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Reference: ET24-1327A

October 18, 2024

Raly Chakarova
Executive Director
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, Ontario
L4W 4Y4

Email: raly@tarba.org

Dear Ms. Chakarova:

Granular Base Equivalency (GBE) and Structural Number (SN) of 19mm and 50mm Crushed Concrete to Assess Pavement Design Equivalency

1 Introduction

In reference to our proposal dated August 6, 2024, Engtec Consulting Inc. ("Engtec") is pleased to present this report detailing the laboratory testing and evaluation of the Granular Base Equivalency (GBE) and Structural Number (SN) for standard crushed concrete, compared against Crusher Run Limestone and virgin granular sand and gravel.

The primary objective of this study was to assess the Structural Number and develop a reliable relationship of equivalency between these materials, based on the testing results. Specifically, the goal was to address the discrepancies and variability in GBE and SN values currently used in the construction industry. These inconsistencies often lead to challenges in material selection and project specification. By harmonizing these values, this study aims to establish a consistent, proven, and industry-accepted GBE and SN value for crushed concrete. This, in turn, would encourage the broader adoption of crushed concrete in construction projects, promoting sustainability by reducing the reliance on virgin materials and providing an alternative with comparable performance characteristics.

2 Background

The use of recycled materials, such as crushed concrete, in construction is gaining momentum due to its environmental and economic advantages. Recycled materials reduce the demand for virgin aggregates, minimize waste, and contribute to sustainable construction practices. However, a critical aspect of their adoption is the need to ensure their structural integrity and performance, particularly when compared to traditional materials like virgin granular sand and gravel, and crusher run limestone. Despite these benefits, acceptance of crushed concrete by project owners and regulators remains inconsistent, primarily due to uncertainties around its performance.

This study offers a thorough evaluation of the Structural Number (SN) and Granular Base Equivalency (GBE) of crushed concrete, comparing its performance with standard materials. The findings are supported by engineering analysis, demonstrating the relationship between structural equivalency and thickness equivalency. Specifically, it highlights how the thickness of each material impacts its load-bearing capacity and overall performance in pavement structures.

The Toronto and Area Road Builders Association (TARBA) has noted inconsistencies in how the structural strength of crushed concrete has been assessed over the past two decades. In some regions, crushed concrete is required to be 10% to 15% thicker than traditional materials, such as Granular A, 19mm Crusher Run Limestone, or Granular B-Type II (50mm Crusher Run Limestone). This additional thickness requirement stems from a perception that crushed concrete has inferior structural properties compared to virgin materials.

This study seeks to challenge that perception by providing data that supports the equivalency of these materials. The tests are intended to demonstrate that crushed concrete can perform as well as traditional materials without the need for increased thickness. Furthermore, the Ministry of Transportation Ontario (MTO) recognizes the potential of crushed concrete, allowing its use in place of Granular A and Granular B-Type II, provided it meets the physical requirements outlined in OPSS.PROV 1010. By establishing the equivalency of these materials, the study aims to promote wider acceptance and use of crushed concrete in construction projects, ensuring that sustainable materials are incorporated without compromising structural performance.

3 Definition(s)

The 19mm or 50mm crushed concrete used and referenced in this report conforms to the requirements of OPSS.MUNI 1010 or OPSS.PROV 1010 for Granular A and Granular B materials, incorporating up to 30% Recycled Asphalt Pavement (RAP).

4 Objectives

The following objectives were proposed and successfully completed as part of this study:

1. Determine the Granular Base Equivalency (GBE) and Structural Number (SN) of 19mm Crushed Concrete in compliance with OPSS.Muni 1010 and OPSS.PROV 1010.
2. Determine the GBE and SN of Virgin Granular A – Sand and Gravel.
3. Determine the GBE and SN of 19mm Crusher Run Limestone.
4. Determine the GBE and SN of 50mm Crushed Concrete.
5. Determine the GBE and SN of Virgin Granular B – Type II.
6. Determine the GBE and SN of 50mm Crusher Run Limestone.
7. Compare the GBE and SN values across these materials to develop a relationship of thickness equivalency.
8. Provide recommendations based on the findings for future use in construction projects.

It is important to note that, according to OPSS.MUNI 1010 and OPSS.PROV 1010, Crushed Concrete products are not permitted to be classified as Granular B – Type II. However, in practice, the construction industry widely uses 50mm Crushed Concrete as a substitute for Granular B – Type II. To reflect this practical usage, this report adopts

the same comparison framework, allowing for a more accurate evaluation of 50mm Crushed Concrete in this role. The report examines the percent crushed content and other physical requirements that assess the product's mechanical strength and suitability for construction purposes, particularly in relation to its Resilient Modulus—a key indicator of the material's ability to withstand repeated loading.

By conducting these evaluations, the study ensures a comprehensive analysis of the material's usefulness and acceptability for future projects, aligning with both industry practices and performance-based assessments.

5 Sources of Materials

The materials selected for this study, along with their respective sources, are summarized in Table 1. All materials evaluated in this study will conform to the physical properties and requirements outlined in OPSS.PROV 1010 and OPSS.MUNI 1010. These standards ensure that the materials meet the necessary specifications for use in construction applications, guaranteeing both compliance and performance integrity throughout the evaluation process.

Table 1: Testing Matrix.

