European Council of Civil Engineers

REPUBLIC OF BULGARIA
Minister of Regional Development and Public Works

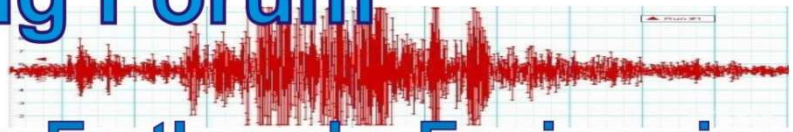
European Council of Engineers Chambers

BEF 2021

Building Engineering Forum

20-21 October 2021, Sofia, Bulgaria

International Conference on Earthquake Engineering



THE ROLE OF CHAMBER – CHALLENGES IN ELIMINATING THE CONSEQUENCES OF TWO DEVASTATING EARTHQUAKES IN CROATIA

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President of the Chamber

Zagreb, October 2021

Earthquakes

Zagreb

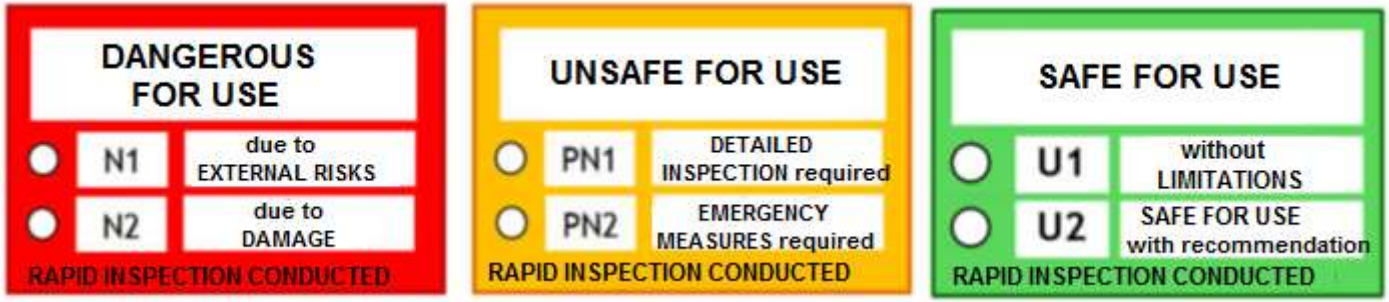
22 March 2020 **M = 5.5**

Sisak-Moslavina County

28 December 2020 **M = 5.0**

29 December 2020 **M = 6.2**

Emergency inspections



Damaged and inspected:

Zagreb
> 25,000 buildings

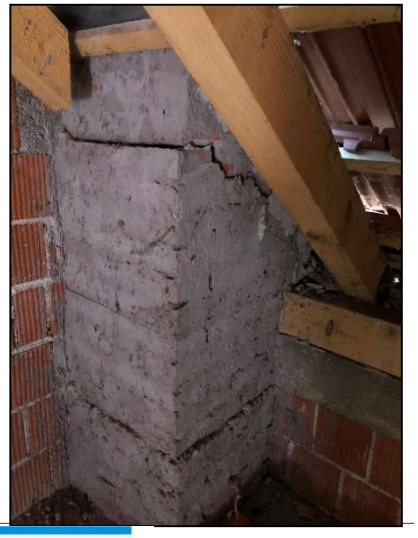
Sisak-Moslavina County
> 39,000 buildings

