



Failure Analysis as a Base for Developing Quality Control Systems

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Summary

Recent experiences and wide spread surveys on the quality of building constructions with respect to life-time aspects like alterations in the profile of use, deterioration of the quality of the used materials due to fatigue, climatic effects etc. and in many cases a lack of inspection and maintenance led to the development of new guidelines for addressing these problems. These guidelines, splitted in two parts, one more formal one dealing with general questions and legal aspects, the other laid out to give tangible technical information for the engineer doing on site checks to determine the structural strength of the construction under consideration, are based on a risk assessment concept which judges possible failures against possible hazards of the structure, the profile of use and the robustness and ductility of the structure. These concepts are partly elaborated in analogy to the well know risk assessment concepts of earthquake engineering. The base for the life-time monitoring is a reliable data base of the structural properties in form of a "Project-Book". For buildings to be constructed it is recommended to develop this project-book parallel to the design, for existing buildings the relevant data must be gathered, if necessary with on site inspection and material testing. Provision for the necessary qualifications of the engineer who is doing the checks are made also with respect to the question of responsibility when judging and certifying the build infrastructure.

Keywords: Failure Research; Design Checks; Execution Checks; Inspection Concepts; Monitoring; Maintenance; Rehabilitation; Project-Book

1. Introduction

Collapses of wide span structures through the last years in Germany led to an intensive discussion about the principles of quality control systems for building constructions, not only with respect to the design- and construction-phase, but also having the question of maintenance, further development, improvement and, if necessary, rehabilitation of the construction in mind. The conclusions taken from the investigations done in the aftermath of these failures – research of the reasons for the structural collapses and widespread survey of the quality of the construction of existing buildings – resulted in significant modifications of the quality control systems, especially with respect to life-time monitoring procedures which are comparable to the procedures known from monitoring of bridges [1].

The reasons for the most tragic failure of the roof of the ice-rink in Bad Reichenhall (Fig.1) in January 2006, which is in essence representative for the whole complex of questions, could be summarized as deficits in the checking and inspection process during design, erection and use of the structure [2]. The actual load situation, the collapse occurs during heavy snowfall, triggered of the accident, but it is worth to be stated, that the failure of the roof construction happened at a load level significantly lower compared to the snow load assumption for ultimate limit state according to the German standard DIN 1055-5:1975 [3] which was, in a provisional version, the design base for this building.

Based on this experience, the German Building Authorities elaborated and issued guidelines for the monitoring of building constructions [4]. The relevant content of these guidelines, which are in many aspects an adaptation of the well known bridge monitoring procedures [1], is: