ISFOG 2020 Cyclic loading prediction event

1. Introduction

Predicting the cyclic response of soft soils is a significant challenge facing offshore geotechnical engineers. The guidance provided in design codes is limited, and approaches used to analyse such problems vary from practitioner to practitioner. A workshop on this topic held (under the auspices of TC209 Offshore Geotechnics) as part 18th ICSMGE in Paris 2013, highlighted many of the challenges. The University of Western Australia (UWA) and the National Geotechnical Centrifuge Facility (NGCF) is pleased to invite geotechnical academics and practitioners from around the world to participate in a cyclic loading prediction event, hosted as part of the ISFOG 2020 conference in Austin, TX.

The objective of the events is to provide insights into the behaviour of conductors under cyclic loading and to help identifying the components of this behaviour that are correctly or incorrectly accounted for by current prediction methods. A series of (centrifuge) model tests has been performed, along with supporting laboratory testing (similar to what might be available to a designer), and participants will be asked to predict the model response – with the predictions shared **anonymously** at ISFOG 2020. This document outlines the scope of the ISFOG 2020 cyclic loading prediction event.

2. Problem Statement

2.1 Prediction problem

The problem that has been chosen is lateral cyclic loading of a 'flexible' pile under free head conditions. While broadly resembling an offshore conductor, the intention is to generally model cyclic p-y behaviour. The tests were conducted in a geotechnical centrifuge at UWA at 80g. The model and prototype dimensions are given in Table 1.

Table 1: Model and prototype dimensions

	Model @ 1g	Prototype@ 80g
Length (L)	300 mm	24 m
Al Diameter	12 mm	0.96 m
Al Wall thickness	0.45 mm	0.036 m
Epoxy wall thickness	0.96 mm	0.0768 m
Total Outer Diameter	13.92 mm	1.114 m
Embedment	228 mm	18.24 m
Roughness	Rough	

A schematic of the centrifuge setup is given in Figure 1.

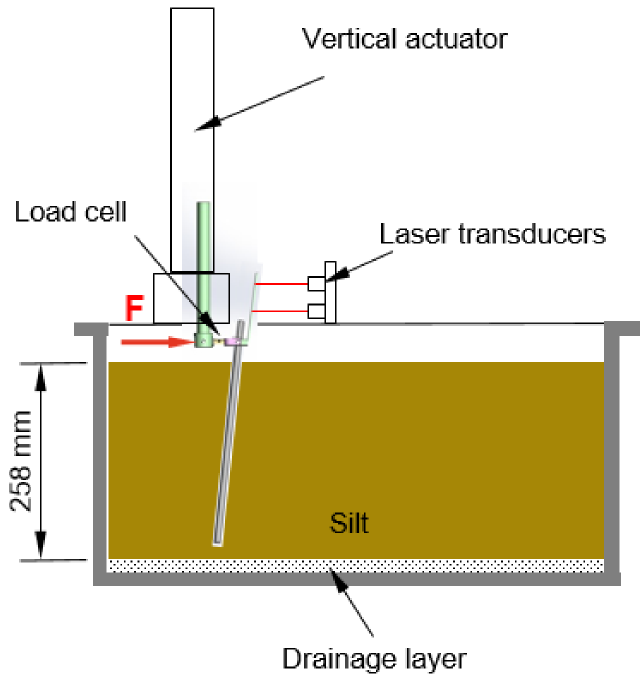

Figure 1: Schematic of centrifuge setup

The pile was manufactured from aluminium 6061T5, with a Young's modulus of 68.9 GPa and instrumented with 13 pairs of strain gauges 20 mm apart, starting 15mm from the toe, as illustrated in Figure 2. The strain gauged pile was covered in epoxy to give an outer diameter of 13.92mm at model scale (1.114m at prototype scale). The "free head" (zero moment) was applied 3.5D – i.e. 42 mm (model) or 3.36m (prototype) – above the soil surface.

