University of Niš
FACULTY OF CIVIL ENGINEERING & ARCHITECTURE

Serbian Academy of Sciences and Arts
Local Branch in Niš
ОГРАНАК САНУ У НИШУ

SCIENCE TECHNOLOGY PARK NIS

International Conference

Synergy of Architecture & Civil Engineering

sinarg 2025

PROCEEDINGS

VOLUME 1

September 11 – 12, 2025
Science and Technology Park Niš, Serbia

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PREFACE

The SINARG 2025 conference reaffirms its mission to foster a productive synergy between scientific research and practical application in architecture and civil engineering. At a time when the construction industry faces urgent challenges, ranging from sustainability and energy efficiency to resilience and digital transformation, SINARG provides a unique platform where theoretical inquiry directly informs practice. By creating a space for researchers, professionals, and practitioners to engage, the conference ensures that innovation does not remain confined to academic discourse, but instead contributes to tangible advancements in the built environment.

This year has marked an important milestone for SINARG. A total of 230 abstracts were submitted, demonstrating the conference's ability to attract a wide range of research interests and ideas. After a careful and rigorous review process, over 140 full papers have been accepted for publication in these proceedings. The international dimension of SINARG continues to grow. Authors from 15 countries contributed to this year's proceedings, highlighting the diversity and inclusiveness of the conference community. Equally significant is the work of the reviewers, who came from 30 countries and whose expertise and critical evaluation have ensured the scientific rigour and quality of the published contributions. This increasing global engagement confirms the international recognition of SINARG and gives us confidence that future editions will attract even broader participation from around the world.

The success of the conference depends, above all, on its authors. Their research represents the foundation upon which SINARG is built, and without their dedication and willingness to share knowledge, this gathering would not be possible. We extend our deepest gratitude to each contributor for advancing the dialogue on architecture and civil engineering, and for ensuring that SINARG remains a space of intellectual exchange and professional relevance.

We also acknowledge with sincere appreciation the support of our sponsors, whose commitment has made it possible to organize a conference without participation or publishing fees. Their investment in the advancement of science, education, and professional collaboration demonstrates the essential role of industry in fostering innovation. By supporting SINARG, our sponsors have strengthened the link between academic research and real-world practice. Looking ahead, the Organizing and Scientific Committees are already preparing the ground for the next edition of SINARG. Building on the experience of 2025, the aim will be to expand international participation even further, strengthen cross-disciplinary collaboration, and continue positioning the conference as a key meeting point for both researchers and practitioners.

The Editors sincerely thank all who have contributed to the preparation of SINARG 2025, authors, reviewers, sponsors, and organizers, for their indispensable roles in shaping the success of this conference. Together, we have created not only a collection of scientific papers but also a community dedicated to advancing knowledge and applying it in practice for the benefit of society.

Niš, September 2025

Editors

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Research paper

INVESTIGATIVE WORKS TO DETERMINE THE NATURE OF CRACKS IN THE INTAKE TOWER OF THE ĆELIJE DAM

Uroš Mirković[1], Dušan Stevanović[2], Nikola Mirković[3]

Abstract

The Ćelije Dam is located in the municipality of Kruševac, built on the Rasina River near the village of Ćelije, approximately 30 km upstream from Kruševac. The construction of the dam was completed in 1978. Ćelije Dam is an earthfill dam, with a height of 51.5 m and a horizontal crest at an elevation of 285 m above sea level. The normal water level of the dam is at 277 m above sea level. The construction of the Ćelije Dam created a reservoir with a total volume of 64 million cubic meters. To extract water from the reservoir, a cylindrical intake tower was constructed with an internal diameter of 4.6 m. The tower is 46.0 m high, with cylindrical walls that are 1.0 m thick. A visual inspection of the intake tower, conducted after extreme hydrological events in the second half of 2019, revealed cracks along almost the entire height of the tower. The cracks are grouped into three vertical directions around the tower, positioned approximately 120° apart from each other. At the end of 2020, the Jaroslav Černi Water Institute initiated extensive investigative works to determine the extent of the damage to the concrete structure of the intake tower and the causes of its occurrence. The primary objective of the investigations was not only to assess the extent of the damage but also to identify the reasons for its occurrence and to predict the future behavior of the structure under operational conditions.

