



## JRC Eurocodes Balkan Summer School | Seismic design of concrete buildings

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*The Joint Research Centre (JRC) of the European Commission supports the Western Balkans to build capacities for adapting their national legislation in the field of construction to the EU legal framework. To this end, the JRC has organized specialized workshops and provided scientific and technical support to the Western Balkans for the adoption and implementation of the Eurocodes. The next planned event is a full-week virtual Eurocodes Balkan Summer School in July 2021, which will offer hands-on training on the seismic design of reinforced concrete buildings.*

### The Western Balkans and the European Commission

The European Commission's **Western Balkans Strategy** (COM (2018) 65 final)<sup>1</sup> outlines, on the one hand, the reforms that are to be implemented by the Western Balkans for accessing the EU and, on the other hand, the EU's increased commitment to support this process of change politically, technically and financially through **six flagship initiatives**<sup>2</sup>. The Strategy stresses that one of the key priorities for accession to the EU is for the Western Balkan partners to *'properly apply EU rules and standards not only in law but in practice'*. It also states that *'the Commission will enhance its technical assistance to the Western Balkans to help them align with EU legislation and ensure its effective implementation in practice'*.

Reaffirming their commitment to this 'European perspective for the Western Balkans' at the EU-Western Balkans summit in Sofia on 17 May 2018, EU leaders outlined new measures for enhanced cooperation in key areas such as security, rule of law and migration through the **Sofia Declaration**<sup>3</sup> and the **Sofia Priority Agenda**<sup>4</sup>. In May 2019, the European Commission's **Communication on EU Enlargement Policy**<sup>5</sup> acknowledged the results yielded by the recent boost of EU's engagement in the region and called for more concrete and brisk action to optimize the momentum gained. As highlighted in the 2019 Communication, the **EU remains by far the biggest trading partner of the Western Balkans** for both imports (73.5%) and exports (80.6%). EU companies are the biggest investors in the region, providing 73% of foreign direct investment making them the main external driver of growth and jobs in the region.

Bringing the Western Balkans closer to the EU is one of the top geopolitical priorities of this Commission – Commission Priorities 2019-2024: Priority 5: **A Stronger Europe in the World**<sup>6</sup> - **Western Balkans' European Future**.

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<sup>1</sup> Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Region: "A credible enlargement perspective for and enhance EU engagement with the Western Balkans" COM(2018) 65 final, 6.2.2018

<sup>2</sup> In the fields of the rule of law, socio-economic development, digital agenda, security and migration, transport connectivity, reconciliation and good neighbourly relations: [https://ec.europa.eu/commission/sites/beta-political/files/six-flagship-initiatives-support-transformation-western-balkans\\_en.pdf](https://ec.europa.eu/commission/sites/beta-political/files/six-flagship-initiatives-support-transformation-western-balkans_en.pdf)

<sup>3</sup> <https://www.consilium.europa.eu/en/press/press-releases/2018/05/17/sofia-declaration-of-the-eu-western-balkans-summit/>

<sup>4</sup> [https://www.consilium.europa.eu/media/34776/sofia-declaration\\_en.pdf](https://www.consilium.europa.eu/media/34776/sofia-declaration_en.pdf)

<sup>5</sup> Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions: "2019 Communication on EU Enlargement Policy" COM (2019) 260 final, 29.5.2019

<sup>6</sup> [https://ec.europa.eu/info/strategy/priorities-2019-2024/stronger-europe-world\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/stronger-europe-world_en)



In fact, the Commission champions for a coordinated approach to external action that secures a stronger and more united voice for Europe in the world. Making Europe an attractive place for business is key to strengthening the EU's role as a global leader while ensuring the highest standards of climate, environmental and labour protection. Such European leadership also means working shoulder-to-shoulder with neighbouring countries and partners, thus reaffirming the European perspective of the Western Balkans.

