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Composite wainscot block construction in medieval sculptures: A question of quality?

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ABSTRACT

In this contribution, a late-medieval technique for constructing polychrome wooden sculptures is discussed. This rare 'composite block' method employed blocks made from wainscot boards glued together. The technique is compared to the more common method of carving a solid block cut from a tree trunk, followed by hollowing out of the block to reduce the risk of cracking and splitting. The composite block technique is not widely known and has not yet been comprehensively studied. It merits further attention because it reveals the medieval carver's advanced technical skills, in-depth material knowledge and concern for quality. Development of the construction technique during the 15th century in Northern Europe is explored by means of a case study of one such sculpture from the Museum of Cultural History, Norway. Northern German, northern Netherlandish and Florentine composite block techniques are examined, pointing to parallels within art production both north and south of the Alps.

INTRODUCTION

Composite block sculptures have been described by a small number of researchers in Sweden, Germany, the Netherlands and Belgium (Rief 1998, Knüvener 2011 and 2015). The technique appears to have emerged around 1400, and interestingly has been observed across Europe. The presence of a group of similarly constructed sculptures in Florence in particular negates the divide often seen to exist between Northern European medieval art and early Renaissance Italian art.

The composite block is essentially a simple laminated wooden structure, and can be loosely compared to glued laminated timber (glulam) used in structural engineering, a material known for its inherent stability and strength (USDA 2010). Such composite block sculptures are characterised by high structural stability and generally consist of two, occasionally three or more wainscot boards glued together. The technique differs from block construction out of separate smaller pieces of wood, such as the sculptures from the high medieval period in Sweden described by Tångeberg (1986). Similarly, it differs from the addition of smaller pieces of wood to a single block due to the need for sculptural features extending outside the log dimensions. Instead, the composite block technique points to medieval woodworkers having a high level of material awareness and utilising their intimate knowledge of the material to create high-quality sculptures of optimum stability.

CASE STUDY

The late medieval sculpture of the *Virgin and Child with Saint Anne* (hereafter called *St Anne*), stylistically dated to the 1470s (Engelstad 1936, 55), is likely to have been imported from northern Germany to Norway (Figure 1). It was originally located in the remote church of Berg on Senja Island, Troms county, northern Norway, and entered the collection of the Museum of Cultural History (MCH), University of Oslo in 1862, together with an ambry and two other sculptures from the church.

The sculpture is constructed out of three wainscot boards, measuring 26 centimetres in width and ranging between 4 and 5 centimetres in thickness. The boards were glued together so that the top face of one was glued to the back face of the next, with grain direction aligned and parallel

to the height of the sculpture. The gluing of the joins is so precise that the construction technique was not noticed during conservation treatment in the 1970s (Lindberg 1976). The sculpture has not been hollowed out on the back, something that was usually undertaken in order to reduce the

Table 1. Selection of known sculptures with composite block construction (Tångeberg 1986; Vereecke and Deveseleer 1995; Rief 1998; Olstad 2008, 2003, 2002; Knüvener 2011; Preising 2013; Preising and Rief 2013; Rief 2014, 2013; Knüvener 2015)

