Innovative Dam and Hydroelectric Project Wins People's Choice Award in Bentley Education's Inaugural Future Infrastructure Star Challenge

Using PLAXIS for Geotechnical Design and Analysis Verifies Technical Feasibility and Scalability of the Sustainable Dam

Addressing Water Shortage and the Global Energy Crisis

As part of the Bentley Education program that inspires young minds to advance infrastructure and develop digital skills, Bentley Systems launched its first Future Infrastructure Star Challenge, asking students to conceptualize a world-changing infrastructure project addressing a global environmental issue, using Bentley applications. The program received 144 entries from over 60 countries, and 10 finalists were selected to design and present their conceptual idea to the public and a judging panel of experts. Rodman Raul Cordova Rodriguez, studying for his Ph.D. in geotechnical engineering at Pontifical Catholic University of Rio de Janeiro, won the People's Choice Award – which includes a USD 2,000 prize – for his innovative dam construction project addressing water shortage and the global energy crisis.

"More than 3 million people do not have access to water, and more than 2 billion are living with extreme water stress," stated Cordova Rodriguez. At the current usage rate, by 2025, 66% of the world's population could suffer from water scarcity. The ensuing energy crisis and climate change compound these deteriorating conditions. As both energy and water consumption continue to grow at four times and nine times the population growth rate, respectively, the impact to the communities and on our environment will only worsen and become more expensive to resolve. Inspired by these alarming facts, Rodriguez sought to implement infrastructure for clean energy generation and better water supply.

Conceptualizing a Scalable, Sustainable Solution

Studying geotechnical engineering, Cordova Rodriguez proposed a solution related to earth and dam monitoring to generate hydroelectricity, a renewable energy source, and simultaneously contribute to the storage of drinking water. "I came up with an innovative idea for a sustainable earth dam that uses plastic recycled asphalt for the dam's core," explained Cordova Rodriguez. A flexible and ductile viscoelastic plastic material, the recycled asphalt provides waterproofing, prevents water seepage through the core of the dam, and has capacity to accommodate forensic displacements and seismic loads that could lead to the formation of cracks. The asphalt core will be a near ideal environment, remaining flexible, durable, and waterproof for the lifecycle of the dam.

By reusing and recycling materials, the dam obtains clean hydroelectric energy in a sustainable, profitable, safe, and reliable manner, aiming to preserve natural resources and achieving economic scalability. Integrating scalable technology in the form of sensors and IoT, Rodriguez's dam can be replicated in indigent areas where it is needed to tackle and avoid water

scarcity, as well as contribute to the generation of electricity and have a positive impact on the health of the communities.

Designing and Executing Innovative Dam Infrastructure

"I used PLAXIS software to perform geotechnical modeling and analysis and handle the different types of information involving my project," said Cordova Rodriguez. Using PLAXIS Designer, Rodriguez generated a 3D model of the earth structure with a crest length of 200 meters and height of 58 meters. He exported the model to PLAXIS 3D and created and integrated a groundwater model to analyze dam seepage, and a slope stability model to analyze and ensure structural integrity of the dam and the slopes of the reservoir basin. Some cross sections of the dam were then analyzed utilizing PLAXIS 2D to determine the safety of the upstream and downstream slope of the dam.

Using Bentley's PLAXIS applications, Cordova Rodriguez verified the technical feasibility, scalability, and longevity of the innovative dam infrastructure. The technology analysis results demonstrated that the recycled asphalt is functioning as desired and requires little or no maintenance. "I am very happy with my project because it has been proven that it is technically feasible with the use of technology, in this case Bentley's PLAXIS software," added Cordova Rodriguez. His dam infrastructure project can produce hydroelectric power and address the global energy crisis and water shortage in a sustainable, environmentally friendly, and economically efficient manner.

Advancing Digitalization to Improve Power Generation and Water Supply

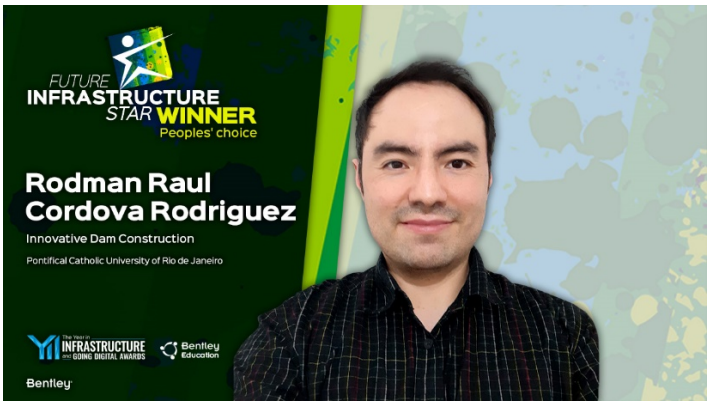
Bentley's PLAXIS application facilitates the integration of field geotechnical data and IoT, using internal and external sensors, such as seepage monitors, corner reflectors, and a weather station on the dam to measure and monitor different parameters. These parameters range from water pressure and displacements, to humidity, soil moisture, and wind speed. The dam also includes air sensors to determine the presence of harmful gases, and a drone station connected to the weather station and dam sensors. When the reservoir is at a low water level, the drones can fly into the clouds to generate rain.

All the data collected by the sensors will be sent to the data center in real time with a 5G connection to be shared with users, owners, public institutions, and local authorities in a web-based environment. The digital platform provides 24/7 secure access, with alarms to alert any issues, and automated report generation. "In terms of technology, the scalability of this project is huge," commented Cordova Rodriguez. It can be replicated in any area experiencing a lack of water supply. By applying advanced digital design, execution, and monitoring devices, Cordova Rodriguez has provided a conceptual solution to improve water supply and power generation that if not addressed presently, will pass along a more severe and more costly problem to future generations to resolve.

For more information, contact Christine Byrne at christine.byrne@bentley.com, or +1 203-805-0432.

# #

Image:



Caption: Rodman Raul Cordova Rodriguez is pursuing a Ph.D. in geotechnical engineering at Pontifical Catholic University of Rio de Janeiro. He won the People's Choice Award in the Bentley Education Future Infrastructure Star program for his innovative dam construction project addressing water shortage and the global energy crisis.