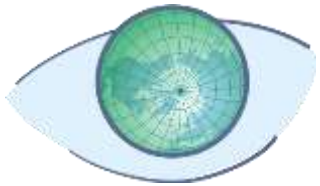


13th International Conference
GEOHERITAGE, GEOINFORMATION AND CARTOGRAPHY
Selce, Croatia, September 7–9, 2017

Cartographic support at 1917 Brežice earthquake study

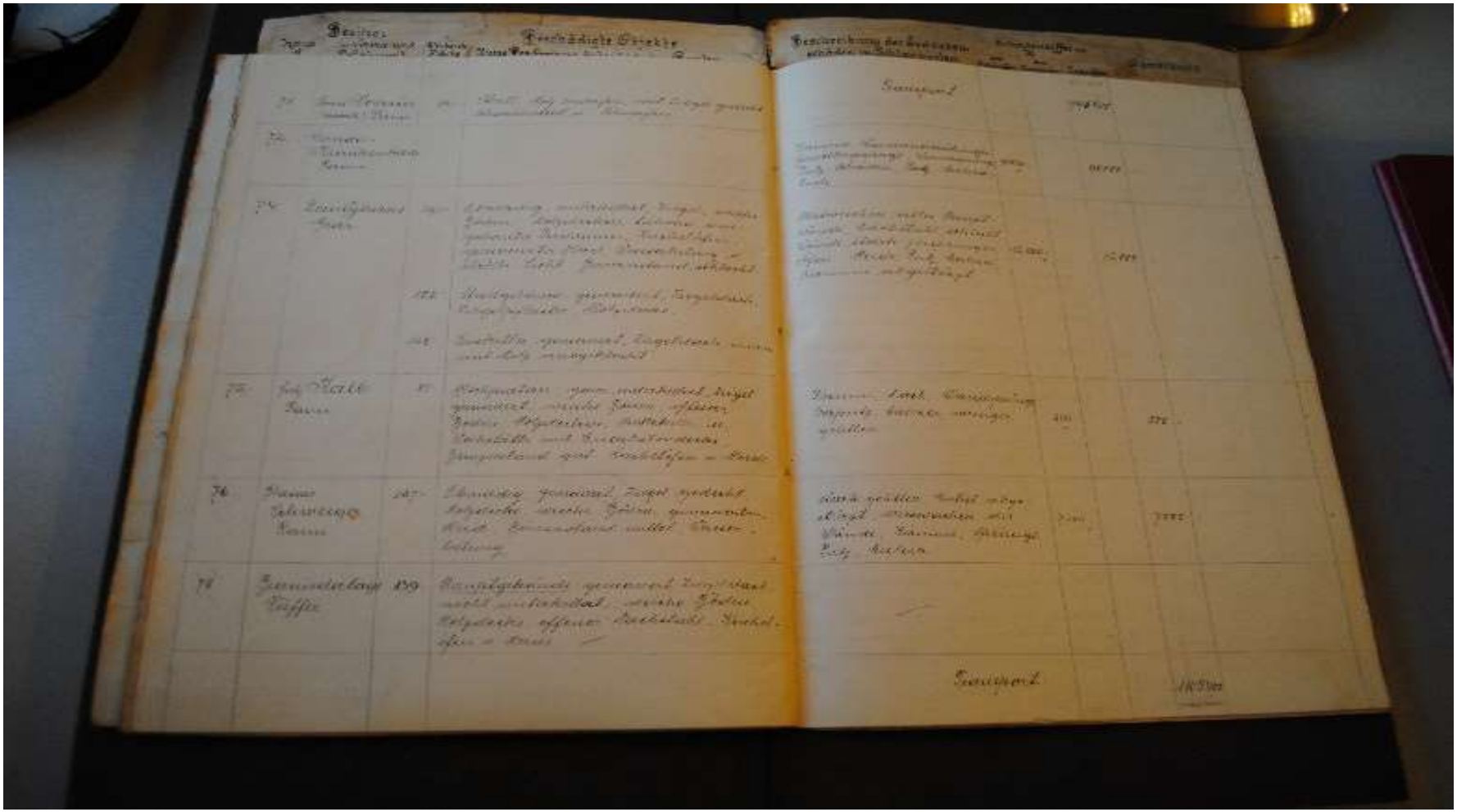
Dušan Petrovič, Marko Berus, Anka Lisec,
University of Ljubljana, Faculty of Civil and Geodetic Engineering

