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=  DEEP SEA DRILLING PROJECT  =
=      VANE SHEAR DATA BASE    =
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I.   INTRODUCTION

A.   BACKGROUND AND METHODS

The Deep Sea Drilling Project (DSDP) vane shear data base
was prepared directly from the shipboard records. Data was
also taken from the Deep Sea Drilling Project Initial
Reports, provided that sufficient information was given.
Data which appears only on graphs within the Initial Reports
was not used.

All shear strengths are encoded as grams per square
centimeter. In order to convert to pounds per square inch,
multiply by 0.01422 . To convert to kilopascals, divide by
10. To convert to dynes per square centimeter multiply by
980.665 .

All records have the same format. Each record is 360
characters long and represents a single shear strength
measurement.

B.   LEGS IN DATA SET

The database contains data from legs: 31, 38, 41, 42, 43,
44, 47, 48, 50, 51, 57, 58, 61, 63, 64, 68, 69, 71-76, 78,
80, 85, 87, 90, 91, 93, and 94. Data from legs 31, 38, 51,
58, 72, 73, 80, and 93 contain only Torvane data. Legs 57
and 87 contain both Torvane and motorized vane data. The
other legs consist only of motorized vane data.

C.   SELECTED REFERENCES

Boyce, R.E., 1977. Deep Sea Drilling Project procedures for
shear strength measurement of clayey sediment using modified
Wykeham-Farrance and laboratory vane apparatus, in: Baker,
P.F., Dalziel, I.W., et al., Initial Reports DSDP, Vol. 36:
Washington (U.S. Govt. Printing Office), p. 1059-1068.

Bennett, R.H., Nastav, F.L., and Bryant W.R., 1984.
Strength Measurements, in: Sedimentology, Physical
Properties, and Geochemistry in the Initial Reports of the
Deep Sea Drilling Project, Volumes 1-44: an Overview.
World Data Center A for Marine Geology and Geophysics.
Report MGG-1. Chapter 8, p. 129-146.

Sibley E.A., and Yamane G., 1966 A Simple Shear Test for
Saturated Cohesive Soils, in: Vane Shear and Cone
Penetration Resistance Testing of In-Situ Soils. Special
Technical Publication No. 399, American Society for Testing
and Materials p. 39.

II. FORMAT AND FIELD DESCRIPTIONS

A. DATA FORMAT

   Record length = 360 characters (4341 records)

COLUMN	FIELD	FORMAT
======	==	======
1-2	LEG	A2
3-5	SITE	A3
6	HOLE	A1
7-9	CORE	A3
10-11	SECTION	A2
12-15	TOP INTERVAL DEPTH (cm)(Implied decimal pt)	F4.1
16-19	BOTTOM INTERVAL DEPTH (cm)(Implied decimal)	F4.1
20-27	TOP OF CORE DEPTH (meters)	F8.2
28-35	SAMPLE DEPTH IN HOLE (meters)	F8.2
36	DATA TYPE (R=Remolded,S=Shear,T=Torvane)	A1
37-44	SPRING CONSTANT (g-cm)	F8.5
45-52	VANE CONSTANT (cm-3)	F8.5
53-54	RATE OF VANE ROTATION (degrees/minute)	I2
55-58	DEPTH OF VANE BURIAL (cm)	F4.2
59	DEFORMATION TYPE ("S","R","D","I")	A1
60	ORIENTATION ("V","H","P","N")	A1
61	TAPED (Y=Yes,N=No)	A1
62-65	TEMPERATURE	F4.1
66-68	WAIT TIME (minutes) (Remolded only)	I3
69	TORVANE (L=Low, M=Middle, H=High capacity)	A1
70	TORVANE CALIBRATION HISTORY ("B","C","D","U")	A1
	SHIPBOARD HAND CALCULATED VALUES	
71-76	SHEAR STRENGTH (g/cm2)	F6.1
77-82	REMOLDED STRENGTH (g/cm2)	F6.1
83-88	SENSITIVITY (no units)	F6.1
	DSDP COMPUTER CALCULATED VALUES	
89-94	SHEAR STRENGTH (g/cm2)	F6.1
95-100	REMOLDED STRENGTH (g/cm2)	F6.1
101-106	SENSITIVITY (no units)	F6.1
107-352	STRESS-STRAIN DATA PAIRS (41 Pairs)	82I3
353-360	OBSERVER	A8

B. FIELD DESCRIPTIONS
    The definition of leg, site, hole, core and section may be
    found in the explanatory notes. In addition, the special
    core designations, as well as the methods of sample labeling
    and calculating absolute sample depths are discussed.