Source/Type	19mm Crushed Concrete	50mm Crushed Concrete	19mm Crusher Run Limestone	50mm Crusher Run Limestone	Virgin Granular B - Type II	Virgin Granular A
Crushed Concrete Supplier A	✓	✓				
Crushed Concrete Supplier B	✓	✓				
Crushed Concrete Supplier C	✓	✓				
Lafarge Dundas – Virgin Material			✓	✓		
Lafarge Caledon – Virgin Material					✓	✓

6 References

The following references were consulted for this project:

1. Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions (MI-183), Final Report prepared by ERES Consultants for the Ministry of Transportation Ontario, 2008.
2. Pavement Design and Rehabilitation Manual, Publication SDO-90-01, dated January 1990.
3. Pavement Design and Rehabilitation Manual, Second Edition, 2013.
4. AASHTO T 307-2021, "Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials."
5. AASHTO Guide for Design of Pavement Structures, Published by American Society of State and Highway Transportation Officials, Published 1993.
6. AASHTO Interim Guide for Design of Pavement Structures 1972, Published by American Society of State and Highway Transportation Officials, Published 1974.

7 Methodology

The methodology adopted for this project is detailed in the following sections.

7.1 Sample Collection:

- Samples of 19mm and 50mm Crushed Concrete, 19mm and 50mm Crusher Run Limestone, as well as Virgin Granular A and Granular B-Type II, were collected from five distinct sources. For the purpose of this study, the Crushed Concrete sources remain anonymous and are labeled as Source A, Source B, and Source C. In contrast, the Virgin material sources are identified and described within this report.

7.2 Laboratory Testing and Equipment Details

- Standard laboratory tests were conducted to evaluate the physical and mechanical properties of the collected samples. These tests were performed in accordance with the specifications outlined in OPSS.MUNI 1010 and OPSS.PROV 1010, ensuring that the materials meet the necessary standards for Granular A and Granular B-Type II.
- The testing was carried out using the UTM-30 machine, manufactured by Controls, along with a triaxial cell setup to assess the Resilient Modulus of the materials. All materials tested conformed to the Granular A and Granular B-Type II OPSS specifications to simplify the analysis while ensuring consistency in the results.

7.3 Equipment Overview

Engtec owns and operates Servo-hydraulic Universal Testing Machines (UTM 30 kN), equipped with high-performance environmental chambers and a broad range of accessories, offering flexibility for performing advanced tests on pavement materials.

Figure 1: Controls UTM 30 Machine and the Triaxial Setup for Resilient Modulus Testing.

These machines are suitable for both research purposes and quality control/quality assurance (QC/QA) testing. The UTM-30 systems can apply loads of up to 30 kN and feature an environmental chamber capable of conducting tests at temperatures ranging from 80°C to -50°C.

7.4 Data Analysis

The primary goal of this step was to analyze the test results to determine the Structural Numbers (SN) for each material and to establish a relationship of equivalency between them. Once the Granular Base Equivalency (GBE) was determined for each material, further analysis was conducted to calculate the SN values. These two interrelated design inputs are essential for pavement design and provide a basis for comparing material performance.

The GBE for the materials was determined using the following equation:

$$\frac{h_1}{h_2} = \sqrt[3]{\frac{E_1}{E_2}}$$

Where:

h_1 and h_2 are relative thicknesses of the two different types of materials in a pavement design; and
E_1 and E_2 are the Resilient Modulus of the two materials determined via AASHTO – T 307-2021.

To develop a relationship for the Structural Number, proportionality rule was applied, correlating the laboratory-determined Resilient Modulus values with the suggested SN values used under the AASHTO 1993 design protocols. This proportionality allows for a direct linkage between laboratory test results and real-world pavement design, ensuring that the materials are evaluated within a framework consistent with industry standards.

8 Physical Property Testing (OPSS 1010) Requirements

As part of this study, a comprehensive range of tests based on OPSS.MUNI 1010 and OPSS.PROV 1010 specifications was conducted for all the Granular A samples received by Engtec. These tests included Washed Gradation and Standard Proctor tests. A summary of the test results for each material is presented in Table 3 below.

Table 3: Granular A – OPSS .MUNI 1010 Summary of Results.

Material	Specification	Granular A – Lafarge Caledon	19mm Crusher Run Limestone – Lafarge Dundas	19mm Crushed Concrete – Source A	19mm Crushed Concrete – Source B	19mm Crushed Concrete – Source C
Percent crushed particles, % minimum, LS-607	60	95	100	99.4	99	99

Material	Specification	Granular A – Lafarge Caledon	19mm Crusher Run Limestone – Lafarge Dundas	19mm Crushed Concrete – Source A	19mm Crushed Concrete – Source B	19mm Crushed Concrete – Source C
Micro-Deval Abrasion - CA, % maximum loss, LS-618	25	21.4	16.8	17.5	18.4	17.8
Micro-Deval Abrasion, FA, % maximum loss, LS-619	30	15.8	11.8	11.2	10.9	12.1
Asphalt Coated Particles, % maximum, LS-621	30	0	0	18.1	18.6	17.0
Amount of Contamination, LS-630	1% Max	0	0	0.92	0.48	0.86
Plasticity Index, maximum LS-703/704	P/NP	NP	NP	NP	NP	NP
Method of Test for Sieve Analysis of Aggregates – LS 602	OPSS.Muni 1010 – Table 2	PASS	PASS	PASS	PASS	PASS
Standard Proctors – LS 706	--	2148kg/m^3 @ 8.3% OMC	2260kg/m^3 @ 7.8% OMC	1987kg/m^3 @ 10.6% OMC	2049kg/m^3 @ 10.4% OMC	1920kg/m^3 @ 12.4% OMC

Similarly, a full spectrum of tests, including Washed Gradation and Standard Proctor, was performed for all Granular B-Type II samples. The results are summarized in Table 4 below.

