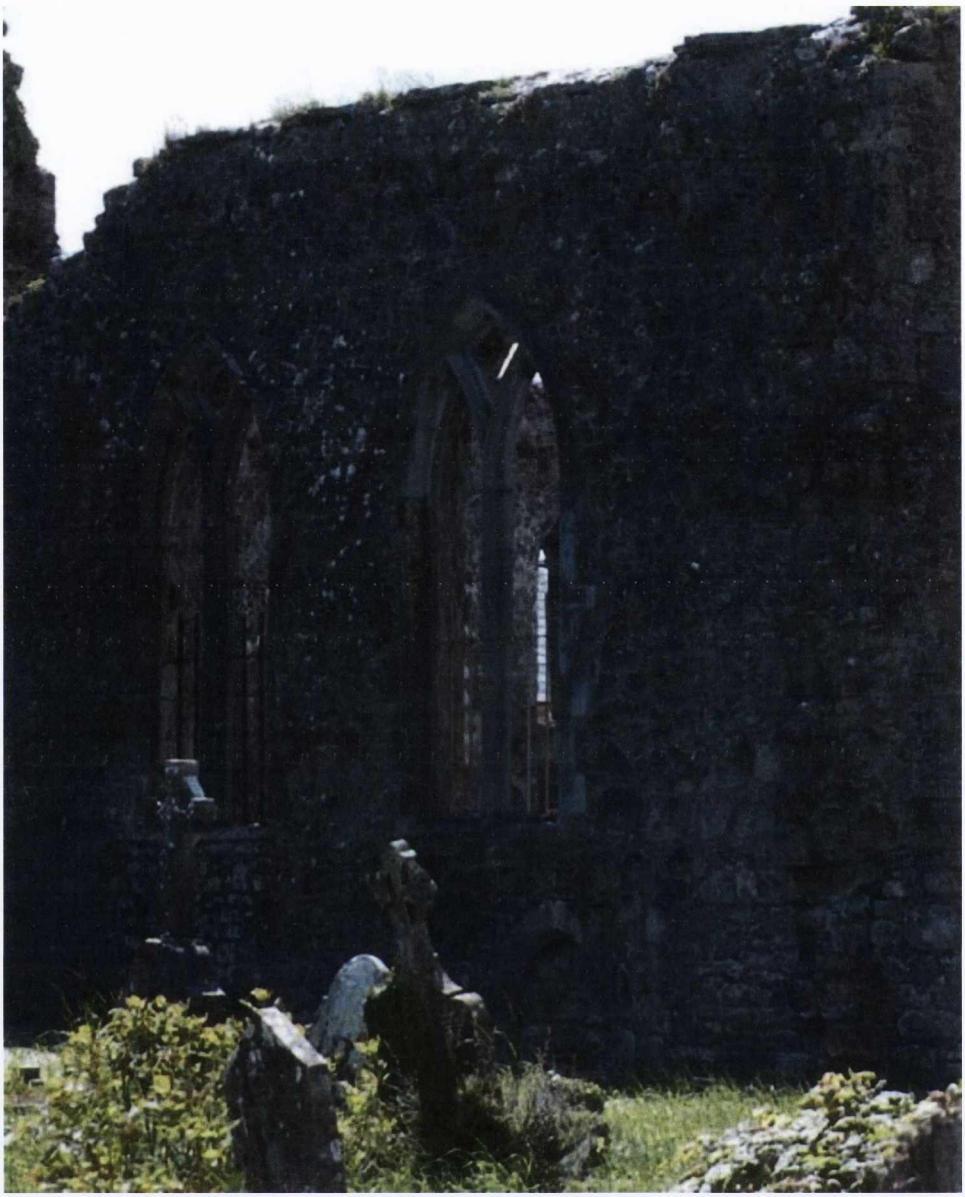

Figure 5.48 Athenry Dominican priory: north transept east wall with blocked doorway

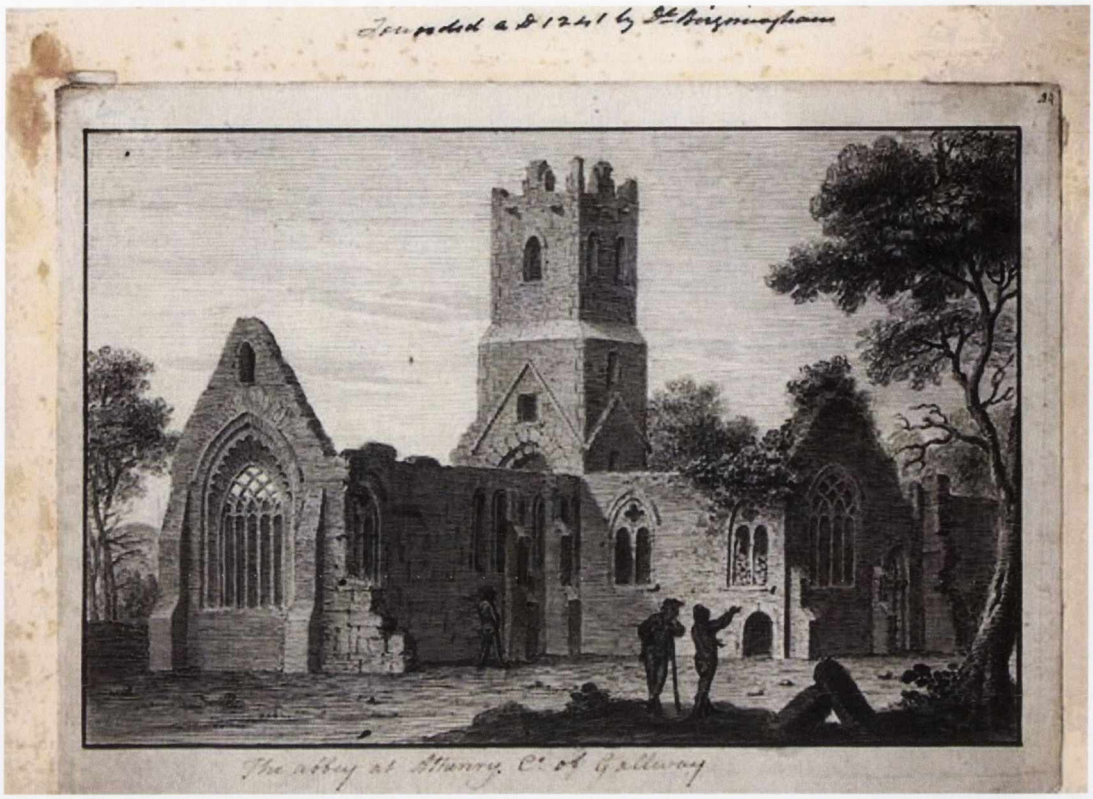

Figure 5.49 Athenry Dominican priory: drawing by Angelo Maria Bigari from 1779

Jim McKeon analysed the stonework surrounding this doorway and found it to have "a simple chamfered moulding" and be "punch-dressed" both of which indicate "a late-medieval date". He also noted "an earlier and bigger embrasure" which was wider on both sides than the other door and which featured "diagonally-tooled jambs". These suggested that the "doorway was present there in the thirteenth or fourteenth century."[84] However, McKeon did not link this doorway to the issues surrounding the north wall arcade.

I would argue that when the north east doorway was blocked the arcade feature was already in existence. At the same time work was also being carried out on the building of the crossing tower and the insertion of the new doorway and aisle arcade at the west side of the north transept (see the fifteenth-century phase of works shown in Figure 5.50).

[84] J. McKeon, 'The Dominican Priory', p. 43.

Figure 5.50 Athenry Dominican priory: Office of Public works plan including building phases. Black represents thirteenth century works, yellow fourteenth, pink fifteenth and blue sixteenth. The assignment of the east and north windows of the chancel to the sixteenth century is not in agreement with the findings of this study.

At that time the masonry below the lower string course of the east wall of the north transept was thickened internally. The red ellipse in Figure 5.51 shows a difference in depth of the wall at string course level. The sharpness of the edge of the east wall in the same image suggests that it was built to stop short of the arcade rather than a section of the wall being cut out to create space for the arcade. No thickening of the wall occurred externally because the scarring visible there is actually as a result of the removal of the buttress (Figure 5.48). The cyan rectangle in Figure 5.52 shows the approximate location of the blocked doorway in an internal overview of the east wall. This photo also shows that the masonry on the transept east wall below the stringcourse matches and joins seamlessly with the masonry inserted at the junction of the transept east wall and the chancel north wall for the construction of the crossing tower in the fifteenth century. The same masonry was also use to partially block the lancet windows on the north side of the chancel.

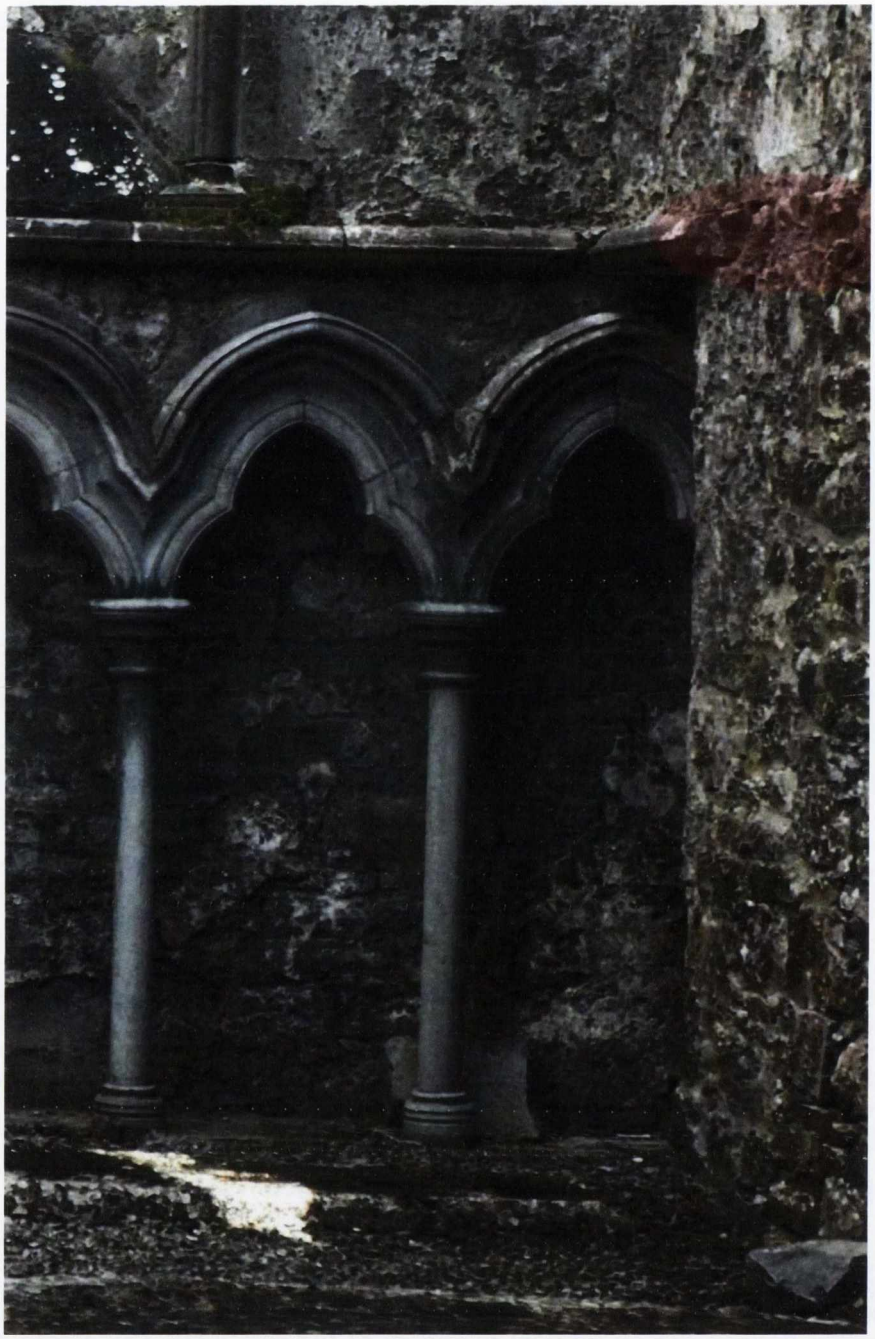

Figure 5.51 Athenry Dominican priory: north-east corner of the north transept. The red ellipse highlights the location below which the wall has been thickened at some time later than the insertion of the arcade.

Figure 5.52 Athenry Dominican priory: north transept east wall, internal view. The cyan highlight indicates the approximate location of the blocked doorway. Note that the masonry on the transept east wall below the stringcourse matches and joins seamlessly with the masonry inserted at the junction of the transept east wall and the chancel north wall for the construction of the crossing tower in the fifteenth century.

Having answered the questions in relation to the north east corner of the transept arcade the issue of the function of this feature must now be addressed. I would again agree with R.A.S. Macalister's assigned function for the feature as evidence of no longer visible tombs because of the presence of spiral decorations on the base of the arcades as can be seen in Figure 5.53. It has been suggested that these spiral patterns were design drawings for some feature in the building. A comparison was made between the design on the slab and all of the piers and other details but none match the style of the four touching circles. This pattern was, therefore, simply adornment on a graveslab in the same way that a number of other slabs in the church are ornamented with tracery and floral images (see, for example, Figure 5.54).

Figure 5.53 Athenry Dominican priory: north transept north arcade base detail

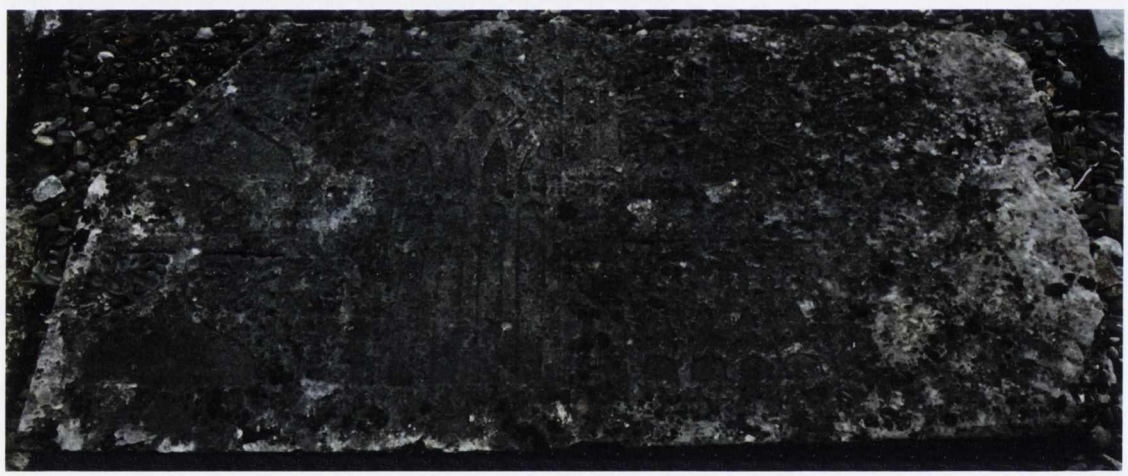

Figure 5.54 Athenry Dominican priory: grave slab with window tracery designs

The final set of architectural details worthy of comment at Athenry Dominican priory are the tomb niches along the north wall of the north aisle (Figure 5.55 and Figure 5.56), which possibly date from the end of the fifteenth century. R.A.S. Macalister describes them as identical although the tracery in the western example has survived in better condition.[85]

[85] R.A.S. Macalister, 'Athenry', p. 209.

Figure 5.55 Athenry Dominican priory: north aisle from the east

Figure 5.56 Athenry Dominican priory: north aisle tombs, eastern (left) and western (right)

There are, however, interesting differences within the tracery related to the presence or absence of central grooves and the mirroring of the external details on the internal, wall-facing side. It would be very unusual to find a groove in a tomb niche since the function of such channels was to receive glass, shuttering or the wood within which glass was held (Figure 5.57). There is no requirement for this in a tomb niche which is built into a solid wall. Furthermore, it makes no sense for a mason to expend the time required for applying detailed mouldings to both the front and rear of the mullions and tracery bars of a feature which would only every be viewed from a single side (Figure 5.58). Figure 5.59 shows examples from other tombs in the church where a more typical form of niche tracery, with mouldings on one side only, is used.

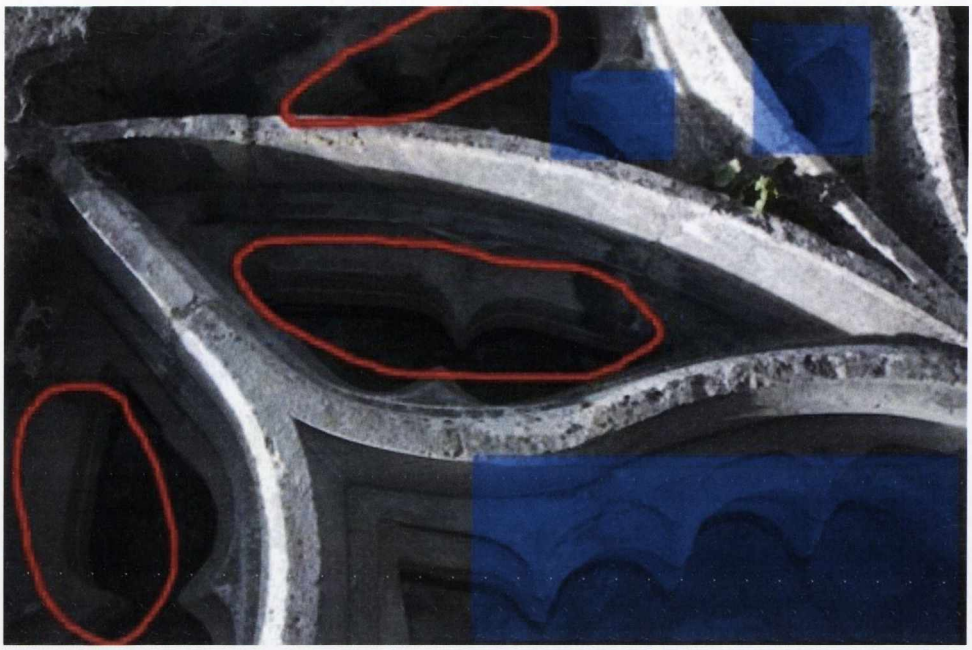

Figure 5.57 Athenry Dominican priory: north aisle eastern tomb details; red circling indicates sections of bar tracery with grooves while blue rectangles indicate the absence of grooves

Figure 5.58 Athenry Dominican priory: north aisle tomb details, eastern (left) and western (right)

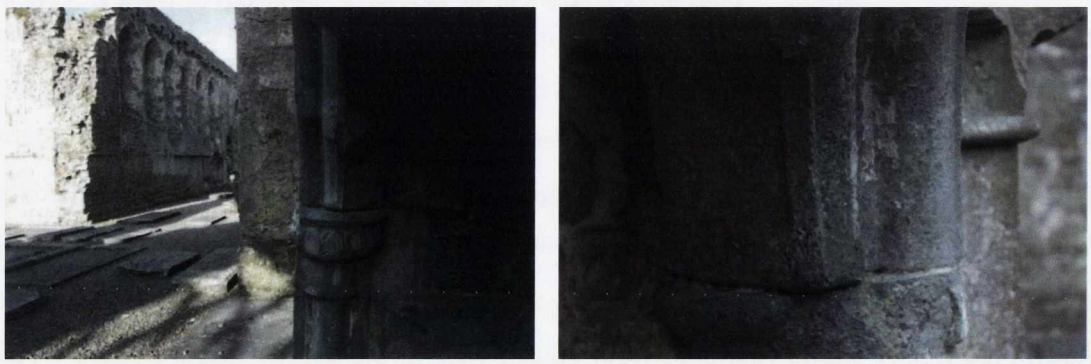

Figure 5.59 Athenry Dominican priory: niche tracery with mouldings on front side only; nave south wall arcade tracery detail (left) and chancel eastern tomb (right)

This suggests that these features were not originally intended to be placed in a blind niche, but rather were sculpted to be positioned where both faces would have been equally visible, probably as part of a window. Although the ogee arches of the "lights" of the north aisle niche tracery would not have been unusual in medieval Irish architecture, the outer frame of the tracery is a shouldered arch, a form rarely seen in Ireland.[86] Setting out such as shape would have required different skills than those needed for round-headed or pointed arches, perhaps indicating the presence of a mason on site who did not share a background with the rest of the builders at Athenry. There is also the possibility that these pieces of tracery were transferred to the site from somewhere else where they had been used for a different function.

One further point of interest as regards the tombs of the north aisle is that three different masons' marks are present on the tracery bars. The first type is a leaf-based design (Figure 5.60) which is well-carved into two sections of tracery, one grooved, one flat, as annotated by the letter A on Figure 5.62.

Figure 5.60 Athenry Dominican priory: north aisle eastern tomb masons' marks; type A

The second mark is more lightly incised and consists of an arrow-head (Figure 5.61). Both marks A and B are found on sections of tracery without grooves as annotated by the letter B in Figure 5.62.

[86] F. Bond, *Gothic architecture in England: an analysis of the origin and development of English church architecture from the Norman Conquest to the dissolution of the monasteries*. London: Batsford, 1905, p. 258. Square-headed windows have been used in a number of locations such as at Loughrea Carmelite monastery in Connaught and at St. Mary's parish church, Callan in Ormond but more complex shapes have not been found during this study.

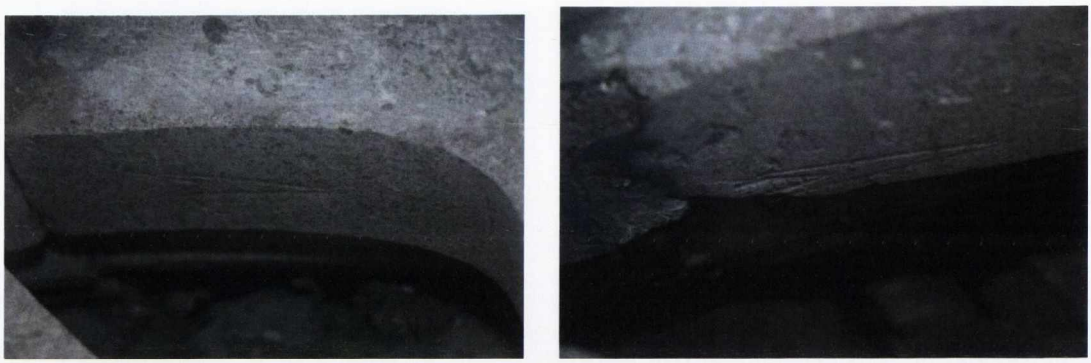

Figure 5.61 Athenry Dominican priory: north aisle eastern tomb masons' marks; type B

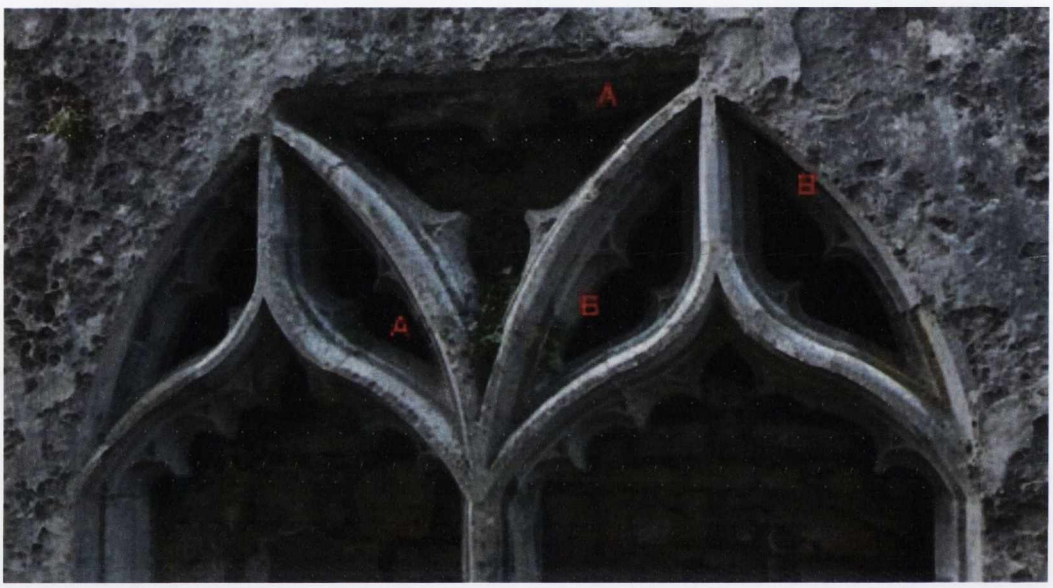

Figure 5.62 Athenry Dominican priory: north aisle eastern tomb masons' marks locations

The third mark is only found once on the western tomb (Figure 5.63 right). It is certainly possible that more marks were originally present but loss of many pieces of tracery prevents this information from coming to light. The mark is lightly inscribed and consists of two sides of a triangle with duplicate lines offset from each other (Figure 5.63 left).

Figure 5.63 Athenry Dominican priory: north aisle western tomb masons' marks; type C (left) and location in niche (right)

A discussion of the possible significance of these marks and how they relate to other architectural historical studies of the period follows in the comparative analysis chapter.

The ground plan of the building revealed little information in relation to proportion and this was partly the result of frequent alterations which seemed to have no regard for any overall geometrical design scheme. The alterations made it impossible to draw any reliable conclusions as regards the preferred metrological systems over time.

A number of different craftsmen seem to have been used over time for decoration of the church and each was given the freedom to utilise geometric design principles as they saw fit, if indeed they were used at all. The tombs in the south wall of the nave are remarkable for the absence of proportional systems or even an awareness of geometrical principles, such as symmetry or simple repeatability. The arcade of the north transept is puzzling but a plausible explanation for what appears to be its forced fit into the transept has been presented. The tombs in the north wall of the north aisle of the nave are particularly intriguing with their internal and external mouldings, as well as the presence of masons' marks. A number of these findings will be considered in more depth in the comparative analysis and masons' chapters.

5.5 Connaught conclusions

Through examination of a significant number of windows in Connaught a metrological pattern has emerged of the frequent use of three units: 0.332m, 0.347m, and 0.357m, and the slightly less frequent use of four other units: 0.236m, 0.257m, 0.278m, and 0.306m. The 0.306m unit probably refers to the legal standard, but the origin of the other units will be discussed in the following.

In relation to proportions, the main preferences were for 1:2, 1:4, 1:3, and 4:5, with the ratios 3:4, 13:23 and 1:1 also prominent. The provenance of each of these ratios will be examined in the following.

Overall, the findings from Connaught demonstrate patterns of repeated use of metrological and geometric systems although not very consistently and, in the following, these will be examined to interrogate their meanings and to make comparisons against other medieval regions.

6 Comparative analysis

Having surveyed the proportions and metrology of tracery in Ormond and Connaught and analysed it in the context of previously identified schools of masons and 'established' chronologies, it now remains to take the results of these empirical investigations and analyse them together and in combination with results for the Desmond region. The aim of this will be to further clarify the issues raised in the previous two chapters in an attempt to answer some of the questions posed at the beginning of the thesis.

6.1 Summary of metrology results

In relation to metrology, the two regions analysed thus far have produced distinctive results regarding the use of particular units. At the outset of this study, when the regions were selected, this result was suspected due to the different cultural conditions in each area during the medieval era. To further inform our understanding of the factors which may have caused this variation, in the following, a third region, medieval Desmond, will also be included in the comparative evaluation. Figure 6.1 compares these findings in a normalised frequency chart for all values between 0.212m and 0.372m.[1]

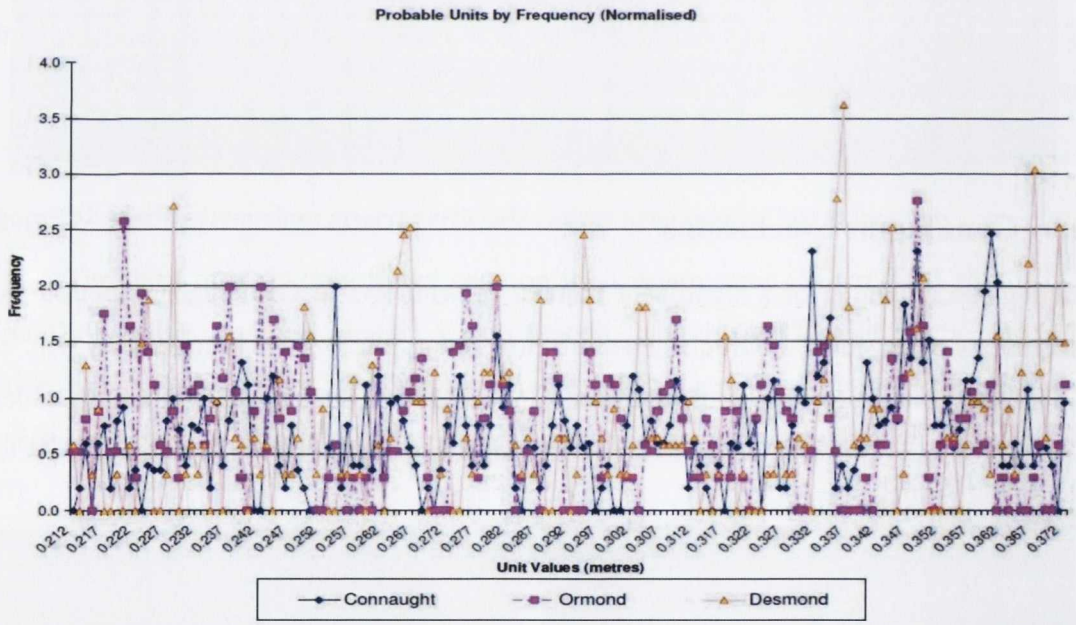

Figure 6.1 Three regions: Frequency of occurrence of all units between 0.212m and 0.372m. Connaught solid blue line; Ormond dashed pink line; Desmond dotted orange line.

[1] Normalisation of the data meant division of the total frequency count in a region by 5 times the number of windows plus 3.5 times the number of lights. 5 measurements were taken from the entire window (overall width, overall height, height to spring, arch width and tracery field height) while 3 measurements were made per light (width, height to arch peak and height to spring) and 1 measurements per mullion (width), where there was 1 mullion per 2 windows; thus 3.5. Since the division process resulted in numbers that were typically well below one these values were made more manageable by multiplying each normalised result by 500. Such data normalisation procedures are commonplace when multiple dataset of different sizes need to be directly compared and are applied in fields as diverse as business, economics and science.

As previously mentioned, the frequency of each individual millimetre unit, while possibly significant, is not as important as analysing the data taking into account medieval tolerances and the limitations of modern surveying methods. To this end, running totals for each adjacent nine millimetres were made, thus identifying the most probable units in each area. This produced the three charts shown in Figure 6.2, Figure 6.3, and Figure 6.4. The lower portion of each bar (in blue where the total count was within 25% of the maximum count for the region and in yellow when within 50%) represents the normalised, grouped frequency of one most probable candidate unit, while the smaller red portion on top of each frequency bar represents a measure of the difference between the probable unit as calculated from the tracery data and the closest known or documented unit as evidenced from the literature.[2]

[2] Since the values that resulted from the difference calculation were very small relative to the frequency counts they were multiplied by 500 in order to make them visible in the graph.