Key words: *Ćellije Dam, Intake Tower, Cracks, Investigative Works, Technical Monitoring*

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1. INTRODUCTION

With the construction of the "Ćelije" dam, a reservoir with a total volume of 64 million cubic meters was formed. The water from this multipurpose reservoir is primarily used for water supply, as well as for improving water quality downstream during low-flow periods. In addition, the reservoir provides storage capacity for flood wave retention and helps prevent flooding during high-water events.

The dam is 51.5 meters high, with a horizontal crest elevation at 285 meters above sea level. The crest is 8 meters wide, and the dam is 220 meters long. The normal water level of the reservoir is at an elevation of 277 meters above sea level.

At the upstream end of the tunnel, a cylindrical intake tower (Figure 1.) with an internal diameter of 4.6 meters was constructed to draw water from the reservoir [1], [2]. The tower has a height of 46.0 meters above the crown of the intake tunnel, with wall thickness of 1.0 meter.

Inside the tower, there are two vertical pipelines Ø900 mm used for water supply purposes. The intake pipes, with a diameter of Ø700 mm, are positioned at elevations 280, 277, 274, 271, 268, 265, and 255 meters above sea level [3], [4].

Figure 1. Intake tower with access bridge

A visual inspection of the intake tower, conducted following extreme hydrological events in the second half of 2019, revealed cracks along nearly the entire height of the structure. The cracks are grouped in three vertical directions, each oriented approximately 120° from the others. The crack openings are widest at mid-height, measuring between 1 and 2 millimeters.

In 2021, the Jaroslav Černi Water Institute initiated extensive investigative works with the aim of determining the extent of damage to the concrete structure of the intake tower and identifying the causes of its occurrence.

The primary objective of the conducted investigative works was not only to determine the extent of the damage, but also to identify its causes and assess the future behavior of the structure under operational conditions. For this reason, it was planned that all investigations be carried out over a one-year period, to monitor the behavior of the structure throughout an annual cycle.

The investigative works included the implementation of the following activities: geodetic monitoring of the tower, detailed visual inspection of the structure and equipment, exploratory drilling of the concrete lining to determine the depth of damage, ultrasonic measurement of crack depths using surface scanning of the concrete, continuous deformation monitoring within the intake tower and assessment of changes in the cylindrical contour of the structure, continuous air temperature monitoring, and the development and commissioning of a system for data collection, archiving, and storage.

The position and width of the crack openings were determined through a detailed visual inspection and mapping of the entire inner surface of the tower, as well as inspection of the visible part of the outer surface above the reservoir water level. To determine the depth of the cracks, two methods were used: a non-destructive method (ultrasonic scanning along all three crack systems) and drilling into the intake tower wall in the direction of the cracks to verify the results obtained by ultrasonic scanning, i.e., to calibrate the non-destructive measurement model.

A review of the documentation provided by the User [5] and measurements on-site revealed that the intake tower was constructed according to the planned dimensions, with minor deviations and modifications. The most significant deviation from the project was the absence of the reinforced concrete platform/landing, which was intended not only to facilitate movement through the tower but also to shorten the height of the tower's cylinder. Instead of the reinforced concrete platform, steel platforms were constructed.

This paper presents an overview of the conducted investigative works and the installed equipment, as well as the measurement results. Additionally, an analysis of the condition of the intake tower has been performed, with recommendations for further activities, including tower rehabilitation, and suggestions for ongoing monitoring.

2. METHODOLOGY OF CONDUCTED INVESTIGATIVE WORKS

To collect the necessary information for assessing the condition and behavior of the intake tower, it was necessary to develop a monitoring system for the tower, which would measure and track specific parameters.

The system was designed and implemented to collect most data automatically in real-time, ensuring continuous data flow. A smaller part of data and measurements, due to their nature, had to be taken manually with a predefined frequency. The monitoring system of the tower included several main groups of observations, which differ based on the applied methods: geodetic observations, physical observations, visual observations, and other observations.