Table 4: Granular B – OPSS .MUNI 1010 Summary of Results.

Material	Specification	Granular B-Type II – Lafarge Caledon	50mm Crusher Run Limestone – Lafarge Dundas	50mm Crushed Concrete – Source A	50mm Crushed Concrete – Source B	50mm Crushed Concrete – Source C
Percent crushed particles, % minimum, LS-607	60	85.8	100	99.1	98.9	98.8

Material	Specification	Granular B-Type II – Lafarge Caledon	50mm Crusher Run Limestone – Lafarge Dundas	50mm Crushed Concrete – Source A	50mm Crushed Concrete – Source B	50mm Crushed Concrete – Source C
Micro-Deval Abrasion - CA, % maximum loss, LS-618	25	20.6	12.9	18.1	17.9	18.3
Micro-Deval Abrasion, FA, % maximum loss, LS-619	30	15.1	12.6	11.5	10.2	11.2
Asphalt Coated Particles, % maximum, LS-621	30	0	0	21.0	22.8	18.7
Amount of Contamination, LS-630	1% Max	0	0	0.86	0.41	0.93
Plasticity Index, maximum LS-703/704	P/NP	NP	NP	NP	NP	NP
Method of Test for Sieve Analysis of Aggregates – LS 602	OPSS.Muni 1010 – Table 2	PASS	PASS	PASS	PASS	PASS
Standard Proctors – LS 706	--	2165kg/m^3 @ 7.8% OMC	2254kg/m^3 @ 6.6% OMC	2020kg/m^3 @ 9.7% OMC	2055kg/m^3 @ 10.6% OMC	1984kg/m^3 @ 11.5% OMC

A review of both Table 3 and Table 4 indicates that the tested materials are compliant with the applicable OPSS.MUNI 1010 specifications for both Granular A and Granular B-Type II materials.

The detailed test results for each material as stated above are presented in Appendix A of this submission.

9 Resilient Modulus of Granular Material(s)

Based on the laboratory-assessed Resilient Modulus for the materials tested, as per the AASHTO T 307-2021 standard, Engtec determined the following values:

Please note that the average Resilient Modulus values presented in Table 5 represent the averages of values obtained by Engtec from three unnamed sources used for this study. For reference purposes, detailed Resilient Modulus values for each of the three sources are provided in Table 6 (19mm Crushed Concrete) and Table 7 (50mm Crushed Concrete).

Table 5: Resilient Modulus Determination as per AASHTO T 307-2021 Standard.

Material	Resilient Modulus (MPa)
Virgin Granular A - OPSS 1010 – Lafarge Caledon	283
Virgin Granular B - TII - OPSS 1010 – Lafarge Caledon	225
19mm Crushed Concrete - *Average*	287
50mm Crushed Concrete - *Average*	244
19mm Crusher Run Limestone – Lafarge Dundas	297
50mm Crusher Run Limestone – Lafarge Dundas	288

A separate linear elastic layered analysis was performed for a typical Ontario pavement structure, which includes 150mm of Granular A and 300mm of Granular B overlaid with 100mm or hot-mix asphalt. This analysis was used to assess the confining pressure range expected for 19mm Crushed Concrete (Granular A) and 50mm Crushed Concrete (Granular B-Type II) under field conditions. The selected Resilient Modulus values for each material are based on this anticipated field confining pressure, as shown in Tables 6 and 7.

Table 6: 19mm Crushed Concrete (Granular A) Resilient Modulus as per AASHTO T 307-2021 Standard.

Material - Classified under OPSS 1010 (MUNI and PROV)	Resilient Modulus - Test Results Summary (10mm Crushed Concrete) - MPa
	Confining Stress, 137.9 kPa.
19mm Crushed Concrete - Supplier A	270
19mm Crushed Concrete - Supplier B	308
19mm Crushed Concrete - Supplier C	282

Table 7: 50mm Crushed Concrete (Granular B-Type II) Resilient Modulus as per AASHTO T 307-2021 Standard.

Material - Classified under OPSS 1010 (MUNI and PROV)	Resilient Modulus - Test Results Summary (50mm Crushed Concrete) - MPa
	Confining Stress, 103.4 kPa.
50mm Crushed Concrete - Supplier A	209
50mm Crushed Concrete - Supplier B	279
50mm Crushed Concrete - Supplier C	243

Figures 2 and 3 below provide graphical representations of the Resilient Modulus values for the tested materials:

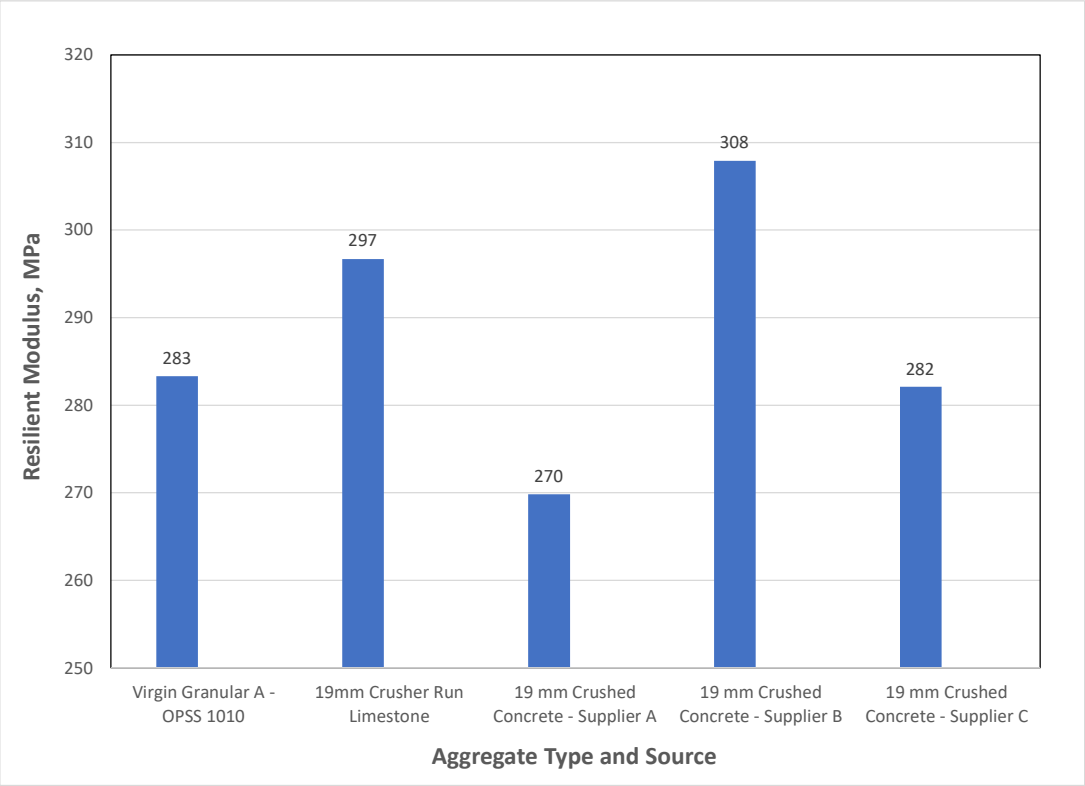

Figure 2: Granular A, 19mm Crushed Concrete and 19mm Crusher Run Limestone Resilient Modulus.

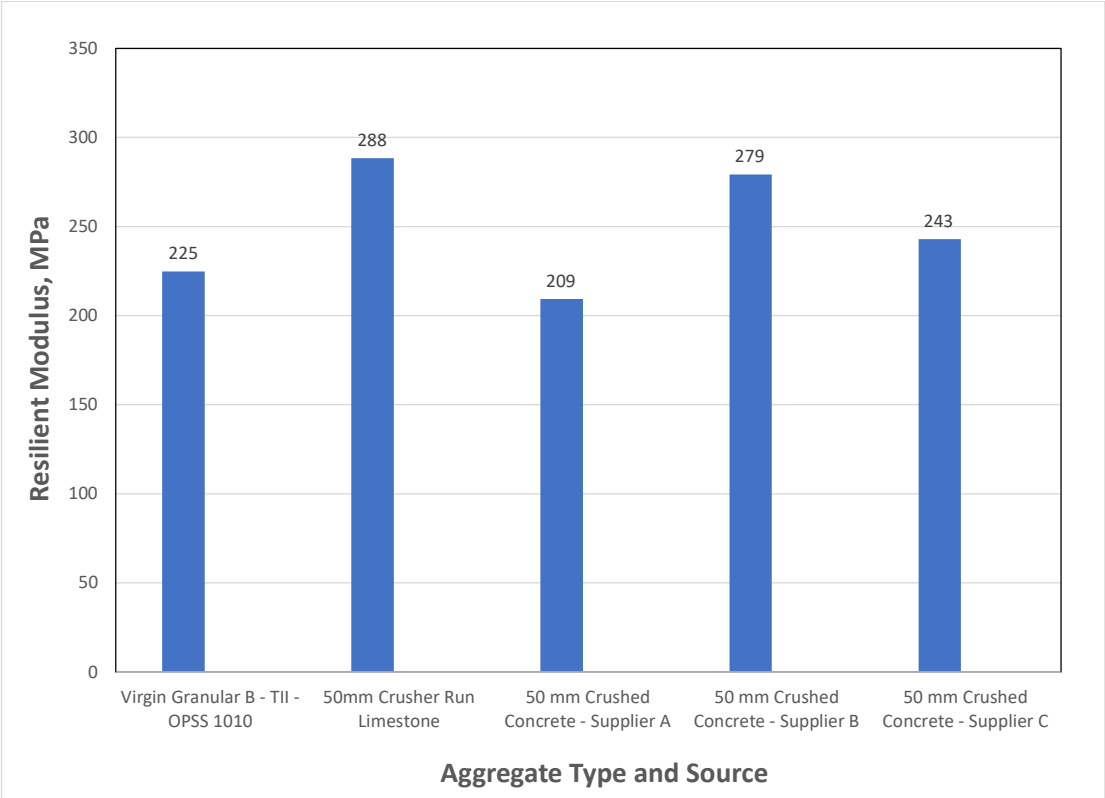

Figure 3: Granular B-Type II, 19mm Crushed Concrete and 19mm Crusher Run Limestone Resilient Modulus.