Sculpture	Provenance*	Date	Size+	Construction	Workshop
St Anne	Berg church, Senja, Troms, Norway	1470s–80s (d)	58 h 26.3 w 3.6 d	Three radial cut Baltic oak boards, wainscot, canvas patches	Northern Germany
St Anne	Schmolde, Prignitz, Germany	1480–90 (d)	45 h 19.5 w 9 d	Two Baltic oak boards, wainscot, canvas patches, large hole in base	Northern Germany
Four sculptures from an altarpiece: Sts Peter, Paul, John, Virgin	Järstad, Östergötland, Sweden	1410–30s (s)	49 h 15 w 7.5 d	Two radial cut oak boards, canvas and parchment patches, large hole in base	Northern Germany
12 apostles	Salzwedel Marienkirche, Germany	1420 (s)	44.5 h 14 w 10 d	Two radial cut oak boards, large hole in base	Northern Germany
Altarpiece (10 saints, two larger scenes)	Bodo, Dalarna, Sweden	1430s (s)	44 h	Two oak boards	Northern Germany
Apostle	Gothem, Gotland, Sweden	1450–1500 (s)	71 h	Two oak boards	Northern Germany
Three sculptures from an altarpiece: Virgin, St Olaf, St Michael	Leka church, Nord-Trøndelag, Norway	early 1500s (s)	62 h 28 w 15 d	Two radial cut oak boards	Utrecht, Netherlands
Three sculptures from an altarpiece: St Olaf and two bishops	Røst church, Nordland, Norway	early 1500s (s)	64 h 23 w 14 d	Two radial cut oak boards	Utrecht, Netherlands
Three sculptures from an altarpiece: Virgin, St Olaf, St Margaret	Grip church, Møre and Romsdal, Norway	1520–30 (s)	86 h 35 w 13 d	Radial cut oak, two boards for two sculptures, three boards for central sculpture	Utrecht, Netherlands
Three sculptures from an altarpiece: Virgin, St Stephen, St Catherine	Hadsel church, Nordland, Norway	1470s (d)	98.5 h 33 w 9.5 d	Three, four and five radial cut oak boards, (two widened with blocks glued to side), nails, canvas patches	Utrecht, Netherlands
Two sculptures from an altarpiece: Virgin and St John	Ørsta church, Møre and Romsdal, Norway	1520 (d)	c. 50 h	Two radial cut oak boards	Utrecht, Netherlands
St Dorothy	Suermont-Ludwig Museum (SLM), Aachen, Germany	1520–30 (d)	89 h 32 w 21 d	Four oak boards, three radial and one tangential cut, nails	Utrecht, Netherlands
St Mary Magdalen	Unna, Münster, Germany	1520–30 (s)	112 h 38 w 28 d	Five oak boards, nails and canvas patches	Utrecht, Netherlands
Female saint with book	Krakow National Museum, Poland	early 1500s (s)	86 h 35 w 23 d	Four oak boards, two inner radial cut, outer tangential cut, wooden nails through all boards via pre-drilled holes	Utrecht, Netherlands
Virgin and child on crescent moon	Catherine convent museum, Utrecht, Netherlands	1525–30 (s)	47 h 21.5 w 10 d	Two oak boards and one additional piece, nailed	Utrecht, Netherlands
St Anthony	SLM, Aachen, Germany	1520s (d)	57.5 h 66.5 w 21 d	Six Baltic oak boards, wainscot	Northern Netherlands
Virgin and child on crescent moon	SLM, Aachen, Germany	1510–50 (d)	58 h 24 w 12.5 d	Two radial cut Baltic oak boards, wainscot	Netherlands
Virgin and child	SLM, Aachen, Germany	1500 (d)	57 h 22 w 14 d	Two radial cut Baltic oak boards, wainscot	Netherlands
St Mary Magdalen	Rijksmuseum, Amsterdam	1520s (s)	64 h	Two oak boards	Brussels
St George and the dragon	Rijksmuseum, Amsterdam	early 1500s	52 h	Two oak boards	Mechelen
Virgin and child	Rijksmuseum, Amsterdam	early 1500s	39.5 h	Two oak boards	Antwerp, Brabant
Carved leaf pattern pedestal from an altarpiece	SLM, Aachen, Germany	1530–40 (d)	21 h 22 w 14.5 d	Three Baltic oak boards	Antwerp, Brabant
St Anne	Private collection, Netherlands	1510–20 (s)	95 h	Six oak boards	Antwerp, Brabant
St Gertrude and two lost male saints (same height)	SLM, Aachen, Germany	1470–80 (d)	76 h 32 w 20.5 d	Three radial cut Baltic oak boards, wainscot, nails	Antwerp, Brabant
Saints Anthony, Cornelius, Hubert and Quirnius	St Irmgardis chapel, Süchteln am Niederrhein, Germany	1520s (s)	62 h	Two oak boards	Antwerp, Brabant
Christ the Saviour	Monastery of Maria zum Frieden, Köln, Germany	1520s (s)	87 h	Several oak boards	Antwerp, Brabant
St Peter enthroned	SLM, Aachen, Germany	circa 1500 (d)	46.5 h 25.5 w 16.5 d	Three radial cut Baltic oak boards, wainscot	Brabant
Virgin and child	St Vincent of Soignies church, Belgium	circa 1500 (s)	106 h 35 w 25 d	Three oak boards attached to oak base with nails, central board hollowed out	Brabant
St John Evangelist	St Genevieve church, Oplinter, Belgium	late 1400s (s)	86 h	Three oak boards	Brabant
St Catherine	Breda Museum, Brabant	1500–25 (s)	61 h 25 w 14 d	Two oak boards	Brabant