Non-structural elements

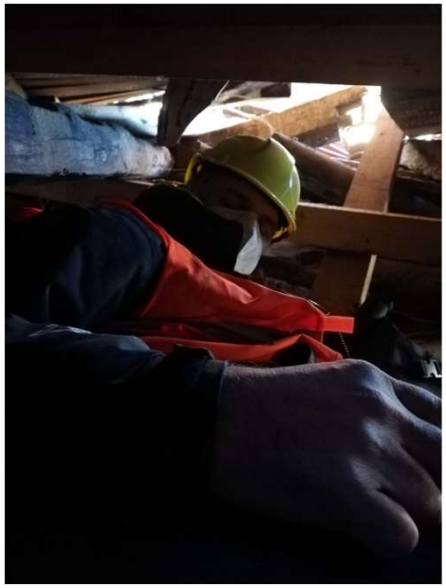
Damaged chimneys

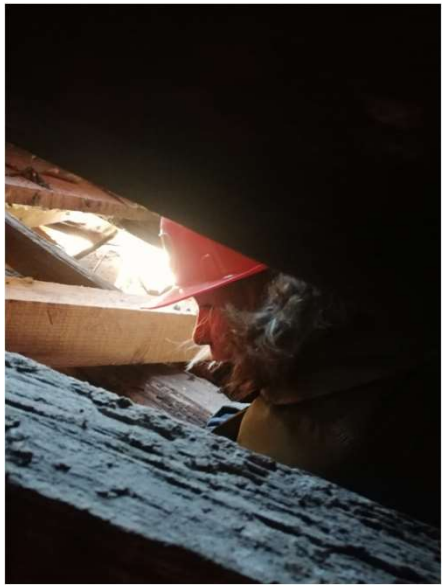
9,000 in Zagreb and ZC
20,000 in SMC, KC and ZC

Damage



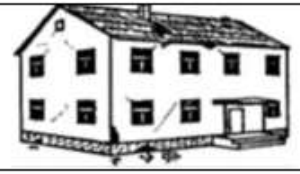
Damage





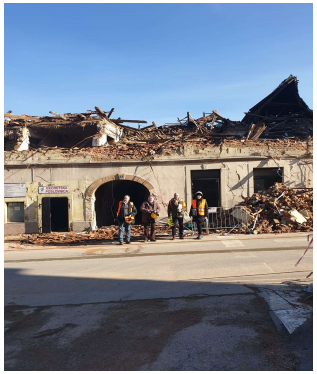
Usability assessment methodology

Category	Facility use	Description	Examples
I	without limitations	SLIGHT NON-STRUCTURAL DAMAGE no visible damage, cracks of smaller size in secondary elements *does not jeopardize the safety of users due to potential fall of non-structural elements*	
II	limited use	SLIGHT STRUCTURAL DAMAGE cracks on a wall, damage to non-structural parts of the building, hairline cracks on load-bearing reinforced-concrete elements, the load-bearing capacity of the building is not jeopardized. Individual parts of non-structural elements may fall down	
III	unsafe for use	MODERATE STRUCTURAL DAMAGE Large and deep cracks on walls, cracks on and damage to columns, partially reduced load-bearing capacity, vacating the building temporarily, structural remediation	
IV	dangerous for use	HEAVY STRUCTURAL DAMAGE holes are opened and walls are collapsing, collapse of approx. 40% of structural components, the state of the building is hazardous and requires vacating it, detailed remediation or demolition	
V	dangerous for use	COLLAPSE OF THE ENTIRE BUILDING A large part or the entire building collapsed, demolition and reconstruction	

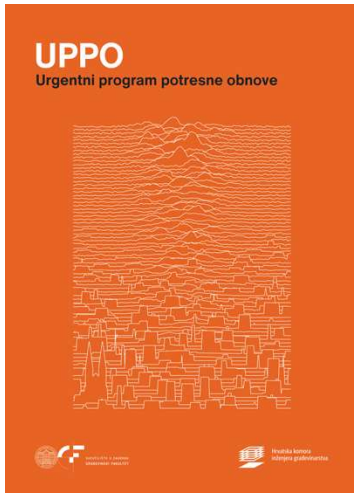
Category	Description	Detailed description
I		**None to slight damage** **- negligible structural damage** **- slight non-structural damage** Very thing cracks in some of the walls Small pieces of plaster falling off Individual separate parts of a wall falling off very rarely
II		**Moderate damage** **- slight structural damage** **- moderate non-structural damage** Cracks in many walls Larger pieces of plaster falling off Partial failure of the chimney
III		**Heavy to severe damage** **- moderate structural damage** **- severe non-structural damage** Large and branched cracks in the majority of walls Roofing tiles falling down Chimney failure at the level of the roof Failure of individual non-structural elements (partition walls, gable walls)
IV		**Total damage** **- severe structural damage** **- total non-structural damage** Significant failure of walls Partial failure of roof structures and floor structures
V		**Failure** **- total structural damage** Complete or almost complete collapse

The role of CCCE

- Participation in removal of the consequences of earthquake-caused damage on buildings
- Calling on and organizing volunteers (chamber members) for rapid building inspections
- Procuring protective equipment, organizing the transportation of volunteers and meals in the field
- Procured a container, a van and a PC workstation through donations
- Purchased a PC workstation to store databases and all field data

