



Seismic hazard zonation and seismic design codes - a regional perspective

Radmila Salic¹, Zoran Milutinovic², Daniel Tomic³, Jovan Trajcevski⁴,
Mirko Dimitrovski⁵, Zabedin Neziri⁶

¹ Associate Professor, Ss. Cyril and Methodius University in Skopje, Institute of Earthquake Engineering and Engineering Seismology (IZIIS) – Skopje, Republic of North Macedonia, r_salic@iziis.ukim.edu.mk

² Professor (retired), Ss. Cyril and Methodius University in Skopje, Institute of Earthquake Engineering and Engineering Seismology (IZIIS) – Skopje, Republic of North Macedonia, milutin.zvm@gmail.com

³ PhD Student, Ss. Cyril and Methodius University in Skopje, Institute of Earthquake Engineering and Engineering Seismology (IZIIS) – Skopje, Republic of North Macedonia, danielt@iziis.ukim.edu.mk

⁴ PhD Student, Ss. Cyril and Methodius University in Skopje, Institute of Earthquake Engineering and Engineering Seismology (IZIIS) – Skopje, Republic of North Macedonia, jovant@iziis.ukim.edu.mk

⁵ PhD Student, Ss. Cyril and Methodius University in Skopje, Institute of Earthquake Engineering and Engineering Seismology (IZIIS) – Skopje, Republic of North Macedonia, mirkod@iziis.ukim.edu.mk

⁶ PhD Student, Ss. Cyril and Methodius University in Skopje, Institute of Earthquake Engineering and Engineering Seismology (IZIIS) – Skopje, Republic of North Macedonia, zabedin@iziis.ukim.edu.mk

Abstract

This work presents systematic and comprehensive review of all up-to-date official seismic hazard zonation maps and design codes for the Former Yugoslav (FY) counties (Table 1). Presented are different methodologies for calculation of seismic design forces related to the different design codes and discusses the methodological and outcome differences. Official seismic zoning maps are presented in uniform GIS manner which enables easy visualization and tracking of spatial differences. The implications of different design codes and seismic zoning maps are significant, discussed through variations of seismic design force value on selected particular building samples.

Key words: Seismic hazard, Design Codes

1 Introduction

This work presents systematic and comprehensive review of all up-to-date official seismic hazard zonation maps and design codes for the Former Yugoslav (FY) counties (Table 1). Presented are different methodologies for calculation of seismic design forces related to the different design codes and discusses the methodological and outcome differences. Official seismic zoning maps are presented in uniform GIS manner which enables easy visualization and tracking of spatial differences. The implications of different design codes and seismic zoning maps are significant, discussed through variations of seismic design force value on selected particular building samples.

Table 1. Official Building Codes and Seismic Zoning Maps for the Former Yugoslav countries

Building Code		Seismic Zoning Map	
Year	Building Code Title	Year	Seismic Zoning Map Title
1948	Provisional Technical Regulations for Loading of Structures OGoFNRY No. 61/48 of July 17, 1948	1948	Division of territory of Federal People's Republic of Yugoslavia into seismological zones OGoFNRY No. 61/48 of July 17, 1948
1964	Provisional Technical Regulations for Construction in Seismic Regions OGoSFRY No. 39/64 of September 30, 1964	1964	S.F.R. Yugoslavia Seismological Map OGoSFRY No. 39/64 of September 30, 1964
		1979	Seismic Zoning Map of S.R. Macedonia OGoSRM No. 2/79 of January 31, 1979
1981	Technical Regulations for Construction of Buildings in Seismic Regions OGoSFRY No. 31/81 of June 5, 1981 (Amendments 49/82, 29/83, 21/88 and 52/90)	1982	Provisional Seismological Map of SFRY OGoSFRY No. 49/82 of August 13, 1982
		1990	Socialist Federal Republic of Yugoslavia, Seismological Maps for Return periods of 50, 100, 200, 500, 1000 and 10000 years OGoSFRY No. 52/90 of September 7, 1990
----	Eurocodes (EN) EN 1998-1	2005-2020	MK: MKC EN 1998-1/NA:2020 RS: SRPS EN 1998-1/ NA:2018 XK: / ME: MEST EN 1998-1/NA:2015 BA: BAS EN 1998-1/NA:2018 HR: HRN EN 1998-1/NA:2011 SI: SIST EN 1998-1:2005/oA101:2005

FY countries have a more than 70 years history of implementation of official design codes. The first official building code was enforced in 1948 with Provisional Technical Regulations for Loading of Structures (OGofNRY No. 61/48 of July 17, 1948). The second edition of building code was published in 1964 with Provisional Technical Regulations for Construction in Seismic Regions (OGoSFRY No. 39/64 of September 30, 1964). In 1981, the third and in some FY counties still administrative valid edition was put on force through Technical Regulations for Construction of Buildings in Seismic Regions (OGoSFRY No. 31/81 of June 5, 1981 with Amendments 49/82, 29/83, 21/88 and 52/90). Today, the majority of FY countries have adopted Eurocodes as official design code with single or parallel implementation. Along with the design codes, for this region 11 different seismic zoning maps were in official use up-to-date, 5 of them related to the period 1948-1990 and 6 EC-8 seismic zoning maps.

The concept of design codes as well as seismic zonation has a direct impact on the seismic risk of the built environment. Starting from this point, we believe that it is necessary to review all up-to-date official seismic design codes and seismic zonation maps, building a ground for further research and analysis in domain of seismic risk assessment.

References

- [1] EN 1998-1 (2004) (English): Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
- [2] Division of territory of Federal People's Republic of Yugoslavia into seismological zones (Seismic zoning map published in Official Gazette of FNRJ No. 61/48 of July 17, 1948)
- [3] Provisional Seismological Map of SFRY (Seismic zoning map published in Official Gazette of SFRY No. 49/82 of August 13, 1982)
- [4] Provisional Technical Regulations for Construction in Seismic Regions (Official Gazette of SFRY No. 39/64 of September 30, 1964)
- [5] Provisional Technical Regulations for Loading of Structures (Official Gazette of FNRJ No. 61/48 of July 17, 1948)
- [6] S.F.R. Yugoslavia Seismological Map (Seismic zoning map published in Official Gazette of SFRY No. 39/64 of September 30, 1964)
- [7] Seismic Zoning Map of Republic of Macedonia with Elements of Seismic Hazard for Return Periods of 95 and 475 years (Seismic zoning map published under standard - EN 1998-1/NA:2020)
- [8] Seismic Zoning Map of S.R. Macedonia (Seismic zoning map published in Official Gazette of SRM No. 2/79 of January 31, 1979)
- [9] Socialist Federal Republic of Yugoslavia, Seismological Maps for Return periods of 50, 100, 200, 500, 1000 and 10000 years (Seismic zoning map published in Official Gazette of SFRY No. 52/90 of September 7, 1990)
- [10] Technical Regulations for Construction of Buildings in Seismic Regions (Official Gazette of SFRY No. 31/81 of June 5, 1981 (Amendments 49/82, 29/83, 21/88 and 52/90)