JUL 3 0 1981

Docket Nos.: 50-329 OM, OL ✓
50-330 OM, OL ✓

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 & 2

SUBJECT: SUMMARY OF JUNE 30, 1981 MEETING ON SEISMOLOGICAL INPUT ISSUES

On June 30, 1981, the NRC staff met in Bethesda, Maryland, with representatives of the Consumers Power Company (the Applicant) and their consultants to discuss site specific response spectra and seismic margin criteria. The meeting attendees are listed in Enclosure 1.

Site Specific Response Spectra

T. R. Thiruvengadam of Consumers Power Company described the scope of a Weston Geophysical Corporation report submitted previously to the NRC on response spectra applicable for the top of fill material at the plant site. The report is Part II of three documents entitled, "Site Specific Response Spectra, Midland Plant - Units 1 and 2," and is dated April 1981. Z. A. Cybriwsky, E. Levine and R. J. Holt of Weston Geophysical then described the report with the aid of illustrations from that document. These illustrations indicate the soil characteristics and shear wave velocities measured at various locations (primarily in California) and present response spectra developed for the top of approximately 30 feet of fill at the Midland site.

The soil profile and properties of natural and fill materials at the site were presented by N. Ramanajum of Consumers Power Company. The figures in Enclosure 2 show the parameters that were used in "SHAKE" code calculations to evaluate the dynamic response of the ground surface in the diesel generator building (DGB) area.

E. Vanmarcke described a study made by himself and two associates at M.I.T. of earthquake motion amplification at the top of the Midland site fill. As indicated in Appendix B of the above report, he concluded that, in the DGB area, the response spectra at the original ground surface may be amplified by a factor of about 1.54 in the neighborhood of 0.50 Hz. The ratio of response spectra generally decreases rapidly for higher frequencies and it falls below 1.0 at frequencies above 2 Hz.

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DATE ▶							

JUL 30 1981

J. Kane of the NRC Hydrologic and Geotechnical Engineering Branch requested the Applicant to provide the plots actually used in the "SHAKE" program (relationships of strain vs shear modulus and damping). The Applicant was also requested to calculate tne present the shock spectra, amplification factors, and rates of response spectra at elevations 634 and 628 for variations of Cases A, B and D (see Enclosure 3) where the full initial shear wave velocities are used with the normalized shear modulus vs shear strain curves to establish the curves actually used in the "SHAKE" code for the full layers. In making these calculations, the Applicant was asked to adopt El Centro and Lytle Creek (Allen Ranch) records scaled to 0.12g as outcrop of Saginaw bedrock. Anticipating receipt of the above information before July 31, Kane said that the Geotechnical Engineering Section plans to complete its review of Part II by August 15, 1981.

The June 1981 Addendum to Part I of the Weston report pertains to response spectra at the original ground surface of the Midland site. In answer to the staff's inquiry as to why consideration of records from the 1966 earthquake near Parkfield, California, were not included, the Applicant's consultants (Weston) responded that they do not believe the Parkfield data to be appropriate for Midland. Their reasons are essentially that: (1) the accelerations recorded at Parkfield are anomalous because the fault ruptured the ground surface; (2) the recordings were nearfield; and (3) neither of those situations prevails at Midland. Robert Jackson, Chief of the Geosciences Branch, stated that the response did not fully satisfy the Staff's concern. Consequently, the Applicant indicated that further study will be made of this matter and the Staff will await additional submittals before determining its position on the site specific spectra at the original ground surface.

Seismic Margin Review Criteria

J. W. Cook of Consumers Power and R. P. Kennedy and J. D. Stevenson of Structural Mechanics Associates presented draft criteria (Enclosure 3) for determination of seismic safety margins of Category 1 structures and components necessary for safe shutdown of the Midland reactors. This proposal will be evaluated by James Knight, Assistant Director for Components and Structures Engineering, and his staff. Further discussions will be conducted by telephone as necessary to clarify the proposal. These discussions are expected to result in a formal proposal by the Applicant on the review criteria.

/S/
Paul H. Leech, Project Manager
Licensing Branch No. 4
Division of Licensing

Enclosures:
As stated

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DATE	7/24/81	7/24/81	7/29/81	7/28/81	7/29/81		

MIDLAND

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Enclosure 1

LIST OF ATTENDEES

MEETING WITH CONSUMERS POWER COMPANY ON SEISMOLOGICAL INPUT ISSUES JUNE 30, 1981 AT BETHESDA, MD.

Consumers Power Company

J. W. Cook
N. Ramanujam
W. Cloutier
D. M. Budzik
T. R. Thiruvengadam

Consultants to Consumers Power Company

R. Holt - Weston Geophysical Corporation
Z. Cybriwsky - Weston Geophysical Corporation
E. P. Levine - Weston Geophysical Corporation

P. Shunmugavel - Bechtel Power Corporation

E. Kausel - Massachusetts Institute of Technology
E. Samaras - Massachusetts Institute of Technology
E. Vanmarcke - Massachusetts Institute of Technology

R. P. Kennedy - Structural Mechanics Associates
J. D. Stevenson - Structural Mechanics Associates

NRC Staff

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A. K. Ibrahim
R. E. Jackson
D. C. Jeng
J. D. Kane
J. K. Kimball
J. P. Knight
A. J. Lee
P. H. Leech
H. A. Levin
D. D. Reiff
L. Reiter
F. Rinaldi
R. L. Tedesco
J. Thessin
O. Thompson

Consultants to NRC Staff

P. F. Hadala - U.S. Army Engineers (Vicksburg)
H. N. Singh - U.S. Army Engineers (Detroit)

Enclosure 2

ENCLOSURE 2

SOIL PROFILE AND PROPERTIES OF NATURAL AND FILL MATERIALS

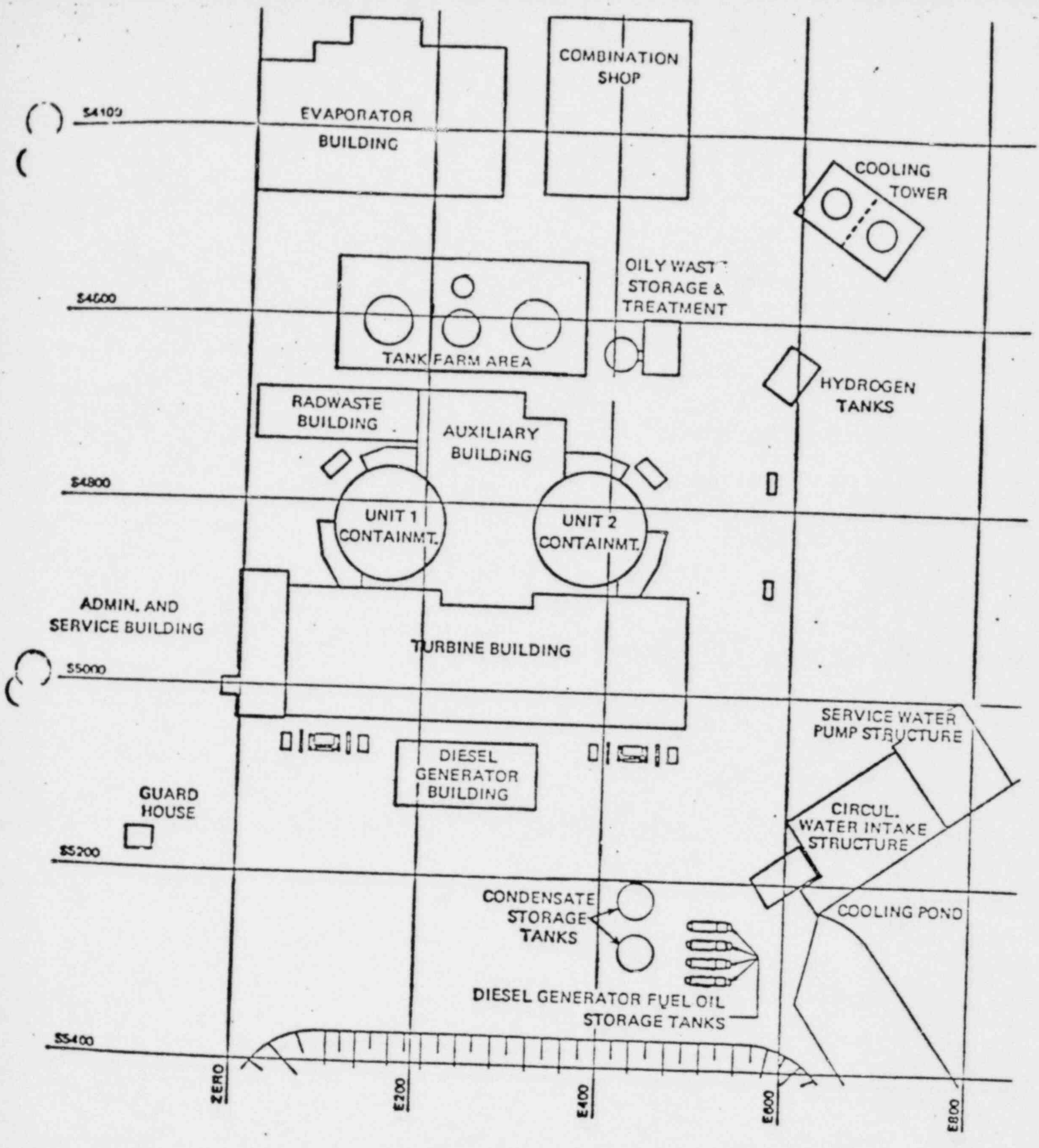


FIGURE 1

Site Plan

SHEAR WAVE (S) VELOCITY OF NATURAL MATERIALS (WESTON GEOPHYSICAL DATA)

