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Meshing around: integrating ground-penetrating radar surveys and photogrammetric documentation for the reconstruction of the spatial layout of the church of St. Lawrence, Sigtuna, Sweden

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ABSTRACT

This article aims at providing evidence for the usefulness of combining data from both above and below the ground in order to provide a more complete understanding of an archaeological site. For this purpose a Ground-penetrating radar (GPR) survey was carried out next to the standing ruins of the west tower of the church of St. Lawrence in Sigtuna, Sweden. The tower ruins were also documented using photogrammetry providing an accurate 3D-model of the site. The result of the GPR survey clearly images the buried wall foundations of the church but it is only when this data is combined with the photogrammetric 3D-model of the tower ruins that the spatial layout becomes complete. The results clearly provide evidence of the benefits of using such an integrated approach. The available evidence suggests that the tower, nave and choir (with a possible apse) were constructed during the 12th century. During the 15th century the church porch was built and arches added to the nave. The building history of the church is thus rather ordinary compared to other contemporary Swedish churches and, as a consequence, it is likely that that the church was built for the city congregation.

1. Introduction

The town of Sigtuna, situated in eastern central Sweden (Fig. 1), was founded in the late 10th century and has been referred to as the first medieval town in Sweden. Sigtuna is home to many churches and church ruins which has attracted the interest of many scholars in the past. The most recent interpretation concludes that it was probably the king, Erik Segersäll (c. 970–995 CE), who founded Sigtuna as a Christian strongpoint in the otherwise heathen Mälaren valley (Tesch, 2007). As such Sigtuna was not founded primarily as a market town but as a religious focal point from which a Christian mission took place. The interpretations are based on more than 400 archaeological excavations carried out in Sigtuna since the end of the 19th century. No traces of any churches from the years around the turn of the thousand millennia have yet been found. Instead hundreds of burials on small burial sites (*sw*. gravgårdar) have been excavated, of which all were Christian burials. No burials of clear heathen origin have been found. About a hundred years later the first stone churches where built. In total there where between 6 and 8 churches in Sigtuna, built in a rather short time span, during the middle of the 11th century to the beginning of the 13th century. Despite the large amount of excavations done in Sigtuna, very few of them have been carried out in the churches. Only research excavations have been carried out on few occasions, e.g. St. Peter (1967–71), St Lawrence (1987), an unknown church at the yard of the Sigtuna museum (1993, 1995) and St. Olof (2001–2005). The combination of rather limited archaeological records and early and rare church constructions also makes the churches very hard to interpret. As a result many different interpretations on the function and dating of the churches have been presented since the scholarly interest began at the end of the 19th century (e.g. Ros, 2001).

Because of the limited evidence available, the spatial layout of St Lawrence has been uncertain. The above mentioned excavation in 1987 was limited and presented a somewhat different spatial layout than what is indicated by a map from 1636 (see Ros, 2001: 161 and references cited therein; Wikström and Viberg, 2015; Fig. 2). But as the size of the excavated area was relatively small, it was difficult to produce conclusive evidence regarding the spatial layout of the church. With the purpose of producing a more accurate spatial layout, a ground-penetrating radar (GPR) survey was carried out on the lawn east of the still standing remains of the west tower in 2010. The actual tower was also documented digitally using Photogrammetry with the purpose of producing complementary information important for the understanding of, for example, the thickness of the walls, the orientation of the church, building material etc. The benefit of using integrated geophysical survey approaches has been discussed for many decades (i.e. Weymouth, 1986;

