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COMPARATIVE ANALYSIS OF A TWO-WAY REINFORCED CONCRETE SLAB ACCORDING TO BAB 87 AND EUROCODE 2

Nevena Marković[1a], Sandra Guševac[1b], Jelena Đorđević[1c], Jelena Stefanović[1d], Mladen Živković[1e]

[1]Mining and Metallurgy Institute Bor, Alberta Ajnštajna 1, 19210 Bor, Serbia
[1a] nevena.markovic@irmbor.co.rs, https://orcid.org/0009-0005-1278-8805
[1b] sandra.filipovic@irmbor.co.rs, https://orcid.org/0000-0002-6776-9899
[1c] jelena.djordjevic@irmbor.co.rs, https://orcid.org/0000-0001-5406-0074
[1d] jelena.stankovic@irmbor.co.rs, https://orcid.org/0000-0001-6418-1814
[1e] mladen.zivkovic@irmbor.co.rs, https://orcid.org/0009-0000-4785-0828

Abstract

This paper presents a comparative analysis of the design of a two-way reinforced concrete slab according to the Serbian Code for Concrete and Reinforced Concrete (BAB 87) and Eurocode 2. A continuous multi-span slab was analyzed using identical geometric characteristics, material properties, and loading conditions for both design approaches. The resulting bending moments and required reinforcement areas were compared. The results show that both design methods produce similar values of bending moments and required reinforcement areas, with the observed differences having no significant influence on the final reinforcement design of the slab.

***Keywords**: reinforced concrete slab, two-way slab, BAB 87, Eurocode 2, reinforcement, comparative analysis, bending moments*

1. INTRODUCTION

Reinforced concrete slabs are important horizontal load-bearing elements in building structures whose primary function is to support and transfer permanent and variable loads to vertical structural elements. Owing to their favorable combination of load-bearing capacity, stiffness, and economy, they are widely used in various types of buildings [1].

Depending on the span ratio and support conditions, slabs may transfer loads in one or two directions. Two-way slabs are used when the ratio of the longer to the shorter span is less than approximately 2, allowing loads to be distributed to all supporting edges and resulting in bending moments in both directions. In continuous multi-span slabs, moment redistribution occurs between spans and supports, which influences the distribution and required amount of reinforcement [1].

The design of reinforced concrete slabs can be performed according to different design codes. In engineering practice in Serbia, the Regulation for Concrete and Reinforced Concrete (BAB 87) was widely used for many years, while modern design is based on Eurocode 2, which applies the limit state design method. Although both approaches have the same objective—to ensure structural safety and load-bearing capacity—they differ in calculation procedures and reinforcement design [1,2].

The aim of this paper is to present a comparative analysis of the design of a continuous two-way reinforced concrete slab according to BAB 87 and Eurocode 2 by comparing the bending moments and required reinforcement obtained using both approaches.

2. DESCRIPTION OF THE ANALYZED SLAB

For the comparative analysis, a two-way reinforced concrete slab supported by beams along all edges. The design according to BAB 87 and Eurocode 2 was performed using the same geometric characteristics, material properties, and loading conditions, including the self-weight of the slab, finishing layers, and imposed loads. Based on the design loads, bending moments were determined, and the required reinforcement was designed using both approaches in order to compare the obtained results.



Figure 1. *Numerical model*

The analyzed slab consists of five spans in the X direction and three spans in the Y direction, with span lengths of Lx=5.3m and Ly=6.5m. The slab thickness is 15 cm. Concrete class C25/30 was adopted for the Eurocode 2 design, while MB30 concrete was used according to BAB 87. B500B reinforcig steel was selected, with a nominal concrete cover of 2.5 cm.

3. NUMERICAL ANALYSIS AND RESULTS

3.1. Design according to BAB 87

The design of the reinforced concrete slab according to the Regulation for Concrete and Reinforced Concrete (BAB 87) is based on determining bending moments using tabulated coefficients that depend on the span ratio, support conditions, and slab continuity. For continuous two-way slabs, positive bending moments in the mid-spans and negative bending moments over the supports are determined, with the distribution of internal forces based on the coefficients specified in the regulation [1,3].

The design load is determined by combining permanent and imposed loads using partial safety factors. According to BAB 87 provisions, a partial factor of $\gamma = 1.60$ is applied to permanent loads, while a factor of $\gamma = 1.80$ is used for imposed loads. Based on the resulting design load, bending moments in both directions are determined [3].

Based on the obtained bending moments, the corresponding parameters for cross-section design are determined, after which the required area of tensile reinforcement is calculated according to the following expression [3]:

$$A_a = \frac{\mu}{100} \cdot b \cdot h \tag{1}$$

where μ represents the reinforcement ratio, b is the width of the cross-section and h is the effective depth of the cross-section.

