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Exhibition paper

Interpreting archaeological boat material, the G1 boat of the Gokstad find

ABSTRACT
We will discuss the limitation of cardboard as a material for reconstruction models, and whether an alternative material could be helpful to overcome these limitations. We have experimented with 3D-printed plastic and ways to reduce the longitudinal high edge stiffness, to get around what we think is the main weakness using cardboard. The goal has been to open the possibilities of interpretation. The end result of the tests has been used to build a 1:5 reconstruction model, for our interpretation of the 10m boat from the Gokstad find (G1) from late 800's. We found that the use of 3D-printed plastic, with a designed internal weakness, gives us more longitudinal flexibility in the model. This flexibility opens up for interpretations that are less feasible when using cardboard.

Keywords:
Waterlogged archaeological wood, Viking age, model building, new material, Gokstad find.

INTRODUCTION

Since the 1970's interpretation and reconstruction of archaeological boat material, with the aim of detecting the original shape of the boat, has been carried out by building cardboard scale models (Andersen, Crumlin-Pedersen, Vadstrup, & Winner, 1997).(Bischoff, 2019) When building these models, the shape of the boat is, to a large extent, decided when the top and bottom edge of the strakes is given its shape. The shape of the strake must be given before building the cardboard model and the angle in the sections of the boat, is very much given by how much the strake is curved. As we will discuss below, this very curvature is subject to doubt and cardboard high edge stiffness locks the curvature and brings it over to the model.

THE G1

Together with the Gokstad ship, dated 890 a.d., three smaller boats, from the same period, were excavated. G1 is with its 10 meters the largest of these three boats and believed to have been built and used in the area where it was found. Two of the boats, the G1 and the smallest, G2, were reconstructed in the 1930's. The reconstructions were carried out in full scale, combining original and new material, for the G1 around 60% original and 40% new. The team, led by naval architect Fredrik Johannessen, got the G1 back together, but the job was done without any sort of documentation, cutting original, and gluing new and original material together. This non-scientific approach, combined with an exceptionally slender construction, with only one width defining beam, lead us to the assumption that the G1 is open for interpretation.

QUESTION AND PROCES

Boat material of waterlogged archaeological wood rarely tells us the entire truth. It could be broken into pieces, twisted or bent in many directions, and some of the material could be missing. (Planke, Stålegård, 2014) (Planke; Øya, Heide, 2022) Therefore, the material must be interpreted. Hull material, such as strakes in a lap strake boat, could suffer from bending on the high edge. Using cardboard for scale model building locks the high edge longitudinal shape of the strakes, because of the high edge stiffness of cardboard, and thus could bring possible incorrect information from the excavated material over to the model, with little possibility to adjust or correct for such systematic changes.

The question we asked, is if there are other materials or methods for reconstruction that do not lock the longitudinal shape of the strakes. We have experimented with 3D-printed plastic and ways to reduce the longitudinal high edge stiffness, to get around what we think is the main weakness using cardboard. The goal has been to open the possibilities of interpretation. Digital means have been introduced, but we find these methods far from the perspectives of crafting and have, therefore, chosen to pursue the path of physical model building, and by that share Vibeke Bischoffs perspective at this point (Bischoff 2019).

FIGURE 1. Stems were made in one piece because they are presumably locked in shape by internal triangles.

METHOD

To make printable strakes, we used a 3D-scan of the original boat and unrolled each strake from the model to 2D using Rhinocerus 6. Each strake was given its rivets placement and scarfs and extruded to a closed 3D object in a printable file. We decided to print the bow and stern as complete sections, since there is not so much interpretation possible in these areas because they are well preserved and there are several triangles giving fixed relations (Figure 1).

A strake out of solid 3D-printed plastic is even more stiff than cardboard. In order to achieve a less high edge stiff material, we have investigated what happens when we reduce internal material from the 3D-print, without changing the outer dimensions. The criterion we set up was that the printed strake should have similarities with archaeological wood, i.e. to be flexible, also on the high edge, and have consistent width and thickness while bending. The concept we designed, was to produce a “ladder” with stringers making the top and bottom of the strake, and crossing “steps” between the stringers. The first test was too flexible longitudinally, so we decided to add a centre stringer, crossing the “ladder steps” to create a stiffer strake.

The test prints of the strake were compared with a strake made of cardboard of the exact same outer dimensions. Both were tested in a jig where a fixed load was applied at different positions of the strake, and the high edge flexibility was measured. The test showed that the 3D-print was about 150 percent more flexible applying the load at the end of the strake, and approximately 400 percent applying the load at the centre, compared to the cardboard.

FIGURE 2. Test shows flexability.

When the method was set and strakes for the entire boat were printed (Figure 3), 2D drawings of the strakes were glued on the inside of the 3D-printed strakes to keep track of what was original and what was added, new, material. This is important information when discussing the shape. The parts were thereafter screwed together with micro screws and the model was mounted in a frame.

FIGURE 3. All the strakes ready for building the model.

CONCLUSION

After building the reconstruction model, it has been the subject of several interpretations. At this point, there are five different interpretations which all have been 3D-scanned for further analyse.(Figure 4). The main importance of these interpretations is to show that G1 holds many possible interpretations, and that the 3D-printed material, based on our idea, is one way to investigate these possibilities. A final hypothesis around the boat shape will, eventually, be a discussion between the material and other circumstances. These circumstances could include the intention of the boat, waters where the boat was used, how it was used – sailing/rowing or a combination, whether it was for cargo or for fast movement of personnel, etc.

We find that the model has more longitudinal flexibility compared to a cardboard model. However, the 3D-printed strakes also have a less desirable property; they have a flexibility that makes them fold outwards when pushed to their outer longitudinal limits. This could be connected to the fact that the top and bottom stringers of the strake have a fixed length and very little flexibility lengthwise, a property that could limit the possibilities of interpretation. Theoretically, flexible wood tend to get longer along the outer curve and shrink along the inner when being subject to high edge deformation.

FIGURE 4. Boatbuilder apprentices from different boatbuilding shops in Norway and Denmark are discussing the shape of the model, and are making their proposal for interpretation.

The connecting area, and how it is designed, between the "steps" and the upper and lower stringer of the 3D-printed strakes, and where the steps are placed, is also important for the high edge flexibility. Our project did not investigate how altering these details affects the result. A deeper investigation would probably be beneficial for optimizing the stringer and «step» design.

Despite these described shortcomings we believe that we already at this stage have a solution that is functional and usable. Longitudinal deformation in hull material has been a possible source of incorrect information, that has been difficult to adjust for using cardboard for model building. We believe that our contribution will, to some extent, overcome this issue and open the room for interpretation.

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