Consumers Power Company

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March 18, 1983

Harold R Denton, Director
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND NUCLEAR COGENERATION PLANT
MIDLAND DOCKET NOS 50-329, 50-330
STATIC CONE PENETROMETER RELATIONSHIPS FOR COHESIVE MATERIALS AND DYNAMIC CONE PENETROMETER RELATIONSHIPS FOR COHESIONLESS MATERIALS
FILE: 0485.16, B3.0.8 SERIAL: 21621

REFERENCE: J W COOK LETTER TO H R DENTON, SERIAL 16656 DATED APRIL 22, 1982

ENCLOSURE: (1) RELATIONSHIP BETWEEN DIAL READING, CONE PENETRATION AND ESTIMATED UNDRAINED SHEAR STRENGTH FOR VICKSBURG CN-973 STATIC CONE PENETROMETER

(2) THE DYNAMIC CONE PENETROMETER

Included in the enclosure to our above referenced correspondence of April 22, 1982, was a graph (Figure SWPS-11) of the relationships between the estimated ultimate bearing capacity for cohesive soils and the dial readings of a Vicksburg CN-973 static cone penetrometer. This cone penetrometer is being used by the Resident Geotechnical Engineer to evaluate the suitability of the subgrade cohesive materials for both the auxiliary building and service water pump structure underpinning. The soil property which is most directly correlated to the cone penetrometer test and the property which the Resident Geotechnical Engineer will evaluate is the undrained shear strength. The ultimate bearing capacity of a cohesive soil is the undrained shear strength multiplied by a constant. Because the undrained shear strength of the underpinning subgrade represents a more directly measured parameter, the vertical axis of the previously transmitted Figure SWPS-11 has been converted into units of undrained shear strength. Enclosure 1 is this converted figure which we are forwarding for the NRC's information and reference.

Enclosure 2 provides a discussion of the relationship between the estimated angle of internal friction and the dynamic cone penetrometer resistance for cohesionless soils. This discussion provides a justification for the relationship that will be used by the Resident Geotechnical Engineer to evaluate the subgrade cohesionless materials for both auxiliary building and

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service water pump structure underpinning. Previously, the relationship of the estimated ultimate bearing capacity to the dynamic cone penetrometer resistance was presented to the NRC as Figure SWPS-12 enclosed to our above referenced correspondence. The relationship identified as Attachment B, which is contained in Enclosure 2, is more appropriate for evaluating the bearing capacity of the soil because it reflects a direct correlation between the property defining the shear strength of the soil, ie, the angle of internal friction, and the dynamic cone resistance. Enclosure 2 is also being forwarded for the NRC's information.

James W. Cook

JWC/RLT/bjb

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WHMarshall, w/o
JPMatra, Naval Surface Weapons Center, w/a
WDPaton, Esq, w/o
SJPoulos, Geotechnical Engineering, w/a
HSingh, Army Corps of Engineers, w/a
BStamiris, w/o

CONSUMERS POWER COMPANY
Midland Units 1 and 2
Docket No 50-329, 50-330

Letter Serial 21621 Dated March 18, 1983

At the request of the Commission and pursuant to the Atomic Energy Act of 1954, and the Energy Reorganization Act of 1974, as amended and the Commission's Rules and Regulations thereunder, Consumers Power Company submits static and dynamic cone penetrometer resistence relationship curves for both cohesive and cohensionless soils materials. These relationship curves will be used to evaluate the suitability of the subgrade materials for both the Auxiliary Building and Service Water Pump Structure underpinning.

CONSUMERS POWER COMPANY

By J W Cook

J W Cook, Vice President
Projects, Engineering and Construction

Sworn and subscribed before me this 21 day of March, 1983.

