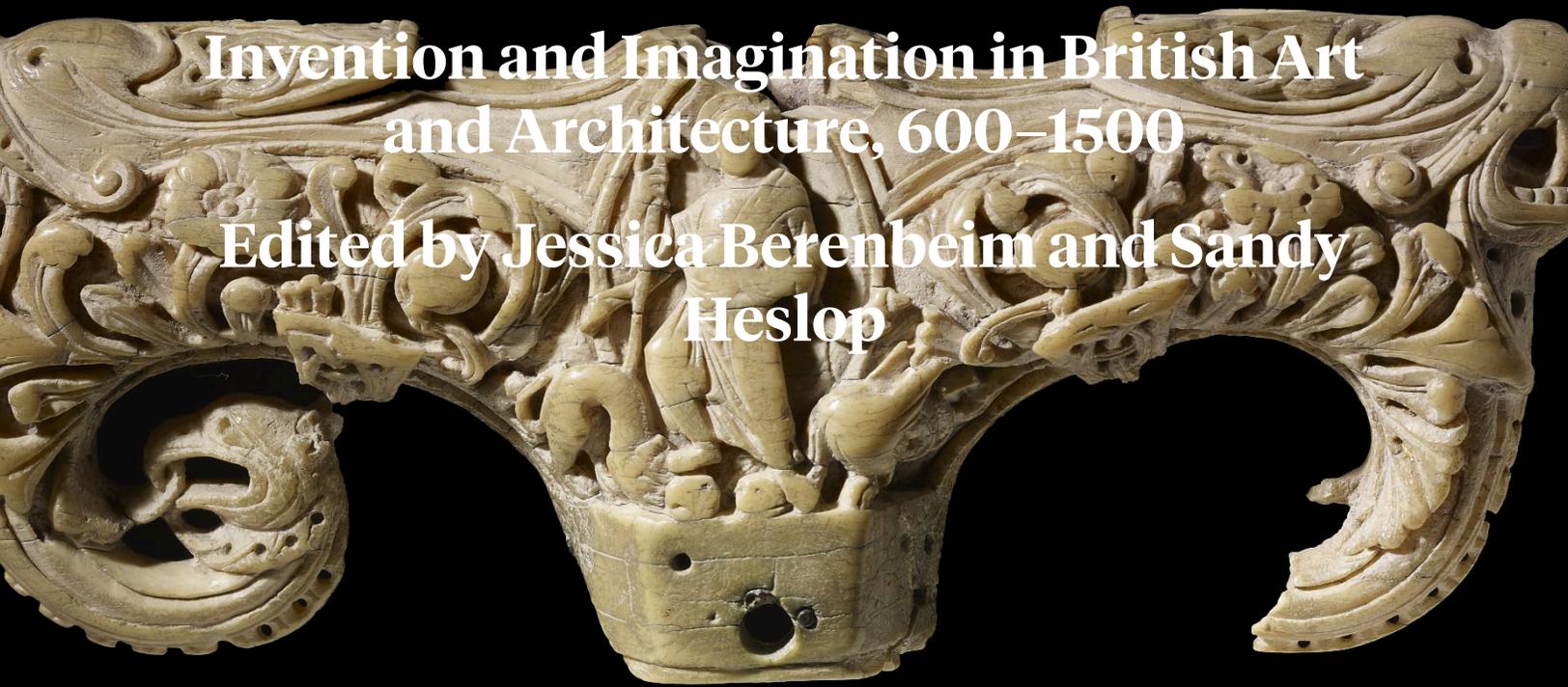


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**Invention and Imagination in British Art
and Architecture, 600–1500**

**Edited by Jessica Berenbeim and Sandy
Heslop**



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Cover image: Unknown maker, Ivory Staff Terminal from Alcester, 11th Century, ivory, 14 × 5 cm. Collection of the British Museum (1903,0323.1).. Digital image courtesy of Trustees of the British Museum

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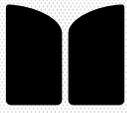
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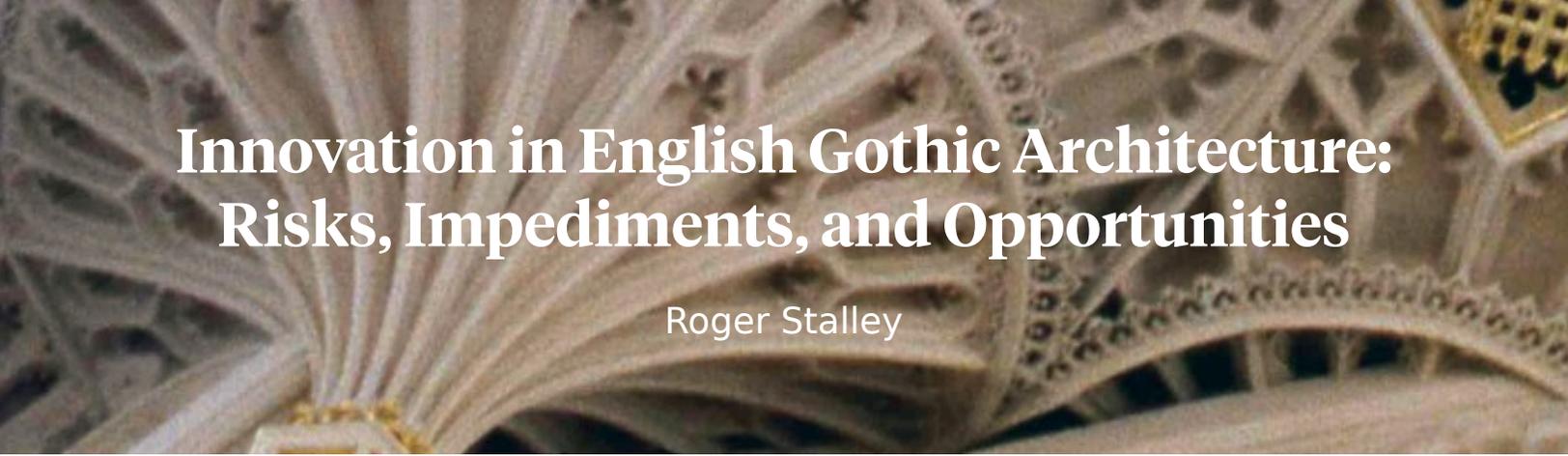


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Innovation in English Gothic Architecture: Risks, Impediments, and Opportunities

Roger Stalley

Abstract

This essay considers some of the practical and human situations that affected innovation in English medieval architecture. These included the scale of the Norman inheritance, the process of incremental construction, and the personal relationships that existed between masons and patrons. Particular attention is given to structural risk and occasions when structural failure provided opportunities for innovation. One of the striking points that emerges from this discussion is the inability of medieval masons and their patrons to learn from past failures when constructing crossing towers.

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Introduction

Early in his career Nikolaus Pevsner remarked that the Middle Ages placed little emphasis on the “creative personality”, an assumption consistent with his view that great artists tend to express the *zeitgeist* rather than create it. Similar assumptions are frequently encountered in subsequent literature, which is not surprising given the difficulties of defining and isolating individual authorship.¹ In contrast with writing on more recent periods of English architecture, the emphasis in medieval studies tends to be on “workshops” and “developments”, reflecting the fact that we know little about the circumstances in which designs were commissioned or carried out. Much of the scholarship is thus concerned with fabric rather than people, with tracing chronologies and stylistic sequences, rather than examining the personalities of client and builder or the options that confronted them. As a consequence, it is easy to conclude that architecture was the product of some autonomous deterministic process, and to forget that much of what we see today was the result of human agency, stemming from personal choice and from initiatives taken by particular individuals.²

Innovation and Risk

Innovation involved risk, in many cases physical risk, whether in vault construction or tower building. As well as concerns about permanent stability, the process of construction itself was a dangerous occupation, as William of Sens discovered to his cost at Canterbury in 1178.³ The only way that medieval masters could assess risk was by reference to past experience, encompassed by the use of the word *scientia*.⁴ Most structural issues must have been settled through discussion that was rarely if ever recorded; the only time we get to hear of such debate is when things went seriously wrong. Master masons were certainly aware of the risks, even if they were unsure about how to tackle them, a point underlined by the various deliberations that took place in the later Middle Ages at Troyes and Milan.⁵ In early Gothic England, the problem was not so much a dearth of experience, as a reluctance to learn from that experience. This was especially the case with crossing towers, where there was a consistent failure to grasp even the most basic practicalities of structural mechanics.

To illustrate what was at stake it is worth noting a few creative episodes where master masons, presumably with the support of their patrons, were prepared to take bold and imaginative decisions. The first concerns the cathedral of Durham, where the ribbed vaults are well known for their precocious designs and for the way in which those designs were modified as work progressed. The vault over the north transept, built shortly after 1100, is especially interesting, in that it involved the construction of a heavy stone

vault over a clerestory furnished with a continuous passageway (fig. 1).⁶ In other words, the upper levels of this part of the building were not completely solid as they were in the earlier choir. In the choir it was presumably thought that solid walls without passages were essential for the support of a stone vault. The north transept solution was thus a structural experiment, though whether anyone at the time regarded it in this way we shall never know. The experiment worked and the formula employed—the combination of a hollow clerestory with a ribbed vault—was repeated countless times in English architecture. Ironically it was the earlier vault over the choir that gave rise to structural problems: by 1235 this was full of fissures and cracks (*plene fissuris et rimis*) and it was subsequently dismantled and rebuilt.⁷



Figure 1.

Durham Cathedral, *vault over the north transept*. Digital image courtesy of Roger Stalley.