While geodetic observations refer to measurements using exclusively geodetic methods, physical observations represent a group of various parameters (displacements, pressures, etc.) measured using different methods and instruments. Visual observations involve regular and emergency site visits, along with the inspection and recording of any noticed changes. Other observations relate to specific activities, such as testing of hydro-mechanical equipment and similar [6].

The technical solution for the monitoring system of the intake tower at the "Ćelije" dam includes the monitoring of the following physically measurable quantities, which serve as indicators of the behavior and condition of the structure: absolute horizontal displacements of the top of the intake tower, opening/closing of cracks in the inner wall of the intake tower, concrete temperature, temperature of the vertical pipelines, relative displacement of vertical pipelines in relation to the concrete structure, and measurement of deformations (changes in the contour of the internal cylinder of the intake tower).

2.1. Overview of the Data Collected from the Facility

Considering that there is a technical monitoring system in place at the dam, for the purpose of analyzing the condition of the structure, all available measurement and observation data from the tower were collected. This includes data on the water level in the reservoir (Figure 2.) and the water temperature at the intake levels (Figure 3.).

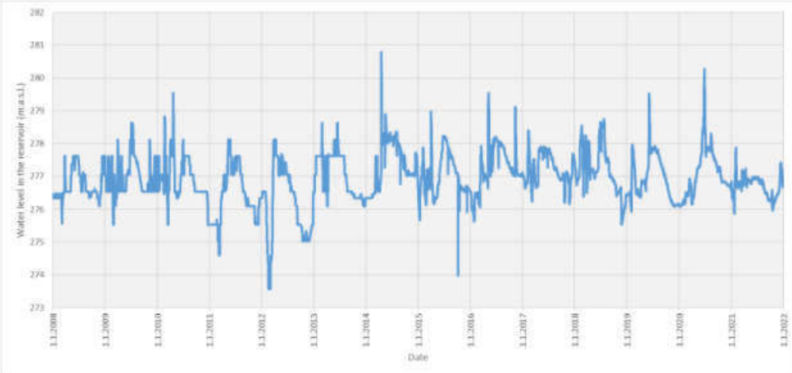

Figure 2. Water Level in the Ćelije Reservoir

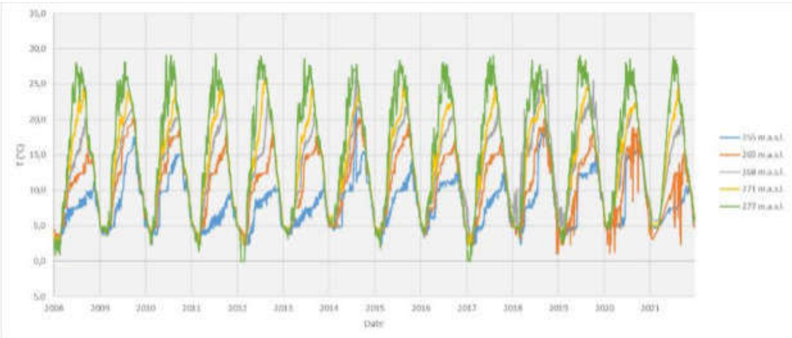

Figure 3. Water Temperature in the Ćelije Reservoir at the Intake Locations

2.2. Overview of the Conducted Research Works

2.2.1. Visual Inspection of the Structure

From December 15, 2020, to December 18, 2020, a visual inspection of the internal concrete surfaces of the intake tower was carried out to determine the position of all cracks. Following this, all observed cracks were mapped, and the crack openings were measured. A visual inspection of the external concrete surfaces above the water level in the reservoir was also performed. The mapping of cracks is graphically presented in Figure 4.

Among all the cracks, three vertical cracks are most prominent, extending throughout the entire height of the tower. The openings of these cracks vary, with the largest being in the central part of the cylinder's height. Since the cracks were dry and no leakage was detected through them, it was concluded that they do not extend through the full depth of the concrete, which was later confirmed by exploratory drilling.