Barbara P Townsend
Notary Public
Jackson County, Michigan

My Commission Expires September 8, 1984

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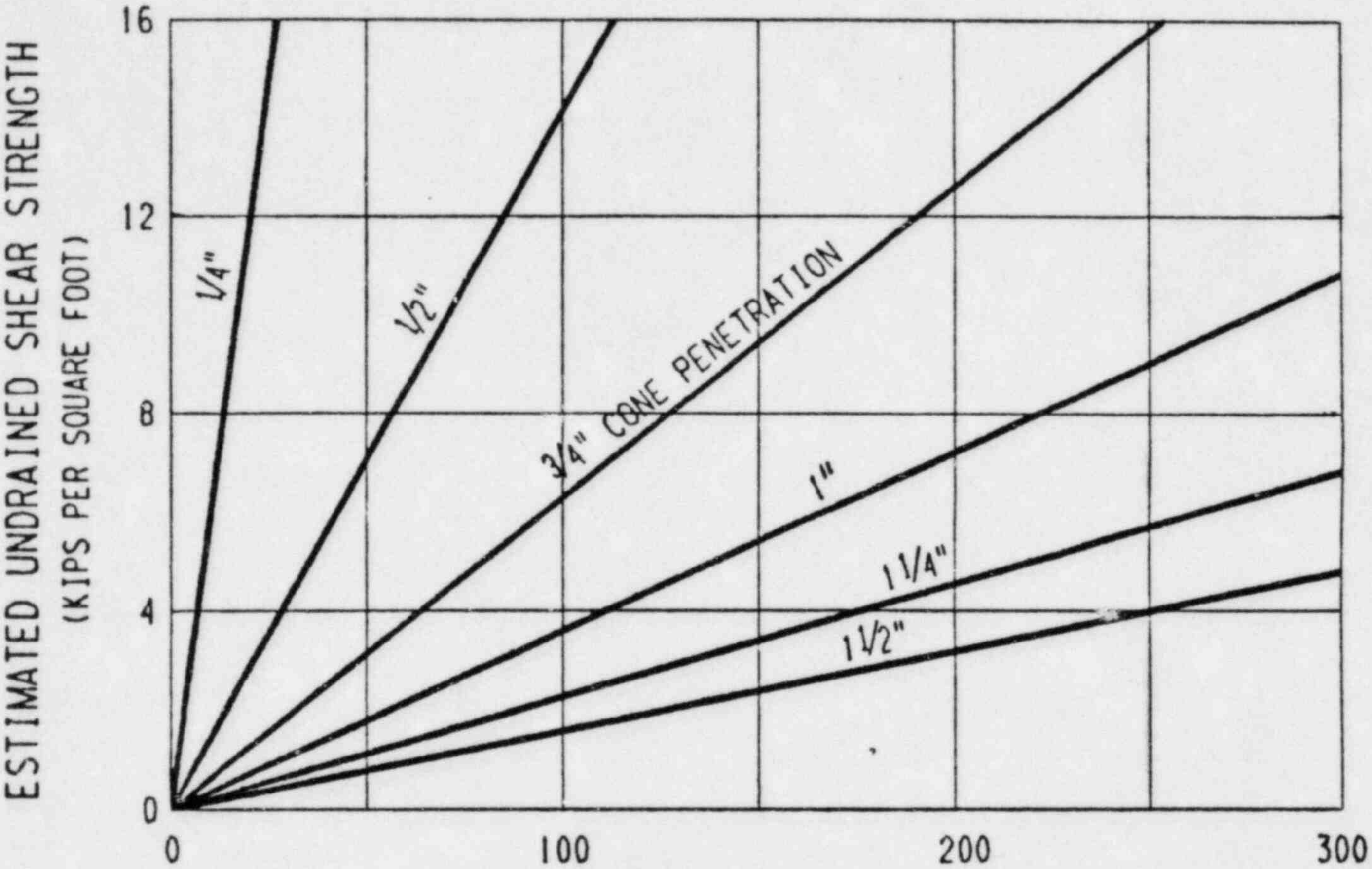


DIAL READING ON CN-973 STATIC CONE PENETROMETER
(POUNDS PER SQUARE INCH)
TIP OF CONE PENETRATING UNDISTURBED SOIL
FOR COHESIVE SOILS

CONSUMERS POWER COMPANY
MIDLAND UNITS 1 AND 2

RELATIONSHIP BETWEEN DIAL READING, CONE PENETRATION AND ESTIMATED UNDRAINED SHEAR STRENGTH FOR VICKSBURG CN-973 STATIC CONE PENETROMETER

THE DYNAMIC CONE PENETROMETER

Dynamic cone penetration tests were developed as a convenient method for determining the approximate shearing resistance of noncohesive soils. The dynamic cone penetrometer to be used for the Midland Project consists of a 60-degree cone of steel attached to a section of rod. The rod is driven into the ground with a 10-pound drop hammer. The hammer is raised and allowed to fall a distance of 24 inches. The 60-degree cone is 1-1/8 inch in diameter. The diameter of the rod is smaller than that of the conical drive point, and short sections of rods are joined by couplings. This arrangement helps to reduce friction and permits use of a drive point and rod of smaller dimensions. When representative samples are desired of a certain strata, the drive point can be replaced with a small drive sampler. The weight of the entire equipment is about 25 pounds. The cone penetrometer may be used advantageously in many soil investigations and is easier to perform than other more complicated field tests.