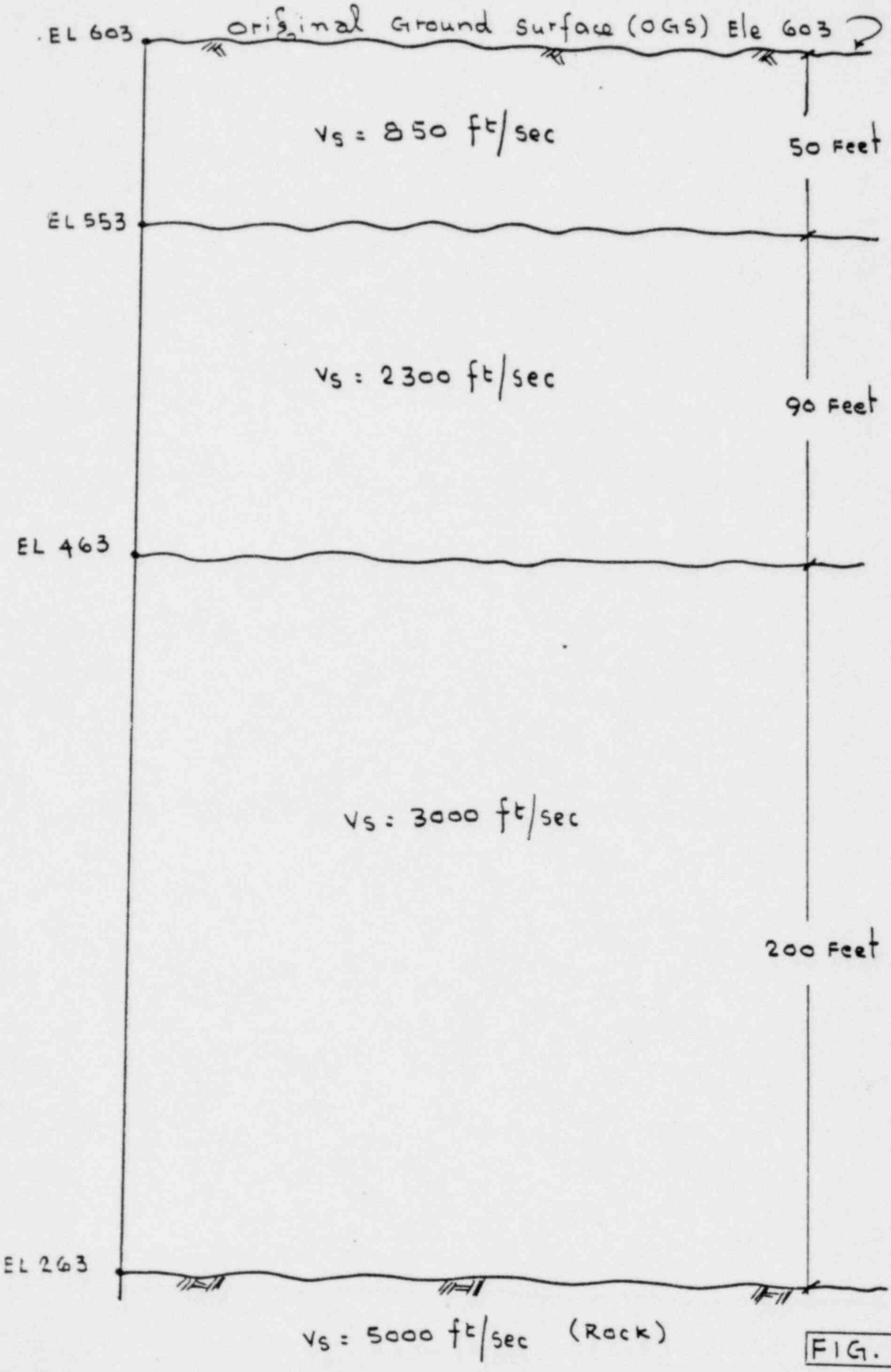


FIG. 2

SHEAR STRENGTH (C) PROPERTY OF NATURAL MATERIALS (DAMES & MOORE DATA)

