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UNIAXIAL COMPRESSION TESTS, BRAZILIAN TENSILE TESTS AND DILATATIONAL VELOCITY MEASUREMENTS ON ROCK SPECIMENS FROM PINAWA AND CHALK RIVER

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UNIAXIAL COMPRESSION TESTS, BRAZILIAN TENSILE TESTS AND DILATATIONAL VELOCITY MEASUREMENTS ON ROCK SPECIMENS FROM PINAWA AND CHALK RIVER

by

A. Annor*, G. Larocque**, P. Chernis***

1. INTRODUCTION

Uniaxial mechanical property studies have been completed on standard samples from study areas 2 and 3 (Chalk River and Pinawa). For select lithologies of these two formations, the uniaxial tests constitute only a segment of more extensive mechanical property investigations.

The more extensive mechanical property investigations of selected lithologies within the Canadian Nuclear Waste Cycle Management Program is seen as meeting the following general objectives:

1. provide data and analysis to the design task,
2. provide data and analysis to the pathway analysis,
3. provide data and analysis to other activities and tasks.

In developing the mechanical properties investigative program, the relatively well defined requirements of the design task were recognized. Two preliminary vault design studies have now been completed. An essential element of these studies, stress analysis, required precise definition of mechanical properties and models as to rock deformation and failure behaviour.

Fortunately, the design task's mechanical properties requirements are so broad that a mechanical investigative program meeting its needs should also meet the needs of the other two general objectives. Possibly the needs of

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pathway analysis studies as to the suitability of candidate vault formations will be met by using models developed to meet design task requirements.

With regards to the design task two models are required for each lithological unit for use in the stress analysis:

1. a deformation and failure model for the matrix material,
2. a deformation and failure model for the joint systems present in the lithological unit.

The models must apply over the temperature and pressure range encountered in and around a vault. For this reason, experimental studies carried out to develop the models must cover the stress range 0 to 35 MPa and the temperature range 20 to 200°C.

The comprehensive mechanical investigations required to develop the data for the above models in addition to the uniaxial studies requires:

1. triaxial tests on whole specimens,
2. triaxial tests on specimens with saw cuts,
3. tilt tests with blocks containing natural joints.

In the case of intact rock, Mohr's envelopes will be developed as functions of temperature and stress conditions and used as failure models (1). The instrumented specimens used in developing Mohr's envelopes will provide essential rock deformation data. Triaxial tests in a rigid test machine will provide information on post deformational behaviour.

It is planned to describe the joint failure envelope using Barton's model (2):

$$\tau = \sigma n \left[JRC \log_{10} \left(\frac{JCS}{\sigma n} \right) + \phi b \right] \quad - (1)$$

where τ = peak shear strength

σn = effective normal stress on joint

JRC = joint roughness coefficient

JCS = uniaxial compressive strength

ϕ_b = residual shear strength (dry or wet)

Uniaxial compressive strength for the formation combined with the results from the triaxial tests on sawn specimens and tilt tests, will be used to determine the constants in the above equation.

Thus in terms of general objective's 1 and 2, the uniaxial mechanical properties are seen as essential in describing the deformational and failure properties of whole and jointed formations.

The most logical link between mechanical property investigations and the geological activity is in the application of engineering classification systems (3,4) for jointed rock masses to evaluate structural integrity. Such models can also be of value and incorporated in pathway analysis studies. Normally these classification systems which take into account joint properties and mechanical properties, are used to establish road or gallery size and artificial support requirements. In the present case they would be used to establish the absolute as well as the relative suitability of formations for vault sites.

Linkage of the mechanical property studies to the geophysical tasks is primarily with respect to seismic investigations of study areas and common interest in the modification of elastic properties (static and dynamic) with stress conditions. The mechanical property studies provide background elastic property data which aids in the interpretation of field seismic measurements.

Having indicated the role uniaxial rock property studies will play in the overall investigation of the mechanical properties of a formation and the integration of mechanical properties investigations with other activities and tasks, the remainder of the report will concentrate on describing the uniaxial mechanical property studies carried out on Pinawa and Chalk River specimens.

2. TEST PROCEDURE

GEOLOGICAL DESCRIPTION OF ROCK SPECIMENS

Rock specimens from boreholes WN1 & WN2 in Pinawa, Manitoba and CR6 & CR7 in Chalk River, Ontario are numbered according to the depth at which they were taken in metres, Tables 1 and 2. Detailed geological descriptions of the rock specimens are provided in technical reports by Chernis P. et al, Electrical - Seismic Rock Property Laboratory, Geological Survey of Canada (5). A condensed generalized description of the specimens tested are as follows.

2.1 Pinawa Site

Sixteen core specimens taken from depths ranging between 24.0 and 461.0 metres were tested from boreholes WN1 and WN2. The samples consisted of fourteen granite and two tonalite specimens. There were no fractures visible in the specimens from WN1 and WN2.