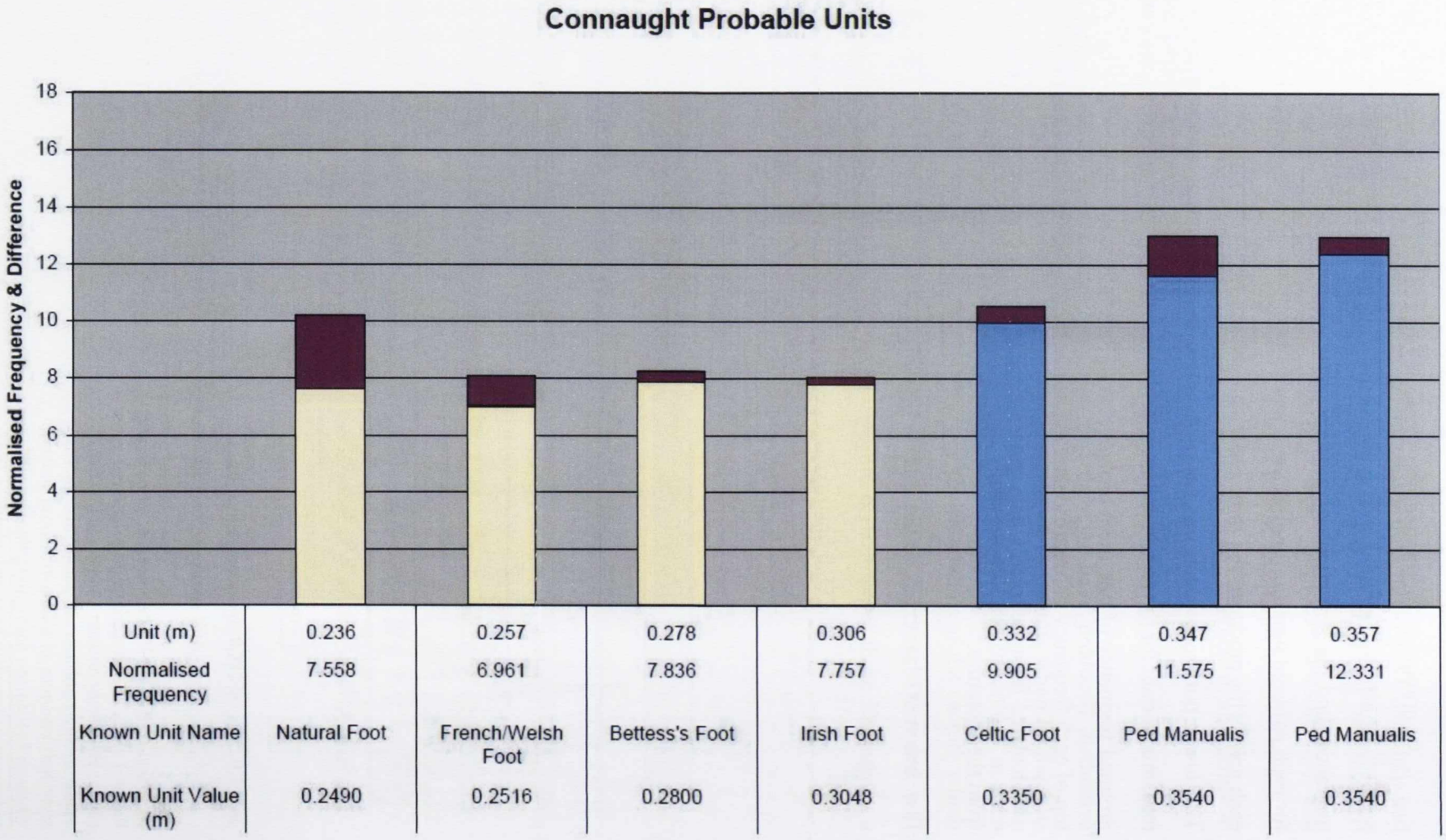

Figure 6.2 Connaught probable units from 9mm running totals

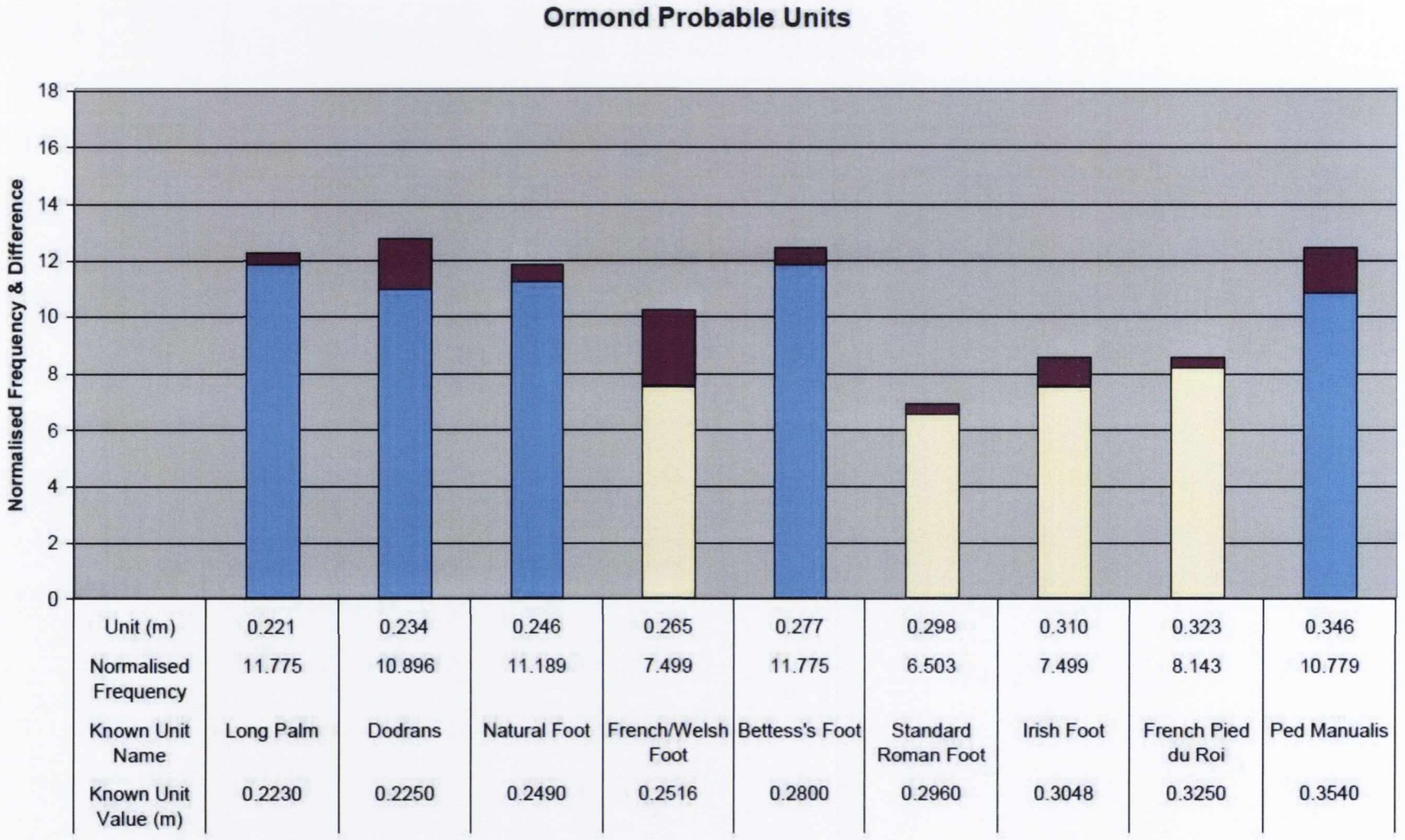

Figure 6.3 Ormond probable units from 9mm running totals

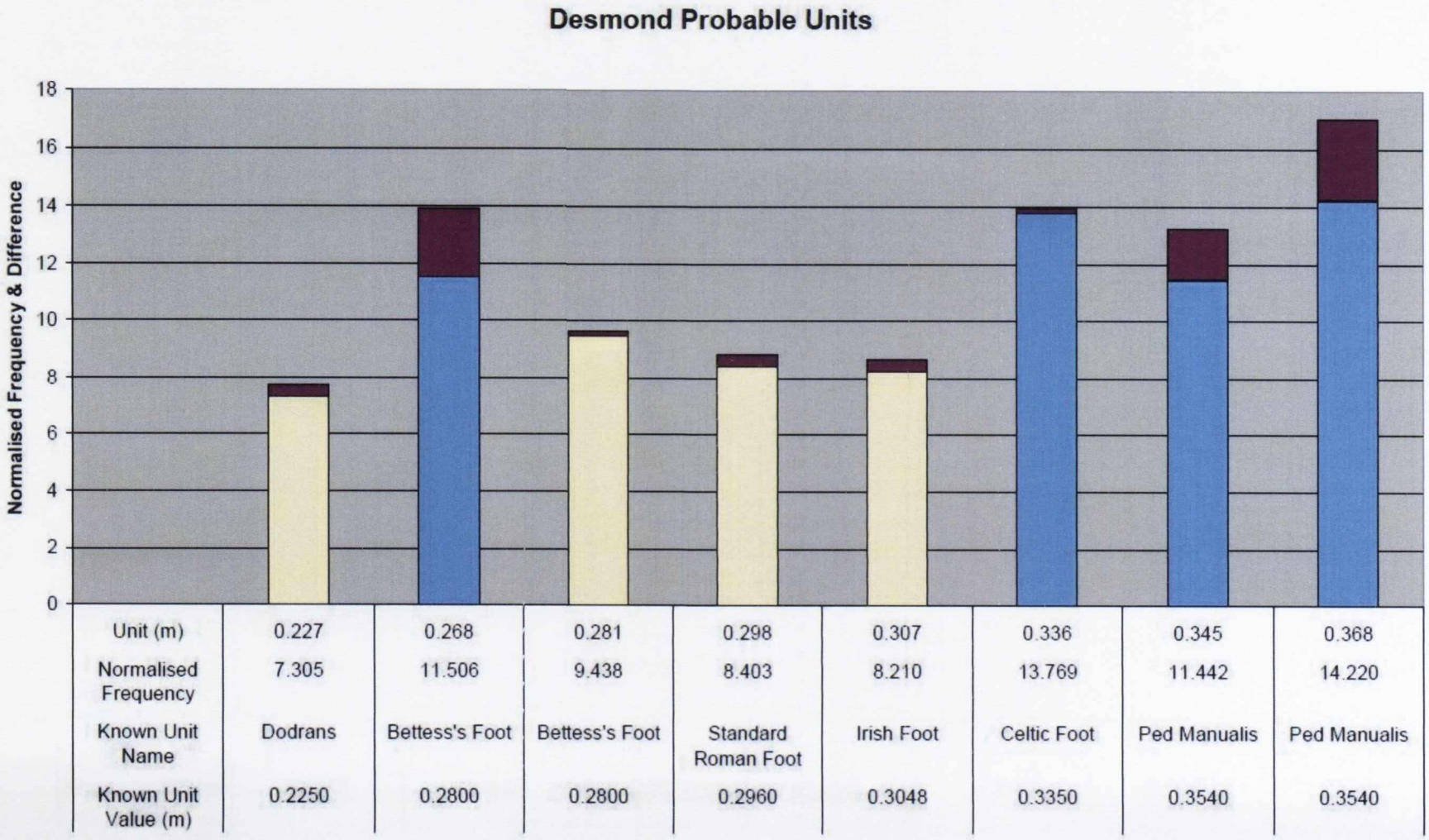

Figure 6.4 Desmond probable units from 9mm running totals

After grouping, three very probable and four relatively probable units emerged for Connaught: 0.332m, 0.347m, and 0.357m, followed by 0.236m, 0.257m, 0.278m, and 0.306m, respectively. For Ormond the very probable units were 0.221m, 0.234m, 0.246m, 0.277m, and 0.346m, while the probable ones were 0.265m, 0.298m, 0.310m and 0.323m. In Desmond the highly probable units were 0.268m, 0.336m, 0.345, and 0.368m with probable units of 0.227m, 0.281m, 0.298m, and 0.307m. Table 6.1 colour-codes the units found in each region allowing comparison, identification of common units, and alignment with known units from the literature.

Table 6.1 Colour-coded comparison of probable units for Connaught, Ormond, and Desmond and alignment with known units

Connaught					Calculated to Known Unit Difference
Unit (m)	Normalised Frequency	Within % of Maximum Count	Known Unit Value (m)	Known Unit Name	
0.236	7.558	50	0.2250	Dodrans	0.011
0.257	6.961	50	0.2516	French/Welsh Foot	0.005
0.278	7.836	50	0.2800	Bettess's Foot	0.002
0.306	7.757	50	0.3048	Irish Foot	0.001
0.332	9.905	75	0.3350	Celtic Foot	0.003
0.347	11.575	75	0.3540	*Ped Manualis*	0.007
0.357	12.331	75	0.3540	*Ped Manualis*	0.003

Ormond					Calculated to Known Unit Difference
Unit (m)	Normalised Frequency	Within % of Maximum Count	Known Unit Value (m)	Known Unit Name	
0.221	11.775	75	0.2230	Long Palm	0.004
0.234	10.896	75	0.2250	Dodrans	0.009
0.246	11.189	75	0.2490	Natural Foot	0.003
0.265	7.499	50	0.2516	French/Welsh Foot	0.013
0.277	11.775	75	0.2800	Bettess's Foot	0.003
0.298	6.503	50	0.2960	Roman Foot	0.002
0.310	7.499	50	0.3048	Irish Foot	0.005
0.323	8.143	50	0.3250	French Pied du Roi	0.002
0.346	10.779	75	0.3540	*Ped Manualis*	0.008

Desmond					Calculated to Known Unit Difference
Unit (m)	Normalised Frequency	Within % of Maximum Count	Known Unit Value (m)	Known Unit Name	
0.227	7.305	50	0.2250	Dodrans	0.002
0.268	11.506	75	0.2800	Bettess's Foot	0.012
0.281	9.438	50	0.2800	Bettess's Foot	0.001
0.298	8.403	50	0.2960	Roman Foot	0.002
0.307	8.210	50	0.3048	Irish Foot	0.002
0.336	13.769	75	0.3350	Celtic Foot	0.001
0.345	11.442	75	0.3540	*Ped Manualis*	0.009
0.368	14.220	75	0.3540	*Ped Manualis*/ Unknown	0.014/ ?

Summarising Table 6.1, there are four occasions where unit values close to known standards appear in all three regions: ~0.225m, ~0.280m, ~0.3048m and ~0.354m. Values near measurements of ~0.335m and ~0.296m appear in both Ormond and Desmond, while between Ormond and Connaught another unit close to 0.2516m was found. In Ormond two unique units of 0.246m and 0.323m were also derived.[3] These units have been aligned sequentially in Table 6.2.[4]

Table 6.2 Numerical sequence of preferred units in Ormond, Connaught and Desmond

Connaught		0.236		0.257		0.278		0.306		0.332	0.347	0.357	
Ormond	0.221	0.234	0.246		0.265	0.277	0.298	0.310	0.323		0.346		
Desmond	0.227				0.268	0.291	0.298	0.307		0.336	0.345		0.368

An explanation will now be given, where possible, of the origin of each of the possible metrological standards beginning with the shortest unit. The sites where these units occurred in Ormond and Connaught were presented in those chapters.

0.221m/0.225m Long Palm / *Dodrans* / *Spithame*

Use of this unit was widespread across all three regions with Ormond demonstrating two types, one centred about 0.221m and another about 0.234m, to which the *Dodrans* of 0.225m was the closest known unit. The term *Dodrans*, in Roman times, was used for both a unit of currency and a unit of measurement. The term refers to three quarters of another measure, in our case, a foot.[5] Using the typical measures available for the Roman foot this gives the *Dodrans* a length of between 0.220m and 0.225m.

Eric Fernie discusses a Roman palm measure, sometimes known as the long palm because there was also evidence for a short palm of 0.075m, of 0.223m.[6] This was calculated as three-quarters of the Roman foot measured by Philander from a porphyry

[3] For legibility the numeric values for the units listed here are those of the closest standard. The actual values are visible in Table 6.1

[4] The relative frequencies can be derived from the previous tables.

[5] "Three quarters of an as, three quarters, alter. of (assumed) *dequadrans*, fr. *de* from + *quadrans* quarter of an as, quarter": Merriam Webster, 'Dodrans.' 2011. Viewed February 2011. <http://www.merriam-webster.com/dictionary/dodrans>.

[6] E. Fernie, 'A Beginner's Guide to the Study of Architectural Proportions and Systems of Length.' *Medieval Architecture & its Intellectual Context: Studies in Honour of Peter Kidson.* Eds. E. Fernie and P. Crossley. London, England: The Hambledon Press, 1990. 229-37, pp. 236-7 (hereafter 'A Beginner's Guide'). Includes reference to L. Paetus, *De Mensuris et Ponderibus Romanis et Graecis*, Venice, 1573, pp. 9-10, 12-13.

column as 974 parts to 1000 parts of the English foot.[7] Thus 0.3048mm * (974/1000) = Roman foot: 0.2979m * ¾ = *Dodrans*: 0.223m. Documentary sources also support the existence of such a measure with Fernie quoting the twelfth-century *Liber Sancti Jacopi* as giving "a man's stature as eight palms", and assuming that average height was between 1.68m and 1.81m, this produces palms of between 0.210m and 0.225m. Furthermore, the long palm was described by Fernie as being in common use in the thirteenth and fourteenth centuries.

A speculative Irish suggestion for the origin of 0.225m is that it could equate to two fists, a standard associated with craftsmen in pre-Norman Ireland for measurements of spears, shields and swords.[8]

0.2516m/0.2490m Welsh/French foot / Natural foot

Both the Connaught and Ormond investigation resulted in units close to the Welsh/French foot of 0.2516m. The Connaught value of 0.257m is 0.005m away from the standard, while the Ormond unit of 0.265m differs by 0.013m. Another similar foot value of 0.249m also occurred in Ormond which matches exactly the reported value of the natural foot. The two Ormond values are distinctive enough, i.e. separated by more than the medieval tolerance established for this study, to be counted as separate results but the closest known standards differ by only 3mm.

The Natural foot, also known as the Phytic foot, was sometimes considered to be the length of the unshod foot, thus introducing local variations.[9] However, it was also defined in documentation, for instance in the *York Memorandum Book* of 26 August 1395, through the relationship of 3 barley corns to the inch, 'and 3 inches make a palm and 3 palms and 3 [barley] corns make a foot'.[10] A version of the same foot was used in Wales where it may have adapted slightly over time resulting in a Welsh standard foot of 0.2516m. The difference between natural and Welsh feet is only 2mm, an acceptable

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[7] M. Raper, 'Enquiry into the Measure of the Roman Foot', *Philosophical Transactions,* 1760, 51 (ii), 774-823, p. 786.

[8] L. Ginnell, *The Brehon Laws, A Legal Handbook*, Ori Publication: The Gresham Press, Unwin Brothers, Chilworth & London. London: T. Fisher Unwin, 1894. A booksulster.com digital reproduction, p. 208-9.

[9] R.D. Connor, *The weights and measures of England*. London: Her Majesty's Stationary Office, 1987, p. 27 (hereafter *Weights and Measures*).

[10] *'et tres polices faciunt palmam; et tres palme et tres grana faciunt pedem'* in M. Sellers, ed. *York Memorandum Book*. Vol. 120, 125, 186. 8 vols. Durham: Surtees Society, 1912, p. 142. The length of the natural foot is also almost exactly half the Sumerian Cubit (0.495m) excavated in Mesopotamia in the 1920s but is also equal to ¾ the Northern foot of 0.332m. The Natural foot was used in North Africa, Asia Minor, Babylon, Egypt (where it was marked on royal cubit rods), Southern France, Greece, Italy, Persia, Sardinia, and Scotland: F.G. Skinner, *Weights and Measures: their Ancient Origins*. OPUB 160.r.1 no.18. London: Her Majesty's Stationery Office 1967, p. 93 (hereafter *Weights and Measures*).

variation for most scholars of metrology. Thus, it is safe to say that the two units were the same.

When Dermot Mac Murrough left Ireland in 1166 to seek support for his claim to the kingship of Leinster, it was to Wales that he went and from there that he recruited mercenaries. In the following years reinforcements of Welsh knights, archers, and foot soldiers arrived under the command of numerous Cambro-Norman lords who then settled in Ireland having been granted lands in the south-east of the country.[11] The requirement to set up defences such as castles and town walls would almost certainly have meant that masons would have travelled in the retinue of the colonising Anglo-Normans, or they would have arrived soon after the invasion. This could explain the route by which the Welsh standard foot of 0.2516m arrived in Ireland and why it was used in the kingdom of Ormond.

However, the unit was also found in Connaught and this could mean that it was transferred there through the Anglo-Normans, or that it developed separately as an "unshod" foot or similar.

0.2800m Bettess's foot: an Anglo-Saxon measure

This unit was used at a wide distribution of sites of all types of religious foundation in all three regions. In England, the evidence for this unit has been reported in relation to a number of Anglo-Saxon sites, explaining the application of the term, Anglo-Saxon foot. However, it must be clearly stated that no scholars have claimed that this was the only Anglo-Saxon foot in use in England; the term is simply a convenient one to use because it gives an indication of the era of significance.

Data in relation to this unit has been presented by Fred Bettess for Jarrow Anglo-Saxon monastery.[12] Parts of this monastery were constructed by non-native craftsmen as recounted by the Vernerable Bede who described the abbey's foundation by Benedict Biscop in 682. During the first phase of building Biscop "brought masons and glaziers from France" in order to follow the pattern of monastery building which he had seen during his European travels.[13] However, this was not the first church on the site at Jarrow

[11] For example, Robert fitz Stephen, Maurice fitz Gerald and Maurice de Prendergast. Fitz Gerald and fitz Stephen were promised the town of Wexford and two adjoining cantreds for their support. For a description of Mac Murrough's dealings with the Cambro-Normans see J. Lydon, *The Lordship of Ireland in the Middle Ages*. Dublin: Four Courts Press, 2003, pp. 30-9 (hereafter *Lordship of Ireland*).

[12] F. Bettess, 'The Anglo-Saxon Foot: A Computerised Assessment', *Medieval Archaeology,* 1991, 35, 44-50.

[13] Bede the Venerable Saint, *Bede's Ecclesiastical history of the English nation*, Trans. J.D. Stevens. London: Dent, 1965.

as archaeological excavations have shown evidence of the "building of a series of small churches in line", a style which was very much a feature of Middle-Saxon monasteries without any precedent on the continent.[14] With continental European influence from some of the craftsmen on site it is certainly possible that a new unit was imported at this time; however, a Germanic connection cannot be firmly established.

Brian Hope-Taylor's excavations at Yeavering, Northumbria found contemporary evidence for the same unit of 0.280m, as did P.J. Huggins from his excavations at Anglo-Saxon sites distributed throughout south-east England. In an attempt to validate his finding and based on an assumption/precedent that Anglo-Saxon buildings were laid out according to the medieval rod of sixteen and a half feet, Huggins searched in Germany, the origin of the Anglo-Saxon people, for enduring evidence of the same unit. He found ten examples of medieval rods of a mean length of 4.63m, very close to 16 and a half times 0.280m, in the Elbe-Weser region of Germany (Figure 6.5), the homeland of the Saxons.[15]

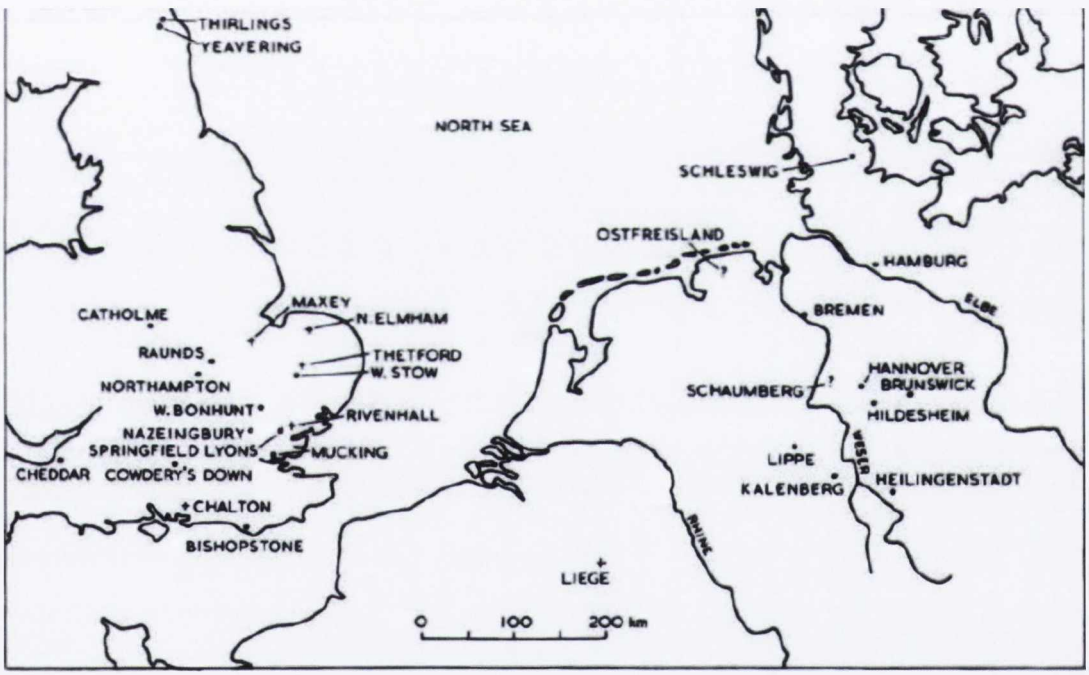

Figure 6.5 After Huggins - Black dots in Germany represent locations where 19th-century rods averaging 4.63m in length have been found; black dots and crosses in England refer to tested Anglo-Saxon sites [16]

Yet more evidence for the existence of such a unit was found by Harry Sunley when searching for a standard Norman measure in England. His study of parish churches,

[14] G. Coppack, *Abbeys & Priories*. Stroud: Tempus, 2006, p. 38.
[15] P.J. Huggins, 'Anglo-Saxon Timber Building Measurements: Recent Results', *Medieval Archaeology*, 1991, 35, 6-28 (hereafter 'Anglo-Saxon Timber Building').
[16] P.J. Huggins, 'Anglo-Saxon Timber Building', p. 23.

abbeys, and cathedrals resulted in 2000 measurements and, using frequency analysis, Sunley provided evidence that a foot unit of *c.*0.280m was the predominant measure of the time.[17] In an effort to consolidate his findings Sunley also measured some post-Romanesque churches, at Mollington, Oxon and Ilmington, Warwickshire and found unit values of 0.282m and 0.280m, respectively. Sunley's conclusion was that prior to the introduction of the modern foot value of 0.3048m, "nominally in 1305", that perhaps 0.280m was the standard.[18] Having extended his investigations to a significantly larger number of sites Harry Sunley has confirmed the widespread usage of a shorter foot of 279.4mm. He suggested that the origin of this foot "may well be Roman" but that has yet to be confirmed.[19] Sunley's results confirm the adoption of the 0.280m unit by Norman settlers.

Therefore, this unit could have arrived in Ireland as a result of Anglo-Norman settlement in Ireland; a possibility supported by evidence from St. Mary's collegiate church in Gowran, one of the earliest Anglo-Norman works in this study, where 0.280m was used in window tracery and for the ground plan of the building.

0.2963m Standard Roman foot

Evidence for use of this unit was collected at a range of Ormond and Desmond sites. The only similar measures in Connaught were probably shortened versions of the Irish foot of 0.3048m, as discussed in the Athenry Dominican priory case study.

Although Ireland is generally thought to have been little affected by the Roman empire there is evidence of the trade of items such as wolfhounds, hides and cattle, which were exported from Ireland in return for the importation of Roman pottery and metalwork, examples of which have been found at two sites in Meath, Lagore Crannóg and the Rath of the Synods, Tara.[20] This trade could, potentially, have brought Irish merchants and craftsmen into contact with the Roman system of weights and Irish law indicates that two terms for early Irish currency – *screpul* (from Latin *scripulus* 'scruple') and *ungae* (from Latin *uncial* 'ounce') – derived their origin from the Romans.[21] If some Roman weights

[17] Unfortunately, no list was given of the buildings included within the study.
[18] H. Sunley, 'The Quest for the Linear Measure Used in Norman England', *Corpus of Romanesque Sculpture in Britain and Ireland,* 2004, Spring 2004, 3-5.
[19] H. Sunley, 'A Linear Measure Used in England and on the Continent in Romanesque Times', *Journal of the British Archaeological Association,* 2010, 163, 152-3; and H. Sunley, 'Romanesque Linear Measures of England and Continental Europe.' The British Archaeological Association Online Publications, 2010.
[20] L. Laing, *The Archaeology of Late Celtic Britain & Ireland c.400-1200AD.* London, England: Methuen & Co. Ltd., 1975, p. 9.
[21] F. Kelly, *A Guide to Early Irish Law. Early Irish Law Series 3.* Dublin, Ireland: Dublin Institute of Advanced Studies, 1995, p. 114 (hereafter *Early Irish Law*).

transferred to Ireland could linear measurement standards also have found their way into the Irish system?

The most likely link is through the word *fertach* (or *pertach* as used in some texts) which bears some resemblance to the Latin *pertica*.[22] Eoin MacNeill suggested a provenance by which the Roman *pertica* unit could have arrived in Ireland. Start with the later definition of land measurement from the Irish law tracts which states that 12 *fertaig*, each of 12 feet, made up a *forrach* giving it a length of 144 feet. This is quite similar in length to 150 feet, which is the lateral measurement of the rectangular strip of land, which is twice as long as it is broad, used in the Celtic tradition in Ireland and in Gaul. The short side of this land area was called *airchenn* in Ireland and the Gaulish equivalent was *arepennis*, which equated to 12 *perticae*.[23] Collumella, the Roman writer from AD 4 - *c*.AD 70, equates one *arepennis* to the Roman *semijugerum* of 150 feet. Therefore, at some point, the Irish *arepennis* of 144 ft and the *semijugerum* of 150 ft were made to conform to each other, thus producing a link between Irish and Roman linear measurement systems.[24] Although there is some degree of conjecture in this link, precedence in England and continental Europe has shown that similar adjustments have been made in order to make inequitable systems fit with each other.

It is also possible, and perhaps more likely, that the Roman foot arrived in Ireland by a more indirect route, through England. One, or possibly both, of these options provides a plausible explanation for the provenance of the Roman foot of 0.2963m in Ireland. The regional use of the units probably relates to the limited contact that would have occurred between Ireland and the Roman or English administration, a contact which did not extend to the more remote parts of Connaught.

0.3048m Irish or English foot or the foot of St. Paul's

Use was widespread throughout the regions and the unit appeared in all types of ecclesiastical buildings. As a foot measure it became the English and Irish standard when legitimised in 1305 by Edward I's *Statutum de Admensuratione Terre*.[25]

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[22] F. Kelly, *Early Irish Law*, p. 99.
[23] A.T. Holder, *Alt-Celtischer Sprachschatz*. Leipzig, 1911.
[24] E. MacNeill, 'Ancient Irish law: the law of status or franchise', *Proceedings of the Royal Irish Academy: Section C*, 1923, 36, 265-316, p. 287.
[25] Discussions in chapter 2 demonstrated that adoption did not happen easily throughout the realm and that this 'standard' did not enjoy wholesale adoption for another three to four hundred years. C. Given-Wilson, P. Brand, A. Curry, R.E. Horrox, G. Martin, W.M. Ormond and J.R.S. Philips, eds. *The Parliament Rolls of Medieval England*. Scholarly Digital Editions / The National Archives / The History of Parliament Trust / Boydell and Brewer, nd.

However, its origins are almost certainly significantly earlier than the fourteenth century since it was first documented, as Algar's foot, in Ralph of Diceto's survey of the London lands owned by St. Paul's cathedral in 1181-3.[26] In fact, Eric Fernie proposed that this foot could have originated earlier than the twelfth century and could actually have been contemporary with the Roman foot of 0.296m, an inference made from the golden section relationship between the 10 foot Roman Perch of 2.96m and the 6 foot English fathom. If Fernie is right, this would make the British foot a much older unit than was previously thought, a suggestion supported by evidence from Durham cathedral.[27] In his investigation into the work of the first Durham master, started in 1093, Jean Bony may have found evidence for the use of the foot of 0.3048m in the setting out of piers.[28] Thus an eleventh-century origin is certainly plausible for this unit.

Signs of use of the 0.3048m foot in Ireland could indicate its arrival as early as the tenth century, but certainly not later than the twelfth. Roger Stalley provided evidence from a range of round tower measurements to suggest that 0.3048m was the metrological standard preferred by Irish tower builders. He based his conclusions on the significant number of occurrences of heights of 100 ft and ratios between height and circumference of 1:2.[29] Following the arrival of the Bernardine plan for the layout of monastic buildings, also in the twelfth century, the 0.3048m measure became more prominent in Ireland. Roger Stalley noted that "several Irish cloisters approximate to a hundred English feet".[30] Certainly the latter example suggests that use of this unit may become more widespread in Ireland with the arrival of new methods of stone construction. Although documentary

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[26] As became regular practice in later periods, the foot of St. Paul's was 'sculptured' into the base of one of the cathedral's columns making it easy to make exact copies and, therefore, transfer the unit. M. Gibbs, *Early charters of the Cathedral Church of St. Paul, London*. Camden third series. Vol. 58. London: Offices of the Royal Historical Society, 1939, No. 252, p. 198 and No. 177, pp. 136-7 quoting BM, Harl. MS. 6956, f. 166. See also P. Grierson, *English Linear Measures: an essay in origins*. The Stenton Lectures. Reading, Berkshire, RG6 2AA: The Publications Officer, Department of History, University of Reading, 1972, p. 18 (hereafter *English Linear Measures*).

[27] E. Fernie, 'Anglo-Saxon Lengths and the Evidence of the Building', *Medieval Archaeology,* 1991, 35, 1-5.

[28] J. Bony, 'The Stonework Planning of the First Durham Master.' *Medieval Architecture & its Intellectual Context: Studies in Honour of Peter Kidson.* Eds. E. Fernie and P. Crossley. London, England: The Hambledon Press, 1990. 19-34, pp. 31-2.

[29] R. Stalley, 'Sex, Symbol, and Myth: Some Observations on Irish Round Towers.' *From Ireland coming: Irish art from the early Christian to the late Gothic period and its European context.* Ed. C. Hourihane. Vol. 4. *Index of Christian art occasional papers*. Princeton: Princeton University Press, 2001, pp. 27-47 and pp. 38-39 (hereafter 'Irish Round Towers').

[30] In his work on Muckross Franciscan friary Stalley suggests that the intended width of the cloister was 50ft but admits that it is only possible to achieve this if an external wall is included, and even then only on one side. Whether this lack of regularity shows that the 50ft dimension was not actually intended or that the builders were incapable of executing the monks' requirements may never be solved. R. Stalley, 'Gaelic Friars & Gothic Design.' *Medieval Architecture & its Intellectual Context: Studies in Honour of Peter Kidson.* Eds. E. Fernie and P. Crossley. London, England: The Hambledon Press, 1990. 191-202 and R. Stalley, *The Cistercian Monasteries of Ireland*. London & New Haven: Yale University Press, 1987, p. 71 (hereafter *Cistercian Monasteries*).

evidence for the arrival of English masons in Ireland is not available until the thirteenth century it is almost certain that foreign-trained masons were required by the Cistercians and other monastic communities since local masons were unlikely to have been trained in the relevant architectural requirements.[31] However, even earlier buildings such as Cormac's chapel in Cashel *c.*1130 and St Flannan's oratory, Killaloe *c.*1100 are also considered to have been the work of English masons based on stylistic assessment.[32] Therefore, it is entirely appropriate that the 0.3048m unit should appear throughout the results of this study.

0.325m French *Pied du Roi*

Found only in the Ormond data there is no obvious connection between the five windows where the unit was probably used either related to location, type of religious establishment or patronage. This unit was a French standard, translating as the King's foot, that was used contemporaneously with the Roman foot of 0.297m and a range of other regional units.[33] It could have arrived in Ireland with a French, or French-trained, mason but then we should expect to see some difference in the style of this window relative to many others and this is not the case.

0.3350m Celtic / Northern / Carolingian / North German / Drusian foot

Also sometimes known as *Ped Manualis* or *Pes Manualis*

Another unit which occurs in Connaught and Desmond, but not Ormond, measures 0.335m. As with most of the other units, the use of this measure can be traced across the entire range of the two kingdoms and its use was not restricted to any particular type of ecclesiastical building.

This unit has also been found throughout northern Europe, the former Carolingian empire, and its origins can be traced to at least a few years before the birth of Christ when it was recorded by the Roman general Nero Claudius Drusus as 'two digits longer than the

[31] See the literature review section on the movement of masons.

[32] R. Stalley, 'Three Irish Buildings with West Country Origins.' *Medieval Art & Architecture at Wells and Glastonbury.* Eds. N. Coldstream and P. Draper: British Archaeological Association Conference Transactions, 1981. 62-80. For Killaloe see R. Gem, *Studies in English pre-Romanesque and Romanesque architecture*. London: Pindar Press, 2001.

[33] For examples of use of the *pied du roi* in conjunction with other units see, for example: J. James, 'Medieval geometry: the Western Rose of Chartres Cathedral', *Architectural Association Quarterly AAQ,* 1973, 5 (2), 4-10 and J. Addiss, 'Measure & Proportion in Romanesque Architecture.' *Ad Quadratum: the Practical Application of Geometry in Medieval Architecture.* Ed. N.Y. Wu. Aldershot, England: Ashgate Publishing Ltd., 2002. 57-82.

