COLLEGE OF ENGINEERING Department of Civil Engineering

# Draft Report

# PROCEDURES FOR CONDUCTING CONSOLIDATED DRAINED AND CONSOLIDATED UNDRAINED TRIAXIAL TESTS

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## ORA PROJECT 320114

## under contract with:

MICHIGAN DEPARTMENT OF STATE HIGHWAYS CONTRACT NO. 71-1322 LANSING, MICHIGAN

## administered through:

August 1972

#### OFFICE OF RESEARCH ADMINISTRATION

ANN ARBOR

LIBRARY RESEARCH LABORATORY TESTING & RESEARCH DIVISION MICH. DEPT. OF STATE HWYS.

#### INTRODUCTION

Soil types that cause problems for the Michigan Department of State Highways (MDSH) are the sediments such as found in the valleys of the St. Joseph, Muskegon and Saginaw Rivers. These sediments consist of strata of loose sand, and organic silt and clay. The methods used to build highways over these deposits vary with the depth and stratification of the deposit and the importance of the highway. Shallow deposits are usually excavated and replaced with sound fill. Deep deposits are bridged using a deep foundation if the highway warrants the cost involved.

If the deposit is deep and if bridging is too costly, the method used involves the limited excavation of the sediments and the floating of the fill. With this method, the soil consolidates under the weight of the fill and the fill settles. To minimize settlement after the pavement structure is built the fill is constructed as far in advance as possible before paving. Any settlement after paving is taken care of by periodic maintenance. The amount of settlement and the time for it to occur are based on past experience.

The laboratory tests, the analytical methods and the field techniques are available for determining reasonable estimates of the rate of surcharging and of the resulting settlement. The use of these procedures could result in construction and maintenance costs savings to the MDSH. For example, it may be more economical on some major projects to surcharge and consolidate these sediments, perhaps with aid of vertical sand drains, than to bridge them using deep foundations. On other projects a more adequate knowledge of the consolidation characteristics of these deposits could result in better control of the surcharging and the settlement. This in turn would lead to a reduction in maintenance after the completion of the project.

The major input data required for the analytical methods are the consolidation characteristics of the soil and the parameters needed to predict the increase in shear strength with

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consolidation. These imput data are obtained from consolidation and triaxial tests conducted in the laboratory on undisturbed soil specimens. In the past the MDSH has not been able to avail itself of these methods mainly because the Testing Laboratory has not been in a position to conduct the necessary tests on a routine basis. The Testing Laboratory now has the necessary consolidation and triaxial equipment. The major purpose of this project is to develop tests procedures for the triaxial equipment so the required shear strength parameters can be determined.

## TYPES OF TRIAXIAL TESTS

The shear strength of fine-grained soils is very complex and not completely understood. These soils are relatively compressible when compared with granular soils. Therefore, when the load is first applied it is initially supported by the pore fluid as an excess pressure or neutral stress and is not transmitted to the soil structure. As the excess pressure dissipates the intergranular pressure or effective stress between the soil particles increases. The rate at which this transfer takes place is dependent upon the permeability of the soil and on the nature of the pore fluid; whether it is air, water or both. In other words. whether the soil is dry, partially saturated or saturated. Further complicating the understanding of the shear strength of fine-grained soils are the very significant forces of attraction and repulsion developed between clay particles because of their large specific surfaces.

Three basic types of triaxial tests are run to study the shear strength of fine-grained soils. These tests are defined in terms of the neutral stress dissipation and the increase in effective stress. The consolidated drained test (CD test) is run in such a manner so as to cause no change in the neutral stress. Any increase in total stress produces a corresponding change in effective stress. The consolidation of the soil takes place in two stages. First, the soil is consolidated under the confining cell pressure

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and second during the application of the axial load. In both stages the soil is allowed to drain freely, and the stresses are applied slowly so that the neutral stress remains unchanged. The void ratio and the water content are reduced during both stages.

The consolidated undrained test (CU test) is also conducted in two stages. The soil is first consolidated with free drainage under the confining pressure. During this stage the neutral stress remains unchanged and there is a reduction in void ratio and water content. After consolidation is complete, the axial stress is applied rapidly without drainage. The increase in stress results in changes in the neutral stress. In the case of saturated soils the void ratio and water content remains unchanged during this stage. In partially saturated soils the water content remains unchanged since there is no drainage but the void ratio can change.

The third type of triaxial test is the unconsolidated undrained test (UU test). This procedure differs from the others in that drainage is not allowed at any time and, therefore, no consolidation takes place. The confining pressure is applied followed immediately by the axial stress. In saturated soils, the void ratio and water content remain unchanged and all of the added stress is supported by the neutral stress.

Since the neutral stress remains unchanged in the CD test, the effective stress and total stress are the same. The shear strength parameters determined from this test are in terms of In the UU and CU tests the excess pore pressure effective stress. is not allowed to dissipate during the shearing process. Therefore, the total stress and effective stress differ by the magnitude of the excess pore pressure. The shear strength parameters from these two tests, then, are in terms of total stress. The parameters can be found in terms of effective stress if accurate pore pressure measurements are made. This is frequently done because of the excessive testing time required for CD tests on soils with low permeability.

The MDSH Testing Laboratory has a procedure for conducting UU tests and have been performing this type for a number of years. The procedure used essentially follows that outlined in ASTM

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Designation: D2850 - 70, Standard Method of Test for Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression.

The Testing Laboratory does not have procedures for the CD and CU tests. As noted in the introduction, the purpose of this project is to develop procedures for these two types of tests.

### METHODS OF LOADING

There are two methods of loading that can be used in conducting the tests: controlling the strain or controlling the stress. In the former the sample is deformed at a constant rate of strain. The stress is determined at various strains so that a stress-strain curve can be plotted. The rate at which the sample is strained is dependent upon the type of test and whether pore pressure measurements are to be made.

The stress controlled method uses incremental loading. The strain is determined for each loading so that a stress-strain curve can be plotted. The magnitude and duration of the load increments is dependent upon the type of test and whether pore pressure measurements are to be made.

There are advantages and disadvantages in each method relative to the other. A paper by Lundgren, Mitchell and Wilson (Reference 1) discusses this topic and presents a triaxial apparatus which uses both procedures at various stages of the test.

The major advantage of the stress controlled method is that, by monitoring the volume change, the duration of the load increment can be adjusted to assure complete dissipation of the pore pressure in the CD test. Pore pressure measurements can also be obtained, if desired, in UU and CU tests by using load durations that result in pore pressure equalization. The pore pressure can be determined by using a pressure transducer. If possible the load increments should be equal, and the duration of each increment should be the same for clay soils to minimize secondary compression effects.

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With the strain controlled method pore pressure dissipation in CD tests can only be assured if the rate of strain is very slow which means the time for testing may be excessive. A method of estimating the strain rate by studying the volume change is presented in Bishop and Henkel (Reference 2) on page 124. Filter paper drains can be used to reduce the testing time (page 81, Reference 2).

In UU and CU tests, the strain rate must be slow enough to allow pore pressure equalization. This rate can be found for CU tests during the consolidation stage by monitoring the pore pressures. UU tests would require the consolidation at the same confining pressure of a duplicate specimen.

There are two other advantages of the stress controlled method. First, for any load increment, strain versus time curves can be plotted. These provide the time dependent creep properties and would allow the plotting of a yield value curve as is done in the transverse shear test. Second, an indication of the yield stress of structure sensitive clays may be obtained.

One of the disadvantages of the stress controlled method is that failure may be abrupt and result in complete collapse of the specimen. With this type of failure it is difficult, if not impossible, to determine the peak failure stress and strain, or to study the stress-strain relationships beyond the peak point. Without the accurate measurement of the peak failure stress and strain, the shear strength parameters would be in error for all three types of test.

Another disadvantage is that in the CD test the application of the failure load can result in failure under undrained or partially drained conditions rather than the complete drainage desired. The failure stress, then, would not be the effective stress as excess pore pressure would be present. Therefore, the shear strength parameters at failure would not be the effective parameters desired.

In UU and CU tests, the application of the failure load increment can cause rapid or abrupt failure so that pore

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pressures at this time cannot be accurately measured. If this occurs it would preclude the determination of the effective shear strength parameters from the undrained test results.

One other disadvantage is that influence of the rate of strain on shear strength cannot be conveniently studied. The rate at which soils are strained has an effect on the shear strength as discussed by Casagrande and Wilson (Reference 3) and by Bishop and Henkel (Reference 2).

The MDSH Testing Laboratory has used the stress controlled method of loading in its shear testing of soils since the early 1930's. The procedures for the transverse, the unconfined compression and the UU triaxial shear tests employ this loading procedure. The latest triaxial apparatus purchased by the Laboratory, Karol-Warner Model 541 Triaxial Tester, is of the stress controlled type. The test procedures for the CD and CU tests developed under this project also use this loading method. Because of the disadvantages of the stress control method discussed above, it is recommended that the MDSH consider the purchase of a strain controlled apparatus to add flexibility to its triaxial testing program.

## DISCUSSION OF PROCEDURES

The detailed step-by-step test procedures employing the MDSH Testing Laboratory's equipment are presented in Appendix I. Since the procedures are given in detail they will not be discussed in depth.