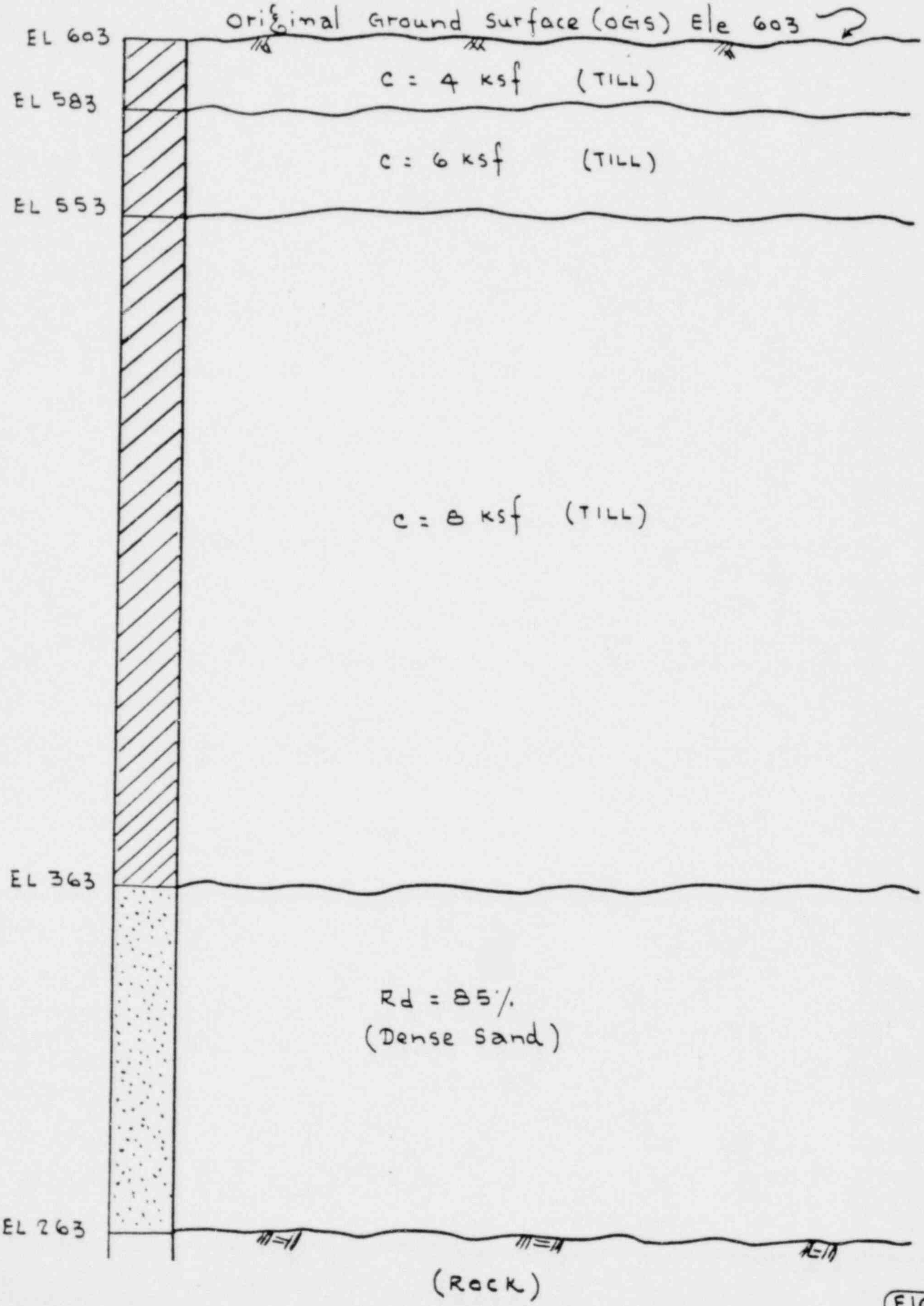


FIG: 3

SOIL PROFILE AND PROPERTIES OF NATURAL MATERIAL

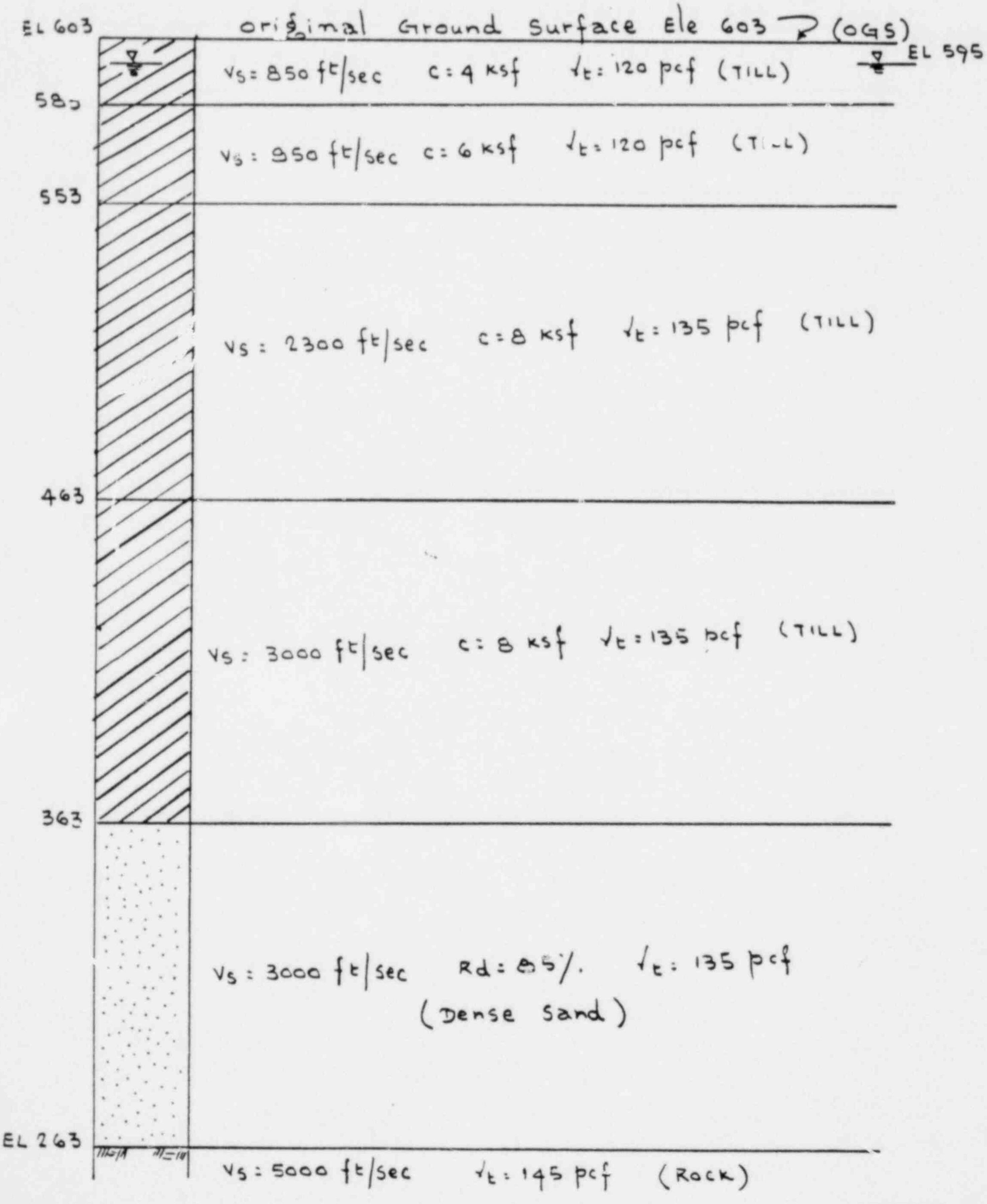


FIG: 4

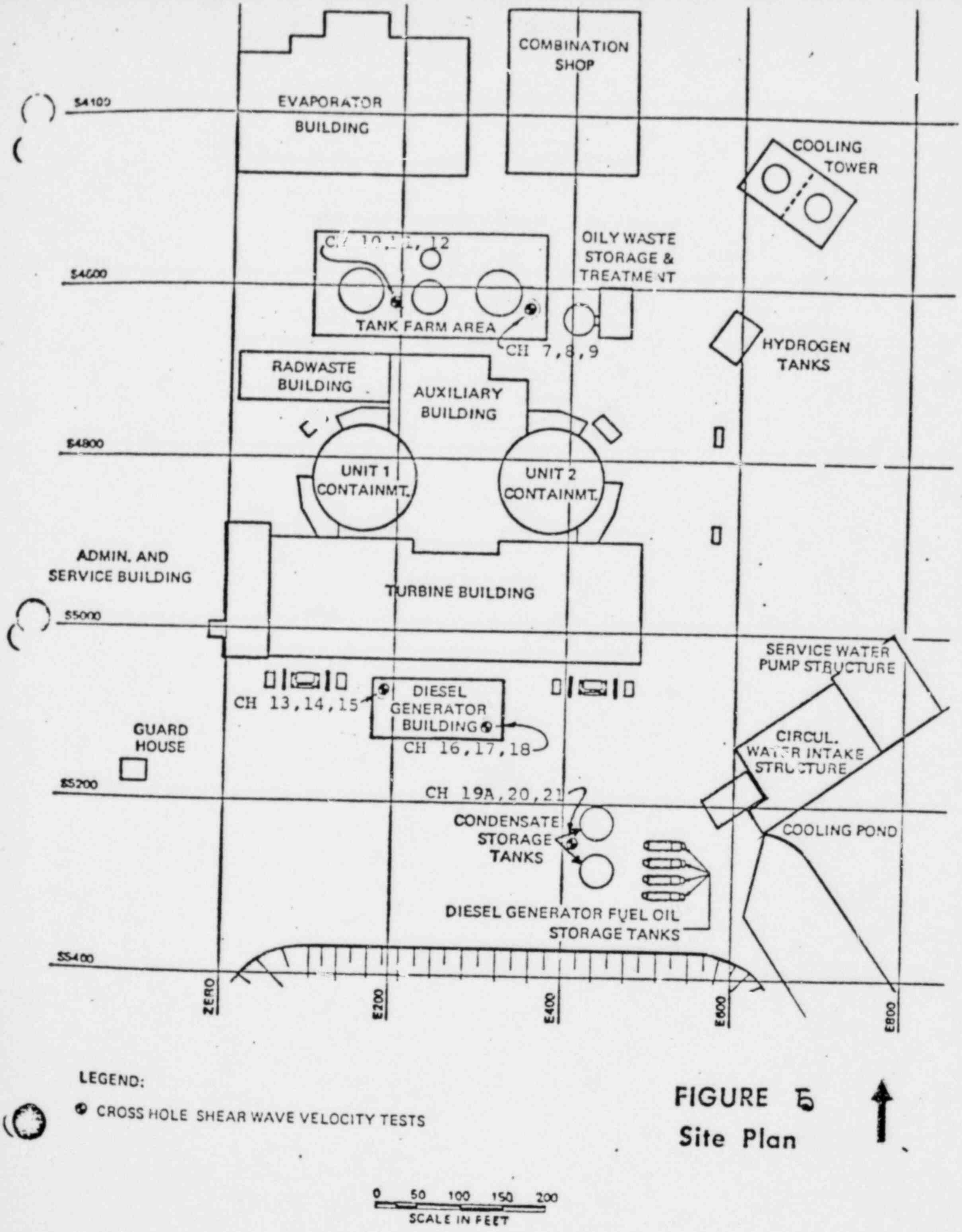


FIGURE 5

Site Plan

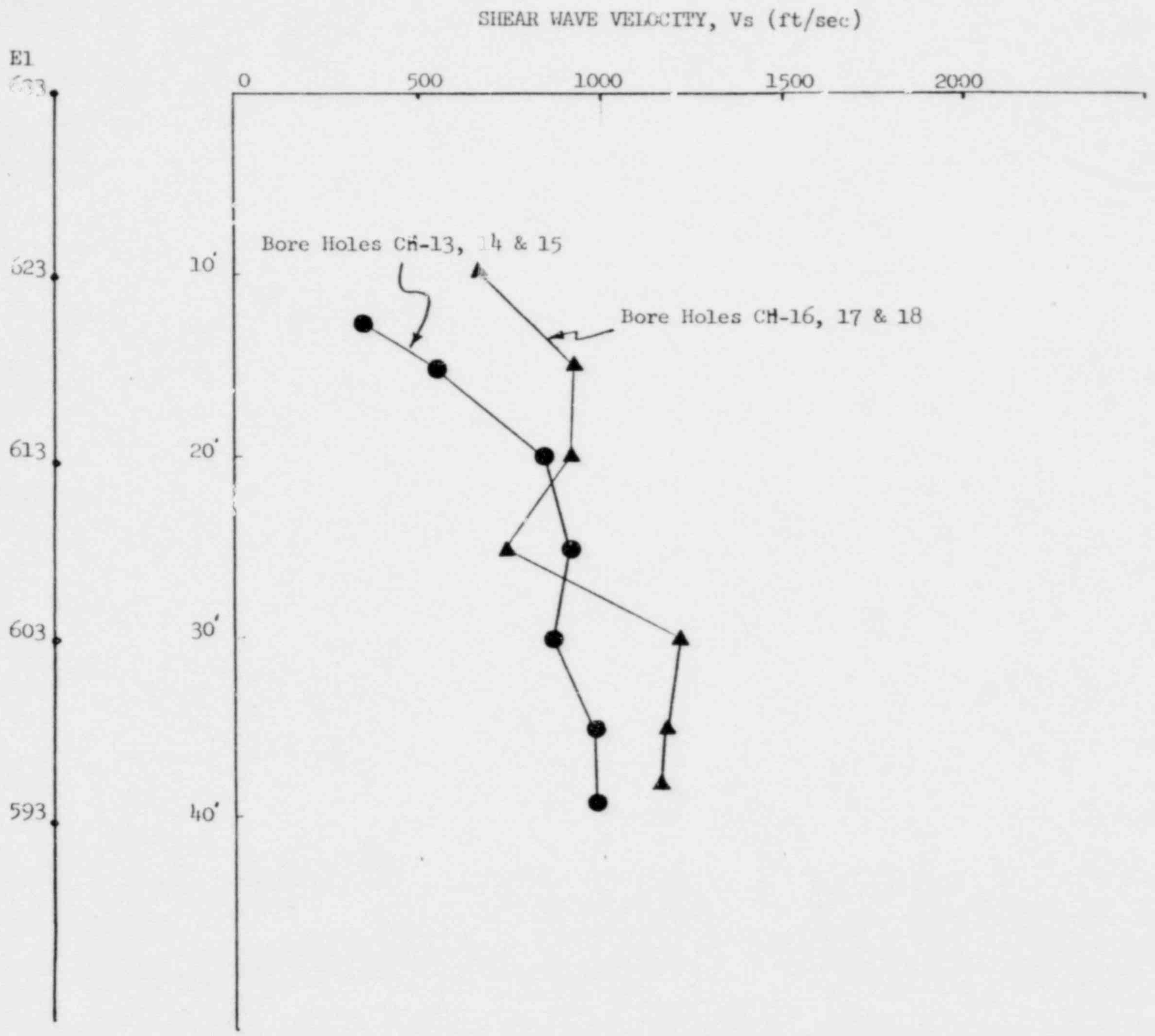