Roman foot', which is (0.296m*16)/18 equating to 0.333m.[34] This standard transferred into Britain either after the Norman conquest of 1066, or after the withdrawal of the Romans in the early fifth century AD.[35] As a foot unit it is too long to actually relate to most human feet and this is because it actually represents a foot as measured by hand, hence the use of terms such as *ped manualis* or *ad manus*, although these have also been applied to even longer measures. While it is possible that the original purpose of the unit may have been to facilitate the alignment of systems of measurement based on hands with those derived from feet, it is more likely that it simply developed as a convenient way of measuring objects that could be handled. In this respect, R.D. Connor's explanation of the way in which the unit was probably used is worth quoting in full:

> "If a stick or rod is grasped by two hands with the thumbs extended and touching, a *pes manualis* is the distance between the extremities of the hands, and the stick can be measured by moving hand over hand along its length".[36]

Most importantly in the current context is that this unit, and its subdivisions into two *shaftements* or four *palms* of 3.3 inches, was ideally suited for application to building purposes. The extent of its adoption was such that Flinders Petrie's work on metrology in the late 1800's led him to conclude that this foot was the most common unit used in English medieval building works.[37] Therefore, the only surprising element about this unit's appearance in medieval Irish works is its apparent absence from buildings in Ormond but, as this study suggested many other units may have been in use instead.

In relation to the arrival of the unit in Ireland two possibilities exist: first, that some Norman masons brought it instead of the Welsh or Natural foot previously described or, second, that this unit developed independently in Ireland, through the logic of its application to measurement of objects that could be handled.

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[34] F.G. Skinner, *Weights and Measures*, pp. 179-87 and P. Grierson, *English Linear Measures*, p. 35.
[35] For the Norman date see: R.E. Zupko, 'English Weights and Measures: The Historical Evolution from Roman to Metric Standards', *The Role of Measurement Standards in Human Civilization*, Budapest, Hungary, 27-30 April 1976, pp. 10-1. For the Saxon date see: R.P. Duncan-Jones, 'Length-Units in Roman Town Planning: The Pes Monetalis and the Pes Drusianus', *Britannia,* 1980, 11, 127-33.
[36] R.D. Connor, *Weights and Measures*, p. 29.
[37] F.G. Skinner, *Weights and Measures*, p. 91 and W.M.F. Petrie, *Inductive metrology: or, the recovery of ancient measures from the monuments*: H. Saunder, 1877.

0.346m or longer ***Ped Manualis*** **– 0.354m**

These units were found in all three regions. Evidence in the literature for European units with values close to 0.345/6/7m, 0.357m or 0.368m was scant.[38] A single author, John James, gave the length of the *ped manualis* as 6/5's of the Roman foot of 0.296m, producing a 'foot by hand' of 0.355m.[39] James' evidence was based on measurements taken of the rose window at Chartres cathedral, where this unit was used in combination with the Roman foot of 0.296m. This foot value cannot, however, be considered as a valid standard because it was based on evidence from a single feature in a single building, exactly the sort of methodology strongly warned against by Eric Fernie and others.[40] In Ronald Zupko's table of European standard measures "from 1800 to the adoption of the metric system in each country" includes long feet from Genoa (manual) 0.34m, Venice 0.35m, and Ancona 0.39m.[41] I do not suggest that these particular units were related to any of the groups in this category, partly because there is no obvious Italian connection and partly because it is not possible to trace whether these units were also in use in the Middle Ages. However, if longer feet existed elsewhere in Europe then there is no reason why they might not have been real standards in Ireland, despite the absence of supporting documentation.

The origin of the measures used in Ireland could, therefore, be entirely native. Typically feet were subdivided into 12 or 16 parts which, in the case of this unit, would result in 'inch' values of 0.029m and 0.0219m, respectively.[42] The latter value is 0.0035m shorter than the modern inch which, in metric, measures 0.0254m. If we suppose that the origin of an inch was three round, dry barleycorns, as specified between 1272 and 1303 in the bill known as the Composition of Yards and Perches (*Compositio ulnarum et perticarum*) then it is possible that Irish barleycorns were "shrivelled and small" when compared to Welsh and English grain, as bemoaned by Gerald of Wales, resulting in a

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[38] Mark Wilson Jones has identified an Ionian or Samarian foot of 0.348m in ancient Greece but it would be nonsense to try to connect this with medieval Ireland. M. Wilson Jones, 'Doric Measure and Architectural Design 1: The Evidence of the Relief from Salamis', *American Journal of Archaeology,* 2000, 104 (1), 73-93, p. 75.

[39] J. James, 'Medieval geometry: the Western Rose of Chartres Cathedral', *Architectural Association Quarterly AAQ,* 1973, 5 (2), 4-10, p. 8.

[40] E. Fernie, 'Introduction.' *Ad Quadratum: the Practical Application of Geometry in Medieval Architecture.* Ed. N.Y. Wu. Aldershot, England: Ashgate Publishing Ltd., 2002. 1-9.

[41] R.E. Zupko, *British weights & measures: a history from antiquity to the seventeenth century.* Madison: University of Wisconsin Press, 1977, p. 173 and p. 169 (hereafter *British weights & measures*): Zupko listed all values "rounded off to two decimal places". Bibliography pp. 194-233: unfortunately, no specific references were given for any of these units and Zupko's Bibliography stretched to 39 pages including very many difficult to obtain documents. Given that the origin of all of these units was in Italy this line of enquiry was not pursued.

[42] Feet with 16 parts were typical when units were partitioned using a dividers, a tool which would typically have been in the possession of a mason. 12 parts were more typical when thumbs were being fitted to feet.

shorter inch.[43] However, the *Composito* continues to specify that there should be 12 inches in the foot rather than 16. This origin is therefore unlikely but merited consideration.

The second possible origin for this unit, and one that I think more likely, is that, rather than being the product of inches of a specific size, this foot was actually created as the subdivision of a larger unit. As with the Roman system of land measurement where the *pertica* varied in length from place to place, from 10ft to 12, 15 or 17ft, according to the quality of the land that was being measured, early Irish land measurement was made in *cumals*.[44] These units were dimensioned based on production value of land rather than on its area. According to the text *Fodla Tire* (properly *Di Thir Chumaile* IV 278 z), "the purchase value of a *cumal* of the best arable land 24 milch-cows, of medium arable land 20 milch-cows, of inferior arable land 18 milch-cows. Of grazing land, the purchase value, according to quality, is given at twelve or eight dry cows".[45] The value of a *cumal* represented an area measuring 6 *forrachs* by 12 *forrachs*, where a *forrach* was composed of 12 *fertachs* each of 12 feet.[46] If the *cumal* was the starting measure then the *forrach*, the *fertach*, and thus, the foot would all vary in length depending on the quality of land being measured. Although this is an early agricultural unit such measures are known to have transferred into usage in construction, as with the English rod, particularly because the feudal system often required farm labourers to also work on building projects for a fixed number of days per year. Furthermore, units are known to have endured through centuries unless some outside imperative forced them to change, thus making the time lapse insignificant.[47] Therefore, a long foot, or many long feet, measuring more than 0.345m, with its origins in agricultural measurement, could have been used for building in Ireland despite its absence from surviving documentation.

One other point worth nothing in relation to the longest preferred unit found by the study, 0.368m, is that, although no documented unit aligns with it, ¾ of this value equals 0.276m, Bettess's Anglo-Saxon foot. This may be co-incidence but, if true, it would add further weight to the evidence for a concerted campaign of use of this measure.

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[43] R.E. Zupko, *British weights & measures*, p. 21 and Giraldus Cambrensis, *The history and topography of Ireland*, Trans. J.J. O'Meara. Revised ed. Harmondsworth: Penguin, 1982, p. 34

[44] P. Kidson, 'A Metrological Investigation', *Journal of the Warburg & Courtauld Institutes,* 1990, 53, 71-97, p. 75.

[45] The *Fodla Tire* is properly known as *Di Thir Chumaile* IV 278 z: E. MacNeill, 'Ancient Irish law: the law of status or franchise', *Proceedings of the Royal Irish Academy: Section C,* 1923, 36, 265-316, p. 287.

[46] Fergus Kelly draws attention to the degree of conjecture associated with the link between *fertachs* and *cumals* since the two definitions of forrach are derived from texts of different dates and require the combination of two systems producing a result which may not be fully reliable. F. Kelly, *Early Irish Law*, p. 99.

[47] F.G. Skinner, *Weights and Measures* and R.E. Zupko, *British Weights & Measures.*

Metrology summary conclusions

This summary has shown that the origins of most of the units found in this study could be defined through comparison with archaeological or documentary evidence. Some units were not traceable but suggestions have been made as to their derivations. Quite why so many units were used in medieval Ireland, and even within specific region, is the remaining question and an attempt will be made in the following to provide answers.

6.2 Summary of proportion results

In the case of the proportional analysis of window tracery, unlike for metrological investigation, no precedent existed for how such a study should be carried out. This also meant that no directly analogous results were available from Irish or, indeed, from international window tracery studies and, therefore, no references were available for comparison. However, as previously reviewed, the use of geometry and proportion in a medieval architectural context has been investigated in relation to building details such as piers, elevations, and, in particular, ground plans, and such investigations were used to try to explain the patterns found in this Irish data.

The most closely analogous work by Vivian Paul on the blind tracery of Narbonne cathedral specifically addressed the sectional design, i.e. the moulding profiles, of the mullions of blind tracery on the walls of the lower portions of the building.[48] Since the actual tracery was never completed it was not possible to make measurements of the elevations of the tracery, as was done in this study. Therefore, Paul focussed on the mullions and concluded that the masons used a geometric schema based on subdivision of a rectangle into halves or thirds to produce the plan of the shaft and plinth of the mullion, respectively. The starting point for the design was the use of a rectangular stone block of a fixed size, as defined arithmetically, which was subdivided in three along one axis and four on the other, thus producing details in the ratio 3:4.[49] Paul also mentioned that she found frequent use of the $1:\sqrt{3}$ proportion in the "bases of the clerestory mouldings, in the diameters of shaft sequences and, possibly, in the design of the window tracery of the clerestory windows" (Figure 6.6). As well as not being certain that this ratio was actually

[48] V. Paul, 'Geometry Studies: The Blind Tracery in the Western Chapels of Narbonne Cathedral.' *Ad Quadratum: the Practical Application of Geometry in Medieval Architecture.* Ed. N.Y. Wu. Aldershot, England: Ashgate Publishing Ltd., 2002. 205-16 (hereafter 'Geometry Studies'). This work was introduced in chapter 1 but more detail is provided here because of the relevance to this study.

[49] The arithmetic definition probably used some fixed unit of measurement, and the axes were the length and breath of the stone block.

used in the window tracery, Paul gave no description of how it might have been employed; for instance, was it present in the relationship between the window width and height, or between the dimensions of lights and the overall window. Despite the absence of some details, this study provides some useful information in the context of general proportion assessments. Firstly, more than one proportion could be used within a building, even one such as Narbonne where a deliberate effort seems to have been made to ensure "visual consistency". To explain this characteristic Paul suggested that masons may have been given more 'license' when designing minor details such as bases and plinths.[50] Secondly, ratios which were not typical of the majority of medieval architectural works were sometimes used, such as $1:\sqrt{3}$, while rejecting the more prevalent ratios such the golden section and $1:\sqrt{2}$. The use of $1:\sqrt{3}$ in this investigation is discussed in the following.

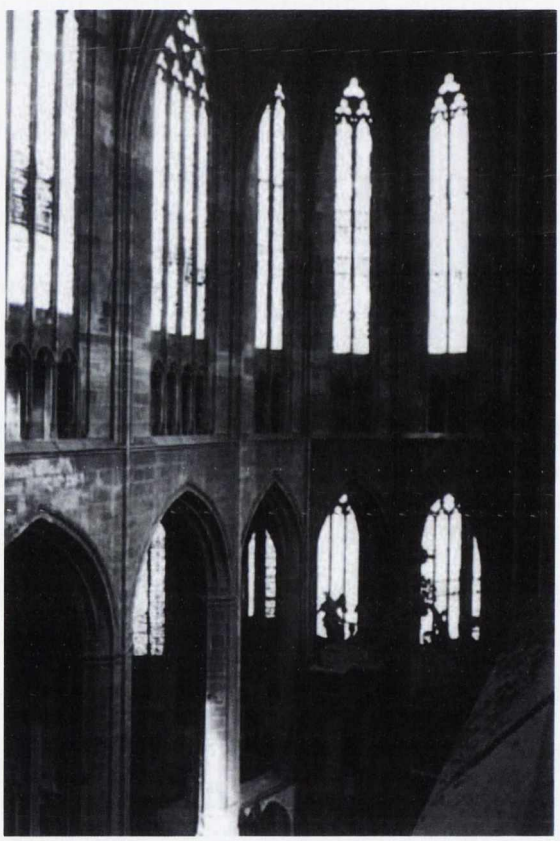

Figure 6.6 Narbonne cathedral clerestory windows (photo credit Vivian Paul) [51]

Turning to the patterns emerging from this research, the level at which a ratio might be considered significant for a given region was set as values in the top 75% and top

[50] V. Paul, 'Geometry Studies', p. 205 and p. 213.
[51] V. Paul, 'The Projecting Triforium at Narbonne Cathedral: Meaning, Structure, or Form?' *Gesta,* 1991, 30 (1), 27-40.

50% relative to the maximum value. All results are included in the Site Catalogue while the regional summary is presented in Table 6.3.

In all three regions the ratios 1:2 and 1:3 were significant. In a significant number of cases these ratios were used to relate a variety of height or width elements of the window or light to heights of different parts of the lights, tracery field, or the overall window. The popularity of 1:2 in the window tracery is important when considered in relation to overall building design. The case studies of Athenry Dominican priory and Gowran collegiate church demonstrated that the masons designing the original portions of the building used the 1:2 ratio in ground plans, as well as in window tracery. At Gowran, the west windows of the north and south aisles of the nave show evidence of the use of ratios 1:2, 1:3, 1:4, and 4:5 with a suggestion of the golden ratio, while measurements from the ground plan indicate that the nave was designed to incorporate 1/4s and 3/4s of the length of the nave. Furthermore, an examination of the profile of the piers of the north nave arcade showed that 3:4, 1:2, and the golden ratio were used. The church at Gowran was subjected to specific examination because its original thirteenth-century fabric had been little altered during the later middle ages. The results from Gowran, combined with the rest of the window tracery studies, suggest two findings. Firstly, that multiple ratios were probably used in combination for both ground plans and architectural detailing, including the design of window tracery, during the thirteenth century. Secondly, it appears that this early work used simple geometry such as the double square, 1:3 and 1:4. However, the broader applicability of these theories throughout Ormond and beyond is unknown and can only be verified by further research on ground plans and architectural details in other early ecclesiastical buildings.

The case study from Connaught, at Athenry Dominican priory, also demonstrated that the original thirteenth-century layout for the ground plan of the church chancel produced a ratio of approximately 1:2 between its width and its length.[52] However, the ground plan measurements also suggest that the later alterations to the layout of the church, which were probably made in the 1320s and included the addition of a north transept and a north aisle of the nave, did not adhere to any particular geometric design. This is limited evidence in favour of the presence of more geometrically-aware masons at the time when the building was first erected. However, this could also show that the first phase of building was unencumbered by any restrictions to the layout of the ground plan whereas later additions were constrained by existing buildings. Eric Fernie's work on Durham cathedral is a useful example of the 'singular vision' which can be achieved by a

[52] Original in this context means before the addition of the chancel extension in the early fourteenth century.

master mason, in this case almost universal application of the 1:√2 proportion, when starting work on a virgin site.[53]

Also popular in Connaught and Desmond, and just below the threshold chosen for significance in Ormond, was 1:4 which frequently occurred because the width of the mullion was a quarter the width of the light as at Athenry collegiate church 2-light, switchline nave south (2 windows); Ballindoon 4-light switchline chancel east; Burrishoole 3-light switchline south transept south; Claregalway 5-light switchline chancel east; Loughrea 3-light switchline south transept south; Moyne 4-light switchline chancel east, 2-light switchline south extension south, and 4-light south transept south; Murrisk 5-light switchline chancel east; Rosserk 4-light flowing chancel east and 2-light switchline nave west; and Ross Errilly 3-light switchline south transept chapel east. With the exception of Rosserk's chancel east, all of these windows share a simple switchline design, although some lights are round headed and some pointed, and the site list covers almost the full range of ecclesiastical buildings. In the chancel east window at Portumna the ratio 1:4 was used between the width of the lights and their height (at arch peak).

The 1:1 proportion was also evident at a significant number of sites in all three areas. While some of the occurrences related to measurements of window width versus arch span, many more related to tracery field height to light height or overall window width to tracery field height or to light height. Used at 16 of 28 sites in Connaught, at 10 of the 18 Ormond sites, and at 10 of the 15 sites in Desmond this proportion would have been easy to execute and would have required little geometrical knowledge.

4:5 was important in Connaught having been found at 16 of the 28 sites, encompassing all of the major types of ecclesiastical building. Although, slightly less important in Ormond it was also found there and in Desmond at 8 and 7 sites, respectively. In the case of Ormond and Desmond, both 4:5 and 5:6 occurred frequently. Given their close numerical proximity, 4:5 (0.800) and 5:6 (0.833), there is the possibility that small measurement errors, both at the time of construction and during this study, could have impacted on the ability to distinguish between them, with the implication that 4:5, or 5:6, might have been even more popular than the results show; perhaps even being the most popular proportion. An analysis of the buildings where the 4:5 ratio was present suggests that it was employed in window tracery throughout the regions from early windows through to the latest pre-Dissolution foundation at Creevelea Franciscan friary.

In Connaught, unique among the regions, the 3:4 ratio occurred only slightly less frequently than 4:5. There is again the possibility that this could not be clearly

[53] E. Fernie, *An architectural history of Norwich Cathedral*. Oxford, England: Clarendon Press, 1993.

distinguished from 4:5 but the numeric values are more distinctive than in the Ormond/Desmond 4:5/5:6 case.

In relation to distinctions between the regions, as briefly mentioned previously, in Connaught the ratio 13:23 occurred only a little less frequently than 4:5 and 3:4 without being anyway significant in Ormond or Desmond. In Ormond no unique proportion seems to have been used but 5:6 is much more popular here than it was in the other regions; however, this may relate to its numerical proximity to 4:5.

Notable in Desmond was use of $1:\sqrt{2}$ and $1:\sqrt{3}$, and to a much lesser extent 2:3. With the popularity of 1:3 we might reasonably have expected 2:3 to be more prominent but its use was relatively limited.[54] The $1:\sqrt{3}$ proportion was significant in Vivian Paul's Narbonne window study but the ratio was not often used in the window tracery examined in this study. In Connaught it usually occurred in windows that also displayed the 13:23 ratio, with which the 2% band partially overlaps, and, because this is more typical of the region, it is more likely.[55] Only one window in Ormond used the ratio more than once, the south western window of the nave of St. Mary's collegiate church in Callan. Two uses of $1:\sqrt{3}$ relate to the overall window width to light height (at arch peak) measure but 2:3 was also found for the ratio from overall window width to light height but at springing point. The exact intention of the mason may never be known. The other occasion, tracery field height to light height (at springing point), may have been intended but it seems more likely that it simply occurred as a byproduct of other measurements/ratios. In Desmond there are a number of suggestions for use of $1:\sqrt{3}$ at Adare Augustinian friary and, given that some work at Adare was believed to have been carried out by an English mason, it is possible that something different would be found here.[56] The analysis also found use of $1:\sqrt{3}$ at Askeaton Franciscan friary between overall window width to light height (at arch peak) for the three south nave windows. However, the ratios to springing point are the more likely ratios of 4:5 or 5:6.

As with the metrological investigation, there appears to be no difference between the design methods used in small parish churches, great cathedrals, or the churches of any of the monastic orders, which is to be expected.

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[54] 8 sites in Desmond, 11 in Ormond, 11 in Connaught.

[55] On a number of occasions 1:root 3 was found for a measurement "to springing point" when another, more typical, ratio was found for the "at arch peak" measurement, or *vice versa*.

[56] D. O'Donovan, 'Building the Butler Lordship 1405–c. 1552', Ph.D. Trinity College, Dublin, 2007, pp. 210-3 (hereafter 'Building Butler').

Table 6.3 Proportional investigation results: Ratios from normalised data ranked by occurrence

Connaught						Ormond						Desmond					
lights	windows					lights	windows					lights	windows				
242	82					161	58					151	49				
Ratio		Numeric	All	1%	2%	Ratio		Numeric	All	1%	2%	Ratio		Numeric	All	1%	2%
1	:2	0.500	8.6	4.6	4.0	1	:2	0.500	10.4	6.6	3.9	1	:4	0.250	6.9	3.4	3.5
1	:4	0.250	7.4	3.6	3.8	1	:3	0.333	7.1	3.9	3.3	1	:3	0.333	5.9	2.9	3.0
1	:3	0.333	7.2	4.4	2.8	4	:5	0.800	5.6	3.5	2.1	1	:2	0.500	5.6	3.0	2.6
4	:5	0.800	6.8	2.6	4.2	1	:1	1.000	5.6	2.8	2.8	1	:root 2	0.707	5.4	0.9	4.5
3	:4	0.750	5.3	3.1	2.2	5	:6	0.833	5.4	2.6	2.8	1	:1	1.000	4.8	1.7	3.1
13	:23	0.565	4.5	1.9	2.6	1	:4	0.250	3.7	1.4	2.3	1	:root 3	0.577	4.2	2.2	2.0
1	:1	1.000	4.3	2.1	2.1	2	:3	0.667	3.7	1.8	2.0	4	:5	0.800	4.2	2.8	1.4
377	:610	0.618	3.6	1.3	2.2	3	:4	0.750	3.7	2.0	1.8	5	:6	0.833	4.2	1.8	2.4
1	:root 5	0.447	3.4	1.8	1.6	1	:root 3	0.577	3.2	1.9	1.3	2	:3	0.667	3.9	3.0	0.9
1	:root 2	0.707	3.4	1.7	1.7	13	:23	0.565	2.8	1.3	1.5	1	:root 5	0.447	3.4	2.2	1.2
5	:6	0.833	3.4	1.3	2.1	2	:5	0.400	2.5	0.9	1.5	377	:610	0.618	3.0	1.7	1.3
1	:root 3	0.577	3.3	1.9	1.4	1	:root 2	0.707	2.3	1.4	0.9	2	:5	0.400	2.9	1.4	1.4
2	:3	0.667	3.2	1.7	1.6	377	:610	0.618	2.1	0.7	1.4	3	:4	0.750	2.6	0.7	2.0
3	:5	0.600	1.8	1.8	0.0	1	:root 5	0.447	0.9	0.4	0.6	13	:23	0.565	2.2	1.0	1.2
2	:5	0.400	1.5	1.0	0.6	3	:5	0.600	0.9	1.2	0.0	3	:5	0.600	1.6	1.6	0.0

Connaught	
Maximum	8.6
75%	6.5
50%	4.3

Ormond	
Maximum	10.4
75%	7.8
50%	5.2

Desmond	
Maximum	6.9
75%	5.2
50%	3.5

The analysis now moves on to examine how these results align with the information previously presented in the literature review of what we know about the use of proportional design in Ireland. In Ireland examination of proportions in early medieval churches predominantly focussed on ground plans. The results showed that internal proportions were typically between 0.555 and 0.679, which included this study's ratios of 13:23, 1:√3, 3:5, 377:610, and 2:3, while external dimensions were typically proportioned between 0.606 and 0.833, this study's 3:5, 377:610, 2:3, 1:√2, 3:4, 4:5, and 5:6. A wide variety of proportions within these ranges were used and Tomás O'Carragáin could not find statistically more occurrences of any ratios including what he described as the four "symbolically significant ratios" of 1:√2, 1:1.5 (2:3), 1:1.618 (Golden 377:610) and 4:7 (~13:23).[57] The great variety of proportions found in these early buildings suggests that Irish masons did not think it necessary to rigorously apply specific ground plan layouts. However, there is also some evidence that they saw value in making close approximations to regular ratios, even if the chosen ratios differed significantly over time and location.

An upsurge in use of the 1:√2 and 3:4 ratios seems to have occurred in parallel with the arrival of the major monastic orders in Ireland, particularly the Cistercians, and it has been suggested by Eric Fernie that the former ratio was "overwhelmingly more popular than any other in the designing of buildings".[58] From this period on 1:√2 and the golden ratio were adopted either separately or together for a range of religious building activities as reported, for example, for parish churches in counties Meath, Kildare, south Dublin, Offaly and Louth, and the friaries of Connaught.[59] Thus, in the medieval period masons in Ireland continued to use geometrically based methods for the layout of building plans. There was significant variety in the schemes and it appears that over time new ratios were added to the existing repertoire.

Relatively few differences were found between the dominant ratios extracted from the examination of tracery: 1:2, 1:3, and, to a lesser extent, 1:1 were popular in all three

[57] T. Ó'Carragáin, *Churches in early medieval Ireland: architecture, ritual, and memory*. London & New Haven: Yale University Press, 2010, pp. 110-113 (hereafter *Churches*). Ó'Carragáin's results were in agreement with those found by H.G. Leask, Peter Harbison and Lloyd Laing as described and referenced in chapter 2.

[58] R. Stalley, *Cistercian Monasteries*, pp. 68-75 and E. Fernie, 'Beginners Guide, p. 230 and E. Fernie, 'The Proportions of the St. Gall Plan', *Art Bulletin,* 1978, 60 (4), 583-9.

[59] M. O'Neill, 'The Medieval Parish Churches in County Meath', *Journal of the Royal Society of Antiquaries of Ireland,* 2002, 132, 1-56, pp. 35-42; M. O'Neill, 'The Medieval Parish Churches of Kildare.' *Kildare: History and Society.* Eds. W. Nolan and T. McGrath. Dublin: Geography Publications, 2006. 153-93; M. Ní Mharcaigh, 'The Medieval Churches of South-West County Dublin', *Proceedings of the Royal Irish Academy,* 1997, 96 (Sect. C), 245-96; E. FitzPatrick and C. O'Brien, *The Medieval Churches of County Offaly*: Government of Ireland, 1998; V. Buckley and D. Sweetman, *Archaeological Survey of County Louth*. Dublin: Government of Ireland, 1991 and S. Mannion, 'A study of the physical remains of the medieval friaries of Connacht', Ph.D. Queen's University, Belfast, 1997, chapter 3 (hereafter 'Medieval Friaries'.

regions. In Ormond, of the five ratios which frequently occurred, four (1:2, 1:3, 4:5, and 1:1) were also typical of both Connaught and Desmond. The fifth most popular ratio, 5:6, was also popular in Desmond and its numeric similarity to 4:5 has been previously discussed.

For 1:1, 1:2, 1:3, and 1:4 there is no need to search for provenance since each of these could have been easily executed by folding a rope, using a dividers, or using simple multiples of a set unit. Only 1:2 had typically been used for ground plans. In the absence of data on architectural details in the Romanesque and pre-Romanesque eras it is not possible to say whether any of the ratios 1:1, 1:2, 1:3, or 1:4 had been used in their design. Thus, it is possible that with the introduction of bar tracery masons started to use new proportions but that they kept them relatively simple.

The only prior evidence for the use of either the 4:5 or 5:6 ratios came from Tomás O'Carragáin's range of external proportions for early medieval churches. It is not certain that external dimensions were important in church design and these ratios exceed the range applied to internal measurements. Therefore, the use of 4:5 or 5:6 in tracery might, again, be a new development but its dominance throughout the country means that it cannot have been used by accident.

While 3:4 was a favourite proportion of the Cistercian order, its expansion in Connaught was much less successful than in the rest of the country, particularly in Ormond, so the prevalence of 3:4 in tracery is somewhat anomalous (Figure 6.7). However, O'Carragáin found that 3:4 was within the range of typical external proportions for the ground plans of early medieval churches. Therefore, the Cistercian use of 3:4 may be irrelevant.

Figure 6.7 Distribution map of Cistercian foundations in Ireland from Roger Stalley [60]

The 13:23 ratio prominent in Connaught was included in this analysis because of a perceived preference by individuals taking part in rectangle shape selection tests in the late nineteenth century.[61] However, as identified by Tomás O'Carragáin, the numeric value of this ratio is very close to 4:7, which had particular symbolic significance.[62] The proportion was frequently used in four buildings, St. Nicholas collegiate church, Kilconnell Franciscan friary, Athenry Dominican priory, and Moyne Franciscan friary, and these may have been connected through patronage, as will be discussed in the following.

Desmond's preferences for $1:\sqrt{2}$, $1:\sqrt{3}$, and 2:3 could represent a continuation of the methods used for ground plan ratios as previously discussed. This is particularly likely

[60] R. Stalley, *Cistercian Monasteries*, p. 32.
[61] K. Elam, *Geometry of Design*. 1st ed. New York, USA: Princeton Architectural Press, 2001, pp. 6-7.
[62] T. Ó'Carragáin, *Churches*, p. 112.

because of the predominance of early churches in this area, which must have created a significant tradition for masons.[63]

Thus it seems that, for the most part, the proportions popular for window tracery in the areas covered by this study did not derive from proportions used for ground plans either in the early or late medieval period. The exception to this finding is the region of Desmond where similar proportions were found between ground plans and window tracery. The apparent continuity of methods from earliest stone building down to the end of the Romanesque seems to have changed in the late medieval period. This might have represented a change in the way that masons were trained, perhaps replacing familial ties with a less locally-focussed apprenticeship system. This could also indicate the arrival in these areas of masons from different, possibly non-Irish, traditions. These ideas will be discussed in the following chapter.

[63] T. Ó'Carragáin, *Churches*: recorded dimensions for 108 church in Desmond compared with 42 in Ormond, 66 in Connaught, and 76 outside the three study regions.

6.3 Metrology, proportion and style as determinants

The results summarised in the previous sections indicate that there is a significant diversity in the range of units and proportions used in medieval Ireland and an effort has been made to try to analyse how such variety could have transpired. I have also attempted to explain the different preferences in different parts of the country through alignment with historical and cultural information. However, the question still remains as to how useful these empirically-based evaluations can be as tools to assist in the comparison of medieval tracery, particularly when compared with traditional architectural historical methods such as stylistic comparison.

The first answer to that question can be suggested by focussing on the most frequently occurring style for medieval windows in this study: switchline tracery. Canice Mooney's study of medieval Franciscan architecture found the following in relation to the chancel east windows of many of the monasteries:

> Nearly all those later east windows have, or had, lights crowned with simple, uncusped but very gracefully proportioned interlacing tracery formed by the continuation upwards of the shafts or mullions in a direction more or less concentric with the radius of the arch, as at Adare, Askeaton, Claregalway, Galbally, Kilcrea, Moyne, Muckross, Quin, Roscrea, Ross, Sherkin.[64]

This design was also employed in every other type of ecclesiastical building with only a small amount of variation in design achieved through the use of cusps or the addition of round or ogee heads at the top of the lights. However, on the basis of measured information, there is a significant amount of variability in the widths and heights of windows and lights, as well as the widths of mullions and the shapes of the hood arches. This variety, based on a sample of the overall numbers of switchline windows, is captured in Table 6.4 and Table 6.5, and this makes clear why it was so difficult to find repeated proportions between sites, even when windows appeared to be stylistically similar.

[64] C. Mooney, 'Franciscan Architecture in Pre-Reformation Ireland (Part II)', *Journal of the Royal Society of Antiquaries of Ireland,* 1956, 86, 125-69, p. 139.

Table 6.4 Comparison of three-light windows based on measurements of mullions, lights, windows and arches (sample), ranked by mullion width.

		Mullion	Light		Window		Arch	
Region	Site	Width	Width	Height	Width	Height	Span	Height
Connaught	Ross Errilly Franciscan	0.108	0.575	2.631	1.709	4.135		1.798
Connaught	Ballindoon Dominican	0.115	0.435	2.015		3.649	2.753	1.944
Ormond	Old Leighlin cathedral	0.119	0.508	1.729	1.522	3.038	1.771	1.555
Connaught	Moyne Franciscan	0.122	0.431	2.509	1.288	3.867	1.519	1.561
Connaught	Galway St. Nicholas collegiate	0.123	0.557	1.650	1.664	3.171	1.803	1.837
Connaught	Burrishoole Dominican	0.125	0.522	1.947	1.563	3.851	1.961	1.701
Desmond	Askeaton Franciscan	0.131	0.451	2.375	1.349	3.377	2.508	1.416
Desmond	Limerick St. Mary's cathedral	0.135	0.530	3.358	1.609	3.947	1.727	1.588
Connaught	Claregalway Franciscan	0.139	0.777	1.614	2.033	3.369	2.067	1.767
Ormond	Callan St. Mary's parish	0.141	0.646	2.281	1.937	4.002	1.950	1.954
Connaught	Kilmacduagh cathedral	0.144	0.531	2.343	1.537	3.297	1.591	1.604
Connaught	Loughrea Camelite	0.149	0.668	2.206	1.956	3.946	2.012	2.057
Ormond	Castledermot Franciscan	0.154	0.724	3.256	2.179	3.929	2.237	1.359
Desmond	Kilmallock collegiate	0.160	0.450	2.910	1.367	3.478	1.497	1.263
Desmond	Abbeydorney Cistercian	0.161	0.372	2.521	1.132	3.923	1.259	1.084
Desmond	Adare Augustinian	0.189	0.632	2.756	1.924	3.490	1.933	1.667
Desmond	Athassal Augustinian	0.205	0.614	3.515	1.841	4.854	2.058	1.727
Desmond	Ennis Franciscan	0.230	0.581	3.992	2.218	7.226	3.131	2.736
Desmond	Kilmallock Dominican	0.236	0.913	3.936	2.842	4.947	3.552	2.600

Table 6.5 Comparison of light widths for three-light switchline tracery, ranked by increasing width.