The granite specimens were generally homogeneous, pinkish and massive, showing mineral compositions in the following approximate proportions: 45 to 60% potash feldspar; 20 to 25% plagioclase feldspar; 25 to 30% quartz and 5 to 10% biotite and other accessory minerals. Potash feldspar occurred as pink subhedral samples while plagioclase was, white euhedral often broken zoned crystals. Quartz made up a grey irregular patchwork and appeared interstitial to the potassium feldspar.

The two tonalite specimens contained large proportions of white oblong shaped plagioclase porphyroblasts less than 0.5 to 1.5 cm., outlined by clots of black hornblende less than 1.8 cm long plus minor biotite. Quartz was intersitial to the plagioclase and constituted about 15% of the rock.

2.2 Chalk River Site

Seventeen core specimens with variable mineral compositions were tested from boreholes CR6 and CR7. Core specimens were taken from depths ranging between 43.0 and 302 metres. The specimens were either banded, layered or foliated.

Geological designations of the individual specimens are as indicated in Table 2. Generalized description of the seven gneissic and four diabase specimens from CR6 in the order of increasing depth Table 2, is as follows:

(1) Granite gneiss: The specimen was fairly uniform pink and grey and well foliated consisting of about 30% pink potash feldspar, 25% white plagioclase, 15% quartz, 10% garnet and 20% mafic minerals. The foliation was oriented at a steep angle to the core axis.

(1) Granulite Specimen: This specimen had a thin green feldspar rich layer near its upper end. Foliation was oriented at about 70° to the core axis. Mineral composition was approximately 20% garnet; 30% mafics and 50% green plagioclase.

(4) Quartz Monzonite: Specimens showed variations in colour from grey to pink; and were composed of about 20-30% mafic minerals; 20% garnet; 10-20% quartz and about 40% plagioclase. Banding was about 70° to the core axis.

(4) Diabase: Samples were generally uniform dark green, fine grained massive and composed of approximately 55% to 60% plagioclase laths in dark fine grained mafic matrix (40%). About 2 millimeter magnetite grains were visible throughout. Two of the diabase specimens were heavily altered and contained innumerable visible fractures.

(1) Granodiorite Gneiss: Consisted of well banded sugary gneiss. Mafic minerals and garnet contents varied from 15-35% and 5-15% respectively, and showed defined layering of banding. Pink and white feldspar occurred together in irregular bands and thin lenses.

Rock specimens from CR7 consisted of three granite gneiss, one granodiorite gneiss and two mafic gneiss. The granite gneiss samples were well foliated and consisted mainly of pink coloured garnet bearing potassium feldspar augen gneiss. Mineral composition was approximately 70% potash feldspar and plagioclase, 15% hornblende plus biotite, 10% quartz and less than 5% garnet. Samples were quite uniform in appearance.

The mafic gneiss specimen were generally greyish, fine grained and finely laminated with the following mineral composition: approximately 35-40% plagioclase, 25% quartz, 25% hornblende and biotite and 15% garnet. Gneissosity was at about 70° to the core axis.

3. DESCRIPTION OF TEST MEASUREMENTS

Cylindrical test specimens with an average length to diameter ratio of about 2.2 were used for these measurements. Samples were cut to slightly over their final dimensions using a diamond saw and water as a coolant. Samples were ground to their final dimensions and tolerance (length variation ±0.001 x specimen diameter, perpendicularity ±0.25 deg., flatness ±0.025 mm) using hardened steel jigs and a lapping wheel.

To carry out elastic deformation measurements, strain gauges oriented to measure axial and transverse strain were cemented to specimen surfaces. All four strain gauges were centered equi-distance from the two ends of the specimens with gauges of similar orientation located on opposite sides of the specimen. The axial and transverse gauges were connected in series to form single active-gauges which were used in half bridge configurations for strain measurement, Figs. 1 and 2.

3.1 Dilatational Wave Velocity Measurements

Axial dilatational velocity measurements were carried out on specimens already gauged for future elastic deformation measurement.

a) Equipment and Measurement Procedures

The measurement equipment consisted of two specimen platens containing piezoelectric transducers, a high voltage pulse generator, a signal amplifier for the received signal after passage through the specimen and an oscilloscope with delay sweep. The above equipment was used with a Tinius Olsen 300,000 lb Universal Testing Machine to measure specimen dilatational wave transit time as a function of applied axial load, Fig. 3.