SHEAR WAVE VELOCITY, Vs (ft/sec)
0
500
1000
1500
2000
El
633
623
613
603
593
10'
20'
30'
40'
Bore Holes CH-13, 14 & 15
Bore Holes CH-16, 17 & 18

FIG: 6

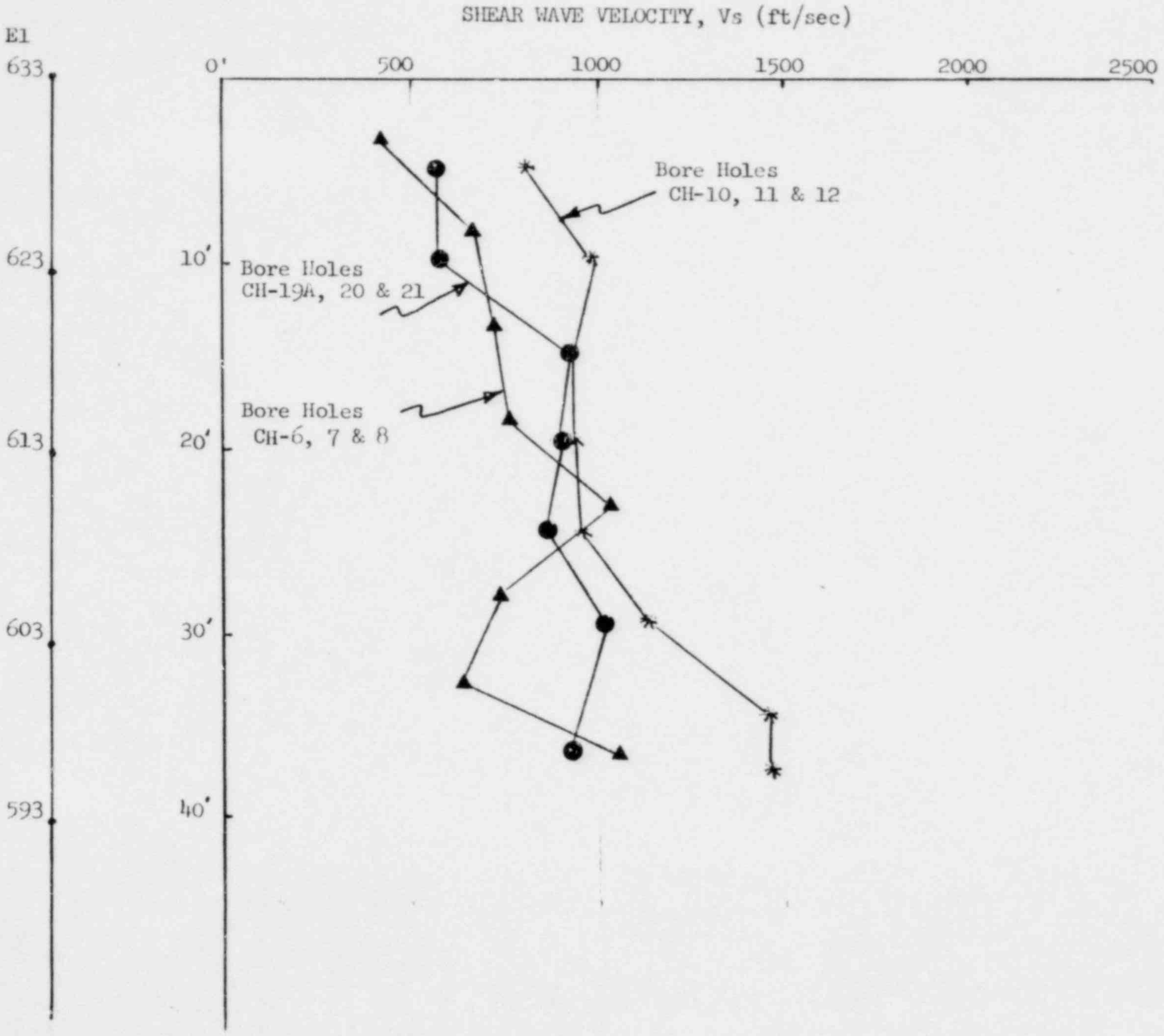
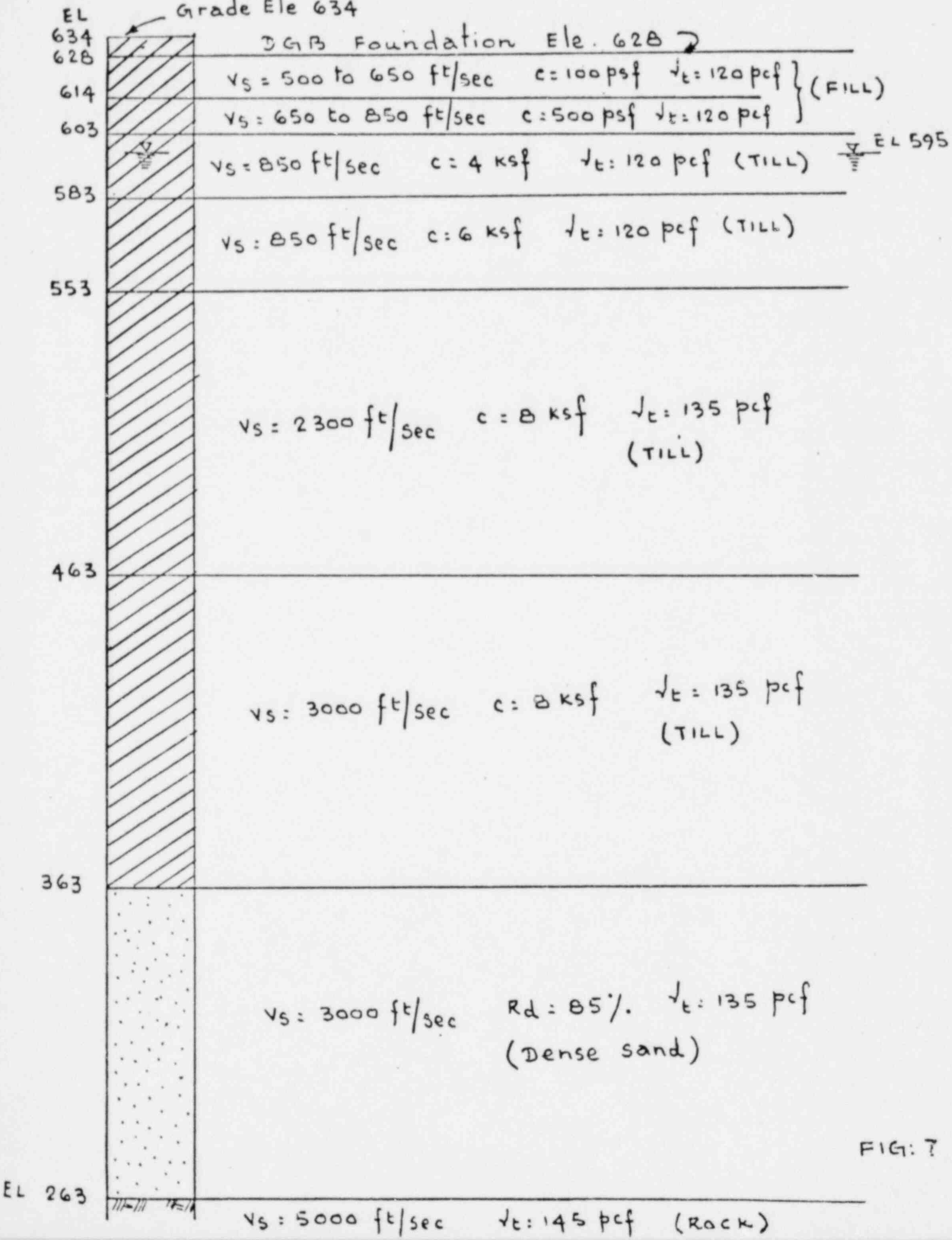

