Coastal Engineering Technical Note

USE OF VIBRATORY CORERS FOR COASTAL ZONE SEDIMENT SAMPLING

INTRODUCTION: Vibratory corers are a practical method of obtaining disturbed cohesive (clay) and cohesionless (sand) samples onshore and offshore in the coastal zone. Two small vibratory corers have been developed at CERC that can be used to obtain near and onshore samples. They are similar to the commercially available vibracorer. This technical note briefly describes all three types of vibratory cores and discusses geological and geotechnical considerations for their use in coastal engineering.

GENERAL: The three types of vibratory corers discussed here are: (1) the standard vibratory corer, the vibracorer (Fig. 1), (2) the small vibratory corer (Fig. 2), and (3) the small portable vibratory corer (Fig. 3). The vibratory system consists of an external power source which drives a vibrating head sitting atop a core tube supported by a tripod. The vibrations fluidize the soil structure allowing the core tube to slip through while the soil

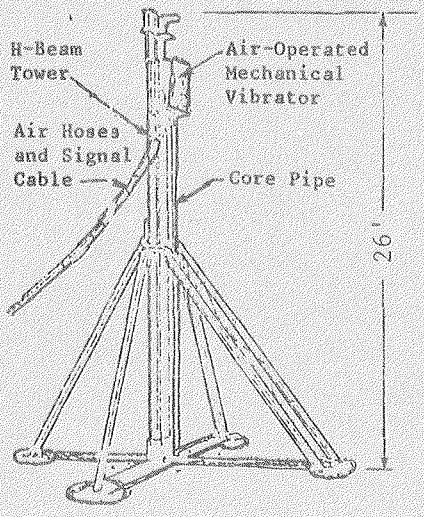

Fig. 1 Vibracorer

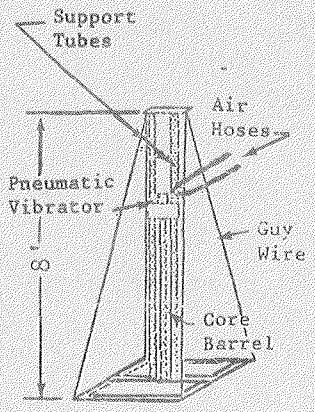

Fig. 2 Small Vibratory Corer

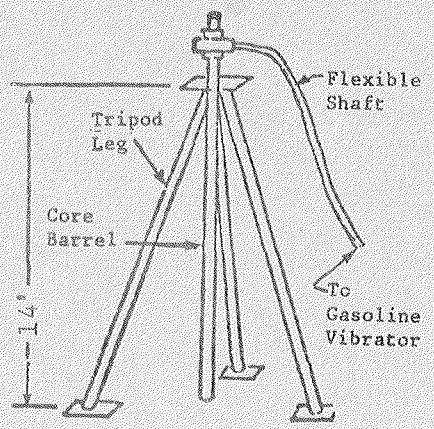

Fig. 3 Small Portable Vibratory Corer

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structure reforms at a denser state. Penetration rates and depths vary according to the sediment type and the frequency and amplitude of vibration. Ease of penetration varies from easy in soft clays to difficult in fine sands with silt and stiff (compacted) clay. The characteristics of these three corers are compared in Table 1.

TABLE 1. Vibratory Corer Characteristic

CHARACTERISTIC	VIBRACORER	SMALL VIBRATORY CORER	SMALL PORTABLE VIBRATORY CORER
Barrel Length (in feet)	20[1]	6	33
Core Diameter (in inches)	3.5	2.0	3.0
Core Barrel Material	Steel with Plastic Liner	PVC	Aluminum
Maximum Operating Water Depth (in feet)	300	150	3
Typical Penetration (in feet)			
(a) Sand	10 to 20	4 to 6	6 to 10
(b) Soft clay	Length of barrel	Length of barrel	Up to 27
Power Source	250 ft^3/min compressor	25 ft^3/min compressor	Portable Gasoline Vibrator
Cost (1981) Excluding Power Source	$35,000	$2,500	$2,000 includes power source
Ancillary Equipment:			
(a) Hoist Capacity (in tons)	7 to 11	2	None Required
(b) Barge or Vessel Length (in feet)	50 to 90	30 to 50	20 to 30
Availability	SAM[2], LMN[3], SWG[3]	NAO[3], CERC[3]	CERC[3]

1 Also can be used with barrels 30 and 40 feet long
2 Limited to SAD use
3 Available for use by other Corps offices

VIBRACORER: The vibracorer is widely used in coastal sampling (Cavallin, 1977; Meisburger and Williams, 1981). The vibracorer is manufactured by Ocean Seismic Survey, Inc., Norwood, NJ. While the vibracorer can be used with core barrels 20, 30, or 40 feet long, the 20 feet barrel is found on most vibracorers. Although all three vibratory corers can be used on land, the difficulty of transporting and the large crane required to handle the vibracorer may limit its use on land.

SMALL VIBRATORY CORER: This vibratory corer is light weight and can be used underwater. The main application for this corer is to identify the type of sediment and its thickness, for penetration less than 6 feet deep, for the design of small coastal structures such as groins, seawalls, bulkheads, etc. Modifications are contemplated to take cores up to 10 feet long. Fuller and Meisburger (1982) discuss this corer in more detail.

SMALL PORTABLE VIBRATORY CORER: As the name states, this vibratory corer is portable by truck, boat, or helicopter. This allows it to be used on remote beaches, barrier islands, and marshes where it would be difficult or impossible to transport the larger vibratory corers. It is limited to use in calm and shallow water less than 3 feet deep. Two or three people are needed to operate the corer. Finkelstein and Prins (1981) discuss this corer in more detail.

GEOLOGICAL APPLICATIONS: Cores taken with vibratory corers are well suited to geologic studies. Although the vibrations cause changes in density; in sand, layering is well preserved and bedding planes remain essentially intact; in cohesive sediments, bedding planes usually curve down at the edges. Tests run on vibratory corer samples for textural analysis, mineralogic identification, and organic content, give acceptable results.

Vibratory corers are often used to identify the sediments in the reflecting layers shown on seismic surveys. Seismic surveys and vibratory corers can be used in combination to investigate large areas rather quickly (Prins, 1980).

GEOTECHNICAL APPLICATIONS: In cohesionless sediments, the vibracorer usually changes the soil density significantly. In dense sands, volume expansions of up to 50 percent have been observed (Koutsoftas et al., 1976). In low density sands, samples will become more dense. As with other sampling techniques, sand samples taken with a vibracorer can be tested for grain size distribution. Correlations have been made between the vibracorer penetration rate and relative density (Cavillin et al., 1976) and between the vibracorer penetration rate and the blow count from standard penetration test (SPT-N). The SPT-N is the number of blows needed to advance 2-inch O.D. split spoon sampler one foot when struck by a 140-pound hammer falling 30 inches. To get engineering properties, i.e., friction angle, for structural design it is best to make a site specific correlation between the SPT-N and the vibracorer penetration rate. Cohesive samples taken with a vibratory corer are somewhat less disturbed than cohesionless samples taken with this type corer. Index tests including

grain size distribution, Atterberg limits, and natural water content can be performed on these cohesive samples. Shear strength tests performed on vibracorer samples may give strength values that are about one-half those values from the same tests performed on undisturbed samples- (Koutsoftas et al., 1976). The use of vibratory corer sample test results, to predict undrained shear strength, are very tentative and should be used for preliminary design only. Consolidation tests (used to predict settlement) on vibracorer samples may give unsatisfactory results, and should not be used. Reconsolidating vibracorer samples in a triaxial cell before shear helps to reduce disturbance effects.

The above geotechnical discussion is generally applicable to the small portable vibratory corer. The amount of sample disturbance is approximately the same as with the vibracorer. However, the small vibratory corer's 2.0-inch barrel increases sample disturbance and therefore makes strength measurements very questionable.

HANDLING OF VIBRATORY CORES: As with other types of cores, vibratory cores should be cut.to lengths of five feet or less, sealed, and labeled as soon as possible aftercoring. The cores should be stored vertically and subjected to as little further vibration as possible.

ADDITIONAL INFORMATION: For additional information please contact Mr. Thad Pratt, (601) 634-2959, Thad.C.Pratt@usace.army.mil.

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