Ina Cecić, Slovenian Environment Agency

Backgrounds

Brežice, January 29, 1917, 12:35

prof. Dr. Dušan Nečak, based on various archive records, established an orderly inventory of earthquake damage



inventory upgraded with estimated vulnerability assessment and damage of the affected objects, Slovenian Environmental Agency

LASTNIK		POŠKODOVANI OBJEKTI		OPIS POTRESNIH POŠKODB V GESLIH	ZNESEK ŠKODE V KRONAH			PRIPOMBE
Hišna številka	Ime in kraj	Pozidano območje v m^2	Kratek opis poškodovanih zgradb		Na zgradbah	Na predmetih	Skupaj	
POTRES – OCENA POPOTRESNE ŠKODE – OKRAJ BREŽICE								
1	Grof Edmund Attems, Gradec	2348	Dvonadstropna stara zgradba obzidana z močnimi zidovi debeline približno 2m, v neenakomernem kvadratu s štirimi stebri podprto ostrešje, visoko, pokrito z bobrovcem. Severno in zahodno krilo imata na dvoriščni strani obokane arkade. Južno krilo služi le kot povezava in ima na dvoriščni strani prislonjeno obokano teraso. Celotno pritličje obokano. Zgornja nadstropja imajo lesene strope, tla v pritličju so betonska ali opečnata, v zgornjih nadstropjih mehka tla, tla iz desk, v posameznih prostorih kapucinska tla. Le tla drugega nadstropja zahodnega krila so trda. Glavno stopnišče je v glavnem iz kamna. Umetnostno dragocene so freske stopnišča in viteške dvorane, kakor tudi arhitektura grajske kapelice in v posameznih prostorih drugega nadstropja štukature. Peči in štedilniki so zidani oziroma	Na splošno gre za hude poškodbe, mnogo razpok zidov, poškodovani oboki, porušene okenske preklade, udrti stropi, mnogo poškodb ometa, dimniki.	100.000			Pripomba nečitljiva

Poor spatial distribution understanding

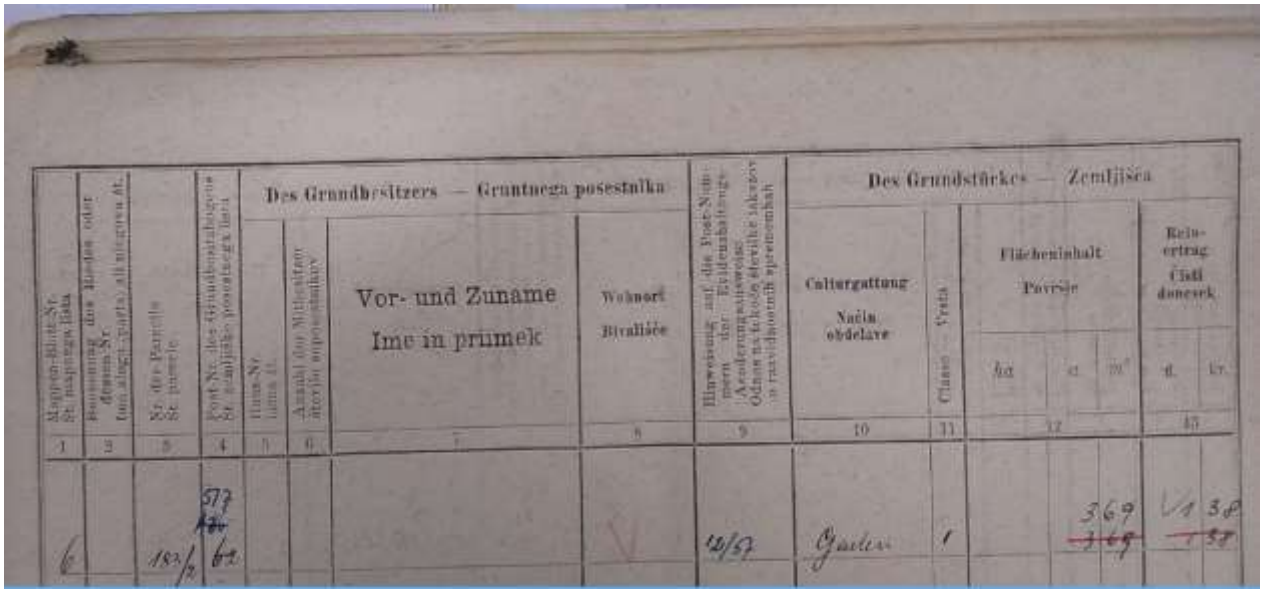
↓

thematic map

basic map:

