



Building Strong®

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Investment

The original cost of construction for the facility was around \$15M (over \$30M in 2022 dollars). Since 2018, significant investments have been made to upgrade the centrifuge and ancillary systems including state-of-the-art instrumentation and newly renovated control building.

Specifications

In the beginning, research applications drove the centrifuge design to support larger payloads and higher accelerations. The max payload is 8.8 tons and the range of potential g-force is 10 to 350 g.

How Fast is That?

Given the size and weight of the centrifuge, it is surprisingly fast. The table below shows how quickly the platform moves around the 50 ft diameter chamber. During one single rotation, the platform travels approximately 158 ft.

Various Velocities			
G	MPH	RPM	RPS
10	56.5	37.1	0.6
20	79.9	52.5	0.9
30	97.8	64.2	1.1
40	113.0	74.2	1.2
50	126.3	82.9	1.4
100	178.6	117.3	2.0
150	218.7	143.7	2.4
200	252.6	165.9	2.8
250	282.4	185.5	3.1
300	309.3	203.2	3.4
350	334.1	219.4	3.7

Centrifuge Research Complex

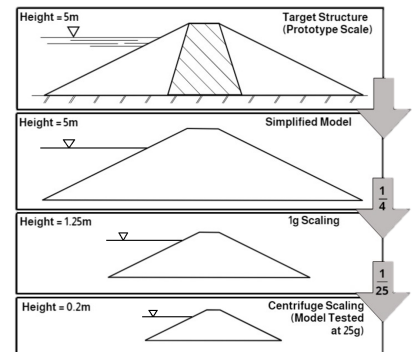
The Centrifuge Research Complex (CRC) was commissioned for operation in 1995. Designed and built by Actidyn Systems of Elancourt, France, the CRC is important to ERDC research because:

- A centrifuge can scale gravity to match real-world conditions in a controlled facility to model complex structures, systems, and phenomena.
- Research conducted in the centrifuge is **reliable**, **efficient**, and capable of producing **multiple model iterations** within the same time frame as a full-scale experiment and at **reduced cost**.
- Centrifuge research is applicable to a wide variety of scale-able problems.
- Research incorporates our unique capabilities and capitalizes on the customer's knowledge to bridge the gap between lab and field scale.

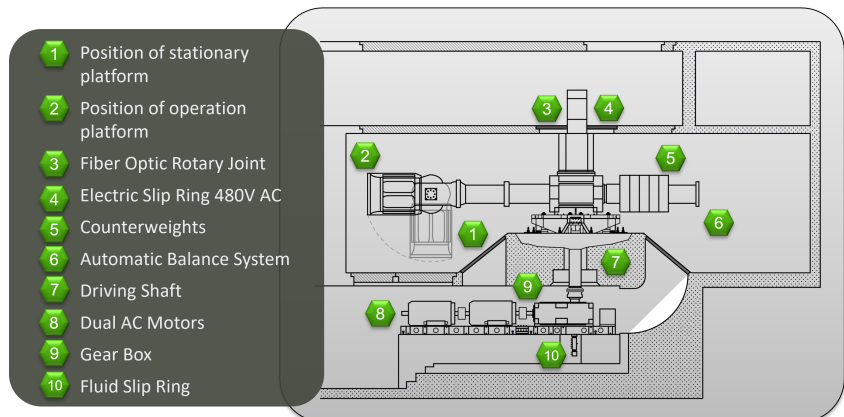
About Centrifuge Modeling

Centrifuge modeling is advantageous because it provides **geometric** and **stress** "similitude" which means that even though the model is scaled down from its full-size prototype by g-level, the centrifuge model behaves like the real thing.

In the figure, a 5-meter high levee is the target structure to be modeled. Researchers will first simplify the model, in this case by removing the core so the soil is homogeneous. If the prototype is scaled down by a quarter, considered a "field scale" or "1-g" model, the levee would still be 1.25 meters high which is a considerable amount of soil and water for researchers to work with and be a different stress state than the real levee. However, if we scale down the levee by 25, the model will be 0.2 meters (200 cm) high. When spun at 25g in a centrifuge, the model will have the same stress state as the actual levee. Trends towards physical modeling of larger prototypes and more complex phenomena have pushed the boundaries of what is physically possible.



