

# TIMBER FRAMING

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*Intersecting Long-Span Trusses*



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1 Portrait of St. Andrew crucified, at the Collège des Écossais, Paris, artist unknown, 17th century.

2 From top, flags of Scotland, Nova Scotia, Spanish Burgundy, and Naval jack of American Confederacy.

3 House of the *Opus Craticium*, Herculaneum, Italy, 1st century, restored in the 1920s. X-bracing in railing only.

4 Roofless house with braceless infill frame, Mileto, Italy, 18th century.

5 Interior wall of *himiş*-style house in Adapazari, Turkey, after 1999 earthquake.

6 Interior of 18th-century building in Lisbon, Portugal, showing *Pombalino gaiola* braced construction technique used after earthquake of 1755.

7 Des Quatre Fils Aymon, 15th-century house in Tours, France, with fully braced walls and carved corner post and casings.

8 House in Rinteln, Lower Saxony, Germany, on the Weser river, in region rich in *Fachwerk* houses, with multiple *Andreaskreuze* beneath windows.

## The St. Andrew's Cross

THE St. Andrew's cross, or in construction the X-brace, is vital to the integrity of many framed buildings, ancient and modern. Saint Andrew himself, the older brother of Peter, was a 1st-century Christian Apostle who followed Jesus and spread Christianity throughout the Roman Empire. He became a martyr by crucifixion at Patras in western Greece, crucified at his own request (it is said) on an X-shaped cross (*crux decussate*) named after the Roman numeral *decussis* for ten, as he thought himself unworthy to be crucified on the Latin or T-shaped cross like Jesus (Fig. 1).

There is evidence that the cross was used as a structural member by the Minoan civilization from 2000 BCE, and countless surviving examples are found in half-timbered houses dating from the medieval period in Europe, around the 13th century and onward, scattered across mainland Europe. Regional and stylistic variations in Europe place the cross in different areas of a frame for structural integrity.

The cross, also known in heraldry as a saltire (from the French *sautoir* or stirrup), carries a symbolic meaning and is seen in a number of flags around the world, notably Scotland's (whose patron saint is St. Andrew), and on coats of arms and seals such as the Cross of Burgundy, used in the 15th century by the Valois Dukes who ruled parts of eastern France, and later by the monarchs of Spain. In the New World, the cross appears in the flags of Nova Scotia and Alabama and in the flags of the American Confederacy (Fig. 2).

The Roman construction technique *Opus craticium* (Figs. 3, 4), described by the architect Marcus Vitruvius Pollio (b. 75 BCE) in

his multivolume work *De architectura*, likely included (we have no direct evidence) X-bracing in its half-timber wall technique of wattle and daub or masonry infill between members, and anticipates *himiş* construction in Turkey, *Fachwerk* in Germany, *colombage* or *pan de bois* in France, *entramadi de madera* in Spain and *Pombalino gaiola* in Portugal. The X-bracing would have been used primarily in wall sections to prevent racking, and in later times specifically to resist the effects of earthquakes (Figs. 5, 6).

According to Scottish legend, in 832 an army of Picts led by Óengus the 2nd battled an army of Northumbrian Angles led by Æthelstan near East Linton in East Lothian. On the eve of the battle, a vision of Saint Andrew appeared to Óengus during prayers, promising victory, and Óengus vowed if his army won to name Andrew patron saint of Scotland. The next morning before battle, the clouds formed a *crux decussate* in the sky. Inspired by this omen, Óengus and his men despite being outnumbered were victorious. Óengus kept his promise to name St. Andrew as patron saint, and the flag of Scotland then adopted reflects the cloud formation seen on the morning of the battle, the cloud-white saltire against a clear blue sky (Fig. 2).

Anglo-Saxons who learned about St. Andrew and the legend of his cross in Scotland might have designated the framing technique "St. Andrew's cross" and translated the name into Germany, Alsace, France and other parts of Europe. *La croix de Saint-André* as it is called is used in many parts of France but notably in Alsace, Normandy and Brittany, as well as at Troyes, Auxerre, and Tours (Fig. 7). Germany's *Andreaskreuz* is found in half-timbered work all around the country (Fig. 8).



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9 Maison des Quatrans, Caen, France, 1460. High-status *pans de bois* façade on masonry building. Note progressive overhangs.

10 Detail, Barley barn, Cressing Temple, Essex, England, ca. 1220.

11 Ridge truss, Citadel of Besançon, Franche-Comté, France, 1668.

12, 13 Germanic structural *Andreaskreuz* supports light or medium rafters without ridge in old and new work.

14 House in Strasbourg with ornamental use of *croix Saint-André*.

15 Symbolic uses of St. Andrew's crosses under windows, all in Colmar, Alsace, France.

16 Author's masterpiece displayed on its own developed drawing.

17 Author's study of St. Andrew's cross in semi-round tower.

The oldest known example of a Saint Andrew's cross in France is probably the façade of the Maison des Quatrans, 1460, in the old part of Caen, though the distinction is uncertain given France's abundance of half-timbered houses (Fig. 9). The oldest known example in England is found the central crossframes of the Barley barn at Cressing Temple, built some time in the 1220s (Fig. 10).