Specimens in the test configuration were placed between the platens of the universal test machine and load applied in increments. At each load level, the transmitter piezometric transducer excited by the pulse generator was used to send stress waves into the specimen which were detected by the receiver piezoelectric transducer. The sweep of the oscilloscope which was triggered by the onset of each generated pulse, was used to display the seismic disturbance detected by the receiver piezoelectric platen. The

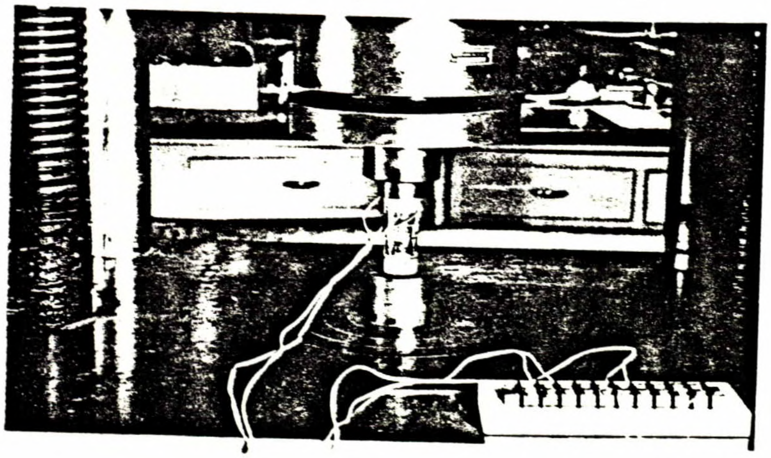

Fig. 1. Gauged Rock Specimen Under Axial Load

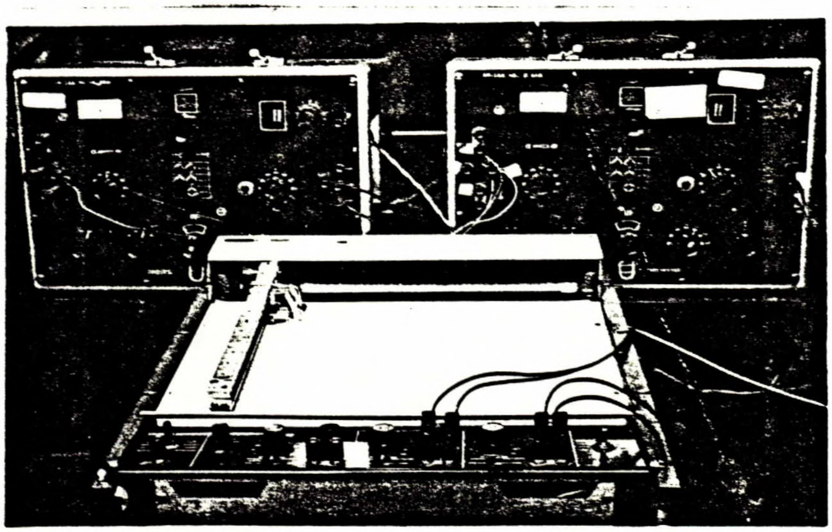

Fig. 2. Uniaxial Compression Equipment Showing (2) Philips PR 9302 Strain Bridges and a Mosley Autograph 2 FRA X-Y Recorder

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measured delayed arrival time of the seismic disturbance, the specimen length and measured zero delay of the sonic system were used to determine specimen dilatational velocity.

Prior to individual specimen time delay measurements, the transmitting and receiving platens were placed together and the zero delay time of the sonic system determined. The zero delay time was noted for use in calculating specimen dilatational velocity.

b) Data Treatment

Using the time of transit t_p the zero delay of the system t_o and the specimen length L the dilatational velocity of the specimen was determined using the following formula (2):

$$Vp = \frac{L}{t_p - t_o} \quad \text{------------------} \quad (2)$$

Combining the Vp velocity of a specimen, with the Poisson's ratio determined by strain gauge measurement, dynamic Young's modulus of each specimen at average applied axial load was determined using the following formula (2):

$$Ed = Vp^2 \rho \ (1 + \mu)(1-2\mu)/(1-\mu) \text{-------------} \quad (3)$$

where Ed = dynamic Young's modulus

ρ = specimen density

μ = Poisson's ratio

The dynamic Young's modulus for each specimen is included in Tables 1 and 2.

3.2 Uniaxial Compression Test

a) Equipment and measurement procedures

Equipment used to measure axial and transverse specimen deformation under applied axial load, consisted of two (2) Philips PR9302 Strain Bridges and a Mosley Autograph 2FRA X-Y recorder. The bridges were used in a half-bridge configuration; axial and transverse gauges were used to provide voltage analog outputs of the axial and transverse strains produced in the specimens by axial loading. These analogs were used to drive independently the two (2) Y axes of the 2FRA X-Y recorder. In this manner, axial and transverse stress-strain curves were developed for each specimen tested. These curves were used to determine Young's modulus and Poisson's ratio. The axial load was increased until specimen failure occurred and the failure load noted. The failure load was used to determine the uniaxial compressive strength of the specimen.

b) Data treatment

Young's modulus was calculated for each specimen by determining the value of the tangent to the axial strain curve, at 50% of failure load. The ratio of the tangent to the transverse strain curve to the tangent to the axial strain curve at the 50% failure point was used to determine the specimen's Poisson's ratio. The ultimate compressive strength of each specimen was calculated by dividing the specimen failure load by specimen cross sectional area. No adjustment has been made for the specimen's length-to-diameter ratio which is minor.