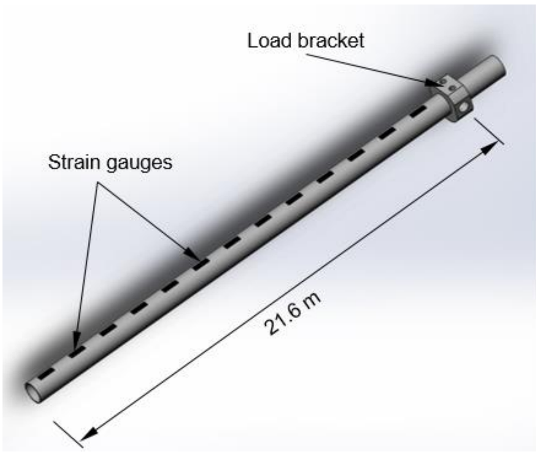

Figure 2: Model pile details

The pile was installed at 1g using a specially designed actuator (Figure 3), allowing the pile to be pushed into the sample at the same time as the internal soil plug was removed by augering– to avoid plugging and cavity expansion effects.

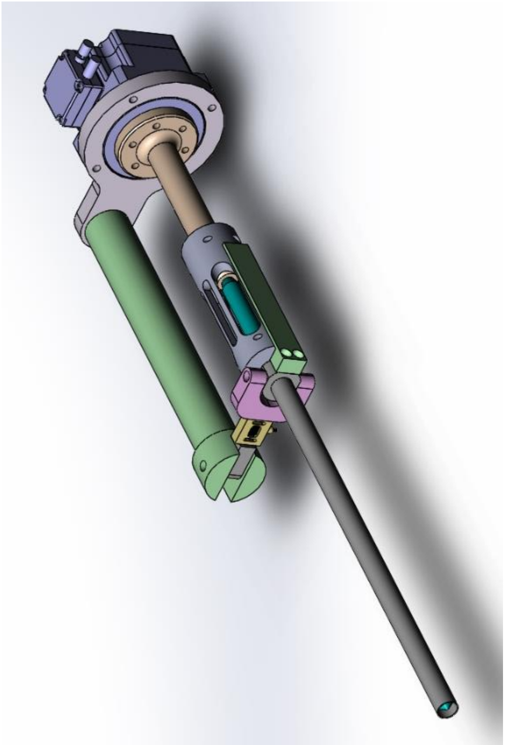

Figure 3: Actuator details

After installation, the upper part of the actuator was removed and the pile head was then free. The pile was restrained to stop vertical embedment (no lateral load or moment was applied to the pile at this time). Figure 4 shows a photo of the apparatus during the installation procedure.

2.2 Soil data

A carbonate silt was recovered from North-West Shelf of Western Australia and reconstituted for use in the centrifuge. Index properties are given in Table 2. Note that the carbonate silt was selected because it has a modest strength gradient and sensitivity, not dissimilar to deep water Gulf of Mexico clay.

Table 2: Index properties

Property	Value
Specific Gravity	2.76
Liquid limit	62.9
Plastic limit	41.6

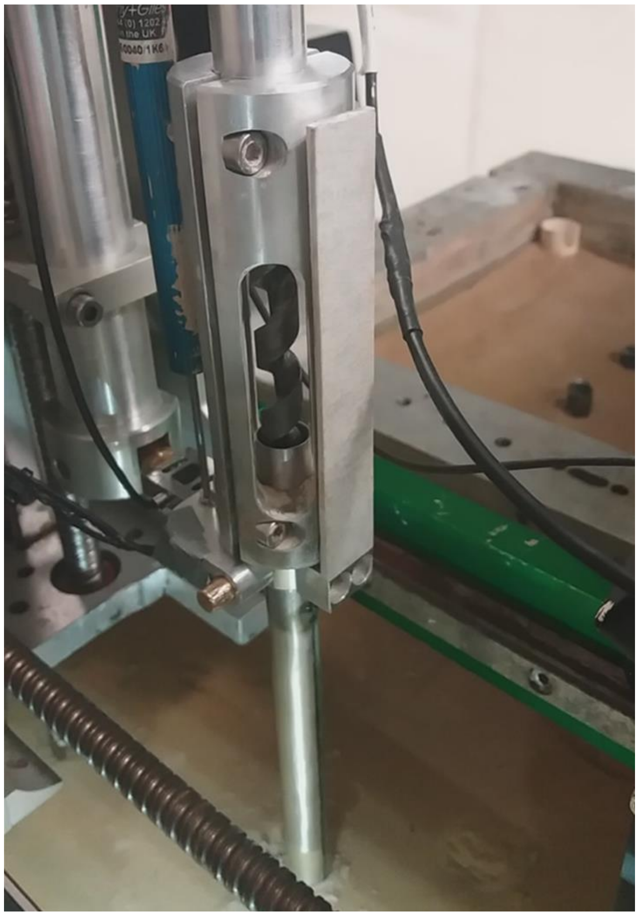

Figure 4: Photo during installation

The silt was mixed to a water content of 140% and allowed to normally consolidate at 80g. Moisture contents were obtained for the profile after consolidation and are available as part of the data set. A series of T-bar tests (with cyclic stages providing information about the soil sensitivity) were conducted inflight, with an example give in Figure 5.