Procedures for conducting CD and CU tests using stress controlled loading are outlined. They follow quite closely, except for the method of loading, the procedures as given in Bishop and Henkel (Reference 2). The most difficult part is the estimation of the load increments. Enough increments must be used so that a well-defined stress-strain curve can be plotted. The magnitude should be such as that the peak strength can be selected as accurately as possible. This requirement will usually result in using equal increments at first and then decreasing them in the later stages of the test.

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The duration of the increment depends upon the type of test being run. In CD tests, there must be time for complete drainage. This can be determined by monitoring the volume change or from past experience with similar soils. In CU tests, the pore pressures should be equalized before applying the next load increment. Either past experience or pore pressure measurements can be used to find the time necessary for equalization. The measuring of the pore pressures has the advantage of permitting the determination of the effective shear strength parameters.

As part of the procedure for CU tests the steps for using the pressure transducer are presented. Also outlined in this procedure is the volume change method for determining when primary consolidation is complete. Both of these methods require that all parts of the involved systems be completely filled with water. Any entrapped air will affect the accuracy of the results.

A procedure for saturating specimens through back pressuring is also outlined. Use of back pressuring and when it is needed is discussed in Bishop and Henkel (Reference 2). It is very important that the specimen be under a confining pressure equal to the back pressure. This will minimize volume changes during saturation.

The set-up of the transducer amplifier is the last procedure presented. The equipment was calibrated and the necessary calibration resistors were installed. There were indications during the use of the pressure transducer and amplifier system that the system lacks the sensitivity necessary for accurate measurement of the pore pressures. The needle on the amplifier showed no change in pore pressure when it was known that changes were taking place. If further testing confirms this, the manufacturer should be contacted to see if the sensitivity can be increased.

#### DISCUSSION OF TEST RESULTS

To aid in the development and to test the procedures, a number of triaxial tests were performed. The results of these

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tests are presented in Appendix II.

Initially it was intended to use an artificially sedimented compressible silt-clay mixture. It was hoped that a soil could be produced that would be somewhat similar to the river sediments mentioned at the beginning of this report. The attempt was abandoned after several unsuccessful tries due to the problems encountered and the lack of time.

The soil selected for use in the testing program was a non-plastic sandy silt taken from near Glacier Way, a road in the vicinity of the North Campus of the University of Michigan. This soil was selected because it has been used for a number of studies conducted in the Soil Mechanics Laboratory of the University. It has enough cohesion so that it can be trimmed to the desired dimensions, and has fair permeability so that pore pressure equilibrium is established in a reasonable time. The graduation of the soil is shown in Fig. 1.

The first series of triaxial tests were CD tests run using the constant rate of strain apparatus in the Soil Mechanics Laboratory of the University of Michigan. The sandy silt was first consolidated under the given cell pressure and then tested at a constant rate of strain of 14.9 min/mm. The resulting stress-strain curves are presented in Fig. 2. Problems with the loading system were encountered in Test CSN-CD3 after a strain of 1.75%. The data after this point is from a previous test conducted in a soil testing class. This test was not used in determining the strength envelope.

The Mohr's circles and the strength envelope for the first series of tests are shown in Fig. 3. The effective angle of internal friction is  $38^{\circ}$  and the effective cohesion intercept is  $0.3 \text{ kg/cm}^2$ . The data for the first series follows Fig. 3.

The second series of triaxial tests were CD tests run using the stress controlled apparatus in the MDSH Testing Laboratory. The specimens were first consolidated under the given cell pressure and then loaded in increments until failure. In Tests CSS-CD1, CSS-CD2 and CSS-CD3, the load was applied in equal increments during most of the test. These increments were

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maintained until the rate of strain approached zero. As the rate of strain increased in the later stages of the tests, the load increments were decreased and duration of loading was reduced so as to determine the peak strength as accurately as possible. Test CSS-CD4 was different in that each load increment was held for three minutes. Average rates of strain varied as follows: 87 min/mm for CSS-CD1, 115 min/mm for CSS-CD2, 94 min/mm for CSS-CD3 and 24 min/mm for CSS-CD4. This is from about 1.6 to 7.7 times slower than used in the constant rate of strain tests.

The stress-strain curves for this series of tests are presented in Fig. 4. Comparing these curves with those in Fig. 2 reveal that there are differences in the stress-strain properties of the tested soil as determined by the two test procedures. For example, under a confining pressure of  $0.8 \text{ kg/cm}^2$  the maximum deviator stress is  $4.08 \text{ kg/cm}^2$  at a strain of 1.3% using a constant rate of strain. Under the same confining pressure the maximum deviator stress is  $3.52 \text{ kg/cm}^2$ at a strain of 2.3%. A possible explanation for these differences is the variations in the rates of strain pointed out above. The specimens were loaded more rapidly in the constant rate of strain tests which would result in higher strengths.

The Mohr's circles and the strength envelope for the second test series are shown in Fig. 5. The effective angle of internal friction is  $36^{\circ}$  compared with  $38^{\circ}$  from the constant strain tests. The respective values of the effective cohesion intercept are  $0.35 \text{ kg/cm}^2$  and  $0.3 \text{ kg/cm}^2$ . These differences are a result of the differences in maximum deviator stresses discussed previously. Therefore, they are also due to the variations in the rates of strain. The data for second series follows Fig. 5.

The last tests presented were run as part of the development of the CU procedure, including the pore pressure measuring and the back pressuring procedures. In Test CSS-CU1, the specimen was first consolidated under a cell pressure of 1.49 kg/cm<sup>2</sup>. A back pressure of 1.0 kg/cm<sup>2</sup> was used to saturate the soil. At the time this pressure was applied to the soil, the cell pressure

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was increased by the amount of the back pressure to 2.49 kg/cm<sup>2</sup>. This was done so that the effective cell pressure would still be equal to 1.49 kg/cm<sup>2</sup>. Since the consolidation pressure and the effective cell pressure were equal the overconsolidation ratio (OCR) is 1.0.

In Test CSS-CU2, the soil was first consolidated under a pressure of 2.98 kg/cm<sup>2</sup>. The specimen was then saturated under a back pressure of 1.0 kg/cm<sup>2</sup> with the cell pressure of 2.49 kg/cm<sup>2</sup>. The effective cell pressure, as in the first test, was 1.49 kg/cm<sup>2</sup>. The consolidation pressure in this case was twice the effective cell pressure so the overconsolidation ratio was 2.0.

After the saturation, undrained triaxial tests with pore pressure measurements were conducted using the stress controlled load method. The load was gradually increased and deflection and pore pressure measurements were taken. The stress-strain curves for the two tests are presented in Fig. 6, and the data follows Fig. 6.

An examination of the data shows that both specimens developed negative pore pressures as they failed due to expansion of the soil structure. These pore pressures must be subtracted if positive and added if negative to the confining and vertical stresses to get the effective stresses.

As can be seen in Fig. 6 there is some scatter of the data points as the strain increases. It is felt that the major cause of the scatter is inadequate sensitivity of the pore pressure measuring equipment.

#### CONCLUSIONS AND RECOMMENDATIONS

The main purpose of this project was accomplished. Test procedures for conducting CD and CU tests were developed for use with the present MDSH equipment. Included were methods for monitoring volume change during consolidation, for measuring pore pressure and for back pressuring.

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The procedures use the stress controlled method of loading because the MDSH triaxial tester is of this type. The advantages and disadvantages of this loading method have been discussed previously. It will take experimentation with different soil types found in Michigan by MDSH personnel to develop the needed experience, especially in the selection of load increments and the duration of each increment. If it is found that the disadvantages of the stress controlled method lead to inaccurate results, then consideration should be given to the purchase of a strain controlled loading device.

Also, as part of the experimentation program, the sensitivity of the pore pressure measuring system should be investigated. If the suspected lack of sensitivity is confirmed, the manufacturer of the present equipment should be consulted about the possibility of increasing the sensitivity. Should this prove to be impossible, consideration should be given to the purchase of more sensitive equipment.

## ACKNOWLEDGMENT

This project was financed by the Michigan Department of State Highways. Their support is very much appreciated.

Thanks are also due to Neville F. Allen, graduate student in soil mechanics at the University of Michigan, who made the necessary modifications in the MDSH equipment to fit the procedures developed. He also ran most of the tests, and aided in the analysis of the data and the preparation of this report.

## LIST OF REFERENCES

- Lundgren, R., Mitchell, J.K. and Wilson, J.H., "Effects of Loading Method on Triaxial Test Results", <u>Journal of the</u> <u>Soil Mechanics and Foundations Division, Proceedings, ASCE</u>, Vol. 94, No. SM2, March, 1968.
- 2. Bishop, A.W. and Henkel, D.J., <u>The Measurement of Soil</u> Properties in the Triaxial Test, Edward Arnold, London,

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2nd Ed., 1962.

3. Casagrande, A. and Wilson, S.D., "Effect of Rate of Loading on the Strength of Clays and Shales at Constant Water Content," <u>Geotechnique</u>, Vol. 2, 1951, pp. 251-263.