These graphical representations help visualize the comparative performance of these materials under the test conditions.

10 Granular Base Equivalency (GBE) Assessment

Using the information presented in Section 8 of this report, combined with the formulation provided in Section 6.3, the Granular Base Equivalency (GBE) for each material was determined. The results for the Granular A materials are summarized in Table 8 below.

Table 8: Granular Base Equivalency Determination Based Upon Resilient Modulus for Granular A.

Material	Granular Base Equivalency (GBE)
Virgin Granular A - OPSS 1010*	**1.0**
19mm Crushed Concrete - *Average*	1.0
19mm Crusher Run Limestone	1.0
Virgin Granular B - TII - OPSS 1010*	**0.67**
50mm Crushed Concrete - Average	1.0
50mm Crusher Run Limestone	0.9

***: Specified under [2] and [3].**

The analysis indicates that the GBE for Virgin Granular A, 19mm Crushed Concrete, and 19mm Crusher Run Limestone are equivalent (GBE = 1.0). Meanwhile, Virgin Granular B-Type II uses a lower GBE of 0.67, which reflects the material's lower performance in comparison to Granular A and its crushed concrete counterparts. For 50mm Crushed Concrete, the GBE is also 1.0, while 50mm Crusher Run Limestone is slightly lower at 0.9.

11 Structural Number (SN) Assessment

Similarly, using the methodology outlined in Section 8 and the formulation provided in Section 6.3, the Structural Number (SN) for each material was calculated. The rule of proportionality was applied to form the mathematical basis for this assessment. The summary of results for Granular B-Type II materials is presented in Table 9 below.

The SN values indicate a consistent performance across the materials, with Virgin Granular A, Virgin Granular B-Type II, and 19mm Crushed Concrete all having an SN of 0.14. 50mm Crushed Concrete shows a slightly higher SN of 0.15, indicating better structural capacity. The 50mm Crusher Run Limestone exhibits the highest SN at 0.18, suggesting that it has the strongest structural capacity among the materials tested.

Table 9: Structural Number (SN) Determination Based Upon Resilient Modulus for Granular B-Type II.

Material	Structural Number (mm)
Virgin Granular A - OPSS 1010*	0.14
Virgin Granular B - TII - OPSS 1010*	0.14
19mm Crushed Concrete - Average	0.14
50mm Crushed Concrete - Average	0.15
19mm Crusher Run Limestone	0.15
50mm Crusher Run Limestone	0.18

***: Specified under [1] and [3].**

12 Structural Number (SN) vs. Granular Base Equivalency (GBE)

The concept of Granular Base Equivalency (GBE) has been in use since the 1970s, establishing a foundation for evaluating the structural contributions of granular layers in pavement design [6]. In contrast, the Structural Number (SN) only gained widespread usage in the late 1990s, coinciding with the adoption of the AASHTO 1993 pavement design protocols [5]. The publication of the 1993 AASHTO Pavement Design Guide, further supported by the Ministry of Transportation Ontario (MTO) publication MI-183, helped solidify the use of the Structural Number in both municipal and private pavement design projects across Ontario [1,3].

From a mathematical standpoint, the GBE formulation, as provided in Equation 1 (Section 6.4) of this report, employs a cube root normalization of the resilient modulus, which significantly reduces subtle differences in material properties. This normalization has been effective in simplifying comparative analysis but may mask more nuanced strength characteristics of individual materials.

In contrast, the Structural Number (SN) approach, as rooted in MI-183 protocols and applied in this analysis, offers a more realistic and robust assessment of material strength. By normalizing material properties based on equivalency factors, the SN-based method more accurately reflects the true in-situ behavior of materials under traffic loads, thus providing a more reliable basis for pavement design. This reality-based assessment is critical when considering long-term performance and durability of pavement structures.

Therefore, it is recommended to prioritize the use of SN values, as presented in Section 10 (Table 9) of this report. These values reflect the incorporation of materials commonly used in municipal, private, and Ministry projects and are grounded in field-verified strength characteristics. Their inclusion ensures that the design is not only theoretically sound but also aligned with the observed performance of these materials in real-world applications.

This conclusion aligns with the procedures and protocols established by the Ministry of Transportation, Ontario (MTO) for pavement design. The MTO's pavement design guidelines recognize the use of Crushed Concrete as a viable and structurally sound alternative to traditional granular materials, provided that the material meets the physical requirements outlined in OPSS 1010. Therefore, our recommendations are consistent with industry standards and reflect a proven approach to ensuring the durability and performance of pavement structures.

13 Conclusion

The results of this study provide a clear and compelling assessment of the performance of Crushed Concrete compared to traditional granular materials such as Virgin Granular A and Virgin Granular B-Type II. Through comprehensive laboratory testing, both the Granular Base Equivalency (GBE) and Structural Number (SN) were evaluated, leading to significant findings that support the use of Crushed Concrete in pavement applications.