3.3 Brazilian Tensile Strength Tests

a) Specimen preparation

For these tests, discs approximately 12.7 mm in length were cut from the NQ3 core with a diamond saw using water as a coolant. The disc ends were then ground parallel in a jig to a tolerance of ±0.001 x disc diameter. The diameter of the disc D and the final disc thickness were measured and recorded for future use.

b) Equipment and measurements

Measurement equipment used in this test consisted of the weighing table of the universal testing machine and two hardened steel platens. The specimens were loaded diametrically between the two hardened steel platens in the universal testing machine. Load was applied until the specimen failed and the failure load noted.

c) Data treatment

The tensile strengh of a specimen was determined using the following formula (4):

$$\sigma \quad 2P/\pi Dt \text{-----} (4)$$

where σ = specimen tensile strength (Pa)

P = failure load in (dynes)

D = diameter of disc (cm)

t = thickness of disc (cm)

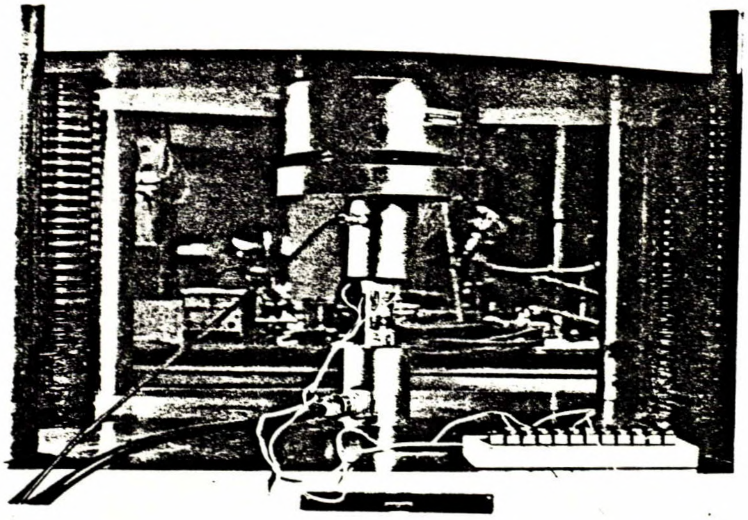

Fig. 3. Dilatational Wave Velocity Apparatus

4. DATA SUMMARY

Tables 1 and 2 summarize the uniaxial compressive strength, dilatational velocity and deformational properties established for the WN1, WN2, CR6 and CR7 specimens. Table 3 summarizes the mean and standard deviation values of the uniaxial compression test results. Table 4 summarizes, the tensile strength data for the WN1 core specimens.

4.1 Basic Data

Fig. 4 is typical of the axial and circumferential stress-strain curves from which the elastic properties of the test specimens were determined. The final load value on the specimens were used to determine uniaxial compressive strength.

A typical sample of the basic data and the calculated values of dilatational velocity with axial loads over the range of 0 to 67.5KN for the specimen tested, is provided in the Appendix.

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TABLE 1: Results of Uniaxial Compression Tests and Dilatational Velocity Measurements For WN1 and WN2 Rock Specimens

Specimen No.	Length (mm)	Diameter (mm)	Density (g/cc)	Compressive Strength (MPa)	Young's Modulus (MPa)	Poisson's Ratio	Dynamic Young's Modulus (MPa)	(Vp) Dilatational Velocity (km/sec)	Mode of Failure	Rock Type
WN1-R Samples										
WN1-138.60-R	96.9	44.7	2.64	213	6.9×10^4	0.26	6.4×10^4	4.8	double cone	granite
WN1-160.90-R	94.5	44.7	2.64	191	6.6×10^4	0.29	5.5×10^4	4.7	double cone	granite
WN1-224.00-R	94.5	44.9	2.64	210	7.2×10^4	0.30	5.6×10^4	4.8	double cone	granite
WN1-246.00-R	95.1	44.9	2.63	219	7.1×10^4	0.20	6.8×10^4	4.7	double cone	granite
WN1-294.50-R	95.5	45.1	2.64	205	7.1×10^4	0.27	6.2×10^4	4.8	double cone	granite
WN1-303.50-R	97.2	45.0	2.63	224	6.7×10^4	0.24	6.5×10^4	4.7	double cone	granite
WN1-345.50-R	95.2	44.9	2.63	227	7.0×10^4	0.24	6.4×10^4	4.8	double cone	granite
WN1-384.80-R	95.9	44.7	2.66	219	6.9×10^4	0.29	5.9×10^4	4.9	double cone	granite
WN1-410.70-R	93.8	44.7	2.63	231	7.3×10^4	0.22	6.7×10^4	4.8	double cone	granite
WN1-460.60-R	97.7	45.0	2.63	214	6.4×10^4	0.24	5.7×10^4	4.3	double cone	granite
Mean for WN1-R	95.6	44.9	2.64	215	6.9×10^4	0.26	6.2×10^4	4.7		
Standard Deviation	1.3	0.2	0.01	12	2.8×10^3	0.03	4.5×10^3	0.2		