SHEAR WAVE VELOCITY, Vs (ft/sec)
El
633
623
613
603
593
0'
10'
20'
30'
40'
500
1000
1500
2000
2500
Bore Holes
CH-10, 11 & 12
Bore Holes
CH-19A, 20 & 21
Bore Holes
CH-6, 7 & 8

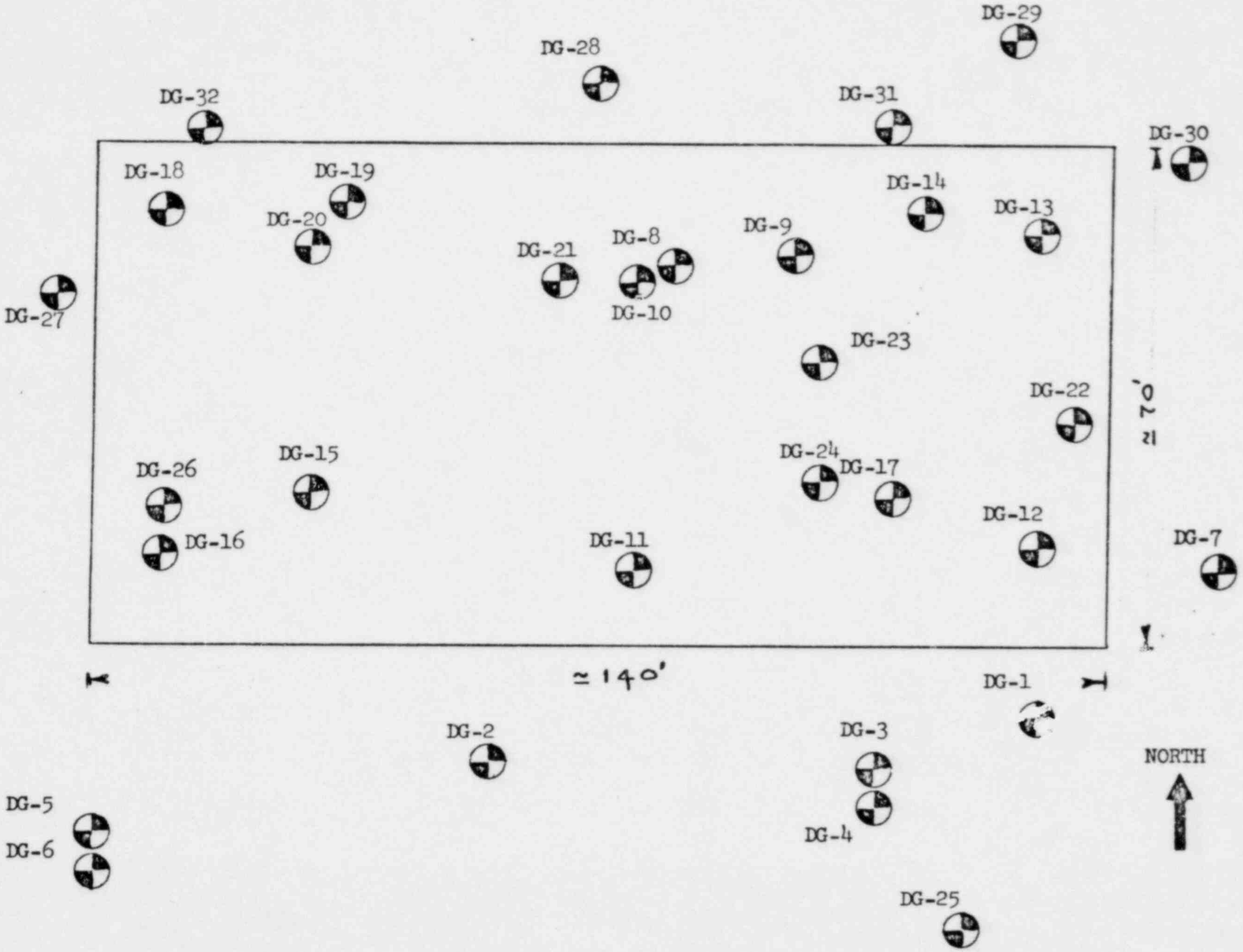
FIG 6A

CASE - A



EL
634
628
614
603
583
553
463
363
EL 263
Grade Ele 634
DGB Foundation Ele. 628
V_s = 500 to 650 ft/sec c: 100 psf γ_t: 120 pcf
V_s = 650 to 850 ft/sec c: 500 psf γ_t: 120 pcf
(FILL)
V_s = 850 ft/sec c: 4 ksf γ_t: 120 pcf (TILL)
EL 595
V_s : 850 ft/sec c: 6 ksf γ_t: 120 pcf (TILL)
V_s = 2300 ft/sec c = 8 ksf γ_t: 135 pcf (TILL)
V_s : 3000 ft/sec c: 8 ksf γ_t = 135 pcf (TILL)
V_s : 3000 ft/sec Rd = 85% γ_t: 135 pcf (Dense sand)
V_s : 5000 ft/sec γ_t: 145 pcf (ROCK)

FIG: 7



DIESEL GENERATOR BUILDING AREA

(NOT TO SCALE)

FIG:8

CASE - B (From Boring Nos: DG-9, DG-13, DG-14 & DG-31)