From a GBE perspective, Crushed Concrete has been shown to be equivalent to Virgin Granular A and Granular B-Type II, highlighting its suitability as a sustainable alternative without compromising the load-bearing capacity or performance. In terms of SN, the study found that 19mm Crushed Concrete performs on par with Granular A, while 50mm Crushed Concrete demonstrates slightly better structural performance than Virgin Granular B-Type II. These results suggest that Crushed Concrete can be used in pavement structures without the need to increase layer thicknesses, offering the same or enhanced performance compared to traditional materials (Virgin Granular A and Granular B-Type II). This conclusion is in line with the Ministry of Transportation, Ontario (MTO) protocols, which recognize Crushed Concrete as a viable alternative for granular materials, provided it meets the physical specifications outlined in OPSS 1010.

While the GBE method has historically been used to assess granular materials, the findings of this report suggest that the SN-based methodology offers a more realistic and reliable assessment of material strength, particularly when considering long-term pavement performance. The **SN** provides a better normalization framework rooted in actual material properties and field performance, aligning more closely with current pavement design needs.

In summary, the use of Crushed Concrete represents a cost-effective, environmentally friendly solution that can match or exceed the performance of virgin aggregates in Ontario's pavement designs. The findings of this study support the broader adoption of Crushed Concrete in future construction projects, aligning with sustainability goals without sacrificing structural integrity or long-term performance.

We trust that this submission meets your requirements. Should you have any questions, please don't hesitate to contact this office.

Yours truly,

Michael Doherty, P.Eng.
Senior Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P. Eng.
Principal
Engtec Consulting Inc.

Appendix A

OPSS.MUNI 1010 Physicals and Other Test Results

Virgin Granular A
19mm Crusher Run Limestone
19mm Crushed Concrete

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09647
Granular Type : Granular A - OPSS.MUNI 1010	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Lafarge - Caledon - Pinkney		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	95.0	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	21.4	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	15.8	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	0	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ September 5, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

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Grain Size Analysis

Project No.	ET24-1327A	Material	Granular A OPSS.MUNI 1010
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon - Pinkney	Date Tested:	September 2, 2024
Sampled Location:	Lafarge - Caledon - Pinkney	Specification:	Granular A OPSS.MUNI 1010
Lab No.	G09647		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	95.8	85	100	
16	89.9			
13.2	83.0	65	90	
12.5	80.9			
9.5	71.7	50	73	
4.75	53.2	35	55	
2.36	41.8			
1.18	32.4	15	40	
0.6	21.0			
0.3	12.0	5	22	
0.15	8.7			
0.075	7.3	2	8	

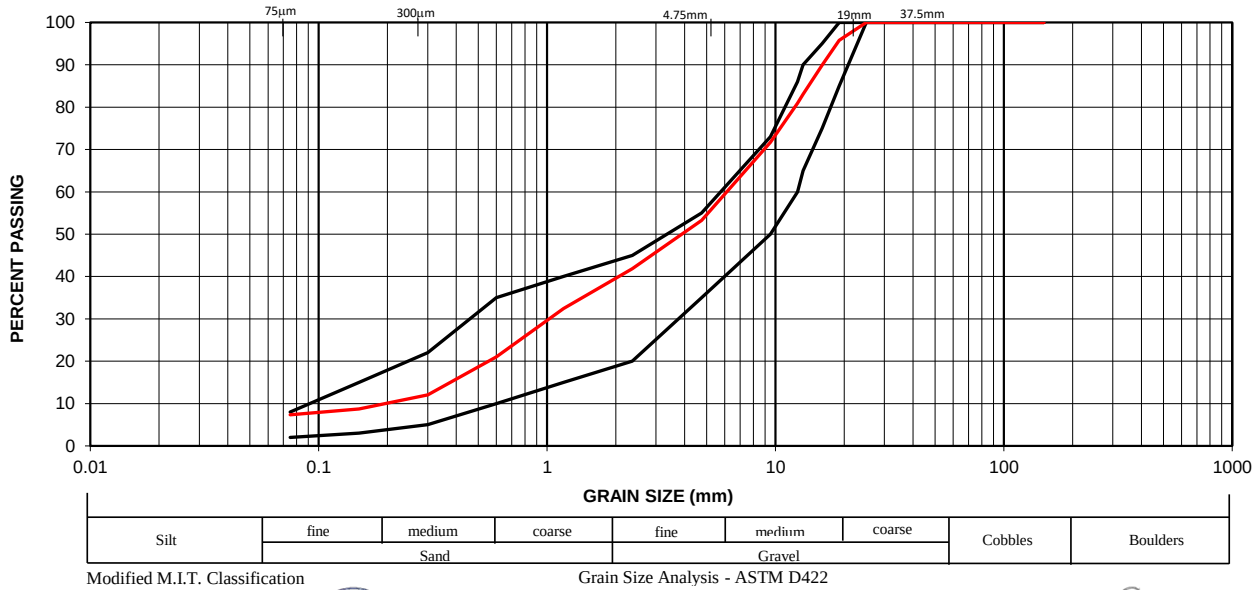
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	0
Crushed Particles (%):	95
Percent Deleterious (%):	0