TABLE 1 (CONT)

Specimen No.	Length (mm)	Diameter (mm)	Density (g/cc)	Compressive Strength (MPa)	Young's Modulus (MPa)	Poisson's Ratio	Dynamic Young's Modulus (MPa)	(Vp) Dilatational Velocity (km/sec)	Mode of Failure	Rock Type
WN2-R Samples										
WN2-24.75-R	97.7	44.8	2.63	233	7.0×10^4	0.23	6.8×10^4	4.9	double cone	granite
WN2-55.45-R	98.5	44.8	2.73	173	7.4×10^4	0.23	7.5×10^4	5.1	double cone	tonalite
WN2-85.40-R	100.0	44.6	2.75	159	7.3×10^4	0.21	8.0×10^4	5.4	single cone	tonalite
WN2-98.50-R	97.8	44.7	2.65	232	6.9×10^4	0.21	7.3×10^4	5.1	double cone	granite
WN2-124.70-R	96.1	44.7	2.63	235	6.9×10^4	0.21	6.7×10^4	4.7	double cone	granite
WN2-145.85-R	96.4	44.8	2.64	224	7.1×10^4	0.21	6.4×10^4	4.5	double cone	granite
Mean for WN2-R	97.8	44.7	2.67	209	7.1×10^4	0.22	7.1×10^4	5.0		
Standard Deviation for WN2-R	1.4	0.1	0.05	34	2.0×10^3	0.01	5.9×10^3	0.3		

TABLE 2: Results of Uniaxial Compression Tests and Dilatational Velocity Measurements For CR6 and CR7 Rock Specimens

Specimen No. CR6-R Samples	Length (mm)	Diameter (mm)	Density (g/cc)	Compressive Strength (MPa)	Young's Modulus (MPa)	Poisson's Ratio	Dynamic Young's Modulus (MPa)	Dilatational Velocity (km/sec)	Mode of Failure	Rock Type
CR6-43.90-R	97.6	44.7	2.70	192	7.3×10^4	0.26	6.5×10^4	4.8	double cone	granitic gneiss
CR6-87.70-R	97.3	44.7	3.09	280	10.4×10^4	0.23	11.1×10^4	6.4	double cone	granulite
CR6-93.40-R	95.4	44.8	2.75	202	6.6×10^4	0.25	6.6×10^4	4.8	double cone	quartz munzonitic gneiss
CR6-143.70-R	97.5	44.8	2.74	226	7.1×10^4	0.28	7.0×10^4	5.3	double cone	"
CR6-166.30-R	96.8	44.8	2.76	220	7.4×10^4	0.27	7.2×10^4	5.4	double cone	"
CR6-193.65-R	94.8	44.6	2.66	179	6.8×10^4	0.25	6.8×10^4	5.2	axial split & single cone	quartz munzonitic gneiss
CR6-227.20-R	98.1	44.7	3.00	216	9.3×10^4	0.27	9.4×10^4	6.2	axial splitting	diabase
CR6-237.20-R	97.3	44.7	2.97	287	9.2×10^4	0.29	9.1×10^4	6.2	axial splitting	diabase
*CR6-245.265-R	96.3	44.7	2.57	34	--	--	--	2.6	axial splitting	diabase (heavily altered)
CR6-286.30-R	97.3	44.8	3.02	209	10.8×10^4	0.29	10.2×10^4	6.6	axial splitting	diabase (altered)
CR6-301.50-R	97.8	44.8	2.74	212	7.3×10^4	0.26	7.9×10^4	5.8	double cone	granodiorite gneiss
Mean	97.0	44.7	2.84	222	8.2×10^4	0.26	8.2×10^4	5.7		
Standard Deviation	1.1	0.1	0.15	35	1.6×10^4	0.02	1.7×10^4	0.7		

*(Sample parameters excluded from the Mean and Standard Deviation Calculations)

TABLE 2 (CONT)