* Where known, the previous location of sculptures is listed instead of the museum where they are currently located
+Size in cm (height × width × depth). Where sizes of sculptures within one altarpiece vary, the largest dimensions are given.
h = height w = width d = depth (d) = dendrochronology dating (s) = stylistic dating

Figure 3. 3D model of *St Anne:* https://skfb.ly/66O9w

effects of cracking, as green wood dries over time. The boards must have been fully seasoned when glued, since gluing requires a low moisture content to be successful and long-lasting (USDA 2010).

Figure 1. *Virgin and Child with Saint Anne* (58 × 26.3 × 13.6 cm), Museum of Cultural History, University of Oslo

Norwegian art historian Eivind Engelstad linked the *St Anne* to one other sculpture from Berg church, a standing male saint identified as a *Bishop*, suggesting that they had previously belonged to the same altarpiece (Engelstad 1936) (Figure 2). However, the sculptures' material construction differs significantly, and technical investigations have resulted in a rejection of this hypothesis.[1] The *Bishop* is carved out of one piece of oak, with an additional narrow vertical section of wood added along the proper left side. The base consists of a separate piece of wood, and the back has been hollowed out. The *Bishop* sculpture is therefore not considered to have any relation to the subject of this paper.

Figure 2. *Bishop* (63 × 22 × 13.5 cm), Museum of Cultural History, University of Oslo

Photogrammetry was used to better illustrate the three-dimensional nature of the sculpture of *St Anne* (Figure 3). The 3D model was generated using Agisoft PhotoScan and uploaded to Sketchfab, where it can be viewed and rotated to gain a clearer understanding of the sculpture's construction.

CONSTRUCTION METHOD

The timber used to construct the *St Anne* sculpture would have been split radially from the pith with an axe, resulting in slightly wedge-shaped boards (Tångeberg 2000). The resulting radial cut of wood is, given the anisotropic behaviour of wood, dimensionally the most stable in terms of moisture response. Such boards are also known as wainscot, a term originating from the Low German term *Wagenschott,* referring to oak boards of a particular size cut radially by splitting (Grimm and Grimm 1854–1961). The dimensions of the *St Anne* and other composite sculptures generally fall within the dimensions of standard wainscot board sizes. These would not have exceeded 40 cm, given that they were split radially from trees with a 90-cm diameter (Ulmann 1993, 227; Rief 2005, 133). Apart from a few exceptions, such as the Hadsel composite group where two sculptures were widened with additional boards glued to either side (Olstad 2008), the width of the board is usually the limiting factor, resulting in medium-sized sculptures with a width of between 15 to 30 cm (Table 1).

The majority of workshops were generally not allowed to have their own wood store, and had to order sufficient wood once a commission was in place (Ulmann 1993, 226). Hence, the use of composite blocks cannot be attributed solely to a thrifty sculptor making do with what is left lying around the workshop and gluing leftover boards together to form a single block, although some such instances have also been identified by Rief (Oellers, Preising, and Schneider 1998, 59–62). Instead, it points to the purposeful purchase of high-quality imported wainscot for sculpture construction.

The boards are likely to have been planed prior to gluing in alternate growth ring directions, given the almost perfect join seen in the CT scan of the *St Anne* (Figure 4). A fine line of parallel marks on the base of the sculpture, seen on the front board only, can possibly be attributed to a workbench used to hold the timber in place during planing (Figure 5). These marks are different from the usual holes visible in the centre of the base, which are more likely to relate to the workbench used for carving. Saw marks on the base could indicate cutting of the excess from the glued boards, especially since the saw marks extend over the edges of the joins and outer boundaries of the sculpture. Enhanced visualisation of the tool marks was achieved with reflectance transformation imaging (RTI).