The ribbed vault over the early Gothic choir at Lincoln is known for its unorthodox pattern, with additional ribs defying the symmetries associated with contemporary quadripartite or sexpartite vaults (fig. 2).⁸ There were no obvious structural risks attached to this, although there are inconsistencies in the way the vault was buttressed (most notably in the gallery). This is one of many cases where the design appears to have been worked out as building progressed, a “sequential” approach encountered in many an English building.⁹ Although dubbed the “crazy” vault, it can in fact be interpreted as a rational response to the particular geometries of the cathedral, as Peter Kidson showed many years ago.¹⁰



Figure 2.
Lincoln Cathedral, *vault over St Hugh's choir*. Digital image
courtesy of Malcolm Thurlby.



Figure 3.

Bristol Cathedral, *vault over the south aisle*. Digital image courtesy of Roger Stalley.

More visually daring is the dramatic “hall church” erected for the Augustinian community at Bristol (now the cathedral), where the spatial gymnastics in the choir aisles represent a veritable display of kinetic art (fig. 3). The surviving choir is one of the most inventive experiments in English architecture, the scheme both visually brilliant and structurally sound, the arches across the aisles acting as a brace to stabilize the high vaults. The identity of the master mason remains unknown, and we know nothing about the circumstances that persuaded the Augustinian canons themselves to accept such a novel design. ¹¹

Finally, there is the vault of Henry VII’s chapel at Westminster, a fantasy world, which, with its stone pendants, seems to defy the laws of gravity (fig. 4). ¹² This was a wonderfully adventurous endeavour, though one in which the design was altered during the course of construction: the great

transverse arch marking the entry to the sanctuary was apparently inserted as an afterthought. The evidence is visible from the upper surfaces of the vault, but even from below the geometrical forms seem compromised; in the words of Jacques Heyman, the arch “spatchcocked in as an afterthought”. ¹³

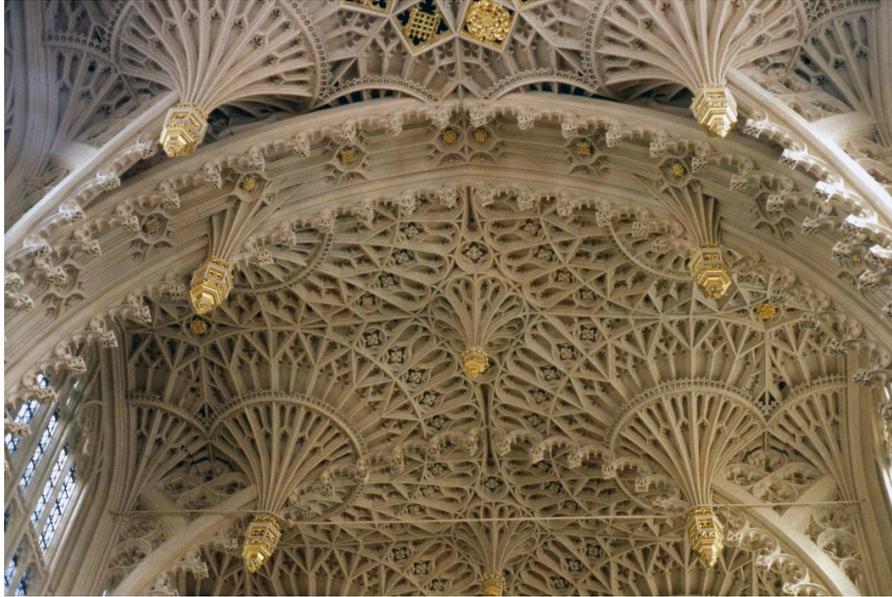


Figure 4.

Westminster Abbey, *pendant vault over Henry VII's Chapel*. Digital image courtesy of Roger Stalley.

At least three of these vaults were the product of sequential design, the original schemes, whatever they were, being modified as work progressed. In none of these cases is there a record of the way in which decisions were taken or much indication of the role of particular individuals. At the planning stage such unorthodox and enterprising schemes must have provoked intense discussion, not to say vehement argument, perhaps akin to that which took place at Canterbury following the fire of 1174. ¹⁴

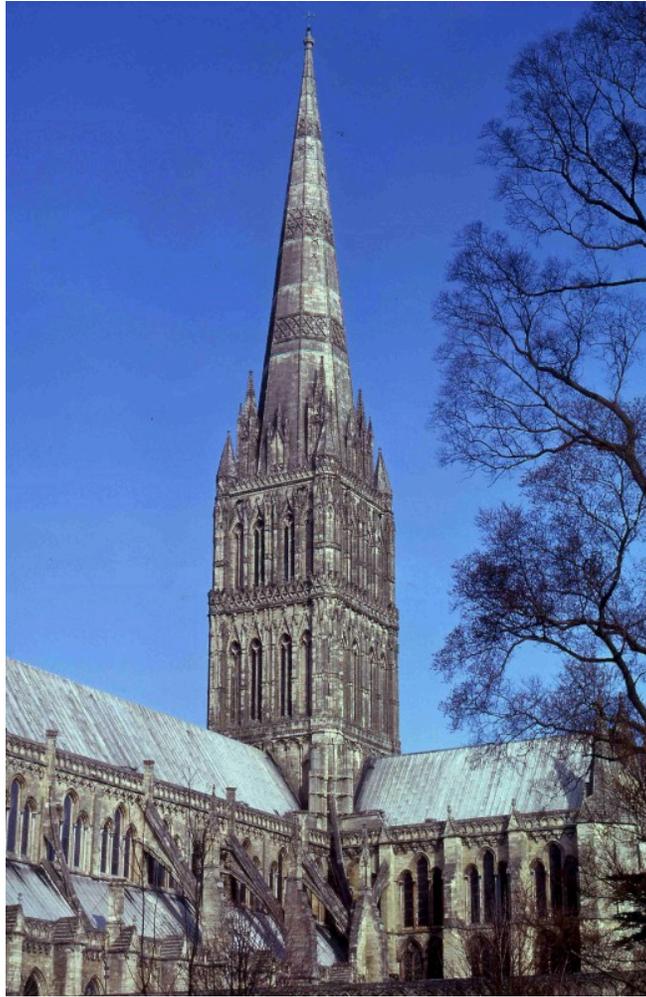


Figure 5.
Salisbury Cathedral, *tower and spire from the south-west*. Digital image courtesy of Roger Stalley.

Tower building was an even more hazardous operation, as demonstrated in recent studies of the tower and spire of Salisbury (fig. 5). This was a stupendously ambitious project, a vast weight of masonry placed over the centre of the church to a height of 123 metres. But as Richard Morris has shown, anxieties developed at an early stage: while the tower was still under construction, the buttressing system was extended and improved, a continuing process that is fundamental to the history of the tower.¹⁵ It is no wonder that Salisbury became the inspiration for William Golding's novel *The Spire*, with its portrayal of a dean obsessed with mega construction.¹⁶

Fiction this may have been, but it reminds us that inventive architects could not operate without ambitious clients. Major projects involved continuous dialogue between patron and architect, but we rarely get a glimpse of this. Indeed, the degree to which the impetus for invention came from the patron

rather than the architect is a perennial issue; it is only in the fourteenth century, with the survival of written contracts, that a clearer impression begins to emerge. ¹⁷

In earlier centuries evidence is scarce, though there are occasional hints, as with the building activities of Henry III. The king's *modus operandi* is beautifully illustrated in the very specific instructions issued to the justiciar and treasurer of Ireland in 1243 for a royal hall in Dublin. This commands:

that out of the King's profits they cause to be constructed in the castle of Dublin, a hall 120 feet in length and 80 feet in breadth, with glazed windows after the hall of Canterbury; and that they cause to be made in the gable beyond the dais a round window 30 feet in diameter. They shall also cause to be painted beyond the dais the King and Queen seated with their baronage: and a great portal shall be made at the entrance to the hall. ¹⁸

This was all to be carried out within two years, complete with an independent water supply. The hall has long since gone, but it was evidently adorned with Purbeck shafts, presumably along the lines of those in the royal hall at Winchester. ¹⁹ The key point here is the reference to a model, notably for the windows. It was not the only time that Henry cited a specific prototype: his admiration for the wooden vaults at Lichfield was such that he asked that they be copied at Windsor. ²⁰

Creativity and the Past



Figure 6.

Chichester Cathedral, *retrochoir looking north-east*.
Digital image courtesy of Roger Stalley.

Deference to existing works was one of several factors that constrained an architect's freedom to create and invent. The impact of the past was a potent factor in English Gothic, a theme explored by the late Larry Hoey.²¹ The scale and solidity of Norman architecture left Gothic builders with a legacy that was hard to avoid. By their sheer bulk, if nothing else, Romanesque cathedrals and great abbey churches exuded authority. They must have seemed well-nigh indestructible, and too expensive to be replaced by something more fashionable. Additions or partial reconstruction were thus the order of the day, which meant that the existing fabric often controlled the configuration of any new scheme, a point frequently cited in attempts to explain the "Englishness" of English Gothic. One might, in these circumstances, have expected those monuments built *de novo* to be more adventurous than the others, though the design of Salisbury suggests that this was not necessarily the case.²² Additive building demanded a different approach, "creative adaptation", to us the words of Larry Hoey. The

extension at Chichester is typical, where a retrochoir was added to the Romanesque church after a fire in 1187 (fig. 6).²³ The main lines of the Romanesque elevation were maintained, the gallery is similar in height, and the arches are round rather than pointed. Creative expression was largely restricted to the mouldings and piers. As so often in English Gothic, the piers at Chichester, with their detached Purbeck shafting, offered the most conspicuous outlet for artistic expression.

Deference to the past could be far more dramatic: the opposite end of the spectrum can be found in the choir at Gloucester, the high point of creative adaption. In this case it was a question of modification rather than addition and one has to admire the sheer audacity of what was done. By stretching a skin of tracery across the interior of the Romanesque fabric, the past was enveloped and concealed (fig. 7).²⁴ While this reduced the amount of demolition required, a major bonus may have been political, for the Benedictine monks got a new identity without losing their old building. The remodelling of the choir can be interpreted as a supremely diplomatic solution, one that quieted any misgivings that existed amongst the more conservative members of the community. And surely there were misgivings, for it would be naive to imagine that every monk would have welcomed the destruction of their ancient church.



