

# OPEN TIMBER ROOFS

## New Thoughts on Nineteenth-Century Architectural Literature

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### A GEOMETRY OF ROOF AND CEILING

As the structure of ceilings in Canada's parish churches constructed in the second half of the nineteenth century became more architecturally complex, the public developed a narrow view of roofs and ceilings.<sup>1</sup> Behind this single-mindedness were popular misunderstandings about the nature and structure of roofs and internal support systems, the latter referred to as "open timber roofs." What is surprising is that as the space between the interior ceiling and the exterior roof was eliminated, the public's attention was directed indoors to exposed timbers, visible trusses, carved beams, and the blessed "emptiness" of vertical space (fig. 1). The space above the ceiling and below the roof, sometimes voided and sometimes filled with trusses, was compressed in a manner that revealed timber roof systems to the view of parishioners. Despite the single-sided discussion of roofs that favoured interiors, the recto-verso rapport of roofs and ceilings suggests an interior/exterior relation whose potential merits some investigation. This paper explores new ideas about timber roofs in the second half of the nineteenth century from a structural and aesthetic point of view.

A starting place for this investigation will be the separate function and structure of roofs and ceilings, coming later to the idea of the two as one unified component. I am interested in exploring how the elimination of the "void," re-fashioned into the open timber roofing system, had aesthetic and spiritual implications.

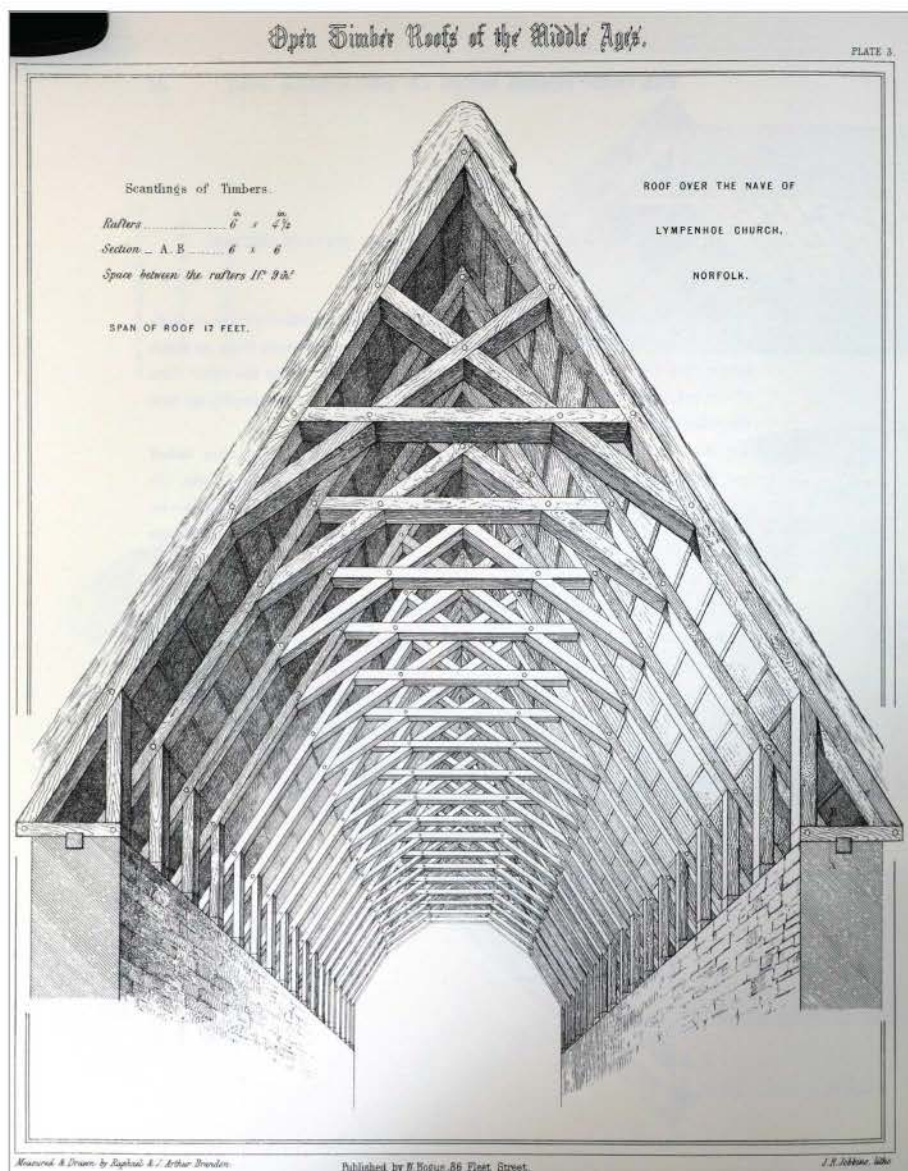


FIG. 1. ROOF OVER THE NAVE OF LYMPENHOE CHURCH, NORFOLK (UK). | ILLUSTRATED IN BRANDON AND BRANDON, 1847, *OPEN TIMBER ROOFS*. SPECIAL THANKS TO MALCOLM THURLBY.

