



Conclusions report 'Welded steel mill stocks'

Vereniging De Hollandsche Molen
The Dutch Mill Association
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Safety and maintenance of mill stocks

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In the Netherlands there are concerns about the condition of some steel mill stocks. In recent years, stocks have unexpectedly broken at a number of traditional windmills in the Netherlands. Fortunately, there was only material damage and no personal accidents occurred. Nevertheless, this and previous accidents showed that there is a great urgency to conduct further investigation to establish the root cause of the failure of these steel stocks. After all, it is of great importance for mill owners to have a good insight into the condition of the stocks of 'their' mill(s), in view of the safety of millers and visitors. This problem therefore had to be thoroughly investigated and clearly mapped out. This has led to the decision of the De Hollandsche Molen association, the Dutch (umbrella) water- and windmill association for mill preservation, to conduct research into mill stocks and the causes of stock failures in consultation with the Cultural Heritage Agency and in close collaboration with the traditional milling community.

The results of the study with conclusions and recommendations have been incorporated in a report. The report is intended for all those directly involved in the fabrication, inspection, maintenance and, if necessary, replacement of welded steel mill stocks. On the basis of this research and after the publication of this report, a risk inventory instrument for existing mill stocks will be developed (the so-called RoeRie = Stocks Risk Inventory and Evaluation) in which knowledge about this complex subject will be brought together. With this tool, a mill owner can map out the risks surrounding the stocks of his mill(s) and take action if necessary. The latter is expressly the responsibility of the owner. Finally, as the final element of the stocks project, the aim is to achieve a uniform national manufacturing and implementation guideline. The research shows that a stocks break can have various causes. Three main causes can be identified: corrosion, poor welds and stress concentrations. However, when estimating the remaining lifespan of a stock, there are many other factors that are also interrelated. Over the years, many different manufacturing methods, designs and materials have been used in the manufacture of mill stocks. For a long time, steel stocks were designed for maximum protection against corrosion. However, even with normal use, stocks are subject to constructive wear.

The own weight of the stocks and the rigging play a major role in this. A number of recent stocks breaks caused by fatigue as a result of years of heavy dynamic loading clearly show this. In recent years, the prevention of so-called stress concentrations has fortunately become increasingly important in design. The aim with new mill stocks should be that the tensions released when turning are uniform. These stresses should not be hindered by, for example, sharp corners of a fence hole or wind shaft cannister, an imperfection in welding, and so on. It is precisely in these places that fatigue can occur and a crack can occur. In the current Dutch milling world there is a great deal of knowledge and expertise in the field of the manufacture of welded stocks. With the current working methods, these can be put together constructively with sufficient strength. They are also very aware that careful construction methods contribute greatly to the safety of mill stocks. Given the monumental nature of the mill, there are limitations in the space that is available to build in more safety margins. As a result, the stocks cannot last indefinitely, if one does not want to run any risks with them. A stock that breaks is the result of a combination of various circumstances, in which the size and weight, the detailing and the history of use are all a determining factors. A reason for rejection based on just one such factor is not sufficient. A stock can be 'OK' in terms of welding work and plate thickness, but due to the heavy rigging, the intensive use regime and an incorrectly detailed fence hole or windshaft cannister, because fatigue has occurred at this stress concentration. The big lesson from this research is that it is precisely the combination of all these factors that should be decisive when estimating the lifespan of a stocks.

Mill owners should be aware of this range of factors and should take them into account when inspecting the stocks of their mill(s) and drawing conclusions. It is therefore advisable to examine the stocks to be inspected from different angles, by involving stocks makers, millwrights, mill consultants and millers. The various parties, with their knowledge and experiences, can thus formulate a better joint assessment for that specific mill. The lack of specific rejection criteria when inspecting welds and plate thickness makes it very difficult to make a definitive judgment on the basis of these investigations. Measurements can say a lot, they can even lead to immediate substitution, but they clearly need to be placed in a broader context. To give direction to this, the De Hollandsche Molen association (The Dutch Mill association) has developed a risk inventory and evaluation, especially geared to welded steel mill stocks. For new stocks, many mill stock makers have made major improvements to their design themselves. It is strongly recommended that more knowledge is shared, especially about the constructive aspects and safety aspects of mill stocks. We therefore ask the sector to actively share the knowledge gained and to provide information about the design, structural calculations and composition of the stocks in a mill stocks file.

Experience has taught us that a well-made welded steel mill stock can last for at least 50 years, provided it is run regularly, is well maintained, is properly inspected and if no major incidents occur. There are currently many old(er) stocks present in the Dutch windmill world and if we want to prevent regular stock breaks, the safety level must be increased. We are very aware that if we want to achieve this, intensive efforts will have to be made in the coming years to monitor the mill stocks during its entire lifespan. It is possible that this will eventually lead to the replacement of steel mill stocks and possibly at a faster pace than previously thought.

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