INTERVAL DEPTH:

Refers to the depth in centimeters within the section at
which the top or bottom of a measurement was taken. Values
are encoded with an implicit decimal point.

CORE DEPTH:
     The subbottom depth in meters to the top of the core.

SAMPLE DEPTH:
     The subbottom depth in meters to the middle of the sample
     interval.

DATA TYPE:
     There are three data types.

     S = Shear data:
         The initial shear strength measurement done on a sample
         using a motorized vane apparatus.

     R = Remolded data:
         A repeat shear strength measurement done on a sample
         which already had a shear (S) type measurement done.
         This test is run so that the sensitivity may be
         calculated. Even though the remolded (R) test is
         conducted after the shear (S) test, the data record for
         the remolded test will occur before the shear test
         record. There is always a shear (S) test associated
         with each remolded (R) test.

     T = Torvane data:
         A single shear strength measurement obtained from one of
         the Torvane instruments. Unlike a motorized vane
         apparatus used to collect the shear (S) and remolded (R)
         data, the Torvane is hand held and provides a direct
         reading of shear strength in tons per square foot.

SPRING AND VANE CONSTANTS:
     The measured constants for the springs and vanes used with
     the motorized vane apparatus. Calibration data for the
     springs and for vanes 1 to 4 can be found in Boyce(1977).
     Calibration data for vanes 5 to 8 are not available. Spring
     5* is a torque cell used only on leg 78. The vane stem
     diameters are included for the sake of completeness.
     Although a correction may be made for the portion of the
     stem which is in contact with the sample, this correction
     has been ignored in this data base.

