Argonne NATIONAL LABORATORY

SUPERCOMPUTERS HELP SOLVE CHALLENGES IN PURSUIT OF **BETTER AND MORE SUSTAINABLE CONCRETE**

THE CHALLENGE

There is broad interest in making concrete – the most widely used building material in human history – better and more sustainable by finding new ways to improve its workability, to recycle it, and to reduce the carbon footprint of producing it.

Given the scale at which concrete is used, improvements in workability or sustainability would provide benefits on a massive scale.

To make better concrete a reality, it has to be better understood in its unset form. However, concrete is made up of particles that vary widely in size – from large stones to grains of sand – and the fluid in which those particles are suspended flows in different ways depending on pressure and stirring.

Due to the complex nature of concrete, finding ways to improve it has proved extremely challenging.

THE COLLABORATION

The continued development of high-performance computers has opened doors to a deeper understanding of the properties and flow of concrete.

Through the U.S. Department of Energy's (DOE's) INCITE (Innovative and Novel Computational Impact on Theory and Experiment) program, researchers from the National Institute of Standards and Technology (NIST) modeled the flow of concrete and developed new tools to accurately measure its fluid and load-bearing characteristics.

Using Argonne Leadership Computing Facility (ALCF) supercomputing resources, NIST conducted simulation studies involving many thousands of concrete particles, with a wide range of sizes and shapes.

The INCITE program promotes transformational advances in science and technology through large allocations of time on state-of-the-art supercomputers.

THE IMPACT

- By tapping into the supercomputing resources at Argonne, NIST dramatically reduced the time and costs associated with its concrete research and development.
- NIST used the knowledge it gained to create Standard Reference Materials for industrial researchers to calibrate rheometers – instruments used to measure the flow of complex fluids – for improved concrete development.
- The insights gained from the collaboration represent a major step toward a new generation of high-performance and eco-friendly cement-based materials.

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