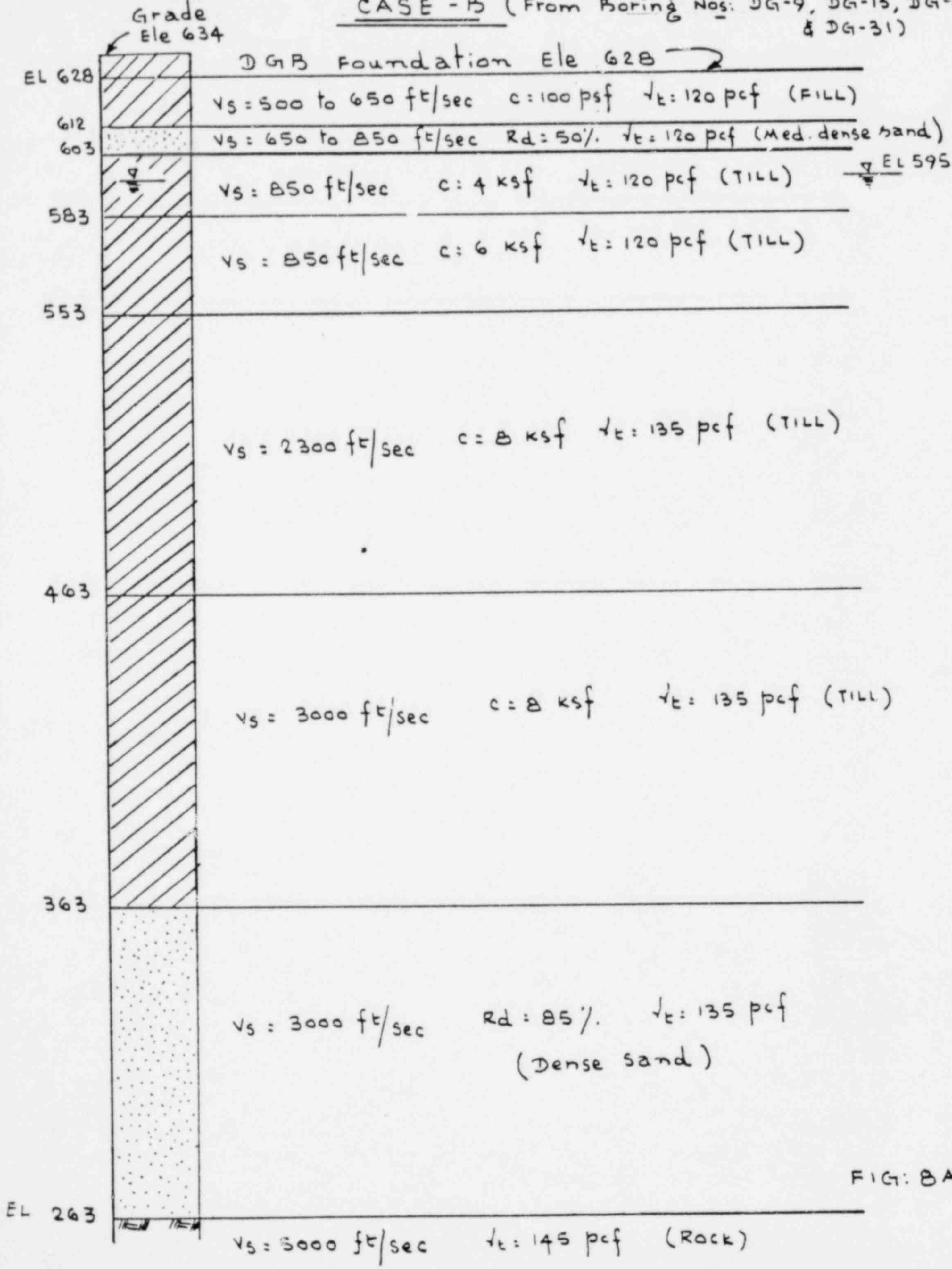


FIG: 8A

CASE - C (From Boring Nos: DG-18, DG-20, DG-27 and DG-32)

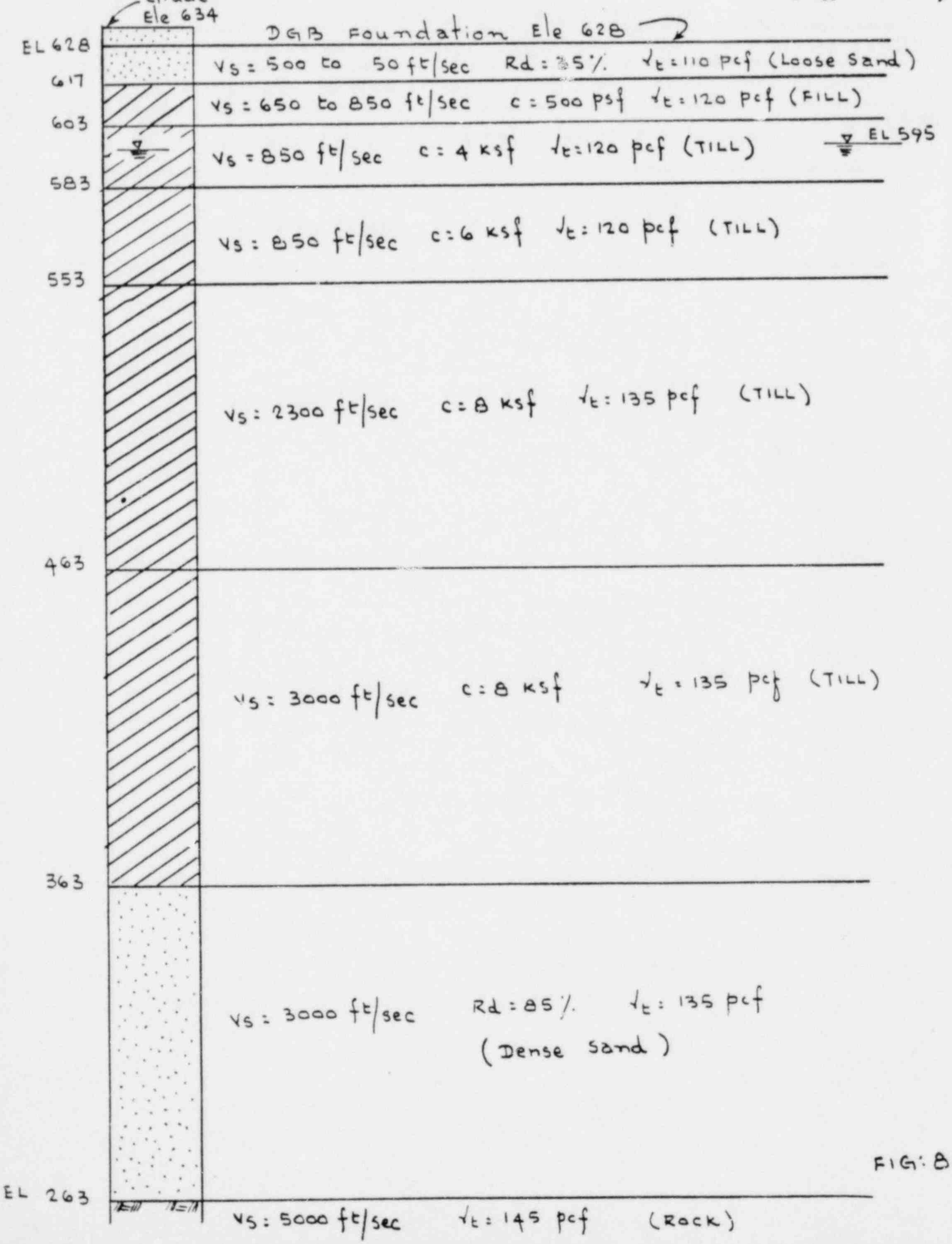


FIG: 8B

CASE - D (From Boring Nos: DG-2, DG-5, DG-6 DG-15 and DG-16)

