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Publication Date

1984-07-18

Peer reviewed

Proceedings of the
SYMPOSIUM ON RECENT ADVANCES
IN GEOTECHNICAL CENTRIFUGE MODELING

A symposium on Recent Advances in Geotechnical Centrifuge Modeling was held on July 18-20, 1984 at the University of California at Davis. The symposium was sponsored by the National Science Foundation's Geotechnical Engineering Program and the Center for Geotechnical Modeling at the University of California at Davis.

The symposium offered an opportunity for a meeting of the International Committee on Centrifuges of the International Society for Soil Mechanics and Foundation Engineering. The U.S. participants also met to discuss the advancement of the centrifuge modeling technique in the U.S. A request is being transmitted to the American Society of Civil Engineers to establish a subcommittee on centrifuges within the Geotechnical Engineering Division.

DESIGN CHARACTERISTICS OF THE BOCHUM GEOTECHNICAL CENTRIFUGE AND POSSIBLE FIELDS OF RESEARCH

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ABSTRACT

1. Design Characteristics

At the end of 1983 the Deutsche Forschungsgemeinschaft (DFG) granted funds for the Bochum Geotechnical Centrifuge. The centrifuge is now under construction and it is planned to have it in operation in the summer of 1985. Figure 1 shows the design principles with the following details:

- Swinging buckets
- Effective radius to the platform: 4.125 m
- Platform area: 1.25 x 1.25 m. In one direction the area is expandable to 2 m
- Payload: 2,000 kg
- Maximum acceleration: 250 g which gives a capacity of 500 g tons
- The centrifuge is driven by 3 hydraulic motors with a maximum power of 400 KW
- The aggregates are located in a separate room beside the centrifuge
- There will be a circular pit with an inner diameter of 9.50 m. The centrifuge building is partly inground placed on hard rock
- The slipring tower has 120 low current sliprings, 6 high current sliprings, 12 sliprings for water, air and chilled brine, and 1 slipring for LN_2 as coolant

The centrifuge is located adjacent to an existing building of an abandoned coal mine (Figure 2 and 3). This building has a large hall in which several soil mechanics test machines are in operation. There is also a test pit inside the hall. The free height to the crane is 6 m.

The ground plan (Figure 3) shows the arrangement of the centrifuge related to the already existing soil mechanics laboratory of about 500 m² area. In the center of this area is a cold room which can be cooled down to -20°C.

The centrifuge building is located outside of the Ruhr-University campus but within walking distance. Heavy equipment is transported between campus and centrifuge by car which needs about 5 km.

2. Intended Fields of Research

The design of the centrifuge allows to simulate the conditions in 300 m depth of the prototype or to investigate the behavior of a prototype with a horizontal length of 500 m.

The centrifuge is equipped with a device to cool or heat models. It is possible to change the temperature field during flight by cooling down to -196°C or by heating up to +200°C.

In the following intended fields of research are summarized:

- a) Frozen soil engineering
 - Frozen soil supporting inground opening such as shafts, tunnels, etc.
 - Buried LNG storage tanks
- b) Cold regions engineering
 - Simulating of frost heave and thaw effects on pipe lines
 - Thaw consolidations
 - Stability of slopes in permafrost
- c) Ice engineering
 - Impact of flowing ice sheets and ice islands on structures
 - Shafts or tunnels in a deforming ice shelf in the Antarctica

- d) Research projects in relation to mining activity
 - Deep shafts
 - Tunnels and galleries
 - Open pit mining
 - Caverns in salt rock for nuclear waste disposal schemes
- e) Transfer of 1 g dynamic test results to flying models
 - Impact loading - dynamic consolidation
 - Cyclic loading using open and partly drained systems