- map of that time situation
- re-embedded Franciscan cadastre plan (1860 - 70)
- georeferencing

- parcel record of the land cadastre, acquired in the archives of Cadastre office in Brežice



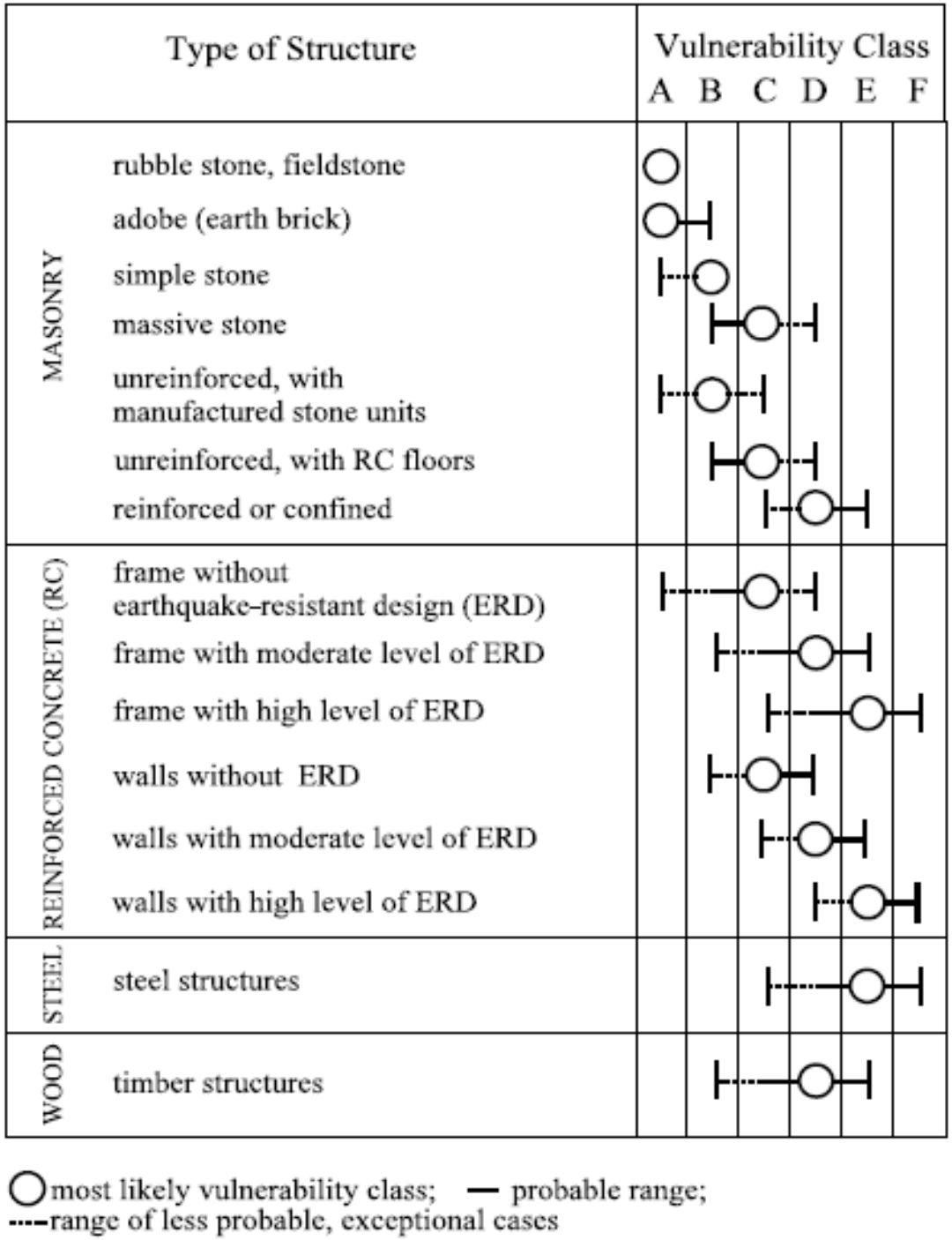
- Identification of the buildings from the inventory to the cadastral plan were made with 94% successfulness

degree of vulnerability (EMS-98)