Variations in cone penetrometer resistance may indicate dissimilar soil layers and the numerical values of these resistances permit an estimation of some of the physical properties of the strata. The penetrometer can therefore be considered a method of both exploration and field testing.

The dynamic cone penetrometer may be used during the underpinning excavation to determine the character of fill sands or natural sands. The details of the penetrometer which will be used are shown in Attachment A. The angle of internal friction of sand can be empirically estimated using the penetrometer blowcount and the graph of angle of internal friction versus dynamic cone penetrometer resistance shown in Attachment B.

To develop Attachment B a testing program was performed on fill sand at various locations at the Midland site. In situ unit weights of the sand were obtained using ASTM D 1556 (sand cone method). Relative densities at the locations were determined based on maximum and minimum densities obtained using ASTM D 2049. The soil in the immediate vicinity of these locations and at the same elevation was tested by a geotechnical engineer using the penetrometer shown in Attachment A. The soil testing was performed by U.S. Testing under the direction of the resident geotechnical engineer or the onsite geotechnical engineer. Quality control was performed according to U. S. Testing's Quality Control Program.

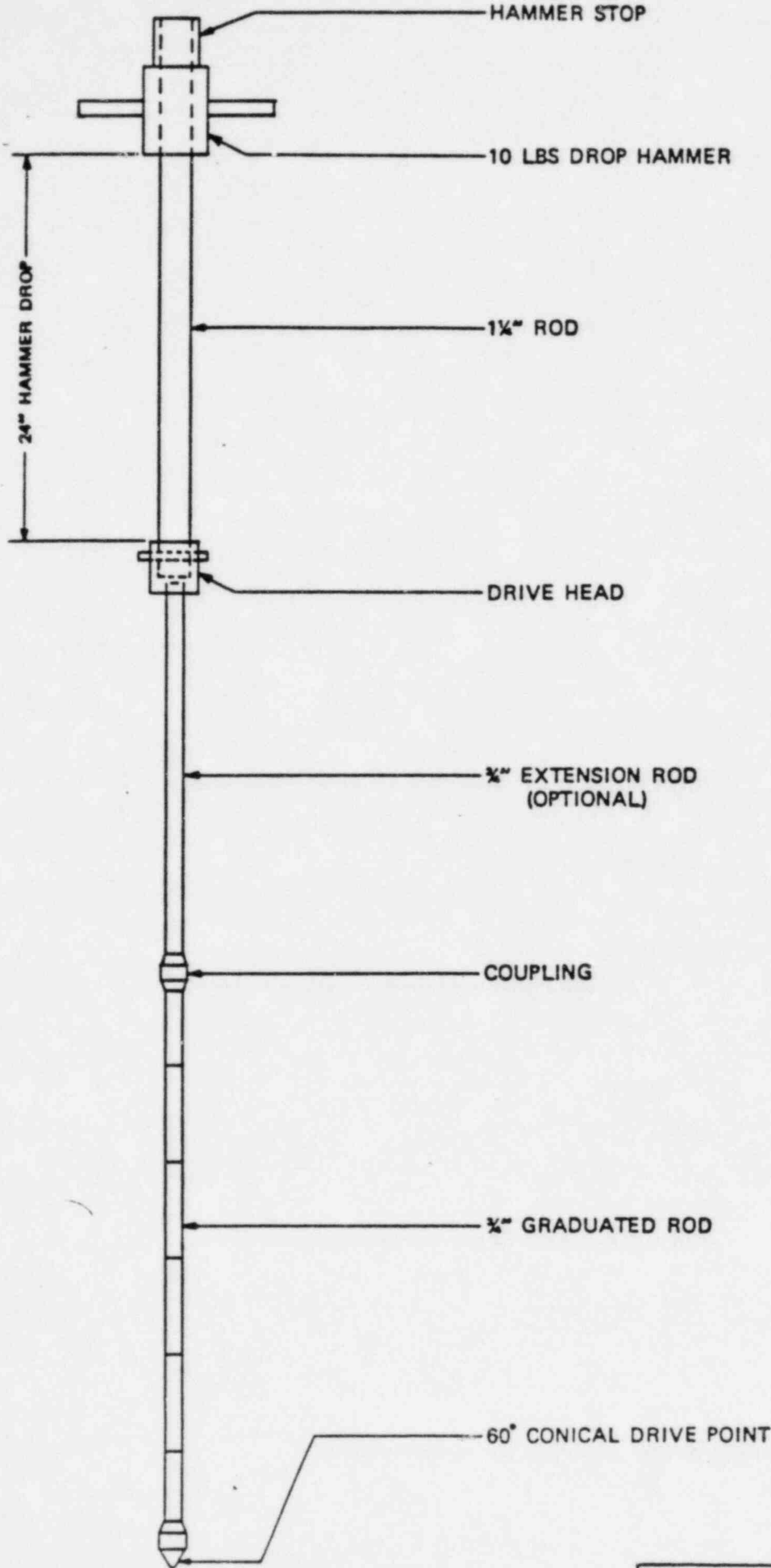
The angle of internal friction corresponding to penetrometer blowcounts at the test locations were used to develop the graph in Attachment B. The angle of internal friction was obtained empirically using the dry unit weights and relative densities obtained at each location and Figure 3-7 of Reference 1 (Attachment C). The corresponding blowcount for one foot penetration was obtained by doubling the 6" blowcount obtained at these locations.