The Commission also plans to integrate the Western Balkans into its priority for a **European Green Deal**<sup>7</sup> – a growth strategy, transforming the Union into a modern, resource-efficient and competitive economy and making EU climate neutral by 2050. The Commission's "**Green Agenda for the Western Balkans**"<sup>8</sup>, guides the region towards the Green Deal targets while benefiting from the added value the Western Balkans could offer. Making the Western Balkans part of the Green Deal may increase the chances of success of the EU climate-neutral agenda right across the continent and ensure the region is given equal opportunities and weight.

On 25 March 2020, the General Affairs Council of the EU gave the **green light to opening of EU accession negotiations with North Macedonia and Albania**<sup>9</sup>, generating a positive momentum across the region, where the accession negotiations with Montenegro started in June 2012, and Serbia opened accession negotiations in January 2014. This decision was welcomed by the European Commission<sup>10</sup> and in the words of the Commissioner for Neighbourhood and Enlargement, Olivér Várhelyi "*Opening of accession talks sends a loud and clear message [...] to the Western Balkans as a whole. It reaffirms and delivers on the EU's commitment to the European perspective of the region: its present is with the EU and its future is in the EU*".

Following the final endorsement of the Council's decision by the European Council members on 26 March 2020, the Commission will submit proposals for negotiating frameworks with the two countries. These frameworks establish the guidelines and principles governing the accession negotiations with each candidate country. The Commission is expected to begin the necessary preparatory work immediately and, during the negotiations, the countries will pave the way to implement EU laws and standards.

## JRC activities in support of the Eurocodes in the Balkan region

One feature of the EU laws and standards, the so-called *acquis communautaires*, which have to be adopted or aligned to by candidate countries in order to join the EU relate to the **advanced common standardization environment** of the Union. The European standards for structural design – the **Eurocodes**<sup>11</sup> provide a common approach for the design of buildings and other civil engineering works and construction products. They are adaptable to the local requirements of each country (i.e. geographical, geological or climatic conditions) and allow for the selection of the levels of safety.

<sup>7</sup> [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en)

<sup>8</sup> COMMISSION STAFF WORKING DOCUMENT "Guidelines for the Implementation of the Green Agenda for the Western Balkans Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions An Economic and Investment Plan for the Western Balkans", SWD/2020/223 final

<sup>9</sup> <https://data.consilium.europa.eu/doc/document/ST-7002-2020-INIT/en/pdf>; Council conclusion 7002/20 of 25 March 2020

<sup>10</sup> [https://ec.europa.eu/commission/presscorner/detail/en/IP\\_20\\_519](https://ec.europa.eu/commission/presscorner/detail/en/IP_20_519)

<sup>11</sup> The EN Eurocodes are a series of 10 European Standards, EN 1990 –EN 1999



The Joint Research Centre (JRC) of the European Commission manages the Enlargement and Integration Action (E&IA), which supports countries to build the capacities to adapt their own national legislation to the EU legal framework (*acquis communautaire*). It also facilitates scientific and technical exchange.

The JRC has offered specialized workshops and provided scientific and technical support to non-EU Balkan region for the adoption and implementation of the Eurocodes since 2013. The first cycle of activities, under the umbrella of the JRC Enlargement and Integration Action (E&IA) 2013 – 2016, focused on assessing the state and specific needs for the adoption of the Eurocodes in the Balkan region. Eurocodes related dissemination events and workshops included the following:

- Adoption of the Eurocodes in the Balkan region, Milan – JRC (2013)<sup>12</sup>
- Building capacities for elaboration of Nationally Determined Parameters and National Annexes in the Balkan region, Skopje (2014)<sup>13</sup>
- Elaboration of maps for climatic and seismic actions for structural design in the Balkan region, Zagreb (2015)<sup>14</sup>
- Current status of the Eurocodes in the Balkan region, Skopje (2016)<sup>15</sup>.