Region	Site	Width
Desmond	Abbeydorney Cistercian	0.372
Connaught	Moyne Franciscan	0.431
Connaught	Ballindoon Dominican	0.435
Desmond	Kilmallock collegiate	0.450
Desmond	Askeaton Franciscan	0.451
Ormond	Old Leighlin cathedral	0.508
Connaught	Burrishoole Dominican	0.522
Desmond	Limerick St. Mary's cathedral	0.530
Connaught	Kilmacduagh cathedral	0.531
Connaught	Galway St. Nicholas collegiate	0.557
Connaught	Ross Errilly Franciscan	0.575
Desmond	Ennis Franciscan	0.581
Desmond	Athassal Augustinian	0.614
Desmond	Adare Augustinian	0.632
Ormond	Callan St. Mary's parish	0.646
Connaught	Loughrea Camelite	0.668
Ormond	Castledermot Franciscan	0.724
Connaught	Claregalway Franciscan	0.777
Desmond	Kilmallock Dominican	0.913

On a few occasions the same mullion width occurred, but this was not matched by similar light widths or, indeed, any other dimensions.[65] This could imply that standard sized mullions were either being produced using the same template, or they were purchased from the same source where they were pre-cut to shape. However, such is the variety of mullion width that it is unlikely such replication was the only method used. Among the most similar mullion widths were Abbeydorney Cistercian and Kilmallock collegiate church at 0.161m and 0.160m, respectively. At a physical distance apart of ~90km they could have been built by the same masons and but their designs differ by the addition of rounded light heads at Abbeydorney and the use of an almost ogee-shaped tracery field arch. The measurements in this study show that lights, full windows and arches varied significantly in size and the unit of choice also differed. This ensured that different proportions resulted from the proportional analysis.

[65] Having the "same mullion width" was evaluated in relation to the medieval/study tolerance of ~1cm.

Figure 6.8 Chancel east, Abbeydorney Cistercian abbey (left) and nave south, Kilmallock collegiate church (right)

The grouping with mullions close to 0.123m in width included windows at Moyne Franciscan, Burrishoole Dominican, and St. Nicholas collegiate church, and an examination of the three side-by-side (Figure 6.9) reveals that the moulding profiles were very similar, although, also, very simple in their design. The results for all three windows in the metrology and proportional analyses, however, were entirely different.

Figure 6.9 Mullion details at St. Nicholas collegiate church, Burrishoole Dominican friary, and Moyne Franciscan friary (left to right)

Other examples of stylistic similarity which is not borne out in the measurements relate to the five-light decorated windows at Clontuskert Augustinian, Cashel Dominican,

and Clonmel St. Mary's parish church (Figure 6.10). The last two sites were discussed previously in relation to the Holycross school/pattern book but the similarity to the window at Clontuskert is interesting to analyse because it is located at a distance of 160km from Cashel and 190km from Clonmel. However, none of the measurements from the three sites, such as mullion width, window width, light width, light height, etc., are shared making it certain that the windows were not made from the same templates.[66] This might not rule out the possibility that all three windows were the work of the same mason - the design may have been adapted to suit the conditions where he worked. For instance, the height of the gable at Clontuskert was much higher than at the other two sites, and at Clonmel a different type of stone, red sandstone instead of limestone, was available. These results suggest that while the mason may have reused the same design idea, he actually started the geometric process from scratch each time, thus resulting in the variations visible in Figure 6.10. There is, however, a possibility that some of the relationships between elements were worked out according to specific geometric relationships because the unitless ratio of the widths of the mullions relative to the light widths at Clontuskert and Clonmel are 0.376 and 0.407, respectively; close approximations to the 2:5 (0.4) ratio.[67]

Figure 6.10 Stylistically similar windows at Clontuskert Augustinian friary, Cashel Dominican friary and St. Mary's parish church, Clonmel

The question must also be asked about the possibility of a link between defined metrological systems and particular proportions, in order to identify whether this could

[66] Some caution must be exercised in drawing conclusions in relation to Clontuskert because the east window was reconstructed in the early 1970s. T. Fanning, M. Dolley and G. Roche, 'Excavations at Clontuskert Priory, Co. Galway', *Proceedings of the Royal Irish Academy: Section C: Archaeology, Celtic Studies, History, Linguistics, Literature*, 1976, 76, 97-169.

[67] At Cashel, the other similar window in the group, the ratio between mullion width and light width is 0.173.

assist in historical determination. The data from this research suggests that there was no fixed relationship. Taking as an example the grouping of windows in Ormond where the *c*.0.277m unit occurred, no pattern of proportional use is identifiable.[68] However, the measurements from each of these windows did show that some proportional design principles had been used, even if different ratios were used for different windows.

As discussed in the metrology section, on the basis of the evidence collected in this survey, there is no indisputable relationship between proportions, metrology and style for Irish medieval window tracery. The variation between patterns used is huge and it certainly seems unlikely that a specific set of proportions was always used with a particular unit of measurement. Masons in each of the three regions, and it is acknowledged that some of these could have been the same craftsmen, seem to have been comfortable using a range of proportions and this flexibility was demonstrated by generation after generation of masons. These results point to similar conclusions to those reached by Danielle O'Donovan, who found that the level of repetition of certain elements over time was such that Irish mouldings did not provide either clear chronological sequences between sites, or methods of distinguishing between the works of different masons or groups of masons.[69]

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[68] The chancel east at Clonmel, chancel east Fethard Holy Trinity, north and south aisle east windows at Gowran, the northern north transept east and northern south transept east at Holycross, the chancel east at Lorrha Dominican, the eastern nave north at Old Leighlin, the nave west and nave north of Callan Augustinian friary, and the nave west and south aisle west of St. Mary's church, Callan.

[69] When discussing the mouldings at Holycross O'Donovan says: "These mouldings did not undergo the type of development encountered in England. Instead, they remain static and, despite variations in scale, when elaboration was required the elements were repeated over and over again.": D. O'Donovan, 'Holycross and the Language of Irish Late Gothic.' *Limerick and South-West Ireland: Medieval Art and Architecture.* Ed. R. Stalley. Vol. 34. *British Archaeological Association (BAA) Conference Transaction Series*. Limerick, Ireland: British Archaeological Association, 2011, pp. 136-7 and in relation to medieval Ireland in general "the same stock of moulding forms were in use throughout the country for much of the fifteenth and early sixteenth centuries. Like a virus, the quadrant and hollow chamfer appeared to have infected every west doorway from Kinsale to Donegal, making it near impossible to discern the work of an individual mason from one site to the next": D. O'Donovan, 'Building Butler', p. 244.

6.4 Meaning

The previous discussions have shown that empirical studies of window tracery can support the traditional work of an architectural historian, particularly when combined with stylistic information and documentary sources. The contribution that these methods can make to investigations of chronology and the transfer of ideas, such as using pattern books, has also been demonstrated. The research has also shown that analysis of metrology and proportion can also independently produce some interesting findings about medieval architecture in Ireland. The key discoveries will be discussed in the following.

6.4.1 Economy

One feature common to a number of buildings in the study was the reduction in size of the principal, usually the east, window. As there is no obvious liturgical reason for this, the reduction in window size may simply have been a response to managing the high cost of maintaining a large area of glazing. The following are some examples of this trend of size reduction showing the preferred unit for the new window: Athenry Dominican 0.279m, Buttevant Franciscan 0.353m, Hore Cistercian 0.244m, Claregalway Franciscan 0.301m, and Kilmallock Dominican 0.279m or 0.357m. As can be seen there is no evidence of a pattern in these data suggesting that even if all of these downsizing events occurred at similar times, due to economic austerity, there was no standard unit of metrology in use at that time.

Another indicator of the economic imperative is the reuse of architectural objects. I have previously shown that at St. Nicholas collegiate church the west window of the north aisle possibly originated at Annaghdown priory or at some other site. At the same church, the early fourteenth century south window of the south transept was moved to the east of the transept to accommodate the installation of a new window sponsored by Dominick Lynch at the start of the sixteenth century (Figure 6.11). While Harold Leask suggested that this move was made, the evidence from the metrological investigation verified his theory. The proportions showed that during the move at least one section of bar was removed from each of the mullions in order to reduce the height of the window to fit in the east wall of the transept, which was lower than the gable end.

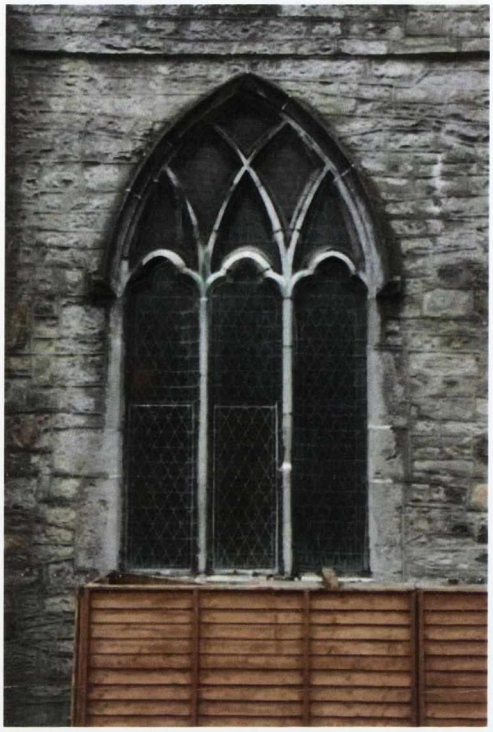

Figure 6.11 South transept east reused from its original south transept south position, St. Nicholas collegiate church, Galway

At Athenry Dominican friary a more curious case of reuse exists regarding the tomb niches inserted into the north wall of the north aisle of the nave (Figure 6.12). These features are unusual because they have exactly the same moulding profiles on the side inserted into the wall as on the side facing into the building. This is unique among the niches at this site and, probably, at many sites. Therefore, I would suggest that this tracery was originally designed for use in an open setting, such as for a window.

Figure 6.12 North aisle tombs, eastern (left) and western (right), Athenry Dominican priory

The possibility that these tomb niches used pieces taken from the early fourteenth-century east window was examined since this would have provided a ready source of materials. It is unlikely that the ogee-heads of the lights would have been altered before insertion in the tomb. Therefore, their widths should be consistent with the original context. The tomb 'lights' are 0.525m and 0.523m wide. The width of the east window

was 5.20m. If it was a six-light window then each light would have been 0.87m wide. Even if it was a seven-light window, which would be unprecedented in this study, the widths of the lights would have been 0.74m. I think this has demonstrated that the sections of tracery relating to the ogee heads did not derive from the remnants of the east window.

A number of other pieces of the tracery could have originated in the east window (circled in red in Figure 6.13) but similar pieces located adjacently in the tomb have no grooves to receive glass or shuttering (highlighted in blue in Figure 6.13). This suggests to me that the origin of these tracery pieces actually relates to an unfinished tracery window, perhaps at Athenry or more likely some other location. One could speculate that the original commission for this window fell through making it available for purchase and creating an economical means by which the friars at Athenry, or more precisely one of their benefactors, could decorate their church.

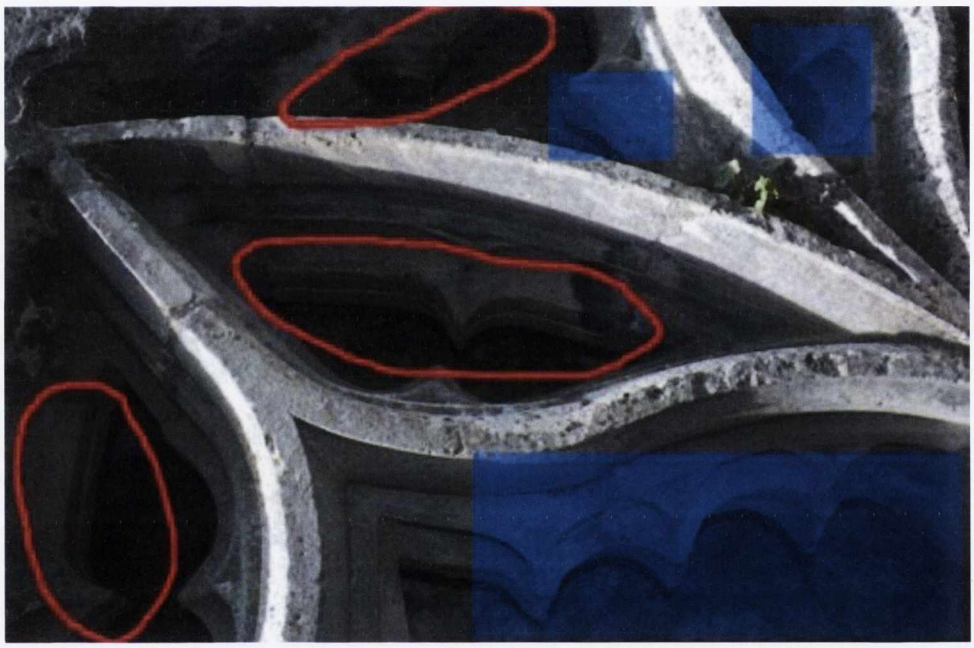

Figure 6.13 Athenry Dominican priory: north aisle eastern tomb details; red circling indicates sections of bar tracery with grooves while blue rectangles indicate the absence of grooves

While we cannot be certain that the tomb now seen is set exactly as was originally intended, e.g. the tracery field might have been supposed to be surrounded by another arch to produce the more typical pointed arch and the height of the "lights" might have been taller or shorter, measurements of the overall width and widths of the lights are unlikely to have been compromised. Therefore, proportions were not examined. After processing the metrology of the tomb was found to be 0.372m. The difference between the style of this tomb and any other architectural detailing in the building agrees with the findings of the

metrological investigation. This unit is significantly longer than any other unit on site and suggests that these pieces did not originate here or even locally. 0.372m is at the longer end of the grouping of units about 0.368m which was found in Desmond: at St. Mary's cathedral, Limerick; Kilmallock Dominican friary; Adare Franciscan friary, Adare Augustinian friary, Muckross Franciscan friary, and Rathkeale Augustinian friary. While some masons marks were found on the tombs no similar data is available for the Desmond sites to attempt an assessment of correspondence. The link in metrology suggests, but cannot confirm, that the origin of this piece is the north Desmond area or that it was made by a mason brought up in the traditions of that area.

6.4.2 Standardisation in architecture

One particular extension of the idea of economy in medieval architecture relates to the standardisation of architectural elements. In this context, both the stonework of the window tracery and the size of the actual glass need to be considered.

There is certainly evidence from medieval records in England that before transportation of stone from the quarry it was hewed into manageable sizes. Douglas Knoop and G.P. Jones suggest that this trend gained particular momentum after the Black Death, probably because of a shortage of skilled labour.[70] There would also be significant economic wisdom in reducing the amount of materials to be carried and in reducing the amount of dirty work which needed to be done on site. The latter imperative would have been particularly important for windows which were later insertions into existing, working buildings. However, these requirements needed to be balanced against the possibility of damage to delicate carving during transport.[71] Certainly by the fifteenth century, L.R. Salzman found such standardisation in the size and pattern of windows for large houses that he believed the rebuilding and alteration of churches was achieved through the purchase of "stock mouldings from the quarry", such is the lack of individuality in many of the "finer, 'Perpendicular' churches".[72]

These blocks became gradually more standardised in dimension to the extent that in 1465 the size of ashlar blocks was given in records of fifteenth-century household

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[70] D. Knoop and G.P. Jones, *The Medieval Mason: An Economic History of English Stone Building in the Later Middle Ages and Early Modern Times*. 3rd ed. Manchester: Manchester University Press, 1967, pp. 70-1 (hereafter *Medieval Mason*).

[71] R. Durman, *Ham Hill: portrait of a building stone*. Reading: Spire Books Ltd, 2006, p. 52.

[72] L.F. Salzman, *Building in England down to 1540: A Documentary History*. Oxford: Oxford University Press, 1952, pp. 123-4 (hereafter *Building in England*).

expenses as twelve inches thick by 18 inches long.[73] The standard most likely applied to one type of stone, since the ability to draw and handle blocks depended on the type of stone, the nature of the beds, and the available mechanisation.

In Ireland, evidence of the use of standard blocks occurred as early as the thirteenth century with examples of Purbeck marble at Christchurch cathedral, Dublin sized at 16 ¼ inches, and Dundry stone in "standard sized blocks of approximately 200mm x 200mm x 300mm" (almost 8" by 8" by 12") also at Christchurch as well as at Duiske Cistercian abbey, Co. Kilkenny and St. Patrick's cathedral, Dublin.[74] These standards apply to the original blocks from which architectural details were carved. However, due to their structural function, the carving of mullions would also have been influenced by the height of the window and the width of glass in the lights.

Still, if standard sizing of stones was commonplace in Ireland, then we might expect to see a standardisation in the sizes of the bars of window tracery in windows of generally similar dimensions. The examination of a sample of switchline windows across the three study regions, as previously presented, suggested that in a very limited number of cases was the same size of stonework used in combination with the same system of metrology: between Callan church mullion 0.141m, 0.267m unit, St. Mary's cathedral, Limerick 0.135m mullion, 0.266m unit, and Askeaton Franciscan 0.131m mullion, 0.265m unit and between Old Leighlin cathedral 0.119m mullion, 0.325m unit and Ballindoon Dominican friary 0.115m mullion, 0.322m unit. The two Desmond sites (St Mary's cathedral and Askeaton friary) were within 27km of each other, making it possible that the same mason actually worked in both locations.[75] The distances between the other sites make could mean that the connection was in the stone, rather than through the masons. This could imply the use of templates or it might be evidence for the reuse of materials originally intended for one site but used at another. Examples of such practices in England were relatively commonplace with, for example, the Fabric Rolls of York Minster recording that "ashlar was sold to the City of York in 1433, stone to Kirkham Priory and

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[73] "First, it is to be understande that every asheler is xij ynch thykke and xviij ynches longe, which multiplied to gedere make ij^{c} xvj ynches; and so every asheler, of what length or breded that he be of, conteyneth ij^{c} xvj ynches; and that schalbe your devysore ever in meatynge (measuring) of ashelers": L.F. Salzman, *Building in England*, p. 103 quoting Roxburghe Club, Manners and Household Expenses of England in the Thirteenth and Fifteenth Centuries, Illustrated by Original Records. Ed. T. H. Turner. London, 1841, p. 438.

[74] R. Stalley, *Architecture and Sculpture in Ireland 1150-1350*. Dublin: Gill and Macmillan, 1971, p. 24 and R. Moss, 'Tales from the crypt: the medieval stonework of Christ Church cathedral, Dublin.' *Medieval Dublin III: proceedings of the Friends of Medieval Dublin Symposium 2001*. Ed. S. Duffy. Dublin: Four Courts Press, 2002. 95-114, p. 98.

[75] D. O'Donovan, 'Building Butler', pp. 240-1.

to the keeper of the fabric of St. Sampson's, York, in 1444, and to the Keeper of Beverley Minster in 1456".[76]

The suggestion then is that at least some Irish masons had little regard for specific proportions, because irrespective of the size of the window they were content to use mullions of the same size. Had a mason been fixed on the use of a particular geometrical scheme he would have ensured that the relationships between elements of the window tracery would have adhered to this system rather than creating the confused picture which many of the proportional analyses have suggested. This is not to say that proportions were not used, because there is enough evidence in the three study regions to confirm that some attention was paid to the use of particular ratios within specific regions, but that the masons were very flexible in their interpretation of the use of these methods.

In the following section the light widths referred to are the space within the lights where glass or shutter would be held, i.e. the glazer's measurement, as opposed to the widths as they would have been set out by the masons, which have been used throughout the rest of the study. The findings of this research show that light widths varied significantly both within and between sites. Using the example of Athenry Dominican friary shows that groups of windows share a standard size light. The north windows of the nave and the west window of the transept have light widths of *c.*0.517m; the chancel east and north transept east windows of late date have widths of *c.*0.600m; the chancel north 0.625m and the transept north 0.808m. At the collegiate church in the same town, only one window had a light of similar width at 0.593m, and, at nearby St. Nicholas collegiate church in Galway town, three early fourteenth-century windows in the south of the chancel display similar evidence. The results in Desmond and Ormond correspond, with contemporary windows on a single site having similar widths but these girths are not replicated at different sites or during different eras. At Holycross, for example three measures can be found, *c.*0.361m, *c.*0.504, *c.*0.386m, while at Adare Augustinian friary groups of *c.*0.490m, *c.*0.610m and *c.*0.625m exist in conjunction with a single measure of 0.583m for the east window.

While evidence shows that glass may not have fitted directly into the stonework of the tracery, but rather that it was housed in a wooden frame, a range of light widths of between 0.235m at Abbeydorney Cistercian abbey and almost 1m at Castledermot Franciscan friary provides no evidence to support the hypothesis that glass was typically purchased in predefined sizes.

[76] D. Knoop and G.P. Jones, 'Medieval Mason', p. 49.

Only one possible standard light size of *c.*0.470m has emerged from the analysis of almost 200 windows. This value occurs in Desmond at Rathkeale Augustinian friary, in Thomond at Ennis Franciscan friary, in Ormond at St. Mary's church Callan and Gowran, but most predominantly in Connaught at Athenry collegiate church, Killursa parish church, and the Franciscan friaries at Claregalway, Ross Errilly and Kilconnell. The range of dates for this group of buildings spans from the early fourteenth century to the early sixteenth century, and the physical locations are distributed across a 100 km radius. Therefore, I do not think it likely that all of these windows can be linked by this one 'standard' size.

In summary of the influence of standardisation on window tracery, the picture of medieval Ireland that emerges from this study is of a country where the commercialisation of window design had not yet developed. Limited suggestions of regularly sized mullions and of window lights have been found but the dominant pattern is one where glass and mullion dimensions were adjusted on a site-by-site basis and that over time, even on the same site, these measures changed. These findings are in full agreement with Richard Fawcett's results from the measurement of thousands of window widths in Norfolk, England.[77]

6.4.3 Pre-existing buildings

Few of the medieval buildings in this study, with the exception of Gowran collegiate church and some of the late foundations such as Creevelea Franciscan friary, represent a single phase of construction. At most sites, changes were made to the building fabric over time and the insertion of new window tracery was a relatively inexpensive way of updating the style of a structure. This characteristic, therefore, raises the question of the influence that existing architecture had on the design and construction of newer windows.

A number of windows within the study were clearly later insertions into walls that had originally been built to accommodate different styles or sizes of window. Buildings which clearly demonstrate the presence of differently shaped earlier windows include the east window of the chancel at Clontuskert Augustinian abbey (Figure 6.14 left), the east window of the chancel of Jerpoint Cistercian abbey (Figure 6.14 right), and the chancel east and nave west windows of Roscommon Dominican friary (Figure 6.15).

[77] R. Fawcett, 'A Group of Churches by the Architect of Great Walsingham', *Norfolk Archaeology,* 1980, 37 (3), 227-94.

Figure 6.14 Chancel east windows at Clontuskert Augustinian abbey and Jerpoint Cistercian abbey

Figure 6.15 Nave west (left) and chancel east (right), Roscommon Dominican friary

At Clontuskert the golden ratio was used for tracery field height to light height (at arch peak) and overall window width to window height to spring but the amount of missing tracery at Roscommon made it difficult to discern any pattern, although 1:4 and 1:2 were suggested for the chancel east while 3:4 and 2:5 were possibilities for the nave

west window. The Clontuskert result must be regarded with caution because of its twentieth century reconstruction but its mason was probably able to accommodate a specific design scheme despite insertion of the window into an existing structure.[78]

For Jerpoint's chancel east window a range of ratios appeared in the results. If the springing point was the important one, then 3:4 was found between tracery field height and light height as well as a ratio of 1:1 between overall window width and light height. If arch peak was the reference point, which I think more likely, then the study found 2:3 between tracery field height and light height, a ratio which also represented overall window width to overall window height. 1:4 for light width to light height and 3:4 for light width to light height were also recorded. 3:4 and 2:3 are not usually used in Ormond tracery and, combined with the use of ball flower ornament on the feature and the incorporation of sculpture, it has been suggested that this is the work of an English mason.[79] The metrological analysis suggests 0.296m as the probable unit, which would agree with this theory, but this unit might be the result of twentieth-century restoration. Given the tracery design the patron of this window certainly seemed to want to make a bold statement and using an English mason would have achieved just that.

All of these examples demonstrate a use of proportions that is as accomplished as in most other windows in this study. Therefore, irrespective of whether the mason was presented with a space defined as part of an old building or was able to set his window in a new section of wall, the application of proportions seems to have been the same.

6.4.4 The legal imperative

Another absent set of supporting documentation for medieval Ireland is building contracts such as those found in England. A significant number of these contracts specify that the mason must utilise specific measures, for example the King's foot or, against national legislation, for example the foot of St. Paul's or the regional measure in Cambridge, etc.[80] These contracts provide information on the types of units in use in particular locations at given times and reiterate how frequently multiple units were in use contemporaneously in a given location, even when national standards were supposed to be enforced by law. In

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[78] T. Fanning, M. Dolley and G. Roche, 'Excavations at Clontuskert Priory, Co. Galway', *Proceedings of the Royal Irish Academy: Section C: Archaeology, Celtic Studies, History, Linguistics, Literature,* 1976, 76, 97-169.

[79] Rachel Moss, personal communication.

[80] L.F. Salzman, *Building in England*, p. 531-2 quoting R. Willis and J.W. Clark, *The Architectural History of the University of Cambridge, and of the Colleges of Cambridge and Eton ... Edited with large additions, and brought up to the present time, by J. W. Clark.* Vol. 1. 4 vols. Cambridge: University Press, 1886, p. 310: "*Ad longitudinem 4 rodarum et di' qualibet roda continente xviij pedes de standardo region.*"

this regard medieval Ireland was more complicated than England because it was governed by two legal systems; the rule of the English and the ancient Gaelic system of Brehon law.

We know for certain that the English administration tried to enforce the same standards in Ireland as in England from, at latest, the third quarter of the thirteenth century.[81] However, by this time the colonial expansion had peaked and many areas of Ireland began to revert to Gaelic lordship. Observation of English laws in many parts of the country, particularly Connaught, would have lapsed between the late thirteenth century and the end of the medieval period. Even within the areas dominated by the Anglo-Normans, hibernicisation was a significant problem for the administration and the statutes of Kilkenny in 1366 recorded that even the English in Ireland frequently resorted to Brehon law for dispute resolution.[82] Again in 1494 Edward Poynings' parliament re-enacted the 1366 Statutes of Kilkenny as a means of controlling the spread of Irishness among the English, but despite this Brehon law was still consulted up until the seventeenth century.[83]

This study found that in each region a unit close to 0.3048m was found, meaning that the requirement to use a legally-defined standard measure had an effect on the design of late medieval window tracery. However, the results which follow may not all relate to adoption of the legal standard at the time of initial installation: Connaught 0.306m, frequency 7.757; Ormond 0.310m, frequency 7.499; and Desmond 0.307m, 8.210. While it might look as if Ormond had the least use of the medieval standard, the analysis of Ormond and Desmond also found another unit within the 1cm tolerance value of 0.3048m: Ormond 0.298m, frequency 6.503 and Desmond 0.298m, frequency 8.403. While it is possible that these units aligned with the Roman Standard foot of 0.298m, as discussed previously, it is difficult to trace how such a unit could have become frequently used in Ireland. If the 0.298m totals are added to the 0.310m and 0.307m totals for Ormond and Desmond, respectively, then the frequencies become 14.002 and 16.613. Then, the 0.3048m unit would have been more widely used in Ormond than in Connaught, a result which could be expected based on the dominant Anglo-Norman lordship and the number of late window insertions. Also, a number of the occasions of use of 0.3048m in Connaught can be dated as late or post-medieval, such as the reconstructed windows at

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[81] Previously quoted work by Roger Stalley on round towers suggest that the 0.3048m foot could have arrived in Ireland as early as the eleventh century. However, I think that widespread introduction was probably more likely to have happened in the thirteenth-century. R. Stalley, 'Irish Round Towers'.

[82] 'Statutes of Kilkenny.' Parliament before Lionel Duke of Clarence, Lord Lieutenant of Ireland. Ireland, 1366. Published online by The Corpus of Electronic Texts < http://www.ucc.ie/celt/published/T300001-001/>.

[83] J. Lydon, *The Lordship of Ireland in the Middle Ages*. Dublin: Four Courts Press, 2003, p. 228 and J.R. Peden, 'Property rights in Celtic Irish law', *Journal of Libertarian Studies,* 1977, 1 (2), 81-95, p. 82.

Athenry Dominican friary and Kilnalahan abbey, and the late or downsized windows at Kilconnell Franciscan friary, Claregalway Franciscan friary, St. Nicholas collegiate church and Strade Dominican friary. Together these results suggest that towards the end of the medieval period in Ireland adoption of the English standard unit of 0.3048m was becoming more widespread and that progress towards its acceptance probably took a path that started in Ormond and gradually moved into Connaught.

Relative to the number of windows measured in the study, the use of the English standard was not as high as might have been expected given the amount of legislation issued over the medieval period in relation to metrology. This could partly relate to the independence of the building industry from the trades for which the legislation was mostly issued, i.e. for the trading of goods at markets and internationally. However, masons must have come into some contact with these trade measures, for instance for the purchase of canvas for templates.[84] The other reason could relate to the range of other units available to masons and the traditions in which they were trained. The provenance of each of the other units highlighted by this study has been discussed previously but consideration of the undocumented measures did not include the possibility that these values may have been stipulated by Gaelic law and possibly regional Gaelic law. I would suggest that this argument is plausible, particularly for the units of *c.*0.346m (which had a total frequency between the three regions of 33.796, far in excess of any other unit), 0.357m (which occurred only in Connaught but had a frequency of 12.331) and 0.368m (which was unique to Desmond and had a frequency of 14.220). Validation of this theory will require collection of a significant amount of data associated with late Christian and early medieval buildings throughout the three regions.

6.4.5 Patronage

As previously discussed, the basis for much historical research in architecture is that individual masons expressed themselves in an identifiable manner through details such as "changes in the moulding profiles, the unit of measure used, pier base designs, or the degree of skill in carving capitals or string courses".[85] However, work on English architecture by historians such as L.F. Salzman, Douglas Knoop, and G.P. Jones has demonstrated that the contribution of patrons in the building process was not always

[84] L.R. Shelby, 'Mediaeval Masons' Templates', *Journal of the Society of Architectural Historians,* 1971, 30, 140-54, p. 143: details records of the purchase of canvas in building accounts. H.S. Sweetman, *Calendar*, p. 177, Letters Patent, Roll 8, p.3 m.9 and p. 316, Close Rolls, Roll 19, 2133: Grants for murage and defensive works for the city of Waterford in 1223 and 1234 included taxation upon cloth and canvas by the ell.

[85] L.E. Neagley, 'The Flamboyant Architecture of St.-Maclou, Rouen, and the Development of a Style', *The Journal of the Society of Architectural Historians,* 1988, 47 (4), 374-96, p. 378.

limited to supplying finance, and that, in some cases, details such as copying or reusing other masons' work were explicitly specified in contracts of engagement.[86] In Ireland, the dearth of such contracts means that other sources of information, including the buildings themselves and any documentation related to buildings or patrons, must instead be used, as has been done by Danielle O'Donovan, Kenneth Abraham, and Tomás Ó'Carragáin, among others.[87] The references to windows in such documents are so few and of such limited detail that it is generally not possible to determine the influence of patrons on medieval window tracery and on the metrology and proportions of same.

One exception to this rule seems to be in the case of a number of ecclesiastical establishments in Connaught which were patronised by the de Burgo family and by various Galway merchant families including the Lynches. The relationship between the Lynch family and St. Nicholas' collegiate church as well as Athenry Dominican priory was discussed in Chapter 5. Ross Errilly Franciscan friary also received patronage in the late fifteenth century from this family though John, son of John, in 1496. The same friary also received 40 pence from John, son of Henry Blake of Galway, in the previous year.[88] The de Burgos provide a link between Moyne Franciscan friary, Portumna Dominican friary, Athenry Dominican priory, and Kilconnell Franciscan friary.[89] Kilconnell was described as undergoing "constant development" by Canice Mooney because of its "constantly expanding population" which meant that I must have been in need of patronage from the merchants of nearby Galway.[90]

At each of these sites fifteenth-century windows display use of the proportions 1:4, 13:23, and/or 4:5 while the unit 0.279m was also frequently used. This might mean that these donors suggested use of particular masons to the establishments benefiting from their patronage. It is possible that the main link between these sites is based on location, but the inclusion of Moyne Franciscan friary in the group, with documented links to the de Burgo family, makes it possible that patronage was responsible for the similarities.

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[86] L.F. Salzman, *Building in England*; and D. Knoop and G.P. Jones, *Medieval Mason.*

[87] D. O'Donovan, 'Building Butler'; A.S.K. Abraham, 'Patterns of Landholding and Architectural Patronage in Late Medieval Meath. A regional study of the landholding classes, tower-houses and parish churches in Ireland, c. 1300-1540', 4 volumes. Queens University Belfast, Belfast, 1991; and T. Ó'Carragáin, 'The Architectural Setting of the Mass in Early-medieval Ireland', *Medieval Archaeology,* 2009, 53 (1), 119-54.

[88] C. Mooney, 'The Friary of Ross: Foundation and Early Years', *Journal of the Galway Archaeological and Historical Society,* 1960, 29 (1/2), 7-14, p. 10: "In his will drawn up on 17 August 1496, John Lynch, merchant of Galway, son of John Lynch, made a bequest to the friary of Ross of 'duas uncias in mercibus'." and "Another citizen of Galway, John, son of Henry Blake, bequeathed forty pence to the friary of Ross in a will drawn up in the year 'MCCCCLXVIH, in crastino Sancti Patricii et confessoris node diet dominice'".

[89] A. Gwynn and R.N. Hadcock, *Medieval Religious Houses: Ireland.* 2nd ed. Blackrock, Co. Dublin: Irish Academic Press, 1988, p. 228.

[90] C. Mooney, 'Franciscan Architecture in Pre-Reformation Ireland (Part I)', *Journal of the Royal Society of Antiquaries of Ireland,* 1955, 85, 133-73, p. 169.

7 Masons

In England and continental Europe the names of some masons and master masons were documented in the fabric rolls of major works, as well as in contracts. The records of the life of Henry Yeveley, the king's mason, are a particular case in point.[1] In Europe images of master masons adorned their own buildings, as did representations of working masons, and some masters were even honoured with tombs within the walls of their buildings, a tribute normally reserved for patrons (Figure 7.1).

Figure 7.1 Portrait of Anton Pilgram (died 1515) designer of the organ-gallery at St. Stephen's cathedral, Vienna (left); Sculpture from *c.*1330-40 of mason with hammer and chisel, Yorkshire Museum, York (middle); Hugues Libergier's tomb slab, Reims cathedral (right).