It ought to be pointed out that I am purposely sounding out ideas without intending unsupportable theological assertions in searching for some social and cultural ideas that might explain why ceilings and roofs developed as they did in parish churches in Canada. For that reason this paper should be seen as a work in progress attempting to investigate some fresh perspectives, with apologies to potential research I may inadvertently gloss over.

Roofs are practical structures; they protect building envelopes from the natural elements. Rain and snow are typically considered the forces that act upon a roof, however, wind is a more ubiquitous and vigorous influence. General audiences misunderstood the affect of wind on roofs. Roofs hold a building in equilibrium through forces of compression to, among other things, counteract the force of wind.<sup>2</sup> Perhaps because the roof exterior presented a limited capacity for ornamented embellishment and due to the limited functional changes over time, the roof exterior fell into an aesthetic timelessness. The consequent design limitations of the part that faced the heavens did not penetrate into the building's interior. The part that faced the congregation on the inside experienced stylistic evolution and multiple taxonomies. The inside of church roofs (or ceilings) was less resistant to change than the outside, a metaphor for the outsider view of organized religion.

Plaster ceilings preceded open timber roofing systems, the former being decorative contrivances devised to hide supportive trusses, braces, collars, and the like from view. Plaster was the material of choice to provide such concealment, thus creating the opportunity and means to decorate ceilings in imitation of richer (and more structurally sound) materials

such as stone. The English Gothic Revival architect and theorist Augustus Welby Northmore Pugin (1812-1852) found fault with this method by arguing that concealment, as a falsehood, was unbecoming a Christian monument. He further attested that the decorative nature of plaster ceilings had no historical precedent in the Middle Ages, the age when Christianity enjoyed its high point as far as he was concerned. Pugin's observation of medieval Churches demonstrated how superfluous decoration was eliminated in the superior designs prior to the Protestant Reformation. In the nineteenth century, Anglican church builders adopted Pugin's ideas originally intended for Roman Catholic consumption; Anglicans eliminated the drop ceiling or plastered boards. The re-imagined church interior consisted of open timber roofs, an idea primarily advanced through architectural literature.

It is generally accepted that Pugin's first two books, *Contrasts* (initially published 1836, reprinted 1841) and *True Principles* (1841), were watershed moments for the elimination of the plaster ceiling and consequently the void above it. A strikingly simplified geometry of the steeply pitched roof was presented in print by the Cambridge Camden Society in 1841 in their widely distributed and inexpensive pamphlet *A Few Words to Churchwardens on Churches and Church Ornaments* (available at three pence), which illustrated a simple geometrical diagram.<sup>3</sup> It demonstrated how pointed windows in medieval churches would be lost if the trajectory of roofs was lowered during the restoration of the church fabric. The Society, known as the Ecclesiological Society from 1846, was intensely worried about poor restorations that altered the medieval fabric in favour of modern convenience; the elimination of steep roofs would have been considered favourable to restorers searching for a way to lighten the load

on ancient walls. Charging themselves with the authority to judge church restorations, the Ecclesiologists attempted to channel the public appreciation of church symbolism into more mundane parts of the building such as the roof. They were successful insofar as they were able to get people to recognize the importance of steeply pitched roofs, but the aesthetic sense of exterior tiling was beyond the reach of anybody and only the interior seemed to attract attention.

A less commonly known, but significant text on the beauty of the roof interior, *Open Timber Roofs of the Middle Ages* (1847) was produced in the offices of the architect siblings J. Arthur and Raphael Brandon. This book provided three things that Pugin's polemical texts did not: technical descriptions for construction, full-page illustrations and diagrams, and an illustrated historical discourse aimed at showing where open timber roofs were used in the Middle Ages. The influence of the Brandons' book will be explained in some detail further on. If the open timber roof afforded the parishioners with a closer spiritual relationship with the Almighty, then the void above the ceiling would have been a metaphorical equivalent of that intermediate state of Purgatory. That is, if one's soul were expected to rise nearer to God while engaged in prayer and listening to sermon, then we might surmise, there had best be no intermediary space blocking the way. A different view, literally and figuratively, was adhered to among Roman Catholics who enjoyed the material representation of Heaven in ornamental and painted drop ceilings.

