Vibrocore Sampling

A vibrocorer comprises a steel tube with an inner plastic liner which is vibrated into the seabed by the action of two counter rotating eccentric weights driven by an electric- or hydraulic motor. Depth of penetration can be up to 6 m. in suitable soil conditions, with samples being obtained in almost all unconsolidated soil types. The tube is pulled out of the seabed by the A frame or crane used for deployment and the sample retained by a core catcher. Once recovered to deck, the plastic liner is removed and the sample described as far as practical and stored within the plastic liner for detailed description and laboratory testing onshore. Limitations to this equipment include sample disturbance in very soft or loose soils and limited penetration in hard seabed such as stiff clays and dense sands. The equipment is normally limited to water depths of approximately 900m. Marine Sampling Holland has developed a High Performance Hydraulic Vibrocorer to cope with the demand for longer sample recovery in dense granular and stiff cohesive materials. A vibrocoring campaign can be performed either from a geophysical survey vessel, provided it has the capabilities (e.g. craneage and station keeping) or from a suitable alternative vessel of opportunity.

Hydraulic vibrocoring equipment

A spread of vibrocoring equipment consists of the following components:

- vibrocorer
- Power reel + electric cable (used to supply electric power and for controls)
- Control unit / control container

Electric power and hoisting capacity are mostly derived from the vessel being used.

The vibrocorer itself has the following components (see figure 1):

- Guiding frame
- Guiding poles
- Coring tube containing core catcher and liner
- Vibrator block
- Electric / hydraulic aggregate

Technical data:

Frame:

Frame footprint	1.5 m x 2.0 m.	Frame weight	1500 kg
Frame footprint with legs extended	2.9 m x 3.4 m.	Frame height	Coring tube length + 2.5 m. (mostly: ca. 8.5 m.)

Vibrating part:

Installed power	11Kw	Excentric moment	38 N/m
frequency	1750 rpm	Centrifugal force	128 kN
Weight vibrating block (in air)	450 kg	Weight vibrating block (in water)	400 kg
Weight aggregate (in air)	750 kg	Weight aggregate (in water)	550 kg
Total height	Ca. 2.2 m.		

General

Electrical energy	220/380 / 11 kW
Total height	Ca. 8.5 m (when using 6 m. length coring tube)
Total weight	Ca. 3500 kg

Additional info can be found in Marine Sampling Holland's brochure on the hydraulic vibrocorer.

Procedure

Prior to deployment, the vibrocorer is set up. Minimum requirements of the vessel to be utilized are a free deck space of 12 m. and a crane capacity of 10 tonnes. General procedure for deployment is as follows (see also figure 2):

1. After setup of frame and vibrocorer, a sampling tube can be attached to the cantilevering attachement below the vibrator block. Straight tubes should be used, cutting edge and integrity of corecatcher should be checked prior to deployment.
2. insert a PVC liner in the sampling tube
3. hoist aggregate + vibrating part to top position
4. switch on / power up the device
5. fasten the sampling tube using the hydraulic cylinder meant for this
6. move overboard
7. extend legs of the vibrocorer frame
8. switch on vibrating engine
9. lower to seabed
10. carefully monitor slack on hoisting cable. If hoisting cable loosens, vibrocorer has penetrated (device to monitor penetration depth is being developed but not yet ready)
11. switch off engine
12. hoist to surface
13. pull in legs
14. loosen coring tube and power down.
15. put the vibrocorer on deck and lower the vibrating part to its lower most position. Take care not to bend the coring tube in the process, preferably support it while it moves to horizontal position
16. extrude liner. Check straightness and integrity of the coring tube. Start at step 1.

Liners typically can have following diameters; ∅108 mm., ∅70 mm. During- or after extraction, the liner can be cut into 1 m. sections for easier handling. Alternatively, the liner is in its whole moved to a suitable location on deck for opening and description of the soil sample inside.