Figure 7.

Gloucester Cathedral, *vault over the crossing*. Collection of Conway Library, Courtauld Institute of Art, London. Digital image courtesy of Courtauld Institute of Art.

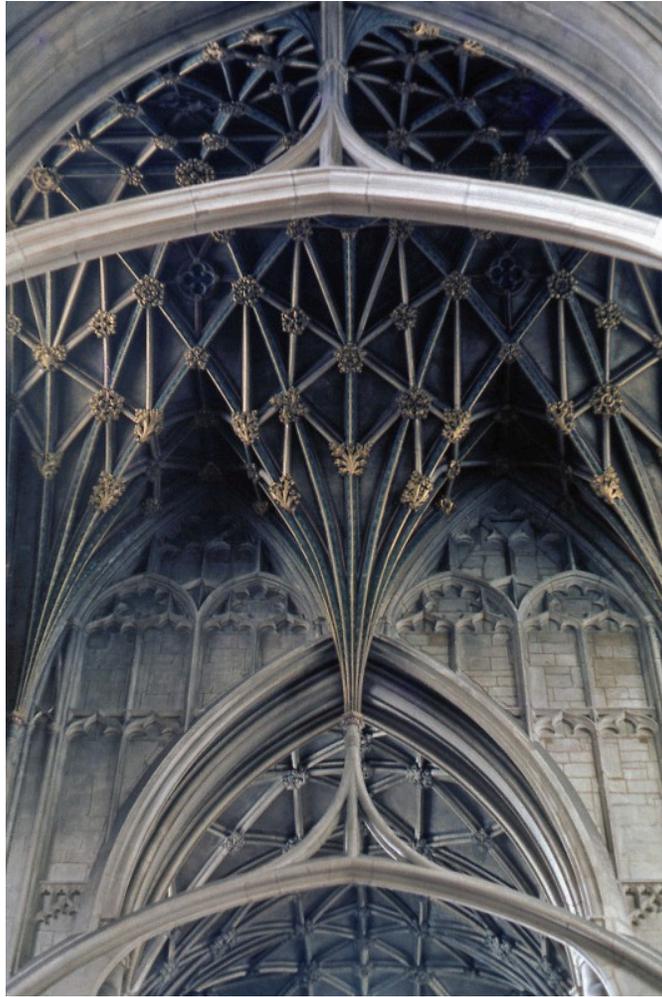


Figure 8.

Gloucester Cathedral, *vault over the crossing*. Digital image courtesy of Roger Stalley.

As at Canterbury a hundred and fifty years before, the eventual solution was a compromise, an integration of old and new. While the tracery veneers at Gloucester looked sleek and fashionable, the retention of round arches provides an acknowledgement of the Norman past. The clothing of the ancient elevation was one audacious stroke amongst many. At the east end of the church, the original apse was replaced with a mighty window, in effect “a monumental hieratic reredos in glass”.²⁵ A further *tour de force* was the insertion of freestanding ogee arches at the crossing to provide a support for the lierne vault—the so-called “coat-hangers” (fig. 8). Even in a design admired for its harmony and consistency, the eventual appearance of the choir was surely the result of a process, rather than an inspired vision conceived by the architect at the start. The scheme was in fact based on what was effectively a trial run in the south transept. In all this we can only speculate about the respective contributions of the master mason, the abbot, and the community (and perhaps the crown).

Processes of Construction

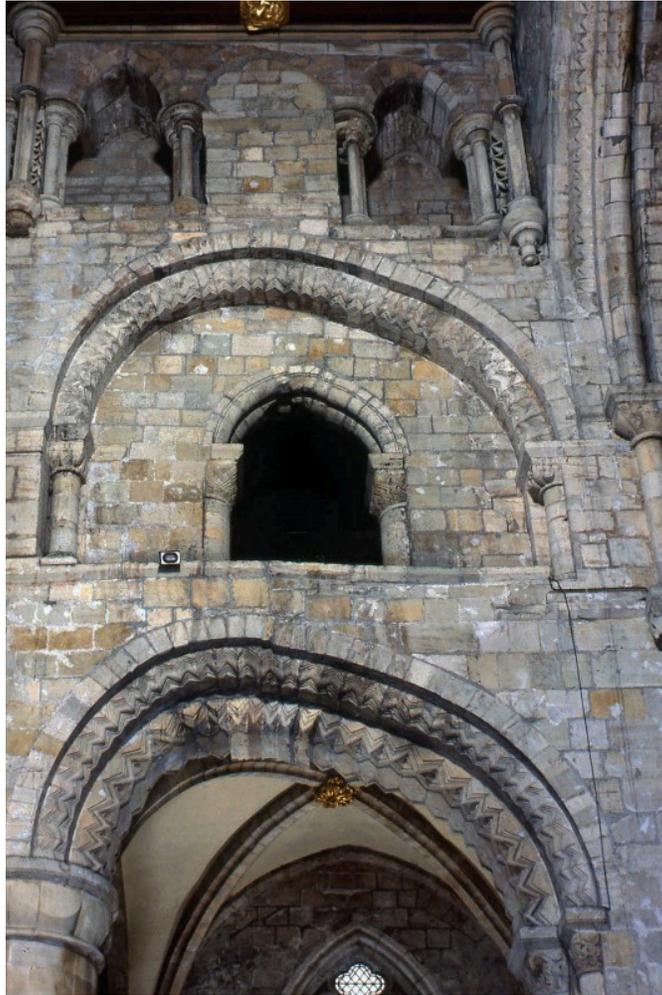


Figure 9.

Selby Abbey, *first bay of the nave, north side, showing differential settlement.* Digital image courtesy of Roger Stalley.

A second factor affecting creativity was the process of incremental or piecemeal construction, whereby building was strung out over a long period, usually as a result of fluctuating resources. This did not necessarily inhibit invention, however, for there were times when master masons seemed to enjoy subverting the designs of their predecessors, sacrificing consistency for *varietas*. An extreme case of this can be found in the Benedictine church at Selby, a building notorious for its architectural discords.²⁶ The abbey church was begun in the 1120s in a manner characteristic of the time. The builders encountered problems quite soon, having decided to construct a crossing tower at a time when only two bays of the nave had been completed. The weight imposed on the crossing piers caused them to sink below the level of the rest of the building, providing a spectacular

demonstration of differential settlement, the structural phenomenon that English builders found difficult to comprehend (fig. 9). At this point the community was faced with a choice: either dismantle the tower or tolerate the distortions in the fabric. The monks opted for the latter, no doubt because it was the cheaper option, even though it involved blocking one bay of the gallery as a reinforcement. Half a century elapsed before construction resumed on the nave: the master charged with the task at this point maintained the original configuration of the elevation, with double bays and a large open gallery, while introducing a new vocabulary of forms: in effect the Romanesque scheme was translated into Gothic (fig. 10). In place of Romanesque cylindrical piers came an eight shaft cluster; in the gallery a miniature tempietto was introduced, a carousel of small columns, inspired by similar tricks at Lincoln, where, in an evocative phrase, they were likened to a circle of dancers by the author of the metrical life of St Hugh.²⁷

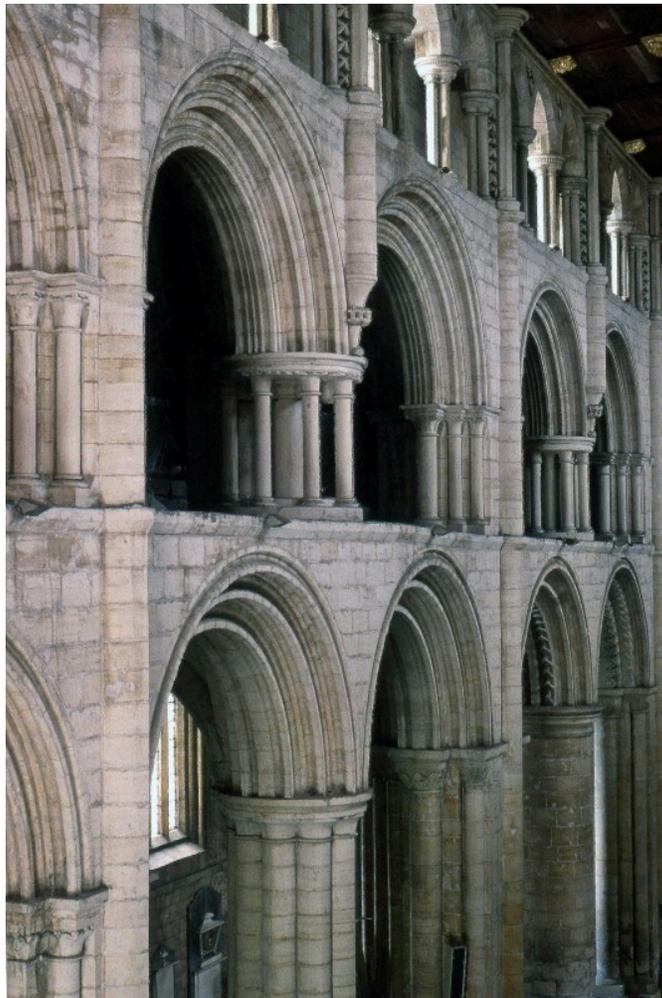


Figure 10.

Selby Abbey, *interior of the nave, north elevation, looking east*. Digital image courtesy of Roger Stalley.