Based on the calculated required reinforcement area, the appropriate reinforcement arrangement and bar diameters are selected in both directions, followed by verification of the minimum reinforcement requirements and other provisions specified by the regulation.

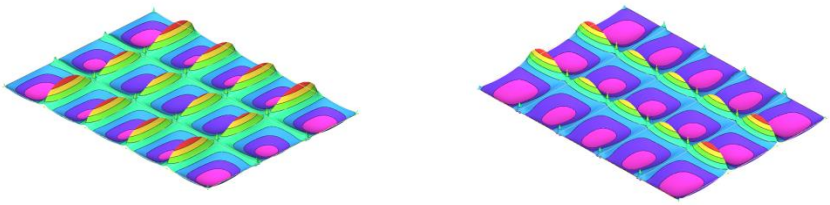


Figure 2. *Bending moment Mx (left) and My (right) according to BAB 87*

3.2. Design according to EC2

The design of the reinforced concrete slab according to Eurocode 2 is based on the limit state design method, where the load-bearing capacity of the cross-section is verified using design values of loads and material properties. The design load is determined by combining permanent and variable loads using partial safety factors. A partial factor of γ_G = 1.35 is adopted for permanent loads, while γ_Q = 1.50 is applied for variable (imposed) loads. The material partial factors are taken as γ_c = 1.50 for concrete and γ_s = 1.15 for reinforcement steel.[1,4].

Bending moments are determined using tabulated coefficients for continuous two-way slabs. Based on the obtained moments, the cross-section is designed, and the required area of tensile reinforcement is calculated according to the following expression [4]:

$$A_s = \omega \cdot b \cdot h \cdot \frac{f_{cd}}{f_{yd}} \tag{2}$$

where ω represents the mechanical reinforcement coefficient, f_b is the design compressive strength of concrete and f_{yd} is the design yield strength of reinforcement steel.

Based on the calculated reinforcement area, the appropriate bar diameter, number, and spacing of reinforcement bars are selected in both directions of the slab. Unlike BAB 87, Eurocode 2 introduces more refined material behavior models and provides more detailed requirements regarding ductility, crack width limitation, and minimum reinforcement.

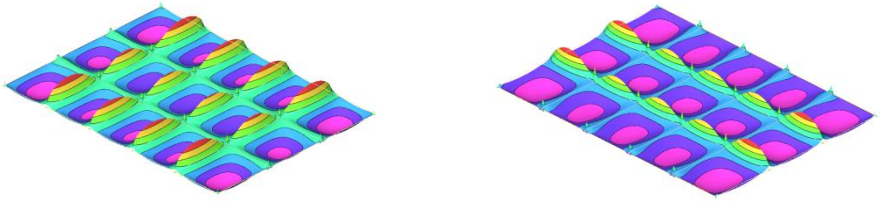


Figure 3. *Bending moment Mx (left) and My (right) according to EC2*

3.3. Poređenje rezultata

Table 1 presents a comparative overview of the design results for the middle span and the corresponding supports of the reinforced concrete slab according to the Regulation for Concrete and Reinforced Concrete (BAB 87) and Eurocode 2.

Table 1. *Comparison of results*

	Span moment Mx [kNm]	Support moment Mx [kNm]	Span moment My [kNm]	Support moment My [kNm]	Required reinforcement area in the span [cm^2]	Required reinforcement area over the support [cm^2]
BAB 87	11.24	-21.93	10.50	-24.55	2.42	3.75
EC2	9.45	-18.44	8.83	-20.64	2.32	3.60

Based on the obtained results, it can be observed that, despite minor differences in the calculated bending moments and required reinforcement areas, the same reinforcement arrangement was adopted for both design approaches in the span regions and over the supports (Ø12/20).

4. CONCLUSION

This paper presents a comparative analysis of the design of a two-way reinforced concrete slab according to the Regulation for Concrete and Reinforced Concrete (BAB 87) and Eurocode 2. The design was performed using the same slab geometry, loading conditions, and material properties, enabling an objective comparison of the obtained results.

The results show that both design approaches provide a similar distribution of bending moments and require almost identical reinforcement. However, the bending moments obtained according to BAB 87 are higher than those calculated according to Eurocode 2, which is a consequence of the application of higher partial safety factors for loads and a more conservative design approach. Although the required reinforcement areas according to BAB 87 are slightly larger, the same reinforcement arrangement (Ø12/20) was adopted in both cases, indicating that the differences in the calculated values did not significantly affect the final reinforcement design of the slab.

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