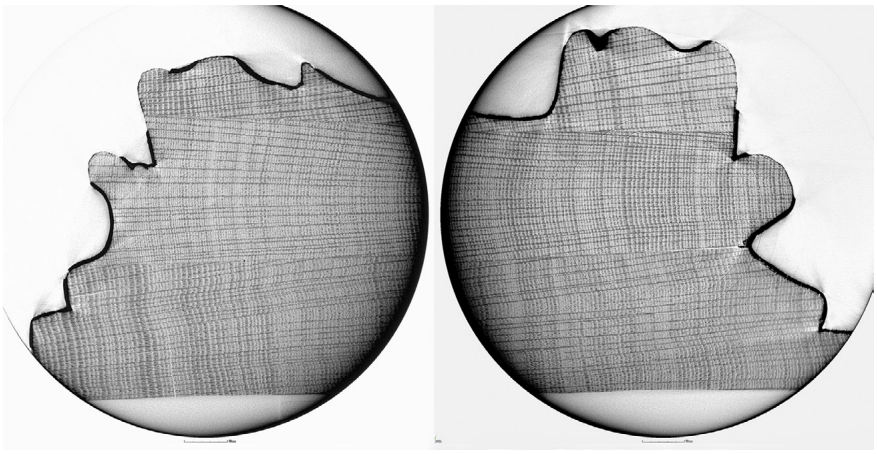

Figure 4. CT scans depicting virtual sections through *St Anne*

Figure 5. RTI still of the base of *St Anne*, showing tool and workbench marks, as well as board dimensions

The glue used to join the boards was analysed using gas chromatography/mass spectrometry (GC/MS) to identify whether animal glue or casein was used. Given the higher water resistance of casein lime glue over animal glue (Bye 1990, 145), it might be expected that material with improved moisture resistance was used for a sculpture destined for travel to Norway by sea. A two-step method was employed by Joy Mazurek at the Getty Conservation Institute, which involved initial quantification of oils, waxes and resins, followed by amino acid quantification and protein identification on the same sample (Schilling, Khanjian, and Souza 1996, Schilling 2005). The identification of proteins was accomplished by comparing the amino acids in the sample to those of standard reference materials using correlation coefficients, where a perfect match is a correlation coefficient of 1.0. Animal glue was identified in the sample based on a correlation coefficient of 0.999. This is interesting, given that both Cennino Cennini and Theophilus Presbyter suggest that casein was preferentially used when gluing wood, due to its greater strength and water resistance compared to animal glue. Cennini introduces his chapter on the preparation of casein glue by stating that 'it is a glue used by workers in wood' (Cennini and Thompson 1954, 68), while Theophilus indicates that casein is used to glue wooden panels together (Brepohl 1999, 64).

DENDROCHRONOLOGY

Non-invasive dendrochronology was undertaken by Aoife Daly. The sculptures were scanned at the Norwegian Geotechnical Institute using a Nikon Metrology XT H 225 LC industrial type computer tomography (CT) scanner with micron resolution. Using this method, over 3,000 x-rays are taken while the sculpture is rotated, and the resulting x-ray images are then compiled into a three-dimensional model that allows virtual cross sections (CT scans) of the sculpture to be viewed (Figure 4). As a result, tree rings can be measured non-destructively by CT scans (Bill et al. 2012, Daly 2016).

The three oak boards used in the construction of the *St Anne* were identified as timber from the Southern Baltic region based on tree-ring curve correlations with identified chronological standards (Daly 2016). The presence of sapwood on the back board provides an estimated felling

date of 1471–85, while the other two boards covered tree-ring curves up to the years 1415 and 1422, indicating that they were felled after 1425 and 1432, respectively. Assuming that the three trees used for the boards were felled at a similar time (1471–85), the sculpture can be dated to the latter part of the 15th century (1471–1500), as the boards are likely to have been seasoned prior to use.

STRUCTURAL REINFORCEMENT

Often, canvas patches or parchment would be employed to cover board joins visible after carving was completed. A group of four composite sculptures examined in Sweden at the Historiska Museum, originally from Järstad, had both canvas and parchment covering some wooden joins. In the case of the *St Anne*, flax fibres were identified using polarised light microscopy (PLM), suggesting that linen canvas was used.

Investigation of the *St Anne* with x–radiography revealed the absence of any structural reinforcement, such as dowels and nails (Figure 6), as well as the straightness of the grain. Known composite block sculptures in northern Germany and Sweden date from the 15th century and usually do not incorporate any additional structural reinforcement other than the glued joins (Knüvener 2011 and 2015). However, composite sculptures thought to originate from the Netherlands are dated somewhat later, to around 1500 or the first part of the 16th century, in addition to often having metal or wooden nails for securing the boards together (Table 1) (Vereecke and Deveseleer 1995, Rief 1998, Olstad 2008, Preising 2013, Rief 2013 and 2014).