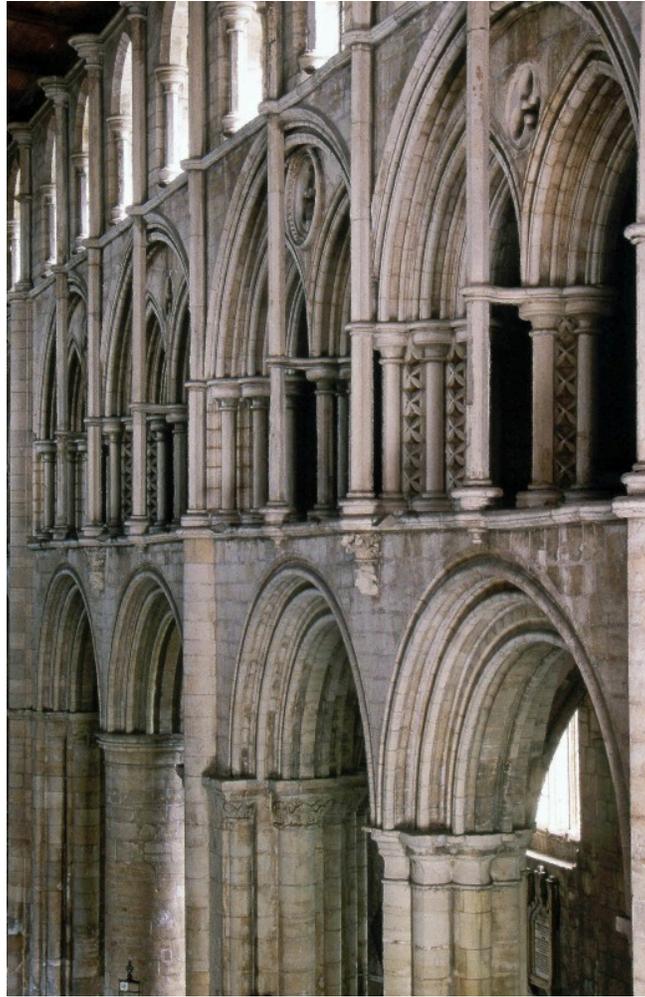


Figure 11.

Selby Abbey, interior of the nave, south elevation, looking east. Digital image courtesy of Roger Stalley.

At Selby the north and south elevations were built separately and by the time the south side was designed, a new master had appeared on the scene, one with little respect for the past. Novelty was the order of the day. Inspired by recent work in the transepts at Lincoln, hanging shafts were added to the face of the gallery, colloquially described as “flagpoles” (fig. 11). These shafts might have made sense if a sexpartite vault had been planned, but this could never have been the intention at Selby.²⁸ There is a wonderful sense of bravado about the architecture of the nave, a triumph for ingenuity over consistency. Many churches have arcades that differ north and south, but rarely are the contrasts quite so stark as at Selby. The curiosities here clearly owed much to human choice, but whether on the part of the abbots, the community, or a series of unusually persuasive master masons remains a matter of conjecture. On the other hand, Selby may provide clues about how buildings were seen and appreciated. It seems that pleasure and delight came from individual parts, not necessarily from the totality of the building.

This is not altogether surprising given the way great churches were experienced on a daily basis. While impressions gained by modern visitors tend to be conditioned by vistas along the main axes, monastic communities moved around their buildings and were familiar with lateral and partial views.

It is clear that splendour and variety were values much admired at the time, as suggested by the use of such epithets as *sumptuosus*, *varietas*, *venustus*, *incomparabilis*, *elegantia*, *splendidus*, *pretiosus*.²⁹ Colour, line, and pattern, along with demonstrations of ingenuity, evidently drew a greater aesthetic response than classical notions of harmony or integrity.³⁰ As Larry Hoey maintained, we are dealing with “a mentality that saw virtue in experiment and put little stock in uniformity and symmetry”.³¹ The delight in variation was not universal, and it is important to remember that there are plenty of English monuments where the initial design was steadfastly maintained throughout the course of construction.³²

Patrons, Personalities, and Communities

A third factor bearing on creativity was the nature of religious patronage, in particular the fact that churches were designed for communities rather than a single patron. Although a bishop, a dean, or an abbot might exercise ultimate authority, there was always the potential for trouble if the support of fellow monks or clergy was not forthcoming. Nor should one forget that religious communities had an abundant supply of aging and no doubt obstinate men. Construction that involved massive investment over a long period was bound to be controversial, and one suspects that disputes like that which ensued within the Benedictine community at Canterbury in the 1170s were not uncommon.³³ Nostalgia, concerns about cash, personal jealousies, distrust of builders, must all have played a part. Some of these factors were apparent at St Albans in the years around 1200, when communal frustrations boiled over; for once we have a guide, albeit a somewhat partial one, in the chronicler Matthew Paris.³⁴

In 1195, or perhaps a year or two later, work began on a reconstruction or extension of the western section of the nave of the monastic church at St Albans. A spectacular facade was a key part of the scheme, and this involved decorated porches, twin towers, and an abundance of detached shafts and elaborate mouldings (fig. 12). This ambitious design was historically significant as it predated the great screen facades at Lincoln and Wells. But just how inventive it was is hard to say, since the little that was achieved has been obscured by restoration and reconstruction.³⁵ The plan was the brain child of a new abbot, John de Cella, who was eager to make his mark. His predecessor had collected the sum of 100 marks for the church fabric, so

abbot John had cash in hand. Things soon began to go wrong: progress was slow, the foundations took an inordinate time to prepare, walls collapsed, finished carving disintegrated. For all this there was a convenient scapegoat in the form of the master mason, Hugh de Goldclif, in the eyes of Matthew Paris “a deceitful and unreliable man”, although he acknowledged that Hugh was “a craftsman of great reputation” (*vir quidem fallax et falsidicus, sed artifex praelectus*).³⁶ The two comments appear contradictory, for how, one might ask, did a “deceitful” master acquire a “great reputation”? There was surely more to the story. Matthew continues his one-sided account, explaining that by the “treacherous advice of the said Hugh . . . carved work, unnecessary, trifling, and beyond measure costly, was added.” Newly built walls were left uncovered over the winter and finished carving disintegrated, the stone apparently being too soft to withstand the elements. Workmen were left unpaid. The site became a laughing stock. Alarmed and humiliated, abbot John washed his hands of the project and put another monk in charge. Nothing more is heard of Hugh de Goldclif. He was presumably dismissed. But who was really to blame? Was Hugh a maverick mason or merely a skilled craftsman who lacked (to use modern parlance) “managerial qualities”? If his proposals were deemed unrealistic or over ambitious, why then had they been accepted by the abbot? Was abbot John himself without blame? The fact that workmen were left unpaid suggests problems in financial management. There was apparently internal discontent, with the monks critical of the extravagance and the lack of progress.



Figure 12.
St Albans Cathedral, *the much restored south-west porch*. Digital image courtesy of Roger Stalley.



Figure 13.

St Albans Cathedral, interior of the nave, west wall, engaged pier designed for detached shafts. Digital image courtesy of Roger Stalley.

What makes this episode especially interesting is that the crisis is fossilized in the fabric of the building. Hugh de Goldclif's nave extension was planned with sumptuous piers, formed of octagons surrounded with eight detached shafts; against the west wall one can still see sections of a respond designed in this way, ready to receive shafts which were never inserted (fig. 13). The internal faces of the porches were likewise ambitious, with double arcades, contrasting arch forms, and luxurious capitals. The nave extension was eventually completed, but to a far more austere design. It was a dull arrangement with no high vaults, minimal detached shafting, and the use of moulded rather than foliate capitals. By now the creative ambitions of Hugh de Goldclif and abbot John had been consigned to the past.³⁷ Here is a case where an excess of invention contributed to a breakdown in trust between architect and patron.

This all took place before the era of elaborate parchment drawings, at a time when it was difficult for patrons to acquire a clear understanding of exactly what they were going to get. If “show drawings”, like those prepared at Strasbourg in the 1270s, had been the norm in England around 1200, then perhaps the crisis at St Albans might have been avoided.³⁸ The type of drawings employed at the time, those incised on walls or marked out on plaster floors, dealt with individual components rather than overall schemes, which was not much help to a prospective patron. In fact the limited scope of such drawings, often laid out at full scale, helps to explain why early Gothic in England so often has an additive flavour, with individual elements worked out one step at a time, rather than conceived together as part of an overall design. This is very much the impression one gets at Lincoln, at least until the 1250s. As is well known, the fabric of the early Gothic architecture at Lincoln suggests a somewhat cavalier approach to matters of design, as if the master in charge was not disposed to think very far ahead; this is especially noticeable in the main transepts, with their disturbing juxtaposition of arches of irregular size, not to mention sundry misalignments (fig. 14).³⁹ Compared with Salisbury or Wells, the lack of consistency is striking; it surely had something to do with the way the Lincoln workshop was organized, indeed its very ethos. The lack of a forceful ecclesiastic presence (in effect a project manager or *custos operis*) might have contributed to the situation. One gets the impression the Lincoln masters were allowed to do much as they pleased.⁴⁰ With the start of the Angel Choir in 1256, however, there is a noticeable change of tone: the effect is as sumptuous as ever, but the design is more consistent, as if an integrated set of drawings was followed from the start. The second half of the thirteenth century seems to mark a significant change in practice, in particular a change in the relationship between design and construction.



Figure 14.

Lincoln Cathedral, *interior of north transept*. Digital image courtesy of RIBA Collections / Photo: Edwin Smith.

