

UC Davis
Civil & Environmental Engineering

Title

The centrifuge as an aid to the designer

Permalink

<https://escholarship.org/uc/item/46d948xn>

Author

Craig, William H

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.

THE CENTRIFUGE AS AN AID TO THE DESIGNER

William H. Craig, University of Manchester, U.K.

The centrifuge in the recently renamed Peter W. Rowe Laboratory at the University of Manchester has been used since its commissioning in 1971 for a wide range of studies, many of which have been allied to site-specific design projects, [Craig and Rowe (1981), Rowe (1983) and Craig (1984)]. For more than a decade this centrifuge has been the machine with the largest purpose-designed geotechnical payload capacity operating in the Western world - 3.5 tonnes to 120 g (structure capable of sustaining 3.5 tonnes to 200 g with more powerful drive system). The philosophy of the Manchester group has been that whilst operating within the limitations of a university environment (as are all three major U.K. centrifuges), such a machine with its unique capabilities should, and can be made available for use in design studies.

If real engineering design problems are to be tackled using centrifuge techniques then the machine and its support team and facilities must be capable of responding within a time period which is acceptable to the overall design team. The centrifuge may fulfill a number of roles; those often quoted include :

- (a) determination of mechanisms,
- (b) parametric studies,
- (c) validation of numerical analyses,
- (d) prototype response prediction.

The time span involved will depend on the individual project and the role of the particular model, but there may be need to be a capability to respond to major new initiatives within months rather than years, and to design changes within days or weeks, if the centrifuge is to contribute to the continuous feedback process of design studies. Examples of the way in which a centrifuge has been used in major projects where all the above roles have been described by Rowe and Craig [(1976, 1978, 1980)].

As a university-based machine, the Manchester centrifuge has been supported by

- (a) academic staff,
- (b) established (permanent) technician and engineering staff,
- (c) research students,
- (d) contract staff.

Of necessity, academic staff have commitments other than to the centrifuge - they are part-timers. Research students whose outlook has both an established target (a higher degree) and a finite time-span, are generally full-time, but this must include significant time spent in literature reviews, analysis and computation. They are in a sense mission-orientated but the restrictions, in the U.K. system at least, make them unsuitable for on-line design projects. We have had, at times, the full time support of one technician dedicated to the centrifuge and the part time support of three other established technicians in the University Soil Mechanics Laboratories - the latter also support teaching and other research. In order to sustain project-orientated activity and major design studies it has been necessary to employ continuously one additional engineer and one or two technicians over the last ten years. The whole group has operated within a single building with additional backing from the greater resources of a major university department. In order to maintain a viable level of activity with continuity of employment for non-established staff, a contract turnover of around \$150,000 per annum has been required.

The Manchester machine can be seen as a forerunner of the latest generation of centrifuges being designed and constructed in a number of countries. The machines have capital investments in excess of \$10⁶. Such sums are generally put up by organisations funded directly or indirectly by government and it seems reasonable to suppose that the centrifuges are intended to respond to the needs of major designs in the national and international engineering context. In brief, the billion dollar project should be able to gain useful access to the million dollar machine. This requires, in addition to the bare machine, a support structure which can accept the challenges as and when they arise.

REFERENCES

- CRAIG, W.H. (1984) : Modelling for site specific prototypes. Proc.Symp. on Application of Centrifuge Modelling to Geotechnical Design, University of Manchester, pp 473-489.
- CRAIG, W.H. & ROWE, P.W. (1981) : Operation of a geotechnical centrifuge from 1970 to 1979. Geotechnical Testing Journal, Vol 4, pp 19-25.
- ROWE, P.W. (1983) : Use of large centrifugal models for offshore and nearshore works. Geotechnical Aspects of Coastal and Offshore Structures. ed. Yudhbir & A.S. Balasubramaniam, pub. Balkema, Rotterdam, pp 21-33.
- ROWE, P.W. & CRAIG, W.H. (1976) : Studies of offshore caissons founded on Oosterschelde sand. Conf. on Design and Construction of Offshore Structures, pp 49-55, Inst. of Civil Engineers, London.
- ROWE, P.W. & CRAIG, W.H. (1978) : Predictions of caisson and pier performance by dynamically loaded centrifugal models. Symp. on Foundation Aspects of Coastal Structures, Paper IV.3, pp 1-16.
- ROWE, P.W. & CRAIG, W.H. (1980) : Application of models to the prediction of offshore gravity platform foundation performance. Int.Conf. on Offshore Site Investigation, pp269-281, Graham & Trotman, London.