GREELY SAND AND GRAVEL
Playground Stone
Surface Impact Testing

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1. Abstract

This report summarizes the results of a laboratory impact surface test that was conducted on peastone by Grace-Kells Consultant Inc. for the Greely Sand and Gravel. All testing was performed in keeping with the procedures specified by the Ottawa-Carleton District School Board and outlined in a report titled New Playstructure Sand Testing (March 2001). The test used a Triax 2000 Impact Surface Testing device to measure the impact attenuating properties of the peastone sample. The purpose of the impact test was to establish the highest drop height attainable that yielded both a HIC of less than 1000 and a peak G-max of less than 200 in a dry state. Results are recorded in tabular form.

2. Distribution List

Brent Pyper, Greely Sand and Gravel

3. Contents

4. Summary

4.1. Surface Impact Tests

Surface Impact Tests were performed on peastone sample at two different depths - 30 cm and 40 cm. The peastone was placed in a testing crib in a dry condition to a depth of 30 cm and tested. Additional peastone was added to the crib to achieve a depth of 40 cm and a second battery of tests was performed.

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At a depth of 30 cm the highest drop heights with a HIC less than 1000 and a peak G-max less than 200 were as follows:

Dry clean playground stone 300 cm

At a depth of 40 cm the highest drop heights with a HIC less than 1000 and a peak G-max less than 200 were as follows:

Dry clean playground stone 300 cm

5. Introduction

Greely Sand and Gravel contracted Grace-Kells Consultant Inc. to perform surface impact tests on a playground stone sample in keeping with the the procedures established by the Ottawa-Carleton District School board in a CALL FOR QUOTOTATION 2000-10-26 and subsequently described in a report titled *Ottawa-Carleton District School Board New Playstructure Sand Testing* (March 2001).

6. Method

6.1. Location

The tests were performed in a garage space at 1971 Old Prescott Road, Ottawa. The tests were conducted over a concrete floor.

6.2. Sample

Approximately 1 cubic Greely Playground Stone was supplied.

The sample was collected and stored on the concrete floor of the testing garage for 1 day prior to testing.

6.3. Apparatus (see Appendix A for details)

6.3.1. Equipment used for impact surface testing consisted of the following:

- 19 mm thick plywood crib 76 cm x 76 cm x 60 cm deep c/w drain holes and lined with geotextile filter cloth
- Triax 2000 Impact Surface Testing device
- digital probe thermometer
- gas powered 81 Kg. Vibra plate
- clock with second hand

6.3.1. Test Procedure

Peastone was placed in the plywood crib then loosened and levelled to a depth approximately 3 cm above the intended test depth. A plywood sheet was then placed over the playground stone. The gas powered vibra plate was placed on top and run for 1.5 minutes to compact the stone. The vibra plate and plywood sheet were removed and the stone surface scraped as necessary to bring the finished

compacted depth to the intended depth (30 cm or 40 cm). The Triax 2000 was installed over the centre of this test crib and an initial series of 3 drops was performed from a given height with the results recorded. The average of the last 2 drops was calculated and recorded as the HIC/G-max value for that height.

The entire loosening and compaction procedure was then repeated and another series of 3 drops held at a height 30 cm up or down as required with the results again recorded and averaged. The procedure was repeated until a maximum passing height (where both the HIC was at or below 1000 and the peak G-max was at or below 200) as well as a minimum failing height (where either the HIC was over 1000 or the G-max was over 200) were both recorded.

7. Results

7.1. Surface Impact Tests

7.1.1. Greely Playground Stone - 30 cm depth

Date of Test: 2007-08-10

Max Drop Height with Peak G-max ≦ 200 and HIC ≦ 1000 : 300 cm

Drop Height (cm)	Drop 1 HIC/Peak	Drop 2 HIC/Peak	Drop 3 HIC/Peak	Avg 2&3 HIC/Peak
300	1404/256	903/179	985/194	944/187
330	1606/268	1531/221	832/157	1182/189

7.1.2. Greely Playground Stone - 40 cm depth

Date of Test: 2007-08-10

Max Drop Height with Peak G-max ≦ 200 and HIC ≦ 1000 : 300 cm

Drop Height (cm)	Drop 1 HIC/Peak	Drop 2 HIC/Peak	Drop 3 HIC/Peak	Avg 2&3 HIC/Peak
300	1146/226	693/138	720/131	707/135
330	2109/308	1539/218	1210/230	1375/224

Tests Performed by: _____ Date: 2007-08-13

Peter Kells

Grace-Kells Consultant Inc.

Appendix A
Apparatus

Stone Storage, Crib and Triax

Tamping Sample with Vibra Plate

Crib With Stone After Drop

High Drop Height

Loosening Sample

Vibra Plate Used for Tamping

Appendix B
Surface Impact Data

Greely Playground Stone - 30 cm depth

Stone Temperature: 22 degrees C.

Test Drop Height: 240 cm

Drop	G-Max	HIC	Velocity
1	234	1,343	683
2	216	1,110	688
3	154	586	691
Avg 2 &3	185	848	690

Test Drop Height: 270 cm

Drop	G-Max	HIC	Velocity
1	186	883	729
2	198	1,225	732
3	158	694	734
Avg 2 &3	178	960	733

Test Drop Height: 300 cm

Drop	G-Max	HIC	Velocity
1	256	1,404	765
2	179	903	770
3	194	985	770
Avg 2 &3	187	944	770

Test Drop Height: 330 cm

Drop	G-Max	HIC	Velocity
1	268	1,606	803
2	221	1,531	810
3	157	832	810
Avg 2 &3	189	1,182	810

Greely Playground Stone - 40 cm depth

Stone Temperature: 22 degrees C.