## ROOFS IN PRINT

For Anglican churches, the re-imagined interior with an open timber roof took on a dual identity: ceiling and roof were

combined in one component. It was one structural entity whose reception in the public sphere was something appreciated for its beauty but not completely understood. That is, the nineteenth-century mind seemed to see the interior “ceiling” and the exterior roofs as separate entities. A singular article printed in *The Building News* in December 1874 advocated for the importance of roofs, but in such technical terms that appealed only to its target audience of professionals.

In every age the covering of buildings must have been looked upon as an art of no small importance, if not ranking as high as the erection of the building of which it forms a part. We have only, indeed to come to more modern times to find such things as hidden roofs—... concealed behind screens, balustrades, parapets, and other ornamentation, as if the roof were a thing to be ashamed of... The ancients we are so wont to imitate, did not think thus; on the contrary, the roof became an essential part of the structure—in fact, it became the crowning effort of skill and art.<sup>4</sup>

A similar view suggests that the open timber roof represented two sides of the same object; a membrane tasked with holding the profane world at bay while showing the face of beauty and harmony to the sheltered community within. Seen in this way it is hardly surprising that parishioners concerned themselves solely with interiors. The exterior envelope of the building, which included the roof, appeared to be limited to the purview of architects, builders, and workmen who laboured in the service of the building but not in the service of religion.

Adaptations and variety were possible in wooden roof interior design largely because of the publication of Raphael and J. Arthur Brandon’s fully illustrated book *Open Timber Roofs of the Middle*

*Ages*, a volume dealing specifically with timber roofing systems. The Brandons’ position was that stone vaults were unnecessarily expensive and were no more authentic than timber roofing, or more properly ceilings, systems. They wrote:

amidst the many beauties that these Sacred Edifices present to the admirers of Medieval Architecture, none are more striking than the taste and skill exhibited in the formation of the Roofs; and, indeed, there is no portion of a building, whether Ecclesiastical or Secular, requiring more skill in its construction, or that is more susceptible of ornament and decoration. Many of our Churches and Ancient Halls still attest the truth of this opinion by the evidence they afford of the matchless skill of the carpenter’s art.<sup>5</sup>

The book was so influential in creating a dynasty for itself through multiple reprints that it virtually shut down subsequent discourse on the subject of roofs and ceilings. Its comprehensiveness was underlined in an article published in February 1875 in *The Building News*, titled “Ornamental Open Roofs,” which lamented that the Brandons’ book had so thoroughly examined the subject that there was only room to write upon technical matters of a very specific nature. The author of the article claimed to have applied a thirteenth-century solution to the achievement of a truss system that used King Posts, thus eliminating the need for suspension rods. This was considered the first step in the transition towards tieless trusses (and eventually hammer-beam roofs).<sup>6</sup> A notice to readers of *The Building News* in 1873 announced the restoration of the Church of St. Mary Magdalene’s, Pulham, and St. Mary’s, Suffolk, adding special mention of the roofs, which had been illustrated in the Brandons’ *Open Timber Roofs*.<sup>7</sup>

Suspicious of masons’ advocacy of pagan (Neo-Classical) architectural styles, *Open Timber Roofs* was published in order to help timber construction return to its professed former glory in the Middle Ages. The book campaigned for a return to Gothic’s “true”—timber—roots. The Brandons appealed to practical minds using the logic that small buildings would require lower ceilings if vaulted in stone, thereby creating a closed and stuffy interior. Alternatively, timber roofs could be supported by thin-wall technology, as opposed to the massive amounts of wall material needed to support stone vaults. Even appealing to taste, the Brandons claimed that the visual effect of an open timber roof was bolder, simpler, and offered territory for coloured painting (preferably gold stars on a blue field representing the Heavenly Sphere).

By implying that the outside space beyond the threshold of the church was banal, the building envelope was constructed of utilitarian and unattractive materials: tar paper, felt, plywood, and shingle (a thin layer of air between timber and shingle prevented wood rot). The roof’s aesthetic marginalization grew from the popular notion that the envelope was considered only when it leaked. The popular idea of “having a roof over one’s head” was an architectonic application of personal security in an increasingly technocratic age. Architects designed roofs for stability, as people well knew, but individuals neglected to understand how variable forces worked against the roof. The idea of roofs as static things may have contributed to the lack of aesthetic changes to the exterior, even in the degree of steepness. Aesthetically, the steep slope of the roof became the grammar most often associated with the Gothic Revival. It went through almost no stylistic variations over time. The same was not true of the other, interior side of the timber roof.