At Lincoln we have some hints about the ways in which originality and invention were perceived; moreover, the cathedral provides an example of the potential conflict between creativity and structural risk. The main body of the cathedral was finished in the 1230s, about the time of the arrival of the formidable Robert Grosseteste as bishop.⁴¹ With its inventive piers, marble colonettes, and exotic vaults, the building would surely have impressed the new bishop. As a scholar who ruminated extensively on optics, colour, and light, it would be interesting to have his views. A few years after becoming bishop, Grosseteste considered the nature of beauty in his commentary on *De Divinis Nominibus* by Pseudo-Dionysius the Areopagite, defining it in classical terms of proportion and concordance and using phrases that could have come straight from Vitruvius: “For beauty is a concordance and fittingness of a thing to itself and of all its individual parts to themselves and to each other and to the whole, and that of the whole to all things.”⁴²

Grosseteste's Platonic approach was admittedly formulated in the context of theological or divine beauty, and architecture may have been distant from his thoughts. But more revealing is the gap between his approach and that adopted a few years before by the author of the metrical life of St Hugh: for the poet it was the emotional impact of the design that brought delight, in particular the polished marble and the pattern of the ribs, not Grosseteste's cerebral notions of harmony and proportion. The poet's observations are immediate and spontaneous, as with his alluring comparison between the marble colonettes that adorn the building and freshly growing fingernails.⁴³

Disaster at Lincoln

Soon after his consecration, Grosseteste announced a formal visitation of the chapter, an initiative that infuriated the canons. This was followed by a structural crisis in the cathedral itself, when the north-east corner of the central tower collapsed, burying three individuals in the process; their fate is not clear, but the chronicles use the word *prostrati*, which sounds final enough. In the eyes of the canons the two events were connected. As Matthew Paris explains, one of the canons denounced the bishop from the pulpit, calling for action with the words, "if we hold our peace, the very stones will cry out", at which point "a certain great part of the church disintegrated and collapsed."⁴⁴ The coincidence of the two events may strain modern credulity, but it made for a good ecclesiastical story.⁴⁵

The Peterborough Chronicle gives a more prosaic account, blaming the collapse on the arrogance of the builders (*propter artificii insolentiam*).⁴⁶

The phraseology recalls that used to explain the fall of the tower at Beverley in 1219, one of the most gripping medieval accounts of a structural disaster. At Beverley we are told the craftsmen in charge of the work "were not as cautious as was necessary; not as prudent as they were subtle in their craft . . . concerned with adornment rather than with strength, rather with delight than with the need for stability". They piled on extra masonry, regardless of gaping cracks appearing below, splitting marble columns "from base to capital". Fortunately nobody was injured or killed when the collapse eventually came, a miracle attributed to the intervention of the church's patron saint, John of Beverley.⁴⁷

The Annals of Dunstable priory provide an additional clue to the cause of the trouble at Lincoln. Following the collapse, we are told that "the columns and arches were reinforced on every side" (*donec circumquaque columnae et arcus firmarentur*),⁴⁸ and it is these reinforced piers that are visible in the cathedral today (fig. 15). The Annals clearly imply that the cause of the disaster was the feeble construction of the original crossing piers, erected some forty years earlier. These had formed part of St Hugh's choir, the work

of one of the most inventive of all English medieval architects.⁴⁹ His surviving piers are ornamented with detached shafts, as was presumably the case with the original eastern crossing piers. Responsibility for the crash should thus be directed, at least in part, towards the architect of the choir, the author of the “crazy” vaults, the ingenious syncopated arcading, and the so-called “Trondheim” pier, an individual celebrated for his creativity.⁵⁰ Invention, it seems, came at a price. But equally culpable was his successor, who chose to erect a tower over inadequate supports, a common failing in English building. When it came to towers, grandeur was all too often paramount. English builders were not, however, alone in their innocence, to judge from the debates at Milan two hundred years later. It is hard to forget the portentous declamation of Italian masters to the effect that “what is vertical will not fall”, a comment preceded by the equally remarkable statement that pointed arches do not exert a thrust on buttresses.⁵¹ These were Italians, ignorant of the wiles of Gothic architecture, but the French and German masters at Milan did not fare much better. Their means of explaining structural mechanics was limited to vapid appeals to geometry and experience, grandly encapsulated by the word *scientia*.

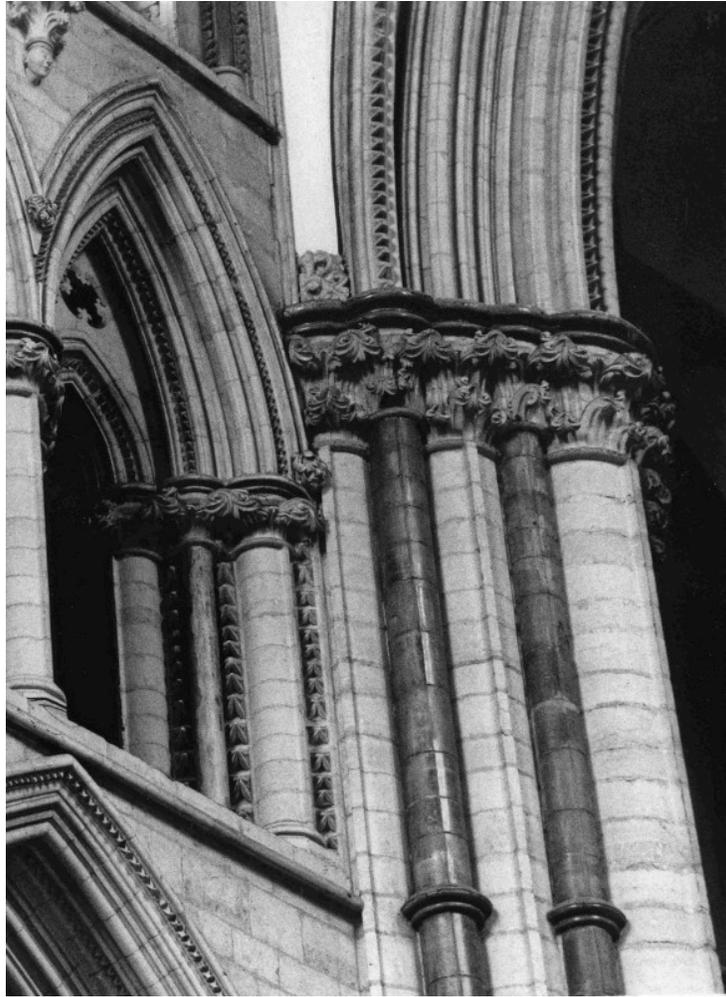


Figure 15.

Lincoln Cathedral, *north-east crossing pier*. Digital image courtesy of Roger Stalley.

Thus invention could, and sometimes did, bring disaster. But there is another side to the issue, for catastrophe also brought opportunity. The most obvious example is the flying buttress. Misleadingly regarded as an “invention” of the Gothic era, flyers were in origin an act of desperation, external props employed to save buildings from collapse. Long before they appeared in France, they could be found in Constantinople, one of several stratagems used to buttress Hagia Sophia. Moreover, the first major use of flying buttresses in France appears to have been a direct consequence of disaster. Antiquarian drawings of the great abbey church of Cluny show flying buttresses in the nave, assumed by some to be additions of the late twelfth century. As a section of the high vault collapsed in 1125, it would have been strange if reconstruction took place without reinforcement, and this is surely when the flyers were erected.⁵² In a Gothic context invention lay not so much in the idea of the flying buttress as in the realization of its potential.

Ely and its Octagon

In England the supreme example of catastrophe leading to invention is the octagon at Ely. The basic facts of the disaster are well known: on the evening of 12 February 1322 the Romanesque crossing tower crashed to the ground with “thunderous noise”, such that “one might think an earthquake had occurred.”⁵³ The collapse was not unexpected: there had been warning signs, sufficient to discourage the community from using the adjacent choir.⁵⁴ We are fortunate to have a detailed, albeit sanitized, account of subsequent events, written it seems by the sacrist, Alan of Walsingham, who effectively acted as project manager.⁵⁵ Having cleared the dust and debris, the position of eight new piers was marked out to form the base of the octagon. Alan, so we are told, measured out the location of the piers “by architectural art”. The ground was then excavated, great efforts being made to guarantee the solidity of the foundations, a point that suggests poor foundations were perceived as a cause of the collapse. Thus the shape of the octagon rose from the ground. It all sounds remarkably straightforward, as if Alan conceived a vision of the completed octagon almost before the dust had settled, it is a tale accepted by almost every commentator.⁵⁶ There is no mention of any plan or drawing on which the building was based.⁵⁷ Alan was a capable individual, with a good knowledge of building, but he was not a master mason or master carpenter. The sacrist rolls mention a number of professionals who came to advise, including one with a talent for *arte architectonica*. His name (or nickname) was, intriguingly, Peter Quadratarius, which suggests someone who could not only cut square blocks, but also measure and calculate.⁵⁸ Alan depended heavily on professional guidance.⁵⁹

The obvious reaction to the disaster might have been to rebuild the tower, and no doubt many in the community expected this to happen. But Alan and his advisers experimented with something different, opting for a vast octagonal space in the centre of the church, an arrangement without precedent in English architecture (fig. 16). In making this choice, they set themselves a variety of problems, both structural and diplomatic. The space created was over 21 metres wide (as measured on the diagonals) yet there were no English precedents for covering such a space, even in wood.⁶⁰ It was not just a question of devising a vault or ceiling that would be structurally stable; there was the problem of how such a structure could be erected. Solving the latter issue was a major part of the ingenuity of the scheme. The plan was ambitious, not least because it required the construction, or reconstruction, of eight piers, rather than the four needed for a more orthodox tower. Then there was the community to convince: some may have regarded the notion of the octagon as a needless experiment,

arguing in favour of a more conservative solution. It was presumably Alan who persuaded them otherwise. He was evidently a powerful advocate, but however charismatic and forceful, it is hard to believe he would have carried the day without substantial professional support. The arguments were compelling enough to persuade the monks of Ely to take the more demanding and inventive option.



[View this illustration online](#)

Figure 16.

Ely Cathedral, *interior of the octagon*. Digital image courtesy of Alamy Stock Photo / Photo: Louis Champion.