THE ITALIAN CONNECTION

An interesting point worth noting is the existence of the composite block technique in Florence from the second half of the 15th century to the 1520s (Stiberc 1989 and 2014). What, then, is to be made of this Italian technique?

Researchers in Florence have investigated a group of composite block sculptures that are constructed from boards in a remarkably similar manner to those from north of the Alps during this period (Stiberc 1989, Fidanza 2010 and 2011, Stiberc 2014). It would appear that during the first half of the 15th century, most sculptors working in Florence carved from solid wooden blocks, which often resulted in cracking and splitting. Given that they were less conversant with woodworking techniques and had greater familiarity with stone as a medium, they worked much like stone carvers would, steadily working the shape out of the block in relief (Ulmann 1984). To reduce the occurrence of splitting, blocks would be hollowed out in the same manner as previously described for the *Bishop* sculpture. However, greater emphasis was being placed on carving the human form, particularly nudes, in three dimensions rather than just frontally. Hollowing out in such cases is not ideal as it detracts from the three-dimensional nature of the sculpture. From the 1480s in Florence, it would appear that the composite block technique developed as a way to counteract this. In addition, sculptors working in the latter part of the 15th century were typically

Figure 6. X-ray image of *St Anne*

Figure 7. Map showing regional distribution of known Netherlandish (blue) and northern German (orange) composite block sculptures

woodworkers by background rather than mainly stone masons, resulting in better awareness of wood technology. While these Italian composite block sculptures are not made from wainscot but from wood common to the region, such as linden or poplar, and there is as yet no evidence of a preference for radial cut boards, the use of dry boards glued together suggests a desire to take advantage of the properties of seasoned wood.

DISCUSSION

Rief (1998 and 2013) has previously discussed composite block sculptures originating from Utrecht, and suggests they would have been manufactured in workshops in coastal vicinities due to the use of wainscot, which would have been imported from the Baltic region. Rief argues that composite block sculptures were manufactured as export art, due to their superior stability over standard single block sculptures, which were more likely to respond to climactic changes. This could certainly apply to Netherlandish sculptures in Norway linked to the Utrecht workshop, as well as some northern German altarpieces in Sweden (Tångeberg 1986, Olstad 2002, Rief 2013), and the *St Anne* sculpture. However, why are there not significantly more imported sculptures in Norway and Sweden that are constructed in this manner? Similarly, the argument that they were manufactured for export cannot be used as an explanation for the existence of numerous sculptures with composite block construction in the Netherlands, the Low Countries and northern Germany, in the vicinity of their likely places of origin (Table 1). Nevertheless, by mapping known Netherlandish and northern German composite block sculptures, trade networks based around the North Sea and Baltic Sea, respectively, can be visualised (Figure 7).

Whether the use of the composite block technique developed independently in Florence, or whether a journeyman from Northern Europe led to its spread is of little consequence. What can be demonstrated is that there was an increased awareness of the properties of wood as a carving material, and that its inherent properties were being exploited by sculptors working in different regions of Europe during the 15th and early 16th centuries. The reasons behind the sculptor's choice of the more expensive and difficult composite block technique as yet evades thorough explanation and warrants further investigation.

CONCLUSION

Addressing a little known subject, this paper outlines a construction technique occasionally found in medieval sculpture from the 1400s. The composite block method of construction using wainscot boards highlights the medieval sculptor's extensive level of material awareness. While not as common as construction techniques involving a single tree trunk or several parts thereof, composite block sculptures have been identified in numerous European countries. Examples such as the *St Anne* sculpture are generally structurally stable and exhibit few cracks. As a result, the preconceived idea of single-block construction being indicative of high quality is yet again challenged (Rief 1998, 77). In addition, the use of boards in composite block construction has been observed in a number of

sculptures in both Southern and Northern Europe, thereby contradicting the myth of a North/South divide in medieval European art.

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NOTES

[1] The research underlying this comparative study of the *St Anne* and *Bishop* sculptures will be published within the course of 2017.

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