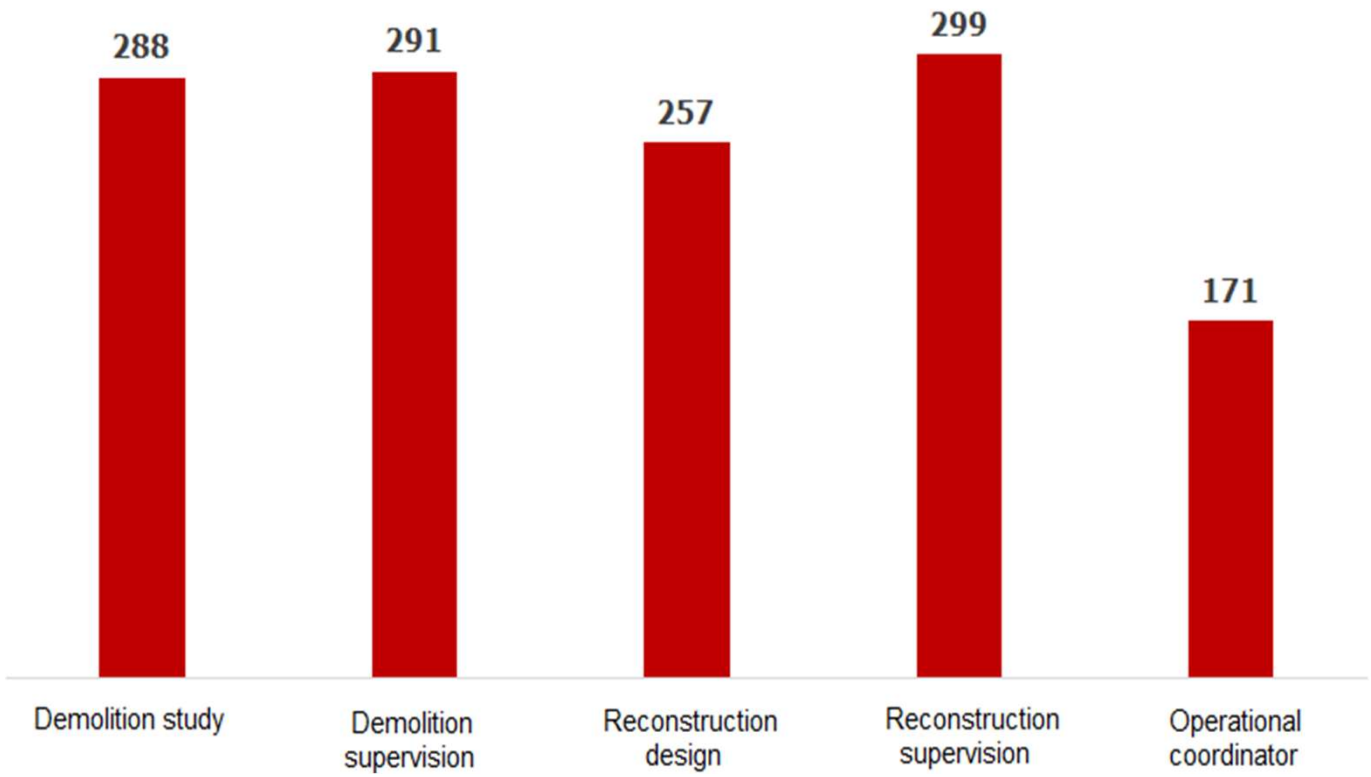


CCCE educating CEs

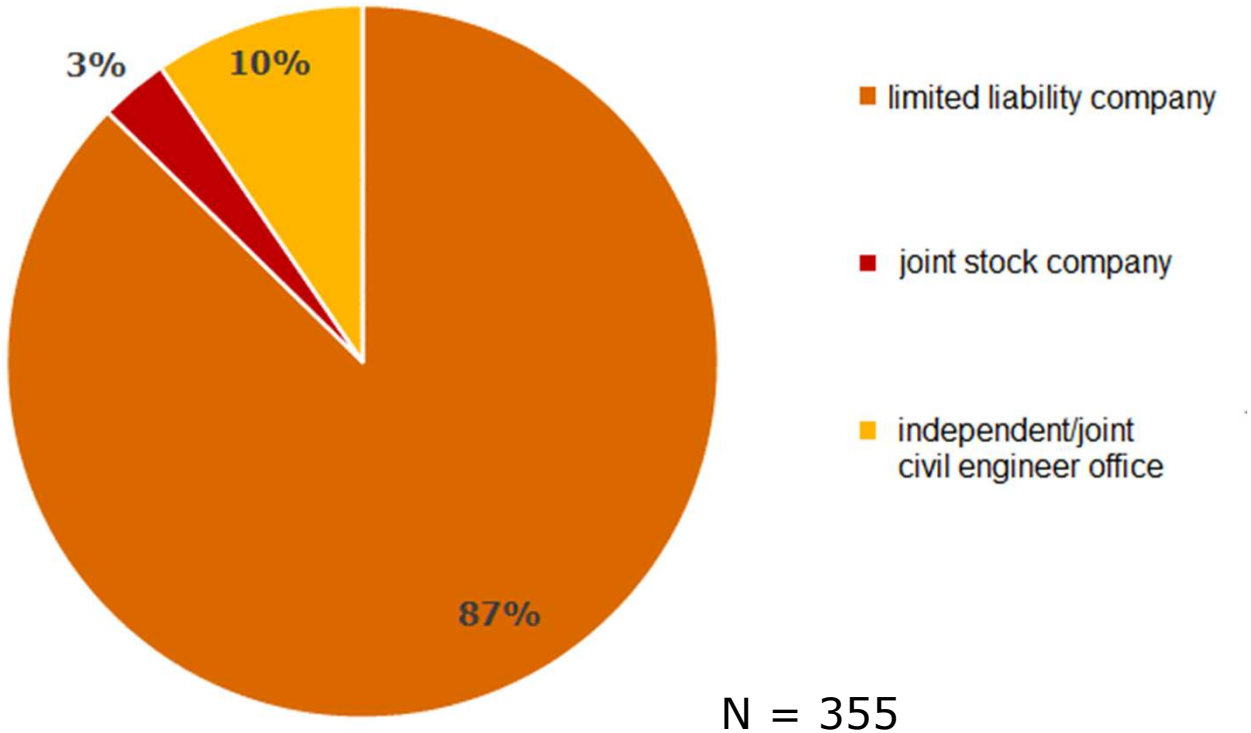


Assessing market potentials

Legal entities interested in reconstruction by type of work



Types of legal entities interested in reconstruction



N = 355

Participating in developing legal regulations

- **Law on the Reconstruction of Earthquake-Damaged Buildings** in the City of Zagreb, Krapina-Zagorje County and Zagreb County, Sisak-Moslavina County and Karlovac County