If the first instinct was to rebuild the tower, it is possible that the idea of a wide octagonal space suggested itself as the debris was cleared away. With remnants of the Romanesque crossing piers removed, the full impact of the space would have been revealed. Was it at this stage that thoughts turned to other possibilities? Alternatively, with the failure of the crossing piers, a more lightweight superstructure, supported on eight rather than four piers, might have seemed advantageous. Whatever the case, there were still major problems to solve, both in design and construction. Foremost amongst them was how lengthy pieces of timber could be manipulated into position at a high level and supported there until such time as the base of the lantern was in place. This served as a horizontal compression ring, the stability of which could only be achieved once it was supported evenly on each side.⁶¹ There is also the question of when the idea of a hanging lantern was devised. Initial thoughts might have involved a continuous roof without a lantern, a point suggested by the presence of redundant corbels bonded into the masonry of the octagon, as pointed out by Philip Dixon.⁶²

Whatever the scenario, it is most unlikely that the final appearance of the design was worked out at the start. The supporting piers took eight years to build, an interval that allowed plenty of time for cogitation. Finished timber was not needed for several years, so precise cutting and carving could obviously wait.⁶³ In fact a decade elapsed before we can be certain of the presence of William Hurley, the king's master carpenter, who has been given credit for the timberwork; he was certainly there in 1334. Unfortunately there is no means of discovering whether the delay was intentional or whether Hurley was called in as a saviour when all else failed. Vital sacrist rolls are missing, so he may have been advising all along, though there is no certainty about this.⁶⁴ Whatever the situation, it seems clear that the design of the octagon was not as straightforward as the polished accounts tend to suggest.

While it is easy to admire the visual effects of the Ely octagon, it is important to remember that invention lay as much in its construction as in the design itself. It is also worth noting that the lantern was an ingenious way of reducing the need for excessive lengths of timber, one reason perhaps why it became an essential element in the scheme. In fact some of the more subtle features of the octagon were products of what was a complex design process: for example, the geometry by which an irregular octagon at ground level culminates in a lantern of regular octagonal shape; or the way the lantern itself is turned so that its angles, not its straight sides, lie on the main axes, a consequence of the disposition of the supporting ribs.⁶⁵

As well as "beneficial" collapses like that at Ely, there were plenty of close calls when disaster was narrowly avoided. Central towers remained a consistent outlet for creative ambition and a continual source of risk. Thus at Wells, after two extra storeys were added to the crossing tower around 1320, the whole structure threatened to collapse. By 1338 the church was said to be *enormiter confracta et deformata*, words that suggest a level of panic. The tower itself was not particularly ambitious in design, but the "strainer arches" inserted to keep it up most certainly were.⁶⁶ Furnished with "gaping eyes" in the spandrels, these arches are now one of the most memorable sights of English architecture (fig. 17). Wells was not necessarily the first time such an expedient had been employed, for Richard Morris has made a good case to show that those in the east transepts at Salisbury were inserted a few years earlier and provided a potential model. The arches at Salisbury, however, look self-effacing and utilitarian, whereas those at Wells are bold and exhilarating. Both works have been attributed to the master mason William Joy.⁶⁷



Figure 17.

Wells Cathedral, 'scissor arches' within the crossing.

Digital image courtesy of Globus Images / Alamy Stock Photo.

The problem they were intended to solve is a familiar one: the construction of heavy crossing towers built without sufficient attention to the stresses imposed on the fabric below. There have been suggestions that the strainer arches at Wells were not much use, taking less than 10 percent of the load of the tower, and, as they were not copied, there may have been doubts about their value at the time.⁶⁸ One would imagine that the clergy were reluctant to accept such an intrusive solution, but the prospect of disaster no doubt helped to focus the mind. It is not so much the originality of the strainer arches that is impressive but the sheer confidence and bravado of the design. Even though the arches have become part of the very identity of the cathedral, one wonders whether the fourteenth-century canons regarded them as anything more than a painful necessity. Whatever the intensity of

opinion, the boldness of the solution suggests a remarkable level of confidence on the part of the master mason and his clients. While invention involved risk, it also required self-belief.

English Practice and Experience Abroad

Building in the Middle Ages was a dangerous occupation and, with large-scale monuments, structural risk was a fact of life. The failure of towers was not a phenomenon restricted to England, and the gathering of master masons to resolve particular problems—as at Milan, Troyes, or Ulm—reveals how deep the uncertainties could be.⁶⁹ Architects assumed huge responsibilities and it is not surprising that patrons sometimes lost confidence in their builders, though in many cases this had more to do with rates of progress than with questions of design or structural stability. About the time that Hugh de Goldclif was sacked from St Albans, the abbot of Bec in Normandy dismissed Ingeran, an experienced mason who was accused of making too little progress in the rebuilding of the abbey church.⁷⁰ A good relationship between master mason and patron was obviously desirable but strained relationships could arise almost anywhere. Discord within religious communities was a potential handicap, as it was initially at Canterbury in 1174.

Costanza Beltrami has recently described a spectacular impasse at Rouen Cathedral after the crossing tower was destroyed by fire in 1514. The canons were divided, one faction hoping to see the tower reconstructed in stone, the other arguing for a cheaper and safer spire of wood.⁷¹ As in England, there were occasions when the past dictated the future. At Magdeburg, for example, the designer of the early thirteenth-century choir was required to incorporate features from the Ottonian building, including heavy columns of porphyry, granite, and marble, transported from Ravenna by Otto I three centuries before; the result was an archaic, heavy-handed design, rather than a more contemporary scheme on the lines of French Gothic.⁷² Relatively few Gothic builders had the opportunity to design buildings from scratch; all too often they were given control of existing projects, the capacity to invent being restricted by what had gone before.

In two respects the situation encountered in England differed from that in continental Europe. Reverence for the past was a feature of religious communities everywhere, the fabric of an ancient building underlining both history and legitimacy. In England, however, the extent to which Romanesque structures affected their Gothic successors is particularly noticeable, both in monastic and cathedral churches. The sheer scale of what was achieved after the Norman conquest became an impediment to radical change, exerting a restraint not found to the same degree in northern

France, for example, where Romanesque structures were for the most part completely removed. But, as we have seen, this very restraint occasionally served as a framework for bursts of creativity, as at Gloucester or Ely.

A second feature of English architecture is the consistent failure of towers, both Romanesque and Gothic. Part of the explanation for this is the predilection for crossing towers, a form inherited from the Romanesque past. And it was not just England that suffered, for there were similar problems with cathedral towers in Scotland and Ireland: at Kirkwall, for example, late twelfth-century reconstruction in the upper reaches of the transepts point to some sort of tower failure, and at Kilkenny, the thirteenth-century crossing tower is known to have collapsed in 1332, “a most terrible and pitiful sight to behold”, according to an eye-witness.⁷³ In the major French cathedrals the idea of a central tower was generally abandoned after 1200, though there were exceptions, notably in Normandy. In fact one of the most reckless episodes in cathedral construction concerns a crossing tower in northern France, albeit one erected in the sixteenth century. This was at Beauvais, where the authorities decided that a central tower and spire was a higher priority than any attempt to complete the nave.⁷⁴ Started in 1563, the new structure was finished in six years, reaching a height of some 130 metres or more, though it did not retain this eminence for long: early in the morning of 30 April 1573 the ambitious and fragile structure fell to the ground; a remarkably short-lived triumph for creativity over prudence.

Footnotes

- 1 Nikolaus Pevsner, “The term ‘Architect’ in the Middle Ages”, *Speculum* 17, no. 4 (1942): 553: “the creative personality did not interest the Middle Ages enough to insist on a terminological distinction between patron and artist”; David Watkin, *Morality and Architecture* (Oxford: Oxford University Press, 1977), 71–111; John Harvey is foremost among the “honorable exceptions”; see John Harvey, *English Medieval Architects: A Biographical Dictionary down to 1530*, rev. edn (Gloucester: Alan Sutton, 1984). In recent years several scholars have made strenuous efforts to define the contributions of individual masons on the basis of style; see, for example, Christopher Wilson, “Gothic Metamorphosed: The Choir of St Augustine’s Abbey in Bristol and the Renewal of European Architecture around 1300”, in *The Medieval Art, Architecture and History of Bristol Cathedral: An Enigma Explored*, ed. Jon Cannon and Beth Williamson (Woodbridge: Boydell and Brewer, 2011), 68–147.
- 2 For valuable comments about the role of individual architects, see Nicola Coldstream, *The Decorated Style: Architecture and Ornament, 1240–1360* (London: British Museum, 1994), especially 163–69.
- 3 As recounted by the monk Gervase; Francis Woodman, *The Architectural History of Canterbury Cathedral* (London: Routledge, 1981), 93.
- 4 James S. Ackerman, “‘Ars Sine Scientia Nihil Est’: Gothic Theory of Architecture at the Cathedral of Milan”, *The Art Bulletin* 31, no. 2 (1949): 105.
- 5 Stephen Murray, *Building Troyes Cathedral: The Late Gothic Campaigns* (Bloomington, IN: Indiana University Press, 1987), especially 30–32, 169, and 216–17.
- 6 As Jean Bony pointed out, the south transept was initially built without a vault; the first English ribbed vault over a clerestory with passages thus came in the north transept. See Bony, “Le projet premier de Durham, voûtement partiel ou voûtement total?”, in *Urbanisme et architecture: études écrites et publiées en l’honneur de Pierre Lavedan* (Paris: Henri Laurens, 1954), 41–49. The “hollow wall” structure was analyzed by Jean Bony in “La technique normande du mur épais, à l’époque romane”, *Bulletin Monumental* 98 (1939): 153–88. The English term “thick wall” tends to imply solidity; “thick hollow wall”, or even “hollow wall”, seem more appropriate terms. For recent analyses of this vault, see Malcolm Thurlby, “The High Vaults of Durham Cathedral”, in *Engineering a Cathedral*, ed. Michael J. Jackson (London: Thomas Telford, 1993), 64–76 and Thurlby, “The Building of the Cathedral: The Romanesque and Early Gothic Fabric”, in *Durham Cathedral: An Architectural Appreciation*, ed. Douglas Pocock (Durham: City of Durham Trust, 2014), 21–53.