Use of the cross exploded during the 13th century when half-timbering techniques became common in most of Europe. The cross is found not only in wall and bent sections, but also often enough in a ridge assembly in or between roof trusses or bents. Simple knee braces between ridge beam and kingpost might be used to obtain a similar anti-racking effect, but in Christian edifices the more appropriate religious symbolism was adopted. The oldest surviving example of the Saint Andrew's cross in a ridge assembly is probably in the 12th-century church in Médevay, Orne, France, the Priory Church of Our Lady of Rest. A more recent example, built in 1668 and recently repaired, is in the Citadel of Besançon, Franche-Comté (Fig. 11).

The two main styles of timber construction found in Europe, Latin and Germanic, employ the cross differently. The cross is typically found in wall and ridge assemblies in Latin construction, and in wall and roof planes in Germanic construction. The Latin style dates to the Roman Empire from about 100 BCE whereas the older Germanic style dates to 500 BCE in northern Europe (modern-day Germany, Denmark, Sweden and Finland).

Latin timber construction employs relatively small-section timbers to construct mainly trusses, or relatively light rafters with a supporting ridge, and its carpenters take advantage of an understanding of load paths and engineering. Germanic

traditional timber construction comprises large-sectioned pieces (often larger than necessary) and rarely employs a roof ridge since the larger rafters generally need none to prevent sagging or, if light common rafters are used, they are supported by heavy substructure (Figs. 12 and 13).

As society's architectural landscape changed, the St. Andrew's cross's ornamental and symbolic uses displaced its structural uses (Fig. 14). Most often seen under a window, its evident ornamental character is also symbolic, primarily as a sign of multiplication, wishing fecundity in the house for both occupants and farm animals. Sometimes multiple Saint Andrew's crosses symbolize the union of two people (Fig. 15a). The diamond shape is a sign of femininity and motherhood (Fig. 15b). The mix of the St. Andrew's cross and the diamond represents large families and livestock (Fig. 15c). The *sella curulis* or curule seat is an elaborate form of the St. Andrew's cross symbolizing the quarters of a chief or important person in the village (Fig. 15d). In ancient times Roman dignitaries were entitled to sit in the curule seat.

Les Compagnons du Devoir associations in France hold dearly to the symbolic and structural applications of the St. Andrew's cross. Part of the intense training of an aspirant is to build models including variants of the cross, and it can be found in the masterpieces built by journeymen to be accepted as Compagnons, such as the French trestle (Fig. 16). One of the last studies undertaken by most aspiring carpenters on their Tour de France is the St. Andrew's cross in a conical or partly conical tower (Fig. 17), also found in masterpieces. The use of such bracing helps to prevent torsion and possible consequent failure, which is not unheard of (Fig. 18 overleaf).



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Labradormix, Wikimedia Commons

18 Church of St. Clement, Mayen, Germany, ca. 1350. Discontinuity and tilt near peak indicate structural failure.



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Paroisse Sainte-Bernadette en Bruilhois

19–21 Église-Notre-Dame-de-l'Assomption, Sérignac-sur-Garonne, France, 13th century. Postcard dated 1903 shows no significant discontinuity in spire, built 16th century, restored 1816, removed 1922, rebuilt 1988 with frame of bolted glulams, including twisted St. Andrew's cross to stiffen spire.

22 Domestic framing by Hamlet Heavy Timberworks, Rigaud, Québec, 2016.

23 Contemporary *guitarde* over doorway, Le Veudre, Allier, France.

24 Left to right, author with Tim Chapple and Yoann Gonzalez scribing St. Andrew's cross for reconstruction of Manoir des Jésuites (1742), Trois Rivières, Québec.

25 Full-height X-bracing, industrial structural steel framing in Canada.



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A contemporary example of the St. Andrew's cross in a twisted steeple is found in the reconstruction of the church spire in Sérignac, Tarn-et-Garonne, France, rebuilt in 1988 using modern glue-laminated pieces (Figs. 19–21). Sérignac's Notre Dame de l'Assomption, built in the 13th century, had an original twisted steeple that had partially failed some time after 1903. In 1922 it was demolished as being a danger to the public. In 1988 a group of Compagnon carpenters gathered to rebuild the twisted spire with bolted glulams. Fig. 21 shows a twisted St. Andrew's cross

used to brace the curved hips along the roof plane (and the Compagnon carpenters' arms as well near the top). This support will resist any future torsion that may occur as a result of wind or seismic activity.

Today the cross can also be seen in the thousands of 19th-century *guitarde*s (see TF 121), console-like roof forms over dormers or doorways, spread throughout France (Fig. 23). In the case of a *guitarde*, the fancy X-shaped pieces (pincer links) are essentially similar to the curule seats that we have already seen on



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the façades of half-timbered structures. If more widely known as X-bracing, the St. Andrew's cross lives on as well in modern framed structures (Figs. 22 and 24), scaffolding, commercial steel construction (Fig. 25) and electrical towers. —PATRICK MOORE  
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