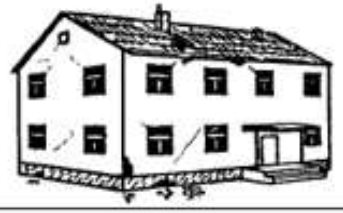
6 classes,

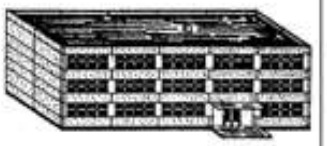
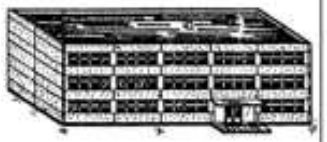
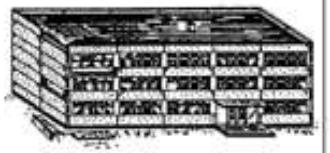
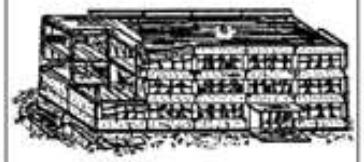
only masonry without reinforced concrete floors

(3 classes A - C)



level of damage in a five-point scale (EMS-89)

Classification of damage to masonry 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 only. Fall of loose stones from upper parts of buildings in very few cases.
	**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. Roof tiles detach. Chimneys fracture at the roof line; failure of individual non-structural elements (partitions, gable walls).
	**Grade 4: Very heavy damage** **(heavy structural damage, very heavy non-structural damage)** Serious failure of walls; partial structural failure of roofs and floors.
	**Grade 5: Destruction** **(very heavy structural damage)** Total or near total collapse.

Classification of damage to buildings of reinforced concrete	
	**Grade 1: Negligible to slight damage** **(no structural damage, slight non-structural damage)** Fine cracks in plaster over frame members or in walls at the base. Fine cracks in partitions and infills.
	**Grade 2: Moderate damage** **(slight structural damage, moderate non-structural damage)** Cracks in columns and beams of frames and in structural walls. Cracks in partition and infill walls; fall of brittle cladding and plaster. Falling mortar from the joints of wall panels.
	**Grade 3: Substantial to heavy damage** **(moderate structural damage, heavy non-structural damage)** Cracks in columns and beam column joints of frames at the base and at joints of coupled walls. Spalling of conrete cover, buckling of reinforced rods. Large cracks in partition and infill walls, failure of individual infill panels.
	**Grade 4: Very heavy damage** **(heavy structural damage, very heavy non-structural damage)** Large cracks in structural elements with compression failure of concrete and fracture of rebars; bond failure of beam reinforced bars; tilting of columns. Collapse of a few columns or of a single upper floor.
	**Grade 5: Destruction** **(very heavy structural damage)** Collapse of ground floor or parts (e. g. wings) of buildings.

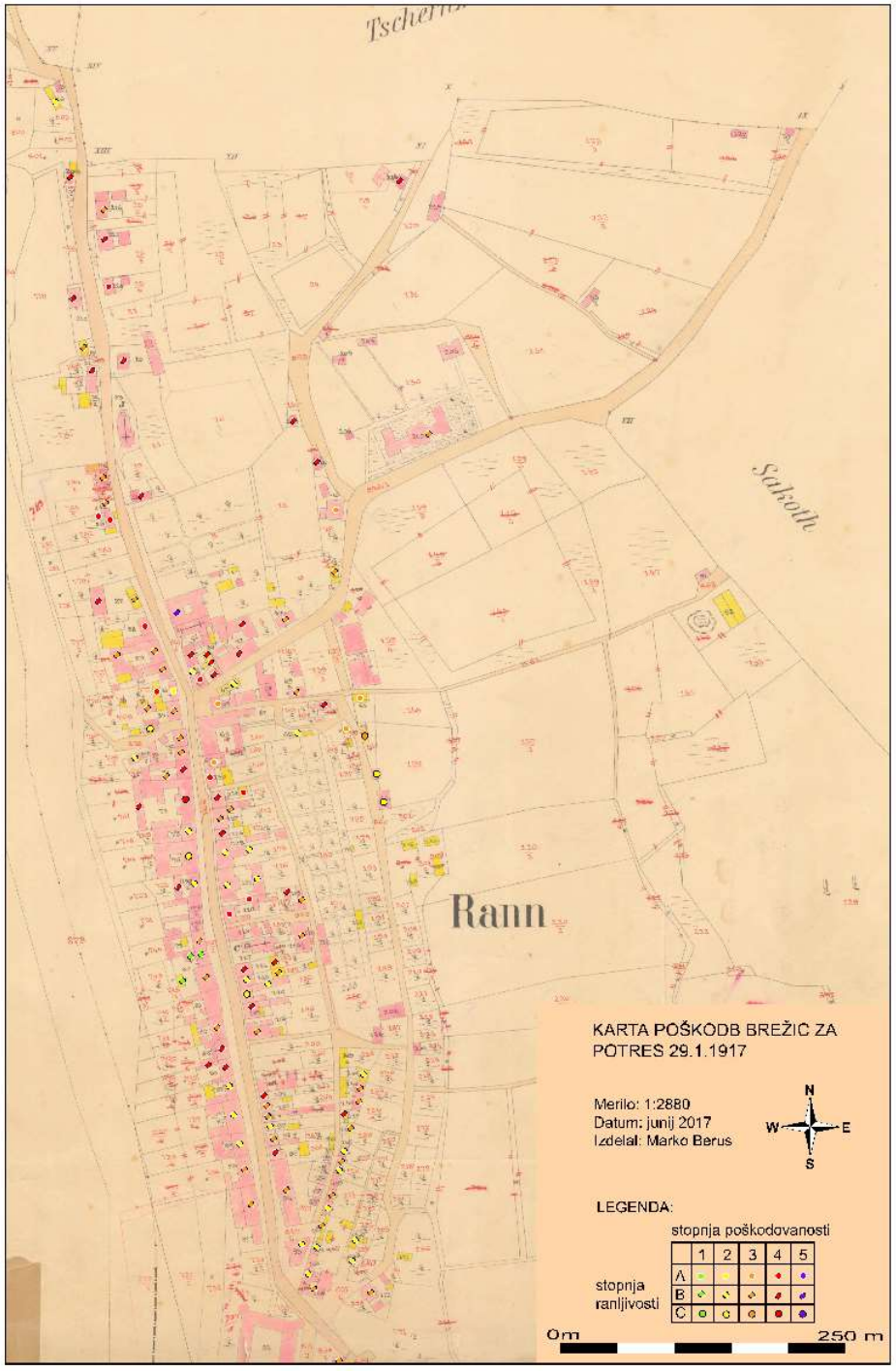
To archive good visibility and understanding:
combined both attributes in one single map symbol