# APPENDIX I

# TEST PROCEDURES

#### TEST PROCEDURES

#### PREPARATION OF SPECIMEN

4.

- 1. Prepare all the apparatus to be used before trimming the specimen.
- Trim the specimen to within 1/8 to 1/4 inch of its final diameter (See Notes 1 and 2).
- 3. Take water content sample from the cuttings from the middle part of the specimen while trimming.
  - Trim the specimen carefully to its final diameter.
- 5. Place the specimen in a mold and take water content samples from the top and bottom cuttings as the specimen is trimmed to final length
- Note 1: Steps 2, 3 and 4 are not necessary if the diameter of the undisturbed specimen is that required for testing.
- Note 2: Always trim from the edges toward the center for essentially cohesionless materials.

#### PROCEDURE FOR CONSOLIDATED DRAINED TESTS

- A. Set-up of the Triaxial Cell
  - 1. Grease the O-ring seal at the base.
  - 2. Grease the base pedestal and top cap where the O-rings seal the specimen against leakage.
  - 3. Place the specimen on the base with porous stones at the bottom and top and set top cap in place (See Note 3).
  - 4. With the aid of a membrane holder secure a membrane to the top cap and base pedestal.
  - 5. Lightly grease the inner surface of another membrane and repeat Step 2.
  - 6. Seal the membranes to the top cap and base pedestal with O-rings.

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7. Determine that the piston is well lubricated and moves freely in the cell cover.

- 8. Remove piston from the cell cover.
- 9. Place a 3/8 1/2 inch ball bearing on the top cap and set cell cover in place.
- 10. Tighten simultaneously opposite clamps on the base.
- 11. Replace the piston so that it rests on the ball bearing on the top cap.
- 12. Place the cell in the loading apparatus and connect the cell water line at A. Open the overflow valve at B (See Note 4).
- Fill the cell to overflowing. Close overflow valve B.
- Note 3: Boil the porous stones in distilled water and use them in the saturated condition. This reduces air entrapment. For fine-grained specimens of low permeability use circular bits of filter paper between the specimen and porous stones. To facilitate radial drainage, cut a drainage filter from filter paper (See Fig. 54, page 81, in Bishop and Henkel, Reference 2) and place around sample. Dip all filter paper drains in water before using to saturate them.

Note 4: The various lines and valves have been identified by labels affixed to the triaxial apparatus.

- B. Consolidation of the Specimen
  - 1. Hold piston in contact with ball bearing by use of the clamp and bar arrangement.
  - 2. Connect cell pressure line.
  - 3. Apply a cell pressure equal to the desired consolidation pressure. Valve G must be open so drainage can take place. The time of primary consolidation is dependent upon the permeability of the soil. Consolidation overnight is usually more than adequate.
  - 4. For saturated specimens, the volume change method for determining the time for 100% primary consolidation is outlined in the Procedure for Consolidated Undrained Tests, Part B, Consolidation of the Specimen.

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- C. Testing
  - Bring the proving ring into mere contact with the piston by applying air pressure in the loading system.
  - 2. Set the deflection indicator in contact with the cell and adjust to zero reading.
  - 3. Remove the clamp on the piston. The piston will rise because of the cell pressure.
  - 4. Restore the zero deflection reading by applying more air pressure to the loading system. The piston is now in its original position at the end of consolidation.
  - 5. Note the proving ring reading at zero deflection. The axial load indicated must be subtracted from subsequent proving ring readings to obtain the actual vertical load.
  - 6. Estimate the failure load and select the load increment. The magnitude of the load increment is a matter of judgement and past experience. Enough increments should be used so as to develop a well defined stress-strain curve, usually 10 to 15.
  - 7. Apply the load increment and leave in place until drainage is complete. Valve G must remain open during entire test. The volume change procedure can be used to determine when drainage is complete for saturated specimens.
  - 8. Read the deflection before the application of the next load increment. If strain versus time plots are desired, intermediate deflection readings are required.
  - 9. Apply load increments until the specimen fails, the peak strength is attained or the strain is greater than 20%.

## PROCEDURE FOR CONSOLIDATED UNDRAINED TESTS

A. Set-up of the Triaxial Cell

Before following the steps outlined in the Procedure for Consolidated Drained Tests, Part A, Set-up of the Triaxial Cell, complete the following steps if pore pressures are to be measured with the pressure transducer.

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- 1. With valve G closed, run distilled water through the opening in the base pedestal and out the line to which the transducer is to be attached.
- 2. Fill the pressure sensing end of the transducer with distilled water making sure no air is entrapped.
- 3. Connect the transducer while water is still flowing from the line. During this operation maintain the transducer in a near upright position in order to minimize the possibility of air entrapment.
- 4. Open valve G and allow water to flush the line of air and then close the valve.
- 5. Before placing the specimen on the base pedestal, be sure that water is still at the surface level of the opening in the base pedestal.
- B. Consolidation of the Specimen

Before following the steps outlined in the Procedure for Consolidated Drained Tests, Part B, Consolidation of Specimen, complete the following steps before Step 3 of that procedure if the volume change method is to be used to determine the time for 100% primary consolidation or when drainage is complete.

- Attach a distilled water filled tube to valve G. Hold a finger over the free end while screwing on the other.
- 2. Insert a water filled burette at the free end of the tube.
- 3. Place the burette on a stand and adjust the water level in the burette to the mid-height of the specimen.
- 4. Open valve G and allow a few minutes for equilibrium to be established.
- 5. Before applying the required cell pressure note the initial burette reading.
- 6. Apply the cell pressure and start a timer.
- 7. Take burette readings at 1, 4, 9, 16, 25 minutes etc. Continue burette readings until there is no change indicating drainage is complete.

8. Plot the change in burette readings, △V, versus the square root of time. The time for 100% primary consolidation is determined as the intersection of the straight line through the initial readings and the horizontal line through the final readings (See Fig. 89 on page 126 of Bishop and Henkel, Reference 2).

### C. Testing

The procedure is essentially the same as outlined in the Procedure for Consolidated Drained Tests, Part C, Testing, except for Step 7. In the consolidated undrained test, valve G is closed after consolidation is complete as no drainage is wanted during application of the shearing load. Each load increment should be left in place until pore pressure equalization is achieved. The pressure transducer can be used to determine when this occurs.

## PROCEDURE FOR BACK PRESSURING

- 1. Fill the back pressure tube and line with distilled water using the following procedure.
  - a. Remove the back pressure tube by unscrewing the nut at the top.
  - b. Connect the distilled water line to connection C and air release line to connection D.
  - c. Place finger over the end of the back pressure tube and fill it with water.
  - d. Disconnect the water supply and air release lines.
  - e. Hold the end of the tube over the coupling E, quickly remove finger and insert tube in coupling.
  - f. Fasten the tube support by replacing the nut at the top of the system.
  - g. Clamp the tube in place by means of the nuts and metal bar attached to the tube support. <u>WARNING</u>: Failure to do this will result in the tube disconnecting at the coupling when pressure is applied.
- 2. Connect the back pressure line to the cell. Close valve F and open back pressure regulator to the desired back pressure. <u>WARNING</u>: Until the pressure capacity of the back pressure tube is determined, use pressures not much greater than 14 psi.

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- 3. Open valve G and then valve F. Increase the cell pressure by the value of the back pressure. From valve G there should occur a flow of water followed by a flow of air as air from the specimen is expelled. When a steady flow of water resumes, close valve G. Pore pressure as indicated by the pressure transducer should be the same as the applied back pressure when saturation is achieved. Allow at least four hours for the back pressuring of clay specimens.
- 4. Before testing, disconnect the back pressure line from the cell. Close the back pressure regulator and release the pressure in the tube by the quickconnect at D.

### SET-UP OF THE TRANSDUCER AMPLIFIER

- 1. Turn on equipment (sensitivity multiplier on standby) and allow 10 minutes for warming up.
- 2. Connect cable to the transducer and while the sample is still in the consolidation stage (valve G open to the volume change monitoring system) turn the sensitivity multiplier to X20 and depress PUSH TO CALI-BRATE button. Needle should read 71 on the upper scale. If it does not, adjust the appropriate channel sensitivity control (i.e. channel B) to read 71.
- 3. If reading cannot be adjusted 71 by use of the sensitivity control, follow the instruction booklet for the amplifier, Section C, Paragraphs 1, 2, 3, 3A and 4.
- 4. The amplifier is now ready for operation. During the consolidation stage the meter should read no more than 2 psi on the lower scale.