No deformations or mechanical damage to the tower's equipment were observed during the visual inspection.

2.2.3. Geodetic Works

The goal of the geodetic observation was to monitor the movement of the tower between two epochs of measurements (observations) using characteristic points on the structure from a 2D reference network.

The results of the geodetic observation of the tower show cyclical movements throughout the year, but after the last measurement, the tower did not return to its original position when the measurements were initially taken. Due to the very small number of observations, it was not possible to draw a clear conclusion about the behavior of the tower and its relationship to the external influences acting on the structure.

2.2.2. Investigative drilling

The selection of drilling locations was made based on the requirement that drilling should not compromise the water tightness of the tower's structure, meaning that priority was given to locations above the normal level, and boreholes were located in areas where ultrasonic measurements indicated greater depths.

At crack no. 1 (Figure 4), borehole P1-K1 (K1) was drilled to a depth of about 450 mm. The borehole remained dry throughout its length, while the crack continued deeper. Subsequent drilling extended the borehole by 220 mm, after which the crack was observed to extend beyond the cross-section of the core of the borehole.

At crack no. 2, boreholes P2-K1 (K2), P2-K2 (K2'), and P2-K3 (K2") were drilled.

P2-K1 (K2) was a borehole with a depth of about 450 mm. This borehole remained dry throughout its length and continued further into the depth. P2-K2 (K2') was a borehole with a depth of 115 mm, while P2-K3 (K2") was about 285 mm deep. Both cracks extended beyond the cross-sections of these boreholes, which remained dry throughout their length.

At crack no. 3, borehole P3-K1 (K3) was drilled to a depth of about 460 mm. The crack continued further into the depth of the concrete. The borehole remained dry throughout its length.

The results of the exploratory drilling, along with the measured but not final depths of the cracks, indicated that all three vertical cracks extend beyond half the thickness of the tower's cross-sectional profile.

2.2.5. Ultrasonic measurement

The goal of using ultrasonic measurements was to gain a more detailed insight into the condition and quality of the concrete, but primarily to determine the depth of the cracks. The individual locations of the measurement points are shown in Figure 4. Field measurements were performed using modern digital ultrasonic equipment from TICO Proceq testing instruments [7].

In the areas where ultrasonic measurements were conducted, measurements were also carried out using a Schmidt hammer to define the concrete's strength.

2.2.6. Testing of strength

Schmidt hammer testing represents a fast and non-destructive method used to assess the compressive strength of concrete in the intake tower. The measurements were carried out with the modern digital Schmidt hammer Silver Schmidt 8200 [8]. This method is classified as non-invasive, meaning there is no destruction of the tested concrete, and no repairs are required after the test.

At each measurement location, several cycles of testing were performed, which involved between 9 and 11 impacts, as prescribed by European standards, in order to obtain the most representative data.