However, in Ireland, few such records exist and, as with the other unknowns of Irish medieval architecture, we must seek to fill the gaps in our knowledge through detailed examination of the buildings themselves. In this chapter, this empirical method of architectural investigation is evaluated in relation to its ability to provide information about the organisation, training, and skills of medieval masons, as well as their mobility and their motivations as craftsmen. These findings are aligned, where possible, with supporting documentary evidence.

[1] J. Harvey and A. Oswald, *English mediaeval architects: a biographical dictionary down to 1550: including master masons, carpenters, carvers, building contractors and others responsible for design*. Revised ed. Gloucester: Sutton, 1984 (hereafter *English Mediaeval Architects*). For Henry Yeveley see pp. 358-366.

7.1 Organisation

As craftsmen, masons in all countries needed some form of organisation to protect their interests and the reputation of the craft, both from unscrupulous employers and from unskilled imitators. These organisations also provided the important mechanisms by which craftsmen could be trained and could keep abreast of new developments.

Within the English masons' organisation, significant attention was paid to the rank and experience of the mason, with many administrative records showing complicated systems of payment.[2] By the 1350s payment per grade was regulated by parliament, and so would have applied to Ireland as well as England.[3] Formalisation of ranking, and the fixing of earnings thus implied, was performed by the formation of guilds. In England, Douglas Knoop and G.P. Jones were only able to find a very few references to masons' guild activity in the fourteenth and fifteenth centuries, and all of the direct references were to London-based activities, where the London Guild of Masons was said to have been formed in 1356.[4] However, the conclusion must be that, although probably organised in some way, the masons had not yet created formal guilds. This is most likely due to the nature of the work; sometimes life-long, sometimes transitory; and, possibly, is partially due to the power of the major employers of masons before the sixteenth century, the crown and the Church and, to a lesser extent, the nobility.[5]

From the Irish perspective, although the Guild of Carpenters, Millers, Masons & Helliers was only founded by royal charter by Henry VII in 1508, the Dublin Chain Book's regulation for the Corpus Christi pageant of 1498 placed the masons "with the cooks as Farao, with his hoste, between the smiths and shearmen, bakers and slaters, and

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[2] For instance, the fabric rolls for Caernarvon castle listed seventeen different rates of pay for masons in 1304, whilst in 1316 there were twelve different rates. This could also be evidence of masons at different stages of training and could also suggest the presence of some female masons on site: D. Knoop and G.P. Jones, 'Masons and Apprenticeship in Mediaeval England', *The Economic History Review,* 1932, 3 (3), 346-66, p. 348 (hereafter 'Masons and Apprenticeship').

[3] C. Given-Wilson, P. Brand, A. Curry, R.E. Horrox, G. Martin, W.M. Ormond and J.R.S. Philips, eds. *The Parliament Rolls of Medieval England.* Scholarly Digital Editions / The National Archives / The History of Parliament Trust / Boydell and Brewer, nd, 1351 Edward III and 1445 Henry VI. By 1388, a statute of Richard II recorded that "master masons of free stone, master carpenters of free work, able to be masters of their art, were to take for the whole day 2 *d.*", a significant reduction in wages. Whether this reduction in pay is indicative of an oversupply of labour, or of a general economic trend is not known: H.F. Berry, 'The Dublin Gild of Carpenters, Millers, Masons and Heliers, in the sixteenth century', *Journal of the Royal Society of Antiquaries of Ireland,* 1905, 35 (4), 321-37, p. 322 (hereafter 'Dublin Gild').

[4] D. Knoop and G.P. Jones, *The Medieval Mason: An Economic History of English Stone Building in the Later Middle Ages and Early Modern Times.* 3rd ed. Manchester: Manchester University Press, 1967, pp. 135-143 (hereafter *Medieval Mason*). Some indirect references have been found to guild presence in Norwich in 1440, 1469 and 1491, as well as to centres at York, Beverley and Coventry.

[5] These theories are developed in D. Knoop and G.P. Jones, *Medieval Mason*, p. 142-3 and other possible reasons for the absence of masons' guilds are given.

the skinners and house carpenters".[6] Inclusion in the pageant roll showed that the masons were established within the ranks of crafts and trades in the city, even if they had not yet been granted a royal charter. The Dublin masons were significantly outnumbered in the early years of the existence of the guild. In 1514 only two masons were listed among the 26 members, in 1521 only four of the 36 members were masons, while by 1560 there was still only one mason among 41 other craftsmen. Henry Berry explained this as the result of masons forming bands and companies working under a master mason, either at one location or with a roving role. This agrees with Douglas Knoop and G.P. Jones' assessment of the pattern for English masons as regards the formation of guilds; it was less of a necessity for this trade than for others.

As discussed in chapter 1 in relation to the differences between the Irish and English building industries, before the arrival of the Anglo-Normans bands of typically 4 masons, some of whom were in training, travelled about with work under the instruction of an *ugtar saer*.[7] It can be assumed that the members of these groups would have produced works with a level of similarity of "architectural expression" and, over time, as a network of masons their works would have become what Harold Leask defined as a "school" expressing "a body of tradition".[8] Harold Leask and Britta Kalkreuter discussed in detail the "School of the West" from the first half of the thirteenth century, while Colum Hourihane's studies of the evidence from masons' marks concluded that, within his study area of the bishoprics of Cashel and Dublin, three distinctive groups or schools of masons operated: Cashel (thirteenth century), Limerick and Holycross (both fifteenth century).[9] Windows in the works related to the thirteenth century schools from the West and Cashel are either of the lancet type or were replaced in the fifteenth century by tracery designs. Therefore, the products of this school were not studied in this investigation.

The Limerick and Holycross schools of the fifteenth century will, for this purpose, be taken as approximating to the regions of Desmond and Ormond, respectively. As was

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[6] M. Clark and R. Refaussé, *Directory of Historic Dublin Guilds*. Dublin: Dublin Public Libraries, 1993, p. 17-8. The Bricklayers & Plasters guild only founded in 1670 (p. 16) and prior to this date these craftsmen were probably based with the masons' guild. J.T. Gilbert and R.M. Gilbert, *Calendar of ancient records of Dublin in the possession of the Municipal Corporation of that city*. Vol. 1. 18 vols. Dublin: Dollard, 1889, p. 241 (hereafter *Calendar*).

[7] J. Ní Ghrádaigh, 'A legal perspective on the saer and workshop practice in pre-Norman Ireland.' *Making And Meaning in Insular Art*. Ed. R. Moss. Dublin: Four Courts Press Ltd., 2007. 110-25, pp. 112-6 (hereafter 'Saer').

[8] H.G. Leask, *Irish Churches & Monastic Buildings*. Vol. II. Dundalk, Ireland: Dundalgan Press Ltd., 1960. 3rd, p. 53 (hereafter *Irish Churches II*).

[9] H.G. Leask, *Irish Churches II*; B. Kalkreuter, *Boyle Abbey and the School of the West*. Wordwell monograph series. 1st ed. Bray, Co. Wicklow, Ireland: Wordwell Ltd., 2001 (hereafter *Boyle Abbey*); C. Hourihane, *The Mason and His Mark: Masons' Marks in the Medieval Irish Archbishoprics of Cashel and Dublin*. British Archaeological Reports. Eds. J. Hedges and E. Hedges. Vol. BAR 294. Oxford: British Archaeological Reports, 2002 (hereafter *Masons' Marks*).

discussed previously, some similarities and some distinctions exist between these regions, both for metrology and proportion. These findings agree with the possibility that masons in each of these regions were part of some type of organisation, which shared masonic information relating to architectural styles, training, and building methods, including metrology and proportion. However, this study can provide no evidence on the exact nature of these organisations.

Since masons' marks were used by Colum Hourihane in defining the range of operation of the Cashel, Limerick and Holycross schools, mention will be made here of some marks found on the tomb niches on the north wall of the north aisle at Athenry Dominican friary and these might inform our understanding of craft organisation (Figure 7.2). Few other marks are available for comparison, particularly in Connaught, meaning that the findings here may be incomplete.[10] Because of accessibility issues for most of the windows included in this research no other masons' marks were available for interrogation.

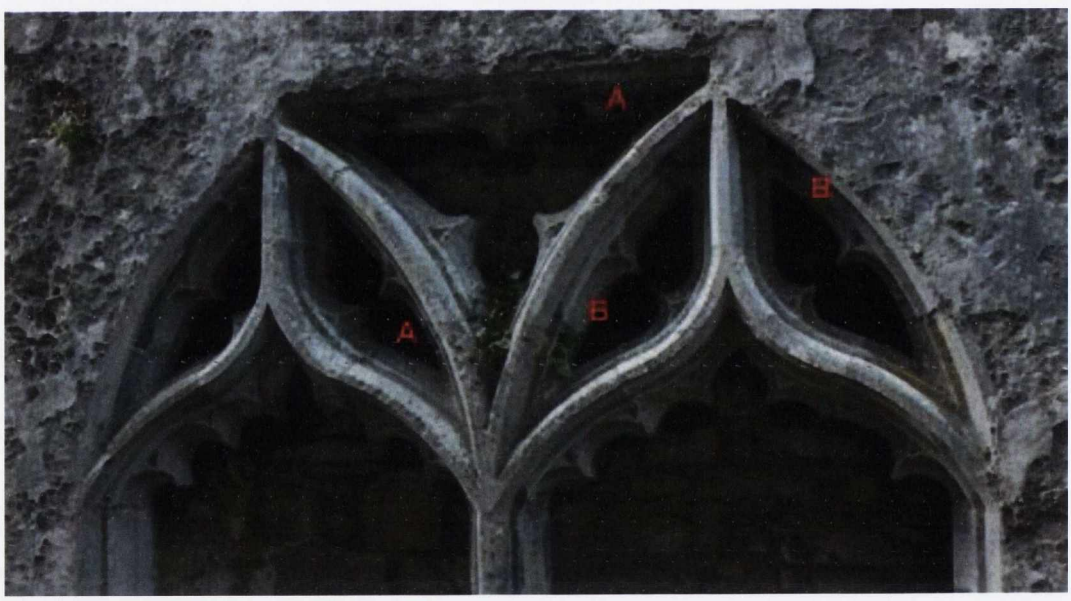

Figure 7.2 North aisle eastern tomb masons' marks locations, Athenry Dominican priory

[10] Other publications include E. Fitzgerald's study of masons' marks at Youghal but none of these marks matched the ones found on the tomb at Athenry: E. Fitzgerald, 'On Ancient Mason Marks at Youghal and Elsewhere; And the Secret Language of the Craftsmen of the Middle Ages in Ireland', *The Journal of the Kilkenny and South-East of Ireland Archaeological Society,* 1858, 2 (1), 67-73 and E. Fitzgerald, 'On Ancient Mason-Marks at Youghal and Elsewhere; And the Secret Language of the Craftsmen of the Middle Ages in Ireland (Concluded)', *The Journal of the Kilkenny and South-East of Ireland Archaeological Society,* 1859, 2 (2), 384-96.

Figure 7.3 Masons' marks type A (left) and B (right), Athenry Dominican priory

The design of the marks at locations A in Figure 7.2 is a leaf motif (Figure 7.3 left), while the B locations mark the positions of lightly-incised arrow-heads. The first type of mark is a variation on a motif found at Kilcooly Cistercian abbey on the western arch under the tower and in the nave of Cashel cathedral, both in Ormond.[11] The second mark closely resembles a mark found on the piers of the tower at Cashel cathedral, Ormond.[12] The other locations where these marks occur have been derived from Colum Hourihane's work on the archbishoprics of Cashel and Dublin. The Athenry marks might be linked to Hourihane's Holycross school of the fifteenth century, but their origins might be entirely different.

As discussed in chapter 1, there is no evidence that any form of 'central register' ensured that masons' marks were unique, therefore comparison of marks between sites must be made with great caution.[13] The Athenry marks could be related to a system of payment, which was local to a site. Examples of this function have been demonstrated in England, including during the Anglo-Saxon era, by Jennifer Alexander, and at Christchurch cathedral Dublin by Rachel Moss, where very few marked stones were present among a large quantity of cut stones.[14] Since other marks have not been found on site an origin that is different to the rest of the stonework is suggested. This evidence combined with the results of the metrological investigation is more reliable than the possible origins suggested by the masons' marks on their own.[15]

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[11] C. Hourihane, *Masons' Marks*, catalogue figures 9 and 17.
[12] C. Hourihane, *Masons' Marks*, catalogue figures 15 and 16.
[13] C. Hourihane, *Masons' Marks*, p. 33.
[14] J.S. Alexander, 'The Introduction and Use of Masons' Marks in Romanesque Buildings in England', *Medieval Archaeology,* 2007, 51, 63-81, pp. 80-1 and R. Moss, 'Tales from the crypt: the medieval stonework of Christ Church cathedral, Dublin.' *Medieval Dublin III: proceedings of the Friends of Medieval Dublin Symposium 2001.* Ed. S. Duffy. Dublin: Four Courts Press, 2002. 95-114.
[15] Proportional investigation was not used because of the possibility that, if moved from a different location, the tracery was not set in the wall as originally intended.

7.2 Training

As regards training, little is known of the book-learning of Irish masons; unlike in England where Lon R. Shelby was able to produce reliable evidence of the education undertaken by master masons.[16] There is little Irish evidence for the role of a master mason in the sense of an administrator of the building works and the individual responsible for translating a vision into reality. Rather in a few limited cases we can identify the work of certain highly-skilled carvers or sculptors.[17] In the traditional master mason's role education in arithmetic and geometry would have been needed to a much higher level than was required by the banker mason. Thus, formal, book-based education would not have been needed by most Irish masons and an oral tradition would have taken its place. This section aligns the knowledge that we have of medieval masons' oral traditions for training and a limited number of written sources, with the evidence from this study.

One of the key classical texts on architecture, Vitruvius' Ten Books written *c.*33/22 BC, was transcribed in Jarrow by Irish monks in the seventh century but it had no impact on local architecture, either Irish or English.[18] The monks in their scriptorium were concerned with the preservation of knowledge through the transcription of books and manuscripts, but there is little evidence that this information became available to the wider community as a result of their efforts. Similar comments have been made about the treatise of Theophilus *De Diversis Artibus* which, although written before 1140 and including only content on glass rather than masonry, was not widely circulated during medieval times.[19]

A text which has received a lot of attention from architectural historians is the Latin translation of Euclid's elements during the twelfth-century.[20] Most Irish masons

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[16] L.R. Shelby, 'The Education of the Medieval English Master Mason', *Medieval Studies,* 1970, 32, 1-26 (hereafter 'Education').

[17] See, for example, the master at Gowran collegiate church: R. Stalley, *Architecture and Sculpture in Ireland 1150-1350*. Dublin: Gill and Macmillan, 1971 (hereafter *Architecture and Sculpture*).

[18] Vitruvius, *The Ten Books on Architecture*, Trans. M.H. Morgan. 1st ed. Mineola, New York: Dover Publications, 1960 and A. Rowan, 'The Irishness of Irish Architecture', *Architectural History,* 1997, 40, 1-23, p. 3.

[19] C.R. Dodwell, ed. *Theophilus: De Diversis Artibus*. 1961. Oxford: Clarendon Press, 1986. Certainly the slower speed of transfer of ideas and the general reluctance towards change could explain how little these texts affected medieval architecture, but Charles Haskins demonstrated that some medieval ideas could move very quickly, particularly if propelled by the administration or by the power of the church, through organised monastic orders or as a result of pilgrimage. The spread of the Bernadine plan and the 3:4 proportion with the Cistercian order are just such examples. C.H. Haskins, 'The Spread of Ideas in the Middle Ages', *Speculum,* 1926, 1 (1), 19-30, pp. 23-4.

[20] R. Fawcett, 'Later Gothic architecture in Norfolk: an examination of the work of some individual architects in the fourteenth and fifteenth centuries', Ph.D. East Anglia, 1975, pp. 498-9. The Latin translation of the Arabic version of Euclid's elements was available in Europe in the twelfth-century. For a detailed discussion of Euclid's elements and their arrival in and effect on Europe see M. Folkerts, *Euclid in Medieval Europe*. Vancouver, Canada: University of British Columbia, 1989. For an analysis of the influence of

would have been unable to speak Latin and would, therefore, have gained access to Euclid's text no earlier than 1570, when Sir Henry Billingsley produced an English translation.[21] Most would also, probably, have been illiterate. The reason that attention is focussed on Euclid's elements is because of the contents of the Regius and Cooke manuscripts. These manuscripts, from 1390 and 1430, respectively, are reworkings of the contemporary "Articles and Points of Masonry" by an unknown English author, which described the "customs and regulations pertaining to the masons' craft in England".[22] Both of these documents accredit Euclid as the founder of their craft. The title of the Regius MS, translated, is: "Here begin the constitutions of the art of Geometry according to Euclid", while a section of the Cooke MS contains the line "Then one of them that had the name which was called Euclid that was most subtle and wise founder ordained an art and called it masonry".[23] However, it is important to note that the contents of these documents relate only to the "socio-economic conditions and institutional forms of the craft" and contain no technical information related to architecture.[24] Thus, while masons may have thought that linking their craft to Euclid gave them validity, there is still little evidence that masons had anything more than a very practical, rule-of-thumb based understanding of what we would call Euclidian geometry. Rather, the regulations in these manuscripts aimed at consolidating the craft with emphasis in the Cooke MS on the need to "keep secret the counsels of his fellows" and in the Regius on the strong requirement that the apprentice "keeps and guards his master's teachings and those of his fellows".[25]

A truer picture of the role of texts for a mason is given by the German fifteenth- and sixteenth-century training manuals from Mathes Roriczer, Lorenz Lechler, and Hanns Schmuttermayer, and by the sketchbook of Villard de Honnecourt.[26] Each of these documents was clearly designed to supplement the oral tradition rather than to be used

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Euclid's elements on the mason's manuscripts of the late fourteenth and early fifteenth centuries, the Regius and Cooke MSs, see I. Bulmer-Thomas, 'Euclid and Medieval Architecture', *Archaeological Journal,* 1979, 136, 136-50 particularly pp. 144-8 (hereafter 'Euclid').

[21] H. Billingsley, *The Elements of Geometrie of Euclide [Books 1-15]* London: John Daye, 1570.

[22] L.R. Shelby, 'The Geometrical Knowledge of Mediaeval Master Masons', *Speculum,* 1972, 47, 395-421, p. 395 (hereafter 'Geometrical Knowledge'). Jean Gimple indicated that the "Articles" were intended for masters of masonry while the "Points" were for the workmen: J. Gimpel, *The Cathedral Builders*, Trans. T. Waugh. Salisbury, Wiltshire: Michael Russell (Publishing) Ltd, 1983, pp. 90-1 (hereafter *Cathedral Builders*).

[23] The Grand Lodge of British Columbia and Yukon, "The Halliwell Manuscript". 2006. Freemasonry. July 2009. <http://freemasonry.bcy.ca/texts/regius.html> and I. Bulmer-Thomas, 'Euclid', p. 147.

[24] L.R. Shelby, 'Education', p. 14.

[25] J. Gimpel, *Cathedral Builders*, pp. 90-1. In an interesting parallel with the need for secrecy Lady Gregory's collected stories of the Gobán Saor included one reference to how "the Gobán never told the secret of his building". Lady Gregory, 'The Goban Saor', *Journal of the Galway Archæological And Historical Society,* 1905, 4, 4.

[26] F. Bucher, *Architecktor: the lodge books and sketchbooks of medieval architects*. Vol. 1. New York: Abaris Books, 1979 (hereafter *Architecktor*).

independently, with focus placed on the use of simple reminder diagrams, such as Villard's generation of the *verina piscia* (Figure 7.4) or, in the lodge book of Mathes Roriczer, for creating a pinnacle (Figure 7.5).[27] These images align with Lon R. Shelby's contention that medieval masons, even master masons, were not literate during the Gothic period of architecture, and therefore needed visual guides rather than written ones.[28]

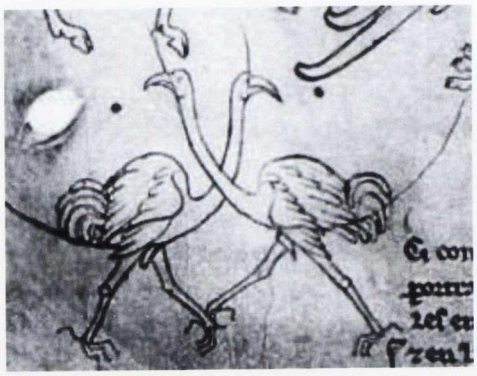

Figure 7.4 Mnemonic for remembering the construction of a *verina piscia* from the sketchbook of Villard de Honnecourt

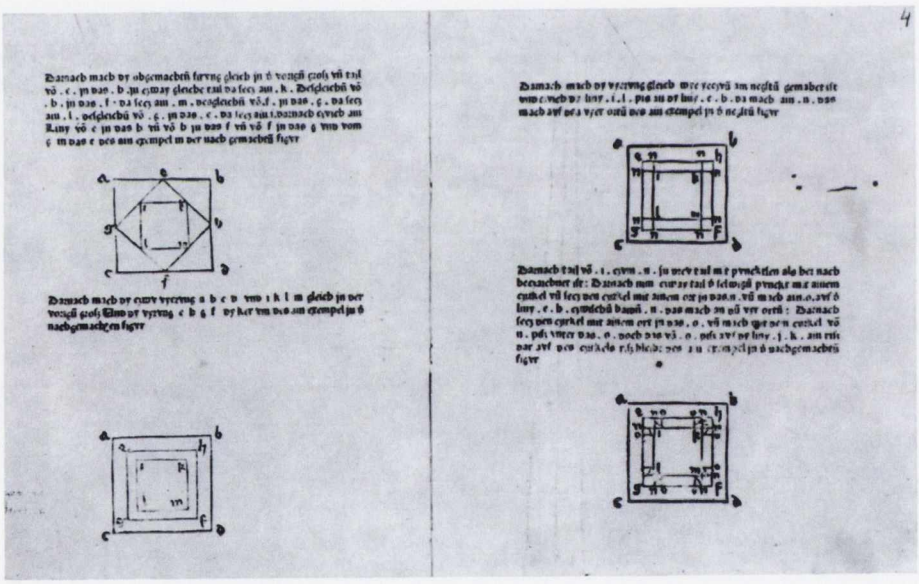

Figure 7.5 From Roriczer's *Büchlein von der Fialen Gerechtigkeit*, setting out a pinnacle [29]

Although no direct reference can be found to the production of similar training manuals in Ireland, an example from the Dominican friary at Athenry (Figure 7.6) provides a possible link to Villard's sketchbook.

[27] R. Woodrow, "Villard de Honnecourt." University of Newcastle, 2000 and F. Bucher, *Architecktor*.
[28] L.R. Shelby, 'Geometrical Knowledge', pp. 397-8.
[29] Würtsburg, Universitätsbibliothek, I.t.q. XXXX, fols. 3^{v}-4.

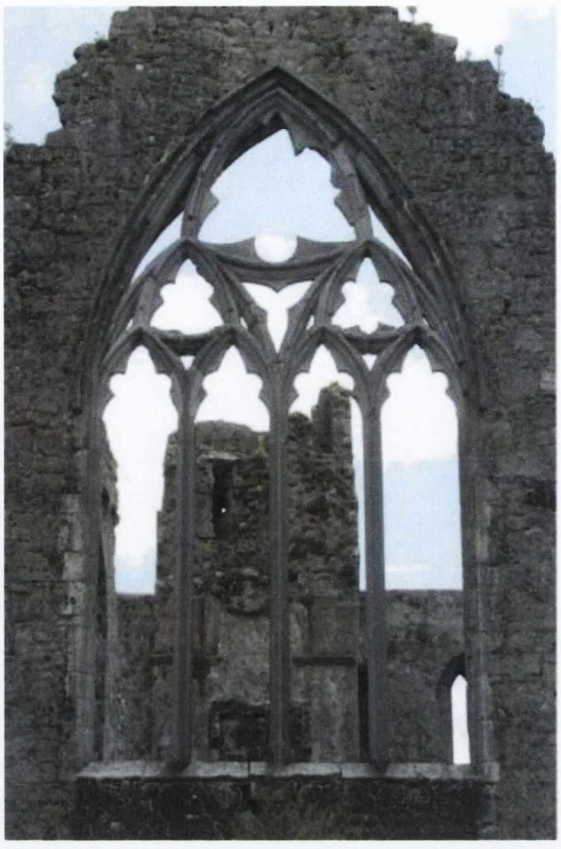

Figure 7.6 North transept north window, Athenry Dominican priory

The north transept north window at the friary is a twentieth-century reconstruction which reused fallen stone from the original tracery. Its design is unique to the regions in this study because of the inclusion of a triangle with curved sides.[30] On folio 14v of Villard de Honnecourt's sketchbook, two wrestlers have been drawn in a typical clinch but without explanation (Figure 7.7).[31] Folio 19, however, contains a set of drawings of people and animals in specific poses overlaid with certain geometric shapes (Figure 7.8). Again the wrestlers are sketched, but on this occasion they are overlaid with a triangle with curved sides. Each of these sketches served as a visual reminder of the relationship between significant points on each geometric shape, enabling the mason to set them out using simple compass and line tools, and without recourse to either complex geometry or arithmetic.[32]

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[30] The south window of the chancel at Athenry Dominican friary also includes elements of the same style but on a much smaller scale.

[31] F. Bucher, 'Medieval Architectural Design Methods 800-1560', *Gesta,* 1972, 11 (2), 37-51, p. 38.

[32] Roland Bechmann described many of the sketches of Villard de Honnecourt as "mnemonic tools that assisted trained masons, through associations with human or animal figures, to remember procedures and plans whose details were transmitted orally from master to stonecutter to apprentice. This memory training had a practical goal: it permitted a craftsman to call up easily and rapidly at the workshop a form, a formula, or a proportion": R. Bechmann, *Villard de Honnecourt: la pensée technique au XIIIe siècle et sa communication.* Paris: Picard, 1991, pp. 313-4. Translation given in M.T. Davis, 'On the Drawing Board: Plans of the Clermont Cathedral Terrace.' *Ad Quadratum: the Practical Application of Geometry in Medieval Architecture.* Ed. N.Y. Wu. Aldershot, England: Ashgate Publishing Ltd., 2002. 183-204, p. 190.

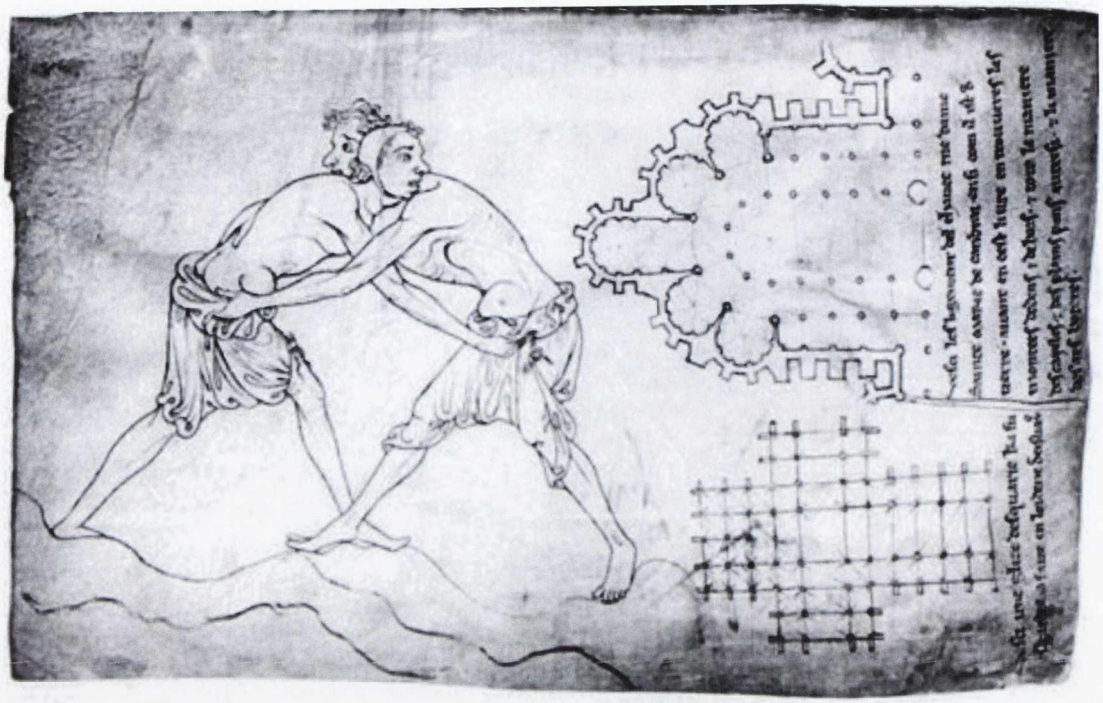

Figure 7.7 Villard de Honnecourt: wrestlers [33]

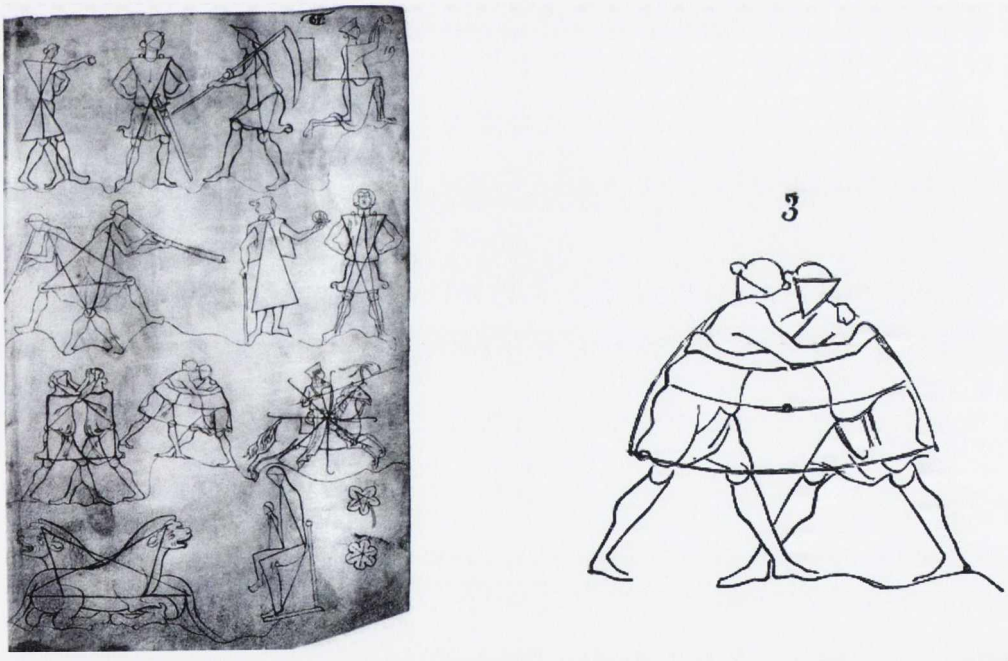

Figure 7.8 Full page from Villard de Honnecourt's sketchbook (left) and detail of the method of remembering the construction of triangles with curved sides [34]

Until now it has been assumed that Irish medieval masons transferred their knowledge through a tradition that was entirely oral or, perhaps, that training manuals

[33] V. de Honnecourt, 1230-70, Triangle with Curved Sides. Wikimedia Commons. http://commons.wikimedia.org/wiki/File:Villard_de_Honnecourt_-_Sketchbook_-_28.jpg
[34] V. de Honnecourt, 1230-70, Triangle with Curved Sides. Wikimedia Commons. http://commons.wikimedia.org/wiki/File:Lutteurs.Villard.de.Honnecourt.2.png

were rare and that all examples have been lost. While the occurrence of a complex design in a single window does not provide evidence of a method of training, it does demonstrate that Irish masons were capable of a level of difficulty in their design of tracery which, on the continent at least, required the use of visual prompts and mnemonics to preserve knowledge between generations of craftsmen. Of course, it is also possible that a foreign mason was employed at Athenry, and the level of patronage certainly makes it feasible that such an extravagance could have occurred. The extracted preferred unit approximated to 0.3048m, which could be original but more possibly relates to the twentieth century reconstruction. The proportions found were 3:4 for overall window width to light height (at springing point), 4:5 for overall window width to window height to spring, and 1:3 for light width to light height (at springing point); all of which align well with typical Connaught standards, making it possible that a local mason created the design.

There appear to have been some differences between how the training of masons was handled in Ireland and in England. The first record of a regulation related to apprenticeship in England appeared in London in 1356, and stated that the process was required to last for seven years.[35] Research by John Harvey and by Douglas Knoop and G.P. Jones indicated that prior to the sixteenth century many masons never served an apprenticeship.[36] It would have been impossible for most masons who were forced to travel for work and often to specialise within a large-scale production environment, to provide the necessities of an apprenticeship – bed and board, as well as a rounded training in the craft. It was only with the security of a role as master mason that taking an apprentice actually became possible, and the earliest evidence found by Knoop and Jones for any form of masons' apprentice in England related to just such a case.[37]

The other alternatives for training masons, stone-cutters or setters, were the following. Firstly, training through familial connections from father to son, uncle to nephew, or older brother to younger brother; a method which agrees well with evidence from Ireland, Germany and Poland, to name a few.[38] No early Irish metrological studies exist for comparison with the late medieval results of this study but the proportions used to set out a number of early Irish stone-built churches are available. This investigation has found that the typical proportions used in medieval window tracery and in the case study

[35] H.T. Riley, *Memorials of London and London life in the XIIIth, XIVth and XVth centuries*. [S.l.]: Longmans, Green, 1868, pp. 280-2.
[36] D. Knoop and G.P. Jones, 'Masons and Apprenticeship', p. 354.
[37] D. Knoop and G.P. Jones, *Medieval Mason*, p. 147-9.
[38] F. Bucher, *Architecktor*; J. Gimpel, *Cathedral Builders,* pp. 192 and T. Ó'Carragáin, 'Habitual masonry styles and the local organisation of church building in early medieval Ireland', *Proceedings of the Royal Irish Academy,* 2005, 105C (3), 99-149.

ground plans agree to some extent with the earlier systems, but that additional proportions had been added to the mason's stock by the late middle ages. However, in both early and late buildings, a significant variety of proportions were used on sites in close proximity, or on the same site. This could be indicative of knowledge handed down through familial ties where trainees were informed of the utility of proportions and of the acceptable variability.