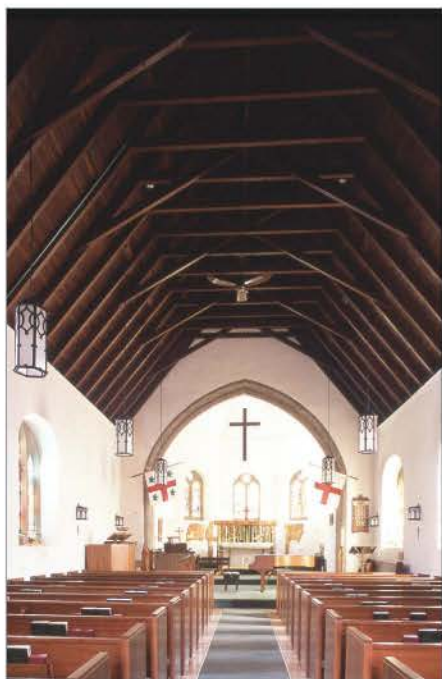


FIG. 2. ST. GEORGE'S-IN-THE-PINES (ANGLICAN), BANFF (AB), ARCHITECT FRANK P. OAKLEY, 1889-1897. | BARRY MAGRILL

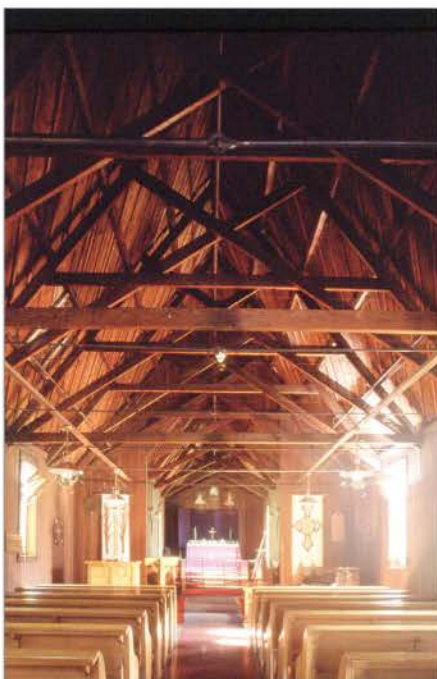


FIG. 3. ST. JOHN THE DIVINE (ANGLICAN), YALE (BC), 1859. | BARRY MAGRILL



FIG. 4. ST. PATRICK'S ROMAN CATHOLIC CHURCH, MEDICINE HAT (AB), ARCHITECT MANLY N. CUTTER, 1912-1914. | BARRY MAGRILL

The inside was glorious. Between 1845 and 1945 the underside of timber roofs developed along artistic and structural lines. Architects of Neo-Gothic churches drew upon the past and experimented

with a series of taxonomies ranging from exposed scissor trusses to elaborate hammer-beam systems. The scissor truss was popular in western Canada as at St. George's-in-the-Pines Anglican

Church, Banff, Alberta (1889-1897), designed by English architect, Frank Page Oakley (fig. 2).<sup>8</sup> Revealing the natural timber in parish churches was advocated as the pinnacle of timeless beauty and harmony. Suffice it to say that enough ink was spilt in the cause of admiring the aesthetic and plastic superiority of open timber roofs that the mass audience of church architecture, no less than churchgoers specifically, readily accepted them in defiance of the laws of thermodynamics. That is, people ignored the physics of rising heat that left the parishioners sitting in the cold. Moreover, few seemed to care about the cost of heating the upper reaches of their sanctuary instead of embracing drop ceilings to retain heat where people gathered in prayer. Parishioners of Canadian churches consoled themselves with the thought that open timber roofs took their spirits closer to heaven; shivering through a sermon on a cold winter's day became a pious act of austerity. Canadians may have been tempted to imagine themselves enduring the same hardships as the faithful in European medieval churches still in use in the nineteenth century, except that Canadian winters were harsher. In response, an increasing number of Canadian parish churches were installing heaters, as advertisements for the conveniences attested. What seemed to matter was that an attractive looking open timber roof offered an aesthetic and spiritual experience unmatched by the drop ceiling.