- 7 Nikolaus Pevsner and Priscilla Metcalf, *The Cathedrals of England: Midland, Eastern and Northern England* (Harmondsworth: Penguin, 1985), 84.
- 8 Peter Draper, *The Formation of English Gothic: Architecture and Identity* (New Haven, CT, and London: Yale University Press, 2006), 132.
- 9 In his paper to the 2014 conference, James Hillson used the term “iterative process” to describe sequential building, pointing out that no design was set in stone . . . until it was set in stone!
- 10 Peter Kidson, “St Hugh’s Choir”, in *Medieval Art and Architecture at Lincoln Cathedral*, ed. T. A. Heslop and V. Sekules, British Archaeological Association Conference Transactions 8 (Leeds: Maney, 1986), 29–46; Stuart Harrison, “The Original Plan of the East End of St Hugh’s Choir at Lincoln Cathedral Reconsidered in the Light of New Evidence”, *Journal of the British Archaeological Association* 169 (2016): 1–37.
- 11 Wilson, “Gothic Metamorphosed”, 68–147. It is possible that the idea of a hall church came from the building that was being replaced.
- 12 Christopher Wilson, “The Designer of Henry VII’s Chapel, Westminster Abbey”, in *The Reign of Henry VII*, ed. B. Thompson, Harlaxton Medieval Studies 5 (Stanford, CA: Stanford University Press, 1995), 133–56; Wilson, “The Functional Design of Henry VII’s Chapel: A Reconstruction”, in *Westminster Abbey: The Lady Chapel of Henry VII*, ed. Tim Tatton-Brown and Richard Mortimer (Woodbridge: Boydell and Brewer, 2003), 141–88.
- 13 Andrew Reynolds, “An Archaeological Survey of the Vaults of Henry VII’s Chapel”, in *Westminster Abbey*, ed. Tatton-Brown and Mortimer, 219–26, and Jacques Heyman, “The Structure of the High Vault of Henry VII’s Chapel”, in *Westminster Abbey*, ed. Tatton-Brown and Mortimer, 205–17.
- 14 Woodman, *Architectural History of Canterbury Cathedral*, 91–92. The literature on the rebuilding of Canterbury after the fire is extensive; for a recent assessment, see Peter Draper, “Recent Interpretations of the Late-12th-Century Rebuilding of the East End of Canterbury Cathedral and its Historical Context”, in *Medieval Art, Architecture and Archaeology at Canterbury*, ed. Alixe Bovey, British Archaeological Association Conference Transactions 37 (Leeds: Maney, 2013), 106–15.
- 15 Richard K. Morris, “The Style and Buttressing of Salisbury Cathedral Tower”, in *Medieval Art and Architecture at Salisbury Cathedral*, ed. Laurence Keen and Thomas Cocke, British Archaeological Association Conference Transactions 17 (Leeds: Maney, 1996), 46–58.
- 16 William Golding, *The Spire* (London: Faber and Faber, 1964). The year 2014 marked the fiftieth anniversary of the novel’s publication.
- 17 L. F. Salzman, *Building in England down to 1540: A Documentary History* (Oxford: Oxford University Press, 1967), 413–602.
- 18 *Calendar of the Close Rolls*, Vol. 5: 1242–47 (London: HMSO, 1916), 23, 152.
- 19 By 1285 marble shafts had been removed or stolen by Stephen Fulbourn, Bishop of Waterford and Justiciar of Ireland; see H. S. Sweetman, ed., *Calendar of Documents Relating to Ireland: Preserved in Her Majesty’s Public Record Office, London, 1171–1307*, 5 vols (London: Longmans, 1875–86), 3: 13.
- 20 In 1243 Henry III instructed Thomas de Gray “to cause work to go on both in winter and in summer until the king’s chapel of Windsor is finished, and to have a high wooden roof made after the manner of the new work at Lichfield, so that it may appear to be stonework, with good panelling and painting”. *Calendar of the Close Rolls*, Vol. 5: 1242–47, 39; H. M. Colvin, ed., *The History of the King’s Works: The Middle Ages*, 2 vols (London: HMSO, 1963), 2: 868.
- 21 Lawrence Hoey, “Work in Progress, Tradition, Innovation, and Creative Adaptation: The Medieval Rebuilding of English Church Architecture, 1066–1530”, unpublished manuscript (2000).
- 22 Thomas Cocke and Peter Kidson, *Salisbury Cathedral: Perspectives on the Architectural History* (London: HMSO, 1993); Draper, *Formation of English Gothic*, 152–60. As Lawrence Hoey pointed out, physical freedom from earlier structures did not necessarily lead to psychological freedom from the need for commemorating them in newer buildings: Hoey, “Work in Progress”, 45.
- 23 Draper, *Formation of English Gothic*, 117–18.
- 24 Pevsner and Metcalf, *Cathedrals of England: Midland, Eastern and Northern England*, 141–45; David Welander, *The History, Art and Architecture of Gloucester Cathedral* (Stroud: Alan Sutton, 1991), 164–83; Christopher Wilson, *The Gothic Cathedral: The Architecture of the Great Church, 1130–1530* (London: Thames and Hudson, 1990), 206–8; Wilson, “‘Excellent, New and Uniforme’: Perpendicular Architecture, c. 1400–1547”, in *Gothic: Art for England, 1400–1547*, ed. Richard Marks and Paul Williamson (London: Victoria and Albert Museum, 2003), 98–119. For a more extensive analysis of Gloucester and the origin of Perpendicular architecture, see Christopher Wilson, “The Origins of the Perpendicular Style and its Development down to c. 1360” (unpublished PhD diss., The Courtauld Institute of Art, University of London, 1980).
- 25 Jill Kerr, “The East Window at Gloucester Cathedral”, in *Medieval Art and Architecture at Gloucester and Tewkesbury*, ed. T. A. Heslop and V. Sekules, British Archaeological Association Conference Transactions 7 (Leeds: Maney, 1985), 127.
- 26 Roger Stalley, “Choice and Consistency: The Early Gothic Architecture of Selby Abbey”, *Architectural History* 38 (1995): 1–24.
- 27 “*Inde columnellae, quae sic cinxere columnas, ut videantur ibi quamdam celebrare choream*”, in *The Metrical Life of St Hugh*, ed. and trans. Charles Garton (Lincoln: Honeywood Press, 1986), 54.

- 28 In the main transepts at Lincoln these additional shafts corresponded to the intermediate rib of a sexpartite vault, but at Selby the lack of responds, along with the general design of both elevations in the nave, show that a vault was never envisaged.
- 29 These comments are derived from a wide range of architectural documents published by Otto Lehmann-Brockhaus, ed., *Lateinische Schriftquellen zur Kunst in England, Wales und Schottland vom Jahre 901 bis zum Jahre 1307*, 5 vols (Munich: Prestel, 1955–60). *Varietas* was a particularly popular source of praise, more frequently applied in the context of colour or precious gems. In architecture the word seems to imply an element of surprise and perhaps ingenuity.
- 30 Paul Binski, *Gothic Wonder: Art, Artifice and the Decorated Style, 1290–1350* (New Haven, CT, and London: Yale University Press, 2014), has much to say on these matters.
- 31 Lawrence Hoey, “Pier Alternation in Early English Gothic Architecture”, *Journal of the British Archaeological Association* 139 (1986): 55.
- 32 The value of symmetry was in fact widely acknowledged at the time. Vincent of Beauvais, for example, regarded it as one of the essential ingredients of architecture. See Umberto Eco, *Art and Beauty in the Middle Ages* (New Haven, CT, and London: Yale University Press, 1986), 39, citing Vincent of Beauvais, *Speculum Doctrinale XI*, 12, 14. There are plenty of English buildings, including the cathedrals at Salisbury and Wells, which are remarkable for maintaining a high level of consistency in design.
- 33 For the latest assessment of the Canterbury choir, see Draper, “Recent Interpretations”, 106–15.
- 34 H. T. Riley, ed., *Gesta Abbatum Monasterii Sancti Albani, a Thoma Walsingham*, Vol. 1: A.D. 793–1290, Rolls Series (London: Longmans, 1867), 217–20.
- 35 Stuart Harrison, “The Thirteenth-Century West Front of St Albans Abbey”, in *Alban and St Albans: Roman and Medieval Architecture, Art and Archaeology*, ed. Martin Henig and Philip Lindley, British Archaeological Association Conference Transactions 24 (Leeds: Maney, 2001), 176–81; Draper, *Formation of English Gothic*, 45.
- 36 Riley, ed., *Gesta Abbatum Monasterii Sancti Albani*, 1: 218. English translations of these passages can be found in *Chronicles of Matthew Paris: Monastic Life in the Thirteenth Century*, ed. and trans. Richard Vaughan (Gloucester: Alan Sutton, 1986), 14–16; see also in Salzman, *Building in England*, 376.
- 37 According to Matthew Paris, Abbot John’s successor, William of Trumpington (1214–35), after “much tedious delay” brought the west front up to the old work. *Gesta Abbatum Monasterii Sancte Albani*, 1: 281; Salzman, *Building in England*, 378, and *Chronicles of Matthew Paris*, 48.
- 38 Robert Bork, *The Geometry of Creation: Architectural Drawing and the Dynamics of Gothic Design* (Farnham: Ashgate, 2011), 55–97. If the canons of Lincoln had seen a complete drawing of the thirteenth-century west front in advance, one wonders whether they would have accepted the overall design.
- 39 Draper, *Formation of English Gothic*, 125–45.
- 40 This is a contrast to what happened at St Albans in the time of William of Trumpington, an abbot who took a fastidious interest in the design of a spire. *Gesta Abbatum Monasterii Sancte Albani*, 1: 281; Salzman, *Building in England*, 378–79, and *Chronicles of Matthew Paris*, 48.
- 41 There is no exact date for the finishing of the nave, but it must have been close to completion in the decade 1230–40. See Draper, *Formation of English Gothic*, 139.
- 42 Eco, *Art and Beauty*, 48. The passage was written between 1239 and 1243 and comes from Grosseteste’s commentary on *De Divinis Nominibus* by Pseudo-Dionysius the Areopagite, for which see James McEvoy, *The Philosophy of Robert Grosseteste* (Oxford: Oxford University Press, 1982), 69–146. The ideas of beauty expressed by Grosseteste relate to his views about divine order in which harmony and concord are essential elements. A critical edition of Grosseteste’s commentaries on the Celestial Hierarchy (of which *De Divinis Nominibus* is a part) by the Pseudo-Dionysius is in preparation. For a brief outline of his career and achievement, see James McEvoy, *Robert Grosseteste Bishop of Lincoln, 1235–1253* (Lincoln: Lincoln Cathedral Publications, 2003). For essays touching on Grosseteste and architecture, see Nicholas Temple, John Shannon Hendrix, and Christian Frost, eds., *Bishop Robert Grosseteste and Lincoln Cathedral: Tracing Relationships between Medieval Concepts of Order and Built Form* (Farnham: Ashgate, 2014).
- 43 Garton, ed., *Metrical Life*, 54.
- 44 Matthew Paris, *Chronica Maiora Matthaei Parisiensis, monachi Sancti Albani*, ed. H. R. Luard, 7 vols, Rolls Series (London: Longmans, 1872–84), 3: 528–29, 638–39. The biblical quotation comes from Luke 19:40.
- 45 The collapse is analyzed by Roger Stalley, “Lapides Reclamabunt: Art and Engineering at Lincoln Cathedral in the Thirteenth Century”, *Antiquaries Journal* 86 (2006), 131–47.
- 46 J. A. Giles, ed., *Chronicon Angliae Petriburgense* (London: Caxton Society, 1845), 134; Lehmann-Brockhaus, ed., *Lateinische Schriftquellen*, 2: 38, no. 2407.
- 47 E. J. Raine, ed., *The Historians of the Church of York and its Archbishops*, 3 vols, Rolls Series (London: Longmans, 1879–84), 1: 345; Salzman, *Building in England*, 377–78.
- 48 H. R. Luard, ed., *Annales Monastici*, 5 vols, Rolls Series (London: Longmans, 1864–66), 3: 149. The crossing piers were in fact rebuilt at this time in well-coursed masonry; see Stalley, “Lapides Reclamabunt”, 133–41.
- 49 Draper, *Formation of English Gothic*, 130–34.
- 50 In praising the architect of the Lincoln choir as an innovator of the first rank, Christopher Wilson was amongst the first to note that he was responsible for the inadequate eastern piers of the crossing; Wilson, *Gothic Cathedral*, 162–63.