The second option was training by learning on site. The fabric rolls from a number of large works in England and continental Europe include evidence that some named masons received significant increases in their rates of pay over time, probably indicating enhancement in their knowledge and an improvement in their outputs, which would have been commensurate with some form of training programme.[39] The third alternative was where the quarry acted as a nursery for masons who progressed from preparing stone at the quarry, to becoming roughmasons on site and then graduating to the role of stone-cutter or hewer.[40] There is also the possibility at some quarries that such was the expertise that have developed over time, possibly generations, that the quarry masons might provide a range of services to a patron involving design, extraction, carving, and building as is believed to have occurred at the Ham Hill quarry, Somerset.[41] None of the options set out in this paragraph can be validated or refuted by this study.

In Ireland it is certainly possible that apprenticeship was typical for stoneworkers throughout the medieval period because of the precedent set by Brehon law and indicated by the requirements of the *Senchus Már* for the *uctar saer*. These regulations stated that patrons who employed the master were also required to look after pupils or apprentices, albeit at a significantly discounted rate.[42] This type of apprenticeship was probably independent of formal guild association and may have related more closely to the previously-mentioned schools. However, the use of some of the same metrological and proportional systems between the regions of Ormond, Connaught and Desmond could have been the result of apprenticeship of individuals to masters working in different regions. This suggestion is hypothetical, but I would argue that such a link could well be valid.

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[39] These individuals sometimes began work as masons' servants or *famulus,* and were noted as such in the fabric or Exchequer rolls.

[40] D. Knoop and G.P. Jones, *Medieval Mason*, p. 78. Evidence is provided for individuals who were identified at quarries and then at different grades of mason on site.

[41] R. Durman, *Ham Hill: portrait of a building stone*. Reading: Spire Books Ltd, 2006, p. 52.

[42] J. Ní Ghrádaigh, 'Saer', pp. 112-6: "For instance, it specifies that only the master is entitled to salted meat until turcbál, and that his servants, that is his pupils or apprentices, are not. During the turcbál (non-quote: construction which seems to have been deemed more important and dangerous and thus worthy of better remuneration) process however, all the *saers* are entitled to good condiments with their bread, although a distinction is still made between the master and the rest, regarding what they get to drink."

When the Dublin Guild of Carpenters, Millers, Masons and Helliers was formed in 1508 a specification was issued for the type of apprentices to be trained in the craft: "Apprentices to be free, of the English nation, and of good conversation, and to be bound for seven years, under indentures, which were to be enrolled by the clerk of the gild, he receiving half a mark for the use of the gild".[43] Since the guild was based in the English-controlled area of the country this requirement is not surprising, however it does not mean that Irishmen were not trained as masons, rather that a separate system of education could have existed in Ireland's Gaelic regions. The regional differences found between the use of systems of metrology and proportion in Connaught and Ormond, and, to a lesser extent, Desmond could certainly have been perpetuated by differences in apprenticeship or training, where masons only trained local students, as dictated by English-style apprenticeship through a guild system or a Gaelic school-based apprenticeship.[44] After training masons probably became more mobile and travelled to wherever work was available since we know that masons with Irish names worked in Dublin by the late sixteenth century.[45] It is also possible that the rule about apprentices being "of the English nation" was not very strictly applied thus allowing Irish masons to use the system.

7.3 Skill

The suggestion has sometimes been made that Irish architecture suffered from a lack of skill, particularly from the mid-fourteenth century onwards when contact with England was limited.[46] Certainly before this date the evidence from sites such as Gowran collegiate church suggests that masons understood that the application of proportional design principles was useful, and possibly essential, when building. At Gowran, the 3:4

[43] H.F. Berry, 'Dublin Gild', p. 324. Also, an entry related to goldsmiths in the medieval accounts of Dublin records that new masters were admitted to the roll of the city every four years. It might be assumed that the same regulations applied for a variety of apprentices. J.T. Gilbert and R.M. Gilbert, *Calendar*. Thanks to Rachel Moss for bringing this reference to my attention.

[44] As noted above, there are also some similarities between metrology and proportion in these regions and where commonality occurs this could have been achieved through apprenticeship outside a trainee mason's eventual area of practice.

[45] For example, John Kelly, Enfranchised, Dublin 25th December, 1587. 213 and James Connor, Enfranchised, Dublin 26th March, 1592. J.T. Gilbert and R.M. Gilbert, *Calendar of ancient records of Dublin in the possession of the Municipal Corporation of that city*. Vol. 2. 7 vols. Dublin: Dollard, 1889, p. 213 and p. 254. Thanks to Rachel Moss for giving me access to her records of named masons in Ireland.

[46] R. Stalley, *The Cistercian Monasteries of Ireland*. London & New Haven: Yale University Press, 1987, pp. 121-2 (hereafter *Cistercian Monasteries*) and D. O'Donovan, 'Building the Butler Lordship 1405–c. 1552', Ph.D. Trinity College, Dublin, 2007 (hereafter 'Building Butler'), p. 130: "Thus the architecture at Holycross appears to be the result of masons with out of date skills responding to the demands of a sophisticated client"; p. 240 in reference to the cloister at Adare Augustinian friary where some arches are properly three-centred while others are poor attempts at copies, the geometry not being properly understood; and p. 246 in relation to St. Mary's church, Callan where skill at carving was noticeable meaning that "the masons were perfectly capable stone carvers".

proportion championed by the Cistercian order was used in both ground plans and architectural details, mirroring the use of particular ratios at sites in England and continental Europe. However, this ratio was combined with a number of others, such as 1:3 and the golden ratio, suggesting that while geometric principles were used, their application was not rigorous.[47]

There is also early evidence that Irish medieval masons used setting out methods for arches that were not so very different from those used in other locations. Although no tracing houses remain in Ireland analysis of the early thirteenth-century etchings on the transept wall at Corcomroe Cistercian abbey presented in chapter 2 showed that one of the masons working there was capable of setting out a three-point arch, a modified gothic arch, and an equilateral arch of specific proportions, golden section, $1:\sqrt{2}$, and 1:1, respectively.

Evidence from Athenry Dominican priory also demonstrates skill on a par with European and English examples. A high resolution laser scan was made of the nave west window as part of the building case study. The points visible in Figure 7.9 represent the edges found in the high resolution dataset.[48]

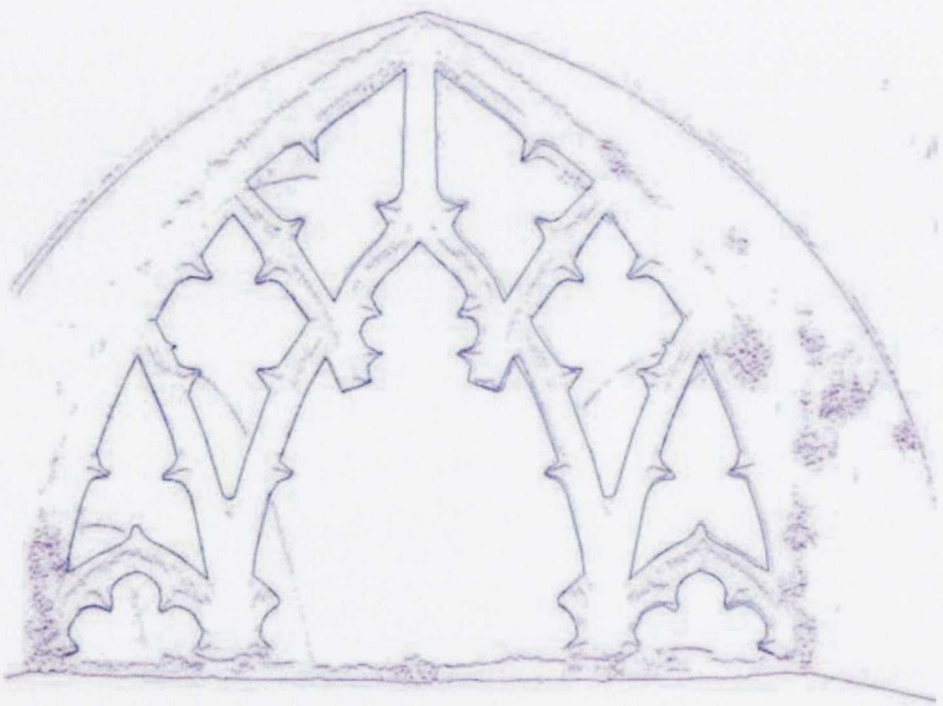

Figure 7.9 Athenry Dominican priory: nave west window from laser scan with overlaid vectors

[47] This finding aligns well with L.R. Shelby's conclusion that Gothic methods were "certainly prescriptive" but "not rigidly restrictive". L.R. Shelby, 'Geometrical Knowledge', p. 420.

[48] The Realworks laser scanning software includes a discontinuity sampling feature which compares each point with its neighbouring points. If the difference in position between two points in any of three dimensions exceeds a certain threshold then the data is deemed to be discontinuous, thus indicating that an edge has been found on the object.

The overlaid linework in the image was actually only digitised for the edges of the left half of the tracery. Using AutoCAD's *mirror* function the linework was then overlaid on the laser points for the right half of the data. As can be observed in Figure 7.9, the fit between the mirrored linework and the measured points is almost perfect and, where errors of some millimetres occur, these can be explained by the difference in incidence angle of the laser beam on the two sides of the tracery. Based on empirical evidence we can say that the mason responsible for this window created high quality work which demonstrated a clear understanding of geometric design principles in the sense of symmetry and repeatability. It also suggests that Irish masons used the same design methods, fully drawing out one side of the tracery and mirroring it for the other, for which evidence has been found in medieval tracing houses in England and continental Europe.[49] Unfortunately, no confirmation could be given by this study of the date of insertion of this window with documentary evidence suggesting either 1324 or post-1423. If the latter date was correct, and there are suggestions that it was (see chapter 5), then this window demonstrates that not all skill comparable with English and continental European masons was lost in Ireland after the mid-fourteenth century.

In analysing later medieval windows and the buildings in which they are found, I would argue that the absence of a proportional pattern between all elements is not reflective of a reduction in the masons' skills, but rather of a different set of skills and method of operation where templates seem to have been little used and design from geometric principles on each occasion was the norm. Examples which have previously been discussed include the similarly styled windows at Clontuskert Augustinian, Cashel Dominican, and Clonmel St. Mary's parish church, and the switchline tracery throughout the study. Irish medieval masons seem to have been unconstrained by the requirement to work to an exact design scheme and used a variety of proportions when allowed to do so.

Danielle O'Donovan argued that the 'lack of skill' was particularly evident when Irish masons were required to "attempt designs alien to their repertoire, such as English Perpendicular forms".[50] However, the results from this study show that even with flowing tracery (e.g. Kilcooly Cistercian abbey's west window) and simple switchline works (e.g. Old Leighlin cathedral's nave south western and, possibly, chancel east windows), where proportional design was used to set out the relationships between lights, tracery field and the overall window, the actual tracery could be poorly executed.

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[49] For example: F. Bucher, 'Medieval Architectural Design Methods 800-1560', *Gesta,* 1972, 11 (2), 37-51 and A. Pacey, *Medieval architectural drawing: English craftsmen's methods and their later persistence (c.1200-1700)*. Stroud: Tempus, 2007.

[50] D. O'Donovan, 'Building Butler', p. 246.

Some of the blame for the seemingly unskilled execution of certain designs may need to be assigned to the patron or client rather than the mason. Instructions about the type of tracery required may have been vague and even though a patron may have been well-travelled, such as James, fourth earl of Ormond, we do not know what form of inspiration would have been provided to the mason. Pattern books were used in some cases (see further discussion below) but in others descriptions may have been verbal or based on sketches, which may not have been taken by masons. As shown by surviving pattern books and medieval drawings, even supposed master masons sometimes produced drawings that would now be considered of poor quality and, at the time, would have been very difficult to copy.[51] This possibly also relates to the medieval concept of copying which did not require the exactitude that we would now expect.

Another suggested indicator in relation to the abilities of a mason is the use of templates. As mentioned when discussing standardisation, there is a limited amount of evidence in this study to show that stonework elements were constructed to exactly the same dimensions, time after time, as would have been the case when templates were used. Although some mullions were similarly dimensioned, not all of these have the same profiles and the measurements may have been coincidental. However, in cases such as Abbeydorney Cistercian and Kilmallock collegiate church with mullions of similar profiles and dimensions it was certainly possible that templates were used, either on site or at a quarry.

At the collegiate church of Gowran in Ormond evidence from the quatrefoil pier bases and capitals implies that templates were not used for these features because, although the pattern of the bases was the same on the middle and eastern pier of the north aisle, the dimensions were not the same. For this result to have been achieved it would have been necessary for a mason to directly set out the design on each occasion when it was used.[52]. It should also have been manageable for the mason to use an arithmetic measure at the beginning of the setting out process to ensure that the end result was the same but, unless the starting blocks were the same size, this would have required a lot more cutting of stone.[53] This may have been considered too costly and instead the mason set out each pier individually to suit the size of the available stone. This finding also

[51] See, for example, R.W.H.P. Scheller and M. Hoyle, *Exemplum: model-book drawings and the practice of artistic transmission in the Middle Ages (ca. 900-ca. 1470)*. Amsterdam: Amsterdam University Press, 1995.
[52] A method by which this design could have been achieved using a straight line and compass was previously proposed.
[53] Such an arithmetic method was demonstrated by Vivan Paul for Narbonne Cathedral: V. Paul, 'The Projecting Triforium at Narbonne Cathedral: Meaning, Structure, or Form?' *Gesta,* 1991, 30 (1), 27-40.

suggests that tracings or engravings, as evidenced at many English and European cathedrals, would not have been necessary.

Using the size of the stone block would explain why metrology differed, even between similar objects in the same building or at nearby sites. This assumes that some quarries did not standardise the blocks that they provided; a hypothesis which is possible if the quarry was owned by the patron and no payment was being exchanged as would have been typical for many Irish medieval sites. Where quarries did produce blocks of fixed size it seems unlikely that these dimensions were standardised between quarries.

One final point relating to the use of templates is that because most medieval Irish building works were relatively limited in scale, the number of masons working at one time must have been quite small. In particular, few banker masons would have been needed relative to the numbers required for setting and the hewing of rough stone. This would have meant that the master mason could have retained a manual role on site and that the templates required at bigger sites as a method of enforcing consistency and stability, as discussed in the literature review, were unnecessary in these circumstances. Only at the large urban sites, such as the cathedrals of Dublin and Waterford, would any works on the scale similar to England and continental Europe have taken place, and at these sites some use of templates at the initial stages of building has been demonstrated. Elsewhere, I think that templates would have been unnecessary and, therefore, they were not utilised. Suggesting that this was a "lack of skill" when it was actually unnecessary for works on Irish medieval scales is unfair to the masons.

As a means of transferring architectural inspirations and as part of the European apprenticeship system, the use of pattern books became widespread at the end of the fifteenth century thus making them another tool in the medieval mason's arsenal.[54] While no copies of such books have been found in Ireland, a possible example from Holycross was previously presented.[55] Interpretation of the contents of a pattern book would have been another skill in the same sense as those presented above.

An example of a problem with interpretation of the pattern book comes from Holycross Cistercian abbey where, although the south transept south chapel east windows display usage of the proportions 1:1, 1:2, and 1:3, the mullions look too heavy for the

[54] F. Bucher, *Architecktor*.

[55] "It is tempting to think that a number of Holycross' design elements were derived from a collection of architectural pattern drawings brought together specifically for the construction of the Abbey. If this is true, the drawings represented forms and motifs from a wide chronological range of sources; this would certainly explain the difficulty in establishing a chronology at Holycross and beyond." D. O'Donovan, 'Building Butler', p. 229 and D. O'Donovan, 'Holycross and the Language of Irish Late Gothic.' *Limerick and South-West Ireland: Medieval Art and Architecture.* Ed. R. Stalley. Vol. 34. *British Archaeological Association (BAA) Conference Transaction Series*. Limerick, Ireland: British Archaeological Association, 2011.

tracery field. The style of this tracery is very similar to a late-fifteenth-century south aisle window in the Hospital church in Esslingen, Germany (Figure 7.10 and Figure 7.11).

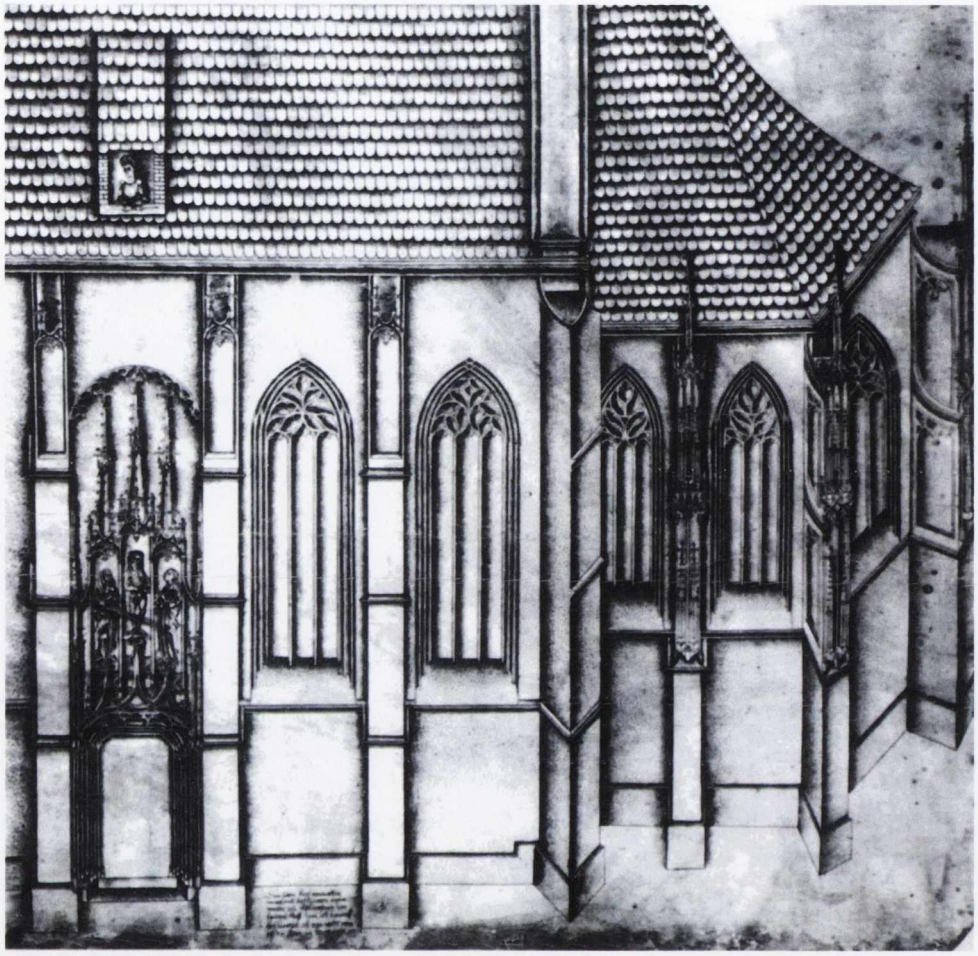

Figure 7.10 Hans Böblinger: the Hospital church of Esslingen (Vienna Akademie) after Bucher[56]

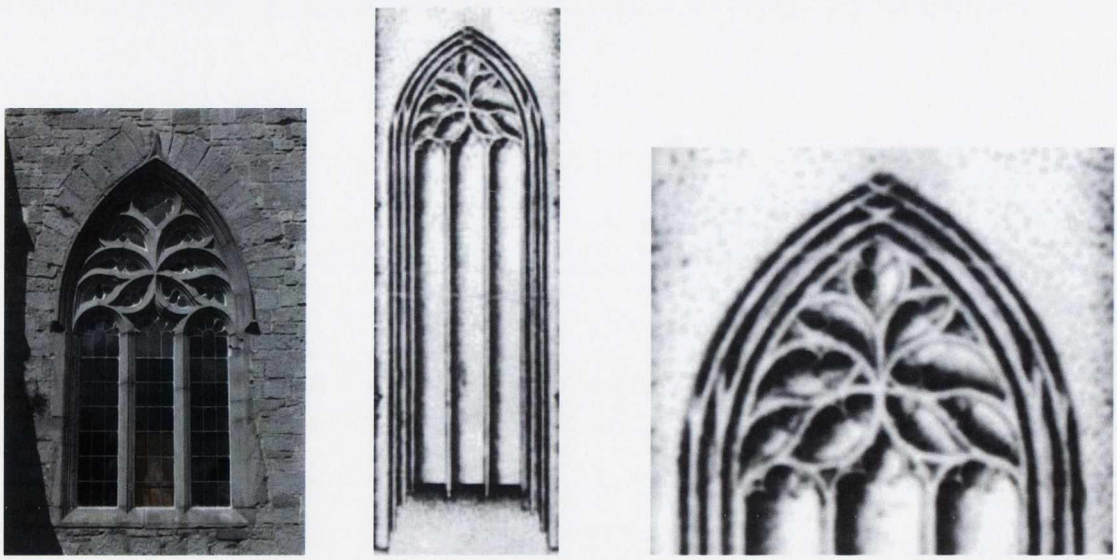

Figure 7.11 South transept south chapel east window, Holycross Cistercian abbey (left) and south aisle

[56] F. Bucher, Design in Gothic Architecture: A Preliminary Assessment, *The Journal of the Society of Architectural Historians,* 1968, 27 (1), 49-71, pp 70 (hereafter *Design*).

windows, Hospital church, Esslingen (mid and right).

The engraving in Figure 7.10 was produced in 1501 by Hans Böblinger the Younger (also known as Beblingen or von Boeblingen) and depicts a building designed by his father, Matheus, who was the second son of Hans Böblinger the Elder.[57] In the drawing Hans is shown holding a 'measuring rod' and François Bucher suggested that this drawing was a model for an engraving to be used in an architectural sketchbook.[58] If true, then it seems that this, or a representation of a similar window, could have been one of the entries in the Holycross pattern book.[59] One could speculated that in transferring the pattern book design to actual window tracery no proportional information would have been available and the mason may have used a standard size of mullion even though it made the window seem heavy, unlike the original.[60]

The variations between the German drawing, if something of the type was used in works at Holycross, and the Irish window reflect the nature of medieval pattern books as sources of inspiration rather than models to be slavishly copied.[61] This evidence would agree with medieval precedent as recognised by L.F. Salzman who suggested that some of the windows at Westminster Abbey were designed using Villard de Honnecourt's sketch of the tracery at Reims as "the working drawing" at the request of Master Henry de Reins.[62]

Since the pattern books were unlikely to have included dimensional information we could not expect to be able to trace foreign influences through measurement of windows created in this way. A proportional system would have been easier to transfer through the simple use of dividers. An example of very similar four-light, elaborated switchline windows at Cashel Dominican friary, Moyne Franciscan friary (*2) (Figure 7.12), Ardfert cathedral, and Ardfert Franciscan friary (Figure 7.13) suggests use of a pattern book because the physical distance between them would have made it unlikely that a mason travelled this far; ~160km, 190km, and 150km between the three locations.

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[57] F. Bucher, *Architecktor*, pp. 375-411.
[58] F. Bucher, *Design*, pp. 69-70.
[59] Danielle O'Donovan also suggested that the "square leaves on some of the panels of the font basin at Fertagh" "may be seen as simplified versions of the kind found in Hans Boeblinger's *Leaf Pattern Book* of 1435" as seen in F. Bucher, *Architecktor*, pp. 383-402. D. O'Donovan, 'Building Butler', p. 230.
[60] In fact the width of the mullions for all of the east facing transept windows, both north and south, are the same at c. 0.134m.
[61] In the modern sense of the word copy.
[62] L.F. Salzman, *Building in England down to 1540: A Documentary History*. Oxford, England: Oxford University Press, 1952, p. 18 (hereafter *Building in England*).

Figure 7.12 Nave west, Cashel Dominican friary (left) and chancel east (middle) and south transept south (right), Moyne Franciscan friary

Figure 7.13 South transept south, Ardfert cathedral (left) and south transept south, Ardfert Franciscan friary (right)

Different units of measurement were found for all windows: Moyne east 0.318m/0.366m, Moyne south transept south 0.372m, Cashel west 0.290m, Ardfert cathedral south transept east 0.260m, and Ardfert Franciscan south transept south 0.264m. This would be in line with expectations, if based on a pattern book. The only similarity in terms of element size is that the mullion widths at the Kerry sites range from 0.119m to

0.127m, while at Moyne the widths range between 0.115m and 0.127m.[63] Such similarity might have been coincidental because of the lack of similarity in other elements. The proportions, which might have been expected to display some likeness, also did not match. Only the ratio of the mullion width to light width suggested any proportional similarity between the windows with values close to the 1:4 proportion. The use of this ratio for this relationship is so commonplace that it cannot be counted as evidence. Thus, in the Irish medieval case, no regard seems to have been taken of proportions in design ideas transferred over long distances, perhaps using a pattern book. This is actually a consistent result because it aligns with the findings thus far which show that repeatability of proportional use does not seem to have been important to Irish medieval masons.

To conclude the section on skills, I would contend that, far from being unskilled, Irish late medieval masons were entirely flexible and adapted their methods, of which they had many, to suit the conditions of a particular project.

7.4 Masons' mobility within Ireland

Our expectations about the mobility of masons within Ireland have been shaped by evidence from England and some areas of the continent, where masons are known to have travelled great distances, as detailed by documentary evidence.[64] In England, a frequent cause of travel for masons was the practice of impressment.[65] Although not generally used in Ireland, one reference from 1399 linked the requisition of materials for the repair of Dublin Castle to the appointment of two individuals "to take and arrest carpenters, masons, plumbers and transport, in England, Wales and Ireland, within the liberties as well as without (Church lands excepted)".[66] In this way both native and non-native masons could have moved to different parts of the country, thus exposing the craftsmen and the areas to different influences. Even without impressment, royal works were sometimes responsible for the movement of masons, as documented by the Irish

[63] The range being the combined result or modern measurement variations plus possible medieval contributions.

[64] The fame of some master masons was sufficient for them to be incentivised to travel long distances to work on specific projects. An example from the provost's records from Paris in 1287 show that Etienne de Bonneuil was to become the "master-builder of the church of Uppsala in Sweden" and that he would take with him a sufficient quantity of companions and apprentices. Another occasion from 1303 recorded an arrangement between the bishop and chapter of the cathedral of Valencia, Spain and the master mason, Nicolas of Southampton.: M. Durliat, 'Les attributions de l'architecte à Toulouse au début do XIVe siècle', *Pallas,* 1962, 11, 205-12.

[65] D. Knoop and G.P. Jones, 'The Impressment of Masons in the Middle Ages', *The Economic History Review,* 1937, 8 (1), 57-67.

[66] T. O'Neill, *Merchants and mariners in medieval Ireland.* Bury St. Edmunds, Suffolk, England: St. Edmundsbury Press, 1987, p. 93.

Exchequer Roll of the term of the Nativity of St. John the Baptist 1284 where 12 masons received "their expenses towards Connaught".[67]

A precedent for mobility was also set by pre-Norman Irish society where masons had freedom to travel with their craft through exercise of their free status, or 'franchise'.[68] Particularly in the Gaelic parts of Ireland, this practice is unlikely to have changed during the later middle ages, suggesting that masons would have continued the tradition of travelling in order to obtain work. The range of this movement included in the Brehon documents indicates that masons could travel outside their *tuath* but this area was typically small, no more than some tens of kilometres squared, and probably not extending beyond the regions in this study.

The regional nature of some of the findings of this investigation suggests that Irish medieval masons generally did not travel over great distances. While some metrological units were used throughout the country, some were only employed in either Ormond or Desmond regions. Connaught's metrology was more limited than either of the other two regions and this suggests that masons based there were less mobile than in other parts of the country. Great variety in the use of proportions was a characteristic throughout the entire area of study, but the evidence indicates that here too some regional differences occurred. In particular, 13:23 and 4:5 were more and somewhat more used, respectively, in Connaught than elsewhere, while 5:6 was most frequently used in Ormond.

Some documentary records do however, exist that describe issues surrounding the mobility of masons. An entry in the Dublin Assembly Records of 1602 details a complaint

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[67] H.S. Sweetman, *Calendar of documents relating to Ireland, preserved in Her Majesty's Public Record Office, London*. Vol. 1. 5 vols. London: Longman: Trübner, 1875, p.519: 1284 Edward 1, Irish Exchequer, Bundle 530.

[68] J.R. Peden, 'Property rights in Celtic Irish law', *Journal of Libertarian Studies,* 1977, 1 (2), 81-95, p. 86 where 'franchise' means 'free status'. An idea of the standing of stone masons in Irish society can be gained from the stories of the Gobán Saor, which demonstrate a significant amount of respect for the skills shown by the master craftsman. Lady Gregory, 'Gobán Saor'. Eoin MacNeill's study of rank in early Ireland demonstrated that *saers* were held in high regard: "V 90.-37. Subject *nemith*, now, wrights and blacksmiths and brasiers and whitesmiths and physicians and jurists and druids and the folk of every art and craft besides ... The franchise of jurists and wrights increases till it reaches food-provision for twelve men and fifteen chattels for *díre*." "V 92.-38. If he be a jurist of the three rules-the rule of Féni, and the rule of *filid*, and the rule of the white speech of Beatus; if he be a chief master craftsman, he rises to twenty chattels for *díre*, and has a month's protection." "V102, V 104.-47. The accurate wright of oaken houses is equal in franchise to an *aire désso*. The diligent wright of ships and barks and hide-covered boats and vessels, who is able to make all of these, has the same amount of franchise. The millwright, the same amount. The master of yew-carving, the same amount. The franchise of an *aire désso* to each of them. V 104.-48. The man who practices together two or three [of the aforesaid crafts is entitled to an honourprice of the value of eight milch-cows, and to food-provision for eight men]. V 104.-49. The man who practices together four (of the crafts aforesaid), fifteen chattels for his *dire*, and food-provision for twelve men, and ten days' protection for him." "V 104.-50. Chariot-wright and house-carpenter and cloth-figurer and relief-carver and shieldmaker, the franchise of the second *bóaire* for them. If be practice together two crafts of them, the franchise of the first *bóaire* for him.": E. MacNeill, 'Ancient Irish law: the law of status or franchise', *Proceedings of the Royal Irish Academy: Section C,* 1923, 36, 265-316, pp. 277-9.

by the citizens of Dublin that artificers, masons, carpenters, and slaters were leaving the city to work in the countryside during the summer. Since this action left a shortage of skills in the city the Assembly decreed that the craftsmen could be brought back if needed.[69] Outside of Dublin, the exploitation of *coign* by the Earl of Ormond's in the early sixteenth century extended "to include the billeting of masons, builders, carpenters, horses, horse boys, and even hounds".[70] This practice indicates that sometimes craftsmen moved in groups at the behest of, and at significant cost to, the local nobility and this must be evidence that their reason for travel was to carry out building works supported by these lords.[71]

Evidence of masons' travel is suggested between Kilconnell and Askeaton Franciscan friaries (Figure 7.14). At Kilconnell, the western window in the south wall of the south transept was possibly designed using a unit of 0.353m.[72] Meanwhile, at Askeaton the eastern window in the north wall of the chancel, which shares a very similar style, demonstrated use of a standard of 0.344m, within the 1cm tolerance of the study. While the units for the rest of the windows at Askeaton all centre about 0.345m, at Kilconnell the 0.353m unit is used only once. Although measurements taken of the window elements are substantially different, the metrological link would suggest a level of similarity beyond visual copying. At both sites these windows are vastly different to all of the other tracery on site and the unit of measurement is also an anomaly.

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[69] J.T. Gilbert and R.M. Gilbert, *Calendar*, I, p. 396. Thanks to Rachel Moss for bringing this reference to my attention.

[70] J.S. Brewer and W. Bullen, eds. *Calendar of the Carew Manuscripts, preserved in the Archiepiscopal Library at Lambeth. (1515-1624)*. Vol. 1. 6 vols. London: Longman & Co., 1867, p. 25; C.A. Empey, 'County Kilkenny in the Anglo-Norman Period.' *Kilkenny: history and society: interdisciplinary essays on the history of an Irish county.* Eds. W. Nolan and K. Whelan. Dublin: Geography Publications, 1990. 75-106, p. 94.

[71] Coign was only permitted under the Statutes of Kilkenny under two conditions: if payment was made and if consent was given: Statutes of Ireland King John to Henry V, pp. 446-7. Part of the reason why the statutes mention the first condition is that liberties had been taken in relation to the numbers requiring *coign* by some ruling families, resulting in complaints to the crown.

[72] The most probable unit for this window was 0.254m while 0.353m was just outside the typical thresholds of this study. However, such was the similarity of the designs of the Askeaton and Kilconnell windows that further investigation was warranted.

Figure 7.14 South transept south western, Kilconnell Franciscan friary (left), north eastern, Askeaton Franciscan friary (middle), and south transept west, Adare Augustinian friary (right)

Based on this evidence, I would argue that this suggests that this particular travelling mason produced single pieces of tracery design. This would make sense given the piecemeal nature of much friary architecture and the likelihood of individual patrons being responsible for the sponsorship of one-off windows, as has been demonstrated at Athenry. This theory is supported by the presence of a single elaborate window at Adare Augustinian friary, a building in which switchline tracery predominates, with a suggested unit of 0.349m. This window, on the west side of the south transept, is similar to, although more complex in design than, the examples at Askeaton and Kilconnell (Figure 7.14). It is possible that the same mason could have been responsible for all three windows.

The Askeaton/Kilconnell/Adare mason could have operated in the same way as a mason called Master Thomas the Plumber, whose work was investigated by Jean Givens through the accounts of Exeter cathedral between 1279 and 1514. Thomas' work was intermittent but highly paid, and that he was only employed to work on specific artistic pieces. The carving work was carried out at Ham Hill quarry in Somerset and delivered to the cathedral fully shaped. Givens suggested that this and other evidence from the cathedral rolls demonstrate that the rank of 'sculptor' was of different status, and thus paid very differently, to the regular 'mason' or to a master mason.[73] Perhaps the Irish mason/sculptor operated in a similar way.

Concluding the discussion on movement within Ireland, I believe that the reason why few Irish masons travelled beyond particular defined regions seems to have related to their attachment to particular schools of masonry or to the retinues of particular patrons.

[73] J.A. Givens, 'The Fabric Accounts of Exeter Cathedral as a Record of Medieval Sculptural Practice', *Gesta,* 1991, 30 (2), 112-8, pp. 113-4.