Church building committees were convinced that open timber roofing systems were not only beautiful but also cheaper to build and maintain. The cost of maintaining drop ceilings was not insubstantial given that they were susceptible to water damage and discoloration from interior moisture. Ten-year life spans for drop ceilings were not uncommon and the cost

of such repairs or replacements was an unsatisfactory idea to congregations still paying their mortgages. Smaller parish churches such as St. Peter's, Cowichan (1877), and its sister church St. Andrew's, Cowichan Station (1909), opted for the open timber roof, employing a simple scissor truss, rather than a drop ceiling. An early version occurred at St. John the Divine, Yale, British Columbia (1859), and there its heavy horizontal tie-beams indicate the tentative use of the scissor truss (fig. 3). These small parishes seemed more intent upon managing the initial cost of construction than paying heating bills, an item that fell under operational costs on the balance sheet. So, congregations seem to have accepted higher heating bills rather than take their chances with drop ceilings that needed periodic but expensive repair and replacement.

A curious case at the Roman Catholic Church of St. Patrick's, Medicine Hat, Alberta (1912-1914), illustrates the rare instance when a drop ceiling was installed post-construction (fig. 4).<sup>9</sup> There, a decade after construction was completed, the congregation decided to install a drop ceiling in the sanctuary, giving up about a third of the verticality of the church hall and sanctuary in a bid to lower the costs of heating. Interestingly, they chose to employ a timber vault to create the appearance of a light and open spacious interior but the damage to harmony and proportions was irreversible. Ironically, the community of Medicine Hat later discovered they were located above a large deposit of natural gas, which could have cheaply heated their building, but by then the congregation was accustomed to worshiping in the renovated space. The hammer-beam roofing system that was installed not only disrupted the proportions established by the architect of St. Patrick's, Medicine Hat, the New York-based Manly N. Cutter.

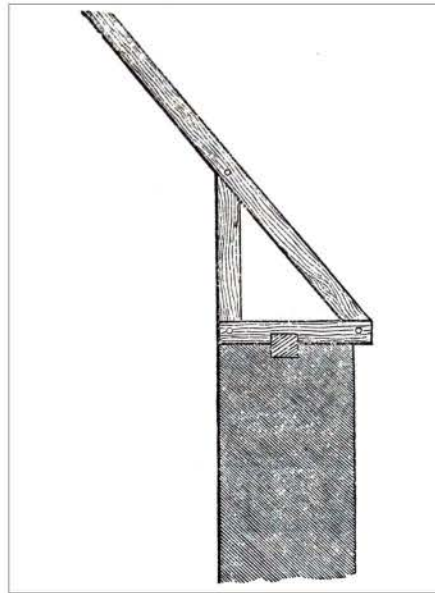


FIG. 5. DIAGRAM OF WALL AND ROOF JOINT. *OPEN TIMBER ROOFS* (1847). | SPECIAL THANKS TO MALCOLM THURLBY.

Architects, clergymen, and parishioners supported the idea of an aesthetics that was light and airy, and open timber roofing systems were the solution. The idea entered the public consciousness without a complete appreciation for the actual weight of the structural support system above their heads. That is, the verticality of the exposed interior timbers created an aesthetic lightness that appeared to deny the actual weight of the roof holding the walls in equilibrium. In fact, the load of the roof itself, minus extraneous snow and wind forces, was so great that steep roofs needed bracing from within. Since external buttresses made little structural or even logical sense when employing a timber roofing system, a more subtle method of reinforcement was required. Looking at the Brandons' text, we see a diagram explaining how the roof was fastened to the head of the wall (fig. 5). Other pages of the book depict hammer-beam roofs whose short vertical members, called struts, carried the thrust down through the wall (fig. 6). These short struts deflected forces that

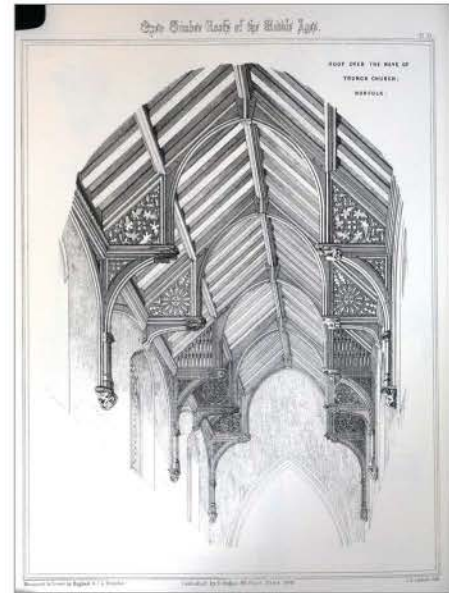


FIG. 6. ROOF OVER THE NAVE OF TRUNCH CHURCH, NORFOLK (UK). | ILLUSTRATED IN BRANDON AND BRANDON, 1847. *OPEN TIMBER ROOFS*. SPECIAL THANKS TO MALCOLM THURLBY.