The grain size distribution of the fill sands tested is probably different than what is anticipated to be encountered in the excavations into natural sands during underpinning construction. This is made evident after studying Attachment D which shows a comparison of the grain size distribution of the fill sand tested with the grain size distribution band of on-site sands encountered in earlier investigations. For this reason, correlations between dry density, relative density, and penetrometer resistance will be made using the same testing procedures as construction proceeds in the natural sand to verify or modify the relation in Attachment B.

In general, the in situ density tests and penetrometer tests were performed on the first 6" of soil from the ground surface or from the excavation level of a pit. (Four penetrometer tests were performed at the edge of the pit and, therefore, were influenced by 6" to 12" of additional overburden pressure.) Any testing during underpinning excavation will also be performed in this way and, therefore, the influence of the overburden pressure on the test results will be negligible.

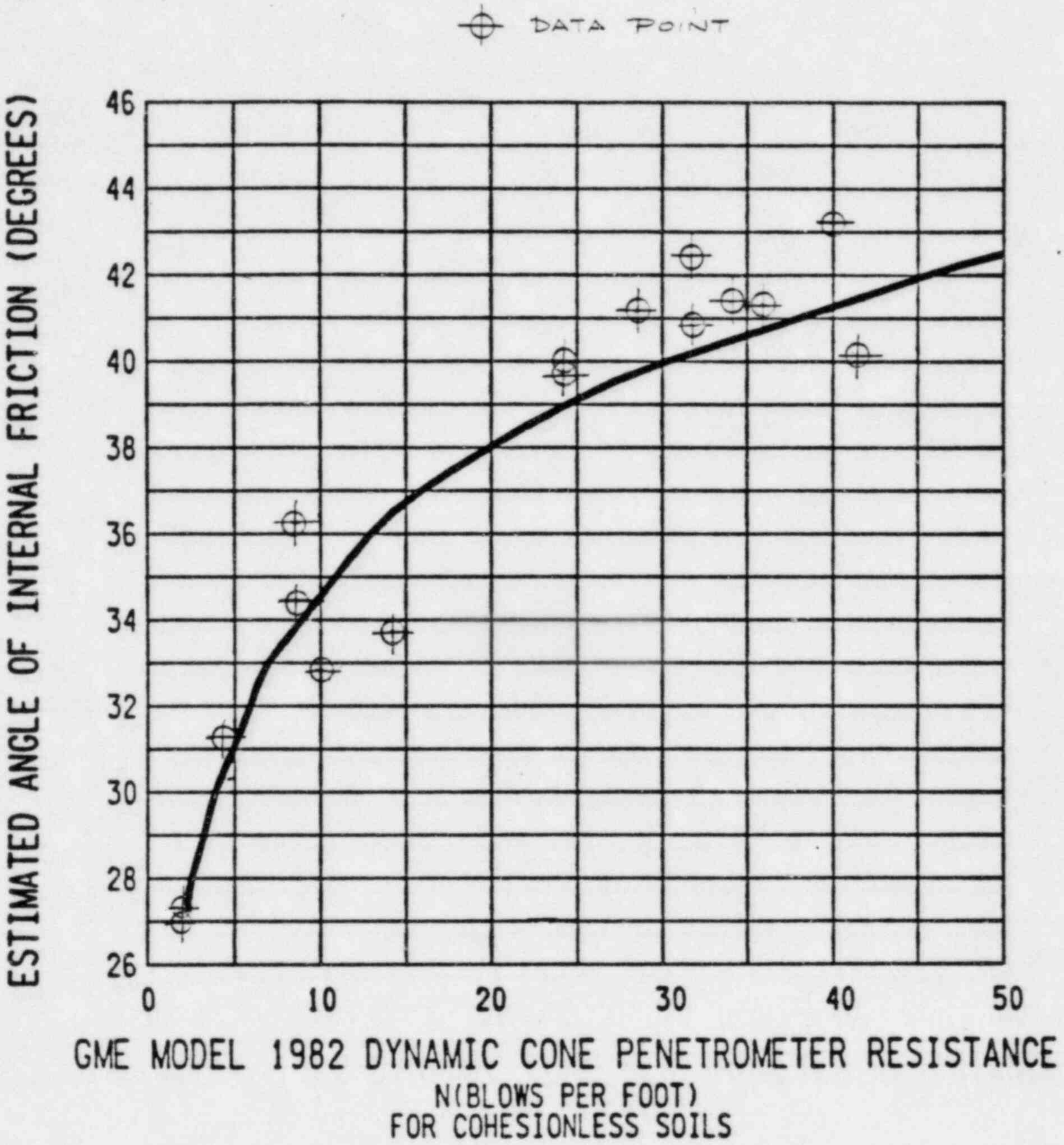
References:

1. Department of the Navy Naval Facilities Engineering Command, Design Manual Soils Mechanics, Foundations, and Earth Structure NAVFAC DM-7, (Washington, D.C., 1971), p. 7-3-17



ATTACHMENT A

SKETCH OF
DYNAMIC CONE PENETROMETER
(GME MODEL 1982)



ATTACHMENT B

ATTACHMENT C

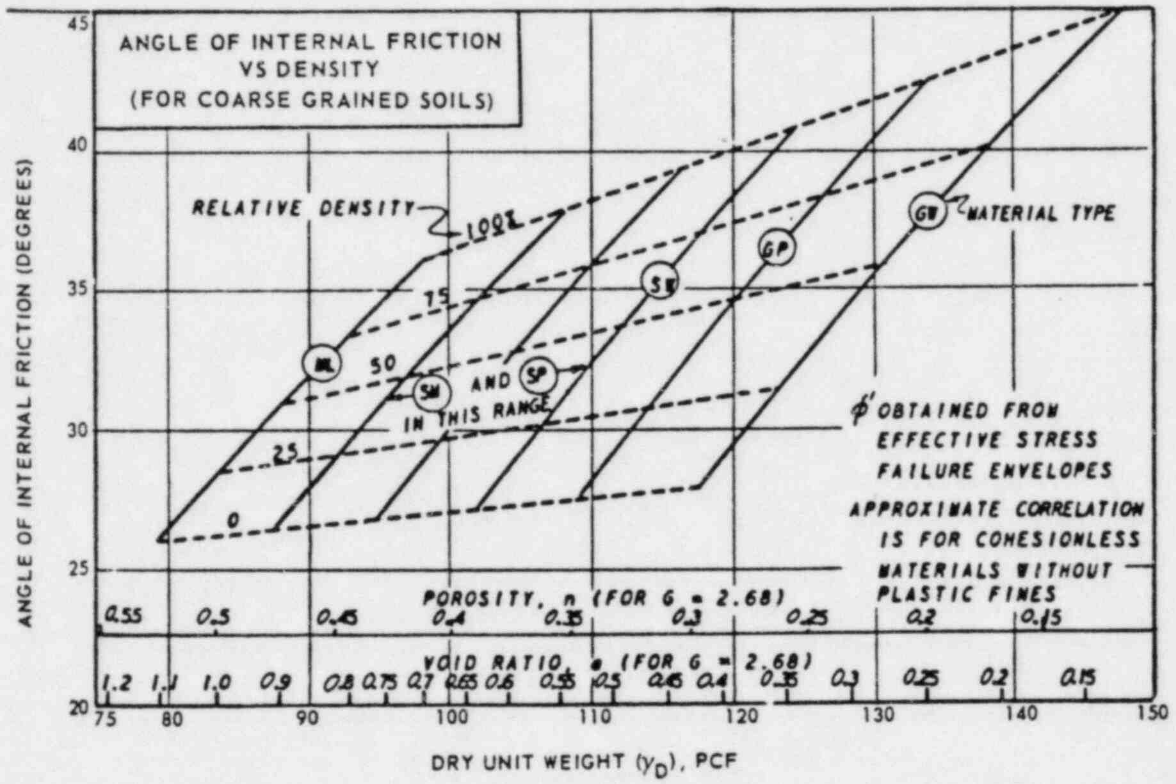