- **Program of measures for reconstruction of buildings**
- **Ordinance on the content and technical elements of design documentation**
- **Technical regulation for building structures** –amendments

Type of building reconstruction

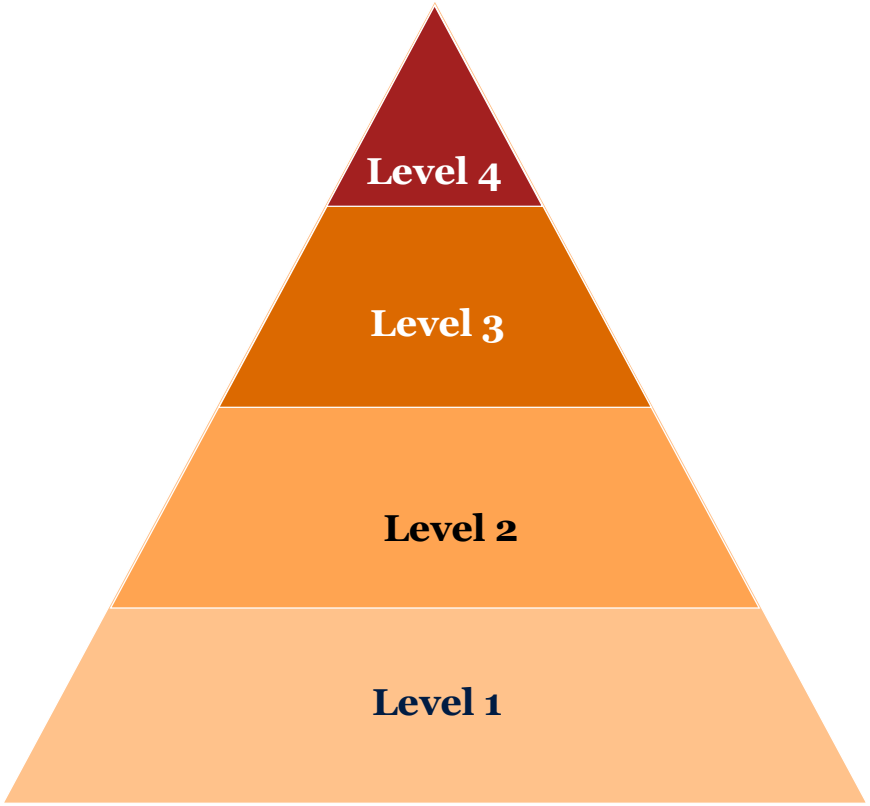
STRUCTURAL

- multi-apartment buildings
- commercial buildings
- residential and commercial buildings
- family houses