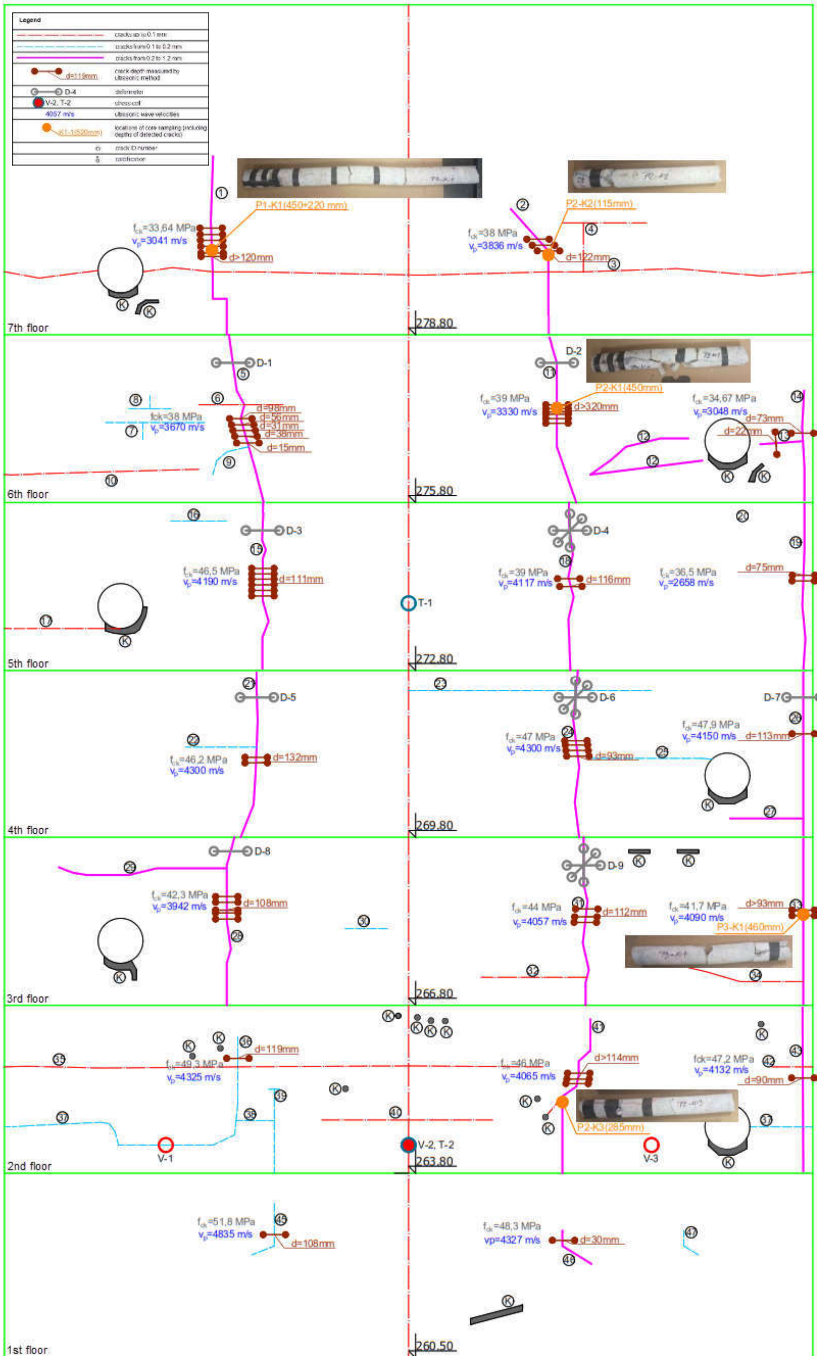

Figure 4. The unwrapped profile of the cylinder of the intake tower with the instruments and research results shown

2.2.4. Convergence measurement

Convergence measurement serves as an indicator of deformation of the internal profile of the intake tower.

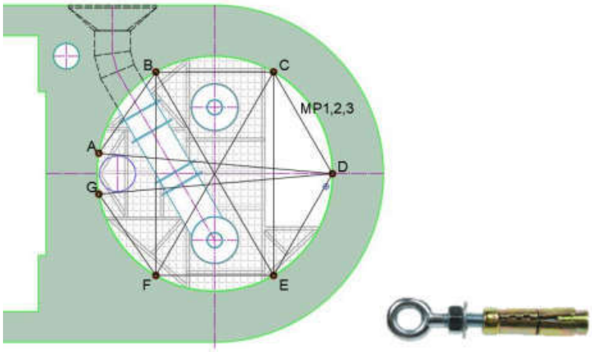

Figure 5. Measurement profile and benchmark for convergence monitoring

The benchmarks for convergence monitoring were embedded in the concrete of the intake tower's inner wall, with a total of 7 benchmarks installed on each of the 3 measurement profiles (at elevations 280.65, 274.80, and 268.60 meters above sea level). The distances between pairs of benchmarks are measured, and by subtracting the results from the previous measurement series, relative changes in distance are obtained (Figure 5.). These values are used to monitor the behavior of the tower profile over time. A total of 12 measurement directions were established for each profile.