would have put outward pressure on the external walls. It is important to note that the load increases with the steepness of the roof's pitch but a horizontal tie-beam would have been visually distracting. Thus, hammer-beam roofs that maintained the openness and beauty of the interior roofing space were chiefly employed, and especially for spans over thirty-five feet. Hammer-beam roofs were both decorative and structural elements. That is why Pugin agreed to their ornamentation: he noted, "they usually represented angels, archangels, and various orders of the heavenly hierarchy, hovering over the congregated faithful, while the spaces between the rafters were painted azure and powdered with stars and other celestial emblems. A beautiful figure of the firmament."<sup>10</sup> These were among the last words from Pugin's pen in his second book, *True Principles*, devoted to the arrangement of timber roofs. However, he was referring only to ancient models; he gave no instructions about the actual construction of an open timber roof in practical terms. It is no wonder that



FIG. 7. ROOF OVER THE NAVE OF LITTLE WELNETHAM, NORFOLK. | ILLUSTRATED IN BRANDON AND BRANDON, 1847, *OPEN TIMBER ROOFS*. SPECIAL THANKS TO MALCOLM THURLBY.



FIG. 8. CHRIST CHURCH CATHEDRAL, VANCOUVER (BC), ARCHITECT C.O. WICKENDEN, 1894. | BARRY MAGRILL.

those influenced by his writing and those uninterested in structure tended to focus on issues of beauty rather than construction theory.

### A BOOK ON ROOFS

Advice and instructions for constructing timber roofing systems came from the architects Raphael and J. Arthur Brandon. They had the final word on church roofs in 1847, stating that the faithful engineering of ancient architecture combined with the application of colour as used in the Middle Ages was summit of present achievement.<sup>11</sup> Their book *Open Timber Roofs* was so comprehensive that it closed down further debate and discussion in the field. They dealt thoroughly with all manner of internal roofing supports: tie-beam, trusses, collar-beam, and hammer-beam designs. Hammer-beam roofs were the most structurally complex and aesthetically pleasing. The Brandons' book dispensed with commonly held notions that hammer-beam roofs were simply tie-beam roofs with the horizontal members cut off. Instead, a carefully calculated geometry was applied in order to

maintain envelope equilibrium. Not only that, but there were a variety of ways to construct a hammer-beam system, which the Brandons observed by examining a series of medieval examples. A variety of permutations included or excluded struts, wall struts, and collars. At Little Welnetham Church in Norfolk (fig. 7), a combination of hammer beams, collars, and struts were connected with curved braces. At Trunch Church, also in Norfolk (fig. 6), the collar beam was omitted and carried up to near the apex of the arch. At St. Mary's Church in Suffolk, the hammer beam has collars but no struts. Lastly, Palgrave Church in Suffolk has neither collar beams nor struts. The varieties of this one type of open timber roof illustrates the breadth of choices available, limited only in the Canadian circumstances to the skill of carpenters. That is why we find so many scissor-trussed roofs in western Canada versus eastern provinces that exhibit hammer beams. It is not that the West did not attract skilled carpenters, but rather by the time the West was populated, carpentry and joinery were being replaced by newer techniques such as balloon framing and even reinforced concrete. An exception

to this situation is the elaborate hammer-beam roof in Christ Church Cathedral, Vancouver (1895), designed by architect Charles Osborne Wickenden (fig. 8). Wickenden envisioned a great hammer-beam roof that spanned a widened nave and aisle combination, thus maintaining envelope equilibrium without resorting too heavily on supportive columns. His idea was to use the open timber roof as a metaphorical concept applied to the whole of the interior space. Canadian architects adhered to the Brandons' ideas as much as might be expected in the colonies, and there were structural highlights as at Christ Church Cathedral in Vancouver and St. James' Cathedral in Toronto. The Canadian connection to the discourse on open timber roofs occurring in Britain came about because of John Medley in 1841, then Vicar of St. Thomas, Exeter, four years before being installed as the first bishop of the Diocese of Fredericton, New Brunswick. Medley's text, *Elementary Remarks on Church Architecture* (1841), argued that the principles of constructing medieval churches needed to be adhered to in the revival of the Gothic style in the nineteenth century. Speaking about lateral thrust,

Medley noted the absurdity of using tie-beams—a modern contrivance—to ensure safety, when wall thickness and proper roof trusses were elegant and reliable solutions. The “pennywise economy” of thin walls, which congregations used, resulted in undue stress on the roof.<sup>12</sup> Medley’s admiration for architecture and his awareness of its application in colonial identity-building were translated into terms ordinary viewers of churches could comprehend; that is, he argued in favour of good taste and proper building methods.<sup>13</sup> The equation of taste and beauty under a moral rubric had lasting potential.