All countries in the Balkan region reported significant progress in the adoption of the Eurocodes in the workshop held in 2016 and it was concluded that **most of the non-EU countries in the Balkan region intended to use the Eurocodes as primary standards**. Though most National Standardization Bodies (NSBs) reported having adopted the Eurocodes as standards, it was noted that they are being used in parallel with existing national codes as none of non-EU Balkan countries had implemented the Eurocodes in the national regulatory framework. The Balkan region partners stressed that they are aware of the needs for harmonization of their national legislation and standardization framework for construction with EU legislation. The main challenges reported related to the lack of institutional support for the implementation of the Eurocodes in the national legislative and standardization frameworks.

## Roadmap for the Eurocodes implementation in the Balkan region

The first cycle of Eurocodes-related dissemination events in the Balkans made evident that further effort and technical assistance is necessary to support the introduction of the Eurocodes into the national regulatory environment and disseminate their use in practice. Particular importance was given to the **harmonization of seismic hazard, snow, wind and thermal maps** for use in the Eurocodes National Annexes.

A second cycle of Eurocodes activities in the Balkan region was designed for the period 2018-2022 in the framework of JRC's E&IA. It aims to enhance building capacities within the National Authorities and facilitate the implementation of the Eurocodes in the region in day-to-day practice. The JRC offers technical assistance at three different levels:

- *National regulatory framework level* – facilitating the implementation of the Eurocodes in the national regulatory framework.
- *Implementation level* – assisting the training of practitioners (design engineers) to enable their understanding and use of the Eurocodes in day-to-day design practice.

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<sup>12</sup> [http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2013\\_12\\_WS\\_Balkan](http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2013_12_WS_Balkan)

<sup>13</sup> [http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2014\\_11\\_WS\\_Balkan](http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2014_11_WS_Balkan)

<sup>14</sup> [http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2015\\_10\\_WS\\_Balkan](http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2015_10_WS_Balkan)

<sup>15</sup> [http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2016\\_06\\_WS\\_Balkan](http://eurocodes.jrc.ec.europa.eu/showpage.php?id=2016_06_WS_Balkan)



- *Maintenance and upgrading level* – increasing awareness of the National Authorities and National Standardization Bodies of the need to maintain the existing Eurocodes and keep pace with the forthcoming second generation of the Eurocodes (expected by 2026)<sup>16</sup>.

The Workshop ‘*The way forward for the Eurocodes implementation in the Balkans*’, which took place in Tirana on October 2018<sup>17</sup> was the first event of the new series of Eurocodes dissemination and training activities in the Balkan region. It was focused on the implementation of the Eurocodes in national regulatory framework level. Summarizing the conclusions of the Workshop, a JRC Technical Report<sup>18</sup> describes the challenges non-EU Balkan region partners are encountering with the implementation of the Eurocodes in the national regulatory framework and provides **recommendations for facilitating the procedure** based on the EU Member State case studies.

## Eurocodes Balkan School on the seismic design of buildings

### a. The concept

The Western Balkan region has suffered numerous and powerful earthquakes in the past decades. In 1961, a 6.1-magnitude earthquake in Skopje killed 1,100 causing major damages in the city. In 1969, Banja Luka suffered a Mw 6.4 major quake. In 1979 in Montenegro a Mw 6.9 earthquake left 136 dead, more than one thousand injured and over 100,000 people homeless. Far smaller quakes have been a regular occurrence throughout the region for decades.

More recently, on 26 November 2019, a Mw 6.4 earthquake hit Albania, with epicenter 34 km northwest of its capital, Tirana, near the coastal city of Durres. 51 people were killed, hundreds were sent to hospitals and thousands were left homeless. However, it was reported that new structures in the area, which were designed implementing the Eurocodes principles, suffered only minor damages. Four months later, on 22 March 2020, a Mw 5.3 earthquake struck a wide area north of Croatia’s capital, Zagreb, the largest to affect the city in 140 years. At least 17 people were injured and widespread damage was reported, including Zagreb’s iconic cathedral.