2.2.7. Measurement of Crack Width Changes

The opening and closing of cracks on the inner wall of the intake tower of the "Ćelije" dam was monitored using electrical crack gauges (teledeformeters, Figure 6.). A total of 9 teledeformeters were installed on the structure, including 6 uniaxial and 3 triaxial devices.

In uniaxial teledeformeters, measurements are taken in the principal direction of crack activity, i.e., perpendicular to the direction of the crack. A triaxial teledeformeter is essentially a set of three uniaxial sensors installed and measured along three orthogonal directions: direction "T" (crack opening/closing), direction "R" (displacement along the crack line), and direction "V" (displacement perpendicular to the inner wall plane of the tower).

The installed teledeformeters are manufactured by SisGeo, model D313 [9].

Figure 6. Installed Teledeformeters (Triaxial and Uniaxial)

2.2.11. System for Data Acquisition, Archiving, and Transmission

Automatic and telemetry-based data acquisition on the installed instruments is carried out using a special data acquisition system, the central part of which is a data logger with an appropriate extension in the form of a twenty-channel multiplexer, allowing the connection of all existing electrical instruments in the observation system (Figure 7.).

Figure 7. Layout of the measurement cabinet with data logger and accompanying equipment

3. ANALYSIS OF THE MOST IMPORTANT OBSERVATION RESULTS

The results of the ultrasonic testing allowed for the determination of the ultrasonic wave velocities in the immediate nearness of the crack (m/s) as well as the estimation of the crack depth (mm), which are shown in Figure 4 at the testing locations. Additionally, the dynamic modulus of elasticity of the concrete (MPa) was obtained. The crack depths were determined using the standard method, which involves measuring the transit time across the crack for two positions of the piezoelectric transducer, with the crack always located in the middle of the measuring device. Also, based on the conducted exploratory drilling, the calibration of the ultrasonic method during testing was performed [10].

Based on the obtained values from the Schmidt hammer test, a diagram was constructed indicating the established correlation between the concrete strength and the ultrasonic wave velocity (Figure 8.).

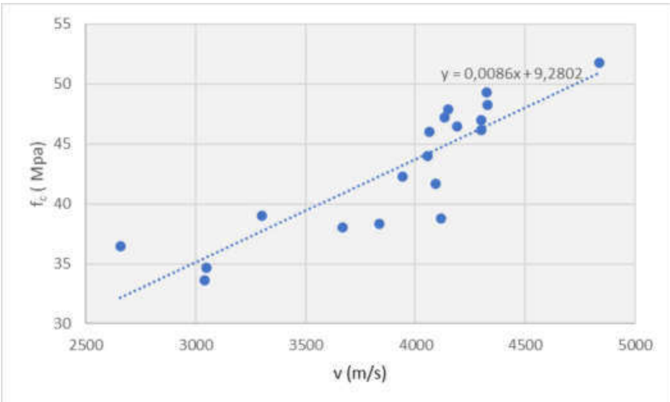

Figure 8. The relationship between the ultrasonic wave velocity and concrete strength

Considering the obtained results, it can be said that the concrete strength is in the range of 34.0 to 51.0 MPa, with an average of around 43.0 MPa.

The results of convergence measurements showed millimeter changes in the diameter of the intake tower and even larger changes in the circumference of the inner wall. These displacements are consistent with the external influences acting on the structure, primarily the changes in the water level in the reservoir and temperature changes. Namely, with the lowering of the water level in the reservoir, greater convergence was observed, which simultaneously coincided with an increase in both air and water temperatures. The increments of measurements on one of the profiles (MP1 at elevation 280.65 m.a.s.l.) are shown in the following image, where positive values represent the divergence of the reference points, and negative values represent their approach.