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

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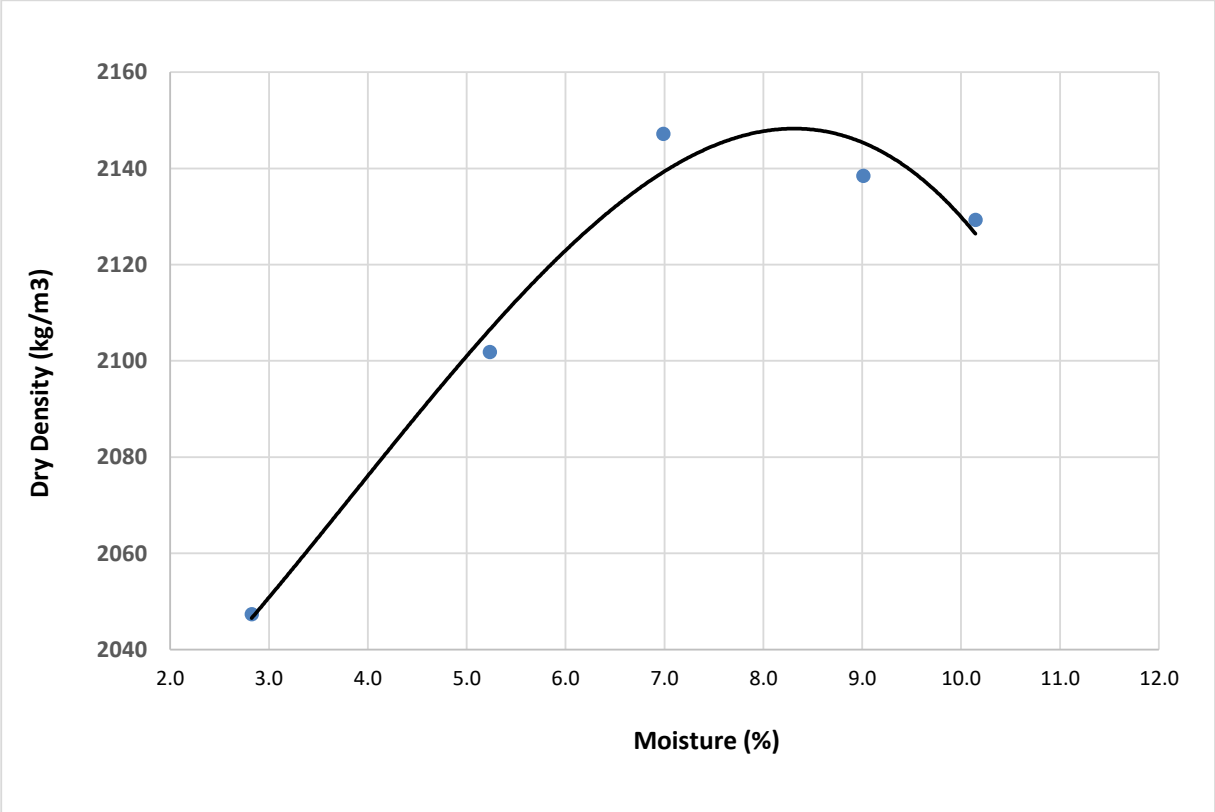
Standard Proctor

Project No.	ET24 -1327A	Material	**Granular A OPSS MUNI 1010**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon - Pinkney	Date Tested:	September 2, 2024
Sampled Location:	Lafarge - Caledon - Pinkney	Specification:	LS-706
Lab No.	G09647		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	2047	2102	2147	2138	2129
Moisture Content (%)	2.8	5.2	7.0	9.0	10.1



Maximum Dry Density	**2148 Kg/m3**
Optimum Moisture Content	**8.3 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09773
Granular Type : Granular B Type II - OPSS.MUNI 1010	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Lafarge - Caledon - Pinkney		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	85.8	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	20.6	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	15.1	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	0	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ September 5, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	Gran A-OPSS.Muni 1010
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Lafarge Caledon (Pinkney)	Date Tested:	September 2, 2024
Lab No:	G09647	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: October 1, 2024

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09645
Granular Type : 19mm Crusher Run Limestone	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Lafarge - Dundas		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	100	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	16.8	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	11.8	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	0	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ September 6, 2024

PRINT NAME | SIGNATURE | DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME | SIGNATURE | DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	Granular A OPSS MUNI 1010
Client:	N/A	Sampled By:	Client
Project Description:	N/A	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	August 30, 2024
Sampled Location:	Lafarge - Dundas	Specification:	Granular A OPSS MUNI 1010
Lab No.	G09645		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	94.8	85	100	
16	86.0			
13.2	78.5	65	90	
12.5	75.5			
9.5	62.9	50	73	
4.75	42.8	35	55	
2.36	32.7			
1.18	24.8	15	40	
0.6	19.5			
0.3	15.7	5	22	
0.15	12.9			
0.075	9.6	2	10	