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# APPENDIX II

# TEST RESULTS

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U.S. STANDARD SIEVE SIZE



FIG. 1. GRADATION OF GLACIER WAY SANDY SILT

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	519.4		1.02	2.56		ويوري وي	u na mana an		e 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
	517	a and a state of the	1.12.4	2.55		1011 Maryan Salashi Markan Ang Katalan Salashi Marka Latada	۲	Mart Same and was a law right many of	n managamana 132 menantikanya selementuk	
120	513.8	a and a second	1.228	2.53	₩₩₩₩₩₽₽₽₩₩₽₽₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩	Ad-644	United Street of All Year and All and All and and and		u na se	
130	511		1-328	2.5			and and a standard state of the standards		1974) (huga seta dini minja (ja mah dini postani muta	
140	506.7		1.432	2.48	· · · · · · · · · · · · · · · · · · ·				n in wy manad	
150	504.5		1.533	2.47	• • •					

Consolidated - Drained Test on Glacier Way PARAvedy Still (in-situ condition)

Pression R	mi 13 285	- Cocie	ning Processing	0.4 kg/cm = {	Jack Pressing	Ta monthermonic				
iony. D-Gonge	Comp (Comp)	P. P. Russian (analian)	Ciris (II)	Asial Stress (*31cm²).	Poro Prosouro (2910m²)	Ventrical Stress (legton?)	Ediscolauz Nortand Stais Arglina <sup>2</sup> )	Ethechurc Lateral Stress (Etyl um <sup>a</sup> )	Stress Bolio (G. 183)	Area <u>Ao</u> 1 - <u>Ai</u>
	. 500.5	بورید بیان میکند از میکند بیان میکند با با میکند با با میکند با با میکند با با میکند. این میکند با با میکند با با با میکند با میکند با میکند با میکند با میکند با میکند با میکند. میکند با میکند با می	1 • 6 36	2.45	a an	, entre anterior de California de La Francisca de la composition de la composition de la composition de la comp	a na gana ang kang kang kang kang kang k		2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	10.69
170	497	- entropy of the Bank Bank Start Tag These strong which is the	1.737	2.44	577-049-14195-0165-190				a series and and the series of	10.7
180	493.5		1.84	2.41						10.71
190	490.8		1. 44	2.40						10.72
200	486.7	, na pri standa di na standa di	2,04	2 - 38	Sanata Minata Minata Minatan Sanata	ann an nanaistean an Sala an S	n an	Sin 1 Sport i Head of Head I Land Market Andre Administration	S (na muse a star diagont saanna ta million sa	10.73
210	483		2.145	2.36					· · · · · · · · · · · · · · · · · · ·	10:74
220	479.2	1 - C. Marilla Malance - A	2.25	2.34	- 2011 1			1 1/1000-1111 PD-00-1213 PD-00-25 PG-120-27 PJ-120-2012		10.75
230	476	والمروف والمحافظ والم	2 35	2.31				с матрити ( достовни и тороно и матрити ( достовни и тороно и т		10.76
										-
			en (n. 1919), − Livet n Bin Jan (2019) frantiskrigtisk skriger							• • • • • • • • • • • • • • • • • • •
<ul> <li>The influence should be the manager of age of the influence of age.</li> </ul>	1. A START 199 (2) for supervise maximum terms with a set of s	a ang ang ang ang ang ang ang ang ang an	's a the Manual Annual Contract of State of the Contract of th	anna ann an Staine an Staine ann an Staine ann an Staine ann an Staine an Staine an Staine an Staine an Staine	an ann a fri s a la statu an	n (h a n Cable Languint) feileadh agus dhaol gur an Languinn agus	y - y yang ang Sang Barland a sa s	a nana kata sa nanaza sa panganan manaka sa na na na na na	n - Estandard Hanna, Anna Anna Anna Anna Anna Anna Anna	
ραι		ا مرد می موجود ۵ های مرد از استفاده می می در می می این می این این می این می	u de un de la grande esta de la defensión de la defensión de la dese	• • • • • • • • • • • • • • • • • •	a dan serie di seman na remanan araban para s		Language and the standard state of the state		an na an a	
			2 <b>2.0005/0</b> 0.000000000000000000000000000000		*** **** *****************************	n an	a and a go one (1996). To make a bary restrict on a single for (	n an de an anna an ann an an an an an an an an		Charles from Party and Party
		اندى بىرى يەرىپىلەر يېلىرىكى يەرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلىرىكى يەرىپىلى	et entrette og som en	n (n. 1997). 1972 - San	остарат из бос <del>уленунуны</del> ны — с наса.	<ul> <li>Model of the second s Second second seco</li></ul>	s yaar daa samangka marii ii dhii aa aa yay daa ya	n an ann an a	j. La pres antro program a comensa La presenta de la presenta de la presenta de la presenta de Esta de la presenta de Esta	

2 0/2

Proving Ring 0.0524 kg/dy Sample No CSN-CD1 Dates 4/11/72 Operator 11FR

	Consolida	iled - Drai	ned Test	lon	Glacie ?^D	Way En Sping	y Sitt (in hadata U.S.A.	- situ condi	tion )	1 08 2
Proving Destabliss Destabliss	Run is 125 Proman Bun Malad (Div)	P. P. Reading Gum/10)	aing Pressur Strain (06)	2 0.8 kg/cm E Avial Stress (Hg/cm <sup>2</sup> ) 97 - 52	Angle Preserie Poro Prosourci (39 (era <sup>2</sup> )	re <u> </u>	Effective Northed States (Kglow <sup>a</sup> )	Steedwoo Lotord Strews (Sgl (m))	3)17853 (3, 183)	Arca Ao 1-24
10	178	<ol> <li>Construction of Social S</li></ol>		0-94				and a subscription of the second s	unitaria in antiralitaria anti-atalana anti- aj	9.896
20	293	. State (1983) Market St. Constant Process Stream State State St.	0.2	1.54	- 15-16/44 M. Prethonauth- una protocological and an anno 1-			ا دىيەت يىلىرى بىرىسى	a a ja suurateet eysteemaateet topoor on sõdatti set	9.906
30	364	יין איז	0.3	1.93	nam susanananananan mananan kutoka jar		a an ang Matrix ang		مى مەركىرىكى بىرى بىرى بىرى بىرى بىرى بىرى بى	9.916
40	513		0.4	2.7/	· Margary Managary		a contract of the level of which the level of the level	an designation of the one of the state of th	an bar mu a transmer an	9.926
50	599		0:5	3.17				ار از معادر میکند. مراجع میکند میکند میکند و میکند میکند میکند میکند میکند میکند میکند میکند میکند میکند.		9.936
60	661.5	n uumuntiittiikke jin 1480a milaanti, kuur kuun maaaaan		3.48	Television and the trace of the second s	a - principa - managementalistic da			ى ، بەر بەۋچىغە يەرە - يېرىلىرىتىتە مىز تەرىمە تەتتىپ مىزى كەر قىلىقى	9.9.26
	705	an a	0:7	3.71		a Sava alam Sayay kuni sa sa kana ang kasaran 10 sa sa	a serie dana serieta una aterrativa pina de la serieta dana de la serieta da serieta da serieta da serieta da s		a namongousna anato anato an ina 100 mm	9.956
80	732		0.8 -	3-85						9.966
. 90	751.5		<u> </u>	3.94	a and a second s	ana matagong ina dan Saturda manang dada di Katara matago		د مارو با دوم می از مارو با می وارد می و می و اور می و می	الم	9.976
100 mm	764-8			4.02	الم - مراجع الم	a hana ang mang mga mga mga mga mga mga mga mga mga mg		, ské slovaní telétry 1. své strovaní kan his žav zá sebu k	) - Thereis a "II" and a balance of the second s	9.986
	773	n may manage university of the star decomposition was		4.06	an and a statement and an art of a statement of the state	an a	a ann an de tradecter anno 17 24 e - Frank ann an deal à se	- 1.2.2.2.2.1.1.1.1.1.1.2.2.2.1.1.1.1.1.1	1994-1995 (1994 1997 1997 1997 1997 1997 1997 1997	9.991
120	777.8	والمراجع وا	1.2	4.08	Port land a faith of the state of the state of the state	- 1 - Jan	- 15 to be to sold as to sold as the total of	a shara an	an and a start of the	10.006
130	779.7	Manager part and a solution of the solution of		4.08		ner syn a baarmaanhan. Grit talaa waa iyo dhala	a garan garang sakat Jawa II - k A - Unit Bara (1996-19-	در این می از این از این از این	a dar da zan er da normañ salannen yezarañ	10.016
	780.3	a nigang ang kanadaran sa para sa sa sa sa sa sa			a - 10 - 10 - 10 - 10 - 10 - 10 - 10 - 1	د. در میروند بین میروند (۱۹۵۵ میروند میروند) در میروند میروند (۱۹۹۵ میروند) میروند (۱۹۹۵ میروند) میروند (۱۹۹۵ می	an a	ан алаган алаган тараатан алаган алаг		10.02.6
150	779.8		1.5	4.075						10-036

Contrained 0.0524 kg/dir Sample No 251-022 Dato 4/12/22 Operator NER

Consolidated - Drained Test on Clacier Way Sandy Ball (unmailed condition)

	2	0%	2	
1.				

