Forensics of a Partially Collapsed Timber Roof

Daia Zwicky

Institute of Construction and Environmental Technology (iTEC), School of Engineering and Architecture Fribourg (HEIA-FR), University of Applied Sciences of Western Switzerland (HES-SO)

Contact: daia.zwicky@hes-so.ch

Abstract

The roofing of an office building partially collapsed after being in use for almost twelve years. The author was appointed as an independent structural expert to investigate the damage event, by approval of all involved parties, i.e. owner, building insurer and roof constructor. The expert report should give answers to several questions related to forensic engineering, e.g. reasons for the partial failure of the roof elements; influence of the snow load present at the moment of partial collapse; faults or deficits in the structural concept, in element production or execution etc. The paper reports on the course of events and actions, the structural and architectural conception of the roofing, its structural behavior, determination of updated failure loads, associated structural safety assessment and degrees of compliance. The paper gives no conclusion on legal or insurance issues.

Keywords: office building; roofing; snow load; partial collapse; timber; structural forensics; structural modelling; structural detailing; degree of compliance.

1 Introduction

In the middle of winter, the roofing of a smaller office building near Fribourg, Switzerland (approx. 650 m altitude), partially collapsed after being in use for almost 12 years, Figure 1.

1.1 Course of events and actions

The partial collapse was reflected by a sudden local deflection of approx. 40 cm of the inferior roofing face in the north-west corner of the roof, at the first interior column (to the east) of the completely glazed north façade. The deflection at the upper face attained approx. 10 cm. The damage took place very quickly and was accompanied by cracking sounds. The concerned building zone was immediately evacuated and emergency strutting was installed, Figure 1. Additionally, a pump was temporarily installed on the roof for evacuating accruing water.

Figure 1: Partially collapsed roof with emergency strutting in place