LEGENDA:

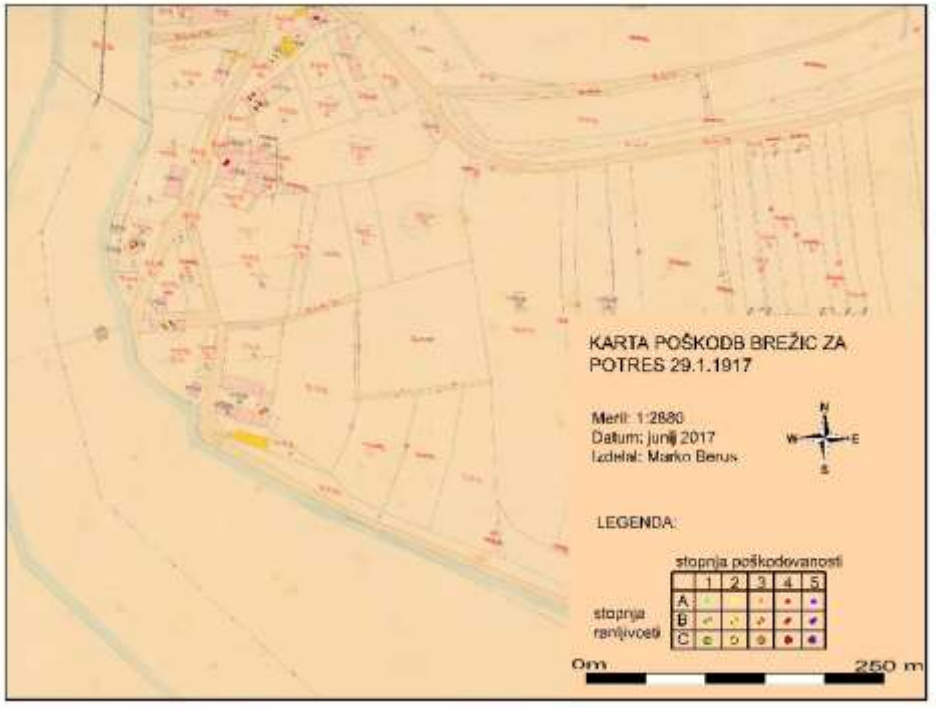
level of damage

	1	2	3	4	5
A	●	●	●	●	●
B	●	●	●	●	●
C	●	●	●	●	●

degree of vulnerability



90% of all buildings at least partly damaged, 73% of all buildings moderately to severely structurally damaged



Conclusions

Can we live without maps?