These schools would have been based at specific locations and worked in limited regions such as Cashel, Holycross, Limerick, and the School of the West.[74] While some examples of almost 'independent' masons were found, these seem to have operated in the minority, as was suggested in England by Jean Givens.

7.5 Masons' mobility beyond Ireland

The second aspect of mobility relates to the movement of masons into and out of Ireland. Roger Stalley argued that by 1350 there was "no evidence of the transfer of masons from England to Ireland" due to the absence of "great works in the 'Decorated' or 'Perpendicular' style".[75] Prior to that date documented examples of English masons working in Dublin include a Worcestershire craftsman who 'was brought to Ireland to work on Christ Church Cathedral" in 1213 and Nicholas de Covintre (Coventry), *cementarius*, who became a free citizen of Dublin (1225-1250).[76] John Harvey's bibliographical dictionary includes examples of at least four English masons or surveyors working in Ireland: 1304 John Matheu surveyor, 1324-1342 Robert Lengynour [Ingeniator] military castle work, and 1334-1336 John de Corfe, chief keeper, purveyor.

However, Rachel Moss has demonstrated that post-1350 there is significant evidence from the names of English and Welsh masons that they were brought into Ireland to work on various royal projects.[77] In 1394 Richard II issued an expulsion order to all Irish living in England.[78] This command must have led to the arrival in Ireland of at least some masons with knowledge of English building methods.[79]

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[74] For the Cashel, Holycross and Limerick schools see C. Hourihane, *Masons' Marks*; for a more detailed examination of the Holycross school see D. O'Donovan, 'Building Butler' and for the School of the West see H.G. Leask, *Irish Churches II* and B. Kalkreuter, *Boyle Abbey*.

[75] R. Stalley, *Architecture and Sculpture*, p. 142; the idea is repeated in R. Stalley, *Cistercian Monasteries*, p. 122 where Stalley suggests that "after 1350 an English trained mason, at least outside the Pale, must have been a rarity".

[76] R. Stalley, *Architecture and Sculpture*, p. 23 and H.F. Berry, 'Dublin Gild', p. 322.

[77] For example, Luke de Hynkeleye who in 1327 was Master of works, responsible for overseeing works to Dublin castle, the exchequer and King's Mills in Dublin. PRI rep. DK, xliii, 27 and Thomas Burell who was Master of works at Dublin Castle between 1278-85: Exchequer payments, I, 30-3, 36-7, 41-2, 44, 49, 50-2, 55-7, 60-1, 63-4, 74, 76-7, 84, 86, 91, 93, 96, 98-9, 105, 107. Thanks again to Rachel Moss.

[78] Calendar of patent rolls, 1391-6, pp. 451-65, 468-9, 471, 486.

[79] The exact numbers can only be guessed working from knowledge that 521 licenses were granted to individuals to remain in England. James Lydon has suggested that this figure may represent one quarter of the total thus implying that approximately two thousand Irish could have returned home. J. Lydon, *The Lordship of Ireland in the Middle Ages*. Dublin: Four Courts Press, 2003, p. 139 (hereafter *Lordship of Ireland*). Modern statistics for Ireland show that ~12% of the population are engaged in construction-related work; up to 5% of that total are professionals. Taking this modern information as an indicative figure and projecting back to the 2000 returning Irish, potentially 100 masons could have arrived in Ireland at the start of the fifteenth century. Central Statistics Office, 'Population Census of Ireland 2006.' Dublin, 2007. Government of Ireland. Viewed September 2009.
<http://beyond2020.cso.ie/Census/TableViewer/tableView.aspx?ReportId=75576>.

In one of the earliest structures in this study, Gowran collegiate church, a number of design features, including windows, pier capitals and pier bases, suggest that the building's master was English, or had trained in England, due to the correspondence with a number of churches in England.[80] The preferred measurement unit at Gowran was *c.*0.280m and I have previously argued that this unit probably arrived in Ireland with the Anglo-Normans via the masons who travelled as part of a retinue. Either through family connections or undocumented apprenticeship the succeeding generations of masons who actually worked at Gowran would have continued the use of this "foreign" measurement standard.

The north window of the north transept at Athenry Dominican priory (Figure 7.15) incorporates a tracery design that suggests foreign influence due to the presence of the triangle with circular sides, as included in a mnemonic in Villard de Honnecourt's sketchbook. The moulding profile of this window (Figure 7.16 right) is also significantly more complex than the other windows on site (e.g. the probably contemporary north aisle north window Figure 7.16 left) with, perhaps, the exception of the chancel east window prior to downsizing (Figure 7.17). It is the only window where a plain roll is used; on the east window a roll and fillet moulding was used.

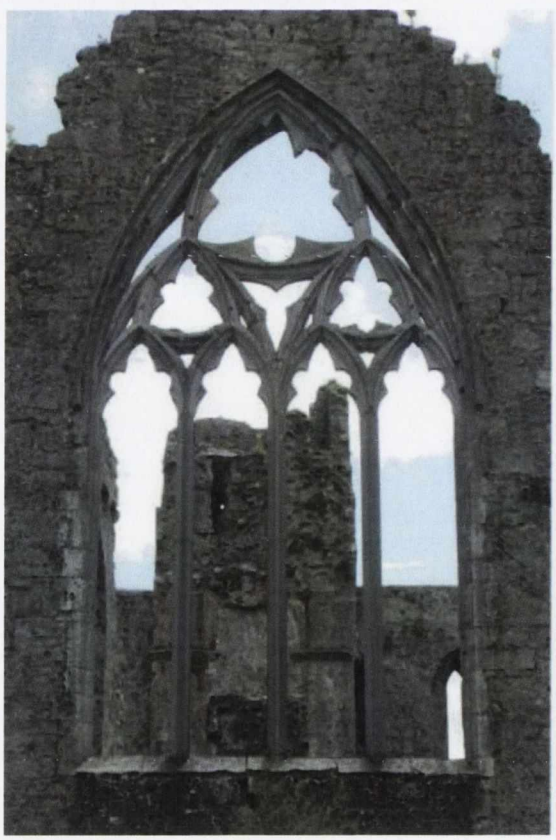

Figure 7.15 North transept north, Athenry Dominican priory

[80] R. Stalley, *Architecture and Sculpture*, pp. 79-80.

Figure 7.16 North aisle north western mouldings (left) and north transept north mouldings (right), Athenry Dominican priory

Figure 7.17 Chancel east moulding, Athenry Dominican priory

For comparison reasons the same experiment was carried out on a slightly lower resolution terrestrial laser scan of the north transept north window (Figure 7.18). As for the nave west window, the laser data was first processed using discontinuity sampling before digitising linework for the left half of the tracery. The linework was then mirrored along the centre line of the tracery field to also overlay the lines on the laser points for the right half of the tracery. The results are significantly poorer than for the nave west window with many of the vectors on the right side not aligned with the laser points. It is difficult to know whether to assign the blame for this error at the feet of the modern conservation masons or their medieval counterparts. Therefore, I will only comment that the poorer quality results demonstrated for the north transept north window serve to emphasise the highly skilled work still visible in the west window of the nave.

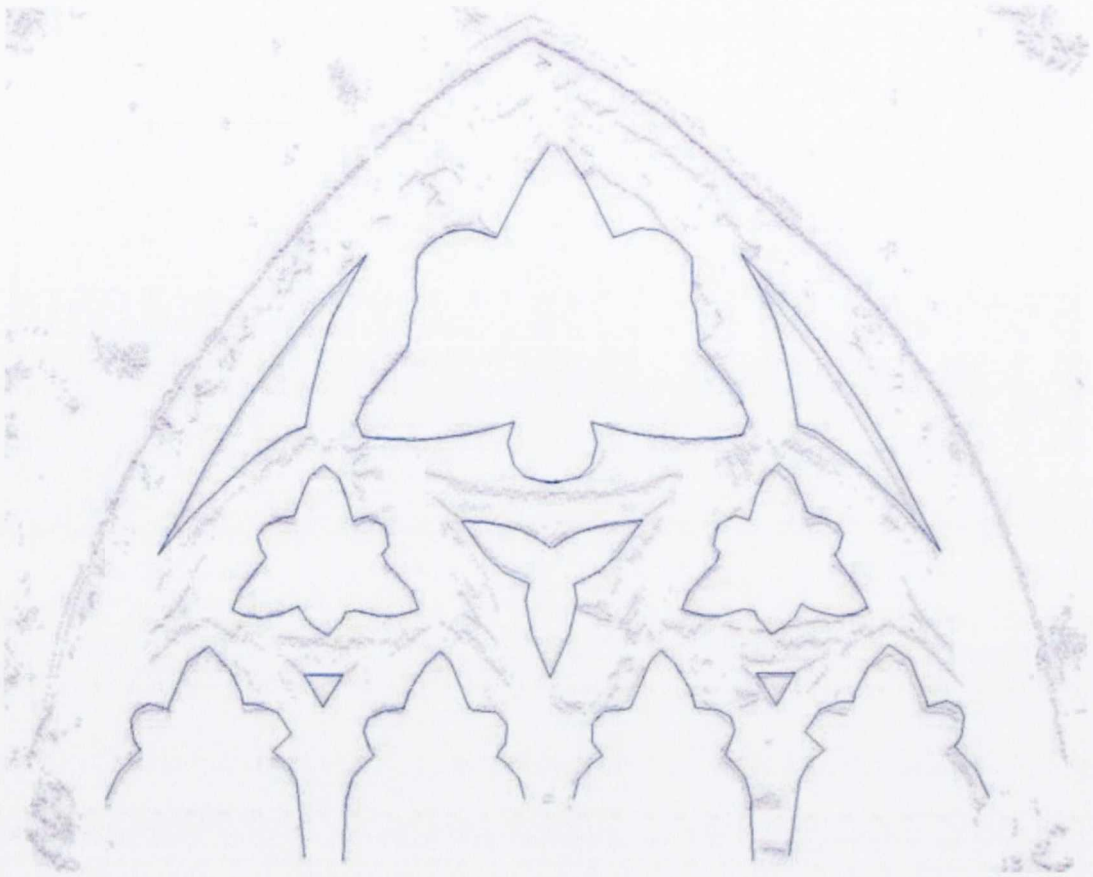

Figure 7.18 Athenry Dominican priory: north transept north window from laser scan with overlaid vectors

Although the convex-sided triangular window was popular in France, e.g. Ste-Chapelle de Paris, and in England, e.g. at Westminister Abbey, in Kent and beyond through development of Kentish tracery, in the thirteenth and early fourteenth centuries, by the mid-fourteenth century when the Athenry window was probably installed, the English fashion had begun to move towards rectilinear designs.[81] The origin of the craftsman who created this window was, therefore, possibly Scotland where this motif endured. In Scotland, the circular triangle is found in tracery from approximately the turn of the fifteenth century at sites such as Melrose Cistercian abbey (Figure 7.19 and Figure 7.20), Dunkeld cathedral, Paisley abbey and Linlithgow parish church.[82] From an

[81] See, for example, S. Hart, *Medieval Church Window Tracery in England*. Woodbridge: Boydell Press, 2010, p. 68. It is noted that some examples of triangles with curved sides occur in decorated windows such as at Alderbury, Shropshire and Maison Dieu, Dover (T. Rickman, *An Attempt to discriminate the Styles of Architecture in England from the Conquest to the Reformation with a sketch of The Grecian and Roman Orders*. Fifth edition with very considerable additions and new plates ed. London: John Henry Parker, 1848, p. 153. Google books edition p. 242.) and Great Hale, Lincolnshire (E. Sharpe, *Decorated Windows: A Series of Illustrations of the Window Tracery of the Decorated Style of Ecclesiastical Architecture, edited with descriptions*. London: J. van Voorst, 1849) but this form is not typical.

[82] R. Fawcett, 'Scottish Mediaeval Window Tracery.' *Studies in Scottish antiquity presented to Stewart Cruden.* Ed. D.J. Breeze. Edinburgh: Donald, 1984, pp. 167-8.

inscription at Melrose abbey we know that the master mason responsible for the tracery designs there was the Paris-born John Morow who "had in keeping all the mason work of St Andrews, the high kirk of Glasgow, Melrose and Paisley, of Nithsdale and Galloway" (Figure 7.21).

Figure 7.19 South aisle from the south east (left) and tracery including triangle with curved sides, seventh chapel from the west, south aisle (right), Melrose Cistercian abbey

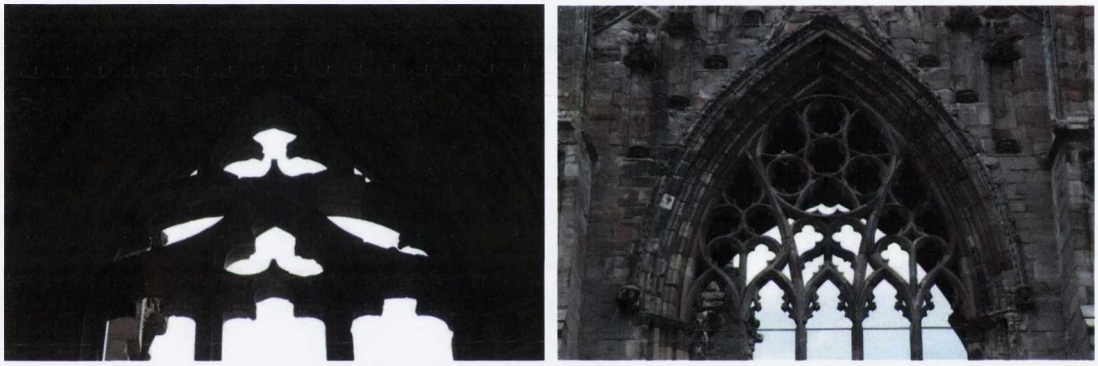

Figure 7.20 Tracery including triangle with curved sides, eight chapel from the west, south aisle (left) and south transept south window also including triangles with curved sides (right), Melrose Cistercian abbey

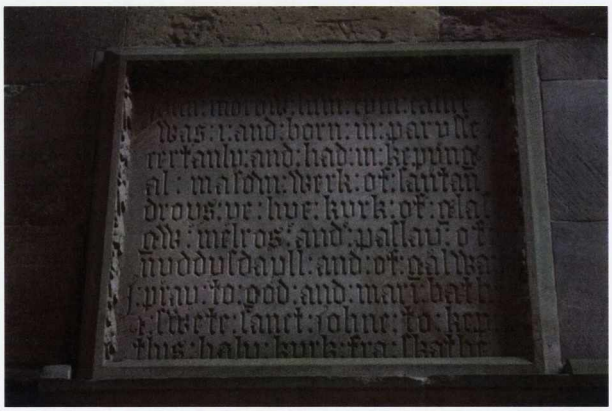

Figure 7.21 Inscription from the south transept to John Morow, Melrose Cistercian abbey

The original unit of measure is uncertain because of the twentieth-century reconstruction, but it is possible that the unit derived by this study of 0.302m actually related to the original design, and therefore, indicates that a foreign mason created it.

7.6 Mobility of a pattern book

In chapter 4 a case was presented for the existence in the Ormond region of a 'pattern book' which had been assembled for the reconstruction of Holycross Cistercian abbey in the fifteenth century. As well as circulating widely within Ormond, this book, or at least sections of it, may also have moved beyond the borders of medieval Ormond and into parts of Desmond, Connaught, and even beyond the areas of this study to Devenish Island in modern Fermanagh.

Examining first the MacGillapatrick tomb from Fertagh parish church the tracery of the left panel (Figure 7.22), as well as being similar to tracery at Callan Augustinian friary, displays some resemblance to a high window in the nave north wall of the Carmelite friary in Loughrea, Connaught (Figure 7.23). Given the rectangular shape of this window not all of the same measurements and proportions could be taken but 4:5, the golden ratio, 1:3 and $1:\sqrt{2}$ were all found (Table 7.1). While 4:5 and 1:3 were typical of both Ormond and Connaught, the golden ratio and $1:\sqrt{2}$ were used more in Connaught, although not with high frequency. This would suggest, as had been found for windows within Ormond based on the probable contents of the Holycross pattern book, that only the style of the tracery was transferred and that local masons then applied their existing proportional knowledge to the selected pattern.

Figure 7.22 MacGillapatrick tomb frontal, parish church Fertagh (photo credit Rachel Moss)

Figure 7.23 Nave north wall, Carmelite friary, Loughrea

Table 7.1 Loughrea Carmelite friary: proportional investigation

	Loughrea		
	Nave North External		
Proportions	Single	Light 1	Light 2
Tracery field height to light height (at springing point)		0.485	0.474
Tracery field height to light height (at arch peak)		0.888	0.895
Tracery field height to overall window height	0.628		
Overall window width to overall window height	0.792		
Light width to light height (at springing point)		0.921	0.901
Light width to light height (at peak)		0.593	0.588
Light width to overall window width		0.418	0.417
Light width to overall window height		0.331	0.330
Window width to light height (at springing point)		0.385	0.375
Window width to light height (at peak)		0.704	0.709
Mullion width to overall window width			
Mullion width to light width		0.191	0.191

Ratio	Numeric Value	1%		2%	
1 : 4	0.250	0.253	0.248	0.255	0.245
1 : 3	0.333	0.337	0.330	0.340	0.327
2 : 5	0.400	0.404	0.396	0.408	0.392
1 : root 5	0.447	0.452	0.443	0.456	0.438
1 : 2	0.500	0.505	0.495	0.510	0.490
13 : 23	0.565	0.571	0.560	0.577	0.554
1 : root 3	0.577	0.583	0.572	0.589	0.566
3 : 5	0.600	0.606	0.594		
377 : 610	0.618	0.624	0.612	0.630	0.606
2 : 3	0.667	0.673	0.660	0.680	0.653
1 : root 2	0.707	0.714	0.700	0.721	0.693
3 : 4	0.750	0.758	0.743	0.765	0.735
4 : 5	0.800	0.808	0.792	0.816	0.784
5 : 6	0.833	0.842	0.825	0.850	0.817
1 : 1	1.000	1.010	0.990	1.020	0.980

Two-light windows based on the central panel of the Macgillapatrick tomb (Figure 7.22) were found in Connaught at Burriscarra Augustinian friary and Ross Errilly Franciscan friary (Figure 7.24). In Ulster a cusped version of this window is now inserted

in the Church of Ireland at Monea but it originated at Devenish Augustinian priory (Figure 7.25). Since this location is outside the area of study it was not measured.

Figure 7.24 South aisle east, Burriscarra Augustinian friary (left) and south transept west, Ross Errilly Franciscan friary (right)

In the Ross Errilly window the tracery field height is half the height of the overall window height and 4:5 of the light height (at arch peak). At Burriscarra, the tracery field height is only 1:3 of the height of the overall window and the relationship between the tracery field height and light height does not match any known ratio. Burriscarra's lights are noticeably more slender than Ross Errilly's, demonstrated numerically by the 1:4 ratio between width and height. However, Burriscarra's mullions are thicker relative to the light width than would probably have been necessary to hold glass in place in a taller window. While most of the windows at Ross Errilly have units of the longer foot type, 0.328m or more, the probable unit for the south transept west window was 0.254m thus marking it as distinct from the other windows. The unit at Burriscarra was definitively 0.341m. Although the two designs may have shared a source of inspiration, the execution of the design in the tracery field, as well as the use of metrology and proportion, varies significantly. This is again in agreement with the assumption that the pattern book was a visual guide but without any numerical or proportional information.

Table 7.2 Burriscarra Augustinian friary and Ross Errilly Franciscan friary: proportional investigation

	Burriscarra South Aisle East			Ross Errilly South transept west		
Proportions	Single	Light/ Mullion1	Light/ Mullion2	Single	Light/ Mullion1	Light/ Mullion2
Tracery field height to light height (at springing point)		0.528	0.525		0.939	0.951
Tracery field height to light height (at arch peak)		0.472	0.477		0.813	0.814
Tracery field height to overall window height	0.328			0.491		
Overall window width to overall window height	0.298			0.465		
Overall window width to window height to spring	0.444			0.914		
Overall window width to arch span	0.810			1.004		
Light width to light height (at springing point)		0.248	0.234		0.437	0.460
Light width to light height (at arch peak)		0.222	0.213		0.378	0.393
Light width to overall window width		0.517	0.490		0.491	0.510
Light width to overall window height		0.154	0.154		0.228	0.228
Light width to arch span		0.419	0.397		0.493	0.512
Overall window width to light height (at springing point)		0.480	0.478		0.890	0.901
Overall window width to light height (at arch peak)		0.429	0.434		0.771	0.772
Mullion width to overall window width		0.188			0.094	
Mullion width to light width		0.364	0.383		0.192	0.185

Ratio	Numeric Value	1%		2%	
1 : 4	0.250	0.253	0.248	0.255	0.245
1 : 3	0.333	0.337	0.330	0.340	0.327
2 : 5	0.400	0.404	0.396	0.408	0.392
1 : root 5	0.447	0.452	0.443	0.456	0.438
1 : 2	0.500	0.505	0.495	0.510	0.490
13 : 23	0.565	0.571	0.560	0.577	0.554
1 : root 3	0.577	0.583	0.572	0.589	0.566
3 : 5	0.600	0.606	0.594		
377 : 610	0.618	0.624	0.612	0.630	0.606
2 : 3	0.667	0.673	0.660	0.680	0.653
1 : root 2	0.707	0.714	0.700	0.721	0.693
3 : 4	0.750	0.758	0.743	0.765	0.735
4 : 5	0.800	0.808	0.792	0.816	0.784
5 : 6	0.833	0.842	0.825	0.850	0.817
1 : 1	1.000	1.010	0.990	1.020	0.980

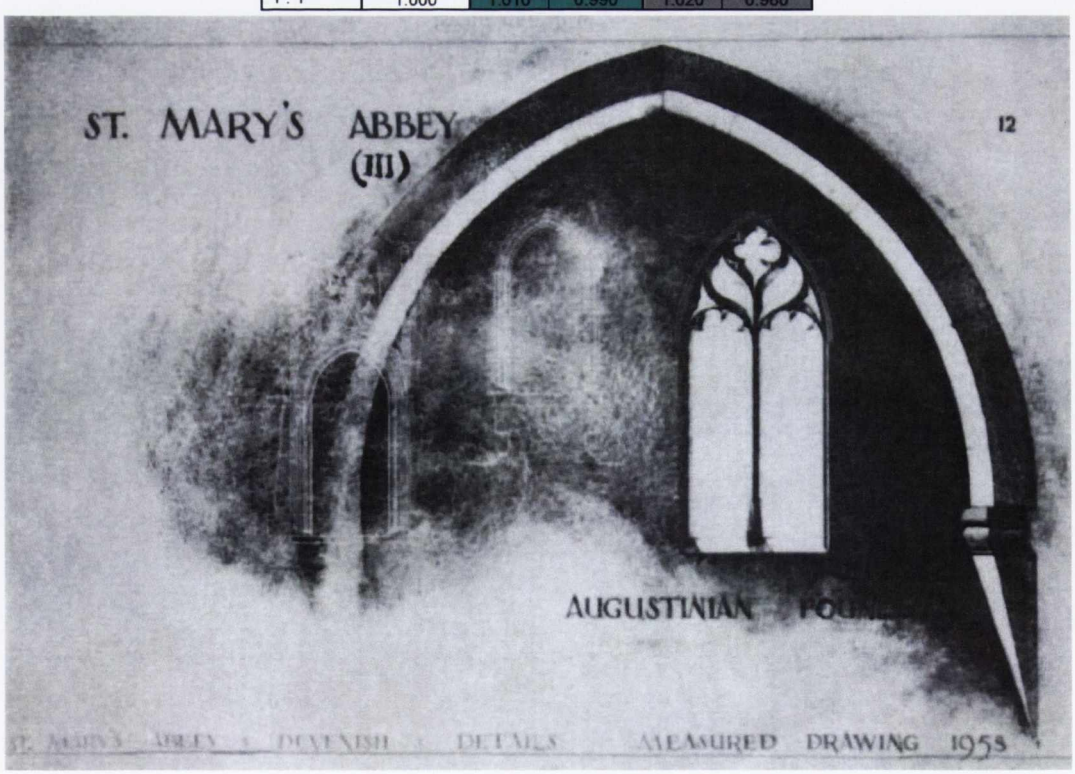

Figure 7.25 Devenish Augustinian priory east window now relocated to Monea Church of Ireland

The other location where two-dimensional representations of elements contained in the Holycross pattern book were found was on the medieval font from Fertagh parish church (Figure 7.26)

Figure 7.26 Fertagh font, side 1, Johnstown Roman Catholic church (photo credit Danielle O'Donovan)

As was previously discussed, no window in Ormond contained tracery that exactly matched the pattern shown in Figure 7.26. Beyond the borders, very good matches for the four-light switchline window tracery without interruption at the light heads were found at Rathkeale Augustinian priory (0.228m or 0.366m), Muckross Franciscan friary (0.365m), Adare Franciscan friary (0.337m and 0.294m), Adare Trinitarian church (0.348m), and St. Mary's cathedral, Limerick (0.367m). While three windows share a unit of measurement, the proportions of the six windows vary significantly. Importantly, agreeing with the findings thus far about the Holycross pattern book, there is no obvious trend in the proportions or the metrology of these Desmond windows towards the values frequently used in Ormond.

Figure 7.27 Chancel east, Rathkeale Augustinian priory (left) and chancel east, Muckross Franciscan friary (right)

Table 7.3 Rathkeale Augustinian priory: proportional investigation

	Rathkeale				
	Chancel East				
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**
Tracery field height to light height (at springing point)		0.859	0.857	0.861	0.864
Tracery field height to light height (at arch peak)		0.788	0.782	0.778	0.780
Tracery field height to overall window height	0.542				
Overall window width to overall window height	0.478				
Overall window width to window height to spring	0.982				
Overall window width to arch span	0.787				
Light width to light height (at springing point)		0.251	0.261	0.261	0.252
Light width to light height (at arch peak)		0.170	0.175	0.175	0.170
Light width to overall window width		0.245	**0.254**	0.255	**0.247**
Light width to overall window height		0.117	0.121	0.122	0.118
Light width to arch span		0.193	0.200	0.201	0.194
Overall window width to light height (at springing point)		0.974	0.974	0.976	0.980
Overall window width to light height (at arch peak)		0.694	0.689	0.686	0.687
Mullion width to overall window width		0.055	0.059	0.055	
Mullion width to light width		0.223	0.215	0.233	
Mullion width to light width		0.232	0.217	0.225	

Table 7.4 Muckross Franciscan friary: proportional investigation

	Muckross East External				
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**
Tracery field height to light height (at springing point)		0.641	0.640	0.639	0.636
Tracery field height to light height (at arch peak)		0.488	0.500	0.499	0.485
Tracery field height to overall window height	0.390				
Overall window width to overall window height	0.499				
Overall window width to window height to spring	0.819				
Overall window width to arch span	0.999				
Light width to light height (at springing point)		0.220	0.193	0.194	0.215
Light width to light height (at arch peak)		0.167	0.150	0.151	0.164
Light width to overall window width		0.268	0.235	0.237	0.264
Light width to overall window height		0.134	0.117	0.118	0.132
Light width to arch span		0.268	0.235	0.237	0.264
Overall window width to light height (at springing point)		0.820	0.820	0.818	0.814
Overall window width to light height (at arch peak)		0.625	0.639	0.638	0.621
Mullion width to overall window width		0.060	0.060	0.060	
Mullion width to light width		0.225	0.256	0.255	
Mullion width to light width		**0.254**	**0.255**	0.228	

Figure 7.28 Chancel east (left) and south transept south (right), Adare Franciscan friary

Table 7.5 Adare Franciscan friary: proportional investigation

	Adare Franciscan Chancel East				
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**
Tracery field height to light height (at springing point)		0.970	0.958	0.963	0.971
Tracery field height to light height (at arch peak)		0.723	0.729	0.726	0.720
Tracery field height to overall window height	0.518				
Overall window width to overall window height	0.525				
Overall window width to window height to spring	0.939				
Overall window width to arch span	0.756				
Light width to light height (at springing point)		0.268	0.268	0.268	**0.247**
Light width to light height (at arch peak)		0.188	0.187	0.187	0.172
Light width to overall window width		0.256	**0.254**	**0.254**	0.236
Light width to overall window height		0.134	0.133	0.133	0.124
Light width to arch span		0.193	0.192	0.192	0.179
Overall window width to light height (at springing point)		0.957	0.957	0.950	0.958
Overall window width to light height (at arch peak)		0.733	0.739	0.736	0.729
Mullion width to overall window width		0.067	0.065	0.061	
Mullion width to light width		0.262	0.264	**0.255**	
Mullion width to light width		**0.254**	0.238	0.256	

	Adare Franciscan South Transept South				
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**
Tracery field height to light height (at springing point)	0.000	0.978	0.986	0.986	0.966
Tracery field height to light height (at arch peak)		0.654	0.649	0.652	0.653
Tracery field height to overall window height	0.456				
Overall window width to overall window height	0.466				
Overall window width to window height to spring	0.837				
Overall window width to arch span	0.920				
Light width to light height (at springing point)		0.232	0.259	0.255	0.259
Light width to light height (at arch peak)		0.155	0.171	0.169	0.175
Light width to overall window width		0.232	0.257	**0.254**	0.262
Light width to overall window height		0.108	0.120	0.118	0.122
Light width to arch span		0.214	0.237	0.233	0.241
Overall window width to light height (at springing point)		0.999	0.999	0.993	0.987
Overall window width to light height (at arch peak)		0.669	0.663	0.666	0.668
Mullion width to overall window width		0.065	0.062	0.066	
Mullion width to light width		0.279	0.252	0.239	
Mullion width to light width		0.243	0.261	0.252	

Figure 7.29 Chancel east window, Adare Trinitarian (left) and south transept south window, mid of three, St. Mary's cathedral, Limerick (right)

Table 7.6 Adare Trinitarian church: proportional investigation

	Adare Trinitarian				
	Chancel East				
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**
Tracery field height to light height (at springing point)		0.823	0.826	0.836	0.835
Tracery field height to light height (at arch peak)		0.588	0.595	0.595	0.598
Tracery field height to overall window height	0.456				
Overall window width to overall window height	0.618				
Overall window width to window height to spring	0.881				
Overall window width to arch span	0.989				
Light width to light height (at springing point)		0.280	0.280	0.281	0.285
Light width to light height (at arch peak)		0.200	0.202	0.200	0.204
Light width to overall window width		0.251	0.250	0.248	0.252
Light width to overall window height		0.155	0.155	0.153	0.156
Light width to arch span		0.254	0.253	0.251	0.255
Overall window width to light height (at springing point)		0.897	0.897	0.883	0.884
Overall window width to light height (at arch peak)		0.797	0.806	0.805	0.810
Mullion width to overall window width		0.053	0.051	0.051	
Mullion width to light width		0.210	0.211	0.203	
Mullion width to light width		0.205	0.206	0.204	

Table 7.7 St. Mary's cathedral, Limerick: proportional investigation

	St. Mary's cathedral, Limerick				
	South Mid of 3				
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**
Tracery field height to light height (at springing point)		0.611	0.611	0.610	
Tracery field height to light height (at arch peak)		0.459	0.471		
Tracery field height to overall window height	0.962				
Overall window width to overall window height	0.909				
Overall window width to window height to spring	0.063				
Overall window width to arch span	0.910				
Light width to light height (at springing point)		0.169	0.177	0.179	
Light width to light height (at arch peak)		0.127	0.137		
Light width to overall window width		0.241	**0.254**	0.256	0.249
Light width to overall window height		0.266	0.279	0.282	0.274
Light width to arch span		0.220	0.231	0.233	0.227
Overall window width to light height (at springing point)		0.699	0.699	0.698	
Overall window width to light height (at arch peak)		0.525	0.539		
Mullion width to overall window width		0.060	0.057		
Mullion width to light width		0.248	0.236	0.223	
Mullion width to light width		0.221			

A previously-noted oddity of the switchline tracery on the Fertagh font (Figure 7.26) is that the extended mullions do not follow the curve of the external arch, as would be normal, creating unusual shapes in the tracery field. Examples of this design executed in stone were found in Connaught at Kilnalahan Carthusian abbey, Burrishoole Dominican friary, and Aghagower parish church. If these windows were copies of the work from the pattern book, and assuming that the strange angles were represented in the book rather than just being faults in sculptural execution at Fertagh, the mason(s) decided to add rounded heads to the lights. As before, no obvious differences between the proportions of these windows and the rest of the Connaught window could be detected.