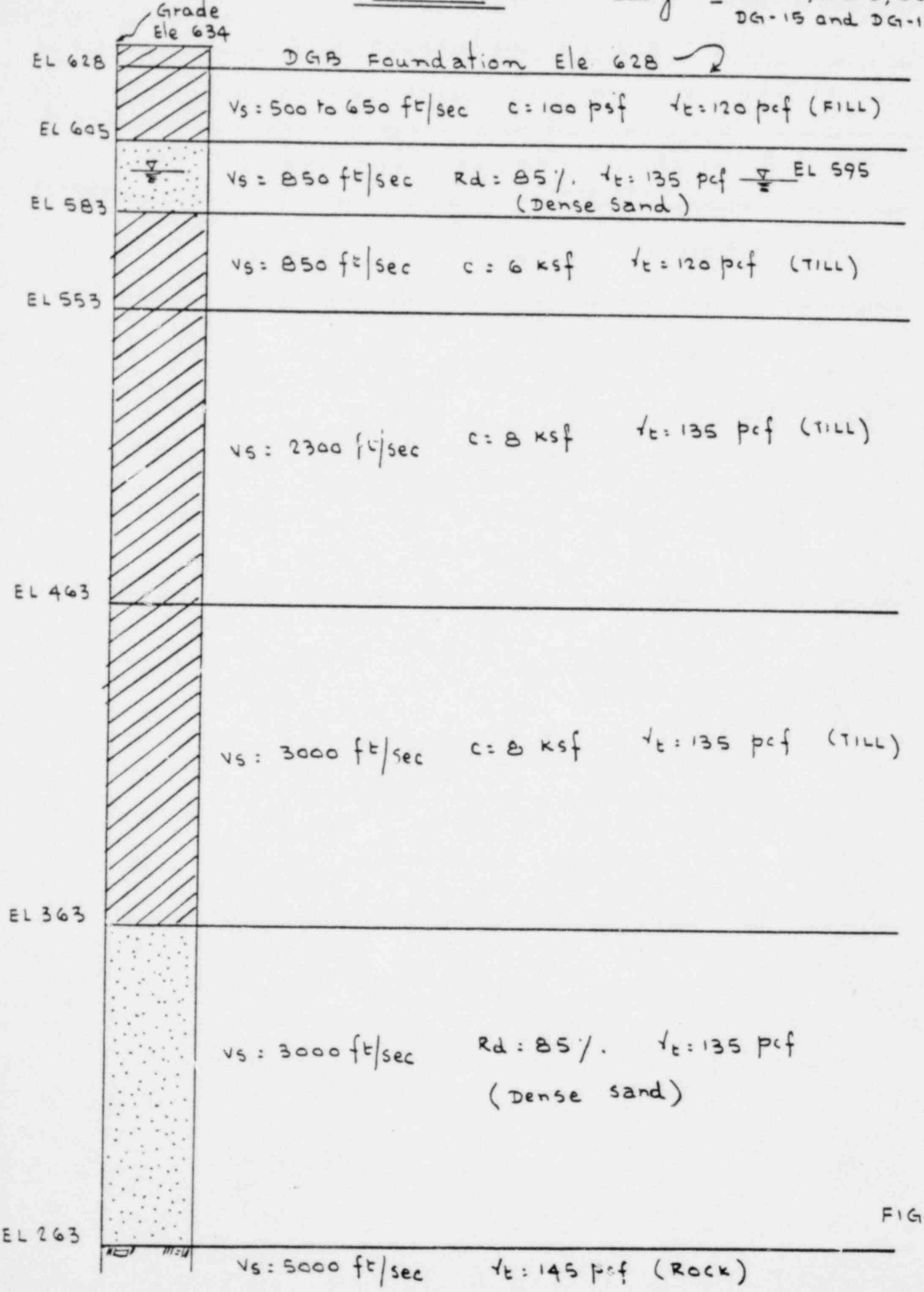


FIG: 8C

Enclosure 3

THE PURPOSE OF THIS PRESENTATION IS TO SUGGEST A DRAFT CRITERIA BY WHICH MIDLAND NUCLEAR POWER PLANT SEISMIC CATAGORY I STRUCTURES AND COMPONENTS NECESSARY FOR SAFE SHUTDOWN OF THE REACTOR CAN BE EVALUATED TO DETERMINE SEISMIC SAFETY MARGINS ASSOCIATED WITH THE SITE SPECIFIC EARTHQUAKE DEFINED FOR THE MIDLAND SITE.

SEISMIC MARGIN REVIEW

A. STRUCTURES TO BE EVALUATED

- (a) CONTAINMENT STRUCTURE
- (b) CONTAINMENT INTERNAL STRUCTURE
- (c) AUXILIARY BUILDING-CONTROL TOWER
- (d) SERVICE WATER PUMP STRUCTURE
- (e) BORATED WATER STORAGE TANK
- (f) DIESEL GENERATOR BUILDING

B. MECHANICAL AND ELECTRICAL COMPONENTS TO BE EVALUATED

- (a) PIPING SYSTEMS - 3 to 4
- (b) TANKS AND HEAT EXCHANGERS - 3 TO 4
- (c) VERTICAL PUMPS - 2
- (d) MOTOR OPERATED VALVES - 3 TO 4
- (e) ELECTRICAL PANEL BOARDS - 2 TO 3
- (f) ELECTRICAL EQUIPMENT RACKS - 2 TO 3
- (g) ELECTRICAL CABINETS - 2 TO 3
- (h) HVAC COMPONENTS - 2
- (i) HVAC DUCT - 2
- (j) CABLE TRAYS AND CONDUIT - 3 TO 4

EVALUATION OF COMPONENTS WILL INCLUDE CONSIDERATION OF ACTIVE AS WELL AS PASSIVE MODES OF FAILURE.

LOAD COMBINATIONS

LOAD COMBINATIONS

THE SEISMIC MARGIN REVIEW SHALL BE CONDUCTED FOR THE FOLLOWING LOAD COMBINATION:

$$U = 1.0D + 1.0L + kE_{sm}$$

WHERE:

U = LIMITING LOAD ON THE STRUCTURE OR COMPONENT

D = DEAD LOAD

L = OPERATING LIVE LOAD DURING NORMAL OPERATION PLUS ANY LIVE LOAD OCCURRING AS A DIRECT RESULT OF EARTHQUAKE LOADING

E_{sm} = SAFETY MARGIN EARTHQUAKE LOAD

k = COEFFICIENT AS A FUNCTION OF DUCTILITY LEVEL[3]

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[3] THE SELECTION OF THE COEFFICIENT OF $k = 0.8$ ACKNOWLEDGES THAT THE STRUCTURE OR COMPONENT CAN WITHSTAND A LIMITING DUCTILITY $\mu = 1.3$. FROM REFERENCE 3 THIS RESULTS IN A REDUCTION OF SEISMIC ACCELERATION INDUCED RESPONSE OF $1/\mu = 1/1.3 = 0.77$ FOR STRUCTURES OR COMPONENTS HAVING DOMINATE FREQUENCIES BELOW 2 Hz AND $1/\sqrt{2\mu - 1} = 1/\sqrt{(2 \times 1.3) - 1} = 0.79$ FOR DOMINATE FREQUENCIES IN THE 2-8 Hz RANGE.

ACCEPTANCE CRITERIA

FOR PASSIVE COMPONENTS (STRUCTURAL AND LEAK TIGHT INTEGRITY ONLY) TOTAL STRESSES RESULTING FROM THE LOADING, U, SHALL BE LIMITED AS DEFINED IN THE MIDLAND FSAR EXCEPT AS FOLLOWS:

(a) A SEISMIC COEFFICIENT OF $k = 0.8$ MAY BE USED FOR THE COMPONENT OF LOAD, E_{sm}, EXCEPT FOR NON-DUCTILE AND BUCKLING FAILURE MODES WHERE A COEFFICIENT $k = 1.0$ SHALL BE USED. ON A CASE BY CASE BASIS, A DUCTILITY > 1.3 MAY BE USED. THEREFORE, THE VALUE $k < 0.8$ DETERMINED AS SHOWN IN REFERENCE 3 MAY BE USED.

(b) ACTUAL MEASURED OR SAMPLED MEAN MATERIAL PROPERTIES MAY BE USED RATHER THAN SPECIFIED MINIMUM YIELD OR CRUSHING STRENGTH.

(c) CURRENT ASME/ACI CODE LIMITS MAY BE USED PROVIDED MATERIAL SELECTION AND FABRICATION REQUIREMENTS ARE COMPARABLE TO CURRENT CODE REQUIREMENTS.

FOR ACTIVE COMPONENTS (MUST OPERATE OR CHANGE STATE), TOTAL STRESSES RESULTING FROM THE LOADING, U, SHALL BE LIMITED TO NORMAL CODE ALLOWABLE PLUS 20 PERCENT, BUT IN NO CASE SHALL EXCEED 0.8 TIMES YIELD OR THE ONSET OF NON-LINEAR BEHAVIOR.

TABLE 2 Damping Values - Percent Critical to be Used in the Seismic Margins Review for Passive Components(4)

Structure or Component	Percent Critical Damping
Large diameter piping systems Pipe diameter 12 in.	4.0(1)
Small diameter piping systems Pipe diameter 12 in.	3.0(1)
Welded Steel Structures	4.0(3)
Bolted Steel Structures	7.0(3)
Welded Steel Components(2)	4.0
Bolted Steel Components(2)	7.0
Reinforced Concrete Structures	7.0(3)
Prestressed Concrete Structures	5.0(3)