COMPREHENSIVE

- public buildings
- individually protected cultural assets

Structure reconstruction



Type of reconstruction

4. comprehensive reconstruction of the structure
3. reinforcement of the structure
2. repair of the structure
1. repair of non-structural elements

Program of measures

intended use of the building	usability assessment	reconstruction of the structure (cost in HRK per m² of gross building area)				comprehensive reconstruction of the building (cost in HRK per m² of gross building area)				demolition of a destroyed building	construction of a replacement family house (HRK cost per m² of gross building area)
		level 1	level 2	level 3	level 4	level 1	level 2	level 3	level 4		
Family houses		233.83	754.28	1,056.00	1,712.22	380.66	1,083.73	1,392.53	2,133.43		
			1,033.37	1,485.94	2,134.62		1,550.05	2,046.96	2,627.23		
				1,787.65	2,489.14			2,335.22	3,098.79		
	destroyed									264.00	5,657.13
Multi-apartment buildings, residential and commercial buildings and commercial buildings		324.34	1,312.45	2,745.59	5,144.22	528.00	1,885.70	3,620.56	6,411.41		
			1,508.57	2,956.79	5,393.13		2,262.85	4,073.13	6,637.70		
				3,349.02	5,574.16			4,374.85	6,939.41		
	destroyed									264.00	
Public buildings						460.11	1,538.74	3,213.25	5,611.87		
							1,810.28	3,424.45	5,853.24		
								3,952.45	5,973.93		
	destroyed									301.71	
Hospitals Schools and kindergartens Cultural and historical, sports facilities						528.00	1,885.71	3,620.56	6,411.41		
							2,262.85	4,073.13	6,637.70		
								4,374.85	6,939.41		
	destroyed									301.71	
SERVICE		Highest service price in relation to the abovementioned amount of investment (%)									
Design		5.40				5.40				1.80	2.00
Expert construction supervision		3.80				3.80				1.80	1.80
Project control		1.50				1.50				0.50	0.50
Financial and technical project control		0.40				0.40				0.25	0.25
Operational coordination		0.60				0.60				0.30	0.30

*Correction coefficient taking into account the surface area of the building:
X – surface area of the facility (gross building area) in m² x K1=1.0 (for facilities up to 0-500 m²) - K2=0.33 (for facilities > 5000 m²) - For facilities between 500 and 5000 m² according to formula - K3 = K1 - (K1-K2)/ 4500* (X-500)

Table 7 – Information on the method of calculation of the estimated value of procurement (in HRK, excluding VAT)*

Reconstruction implementation

Application for reconstruction and reconstruction → MPPC the decision on

Organization and implementation of reconstruction:

- **Reconstruction Fund** - multi-apartment buildings, commercial, and residential and commercial buildings (ZG, ZC, KC, KZC and SMC) and family houses ZG and KZC
- **Central State Office for Reconstruction and Housing Provision** private houses where a state of disaster had been declared (SMC, KC and ZC)
- **Reconstruction subjects for public buildings** (owners and founders)

Where we stand with reconstruction

- The basic objective of the Act is structural reconstruction of buildings
- Reconstruction is not yet in full swing
- The process of amending the Reconstruction Act and bylaws is ongoing
- Demolition of damaged buildings
- Non-structural elements of family houses in SMC are being reconstructed
- Self reconstruction of multi-apartment buildings in Zagreb
- Preparation of studies and designs for the reconstruction of public buildings and individually protected cultural assets

Key messages

- Construction quality and safety is crucial
- The engineering profession has shown that it can respond immediately in a crisis, in terms of providing volunteers, regardless of the fact that it was not institutionally organized
- Engineers emergency intervention service engineer that must operate throughout the state, educate and prepare chartered engineers for action in such disasters
- Introduce earthquake engineering study programs at civil engineering faculties
- Continuously train chartered engineers
- Mentor support

How to prepare for the future?

- Draft legal regulations and harmonize by-laws
- The profession needs to participate in drafting the acts; attitudes and opinions of the profession (chartered engineers) need to be taken into account
- Prepare the Strategy of seismic reconstruction of buildings in the Republic of Croatia

Thank you for your attention!

Do you have any questions?