Figure 7.30 East window northern (left) and southern (right), Kilnalahan Carthusian abbey

Table 7.8 Kilnalahan Carthusian abbey: proportional investigation

	Kilnalahan East Northern External			
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**
Tracery field height to light height (at springing point)		0.762	0.765	0.761
Tracery field height to light height (at arch peak)		0.684	0.683	0.686
Tracery field height to overall window height	0.433			
Overall window width to overall window height	0.513			
Overall window width to window height to spring	0.904			
Overall window width to arch span	0.966			
Light width to light height (at springing point)		0.309	0.300	0.294
Light width to light height (at arch peak)		0.277	0.268	0.265
Light width to overall window width		0.342	0.331	0.326
Light width to overall window height		0.176	0.170	0.167
Light width to arch span		0.331	0.320	0.315
Overall window width to light height (at springing point)		0.901	0.905	0.900
Overall window width to light height (at arch peak)		0.809	0.808	0.811
Mullion width to overall window width		0.075	0.078	
Mullion width to light width		0.219	0.226	0.230
Mullion width to light width		0.226	0.234	0.237

	Kilnalahan East Southern	
Single	**Light/ Mullion1**	**Light/ Mullion2**
	0.809	0.820
	0.695	0.698
0.450		
0.421		
0.766		
0.939		
	0.378	0.383
	0.325	0.327
	0.500	0.500
	0.210	0.210
	0.469	0.470
	0.756	0.767
	0.650	0.653
	0.106	
	0.211	0.211

Figure 7.31 Chancel east, Burrishoole Dominican friary (left) and chancel east, Aghagower parish church (right)

Table 7.9 Burrishoole Dominican friary and Aghagower parish church: proportional investigation

	Burrishoole Chancel East				Aghagower Chancel East			
Proportions	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**	**Light/ Mullion4**	**Single**	**Light/ Mullion1**	**Light/ Mullion2**	**Light/ Mullion3**
Tracery field height to light height (at springing point)		0.781	0.781	0.788			0.607	0.612	0.610
Tracery field height to light height (at arch peak)		0.711	0.713				0.557	0.554	0.559
Tracery field height to overall window height	0.437					0.377			
Overall window width to overall window height	0.413					0.409			
Overall window width to window height to spring	0.735					0.659			
Overall window width to arch span	0.969					0.839			
Light width to light height (at springing point)		0.185	0.186	0.187			0.210	0.238	0.223
Light width to light height (at arch peak)		0.169	0.170				0.193	0.216	0.204
Light width to overall window width		0.251	0.253	0.252	0.246		0.319	0.359	0.336
Light width to overall window height		0.104	0.104	0.104	0.102		0.130	0.147	0.137
Light width to arch span		0.243	0.245	0.244	0.238		0.268	0.301	0.282
Overall window width to light height (at springing point)		0.738	0.738	0.745			0.658	0.664	0.661
Overall window width to light height (at arch peak)		0.672	0.673				0.604	0.601	0.607
Mullion width to overall window width		0.075	0.073				0.111	0.112	
Mullion width to light width		0.297	0.295	0.289			0.347	0.309	0.329
Mullion width to light width		0.290					0.351	0.312	0.333

Assuming that not all windows in the Holycross pattern book were actually represented on the tombs at Fertagh and Callan, and the font at Fertagh, consideration must also be given to occasions where it seems that Holycross windows served as inspiration for, or in some cases were inspired by, windows outside the Ormond region. Examples include similarity between the following groups of windows:

- Holycross east; Kilmallock Dominican south transept south; St. Mary's Callan east; Cashel east (Figure 7.32 and Figure 7.33)
- Holycross west; St. Nicholas's collegiate church, Galway, nave west (Figure 7.34)

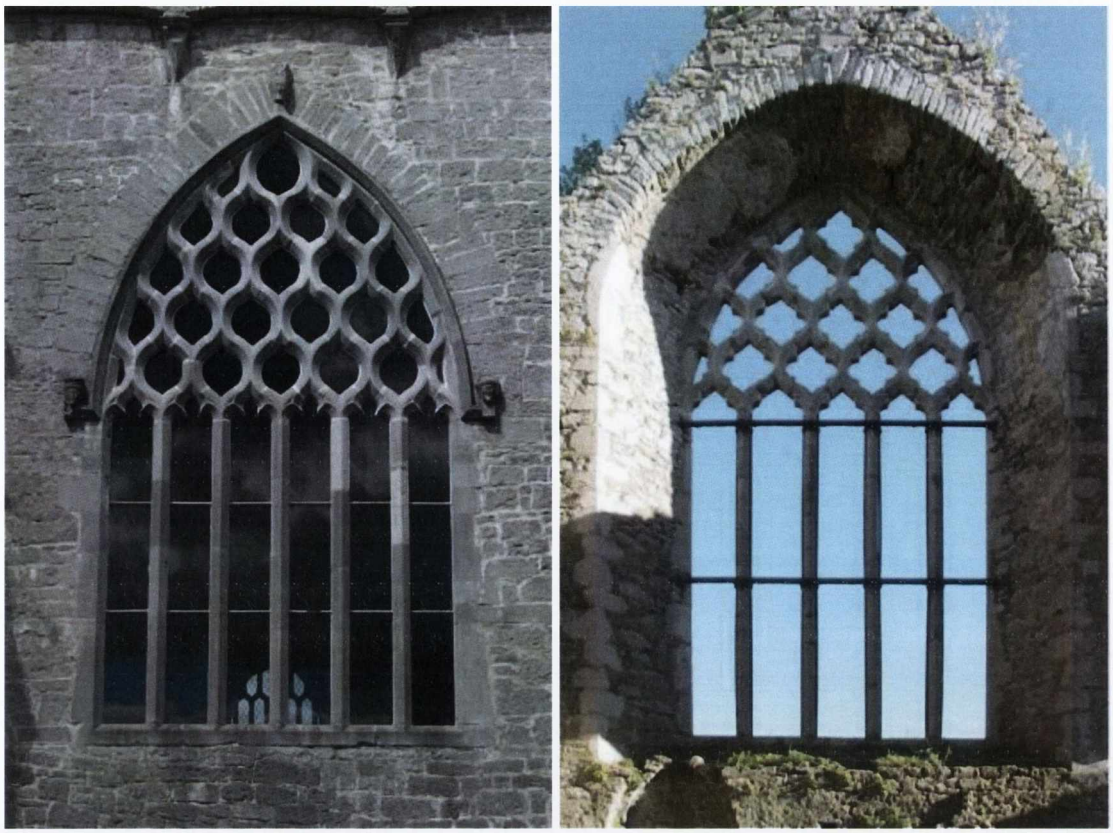

Figure 7.32 Chancel east, Holycross Cistercian (left) and south transept south, Kilmallock Dominican (right)

Figure 7.33 Chancel east, St. Mary's, Callan (left) and chancel east, Cashel Dominican (right)

Figure 7.34 Nave west, Holycross Cistercian (left) and nave west, St. Nicholas' collegiate church

In all of these cases the outcome of the empirical investigation was the same. Although the designs may have been similar no significant evidence could be found to demonstrate that either metrology or systems of proportion were transferred with the artistic inspiration which was possibly a pattern book.

7.7 The artistic independence of masons

A final note on masons and their craft refers to the degree to which an individual mason could be required by a patron to implement designs not of their making. This information is important because it is a generally held premise of architectural historical studies that "as new masters take over a workshop, their individual personality and skill are expressed through changes in the moulding profiles, the unit of measure used, pier base designs, or the degree of skill in carving capitals or string courses".[83] If this idea is challenged then the implications for trying to piece together architectural histories based on the evidence in the structure becomes much more difficult.

Evidence of a lack of autonomy was demonstrated at Lacock Abbey in 1315, where an agreement was made between the Abbey and the patron, Sir John Bluet, for the

[83] L.E. Neagley, 'The Flamboyant Architecture of St.-Maclou, Rouen, and the Development of a Style', *The Journal of the Society of Architectural Historians,* 1988, 47 (4), 374-96, p. 378.

enlargement of the church, including the completion of the Lady Chapel. Within the chapel the agreement states that there will be four windows, "of which two have already been made" and that these will be placed and finished by the new builders.[84] On another occasion, a contract concerning Catterick, Yorkshire in 1412 detailed the demolition of an old church and its replacement with a new building on a new site, but stipulated that "the forsaide Richarde sall take the wyndowe that standes now in the north side of the alde kirke and sette it in the este side of the north ele ouer the awter with a franche botras on the cornere dyand under the tabill".[85] L.F. Salzman cited another contract from 1442 which stipulated that a new mason must use certain windows designed by another mason: "And in the first flore ij wyndowys On yn the Sowth and another yn the North everych of on day with iiij genelas (cusps) yn the hedd of every window And iiij wyndowys at the bell bedd of ij days with trawnson and a moynelll according to the patron ymade by the avyce of Rychard Pope Fremason".[86] This contract is also notable for the specifics given about the tracery design which exceeds the typical specification of a number of lights: mouldings, cusps, transoms, and mullions are described, all being the types of details which are typically recommended for use in the identification of the hand of an individual mason.[87]

For many artists, and craftsmen, the idea that a patron could exercise such control over their work would be deplorable, particularly if that craftsman had a very specific style and was renowned for particular designs. In Brehon law masons were highly ranked along with other craftsmen such as poets and goldsmiths. However, in the middles ages, as now, there were probably vast differences in the abilities of craftsmen and some may have been happy to utilise the designs of others, perhaps because they were not as highly skilled.

Although no contractual evidence exists in Ireland, the persistence of certain tracery designs could be relevant to an examination of the limitations placed on masons by their patrons. Susan Mannion argued that, in relation to the friaries of Connaught, Irish masons were sufficiently skilled to be able to create complex tracery designs, but switchline tracery was preferred because of the absence of funds for building and because

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[84] L.F. Salzman, *Building in England*, pp. 424-5: "*Ceo est asavoir en chescun gable une fenestre si large com la une est feate e chevie e lautre come elle est comemcee serra biem feat e finie e en le forein costee de lavauntdite chapele la une soit telle com elle est feat e chevie e lautre si large come elle est comencee serra feat e finie de bone overaigne e convenable. E serront leas avauntdites fenestres convenablement ferrees e evrrees.*"

[85] L.F. Salzman, *Building in England*, pp. 487-90 quoting H.B. Maccall, *Richmondshire Churches - Illustrated*. London: Elliot Stock, 1910, pp. 37-40.

[86] L.F. Salzman, *Building in England*, pp. 514-5 quoting Archaeological Journal, xxxviii. 217.

[87] See R. Mullin, 'A regional study of late medieval window tracery in Ireland', M.Phil. Queen's University, Belfast, 1999.

it was the preferred style of the mendicant friars due to their predilection for austere designs.[88] My previous arguments agree that Irish masons were not very differently skilled than their English and European counterparts; therefore it is unlikely that there was insufficient confidence to try new tracery patterns. It is more likely that patrons, clients, and the hardness of the Irish stone, as discussed in chapter 1, were the motivators in simplifying designs.

Another suggested limitation on masons related to the standardisation of glass sizes. The evidence from the examination of the width of window lights in this study has shown that little standardisation seems to have occurred for this medium.[89] I would argue that these findings point towards a lack of development in the glass manufacturing industry in medieval Ireland, a view supported by an entry in the Calendar of State Papers of Ireland from 1586-8 which records that a Captain Woodhouse had applied for the extension of a license to manufacture glass and to retain a monopoly.[90] Although this reference is later than the period investigated in this study, the application was for an "extension" which suggests that production of glass could also have been limited in previous eras.

Monopolies are rarely good for innovation and they are certainly problematic for customers who are forced to pay higher prices because of the absence of alternative sources. If glass prices were high and availability was limited this would make patrons very conscious of the need to reuse glass. L.F. Salzman quoted an entry from an Eltham palace account for 1402 which required the purchase of "new glass" which implies that old glass must also have been considered at times.[91] The solution to this problem was to retain the same style of tracery over long periods of time. While this was probably the case at most sites in medieval Ireland, there are records of the importation of stained glass in 1490 on the Spanish ship *Sante Marie* from La Rochelle to Limerick and Galway as part of a cargo of luxury items that also included *hone*, saffron, and silk.[92] Irrespective of whether its origin was local or foreign, glass cutting to fit the complex shapes of geometric, decorated and perpendicular tracery would have required the presence of

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[88] S. Mannion, 'A study of the physical remains of the medieval friaries of Connacht', Ph.D. Queen's University, Belfast, 1997, p. 149.

[89] Light widths varied from 0.235m at Abbeydorney Cistercian abbey to almost 1m at Castledermot Franciscan friary.

[90] H.C. Hamilton and Great Britain. Public Record Office., *Calendar of the state papers relating to Ireland [of the reigns of Henry VIII, Edward VI, Mary, and Elizabeth, 1509-1603] preserved in the State Paper Department of Her Majesty's Public Record Office*. Nendeln: Kraus Reprint, 1974, p. 234.

[91] L.F. Salzman, *Building in England*, p. 176 citing Journal of the British Society of Master Glass-painters. ii. 119.

[92] A. O'Brien, 'Commercial relations between Aquitaine and Ireland c.1000 to c.1550.' *Aquitaine and Ireland in the Middle Ages.* Ed. J.-M. Picard. Dublin: Four Courts Press, 1995, p. 51.

skilled glassworkers. With monopolies on glass production, limited numbers of installers were likely to be available and their services were probably very expensive.

The cost of glass might also have forced masons to retain particular window designs, even after they were fashionable, in order to reuse and not incur new expense. This possibility was examined in relation to the unusual window tracery of the chancel east at the church of the Augustinian canons in Cahir (Figure 7.35). This fifteenth-century window was described by Peter Harbison as a "curious" insertion into the mainly thirteenth-century fabric of the building.[93] This window replaced an earlier, much larger opening, suggesting a preference for a less grand style or, more probably, indicative of reduced funds available for glass, even after bearing the cost of inserting the new stonework.

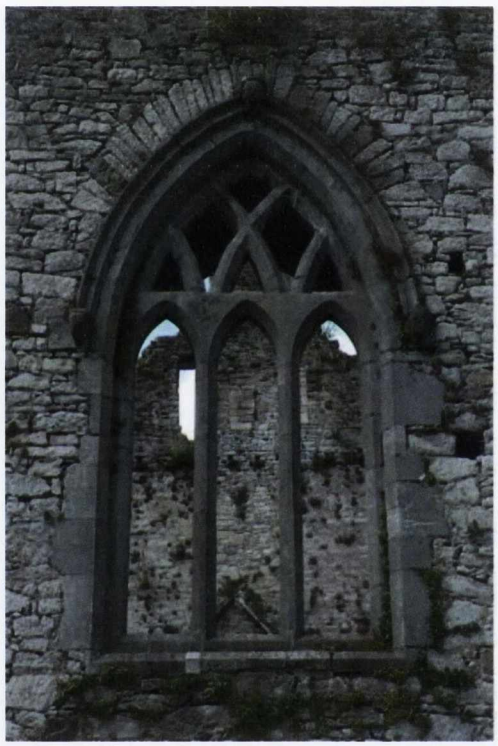

Figure 7.35 Chancel east window, Cahir Augustinian

The possibility that the Cahir window was the result of combining stonework from two separate windows was considered due to the strange design. However, an examination of the moulding profiles for both the lower bars and the upper tracery field reveal them to be identical in shape and carved from the same blocks of stone making it unlikely that they were created at different times or for different original purposes. Thus, the

[93] Following excavations in 1994 David Pollock dated the reconstruction of the east window as late 15th/16th century: D. Pollock, "Cahir Abbey', Cahir Abbey Lower 1994:201.' 1994. Database of Irish Excavation Reports. R049249 94E124: Department of Environment, Heritage and Local Government. Viewed April 2011. http://www.excavations.ie/Pages/Details.php?Year=&County=Tipperary&id=2734 and P. Harbison, *Guide to the National & Historic Monuments of Ireland*. 3rd ed. Dublin 12, Ireland Gill & Macmillan Ltd., 1992, p. 298.

explanation that the design was chosen in order to re-use glass from lancet windows and a window with switchline tracery at this site and/or another becomes plausible. This ought to have impacted on the proportions and made them different to other windows but, as shown in Table 7.10, the Ormond standards of 1:2 and 5:6, potentially with 1:1, were identified.

Table 7.10 Cahir Augustinian priory: proportional investigation

Cahir

East External Proportions	Single	Light Mullion 1	Light Mullion 2	Light Mullion 3
Tracery field height to light height (at springing point)		0.994	0.999	0.995
Tracery field height to light height (at arch peak)		0.820	0.821	0.825
Tracery field height to overall window height	0.499			
Overall window width to overall window height	0.517			
Overall window width to window height to spring	0.971			
Overall window width to arch span	0.774			
Light width to light height (at springing point)		0.345	0.354	0.341
Light width to light height (at arch peak)		0.281	0.290	0.280
Light width to overall window width		0.331	0.341	0.328
Light width to overall window height		0.171	0.176	0.169
Light width to arch span		0.256	0.264	0.254
Overall window width to light height (at springing point)		0.960	0.965	0.961
Overall window width to light height (at arch peak)		0.849	0.850	0.854
Mullion width to overall window width		0.089	0.096	
Mullion width to light width		0.268	0.259	0.270
Mullion width to light width		0.290	0.281	0.293

Ratio	Numeric Value	1%		2%	
1 : 4	0.250	0.253	0.248	0.255	0.245
1 : 3	0.333	0.337	0.330	0.340	0.327
2 : 5	0.400	0.404	0.396	0.408	0.392
1 : root 5	0.447	0.452	0.443	0.456	0.438
1 : 2	0.500	0.505	0.495	0.510	0.490
13 : 23	0.565	0.571	0.560	0.577	0.554
1 : root 3	0.577	0.583	0.572	0.589	0.566
3 : 5	0.600	0.606	0.594		
377 : 610	0.618	0.624	0.612	0.630	0.606
2 : 3	0.667	0.673	0.660	0.680	0.653
1 : root 2	0.707	0.714	0.700	0.721	0.693
3 : 4	0.750	0.758	0.743	0.765	0.735
4 : 5	0.800	0.808	0.792	0.816	0.784
5 : 6	0.833	0.842	0.825	0.850	0.817
1 : 1	1.000	1.010	0.990	1.020	0.980

Whatever the, possibly complex, reasons for the horizontal break and strange lancet tops at Cahir, this style provided sufficient flat stonework to accommodate a knotwork design on the external elevation (Figure 7.36). Since this combination of tracery style and sculpting is unique among the windows of this study, it may have been created by a mason who was primarily a sculptor but who executed one, surviving, window.

Figure 7.36 Chancel east window, carved knotwork detail, Cahir Augustinian priory

7.8 Discussion

In cases where money was plentiful and where the client did not specify any particular design, other influences can be examined. One of the premises upon which elements of this study, and many similar studies, is based is that masons were predictable in their behaviour, particularly in relation to the continued use of a system, over their entire careers. These systems could relate to any or all of the concepts of metrology, proportion, and moulding profiles, but they are considered useful because they are measurable, and thus can assist us in tracing the movement of a mason. However, these assumptions are only valid provided that the basic tenets of repeatability are true.

I would argue that the variety of combinations of proportions, ratios, and styles found by this study indicate that medieval masons were not rigid in their approaches to tracery design. While it might be too much of a leap to suggest that their designs were whimsical, it seems that many masons had a large portfolio of proportions and styles which they applied in different combinations on individual occasions.

I suspect that of the elements of metrology, proportion, style, and moulding profiles, it was only metrology that remained relatively fixed for a mason over their working careers. This conclusion was reached because there appears to be a pattern of usage which relates to specific regions, and previous discussions have shown that the origin of most of the prominent units can be logically traced. Metrology impacted significantly on medieval architects through economics; work was often paid by the foot,

therefore attention to measurement must have been important. Research in France has shown that in cases where more than one unit was present on site, the smaller unit was preferred by the builders as a way of increasing payment, while the longer measure was favoured by those in charge of funding the enterprise.[94] Although tracery would have been piece work, more in the style of sculpture than the stone hewing to which the previous example refers, I believe that some Irish masons would have switched between the hewing and decorating roles, making it likely that a tradition such as retention of preference for a particular unit would have occurred. Thus, I believe that a mason would only have changed his preferred unit of measure, as a result of outside stimulus such as a legal imperative, through contact with other masons, or if constrained by some external factor.[95] In each case the financial imperative would have been paramount. Otherwise, he would probably have retained the same unit throughout his working life.

While we can say as a result of this study that proportions were used in the context of window tracery, masons seem to have considered that ratios were attractive, and possibly helpful, but not essential. Proportions cannot have been considered fundamental to the successful execution of a design or their application would have been much more rigorous, and patterns would have been clearer. Although not the most popular ratio in each region the one which attracts most attention as a result of this study is 4:5, because it often seemed to link together entire windows: overall width to light or overall height, and light or tracery field height to each other or to the overall height. It also seems that most structures in medieval Ireland were built in such a piecemeal manner that ideas of harmony and consistency, which could be applied at many of the great cathedral and monastic works in England and Europe, were impossible to achieve.

Masons, where permitted, were motivated to consider new stylistic ideas and new systems of proportion, and they did try to be independent and distinct. However, they seem to have been attached to particular metrological systems and they were often constrained by outside influences, particularly that of economy. Comments about a 'lack of skill' have been shown to be somewhat unfair because some of these "skills" were actually unnecessary for the Irish mason in all but a limited few circumstances. The suggestion has also been made that some of the responsibility for poor tracery designs might lie with those who commissioned the tracery because of the methods by which they transferred their requests.

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[94] S. Murray, 'Reconciling the Feet at Beauvais & Amiens Cathedrals.' *Ad Quadratum: the Practical Application of Geometry in Medieval Architecture.* Ed. N.Y. Wu. Aldershot, England: Ashgate Publishing Ltd., 2002. 169-82, p. 170.

[95] For example, the imperatives discussed in the previous chapter, such as existing buildings, patrons, etc.

8 Conclusions

8.1 Method

Prior to this study no empirical investigation of medieval window tracery had been carried out in Ireland. In continental Europe, windows had mainly only been examined as part of particular building investigations, while in Britain only the work of Richard Fawcett used any measurements and, even then, only a single parameter, the window width.[1] Thus, no precedent for a methodology by which window tracery could be empirically analysed existed. This thesis has presented a set of procedures, built upon metrological and proportional investigations of ground plans, using remote measurement techniques (photogrammetry and laser scanning) and systematic analysis, through which tracery can be interrogated in an unbiased and autonomous manner. The results have been analysed independently and in conjunction with standard architectural historical practices, and have revealed a range of new findings as summarised below.

The main strength of the method is the impartiality of the data collection, which allows the user to analyse the entire data set *a posteriori* the processing stage or to sample subsets of the data based on *a priori* knowledge, as was presented here for the 'Holycross pattern book'. The method is also not without its weaknesses because, as often happens when dealing with large sets of numerical data, random or unintended results can occur, particularly in the extraction of preferred units of measurement. Extracting these effects from the results can be problematic and demonstrates that due diligence must be exercised in the application of the developed methodology. These techniques could be widely applied to other types of architectural investigation, as was demonstrated by the case studies of the full buildings of St. Mary's collegiate church, Gowran and Athenry Dominican priory. Thus, a viable method of investigation of window tracery has been developed and successfully tested.

8.2 Metrology

Our understanding of Irish medieval metrology has significantly increased as a result of this study. Previously, relatively little was known about medieval units, with the exception of evidence gathered by a number of authors for use of the 0.3048m foot and its perch equivalent. We now know that a wide variety of units were used in medieval Ireland and

[1] R. Fawcett, 'A Group of Churches by the Architect of Great Walsingham', *Norfolk Archaeology*, 1980, 37 (3), 227-94

that these ranged in length from a 'long palm' or *dodrans* of ~0.225m to a 'foot-by-hand' or *ped manualis* of ~0.368m. The English legal standard foot of 0.3048m was found in all three regions, although in Connaught it was frequently associated with post-medieval insertions or reconstructions. Other units could be traced to contact with the Romans or, more likely, to the arrival of the Anglo-Saxons, Anglo-Normans and Cambro-Normans. The newly acknowledged Anglo-Saxon and "Romanesque" standard of 0.280m was used throughout the country, as was an undocumented unit measuring ~0.347m.[2] Two further new 'long' foot measurements were also detected: 0.357m in Connaught and 0.368m in Desmond. These final three units, which could have originated in agriculture or, more likely for architecture, in some body-based system, now require further investigation to try to identify the extent of their use, both spatially and temporally. Determining their exact origin might be more difficult but the suggestion is that the basis may have been in Brehon law, particularly given the widespread use of 0.347m.

8.3 Proportions

The great European debates between advocates of *ad quadratum* and *ad triangulum* about how best to design a structurally sound building were irrelevant to most Irish ecclesiastical building in this study because of their size.[3] In Britain and continental Europe the same proportional systems were applied to ground plans and architectural details as a way of both ensuing the stability of the features and creating consistency across the entire building.[4] The inconsistent use of proportions in this study seems to imply that their structural function was not important in the design of tracery.

1:2 and 1:3 were popular in all 3 regions with 4:5 also prominent. In Connaught 1:4, 3:4 and 13:23 also featured strongly, while in Ormond 1:1 and 5:6 were very evident in the data. In agreement with Tomás Ó'Carragáin's early medieval investigations, ratios that have been found frequently in English and continental European architectural historical studies were of little significance in this research.[5] While $1:\sqrt{2}$ was intermittently used in Desmond, the golden section was rarely found in Irish tracery. Perhaps the most notable ratio, although not the most popular ratio in each region, is 4:5 because it often

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[2] H. Sunley, 'A Linear Measure Used in England and on the Continent in Romanesque Times', *Journal of the British Archaeological Association,* 2010, 163, 152-3 and P.J. Huggins, 'Anglo-Saxon Timber Building Measurements: Recent Results', *Medieval Archaeology,* 1991, 35, 6-28.

[3] J.S. Ackerman, "Ars Sine Scientia Nihil Est" Gothic Theory of Architecture at the Cathedral of Milan, *The Art Bulletin,* 1949, 31 (2), 84-111.

[4] E. Fernie, 'The Ground Plan of Norwich Cathedral & the Square Root of Two', *Journal of the British Archaeological Association,* 1976, 129, 77-86.

[5] T. Ó'Carragáin, *Churches in early medieval Ireland: architecture, ritual, and memory*. London & New Haven: Yale University Press, 2010, pp. 110-113.

seemed to link together entire windows: overall width to light or overall height, and light or tracery field height to each other or to the overall height. Setting out this ratio would also have been a little more involved that the simple 1:1, 1:2, 1:3 and 1:4 ratios, suggesting that some importance might have been attached to its use. An examination of other architectural details in the buildings where this ratio was prominent might provide some information on the significance of this ratio and might indicate whether it was simply a 'window tracery' proportion.

Fixed patterns of the use of proportion could not be established either within particular buildings, even those built mostly in one phase such as Moyne Franciscan friary, or when windows of similar styles, or with similar mullion widths and/or moulding profiles, were examined.

8.4 Metrology & Proportion

No link between metrology and proportion could be established at any site, between sites, or in any region. This suggests that the two elements were not linked in the training of the medieval mason.

8.5 Regionalism or Schools of Masons

Some of the regionalism detected by stylistic analysis was also evidenced in the preferred proportions and measurement units.[6] Some units were popular throughout the study while others were only found in one or two of the regions studied. The same results were found for the use of proportions.

Although some 'schools' existed there is little evidence that they used any rigid system of metrology or proportion so this study cannot be independently used to establish the existence of a school. However, when taken in conjunction with other stylistic features, such as the overall design of the tracery and the moulding profiles used, these results can help to identify the work of particular individuals or groups. No particular metrology or proportion could be linked with a previously-identified school of masons in Ormond. This is possibly because one of the sources of inspiration for these masons was a pattern book in which neither measurement nor proportion was included.

[6] S. Mannion, A Study of the Physical Remains of the Medieval Friaries of Connacht, Ph.D. Diss. Queen's University, 1997 and R. Mullin, A Regional Study of Late Medieval Window Tracery in Ireland, M.Phil. Queen's University, 1999, among others.

8.6 Chronology

An examination of metrology, sometimes supported by analysis of proportion, can help to validate suggestions about windows that are thought to be contemporary on the basis of stylistic, documentary or other evidence. Metrology results have also sometimes been found to suggest alternative dates to those given by stylistic analysis alone. In the case of St. Nicholas collegiate church, Galway, this lead to a re-evaluation of the established chronology for the chancel, and a new hypothesis was argued using the empirical evidence, and reconsideration of the documentation and the building fabric analysis.

Thus far, the sample of data provided by this study is much too small, both temporally and spatially, despite recording nearly 200 windows, to enable creation of a chronology of Irish medieval units. This study has, however, confirmed that numerous units were in simultaneous use and that the length of these units varied from a 'short' foot of ~.227m to a 'long' foot of ~0.356m, with a number of other values in between. A lot more work is needed on medieval ecclesiastical ground plans and other architectural details, as well as secular medieval and Romanesque era buildings, before a viable chronology of medieval units could be proposed.

8.7 Standardisation and Economy

No clear evidence indicating that stonework for windows was produced in standard sizes could be found. While for many buildings stonework may have been produced at the quarry in order to reduce the cost of transport, decisions about the size and design of these pieces seems to have rested with the mason attached to the building and not to the quarry. With the close proximity to suitable stone demonstrated for each region, it is more likely that masons travelled to the quarries to cut their stone rather than sending the templates which could have facilitated a form of mass-production.[7] Cutting at the quarry would probably have been preferred by Irish masons because of the nature of the stone which

[7] Of course there is the much reported case for Canterbury of William of Sens sending templates to the quarry but this represents building on a scale not see in Ireland: W. Stubbs, ed. *The Historical Works of Gervase of Canterbury*. Vol. 73, 1:7. London, 1879. My conclusion in opposition to this theory is again in agreement with Richard Fawcett's Norfolk findings: "Inevitably the decreased variety in the design of window tracery in the course of the fifteenth century has also suggested the possibility of mass production at the quarry, but, again, the evidence is against such a conclusion.": R. Fawcett, 'Later Gothic architecture in Norfolk: an examination of the work of some individual architects in the fourteenth and fifteenth centuries', Ph.D. East Anglia, 1975, pp. 490-1 (hereafter 'Norfolk').

was most workable when freshly cut.[8] No evidence was found to support the hypothesis that panes of glass were produced in standard sizes.[9]

Suggestions relating to the reuse of full windows or elements of window tracery were validated on a number of occasions through identification of a particular foot measure in a setting where a different unit was otherwise used.

8.8 Buildings

The influence of buildings on tracery as revealed by empirical investigation was threefold. Firstly, the function or ownership of the building was found to have no impact on either metrology or proportion. Medieval masons, it seems, worked for whoever paid and there was no such thing as a Cistercian measurement or a Franciscan proportion, for example. Secondly, the part of the building where a window was located also had no impact on geometry or measurement. Thirdly, windows that were inserted into existing buildings demonstrated no obvious difference in the application of proportions relative to windows built into new walls.

8.9 Legal intervention

The influence of interventions from successive medieval administrations in relation to metrology was examined in some detail. The legal standard Irish foot of 0.3048m was more commonly used in Ormond than in Connaught or Desmond but, in general, we can say that the significant legal intervention in relation to the short selling of measures in trade had little or no impact on the building industry in Ireland. Only at the end of the era of study does the official foot standard seem to have gained wider acceptance. However, other units were still in use as late as the first quarter of the sixteenth century, such as at Creevelea Franciscan friary.[10]

8.10 Patronage

Due to the difficulty in linking patrons to existing windows, even in documented cases such as Athenry Dominican priory and St. Nicholas collegiate church, little can be said about whether or not their influence can be detected via empirical investigation.

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[8] R. Durman, *Ham Hill: portrait of a building stone*. Reading: Spire Books Ltd, 2006, p. 39.

[9] This agrees with Richard Fawcett's findings that "measurement of the widths of several thousand windows has shown that there is not the slightest evidence of standardization of even this dimension": R. Fawcett, 'Norfolk', pp. 491.

[10] A unit of *c*.0.257m was found.

The one possible exception to this rule is the group of Connaught windows where the 13:23 ratio was frequently used. The windows were found in St. Nicholas' collegiate church, Athenry Dominican priory, Ross Errilly Franciscan friary, Moyne Franciscan friary, Portumna Dominican friary, and Kilconnell Franciscan friary, and can be linked to patronage from Galway merchant families, such as the Lynches and the Blakes, and to connections with the de Burgos.[11]

8.11 Masons' training and skills

Some variations between the documented practices of English and European masons and the empirical evidence for Irish masons' methods were found. For instance, this analysis suggests that templates were rarely used in any context in Ireland. While the small scale of most Irish works did not require the use of templates as the blueprints by which a master mason would translate his vision for a great building into physical form, it might have been expected that a mason would use templates to ensure that he did not need to return to geometric principles every time that he created a mullion or moulding profile for a new window or other decorative feature. However, this seems to be just what was done. Part of the reason for this might be the lack of standardisation of the size of stone blocks from quarries and the need to minimise the amount of stone cutting due to the hardness of the material. The use of geometric principles on every occasion possibly accounts for the simplicity of most of the moulding profiles in this study and the many occurrences of switchline tracery. On the other hand, it also demonstrates a confidence and a skill that should be applauded.

Not all Irish methods differed from those used in Britain and Europe. The setting out of arches, as shown in a tracing at Corcomroe, and the symmetry of the nave west window at Athenry Dominican priory suggest that Irish masons were proficient in the use of tracing surfaces and that only half windows were set out, just as evidenced in Britain.

Suggestions of the 'paper' transfer of ideas appear to be limited to pattern books. Assuming that these did exist, the measurements from the surviving tracery imply that it was only the overall design that was transferred in this way, not the method by which it should be laid out, the unit of measure that should be used, or the moulding profile.

Although little documentation can be found on the training of masons, the evidence of the high survival rate of the windows and the quality of execution of all but a

[11] A. Coleman, 'Regestum monasterii fratum praedicatorum de Athenry', *Archivium Hibernicum,* 1912, 1, 201-21; C. Mooney, 'The Friary of Ross: Foundation and Early Years', *Journal of the Galway Archaeological and Historical Society,* 1960, 29 (1/2), 7-14, p. 10; and A. Gwynn and R.N. Hadcock, *Medieval Religious Houses: Ireland.* 2nd ed. Blackrock, Co. Dublin: Irish Academic Press, 1988, p. 228.

few of these, suggests that the organisation of the craft in relation to the transfer of skills was relatively high. Again referring to the large number of switchline windows, it seems that experimentation in design was not encouraged but the hardness of the stone, and perhaps the wishes of the patrons, may also have influenced this apparent stagnation.

Proportion does not seem to have been rigidly applied in any of the windows in this study. This suggests that masons were trained in the use of a large portfolio of ratios and were free to apply them as they saw fit on a window-by-window basis. The tenet that masons used the same proportion throughout their careers seems not to be guaranteed in the Irish case. Metrology may have been more fixed but without the ability to identify individual masons this cannot be confirmed.

8.12 Masons' mobility

Irish masons appear to have been open to an amount of influence from outside their home regions and from abroad, both England and continental Europe. The variety of metrological systems in use points strongly towards the presence of masons from different origins practicing in medieval Ireland.

The differences in metrology between regions suggested that some masons did not travel beyond regional boundaries, while the similarities between other preferred units and proportional systems across regional boundaries suggested that other masons did travel.

Influences and new ideas might also have been transferred in the form of pattern books which acted only as inspiration only but did not include any information on measurements, proportions or moulding profiles.

8.13 Summary

In general, I would conclude that proportional analysis, on its own, can only provide limited information to the architectural historian. Combined with metrological investigation the results are significantly improved, while metrology alone can sometimes be very informative. Some indication has also been given that the results of empirical investigation do not always align with stylistic similarities and sometimes documentation can be incorrectly interpreted, as at St. Nicholas' collegiate church, Galway.

This investigation proves that the architectural historical investigation method most likely to prove successful is one which uses a three-pronged approach of evidence from documentary or written sources, visual or stylistic analysis of the design, and

physical (archaeological) investigation of the fabric of the building.[12] While moulding profile analysis and masonry examination are established tools in the architectural historian's arsenal, until now empirical investigation of the metrology and proportions of window tracery has not been. This study makes the case for expansion of that arsenal to include just such a methodology.

[12] E. Fernie, Archaeology & Iconography: Recent developments in the Study of English Medieval Architecture, *Architectural History,* 1989, 32, 18-29.

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