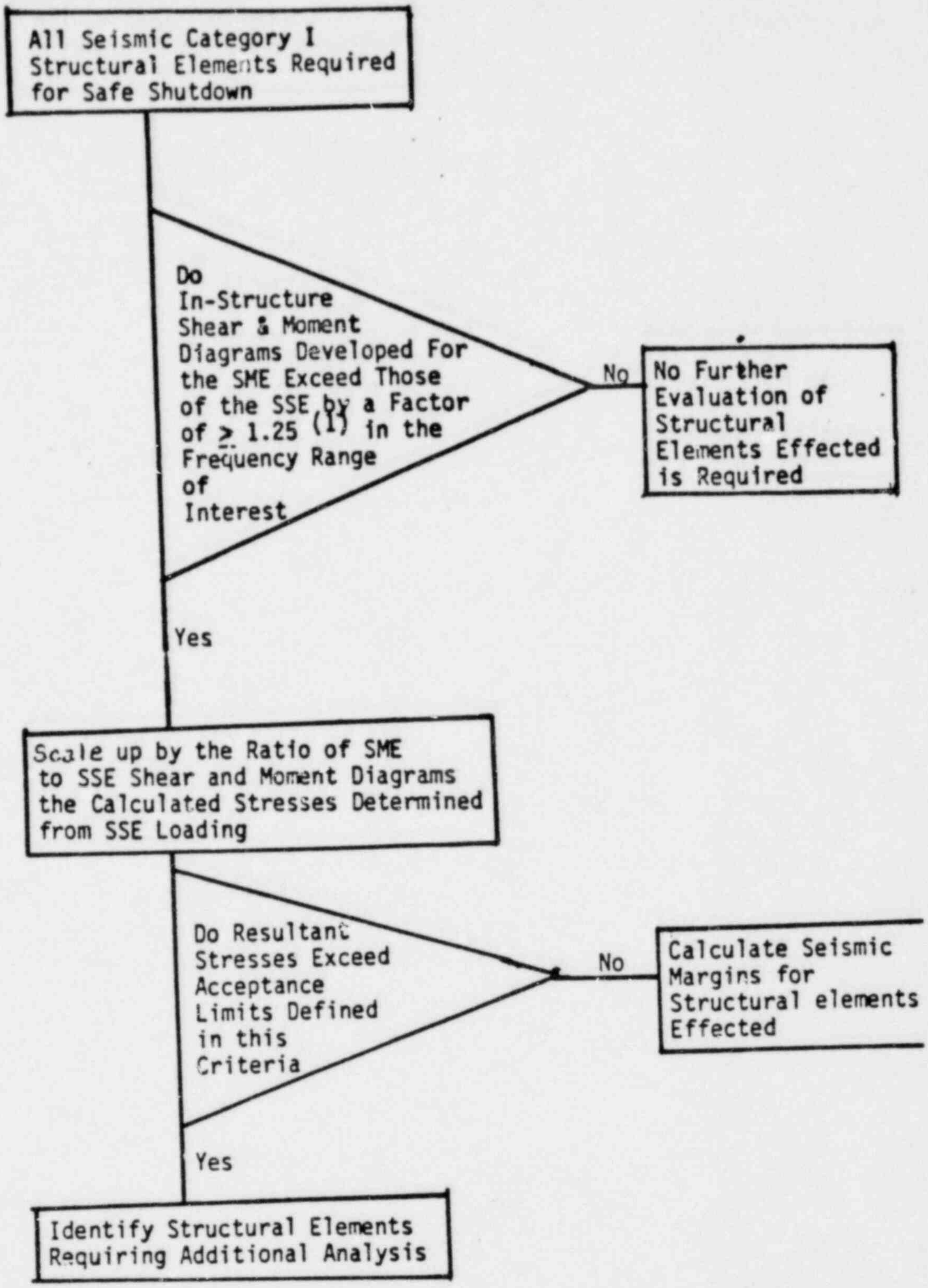
---

(1) These values are based on test performed by Westinghouse Electric Co.(6, 7)

(2) These damping values are consistent with damping values defined for welded and bolted structures and by review of existing test data.(8)

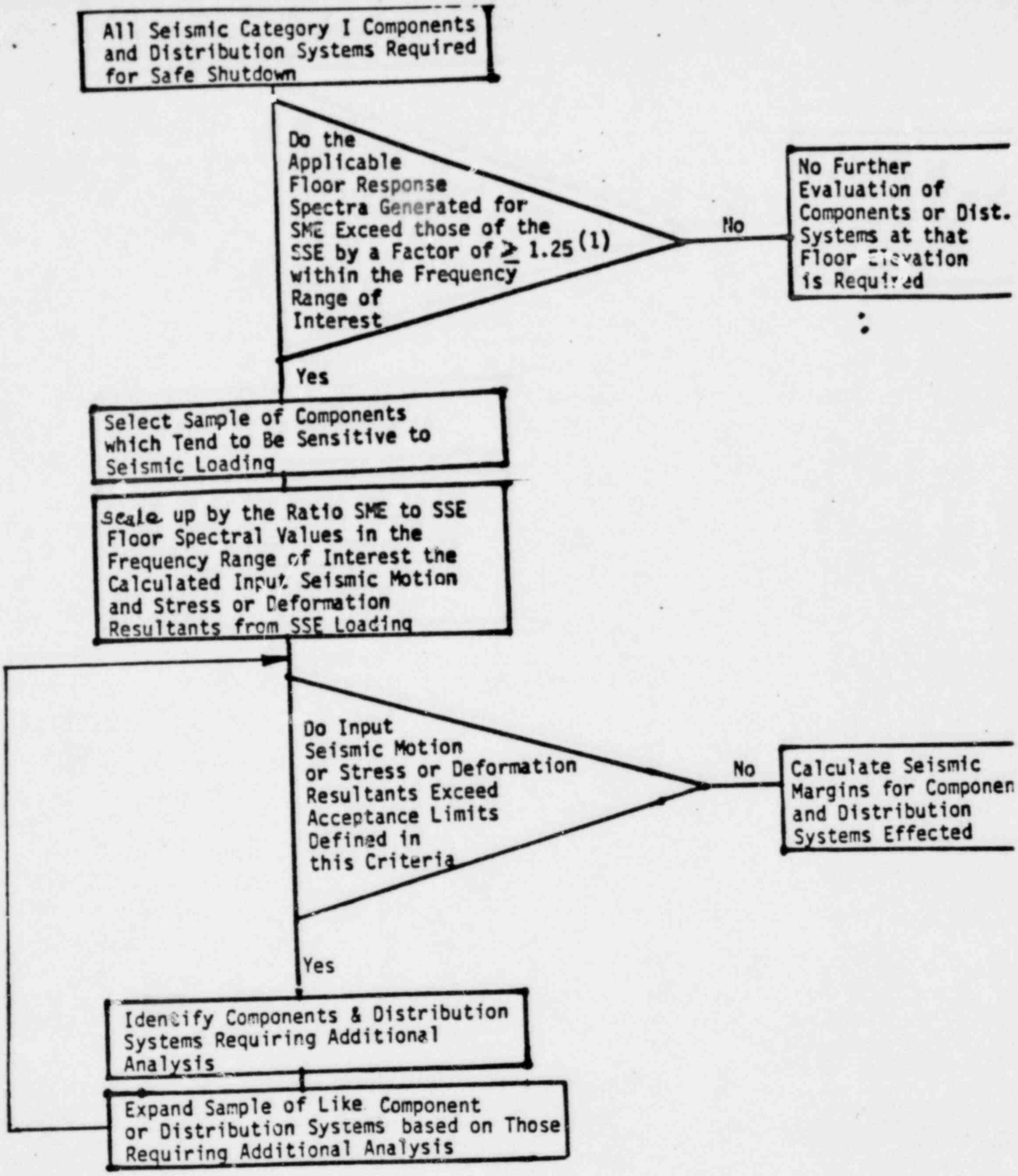
(3) R.G. 1.61 OBE damping levels shall be used as structural damping in generation of floor response spectra where total calculated stresses in the structure for the SME do not exceed 1/2 yield.

(4) Damping values used in evaluation of active components shall be reduced in the same proportion of OBE to SSE damping values as defined in Table 1 of R.G.1.61.



(1) See footnote 3 to Section 4.1 for development of 1.25 coefficient as reciprocal of 0.8.

Figure 1 - Screening Process to Select Structural Elements for Seismic Safety Margin Evaluation



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(1) See footnote 3 to Section 4.1 for development of 1.25 coefficient as reciprocal of 0.8.

Figure 2 - Screening Process to Select Components and Distribution Systems for Seismic Safety Margin Evaluation

SOIL STRUCTURE INTERACTION

A SIMPLIFIED APPROACH INVOLVING A LUMPED PARAMETER MODEL SHALL BE USED SUBJECT TO THE FOLLOWING CONDITIONS:

(a) TWO CONTROL FREE FIELD SITE DEPENDENT GROUND RESPONSE MOTIONS ARE DEFINED AT THE TOP OF NEW FILL AND AT ORIGINAL GRADE LEVEL (TOP OF TILL). FOR BUILDINGS FOUNDED BELOW THE ORIGINAL GROUND LEVEL, THE ORIGINAL TOP OF TILL SPECTRA SHALL BE USED AS INPUT AT THE STRUCTURE FOUNDATION LEVEL. FOR BUILDINGS FOUNDED IN THE FILL, AN ENVELOPE OF THE TOP OF FILL AND TOP OF TILL SITE SPECIFIC SPECTRA SHALL BE INPUT AT THE BUILDING FOUNDATION LEVEL.

(b) SOIL STIFFNESS VARIABILITY SHALL BE BASED ON A BEST ESTIMATE OF SOIL PROPERTIES PLUS UNCERTAINTY BOUNDS

(c) RADIATION AND MATERIAL ENERGY DISSIPATION (I.E. THE SOIL DAMPING VALUES) ARE ADDITIVE

(d) DAMPING VALUES USED IN THE ANALYSIS SHALL BE DETERMINED AS FOLLOWS:

  (i.) MATERIAL SHALL BE TAKEN AS 5 PERCENT OF CRITICAL

  (ii.) RADIATION-TRANSLATIONAL (HORIZONTAL AND VERTICAL) TO BE TAKEN AS 75 PERCENT OF THEORETICAL VALUE[1]

  (iii.) RADIATION-ROTATION (ROCKING AND TORSION) TO BE TAKEN AT 100 PERCENT OF THEORETICAL VALUE[1]

  (iv.) COMPOSITE MODAL DAMPING VALUE IN EXCESS OF 10 PERCENT OF CRITICAL SHALL BE JUSTIFIED ON A CASE BY CASE BASIS IF USED.[2]

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[1] AS CALCULATED BY GENERALLY ACCEPTED METHODS, (e.g. VIBRATION OF SOILS AND FOUNDATIONS, BY F.E. RICHART, J.R. HALL AND R.D. WOODS, PRENTICE-HALL INC., 1970

[2] FOR RIGID BODY MOTION NO CUT OFF IS DEFINED

MEETING SUMMARY DISTRIBUTION

JUL 3 0 1981

Docket File 50-329/330 OM, OL
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