The Cambridge Camden Society weighed in on the subject of timber roofs, noting, “The common way of late is to have a tiebeam with king or queen posts: and no grant is given by the Incorporated Society for Churchbuilding except there be a tiebeam: – a rule which I earnestly hope will be dispensed with ere long.”<sup>14</sup> Tie-beams made the interior look like a “barn” and the alternative of hiding the roof by a flat ceiling was in their estimation a “hideous” act of barbarism.

The Brandons’ text notwithstanding, there was a lack of guidance given to builders about the proper construction of an open timber roof. It is then no wonder that claims of taste tended to prevail in the general discourse when it came to matters not consistently covered in multiple books. Claims about taste were considerably easier to make than learning about complex constructional systems. Worshipers may not have known the typologies of timber roofing systems, but they could parrot arguments about beauty and harmony. Viewers did not need to comprehend the construction of timber roofs, nor their history, but only a generic understanding of beauty. Few people beyond architects cared about

the difference between Early English and Tudor Gothic; taste was what mattered. This might explain why pattern books, and the Brandons’ *Open Timber Roofs* was among them, contained a historical analysis; the aim was to educate the lay public as well as architects and builders engaged in the profession. Claims about taste were made extensively in the pattern books, and this may have been the case because authors knew how to appeal to and entice the ordinary reader.<sup>15</sup> Colour was a significant part of that narrative as expressed in the Brandons’ text, which highlights the notion that viewers were distracted by pleasing hues termed beauty and harmony.

As far as the reading and viewing public was concerned, truth came from beauty and harmony in a circular discourse aimed at extending the enduring distinctions of taste. The expression of a steeply pitched roof—on the interior an open timber system with exposed trusses—was cast as truthful and beautiful. The two ideas were part of a coherent design philosophy that Christians deemed invaluable. But, in fact, the idea of truth and beauty was not limited to Christian architecture at all. It pervaded the architecture and written discourse of a wide variety of practitioners for reasons of common sense, for reasons of making architects more marketable<sup>16</sup> to clients, and as a competitive strategy that architects adopted. The truth/beauty relationship was prime territory for the critic John Ruskin, who considered that beauty was a reflection of purity and a manifestation of organic nature, impossible without avoiding the moral delinquency of architectural falsehoods like the pendants of late Gothic roofs, features that served no supportive function. The open timber roof must have qualified as truthful since its exposed members were also functional. Architecture that reflected organic nature was, according to Ruskin,

inherently truthful and beautiful—the pointed leaf, the arch in the arc of the horizon were reflected in the pointed window and the collar-beam roof. Artists were encouraged to adopt organic forms, not imitate them, which was why Greek acanthus on a Neo-Classical façade was considered by Ruskin and his followers to be imitation and consequently morally reprehensible.

Ruskin ushered in the twentieth century with his own death, and the next generation proceeded to negotiate a path for the Gothic Revival. The collegiate Gothic of the American architect Ralph Adams Cram was highly influential and his forethought included courting the media. In journals and newspapers, he complained vociferously that the specific taxonomies of open timber arrangements were likely lost on most worshippers, and notions of taste were to blame. “A perfectly square box with a steep ‘pitch roof,’ becomes doubly hideous through the arched windows, the silly wooden buttresses, the futile belfries and pinnacles that are not ecclesiastical, though their creators thought so.”<sup>17</sup> In this case, Cram was responding to a perception that people had lost the ability to “read” architecture. The last vestige of that dying literacy was the roof, a heavenly symbol.

Complicating the “reading” of Gothic architecture after 1870 was eclecticism. Perhaps Cram, the Gothic modernist, was nostalgic for the 1840s and 1850s when Neo-Gothic architecture was asserting itself with much vigour and there was a proliferation of architectural writing in a bid to insert the Gothic Revival into the architectural canon. By the 1870s, if not a decade earlier, a kind of collective memory loss descended on the populace. Individuals lost the grammar to read much about the Gothic Revival beyond its steeply pitched roof. By the

early twentieth century, Cram was in full battle mode against a growing architectural illiteracy, which he blamed squarely on eclecticism. With eclecticism so closely tied to the social claims of taste rather than connoisseurship, Cram saw the return of the plaster ceiling. Cheaper and easier to build, and aesthetically pleasing, the plaster ceilings of the twentieth century were adopted fairly quickly. Soon these were superseded by mass produced drop ceilings used to hide the building's infrastructure.