- 51 Ackerman, "Ars Sine Scientia", 97-101.
- 52 K. J. Conant, *Cluny: Les églises et la maison du chef d'ordre* (Macon: Protat Frères, 1968), 99-100, 105-7, 110. Conant appears to have accepted the idea that the external buttressing in the nave belonged to the period 1125-30, though he makes no mention of its potential significance in the context of early Gothic architecture.
- 53 H. Wharton, ed., *Anglia Sacra*, Part 1 (London, 1691), 643-44; Salzman, *Building in England*, 390.
- 54 The cause of the disaster evidently lay with the foundations of the crossing piers, a view borne out by the concern shown for solid ground when the piers of the octagon were constructed.
- 55 F. R. Chapman, ed., *Sacrist Rolls of Ely*, 2 vols (Cambridge: Cambridge University Press, 1907). The first relevant roll is for Michaelmas 1322 when the clearing of the site was still going on. The "heroic" nature of Alan's text is analyzed in Binski, *Gothic Wonder*, 227-28.
- 56 There are obvious comparisons here with the smooth account of the rebuilding of Canterbury Cathedral choir as told by Gervase, for which see Carol Davidson Cragoe, "Reading and Rereading Gervase of Canterbury", *Journal of the British Archaeological Association* 154 (2001): 40-53.
- 57 A point made by Chapman in *Sacrist Rolls*, 1: 14.
- 58 Chapman, ed., *Sacrist Rolls*, 1: 22 and 2: 33.
- 59 There is reference to an unnamed individual from London called in to advise on the "new work" in the first year after the disaster (1323-24). On stylistic grounds the design of the piers has been associated with John Ramsey of Norwich, and it is significant that the sacrist rolls include references to a master mason named John between 1322 and 1326; Chapman, ed., *Sacrist Rolls*, 2: 34, 48, 61. See also John Maddison, *Ely Cathedral: Design and Meaning* (Ely: Ely Cathedral Publications, 2000), 65; Harvey, *English Medieval Architects*, 241.
- 60 The original eleventh-century roof of Westminster Hall had a comparable span measuring approximately 20.4 metres without intermediate supports, as confirmed by Roland Harris and Dan Miles in their presentation at the Westminster Conference of the British Archaeological Association in July 2013; this of course covered a rectangular space rather than a centralized one.
- 61 Philip Dixon has made the interesting observation to me that if one or more of the original crossing piers was retained during construction, they could have provided temporary support at a high level for centring and lifting machines. Maddison suggests that the flat surfaces of the corner turrets were used as working platforms; see Maddison, *Ely Cathedral*, 70.
- 62 I am grateful for the opportunities afforded by the annual meetings of the research group "All Things Stone", at which Philip Dixon outlined his thoughts on Ely.
- 63 The timberwork is discussed by C. A. Hewett, *English Cathedral Carpentry* (London: Wayland, 1974), 82-89, and by John Fletcher, "Medieval Timberwork at Ely", in *Medieval Art and Architecture at Ely Cathedral*, ed. Nicola Coldstream and Peter Draper, British Archaeological Association Conference Transactions 2 (Leeds: Maney, 1979), 63-65. There are extended discussions of the octagon and its significance in Maddison, *Ely Cathedral*, 61-70 and Binski, *Gothic Wonder*, 217-29.
- 64 Harvey, *English Medieval Architects*, 154-55. Harvey suggests that an unknown Londoner who visited Ely in 1323-24 to "ordain new work" and was paid 3 shillings, may have been Hurley, but there is no proof of this. Binski is adamant that Hurley was "clearly implicated from 1322 in view of the imaginative priority of the timber construction": *Gothic Wonder*, 218. Ely had close connections with the royal administration through Bishop John of Hotham, who served as both Treasurer and Chancellor; given these connections early contact with a royal carpenter would have been an obvious move.
- 65 In scale the closest precedent appears to be the timber vault over the chapter house at York, which has an internal width of 18 metres; see Nicola Coldstream, "York Chapter House", *Journal of the British Archaeological Association* 35 (1972): 16. For the design of the ribs, the chapter house at Wells provides a remarkable parallel, as Peter Kidson has pointed out in Peter Kidson and P. Murray, *A History of English Architecture* (London: George G. Harrap and Co., 1962).
- 66 Pevsner and Metcalf, *Cathedrals of England: Midland, Eastern and Northern England*, 295, 317; John Harvey, "The Building of Wells Cathedral, II: 1307-1508", in *Wells Cathedral: A History*, ed. L. S. Colchester (Shepton Mallet: Open Books, 1987), 87-89. The strainer arches have been attributed to William Joy who was appointed master mason at the cathedral in 1329; see Harvey, *English Medieval Architects*, 164-65. The design of the upper stage of the tower has been compared with work at St Augustine's, Bristol, by Richard K. Morris, in "European Prodigy or Regional Eccentric? The Rebuilding of St Augustine's Abbey Church, Bristol", in *Almost the Richest City: Bristol in the Middle Ages*, ed. Laurence Keen, British Archaeological Association Conference Transactions 19 (Leeds: Maney, 1997), 48. The stabilization of the tower involved various other reinforcements, including a stone grid above the existing fan vault. The structural problems were most severe on the western side.
- 67 Morris, "Style and Buttressing of Salisbury", 46-58. Morris has placed the start of work on the tower at Salisbury to about 1300 on stylistic grounds, and assigned the east strainer arches to 1320-30. There has been much debate about the date of the internal scaffold in the spire: dendrochronological dates for timbers have been assigned to the period between 1344 and 1376, but the five samples came from braces at the base of the first stage which may be additions; see A. Richard Jones, "The Salisbury Spire Scaffold Debate", *Avista* 15, no. 1 (2005): 8-17. Jones argues that an internal scaffold must have been used during construction.
- 68 Robert Mark, *Experiments in Gothic Structure* (Cambridge, MA: MIT Press, 1982), 78-91. The tower, however, has survived without provoking the level of anxieties encountered elsewhere.

- 69 Ackerman, "Ars Sine Scientia", 84-111; Murray, *Building Troyes Cathedral*, especially 30-32, 169, and 216-17; Reinhard Wortmann, *Das Ulmer Münster* (Stuttgart: Müller und Schindler, 1972), 21-22. The problems at Troyes included the collapse of the crossing tower in 1365.
- 70 Lindy Grant, *Architecture and Society in Normandy, 1120-1270* (New Haven, CT, and London: Yale University Press, 2005), 137.
- 71 Costanza Beltrami, *Building a Crossing Tower: A Design for Rouen Cathedral of 1516* (London: Paul Holberton, 2016), 81-88.
- 72 Norbert Nussbaum, *German Gothic Church Architecture* (New Haven, CT, and London: Yale University Press, 2000), 41.
- 73 For the fabric of Kirkwall Cathedral, see Malcolm Thurlby, "Aspects of the Architectural History of Kirkwall Cathedral", *Proceedings of the Society of Antiquaries of Scotland* 127 (1997): 855-88; the collapse at Kilkenny was described as follows: "Cecidit campanile Sancti Kannici, Kylkennie, et magna pars chori, vestibulum capellarum, et campanas, et mererium confregit, die Veneris . . . unde horribile et miserabile spectaculum erat contuentibus", in Bernadette Williams, ed. and trans., *The Annals of Ireland by Friar Clyn* (Dublin: Four Courts Press, 2007), 206-7.
- 74 Stephen Murray, *Beauvais Cathedral: Architecture of Transcendence* (Princeton, NJ: Princeton University Press, 1989), 143-49.

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