Popular summary in English

The work presented in the thesis stems from the many roof failures that occurred due to heavy snow loading during the winters of 2009/10 and 2010/11 in Sweden. Similar events have occurred during other winters in other countries as well. Failure investigations indicate that many collapses are due to major design errors and not to the loading being extreme, i.e. exceeding the design snow loads.

The overall objective of the thesis was to increase awareness of the need to ensure adequate safety of slender roof structures and also to contribute to certain technical knowledge concerning the design of slender structural members.

The designing of slender structures typically involves uncertain parameters; engineers thus usually need to make subjective choices in modelling slender structures. In order to learn more regarding the effects of imperfections and of slip and slack, which are examples of uncertain parameters, on the bracing performance of slender structural members, numerical analyses involving such members were carried out. For example, it was shown that the performance of slender structural members is highly sensitive to structural imperfections. The imperfect shape of a structural member that is critical for the load-bearing capacity of the member itself is generally not the same imperfect shape that is critical for the forces that would be involved in the bracings of the member. Slip in bracing systems can reduce the load-bearing capacity of the braced member and also increase the bracing forces.

Full-scale laboratory testing was conducted in order to learn more regarding the effect on the bracing stiffness of a timber roof structure's different members; a special test rig that could be used to determine the point-wise bracing stiffness of the roof structure was developed. Both stabilization by means of diaphragm action and wind trusses in the plane of the roof were considered. Through use of finite element model updating approaches and the results of laboratory tests that were carried out, the stiffness values of connections, for example, could be estimated. It was found that the stiffness of bracing systems can be markedly overestimated if the connections are not accurately accounted for in the models employed. Also, the methods used in the laboratory testing can be used for the field-testing of roof structures, so as to verify that the structure is adequately stiff (i.e. that it meets design assumptions).

In order to learn more concerning important aspects of the design of slender structures, and to identify potential sources of errors in designing such structures, a survey of experienced structural engineers was conducted. The results of the survey indicate that many structural engineers believe that structural failures are commonly due to erroneous calculations, and they also indicate that improved communication between different partners

in a building project would be useful for improving the overall safety of structures. In addition, the survey revealed that the designing work of experienced engineers varies significantly, in ways that have a potential for reducing structural safety. Thorough and independent review is seen as important for ensuring the adequate design of structures.