A series of soil laboratory tests is available, including:

- Monotonic and 2-way cyclic simple shear
- Monotonic triaxial
- Resonant column and bender element

All advanced tests were performed at a vertical stress of 30 kPa (roughly 6 m depth). Additional test data may be provided as the event progresses and will be made available to all participants.

Participants can download the full dataset provided for this event.

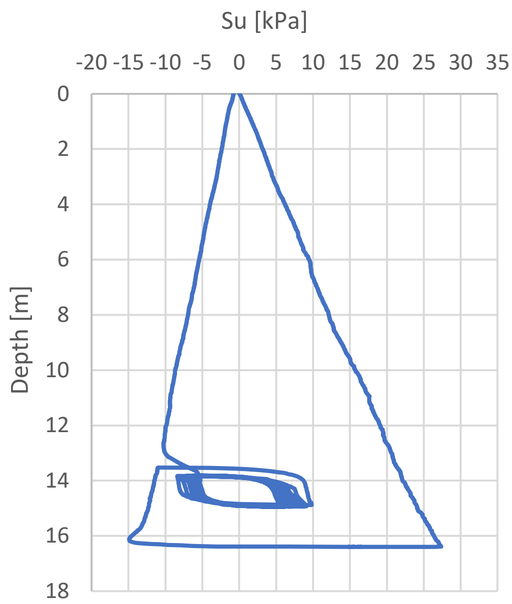

Figure 5: Typical T-Bar test result

2.3 Prediction

Participants are asked to predict the monotonic and cyclic response of the model pile.

For the monotonic response, participants are asked to:

1. Predict the pile head load-displacement curve for a displacement controlled lateral push, as well as the bending moment profiles at a proportion of the maximum predicted reaction load.

The cyclic tests were performed under either displacement controlled or load controlled conditions:

2. For displacement controlled tests, participants are asked to predict the pile head lateral load after specified numbers of cycles, as well as the bending moment down the pile.
3. For load controlled tests, participants are asked to predict the pile head lateral displacement after specified numbers of cycles, as well as the bending moment down the pile.

Full detail are provided in the submission template.

Participants are encouraged to provide details on the methods used to make their predictions, so the geotechnical community can improve its overall knowledge on the prediction of conductor performance, and cyclic loading more generally.

3. Guidelines for Participation

3.1 Submitting contributions

An excel template will be provided on the hosting platform (https://shwca.se/isfogcyclic). Participants are asked to use this template to submit their prediction. They are also encouraged to provide as much information as possible on the methodology used by submitting addition documentation (spreadsheets, reports etc.). It is accepted that design methodologies may be proprietary, and the submission on these details is not a prerequisite for participating.

Predictions can be submitted via email (isfog2020@uwa.edu.au).

3.2 Summary and presentation of results

All submissions will be treated **confidentially** and results will be **anonymised** during the presentation of the event findings. If considered appropriate, you may submit your predictions using an anonymous email address (e.g. @gmail).

The lessons learnt from the prediction event will be discussed via an ISFOG 2020 paper and presentation.

3.3 Timeframe

Predictions will be accepted until 31 March 2020.

Please contact us at isfog2020@uwa.edu.au if you have specific requirements

3.4 Communication and support platform

The event data will be hosted using a Dropbox Showcase web site (accessible via https://shwca.se/isfogcyclic). Participants are encouraged to access the data while logged into a Dropbox account. This will provide event organisers with a contact email address, which will be used to notify participants of any updates to the data set.

Note that it will be possible for others to see who has accessed the web site. However, only the event organisers can see who has downloaded information. Per above, submissions are made directly to the organisers (not through the website) and details will not be made public.

Questions can be directed to isfog2020@uwa.edu.au. A list of FAQs will be created and kept up-to-date (at https://shwca.se/isfogcyclic) during the event.

3.5 Our 'thank you' for participating

The centrifuge tests results will be made available exclusively to participants via return email (after closing of the prediction event).