Test Drop Height: 300 cm

Drop	G-Max	HIC	Velocity
1	226	1,146	770
2	138	693	775
3	131	720	775
Avg 2 &3	135	707	775

Test Drop Height: 330 cm

Drop	G-Max	HIC	Velocity
1	308	2,109	803
2	218	1,539	810
3	230	1,210	810
Avg 2 &3	224	1,375	810

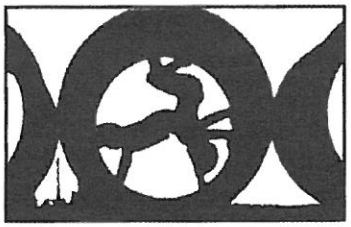
Appendix C
Certificates

CERTIFICATE OF ACHIEVEMENT

AWARDED TO

Mr. Peter Kells

In recognition of his attending and passing the training program for the utilization of the TRIAX 2000 SIT (Surface Impact Tester) in compliance with the ASTM F1292-99 Standard Specification for Impact Attenuation of Surface Systems under and Around Playground Equipment.



Course designed and provided by:
Playground Clearing House

Paul Hogan — President

May 5th, 2000 — Date

alpha automation

alpha automation, inc.
125-127 Walters Avenue
Trenton, New Jersey 08638
609-882-0366 FAX 609-882-0382

CERTIFICATE OF COMPLIANCE

TRIAX 2000

The Triax 2000 system for surface resiliency testing meets the equipment specifications as stated in ASTM F1292-99

Paul Bamburak, P.E.

• Engineers and Manufacturers •
Electronic Instruments and Controls • Precision Mechanisms

Dytran Instruments, Inc.
21592 Marilla St. Chatsworth, CA 91311 Ph: 818-700-7818 Fax 818-700-7880
www.dytran.com email: info@dytran.com

CALIBRATION CERTIFICATE
TRIAXIAL LIVM ACCELEROMETER

CUSTOMER:	ALPHA AUTOMATION			TEST REPORT #: 1356	1/24/2007
PURCHASE ORDER #:	17961	SALES ORDER #: RMA# 15887		PROCEDURE:	TP3002
MODEL: 3014M2	SERIAL #: 1356	RANGE, F.S. (g's): +/- 500			
NEW UNIT	RE-CALIBRATION [1] X	AS RECEIVED CODE 1		AS RETURNED CODE 1	
TEMPERATURE (°C): 23				HUMIDITY (%): 36	

FREQUENCY RESPONSE [2]

FREQUENCY (Hz)	AXIS 1 (mV/g)	AXIS 2 (mV/g)	AXIS 3 (mV/g)
20	10.30	10.20	10.30
30	10.30	10.20	10.10
50	10.30	10.20	10.10
100	10.30	10.20	10.10
300	10.40	10.30	10.30
500	10.40	10.40	10.40
1000	10.50	10.50	10.50
2000	10.60	10.60	10.60
BIAS VOLTAGE (VDC)	10.6	10.6	10.6
DISCHARGE T.C. (sec)	0.50	0.50	0.40

REMARKS: NONE

TEST EQUIPMENT LIST - CALIBRATION STATION # 8

DII #	MANUFACTURER	MODEL	SERIAL #	DESCRIPTION	CAL DATE	DUE DATE
528	INSTEK	GFG-8217A	B720273	FUNCTION GENERATOR	04/19/06	04/19/07
651	BK PRECISION	2160A	05075324	OSCILLOSCOPE	01/09/07	01/09/08
525	FLUKE	45	6188017	MULTIMETER	04/14/06	04/14/07
214	TRIG-TEK	346B	118	SYNTHESIZED CALIBRATOR	08/30/06	08/30/07
686	DYTRAN INST.	3010M14	1684	ACCELEROMETER	07/13/06	07/13/07
522	NICOLET	3091	88D04384	DIGITAL OSCILLOSCOPE	01/30/06	01/30/07

[1] AS RECEIVED / AS RETURNED CODES
1 = IN TOLERANCE, NO ADJUSTMENTS
2 = IN TOLERANCE, BUT ADJUSTED
3 = OUT OF TOLERANCE < 5%
4 = OUT OF TOLERANCE > 5%
5 = REPAIR REQUIRED
6 = REPAIRED AND CALIBRATED
7 = UNIT NON-REPAIRABLE, RECOMMEND REPLACEMENT
8 = UNIT SERVICEABLE WITH CURRENT CALIBRATION DATA

[2] THIS CALIBRATION WAS PERFORMED IN ACCORDANCE WITH MIL-STD-45662A, ANSI/NCSL Z540-1-1994, ISO 10012-1 USING THE BACK-TO-BACK COMPARISON METHOD PER ISA RP37.2 AND IS TRACEABLE TO THE NIST THROUGH TEST REPORT # 13185 DUE 07-13-07
ESTIMATED UNCERTAINTY OF CALIBRATION: 2% FROM 5-50 Hz, 1% FROM 100-2000 Hz

CALIBRATION TECHNICIAN: OSCAR ESPITIA

TEST DATE: 01/24/07

RECALL DATE: 01/24/08

The Canadian Parks and Recreation Association

certifies that

Peter Kells

has successfully completed the requirements to be a

Canadian Certified Playground Inspector

[Expiry Date: April 06, 2009]

April 20, 2006
Date

Together for Healthy Communities
Ensemble pour mieux vivre chez nous

CPRA President

ONTARIO PARKS ASSOCIATION
"Protecting Tomorrow Today"®

This is to certify that

PETER KELLS

based on his considerable experience and background in the Playground Equipment Industry, and as a lead instructor of the

ONTARIO
PLAYGROUND
ACADEMY

is hereby registered as a

PLAYGROUND PRACTITIONER

Dated: May 1, 2001

President, 2000 – 2001
Ontario Parks Association

Executive Director
Ontario Parks Association