Specimen No. CR7-Samples	Length (mm)	Diameter (mm)	Density (g/cc)	Compressive Strength (MPa)	Young's Modulus (MPa)	Poisson's Ratio	Dynamic Young's Modulus (MPa)	Dilatational Velocity (km/sec)	Mode of Failure	Rock Type
CR7-11.10-R	99.5	44.8	2.69	171	5.8×10^4	0.23	6.6×10^4	4.6	single cone	granite gneiss
CR7-26.00-R	99.2	44.9	2.70	188	6.7×10^4	0.27	6.7×10^4	5.0	double cone	granite gneiss
CR7-69.90-R	96.0	44.7	2.78	188	6.3×10^4	0.22	7.2×10^4	5.2	single cone	mafic gneiss
CR7-81.10-R	97.0	44.6	2.67	248	6.3×10^4	0.24	6.4×10^4	4.7	axial splitting	granite gneiss
CR7-104.90-R	91.5	44.8	2.67	195	6.7×10^4	0.26	7.0×10^4	5.2	single cone	mafic gneiss
CR7-132.00-R	95.4	44.9	2.73	219	7.5×10^4	0.29	7.6×10^4	6.0	double cone	granodiorite gneiss
Mean for CR7	96.4	44.8	2.71	202	6.6×10^4	0.25	6.9×10^4	5.1		
Standard Deviation	2.9	0.1	0.04	28	5.7×10^3	0.03	4.4×10^3	0.5		

TABLE 3: Mean & Standard Deviation Values for Mechanical Properties of WN1, WN2, CR6, & CR7 Specimens

Borehole Identification	Principal Rock Type	No. of Specimen	Avg. Length (mm)	Avg. Diameter (mm)	Avg. Density g/cc		Compressive Strength (MPa)	Young's Modulus (MPa)	Poisson's Ratio	Dynamic Young's Modulus (MPa)	(Vp) Dilatational Velocity (Km/s)
WN1, WN2	granite	14	97.8	44.7	2.67	mean	220	6.9×10^4	0.24	6.3×10^4	4.8
						std. dev.	12	2.4×10^3	0.03	5.1×10^3	0.2
WN2	tonalite	2	99.3	44.7	2.74	mean	166	7.4×10^4	0.22	7.6×10^4	5.2
						std. dev.	10	7.1×10^3	0.01	3.5×10^3	0.2
CR6	gneiss & diabase	10*	97.0	44.7	2.84	mean	222	8.2×10^4	0.27	8.2×10^4	5.7
						std. dev.	35	1.6×10^4	0.02	1.7×10^4	0.7
CR7	gneiss	6	96.4	44.8	2.71	mean	202	6.6×10^4	0.25	6.9×10^4	5.1
						std. dev.	27	5.7×10^3	0.03	4.4×10^3	0.5

*Eleven (11) specimens were tested; one specimen failed during the dilatational velocity measurements, hence values were excluded from computations.

TABLE 4

Brazilian Tensile Test Results for WN2 Specimens

at 324.50-324.60 m levels

Specimen Number	Diameter (D) (mm)	Thickness (t) (mm)	Load (P) (KN)	Stress (kPa)
A	43.6	13.0	7.3	8,200
B	43.6	12.7	8.6	9,900
C	43.6	13.1	6.8	7,500
D	43.6	12.6	8.7	10,000
E	43.6	12.7	7.7	8,800
F	43.6	12.5	7.3	8,500
G	43.6	12.7	8.3	9,500
mean		12.8	7.8	8,900
standard deviation		0.2	0.7	930

5. DISCUSSIONS

Table 3 provides a summary of the means and standard deviations with respect to the following mechanical properties of the rock specimens tested: 1) compressive strength; 2) Young's modulus; 3) Poisson's ratio; 4) dynamic Young's modulus and 5) dilatational velocity. The standard deviations obtained with respect to the listed properties were very low for the granite specimen from the Pinawa site. This indicates a homogeneous