	COM) Sul Days	P. P. Borton (union)	Shrin (95)	Avial Strees (Malan <sup>2</sup> ) 	Presserv Presserv (2716m2)	Sives Sives (sains)	Eritective Ventrestates (Kylenz)	Cifedana Introd Staras (1336a)	310000 Relia (8, 183)	Area A. 1-4
160	777.3	Trade of the former is applicate to a subject to the subject to th	1.6	ma Hill	1.) Kong magy makana kana kana kana kana kana kana ka				ىدۇ، مەردۇ ئەتلەرلەردۇ. 126%مەردۇر بەردۇمىزىتى ۋەيمۇر مەردۇرىيەر	10.046
170	7.7.5	- Second synthesis and provide subgroups and	1.7	4.04			- 1			10.056
180	772.5	ni 1. J. J. J. State of the State of St	1.8	H-02-		- 1987 - 425 May 10, 21 - 1, 198 May 10, -				10.066
. 190	769-1	n oleh selatara seran sura una seran seran sura seran sura seran sura seran sura seran seran sura seran seran s	1.9	4.0	مى مەربىيە تىرىپى بىرىپىرىيە تەربىيە تە	-united states and the state of the states and the		٠، كانت المروق المحالي المحالي المحالية المحالية المحالية المحالية المحالية المحالية المحالية المحالية المحالي المحالية المحالية المح	a na antina di Manaza da Santa	10.077
200	766	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2.0	3.98		A standard to sugar to sub-life in the sign of sub-life in the sub-	) - ( - )		allen same	10.087
210	763.4		2:1	3.96			و روی دو او و و و و و و و و و و و و و و و و و	- 		10.098
220	760.5	Storman Table of Sur	2.2	3.94	200 - 21 1, -2 - 2 - 2 - 1 1 - 1 1 - 2 - 2 - 2 - 2	ا موت المعرفة ا			- 1	10-10.8
230	757	an an an an an ann an Anna an A	2.3	3.92						10.119
240	755		2:4	3.9		الم ، فرو از	المحافظ والمحافظ والم	۲۵۹، میکومیک کوچون در <sup>ایر</sup> میکودیک کوچون در اینده اینده کرد. در اینده اینده کرد. در اینده میکود و بر اینده میکو مرابع	د. رو مورد وی ۲۰ مار میکرد وی ور مورد وی ور میکرد. مربوع	10.129
250	753		2:5	3.89					a through as no first products around the	10 139
		er y er anset av efter som and kann mansk var syndage beserver			a mana any farita di santa da sa	من الأول المراقب الم	مارون و الارون و ال	a a firm y a gand frank a start	a server a s	
	n and a state of the		alaan in ny <sup>19</sup> ak 19ak - an Guadhigh para <b>marao</b> n	e nort al municipal de la constantita proprioritation	a Menadeling (*** +11-44 B Faransa gebietar) -	. namera UNA da kasara baba kasara opumu Asara ay		. • «	an an air a' su ann a bhairt tha de fhanair sa ann ann an	~
	a sa sa ang sa		a to go at the first of					- 100-000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000 - 000	-	
			· · · · ·							-
			-							

0.0524 kg/di Sample 110 CEN-CD2 Dato 4/12/72 Operation NER Rowing Ring Calibration Radior

Consolidated - Drainad Test on Clacier Way Sandy Sitter (in-situ condition) 925 1.0 kg/cm² .....

										A
· · · · · · · · · · · · · · · · · · ·			499 80 80 80 80 80 80 80 80 80 80 80 80 80							A. 1
10	178		125	9-3 • 944		ine per the design of the period of the peri	<pre></pre>	ан алан алан ал ал ан		9.85
20	321		25	1.703	an a subsequence of subsequences and					9.86
30	451		• 375	2.389					, , , , , , , , , , , , , , , , , , ,	9.87
40	571		•5	3.023	a a a constante a constante a seconda de la seconda de				1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	9.87
50	657		•625	3.524	and the second		, , , , , , , , , , , , , , , , , , ,	n A A A A A A A A A A A A A A A A A A A	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	9:90-
60	740	· ·	. 75	3.902					e Alexandre de la companya de la company de la companya de la comp	9.917
70	797		•875	43.0	: 			2 2		9.9.2
80	837		1.0	4:406	- 	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	• • • • •		9.94
90	264	· · · · · · · · · · · · · · · · · · ·	1.125	4.541						9.954
105	886		1.2.125	4.653		a na ang ang ang ang ang ang ang ang ang				9.97
	893	3 3 	1.375	4.679		en e				9.98
/20	897		1.5	4 · 7074	a a substance a substance and a substance	a film - article construction and a second	α γ. μ. μ. μ. τ.		And the second s	9.991
130	922		1.625	4.718	1 1 2 2 2 3 4	ο Τ το που την στο 2 την <b>Έλλ</b> ου το Κηρητορια.	α 			10.00
140	904-5 - N 1		} <b>/ • 75</b>	4-726	Motor	st oppe	L after	this rea	Jing.	10.01
150	1410y 3754 895	e a	1-875	4.686	Data Class	trom thi test.	s voint	lon from	previous	10.0:
n an standard a Standard an standard an stan Standard an standard an stan	0.1	0524 kali		CSN-CD3		5/18/22.	na se	NA.	in a second come and	<sup>7</sup>

Coldated - Drained Test on Glacier Way Sandy Setting (in situ condition)

2 %

. 925 Production 1.0 kg/cm i se la j  $\sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1}$  $\sim 1$ 47.2 903.5 10.043 160 2.0 4 71 10.05 4.71 170 2.125 194.5 4-704 10.068 904 2 180 2.25 4.701 10.08 906 190 2.375 10.095 4.690 2.5 904.5 200 10-108 2.625 210 10.121 220 2.75 10-134 230 2.875 10.147 240 3.0 Note: Results non platter with previous class data and found to be in agreement with class findings 5/10/22 Contra N.A. 20524 kg/dr CSN-CD3 

	Provin T	Consolidat	ed- Dramed	Test or	Glacier 1.2 kg/cm <sup>2</sup>	Dels Presen	andy & Sitt	radennian-situ	condition >		1073
· .	aciliotteQ GaQ	Proving Burg Belled	P. P. Rendian Jonala)	Strain (101	Arial Strees ( <sup>15</sup> 3/cm <sup>2</sup> )	Pore Prossure (sy tem <sup>2</sup> )	Ventical Stres (isqlom <sup>8</sup> )	Eddecive Vertical State (Replace <sup>2</sup> )	Ethodrus Latord Stras (Mglem <sup>2</sup> )	Sinces E Alo (G, 153)	Area Ho 1-At
	and a construction of the	14.6 an-marma	n an stand an		0.764	ל בין אומי אינער אינעראיז איז איז איז איז איז איז איז איז איז	الدار می از این از این	ັ ເປັນອີກເປັນເຊັ່ງການ ອອກແຫຼງ ແລະ	a ang ang ang ang ang ang ang ang ang an	under ander and an ander and an and an and an and a	9.947
		321	n na 11 filosofian mai strator provi essencia da de de de de serve	0 · 2	unumbai kitostamaan	19. an	2 	را در این در این می میکور و می میکور و میکور و			9.957
	30	475	s 1 f genter stragensk namet sjørgen fun og et er forstatter store	0-3	2.5		2.5. hegen (any 12.5). Str. of the Western (2), it (as ) is (3.5. and it (2.5. a)).		1. Jay 1. 2. and 1. and 1. a state of the st	- The set of the set o	9.967
	40	607	- 10 Miles Subdersonger (s. 24 automatical Subderson	0.4	3.187	المراجع بالمراجع المراجع المراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع		1	<b>. 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19. – 19</b> . – 19	n an	9.977
•	5Q	712	a a an ann an thair an an thair an an thair an t	manaco Suissensensensensensensensensensensensensen	3.725		and the second		n ya maga awayang nga milinan maraka sa milinan inga sa milina kata sa	a a a a a a a a a a a a a a a a a a a	9 987
	60	787	<sup>1</sup> 1. 2 <sup>nd</sup> SBLMCLARMAN, rol Colombia, Part & analysis, and an art rol of a second second second second s	0.6	4 13 	and the second state of th	and the state of the	11 Million #21 Million Madera (Million ) - On your Million (Million (Millio			9.997
		844	1 - <b>New Jones Contractory</b> (1997)	andrizo wana.	4.417		a angan samata angan ang gangani salagi ta 1999 pinanan di sari 1964 pina a	and we have a set of the second s	1 maad maating of a 19 a 1	। । अने ने 1914 - ने त्या र मार्थरे, क्राइटिंग से क्राइट राज्य का स्थाप र गण्ड र राज्य स्थान का स	- 10.007
	80	682		07	4.64		·····				- 10.017
	90	920		0.9	4-807					al San muunika m <u>anagangan ma</u> ji us <u>tati u</u> u ja naam y <u>uungana</u> Sa	10.627
	100	946			4.92	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	- Particular and Same and Common and a subject of the same and		ا بالا الا الا الا الا الا الا الا الا ا	and the state of the	10.037
	110	965		1-1	5.026		ang ung ng n	م الم الم الم الم الم الم الم الم الم ال	a da an ta mana da da an an a da da a ba ta mana an	a ta ta chu an an ann ann ann a mar ann an	10-047
	120	979	n - an		5.09	a - Manu anisisti - Audului a an Anada -	a sana araba sa	na nitadin shekaranganakaka kasa sininin mesesinta fir		a contra di setta contra di se La contra di setta contra di set	-10.058
	130	.989	a a contraction and a second	1.3	5.135				us in nondrata substitute en la nua	and an a set between our date to " strategy and a	10.048
		997	1977 (20 <u>20)</u> - 1976 -	the there are a series	5-17	аналарынан каталарын каларын калары		and a state of the	n na na ann an Artain An an Anna Anna Anna Anna Anna Anna		10.078
-	150	1003		15	5.194					and the second second second	10.088
	Plening R Ostronomia	Ving) Display	0524 kg/d.+ *	Someter a	- <u>CSN-CD</u>	# Date :	5/18/72	Ópester –	<u>NF P</u>		