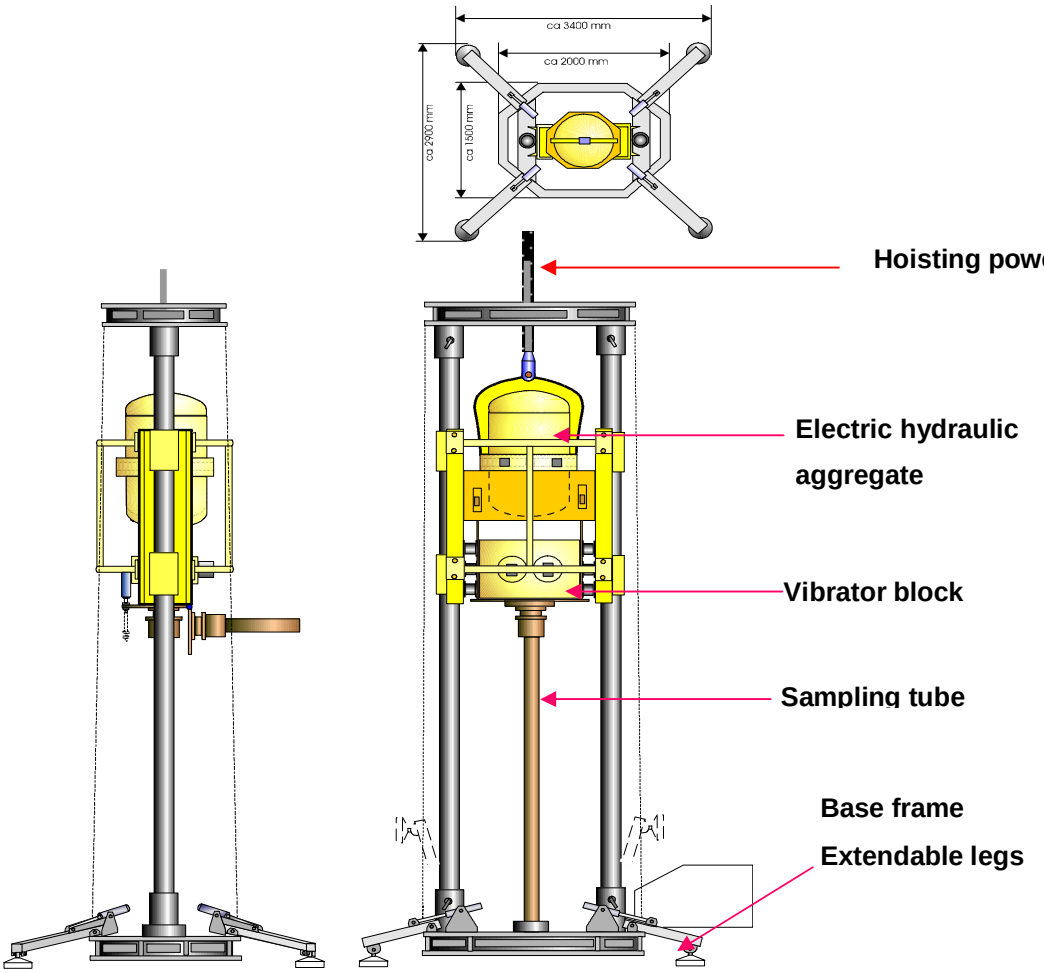

Figure 1: hydraulic vibrocorer components

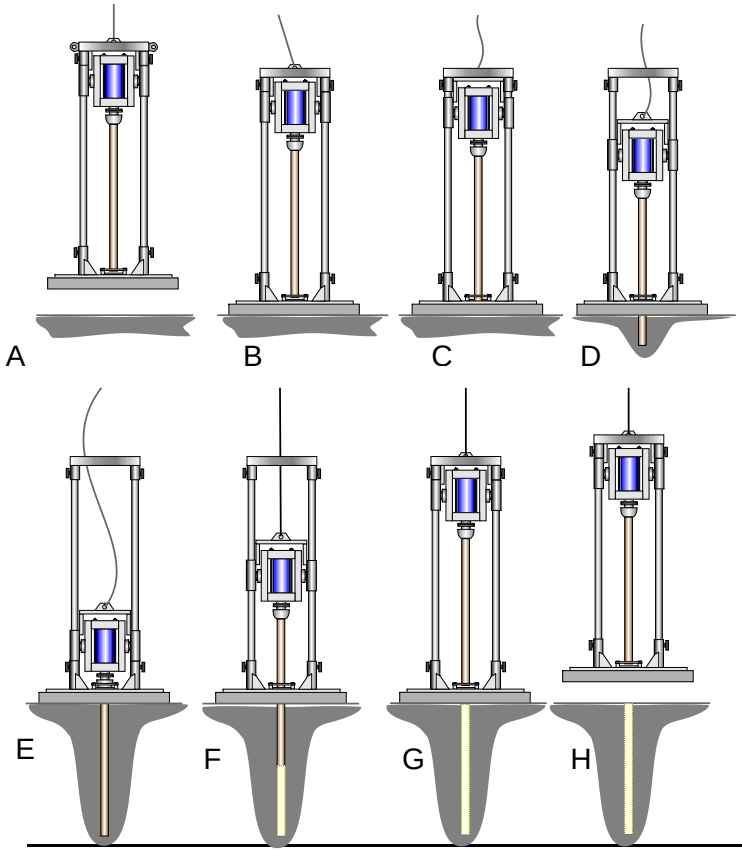

Figure 2: vibrocoring procedure

A – B : lowering to seabed

C – E : vibrocorer penetrating into seabed

F – H : retrieve to surface

Penetration- and elevation measurement

Location of the vibrocorer during lowering- and after landing on seabed can be monitored via a USBL that can be mounted either on the top frame or on the vibrocorer engine housing.