Indeed, due to the high seismicity of the Balkan region, most non-EU countries in the Balkan region are close to, or are intending to, formally adopt EN 1998<sup>19</sup>, which provides the principles for the **design of structures for earthquake resistance**. JRC plans to provide for technical assistance at the Eurocodes implementation level addressing the seismic design of concrete buildings through the JRC **Eurocodes Balkan Summer School**.

The Eurocodes Balkan School aims to assist the training of practitioners (design engineers) in the use of the Eurocodes in their day-to-day design practice. The School will provide hands-on training on the Eurocodes use (i.e. lectures with worked examples and interactive sessions for the participants) in addition to plenary sessions and

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<sup>16</sup> More information on the Second Generation of the Eurocodes: <https://eurocodes.jrc.ec.europa.eu/showpage.php?id=63>

<sup>17</sup> More details on the workshop at [https://eurocodes.jrc.ec.europa.eu/showpage.php?id=2018\\_10\\_WS\\_Balkan](https://eurocodes.jrc.ec.europa.eu/showpage.php?id=2018_10_WS_Balkan)

<sup>18</sup> A. Athanasopoulou, P. Formichi, P. Spehl, I. Dabizheva, V. Gacesa-Moric, J. Markova, J. A. Calgaro, N. Malakatas, M. Lurvink, P. Croce, R. Apostolska, D. Sumarac, M. L. Sousa, S. Dimova, The implementation of the Eurocodes in the National Regulatory Framework, EUR 29601 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98657-4, doi:10.2760/033434, JRC115175.

<sup>19</sup> EN 1998 “Eurocode 8: Design of structures for earthquake resistance”: <https://eurocodes.jrc.ec.europa.eu/showpage.php?id=138>



keynote lectures given by experts in the field. As the topic to be addressed is the seismic design of concrete buildings, the main focus will be on EN 1998 also covering relevant parts of EN 1992<sup>20</sup>, EN 1990<sup>21</sup>, EN 1991<sup>22</sup> and EN 1997<sup>23</sup>.

The training material as well as a JRC Report summarizing the conclusions of the event and providing impact assessment of the activity will be made freely available on the JRC Eurocodes website<sup>24</sup>. The event will provide an opportunity to build upon the experience, initiatives, difficulties and solutions concerning the implementation of the European standards and policies for construction in the Balkan region. The material may serve as a reference not only for practitioners in the Balkans but also worldwide as there are many third countries interested in the adoption of the Eurocodes and in particular, EN 1998.

## **b. Key elements of the School programme**

The aim of the School is to provide the participants with an overview on seismic design procedures for typical multi-storey reinforced concrete buildings. At the end of the School, the participants are expected to:

- Have an overall understanding of the seismic design concepts, procedures and current practices using the Eurocodes, enabling them to plan and direct the construction activity appropriately.
- Understand the methodology of seismic design to be able to execute a proper design using EN 1998 and relevant Eurocodes.
- Have a better appreciation of various construction details with respect to seismic response when applying the Eurocodes.

In particular, **topics to be addressed related to EN 1992 and relevant parts of EN 1990, EN 1991:**

- Introduction to design of buildings with EN 1992 (to also cover relationship to other Eurocodes);
- Basis of design, combinations of actions with design examples;
- Preliminary (conceptual) design of RC buildings;
- Materials, durability, structural analysis;
- Limit state design (ULS - SLS) (to cover flexural design, shear design, punching shear and axial resistance; deflection and crack control);
- Geotechnical aspects (foundation design);
- Detailing of structural elements.