Facility Elements



Research Areas

The CRC has a number of traditional research areas and scalable centrifuge problem sets which align with the USACE research and development (R&D) priorities ([more details](#)). Centrifuge facilities worldwide investigate diverse problem sets

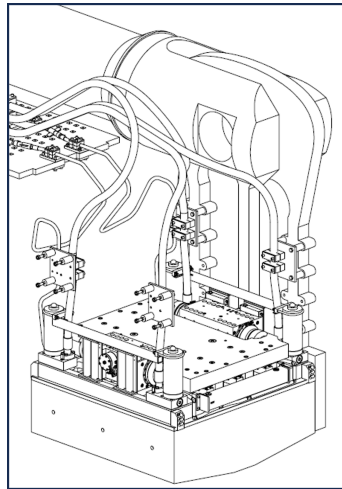
applicable to a number of engineering fields. The data generated, especially when coupled with full-scale monitoring and numerical modeling, can be used for investigation and verification of new theories and/or problem sets.

USACE R&D PRIORITIES

	Modernize our Nation's Infrastructure		Win Future Wars	Mitigate and Adapt to Climate Change	Resilience
	Built Infrastructure	Natural Infrastructure	Military	Environmental	Resource Protection
SCALABLE CENTRIFUGE PROBLEM SETS	TRADITIONAL RESEARCH AREAS				
	Design Guidance	✓	✓	✓	
	Safety Factors	✓	✓		
	Failure & impact prediction	✓	✓		
	Earthquake Susceptibility	✓	✓		✓
	Soil/Structure Interaction	✓	✓		
	Blast Mitigation		✓		✓
	Fragmentation Effects		✓		✓
	Ground Shock Mechanics		✓		
	Soil Contamination		✓	✓	✓
	Seepage			✓	✓
	Vegetation/Ecosystem Effects	✓	✓	✓	✓
	Resilience	✓	✓		✓
	Bio-cementation	✓	✓	✓	
	Aquifer Restoration/Protection		✓	✓	✓

ES-80 Shake Table

In February 2024, the ES-80 servo-hydraulic shaker designed by PVL Technologies was retrofitted and installed on the ERDC centrifuge to permit high quality dynamic testing of centrifuge models at elevated g-levels. The uniaxial shaker can provide a wide variety of motions including 1D acceleration time histories comprised of periodic, aperiodic, random, or scaled earthquake signals to soil models facilitating seismic investigation of scaled geotechnical systems. The shaker has a maximum stroke of 12mm and a top velocity of 1.25 m/sec. Both laminar and rigid containers are available for the table.



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“... finding innovative ways to work with partners to deliver new capabilities for our nation's security and well-being” — Dr. David Pittman, Director of ERDC, 2020-2030 Strategy

Major Historic Projects

New Orleans' levee research following Hurricane Katrina: In August 2005 the water rise in New Orleans following Hurricane Katrina caused the levees to fail resulting in \$161B of damage and 1,800 confirmed deaths. With the help of Rensselaer Polytechnic Institute, the levees were modeled in the centrifuge to understand the failure mechanisms. This research has directly influenced how levees are designed and the infrastructure system governing them. [More Details](#)

Progressive Collapse: A 1/18-scale model of a 4-story reinforced concrete structure was tested at 18g in the centrifuge to support the computational model development of the progressive collapse of multi-story buildings. The model structure was 4 bays long and 3 wide with column spacing about 33 cm in each direction and story height of 20.3 cm. Three columns at the 1st story were explosively removed while the model was spinning. [More Details](#)

Wall Barrier Breach Characterization: Investigated the feasibility of accurately simulating full-scale, blast wall tests using the centrifuge. Results showed that model testing reasonably approximated breach length, displacement from original position, and the breach shape. [More Details](#)

Overtopping: Overtopping failure mechanisms are a complex mixture of erosion, slope stability, and hydraulic flow conditions that are not easily mathematically modeled and which stress state plays a significant role. It is estimated that 40% of earthen dam failures take place due to overtopping. This work will establish centrifuge techniques to reliably raise water levels in-flight to maintain overflow in order to categorize breach initiation, formation, and progression depending on material description and geometry. [More Details](#)

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