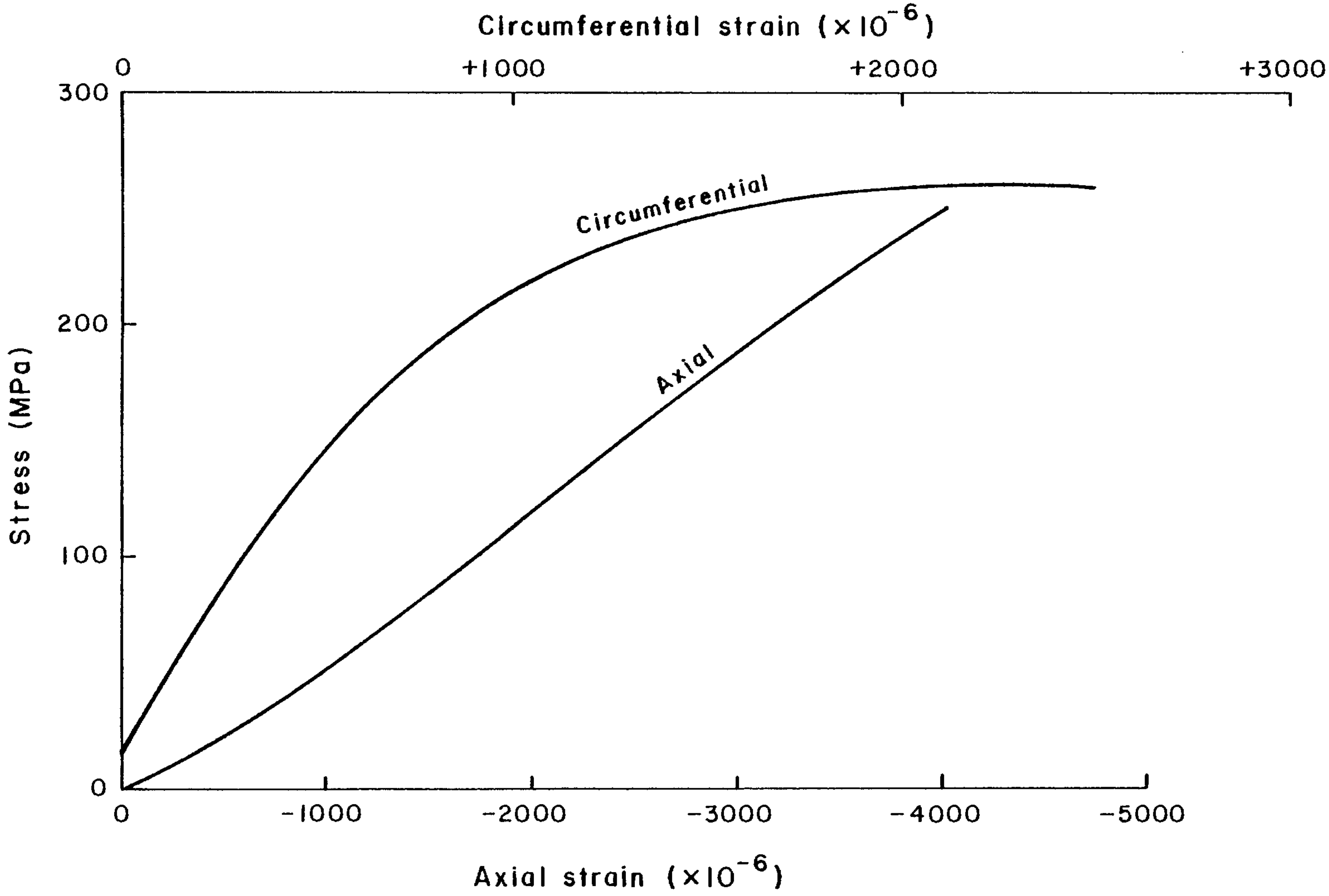

Fig. 4. Axial and Circumferential Stess Strain Curves

rock formation: - a confirmation of the geological description of the rock.

The mean compressive strength and standard deviation for the granite specimen from the Pinawa site, were found to be 220 ±12 MPa. The mean and standard deviation values of Young's modulus and Poisson's ratio were found to be 69.0 $\pm 2.4 \times 10^3$ MPa. and 0.24 ± 0.03 respectively.

Even though there is a larger spread in the values of Poisson's ratio (0.20 - 0.30) as compared to other measured properties, the lowest and highest observed values have very low frequencies of occurrence. This would seem to suggest the possibility of measurement error.

The mean compressive strength values for CR6 and CR7 specimens were 222 ±35 MPa. and 202 ±28 MPa. respectively. The mean Young's modulus were 82.0 $\pm 16.0 \times 10^3$ MPa for the CR6 samples and 66.0 $\pm 5.7 \times 10^3$ MPa for the CR7 specimens. Calculated mean Poisson's ratio for CR6 specimens was 0.27 ±0.02; the value for the CR7 samples was 0.25 ±0.03. These values are within the generally accepted range for rocks with similar compositions. The mean tensile strength for the WN1 specimens was 8900 ± 930 kPa.

The uniaxial compression test results for the specimens from Pinawa and Chalk River are within the generally accepted values for rocks with similar compositions.

The measured mean values with respect to compressive strength, Poisson's ratio and Young's modulus for the rock specimens from the two test sites are of the same orders of magnitude - Table 3.