What began as a move indoors to appreciate an open timber roofing system that people increasingly misunderstood concluded with a return to the eclecticism that Pugin and his followers abhorred. Along the way viewers of open timber roofs forgot all about the roof's exterior, perhaps mesmerized by the virtuosity of hammer-beam roofing systems. That open timber roofing systems were part of a two-sided unity was consequently eclipsed. The exterior was cast in practical terms while the inside was cast separately in aesthetic ones, when, in actuality the supportive members of the timber roof were found on the inside internal. That was their hidden beauty; structural members disguised as aesthetic ones in plain sight of all. The cohesive nature of the timber roof not only held in balance the entire building structure but also represented a thin membrane between earth and heaven.

## NOTES

1. I am greatly indebted to Malcolm Thurlby for providing much insight and factual support, as well as assistance with image production, toward the completion of this paper. He pointed out several examples of timber roofs in Canada and in Britain that greatly benefitted the article.

2. *The Building News*, December 18, 1875, p. 715. "[B]ut it must be considered that the strain on a slant roof is not merely that of the gravity of its material acting vertically; the strains often act horizontally (as the force of wind), and the resultant of the gravity and the force of wind would act in a direction more or less at right angles to the surface of the roof... Steep roofs, therefore, require stouter rafters than flatter ones to enable them to carry an equal weight of covering per square yard. To attain this equal strength the rafters must be made deeper in the ratio of the square root of their length."
3. See, p. 10. See also the republication of *A Few Words to Churchwardens on Churches and Church Ornaments* in Webster, Christopher, 2003, "Temples... Worthy of His Presence": the Early Publications of the Cambridge Camden Society, Oxford, Spire Books, p. 189-209.
4. *The Building News*, December 18, 1875, p. 715.
5. Brandon, Raphael and J. Arthur Brandon, 1847, *The Open Timber Roofs of the Middle Ages*, London, D. Bogue, p. 2.
6. *The Building News*, February 5, 1875, p. 145. The article suggests, in opposition to the Brandons' view, that tie-beams could be ornamental as well as structural components. Using tie-beams with an arched form and curved braces, the author asserts a pleasing and strong solution achievable in an economical and historically accurate manner.
7. *The Building News*, December 5, 1873, p. 633.
8. St Paul's, Glanford, Ontario (by Frank Wills c.1851), made economical use of a scissor truss in the nave where less than members support the roof. Special thanks to Malcolm Thurlby for pointing this example out. See Thurlby, Malcolm, 2007, "Two Churches by Frank Wills: St. Peter's, Barton, and St. Paul's, Glanford, and the Ecclesiological Gothic Revival in Ontario," *Journal of the Society for the Study of Architecture in Canada*, vol. 32, no. 1, p. 53.
9. See, Magrill, Barry, 2012, "Pouring Ecclesiastical Tradition into a Modern Mould: Reinforced Concrete Churches in Canada," *Journal of the Society for the Study of Architecture in Canada*, vol. 37, no. 1, p. 3-15.
10. Pugin, Augustus Welby Northmore, 1841, *True Principles of Pointed Christian Architecture*, London, J. Weale, p. 34.
11. Brandon and Brandon : 2-7.
12. Medley, John, 1841, *Elementary Remarks on Church Architecture*, Exeter, P.A. Hannaford, p. 32.
13. Medley is thought to have had some training in architecture. I am indebted to Malcolm Thurlby who pointed out that Medley was responsible for the design of the Chapel at Oldridge, near Okehampton (Devon), 1841-1843.
14. Cambridge Camden Society, 1841, *A Few Words to Churchbuilders*, Stevenson, Cambridge, p. 17.
15. Magrill, Barry, 2012, *A Commerce of Taste: Church Architecture in Canada 1867-1914*, Montreal, McGill-Queen's University Press.
16. See, Ruskin, John, 1849, *The Seven Lamps of Architecture*, New York, John Wiley, p. 29-30.
17. Cram, Ralph Adams, 1906, *Church Building: A Study of the Principles of Architecture in their Relation to the Church*, Boston, Small, Maynard, p. 14.