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                   SPRING                VANE         VANE STEM
          SPRING   CONSTANT   VANE       CONSTANT     DIAMETER
          NUMBER   (g-cm)     NUMBER     (cm-3)       (cm)
          ======   ========   ======     ========     =========
            1        9.1185     1          0.22858      0.32
            2       20.219      2          0.22665      0.32
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            3       32.718      3          0.13264      0.310
            4       51.106      4          0.13264      0.310
            5*      35.338      5          0.2273
                                6          0.22367
                                7          0.23078
                                8          0.22115
                                9          0.2331
```

RATE OF VANE ROTATION:
    The rate of vane rotation was 89 degrees per minute for all
    the legs except leg 41 (90 deg/min) and leg 43 (60 deg/min).
    A rate of vane rotation is not encoded for Torvane data.

DEPTH OF VANE BURIAL:
    The depth in centimeters that the vane blades were buried in
    the sample. Boyce's procedure calls for the vane to be
    buried 2.0 centimeters on unsplit cores and 1.0 centimeters
    on split cores. He goes on to say, "If the sample is too
    small to bury the blades 1.0 centimeters, then the depth of
    burial is measured and recorded" . This would suggest that
    if this data field is blank, then one may assume that the
    burial depth is correct for the orientation.

DEFORMATION TYPE:
    Four types of deformation may be recognized by looking at
    the stress versus strain plot. Deformation types are
    defined by how the slopes (delta-stress/delta-strain) behave
    between adjacent data points. Only the data up to the DSDP
    determined (see SHEAR STRENGTH) maximum stress value are
    considered. Deformation types are not determined for
    remolded data. The deformation types are encoded as
    follows:

    S = Smooth deformation:
        The slopes start at an initial high value and then
        continously decrease.

    R = Rough deformation:
        The slopes do not continously decrease but rather
        increase and decrease throughout the curve.

    D = Discontinous deformation:

The strain stops and starts even though the stress
continued to increase steadily. This leads to a curve
whose slopes repeatedly approach infinity.

I = Indeterminable deformation:
    There are not enough data points present to determine
    the type of deformation. At least three slopes, or four
    stress-strain data points are required to determine the
    deformation type. Torvane data always has an

    indeterminable deformation type.

ORIENTATION:
    Boyce (1977), outlined the procedure for operating the
    Wykeham-Farrance motorized vane apparatus. According to
    this procedure, the operator was instructed to record the
    orientation of the vane relative to the core. How this
    orientation was to be noted was not specifically discussed.
    Boyce also discusses the orientation of the vane apparatus
    itself in terms of being setup either vertically or
    horizontally. There is no indication that this information
    was meant to be recorded.

    Unfortunately, these ambiguities were not clarified by the
    work sheet used at sea. The vane shear work sheet was
    designed as an aid in recording the various parameters used
    during each shear measurement. The work sheet simply asks,
    "vertical or horizontal?". This certainly led to confusion
    as to what was vertical or horizontal; the apparatus or the
    core? It failed to ask for an unambiguous relative
    orientation between the vane and core.

    Boyce does mention that the longer vanes (vane# 3 and 4)
    were to be used only on unsplit cores by inserting the vane
    in a core end. This is because these vanes could not be
    entirely buried in a split core. It can probably be assumed
    that any measurements which used either of these vanes, must
    have had the vane axis perpendicular to the plane of
    bedding. However, this assumption was not used in the
    development of this data base.

    Marine technicians who witnessed vane shear measurements on
    several legs have stated that the vast majority of the
    measurements were done on horizontal split cores with the
    apparatus set up in a vertical position. This would mean
    that for most of the tests, the axis of the vane was
    oriented perpendicular to the axis of the core or parallel
    to the plane of the bedding.

    In order to clarify the orientation when it was explicitly
    noted by the observer, or in a DSDP Initial Report, this

field is encoded as follows:

    V = Vertical (Orientation is uncertain)
    H = Horizontal (Orientation is uncertain)
    P = Parallel (Vane axis is parallel to bedding plane)
    N = Normal (Vane axis is normal to bedding plane).

TAPED:
    Was the pointer taped to the pointer deflector?
        Y = Yes N = No

    If untaped, the pointer would remain on the maximum stress
    after shearing had occurred. The pointer had to be taped to
    the pointer deflector if the investigator wished to measure
    the stress and strain readings after shearing had occurred or
    anytime the apparatus was operated in a horizontal position.

TEMPERATURE:
    Assumed to be room temperature; which in the case of a split
    core would usually match the temperature of the sample.

WAIT TIME:
    According to Boyce(1977) this is the time which was allowed
    for the vane to sit stationary in the sample before the
    remolded test was begun. This parameter is encoded only on
    the remolded (R) data records.

TORVANE:
    A Torvane is a hand-held device for the rapid determination
    of shear strength in cohesive soils. They are manufactured
    by SOILTEST, INC. (2205 Lee St., Evanston, Illinois, 60202).

    The device gives a direct measurement of shear strength in
    tons per square foot (multiply by 976.486 to get g/cm*cm).
    There are three interchangable vane adapters which provide
    different ranges of operation. Since the dial on the device
    does not change, it is necessary to multiply the dial
    reading by the maximum capacity of the adapter. The vast
    majority of measurements were conducted using the middle
    range adapter. This field is encoded as follows:

        L = Low: The range is 0-0.2 tons per square foot.

        M = Middle: The range is 0-1.0 tons per square foot.

        H = High: The range is 0-2.5 tons per square foot.

TORVANE CALIBRATION HISTORY:
     The calibration history gives information regarding the
     use of a calibration curve provided with the instrument.
     The curve compares Torvane results with values derived
     from unconfined and triaxial compression tests. The
