

## ACCEPTING OF INFLUENCE OF STABILITY LOSS DURING DISPLACEMENT-CONTROLLED LOADING IN FRACTURE TEST

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*Stability loss during displacement-controlled loading is possible due to the low rigidity of the loading machine (loading set-up). This stability loss appears as a jump in measured parameters (catastrophe), while needed dependency is not obtained. Here, a procedure is used for recognition of this problem and its correction in the case of fracture tests on specimens of selected cement-based composite. The reasons for overestimation of fracture energy evaluated from load–deflection diagrams without correction are indicated in the paper.*

### Introduction

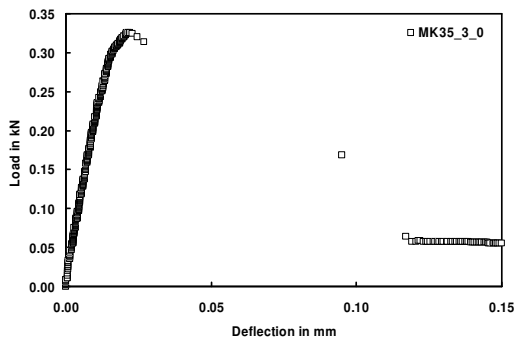
It is well known, measurement of building material properties is usually provided by loading. So-called quasi-static loading is often used, where the slow change of all parameters (load, displacement or strain) is considered. Fracture tests – three-point bending of notched specimens – are focused

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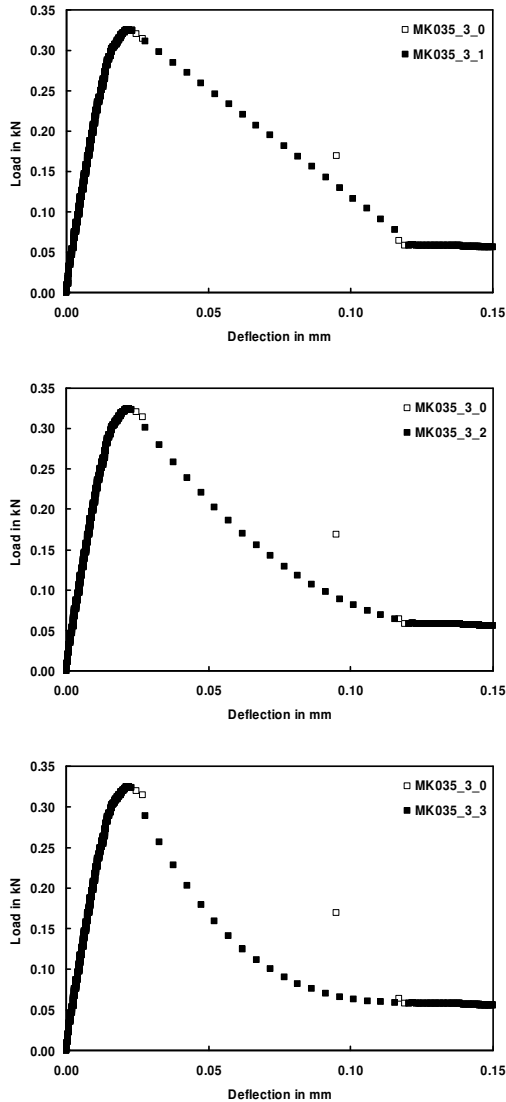
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on the quantity of energy which is dissipated by failure/collapse of a specimen (e.g. Karihaloo, 1995). For quantification of this fracture energy displacement-controlled loading is used. The response of a specimen is determined by the stiffness of the loading machine and by the stiffness of intermediate part of the specimen. A qualitative change in the measured loading diagram can appear during loading on testing machine with low stiffness – see Fig. 1. This change can be considered as a sudden loss of loading stability named *fold singularity*. Catastrophe theory can be used for the analysis of the origination of this singularity (Arnold, 1983; Bažant & Cedolin, 1991). ‘Catastrophe’ in this theory means a sudden change in the inner parameter of a system (here it is the value of loading force) during continuous change of a control parameter (here it is the measured displacement of the tested specimen or the stiffness of the loading machine).

Results of many measurements show, that analysis of a measured time series of inner system parameters can serve for the recognition of the catastrophe origination (František et al., 2006, 2007). For example, a time series of loading-point-displacement of such a ‘catastrophic’ fracture test is characteristic by an irregularity in loading speed during the fracture progress and particularly by a typical sudden increase in the displacement. Therefore, the time derivative of this displacement is a useful criterion for the identification of the origination and range of the fold catastrophe. The catastrophe is recognizable as extreme values of loading speed. The measured load–displacement diagram with the fold singularity has such properties which can help to discover the probable development of the diagram in the catastrophic part. As a first attempt to create an algorithmic development of this correction a polynomial function was applied.



**Figure 1. Selected load–deflection diagram before correction.**



**Figure 2. Selected load–deflection diagram before (empty boxes) and after (black boxes) polynomial corrections: degree of the polynomial function is equal to 1 (above), 2, and 3 (bottom).**

## Conclusion

Selected load–deflection diagram before and after polynomial corrections is depicted for illustrative purposes in Fig. 2. Values of specific fracture energy were presented in Frantík et al., 2007. These values were calculated from measured/corrected load–deflection diagrams. Relative values of fracture energy from the measured load–deflection diagram without correction were overestimated in all cases.

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