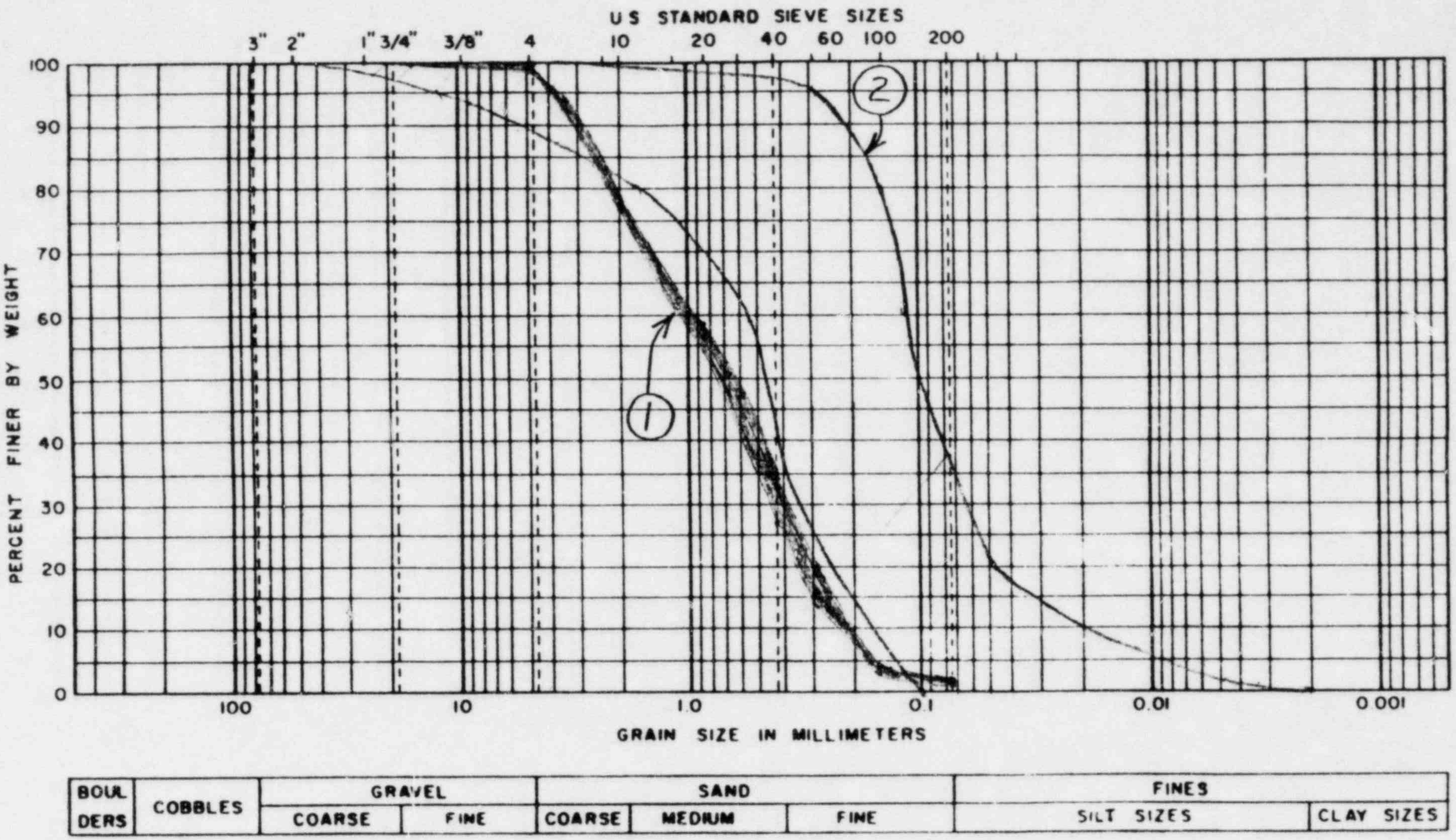


FIGURE 3-7
Correlations of Strength Characteristics

(REFERENCE: SEE TEXT REF. 1)



GRAIN SIZE DISTRIBUTION

(1) FILL SANDS USED IN DYNAMIC CONE PENETROMETER TESTING PROGRAM

(2) NATURAL SITE SANDS FROM F.S.A.R. (FIG. 2.5-131)

ATTACHMENT D