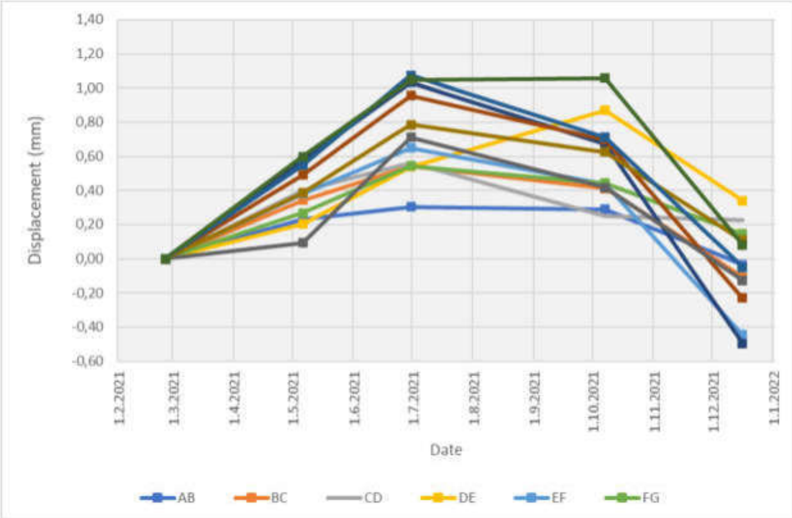

Figure 9. The change in the contour of the cylinder on one measurement profile (MP1)

The results of measuring the crack opening indicate cyclic deformations of the intake tower. The measured change in the opening is consistent with the results of the cylinder convergence measurements, meaning that the reduction in the crack opening coincides with the expansion of the tower's cylindrical contour. Positive values in the diagrams below refer to the upward movement of the right end of the crack relative to the left (D-4R, Figure 10.), the opening of the crack (D-4T, Figure 11.), and the lifting of the right end of the crack relative to the left (D-4V, Figure 12.).

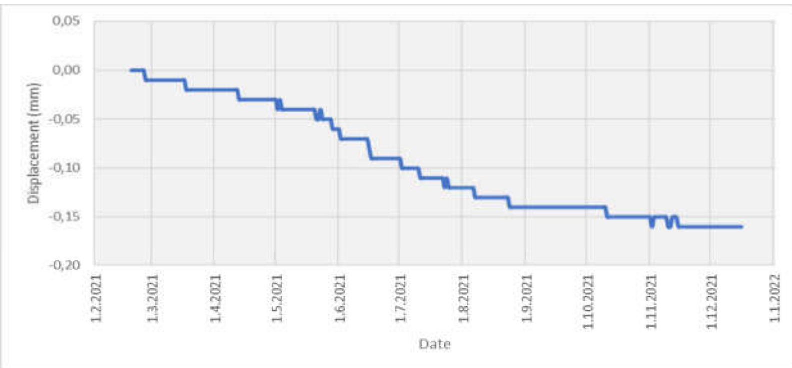

Figure 10. The diagram of crack behavior (deformeter D-4R)

Figure 11. The diagram of crack behavior (deformeter D-4T)

Figure 12. The diagram of crack behavior (deformeter D-4V)

4. DISCUSSION AND CONCEPT OF THE SOLUTION FOR THE REHABILITATION

Based on the previously mentioned information, in the next period, it is necessary to prepare the technical documentation for the rehabilitation of the structure and begin the rehabilitation works to ensure the permanent safety and functionality of the structure.

It is recommended that the calculation analyses be performed using one of the FEM software packages that have the ability to model the complex geometry of the structure (Figure 13.), taking into account all combinations of actions acting on the structure, as well as boundary conditions. This type of modeling allows the designer, based on the presented measurements, to calibrate the parameters of the tower model and perform stress-strain analyses (for the case before and after rehabilitation) along with calculating the safety factor of the structure.

Considering that, according to the results of the investigative works, the cracks were caused by various deformations due to the complex actions acting on the tower, and taking into account the lack of the RC platform whose task was to tension the structure in multiple places along the height, the concept of the technical solution should be based on a solution that will bring the tower to the condition foreseen by the project.