**Topics to be addressed related to EN 1998 and relevant parts of EN 1997:**

- Introduction to seismic design of buildings with EN 1998;
- Seismic hazard and earthquake actions (review of the methods used in determining seismic hazard and earthquake actions; to cover seismicity and ground motion models, with specific reference to the stipulations of EN 1998);
- Structural analysis (review of basic dynamics including the response of single- and multi-degree of freedom systems and the use of earthquake response spectra, leading to the seismic analysis methods used in EN 1998);

<sup>20</sup> EN 1992 “Eurocode 2: Design of concrete structures”, <https://eurocodes.jrc.ec.europa.eu/showpage.php?id=132>

<sup>21</sup> EN 1990: Basis of structural design, <https://eurocodes.jrc.ec.europa.eu/showpage.php?id=130>

<sup>22</sup> EN 1991 “Eurocode 1: Action on structures”, <https://eurocodes.jrc.ec.europa.eu/showpage.php?id=131>

<sup>23</sup> EN 1997 “Eurocode 7: Geotechnical design”, <https://eurocodes.jrc.ec.europa.eu/showpage.php?id=137>

<sup>24</sup> Eurocodes: Building the Future (<https://eurocodes.jrc.ec.europa.eu/>)



- Basic seismic design principles for buildings (to present general considerations; to cover shape and regularity, proper arrangement of the lateral resisting elements and suitable foundation system; introduction to commonly adopted approaches of design and dimensioning, e.g. capacity design);
- Seismic design of concrete buildings (describe the design concepts related to structural types, behaviour factors, ductility provisions DCM and DCH and other conceptual considerations; discuss the procedure associated with the design of various ductility classes with particular emphasis on the design of frames and walls, specific rules for design and detailing of concrete buildings; local effects due to infills, design and detailing of secondary seismic elements, provisions for concrete diaphragms);
- Shallow and pile foundations (design of shallow and pile foundations; behaviour of soils and seismic loading conditions; cover issues related to liquefaction and settlement as well as static and dynamic performance requirements; design examples to EN 1998 including pad, raft and pile foundations);

A keynote lecture on the Second Generation of the Eurocodes, expected to be published by 2026, is also planned. The lecture will focus on the highlights related to the design of reinforced concrete buildings expected in the Second Generation of the Eurocodes.

### c. Target audience

Participants from the Western Balkan region (Albania, Bosnia and Herzegovina, North Macedonia, Kosovo<sup>25</sup>, Montenegro and Serbia), Turkey and also Moldova (Horizon Europe Associated country) may attend the Eurocodes Summer School by invitation from the Organising Committee.

We are looking for participants with a Bachelor's degree in Civil/Structural Engineering (essential) and a Master's degree in Civil, Earthquake or Structural engineering (preferred). The curriculum of the Eurocodes School is designed for designers having already professional knowledge on the design of building structures for earthquake resistance. In particular, participants are expected to have minimum two years of collaboration or contribution to design projects following the completion of relevant studies (alternatively 240 credits of continuous professional development) (compulsory) but no more than five years of related professional experience following the completion of the latest relevant studies. Knowledge of EN 1990 and EN 1991 would be useful, but not essential.

Experts from the European Commission, EU Member States and CEN/TC250 'Structural Eurocodes' will participate and give the lectures. A special session will focus on the presentation of case studies for buildings in the Western Balkan designed with the Eurocodes and the exchange of regional experience .

### d. Details for the event planning

#### o Dates & Venue

The Eurocodes Balkan Summer School will be structured in 10 half-day sessions. Due to the continuously evolving situation with the COVID-19 pandemic, the School will take place virtually via the appropriate platform.

#### o Event Registration

Registration of the invited participants will be done online through a dedicated registration site. There will be no registration fee for the Eurocodes School.

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<sup>25</sup> This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.



- **School training material**

Relevant training material will be distributed to the participants at the Summer School. The material (i.e. presentations and other relevant material) from the training will be made available on the JRC Eurocodes website. The training scheme and material is envisaged to be of interest to other countries worldwide that have expressed interest in the Eurocodes and in particular EN 1998.

- **Language**

All presentations and lectures will be in English (no translation will be provided).

## **Organizing Committee**

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CEN/Technical Committee 250 "Structural Eurocodes" Sub-Committee 8 "Eurocode 8: Design of structures for earthquake resistance"

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