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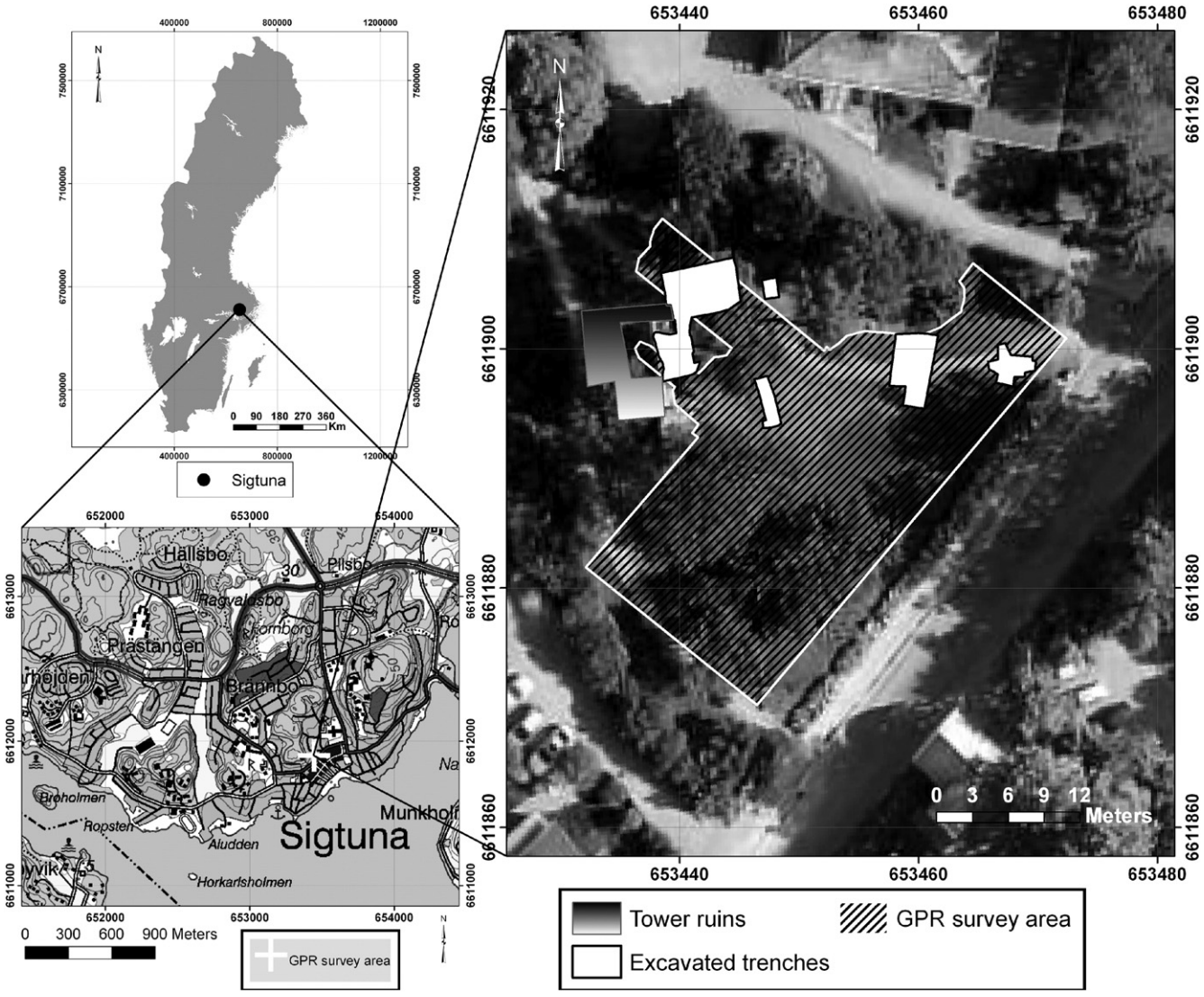

Fig. 1. (upper left image) Map of Sweden showing the location of Sigtuna. (bottom left image) Map of Sigtuna with GPR survey area indicated. (right image) Map of GPR survey area, excavated trenches (1987) and the outlines of the still standing tower ruins. Coordinates in SWEREF 99 TM. ©Lantmäteriet, I2014/00,691.

Fig. 2. Selected part of a historical map of Sigtuna (1636) showing three of the medieval churches of the town. The church of St. Lawrence is situated within the square. © Lantmäteriet.