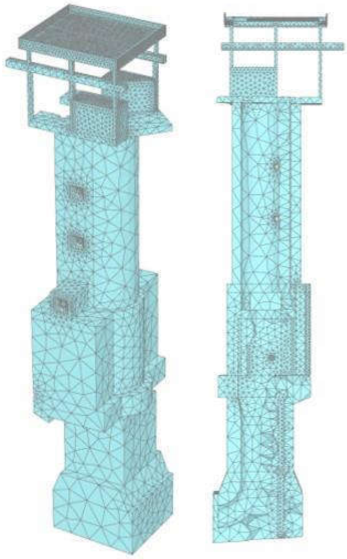

Figure 13. FEM model of the water intake tower

As an additional measure to tension the tower and ensure cooperation between the existing structure and the newly designed RC platforms, the technical solution needs to consider additional tensioning of the structure on the external side with RC pre-stressed beams at the levels of the new RC platforms or according to the results of the rehabilitation analyses. These works would be partly performed underwater, with the pre-stressing of beams being carried out after the construction of the RC platforms.

5. CONCLUSION

Based on the analysis of all the data obtained in the previous period, as well as the review of the available documentation about the facility, the following conclusions can be drawn:

- A visual inspection of the water intake tower revealed that the tower was not fully constructed according to the project documentation. The most significant deviation is the absence of the reinforced concrete platform/landing, which was intended not only to provide movement through the tower but also to stiffen the tower's cylinder along its height.
- The results of the observations and measurements indicated deformations in the concrete structure of the water intake tower, which may have caused the observed damage in the form of three vertical cracks along the height of the tower. This primarily refers to the results of convergence measurements and the crack width changes, which correspond to fluctuations in the water level in the reservoir and temperature variations. Particularly concerning are the drilling results, which revealed that the cracks extend through more than half the thickness of the concrete section.

The integrity of the tower at the given moment was not threatened, but the unfavorable operational conditions in which the tower might be subjected (earthquake, fluctuations in the water level in the reservoir, extreme temperatures, etc.) could lead to further development of damage, which could result in water leakage into the tower, making water intake from the reservoir difficult or nearly impossible.

The future technical solution needs to consider the possibility and effects of implementing an RC platform entirely according to the water intake tower project (removing the existing steel platforms or connecting it with the existing steel structure) as well as the execution of RC pre-stressed beams on the outside of the tower.

REFERENCES

[1] **MHPP „Ćelije“ - Conceptual design and feasibility study - Book 1**, Energoprojekt Hidroinženjering, Belgrade, 2009.

[2] **„Ćelije“ Reservoir - Conceptual design - Book I.1 - Evacuator - Hydro-construction part**, Energoprojekt, Belgrade, 1974.

[3] **„Ćelije“ Resevoir - Evacuator - Main Project - 5460- XГ/VI - Volume VI - Static and Hydraulic Calculation**, Serbia Project, Hydrosector, Belgrade, 1970.

[4] **"Ćelije" Reservoir - Main Project - Book IV, Volume 2/2 - Evacuator - Intake Tower and Inlet Tunnel - Formwork and Reinforcement Plans**, Energoprojekt, Belgrade, 1975.

[5] **"Ćelije" Reservoir - Detailed Design - Book IV, Volume 2/2 - Hydro-construction part - Evacuator - Intake Tower**, Energoprojekt, Belgrade, 1978.

[6] "Jaroslav Černi" Water Institute, **Bureau for Structures and Geotechnics: Instructions for technical inspection of high dams**, special book, Book 24, Belgrade, 1982.

[7] https://www.iziis.ukim.edu.mk/wp-content/uploads/labs/ndt/Proceq_Tico_Ultrasonic_Operating_Instructions.pdf (29.04.2025.)

[8] https://www.screeningeagle.com/en/products/silver-schmidt-os8200 (29.04.2025.)

[9] https://sisgeo.com/wp-content/uploads/Prodotti/Crackmeters%20and%20Joint%20meters/Electrical%20Crackmeters%20and%20Jointmeters/EN/Datasheet/D313_EN_16_electrical_and_vibrating_wire_crackmeters.pdf (29.04.2025.)

[10] **“Ćelije” Dam - Urgent Research Works with the Procurement and Installation of Equipment on the Water Inlet Tower of the "Ćelije" Dam** - *Final Report with Measurement and Observation Results and the Concept of the Technical Solution for Remediation*, Belgrade, 2022.