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TOWARDS AN UPDATED DESCRIPTION OF IMS DAMAGE GRADES INCLUDING NON-STRUCTURAL ELEMENTS

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Abstract: *The classification of damage according to five Damage Grades shapes the most essential part of the EMS-98 macroseismic scale together with the differentiation of building structures into Vulnerability Classes and the definitions of quantity. As an important step towards a new International Macroseismic Scale (IMS), up-dated descriptions of IMS Damage Grades for all building types and for damage in non-structural elements will be presented. Since its publication in 1998, workshops about EMS-98 have identified a number of limitations of the current Damage Grade descriptions and ideas for improvements have been proposed. Primarily, the following issues will be covered in the paper: Additional Damage Grade descriptions for building types with well-known seismic response and structural performance, mainly for timber and steel buildings and maintaining the existing five Damage Grades; additional Damage Grade descriptions for non-structural elements in buildings: The quantitative classification "few", "many", "most" of the number of structural elements affected by a certain Damage Grade, currently used mainly for masonry, will be extended to all Damage Grade descriptions. Illustrations of Damage Grades will be updated and extended to timber, steel, and adobe buildings. Updated quantitative Damage Grade descriptions such as crack width will be systematically introduced as far as possible. The differentiation between peak and residual deformations will be carefully elaborated. Particularities of damage to be expected in structures with Earthquake Resistant Design (ERD) will be discussed for RC frame and wall buildings taking into account recent code developments in Europe and in the rest of the word. The aforementioned descriptions will be elaborated based on literature, earthquake damage observations, experimental tests, and numerical analyses. Worldwide data will be considered including building damage descriptions from other macroseismic intensity scales and from procedures for safety evaluation of buildings following earthquakes. Backward compatibility to previous versions of EMS scales of the proposed updated descriptions will be carefully secured.*

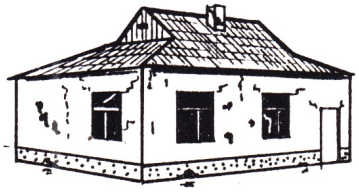
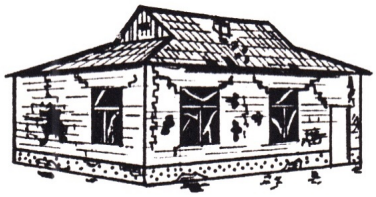
1 Introduction

This is a preliminary version of the paper serving as a template for the October 2023 submission deadline. A more elaborate version will be submitted by end of November 2023 and the final version will be submitted by end of January 2024.

2 Classification of damage to adobe buildings

As an additional table of classification of damage to adobe buildings for the IMS-24 is proposed as shown in Table 1. The five sketches in Table 1 were drawn by Kenjebaev & Taubaev, 1990.

Table 1: Classification of damage to adobe buildings (sketches by Kenjebaev & Taubaev, 1990)

Classification of damage to adobe buildings	
	**Grade 1: Negligible to slight damage (no structural damage, slight non-structural damage)** Hair-line cracks in very few walls. Fall of small pieces of plaster.
	**Grade 2: Moderate damage (slight structural damage, moderate non-structural damage)** Cracks in many walls. Fall of fairly large pieces of plaster. Partial collapse of chimneys.
	**Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage)** Large and extensive cracks in most walls. Fall of parts from walls. Roof tiles detach. Chimneys fracture [at the roof line]. Failure of individual (few) non-structural elements.
	**Grade 4: Very heavy damage (heavy structural damage, very heavy non-structural damage)** Serious failure of walls; partial structural failure of roofs and floors. (Partial collapse of outer bearing walls)
	**Grade 5: Destruction (very heavy structural damage)** Total collapse.

3 References

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