	Proving R October	Proving Proving	P. P. Rening	<u>ing Proves</u> Shiri Car	12 kg/cm = 8 Aviat Stars	Pare Pare Paresers	Norman Marting	Germensula c Gerenaus Northerferen	Condition) (Charling Laboral Stress Walters	Colores Colores Colores	Area Ro
	anna car an car ann an 1943. 1973 Dùthairte	in (1 ) (1 ) National (1 ) (1 ) (1 ) (1 ) (1 ) (1 ) (1 ) (1	ana manana mananana Dini <b>1 en 1</b>	anta in an	1		an the state of the second	an sana an	132131 2010	in energy i i i i i i i i i i i i i i i i i i i	1-4
	160	1007.5	, i i i ja už žela tako dom s Provi tako and i move, i i Na se	1.7	5,22				а	an Sama an Sana da Sana Sana an an an an Sangagay ( 199 - An an Saharan Sangagah Sangarah Internetional Ang	10.108
- - -	180	1013.2		1.8	5.23	าร์มาร แก่งการณาตรรณหาการ เลย รณหรือ (	nimetra string of the string o		د مانسونی و در از در از	a balanta balanta menjar sa da manangan sa	10.119
		1614.8	a a a a a a a a a a a a a a a a a a a		5.23	ang kanana ta ang tang kang kang tang kanang kang kang kang kang kang kang	andan saya ang ang ang ang ang ang ang ang ang an	ana ang kasalan katalan	, and funded and a start of a start of the second start of the sec	eneratives of the one constraint strains	10.129
	2-00	1016.2	auronautorenan santaatan at saamaantaa	2.0 2.1	5.227	<ul> <li>Institute Constitution Beneficial Constitution</li> </ul>	ann - ma sa mangagan sa sa mana a	anal anti I con quanta da mana da mana L	offeinen overweettigeet <sup>e</sup> tte fost – sis Lis	n na haan ahaa ka madaa ahaa ahaa ahaa ahaa ahaa ahaa ah	10.140
	220	1017.4		2.2.2	5.23	1. 11 I I I I I I I I I I I I I I I I I		ande Señalda e paga Salange e paga (a cara da sena da s		en anders and an	10.160
	230	1017.0	1 - 1 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	2.3	5.22	1 <u></u>				· · · · · · · · · · · · · · · · · · ·	12.171
	240	1016.9		2.4	5.216			anga ya kutu a gatanya kutu a gatany	1.999-999-99 - 19-99-999-999 - 19-999-999-	د رسی در این ور در این می ور در و در در ور می ور در ور و	10.181
	260	1016.4		2.5	3.2 • 5.195					n man an a	10 20:
	270	1015.2	, tanakanan parista kata sa sa s	2.7	5.189.	- ol	n de generative tals restore for per dispetier speciel proget per e		1872-19 March 16, Startford 1977 No.	to apparent in the state of the	10-213
	280	. 1014 :	ν γ • σταφιθί Ψινακιστικα - ο - ο ο ο - γ , γ μα ι	2.8	5.184	ւ	arma (m	a a a anna 1997 Duna mara a sa' a a sa i	میرون ( میروند ( در میروند و را میروند را در میروند و را میروند و میروند و را میروند و میروند و میروند و میرون میروند	a a star a s	10.22
	290	1012		3.0	5.169		α τη μαγοριάζα το μαγοριά το πορογοριά το πορογοριά το πορογοριά το πορογοριά το πορογοριά το πορογοριά το πορο	<ul> <li>A second state of the second stat</li></ul>		an a success of the s	10-234
-		NA - 0.0	524 kg/j.		CSN-CD 4.	A Carrow	5/12/22	Openator	<u> </u> <u>NF9</u>		

Consolidated - Drained Test on Glacier Way Manaly & fill willing situ condition)

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r-Hendioa (Ord)	(DIA) (Shil Diring (Shil Diring)	P. P. Readicy (analia)	Strain (16)	Avial Strus (Uglom <sup>2</sup> )	Pore Success (Sylena)	Vertical Stress (lig162)	Essentime Northerd Stories (Kglend)	eritednus Lotecil Steves (isglem <sup>e</sup> )	Sines (3,158)	Area <u>A</u> o 1-0
310	1007		3.1	5.129					an ang an	10.2
320	1004	1 - Elizabeth Albert John - Samthan Marine Jack - Samthan - Sa	3.2	5.114		raf zalazitani		ფა <b>პირიაფილი</b> ლი იაფირ პიტელებები კეტება	s server Miller the agency for the state of the state	10.26
330		ананананананананананананананананананан		5.082	naryzza + () - antifeszargzade piszeran, a seteran	-2.2.000 - 100 (1921) 1.2000 - 100 - 100 (1920) 120 120 120 120 120 120 120 120 120 120	entropologistation, lanari majatukationenenenga tendenenen f	11 ° 1 ° 1 ° 1 ° 1 ° 1 ° 1 ° 1 ° 1 ° 1	an a	10:27
340	999	an a	3.4	5.075		an a sur france de fontantes a provensió d'art despretantes de futuras.	and a state of the	and a state of the second s	n gen <u>ann</u> a dheann an a' g <mark>heannachad</mark> mar an a' dheannachad mar an an a' dheannachad mar an a' dheann a' dheann	10.28
350	997.5		3.5	5.06	lan il sugit dan kang pangan ta kasa sa pangan ta	an a - The Same Angel and the Same and the Sam	muse and the second of the second second second second second	anterlijk (* 1941) al i solo solo solo solo solo solo solo s	an a	10.29
360	994-6		3.6	5.044	يې د مېرو د د ورو د د چې ور د د مېرو د د مېرو د د مېرو د			and the second	يې مېرې د د د د د د ورو ورو ورو ورو ورو ورو ورو	0.309
an sector a construction and the sector and the sector and	Summer states	ana mana katala kata	19997771974-00-0012227240-00-00-00-01-00-02 <sup>20</sup> 10-00	s i stanio as actuar an an si anterio de s		د مربق می از می واقع این می واقع این مربق می مربق می واقع این م مربق		an an a tha an	ې د د د د د د د د د د د د د د د د د د د	
and the state of the second state of the secon	ta sarana an ar nanadar takan ar s	an an an 1970 and a market mark with the sub is not a finite room when we			والمراجع				- -	
			an la maan daali ka aa ah ah ah aa ah	والمحمد المعارية بعر والمعالية والمعارية والمحمد والمحمد والمحمد والمحمد	ana dia mampina di seconda di seco	المرد مراجع ومحمد مردوم وروم وروم وروم وروم وروم وروم و	الم	rada mandal dan ca Interdati tana tang da tangan ini	د میرو رو به در میرود. مربق میرو و میرو میرو و م	
					a da a da	and with the foundation of the state of the			na santa sa	5
		,						n gana a aggadatan kaya gagan na ayaan kata		
	a a a pa galaman a tang a a a a a a a a a		ng an Spalland gang ang sa sa sa sa sa sa sa sa sa	an a	والمحفول ومعارض والمعارض والمعارف والمحافظ والمحفول	and the second	a an a can ann an	and the second	e temperatur de la companya de la compan	
-	ی میں میں ایک اور		An dromos parasizones an orene an e	, e e e anno 2011 - 11 de mayor a compositores de la	and the second second second second second	an general state of the state o		202 (Sawajaranana Logander A. Kaja (Sara)	د الله الله الله الله الله الله الله الل	-
		n an 1997 Theodor School Statistics in the annual school of the state	a de la secto de transforma de la companya de la c		a ng mga ga ang mga na ang mga ng	1. Sugar in sugar sug	1 - 1 - Sizer - 127 - A 2013 - Heren, a Mais Science above 10 - 1994 - 2	a na na programa na tanàna amin'ny fisiana amin'ny fisia		-
Presing By	ng et	552 4 kg/jir	1	, CSN-CD	4 - Qasta .	5/18/22.	0psra109	Y.F.J	a sejat ar a a su a su a su a su angener e parte	









