Easing the ravages of time

by Rikard Evertsson and Mattias Bornholm

In the 17th century, vessels were not built from plans or drawings but from "rule of thumb", based on a shipwright's instincts and his sea experience. The builder of the warship Vasa poorly estimated its proportions. The underwater section of the vessel was far too small for the visible part above the waterline, making the ship completely unstable. On the day of its maiden voyage in 1628, the Vasa was loaded to full capacity. 64 bronze cannons were proudly displayed with all gun port windows open. As the Vasa left the harbour and its sails filled with wind, the boat rolled dangerously to one side and was swiftly filled with water coming in from all the open gun port windows.

Although the ship sat in less than 40 metres (131 feet) of water, it remained to a large degree unscathed in Stockholm's sheltered harbour until 1961. Now 333 years after sinking, the Vasa is an almost untouched piece of 17th century Swedish history that has returned to the surface.

Before being moved to the museum where it now rests, the Vasa was stored in a harbour shipyard with little protection to elements. It was coated with PEG, a chemical compound that replaced the water in the wood, and helped to prevent shrinkage and cracking of the 300 year old timber. The first visible signs of change were seen in the 1990's when white spots appeared on the surface of the wood caused by sulphur and iron used to build the ship.

These visible signs ultimately led researchers to focus on changes taking place below the surface and the first monitoring of the ship began in 2000. At that time, it was decided the best device to monitor the vessel was the Leica TDA5005. The data collected proved that even with PEG treatments, the structure of the ship was seriously altered by gravity. The 300 year old wooden structure of the ship had already lost over 40% (in certain parts, even up to 80%) of its mechanical strength. It was absolutely necessary to collect precise data in order to decide how to stop deformation and best conserve this historic vessel.

The correct support for the structure

Today the Vasa sits on standard storage blocks in a museum that was specifically built for the ship. These common storage blocks date back to the 1960's and do not provide proper support for the boat. Research shows a new storage system desperately needs to be built in order to properly support this fragile historic ship. However, in order for carpenters to build the correct support structure, huge amounts of accurate data need to be collected and analysed to determine exactly how the wood and the ship's structure have chemically and mechanically changed over the course of time. A Leica Nova TS50 using Leica SmartWorx Viva software was chosen to collect the data to make a prototype, which can be designed, tested and put to use.

Monitoring

Monitoring the Vasa takes place twice a year. Each surveying epoch takes roughly ten working days to accomplish, depending on the how many visitors are at the museum. Measurements are made by museum

staff and the Department of Geodesy and Satellite Positioning at Kungliga Tekniska Högskolan.

In order to collect data from the Vasa with absolute precision, no less than twenty-nine prism points are attached to the museum's static walls. These serve as reference points to get the exact position of the Leica Nova TS50. Once these are calculated, the operator measures thirty-three prisms that have been attached to the inside of the ship's pliable hull and about 330 customised reflector tapes on the outside of the Vasa to collect information regarding deformation of the ship's structure. To ensure that data collection has been carried out correctly, a second measuring procedure is carried out from different setup position. This process is done over several years, again and again, in order to determine just how fast the deformation is occurring.

After each epoch, the data is processed and compared to earlier monitoring epochs done on the ship. The results prove that the ship has been tilted and pulled down by gravity over the course of time.

As a result of the last 15 years of monitoring, a new support system for Vasa will be developed. Over six million Swedish Krona (690,000 USD/650,000 EUR) has been appropriated for research use and will include a study of how the quality of the wood and the structure of the ship have changed over the course of time. Research will last until 2016, after which a basis for designing a new working structure will be in place and the actual construction of the ship's storage block can begin.

Aside from helping with the design of a new supporting storage block for Vasa, the measurement data collected using the Leica Nova TS50 will certainly help determine the extend and speed of the ravages of time on the Swedish vessel and will enable researchers to better predict future changes in the wood, which is of great importance to the future of the Vasa. ■

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Rikard Evertsson has worked for Leica Geosystems in Sales since September 2007 and Mattias Bornholm since September 2010. They are now responsible for sales in the Stockholm region. Before working in sales, Evertsson worked as a surveyor starting in 1995 and Bornholm in 1994.
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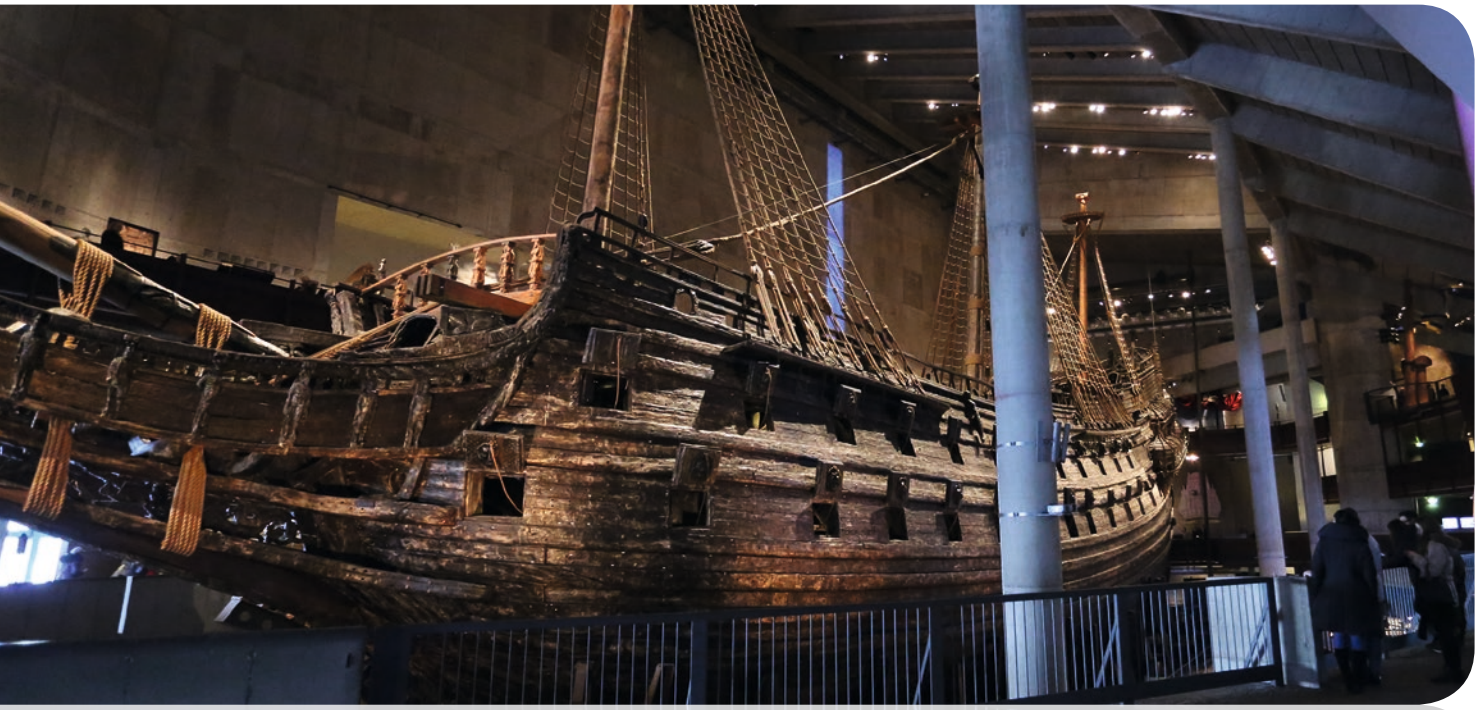

■ **A perfect support structure for the historic Vasa ship is needed to avoid further tilting.**