The lower standard deviation values characteristic of the measured strength and deformation properties of the granitic specimens, can be explained by the homogeneous geologic composition of the rock mass at the Pinawa test site. Similarly, the higher standard deviation values for the observed properties within the Chalk River specimen, is as a result of the wide variations in geological composition of the in situ rock mass at the test site. It is not certain whether the numerous fractures characteristic of the Chalk River specimens were induced by drilling or are indicative of the in situ state of the rock mass. Influence of the fractures on the dilatational velocity of CR6 & CR7 specimens is not clear since velocity varied only slightly with increasing confining pressure (Fig. 5). On the other hand, the gradual increase of dilatational velocity with increasing confining pressure for the granitic specimens can be explained in terms of the pore structure properties.

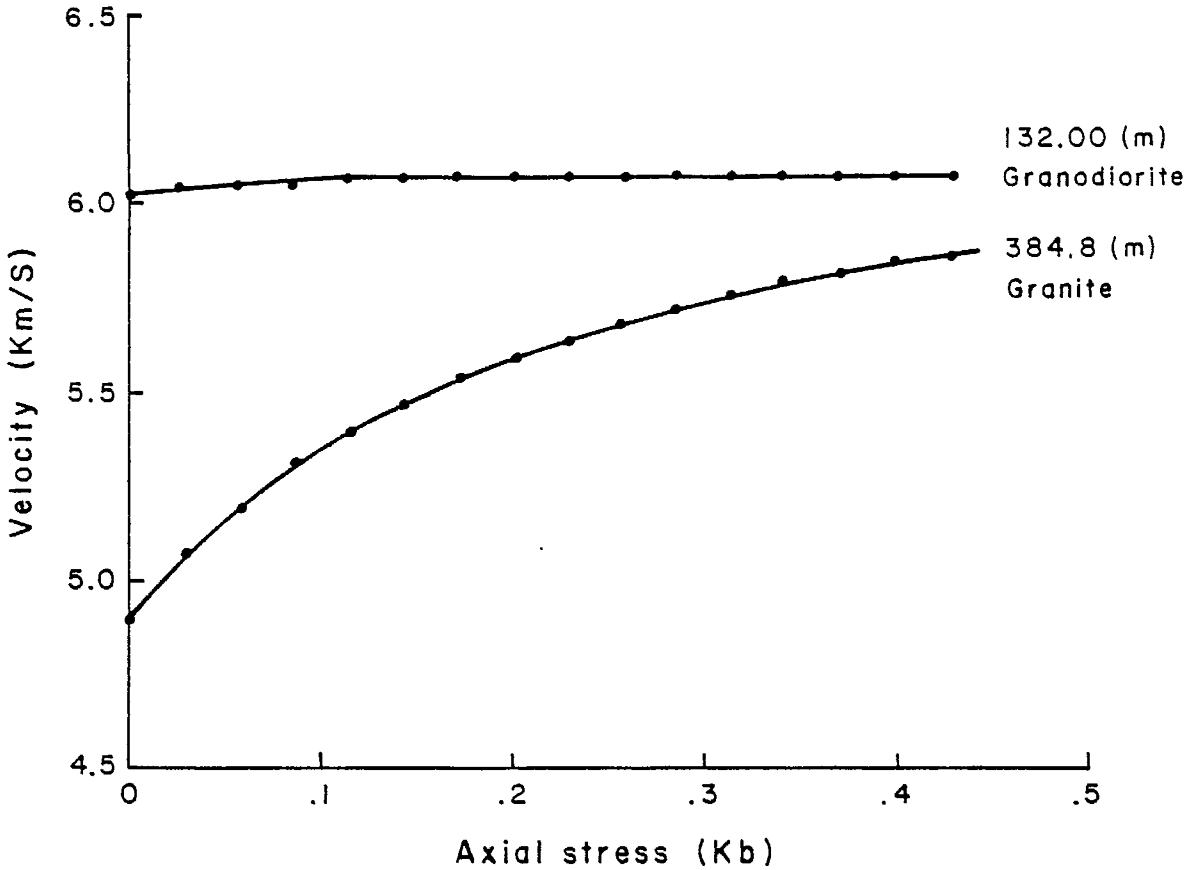

Fig. 5. Dilatational Velocity vs. Axial Stress Graphs for Granite and Granodiorite

5.1 Conclusions

The results of uniaxial compression tests, dilatational wave velocity measurements and Brazilian tensile tests on rock specimens from WN1 and WN2, Pinawa test site and CR6 and CR7 from Chalk River, have been presented in this report. In general, the test results indicate consistency in mechanical properties among rocks of similar geological description with respect to the following properties: compressive strength, Young's modulus, Poisson's ratio and dilatational velocity. The standard deviations were lower for the WN1 and WN2 granitic specimens from the Pinawa site, than for the CR6 and CR7 specimens from the Chalk River test site. This confirms the homogeneous nature of the Pinawa granite as well as the variability of the Chalk River specimens. These results will be of particular value when mechanical property models are developed for the granite of the Pinawa formation.

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