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Preving Row	Vertical	Local ka		-	Cerrected	D'fee!
Reneration	Roud A	chial 1	Time Min	Dellection	Arren .	Stress
	4.01	0		Ŏ	9.890	Rg/ann O
40.	7.61	2.05	.5		9.92	0.21
1.0		<u> </u>	kor		0.97	
<u></u>		5.82	~~~~	<u> </u>	9.744	
<u> </u>	12.6	8.39			9.93	5-87
100	15.4	11.36			9-936	1.14
120	18.14	14.14	6	13-7	9.941	1.42
	20.92	16.91	7	15.7	9.942	1.7
160	23.69	19.68	7	17.5	9.953	1.9%
180	26.46	22.45	10	20.0	9.961	2.25
200	29.24	25.22	11	22.1	9.969	2.52
220	32.01	24.39	10	24.9	9.977	2.001
2.40	34.78	20.77	10	28.1	9.927	3.08
21,0	37.55	23.54	28	33.0	10.013	3+35
220	40.32	36 31	25	40.0	10.025	3.62
310	43.69	39.08	25	50.2	10.058	2.29
	45.97	41.00		12.0	10 . 697	1 24. 121
262	73.8/	71.25		62.17	10 12	
	42:8/	41.85	160		10.15	
		,				
N.J.		11	1.1			1 "/
	A POLICE	phine .	005errer	J II	· · · · · · · · · · · · · · · · · · ·	1/3
	2. Analo	<u>ni 57</u>	ear plan	<u> 7.3 % 6</u>	<u>Aorizen hi</u>	1
		sinculoly	65			
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		т. <b>н</b>				

1000 		Conso/ida)	led Draw	1851	#2 (	Constant	> Xess )
-	Preving Ring	Vertical	Look kg	· ·		Corrected	Thechy
	Reading	Read	Petrost	Time	Dellection	Fired	Stress
	-4-3	2.11		<i></i>	0	9.878	1.2
; ,	20	4.29	2.18	3		9.404	<u>).22</u>
:		7.06	4.95	5	3.7	9.910	0.50
	6.0	9.83		5		9.916	<u>0.72</u>
		126	10.49	7	2.1	9.924	1.0%
	100	15.38	13.26	<u> </u>	11.2	9.933	1.34
	120	18-15	16.03		19.0	9.939	<u> </u>
-	140	2.0.92	18.81	10	17.2	9.954	1.89
	160	23.69	21.58		21.9	9.969	2.17
	170	25.08	22.96		24.9	9.977	2.30
ļ	180	26.46	24.35	76	27.2	9.987	2.44
	185	27.16	25.04	12	31.0	9.996	2.51
	190	27.25	25.74	10	34.0	10.006	2.57
.   	195	28.54	26.43	4	30	10.022	2.64
. 	200	29.23	27.12	5	. 417	10.048	2.7
	· · · · · · · · · · · · · · · · · · ·		l .	137			
	Move :		Shear ,	Vince ar	o//amina	61. 100	16 11/2
		1	Lorizontal				-
	·	2					
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2							
		,	à 11	· · · · · · · · · · · · · · · · · · ·		4	

	Con	solidated	Drained	Test # 3	3 (Cousta.	at Stress)		1993. 1
	Priving Ring	Vertical	Local kg	1		Concorded	E Meet 12	5/10-1
	Rindry	Berg	Petrol	Time	Deflection	Pirea cm2	Stress	0/2
	18	4.01	0	0	ρ	9.898	0	
	49.	. 7.06	3.05	5	3.2	9.408	*30E	
	60	9.83	5.82	/	4.6	9.913	-587	
	80	. 12.6	8.59	10	6.1	9.917 .	. 866	
t i Gati	100	15.38	11.37	10	8.0	9.923	1.146	
4 S. 2	120	18.15	14.14	13	9.7	9.929	1.424	
	140	20.92	16.91		11.4.	9.934	1.702	- - -
		2369	19.68	13	13.3	9.94	1.98	,
	180	26.46	22.45	15	16.0	9.949	2.257	
	200	2.9.2.4	25.23	17	19.0	9.958	2.534	
	220	32.01	28.0	25	23.0	9.971	2.808	
	240	341.73	30.77	24	30.0	9.993	3.079	
	250	36.17	32.16	2.2	35.0	10.009	3.2/3	
	263	371.55	33.54	26	42 5	10.033	3.343	ļ
	2.5.5	38.24	34.23	2/	53	10.067	3.400	
	270	39.94	34.93	5	58	10.084	3.464	
	275	39.63	35.62	<u> </u>	7.3	10-123	3.519	
	275	39.63	35.62		·	10.223	3.484	
		<u>.</u>		239		• •		
	Notes		Ruman	y dettes	an aller	three min	ules	
	·		at	proving	ring sead	ng of 273	5	 
		2	Skelc	L of ta	Vare plane	5		
						· · · · · · · · · · · · · · · · · · ·		
				602	· · · · · · · · · · · · · · · · · · ·		1   	
			1					
	al charles	172 -	s. 11			1. 0	1.	, ,

	Cons	olidated	Drained	Test #	4	(Cons	Tant Stre	255)	- 1 1 - 1 - 1
	Priving Ring	Vertical	Loca	Elabaca	x.	1.	Convector	Steel its	
	Rending	Ress	Behral	Time	Della	chon	Arrea	SHELS	6 2 2
》:上		3.87	<u>A</u>			2	4.898		
	<u> </u>	7.06	3.19	3	6.2	2	9. 849	1322	
	6.0	9.83	5.96	6	8.8.		9.911	•401	
	80	12-6	8.73	9	11.0	6.2	9.918	188-	
	100	15.38	11.5	12	13.3	2.5.	9.925	1.16	
	12.0	18.15	14.27	15	15.7	13.9.	9.932	1.24	
	140	20.92	17.05	18	18.0	13.2	9.940	1.71	
	160	23.69	19.82	21	20.2	15.4	9.94.7	1.99	
	170	26.46	22.58	24	23.2	18.4	9.956	2.27	
	2.00	29.24	25.36	27	26.2	21.4	9.966	2.54	
	220	32.01	28.13	30	30.2	25.4	9.978	2.82	
	23.0	33.39	29.52	33	33.1	28.3	9.900	2.96	
	240	34178 .	30.91	36	32.0	32.2	10.000	3.11	
	2.45	35 47	31.6	29	40.0	35.2	10-010	3.16	
	250	. 36 .16	32.29	42	43.0	38.2	10.020	3.22	
	255	36.86	32.98	45	46.9	42.1	10.032	3.29	
	260	37.55	33.68		52.5	47.7	10.050	3.35	
	26215	37.9	. 34.02	51	52.0	52.2	10.068	3.38	
	265	38.24	34.37	54	66.2	·61 · 4	16-095	3.40	
	267.5	38.59	34.72	55	72.0	67.2	10.114	3.23	
2	267.5	38.59	34:72	56	77.0	72.2	10.130	2.43	
	267.5	38.59	34.72	57	\$3.0	78.2	10.150	3.42	
	270	38.44	35.06	58	100	95-2	10 + 2.09	3:43	
				-					
	Note.	Lac	X lood	in crain	a y	held	the three	A CALLER STR	
		1:		- <b> </b>	- <b> </b>		<u>ا</u> ــــــــــــــــــــــــــــــــــــ	· · · /	



÷.	Bassens D	100 1. 279	i i 20. Colda	- 	2.119 kg /2 35.5 /21 8	) Verte Protesta	200 14.2 ber	0. [1.0 kg/om	C.R? = 1 •)		1 01 4
Time (mm)		Contraction Contraction Contraction	P. P. Rection (Section (Psi)		Axial / Shina (Ishaa)	Pose Poseouse Chilosoff	Norbest Stors (Squast)	Eddodaer Vertrakter (aphakt			
: 0	0		and the second second			0	1.49	1.49	1.49	1.0	
. 1	n presentaria, respective for a constraint to a structure of the structure	and a second a second sec	15.2 2	\$127	a ang a sana ana ana ana ana ana ana ana ana	0 	- 1 5	1.5	1.49	1.0	
2	4.0	and the Ender	15-12	127	0.0067		1.5	<u> </u>	1.49	1.0	14
ور. تسد	2.0	and the second	15 - 15	.25	. 0121		1.5	1.5	1.49	1.01	
4.	n Se come en la secondaria de come en la secondaria.			-31	.0121	0	1.5	1.5	1.49	1-01	
5	n Na sana ang	and the second sec		•39	0121	<u></u>	1.5	1-5	1-49	, 1.01	
4	Karana ang k Karana karana ang karana			· 41	.0134	0	1.503	1.503	1.42	1.01	
-/		and a second and a s		.53	*0134	<u> </u>	1.583	1-503	1-49	1.01	
.9				•60	• 147	a contraction and a second sec	1.64	. ).64	1.49	t total and the	
1)		9 	15.1.	.72	• 267	0		1.76	1.42	1.18	
	and a second sec		and the second se	-76	. 534	0	2.02	2.02	1.49	1.34	
14			15.1	8.4	.913	:014	2.4	2.39	1.48	i i 1.62	
10		a and substantion of the substantial of the		.93	1.199	:0.07	2:69	2:68	for the second second	. 1.81	
19				1.00	1.53		3.02	3.1	1-48	2.03	1
				1.14	1.78	:007	3.27	3.26	1.48	2.20	on service and the service of the se
	an a	an a	, 1999		ly CSS-CU	n a standar en a ser an an an ser an ser Norden en an ser an s	6/29/72	a series and a series of the s	n inene en	n nyye a kiry a yayarin nyemeyar	