In order to monitor penetration of the vibrocorer coring barrel into seabed, magnets have been mounted into one of the 2 guiding poles. Every 5 cm., a magnet has been placed. The location of the magnets is being read by a ("Hall"-) sensor. Sensing data can be read real-time in the control container; where penetration depth in cm. is displayed. After vibrocoring has finished, penetration depth can be compared with sample recovery for QA purposes.

To make optimum use of the penetration measurement, software has been written to log penetration depth versus time. Plotting penetration speed vs. depth renders insight into penetration resistance of soils. In non-cohesive material, a speed vs depth plot may render information on relative density. In cohesive material, correlation with shear resistance is likely. In projects where CPT tests are done, the speed vs. depth plot allows for easier comparison- and cross-correlation with CPT data.

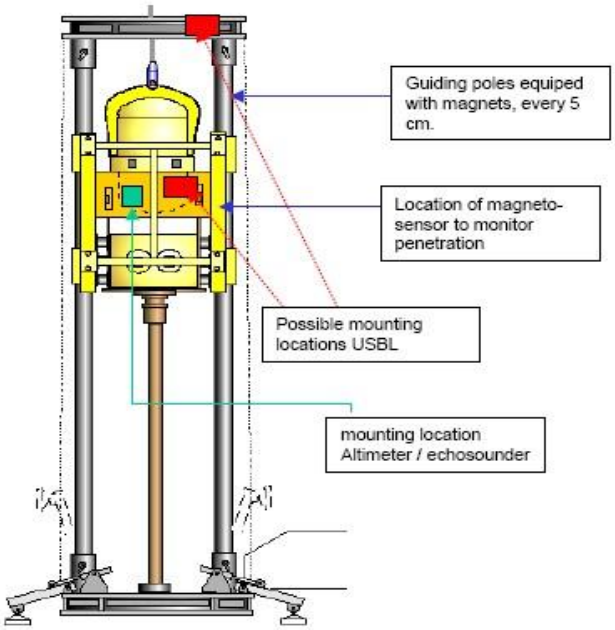

Figure 3 – elevation and penetration measurement

In order to monitor both elevation of the vibrocorer and penetration of the vibrocorer / seabed frame into seabed, a combined altimeter / echosounder can be mounted on the engine housing. Penetration into seabed is typically found, by comparing echosounder ultimate value to the ultimate penetration depth of the coring barrel into seabed.

In order to monitor (approximate-) waterdepth at location (after tidal correction this can be used to calculate approximate seabed level) a (water-) pressure transducer can be mounted on the vibrocorer. This can either

be a baro-diver mounted on the outside of the vibrocorer, for independent logging, or a pressure transducer integrated into the vibrocorer engine housing and logged in the integrated logging software.

Sample handling

Undisturbed soil samples are preferably sealed as to preserve in-situ water content and (in case of environmental samples) pollutants. For sealing, different methods can be used. Most commonly used are liquid paraffin (which hardens after poring it over the sample top- and bottom surfaces), plastic caps and paraffin tape. Preferred method of sealing depends on requirements of the client and on the standardisation-system followed.

After sealing, vibrocore samples are being stored in special sample collection boxes, with welded-in mesh grid to keep the samples in a vertical, upright position. If needed, samples are stored in a cooling container, thus allowing conditioned storeage.

Soil samples are typically used for accurate classification and in different laboratory tests.

Administration

The following information about the borehole will be registered:

- project name
- client name
- project location
- Borehole number
- Borehole location (x, y coordinates)
- Start time
- Sea level
- Sea-bottom level (i.e. start level of borehole)

After Drilling, the following information is recorded per borehole:

- Penetration depth
- Sample recovery
- Number of (sub-) samples produced

The following information is recorded on the samples taken and indicated on the sample container:

- Project number
- Borehole number
- Sample number
- Top of sample relative to seabed
- Bottom of sample relative to seabed
- Top of liners and tubes (undisturbed samples only) will be clearly marked.

- Date & time
- Optional: soil type in top- and bottom of liner section
- Optional: hand-vane test, hand-penetrometer test, temperature measurement on- and photograph of top- and bottom of liner sections
- Optional: field description of soil material found in top- and bottom of liner section

Field logs of the above may be made available after finalisation of works.