     curve applies only to the middle range Torvane.
     According to the manufacturer, curves are not available
     for the high and low range adapters. They also warn that
     the shape of the curve may change depending upon the
     material being tested. The curve labeled "fast rate of
     loading" was used when calculating the DSDP shear
     strength. A "fast rate of loading", had a time to
     failure of 10-20 seconds. The points along this curve
     that were used by the DSDP computer program are listed

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     below.

     The curve is a comparison of Torvane values to other
     shear strength methods. It is not always possible to
     tell whether an observer used the curve. In order to
     clarify when the curve was used this data field is
     encoded as follows:

     B = Both:
         The calibration curve was used by both the observer
         and DSDP. The observer reported the uncorrected
         Torvane readings. This allows the algorithm to use a
         digital representation of the curve to correct the
         readings. The digital representation is listed
         below. The program interpolates between the given
         points, and extrapolates beyond the points by using
         the slope between the last two points. The shipboard
         shear strength is checked for errors if the observer
         recorded the values that he obtained from the curve.

     C = Caution:
         The calibration curve was used only by the observer,
         who reported only the calibrated values. Since the
         raw torvane readings were not recorded, calibration
         was not done by the algorithm when calculating the
         DSDP strength. The shipboard shear strength is
         corrected for math errors.

     D = DSDP only:
         The calibration curve was used only to calculate the
         DSDP shear strength. It is known for certain that
         the observer did not use it. The shipboard shear
         strength is corrected for any math errors.

     U = Unknown:
         It is not known if the calibration curve was applied

to the original data. No corrective action is taken
on the data prior to calculating the DSDP shear
strength. The shipboard shear strength is corrected
for math errors.

CALIBRATION CURVE USED BY DSDP COMPUTER PROGRAM

The points are given in Cartesian coordinates (x,y). The
abscissa (x-axis) should be labeled TORVANE SHEAR
STRENGTH (tons/ft*ft) and the ordinate (y-axis) should be
labeled SHEAR STRENGTH (tons/ft*ft).

(0.0,0.00),(0.1,0.07),(0.2,0.165),(0.3,0.28),
(0.4,0.425),(0.5,0.605),(0.6,0.785),(0.7,0.965),
(0.8,1.145),(0.9,1.325),(1.0,1.505)

NOTE: A DSDP shear strength can not be calculated

without primary data. Without the Torvane reading or a
calibrated value, recalculation is not possible. In this
case no DSDP strength is given and the shipboard value
cannot be checked for math errors.

SHEAR STRENGTH:
The shear strength (SS) or remolded strength is calculated
using the following equations condensed from Boyce(1977):

SS = (vane constant)(spring constant)(maximum stress).

Two values for shear strength are encoded on each record.
These are the shipboard value, calculated by the observer,
and the DSDP computed value. The shipboard value is encoded
directly from the observers notes taken at sea. The DSDP
shear strength is calculated using a DSDP computer
algorithm. The algorithm uses the stress-strain data pairs
to find the maximum stress value for each trial. Since the
maximum stress value chosen to calculate the shipboard shear
strengths is not known, minor discrepancies between the
shipboard and DSDP shear strengths are not corrected. The
algorithm compares strength values and flags any gross
discrepancies. Flagged values are investigated and
corrected as needed.

The maximum stress, as defined within the algorithm, is the
last recorded stress value before the slope of the stress
versus strain curve drops below a threshold value of one.
This threshold was selected as being the most applicable to
the entire data set. The vast majority of data showed an
abrupt decrease in slope after reaching a value of one. In
addition, very few trials had slopes which ever went to

zero.

The curve, as viewed by the algorithm, is made up of a
series of independent slopes between adjacent data points.
As a caution, the slope must drop and remain below the
threshold for at least two consecutive data points. If only
one stress is recorded, then this value is used as the
maximum stress. If the slope of the curve never drops below
one, then the greatest stress value recorded is used. On
occasion, the observer failed to record the strain value
associated with the final stress value. In this case, if
the slopes prior to the final slope were above the
threshold, then the final slope is also considered to be
above the threshold, and the final stress value is used to
calculate the shear strength.

The Torvane gives a direct measurement of shear strength in
tons per square foot. If the Torvane reading was recorded
by the observer, then a DSDP shear strength is calculated.
If the Torvane reading was not recorded, recalculation is
not possible and a DSDP shear strength is not given. The

DSDP shear strength, for Torvane data, is simply a
recalculation of the conversion from tons per square foot to
grams per square centimeter. A Torvane calibration curve is
used when calculating the DSDP shear strength whenever it is
appropriate (see TORVANE CALIBRATION HISTORY).

REMOLDED STRENGTH:
    The remolded strength is calculated the same way as the
    shear strength (see SHEAR STRENGTH). The remolded strength
    is determined for a sample which already had a shear
    strength measurement done. The sample is remolded by hand
    and the vane is reinserted. The vane is allowed to sit
    stationary for about ten minutes (see WAIT TIME). The shear
    strength is then measured for the remolded sample. The
    remolded strength is used to determine the sensitivity (see
    SENSITIVITY). Remolded trials are not done on Torvane
    samples.

SENSITIVITY:
    Defined as the ratio of shear strength to remolded strength.

STRESS-STRAIN DATA PAIRS:
    Stress is the angle of spring rotation. Strain is the angle
    of vane rotation. Although not always explicitly encoded,
    each measurement begins with zero stress and strain.

NGDC NOTES: (list of deviations from field descriptions)

Description of deviation	Record Number(s)
Top interval depth exceeds bottom	651-652,830,1166,1278,1330
Temperature not in specified format	1361-1362,1365-1371,1595-1601, 1606-1607,1639-1640,1695-1696, 1893,2069,2683-2684,2713-2716, 2719-2720,2729,2733,2754,2760, 2777-2779,2870-2877,2880-2906, 2909-2914,2916,2919-2944,2947- 2952,2957-2958,2963-2977,2979- 2999,3331-3332
Stress-strain pair missing one value: cols 215-220	1945,2041

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