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				i tin National States and States	2.49 kg/cm	Den <b>e</b> e e e e e e e e e e e e e e e e e e	14.17 E 0	la rino la forma	0.C.R.	-	2 01
Trine (min)			R. F. Novin Grates		Anist Striss (Striss (Striss)	(ore Presture (m(sol))	Vartical Shorts (Calcor)	Essective Vertical States (Figlica 7)	tillition Internationale (Internationale)		
2	and the second	1.11	<u></u>	<u>]. 17</u>	1.887	01	3.38	3 · 38	1.5	2.26	
annor determine the second	and the state of the		n an an ann an an ann an an ann an an an	1.22			3.51	3.52	1.5	2.35	
	40. 	n de la companya de		1.27	2-151	0.0	3.14	3:64	1.49	2.44	an dan bermuta na Lun
1.0 1.1	11 De constante de la constante		an a	1.33	2.282	0.0	3 - 77	3.77	1.49	2.53	
	n 1		a na manana ang ang ang ang ang ang ang ang an	1.38	2.427	0.0	3.92	3.92	1.49	2.63	
		en en fan de services en en fan de services en en e		1.46	2.570	0.004	4.06		1.49	2.73	
	ana ya kibatata sa sa			1.53	2.71	<u>C.0</u> 04	4.20	4.20	1-49	2.83	
221			27.3	1.6	2.86	:007	4:35	4.34	1.48	2.93	
			in. 3	1.7	3.01	· 007	4.5	. 4.49	1.48	3.03	
	57			1 81	3.195	.007	4.69	4.68	1.48	3.15	
10 10 10				1.94	3 . 376	-007	4.87	41.86	1.48	3.28	
Andrews III and Andrews III an			15.2	2.06	3.529	0.0	5.02	5.02	1.49	3 37	
		e 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	month in the second second	2.19	3.682		5-17	5.17	1.49	3.47	a familie -
• /			15:2	2.35	3.92		5.41	5.41		3-63	
			15.0	2.56	3982	-0.014	5.47	5.49	1.50	3.45	r e v aver e constante
			n na na na sana sa na sana sa sana sa sana sa		3 <u>CSS-CU1</u>	international and a start of a second sec	6/29/72	Operator A	159 159	a uu uuama ka uu ka ay ku shikada	

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	Denner D	ma :: \$790	en Chair	WAR RECEIPT	2.49 kg/cm 35.5 bsi E	in en	14.2 psi	seesanting (1.0 kg/an+)	0. C. R. =		· · · ·
Time (min)	Pattertion (Or3	Proving Daug Politics (OPC)	P. P. Beeding Guadal	Strin (2.)	Assial Stress (Malene)	Porz Prosaurs (nglicati)	Nortical Stress (Chicath)	BARCHERS Verter (Barchers (Calcar)			
20	reneral de la companya de la company Internet de la companya de la company	2/2 2/2	14. J	2:79	4.117	028	5.61	5.64	1.52	3.7/	
 21 [	1.j.) Na second se		and a start of the second s	z .98	4:27	028	5.76	5.78	1.52	3.51	
	Server and the server	an the state of the	an an an air an	3 . 24		035	5.90	- marine on a star and the service and the service and the service of the service	1. 53	3:29	
4.5	) 2.5 		and a second	<u> </u>		085	6.04	6.12	1.57	3.89	
			13 7	H. G. anner	4.656	106	6-15	6.25	1.6	3.92	-
2.2		22.	<u>-13-11</u>	5.05	4.76	127	6.25	6.38	1.62	3.95	
- 60	192.	432	13.0	6.1	4.836	155	6.33	6.48	1:64	3.94	
65	200	438	<u>13 0</u>	6.35	4 . 898	- 155	6.39	6.54	1.64	3.99	1
72	2.16	445	12.8	6.67	4.97	- 169	6.46	6:63	1.66	4.0	
45	231		12.5	7.33	5.01	- • 190	6.5	6.69	1.68	3.97	
. 100	230	457		7.46	5.08	204	6.57	6.77	1.62	4.0	and the second second
104	2.41	464	12.2	7.65	5.15	- :211	6.64	6.85	1.70	. 4.13	
111	250	471	12.0	7.94	5.22	225	6.71	6-94	1.72	4:05	
115	262	475		8.32	5.25	232	6 . 74	6.97	1.72	4.05	
120	285	480	11.1	9.05	5.27	- · 229	6.76	7-85	1.78	3.96	والإرادين فقرينا المريمي
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Time (min)										
125	307	482	10.9	9.75	5-25	- ·303	6:75	7.05	1.79	3.93
120 ;	328	424	10.7	10.41	5-24	- • 3/7	6.73	7.05		3.90
135	344	425 5	· 10 · 4	10.92	5.23	- 338 ,	6.72	7:06	1.83	3.86
140	359	1187.5	10,2		5.22	352	6.71	7.06	1.84	3.84
1415	374	489	10.1	11.87	5.21	- :359	6.70	7.06	1.85	3.82
150 :	390	410.2	; 10.0	12.38	5.20	366	4.69	7.05	1.86	3.80
155	402	4171.8	9.9	12.76	5.19	- 373	6.68	7.06	1.86	3-79
160	428	492.8	9.6	13.59	5.16	- • 394	6.65	7.04	1.88	3.74
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6 .	. 11.	95	14.25	•35	.59	- :004	2.02	2-08	1.49	1.39
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4	20	188	14.5	· 10 44	1.83	.014	3.32	3.3/	1.48	2.24
16			4.6		2.08	-021	3.57	3.55	1.47	2.42
<i>'?</i> '	24.7	221	14.5		2.27	• 014	3.76	3.74	1.48	2.54
20	27-5	234	14:6	• 87	2.51	-021	4.0	3.97	1.47	2.7/
22	31	2.5%		.98	2.73	.014	4.22	4.21	1.48	2.85
24	34	273	14.45	1-02	2.95	- 025	4 44	4.42	1.47	3.02
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30	49	328	14.5	1.5.6	3.67	·014	5.14	J. 14	1.48	3.48	
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34	63	359.5	14.2	2.0	4.07	- 007	5.56	5.56	1.5	3.72	
36	70.5	371	1. 	2.24	4.21	- :0.14	5.7	5.71	1.5	3.8	-
38	78	381	13.9	2.48	4.33	028	5.82	5.85	1.52	3.85	
40	83	389	13.8	2.64	4.42	- 035	5.92	5.95	1.53	3.9	
42	92	398	13.6	2.92	4.53	- :0419	6.02	6.07 -	1.54	3 94	
44	100	4.04	13 4	3.18	4.6		6.09	6.15	1.55	3.96	
44	106.5		13.2	3.38	4.64		6.13	6.21	1.57	3.94	
48	1/2	412	13.1	3.56	4.68	084	6.17	6.24	1.57	3.97	
50	120	416	13	3.8/	4.72	0.9.1	6.21	<u></u>	1.58	3.99	
55	129	422	12.9	4.1	4.78	098 -	6.27	6.37	1.59	4:01	
40	138-5	426	12.8	4.4	4.82	- :105	6.31	1 6 - 42	1.6	4.02	a anna ann
65	144	428.5	12:75	4.57	4.84	- 108	6.33	6.44	1.6	4.03	يرتب والملك المرابع والم
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70	146.5	431	12.7	4.65		//3	6:36		1.6	4 04
75	151	436	12.6	4.79	4-93	12	6.42	6.54	1-61	4.06
80	153	436	12.55	4.86	4.93	123	6.42	6.54	1.61	4.05
85	156	441	12.5	4.95	4.98	- • 127	. 6:47		1.62	4.08
90	163	451	12.3	5.18	5.1.	141	6.59	6.73	1-63	4.13
95	179	462	1 12.0	5.68	5.21	- :162	6.70	6.86	1.65	14.16
100	196	467	11-8	6.22	5.25	- :176	6 . 7.4.	6.91	1.67	4.15
105	208	471	11.2	6.60	5.27	218	6.76	6.98	1-71	4.09
110	224	474	lin Ilio	7.18	5.28	- 232	6 77	7.0	1.72	4.07
115	236	477.5	10.8	7.49	5.31	246	6.8	7.04	1.74	4.06
120	246	480	13.7	7.81	5.32	2.53	6.81	7.06	1.74	4.05
12-5	254	: : : : : : : : : : : : : : : : : : : :	10.5	8.04	5.34	267	6.83	7.1	1.74	4-04
180	262	486	10.4	8.32	5.36	274	6.85	7.13	1-76	4.04
135'	2627	489	10.3	8.54	5.3%	281	6.85	7.16	1.77	4.54
145° ;	281	492.5	10.2	8.92	5.411	288	4.9	7.19	1.78	4.04
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- <u>-</u>	286.8	495	10.2	9.11	5.43	- 227	6.92	7.21	1:78	4.05
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··	354	515	9.3	11.24	5.54	352	7.03	7:38	1.84	4.01
	370	518.5	9.3	11.75	5.55	352	7.04	7.39	1.84	4.01
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·	395.5	512.5	9.0	12.56	5.5	- : 373	<u> 6.99 - S</u>	7.36	1.86	3.95
-a	405	518.5	9.0	12.86	5.48	373	6.97	7.34	1.86	3.94
pat r, 40	420	520	9.0	13.34	5.47	373	6.96	. 7.33	1.26	3.23
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