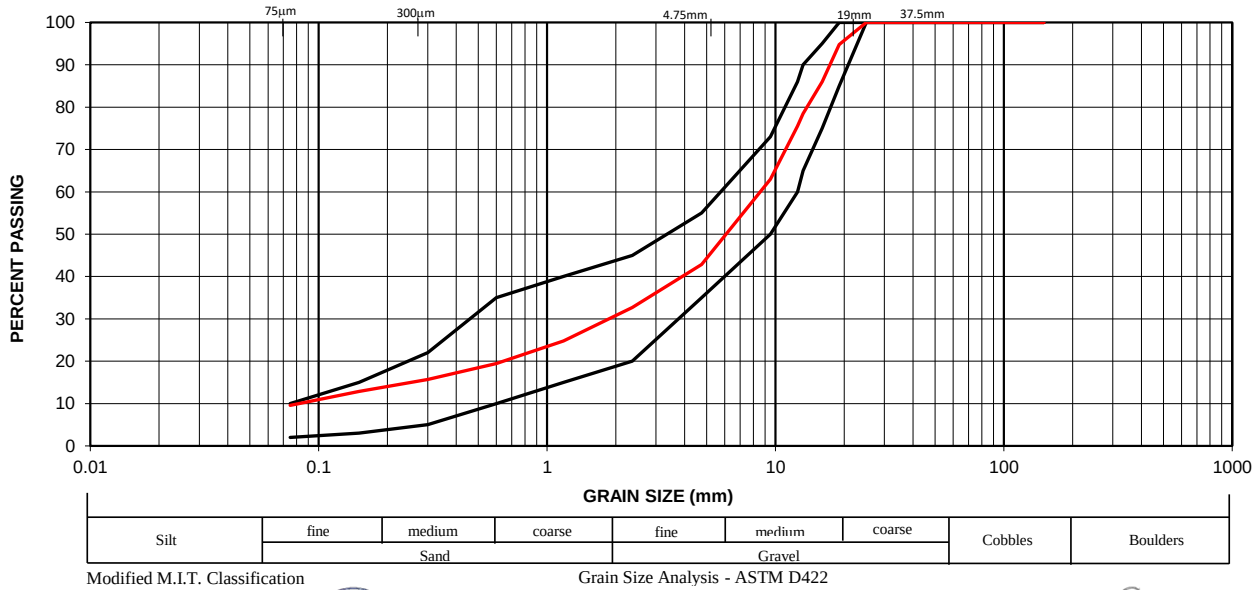
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	0
Crushed Particles (%):	100
Percent Deleterious (%):	0

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

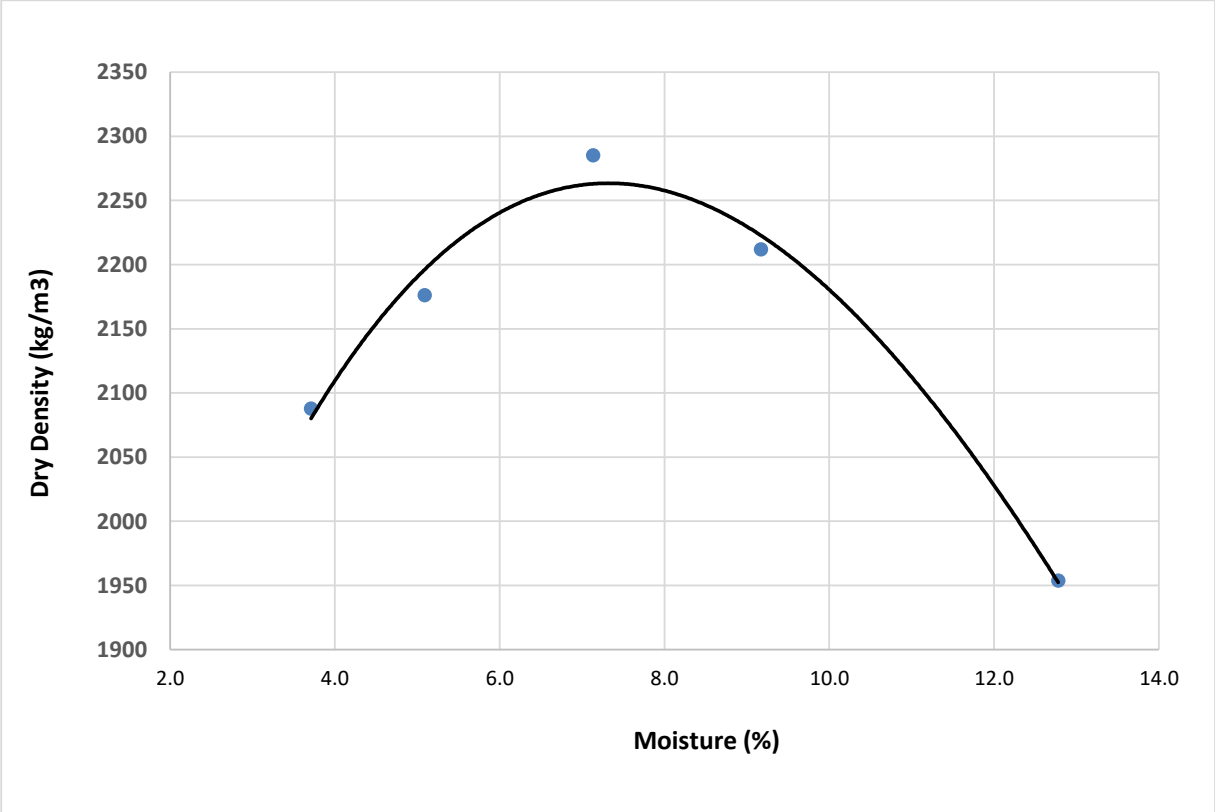
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**Granular A OPSS MUNI 1010**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	August 31, 2024
Sampled Location:	Lafarge - Dundas	Specification:	LS-706
Lab No.	G09645		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	2088	2176	2285	2212	1954
Moisture Content (%)	3.7	5.1	7.1	9.2	12.8



Maximum Dry Density	**2260 Kg/m3**
Optimum Moisture Content	**7.8 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	Gran A-OPSS.Muni 1010
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Lafarge -Dundas Quarry	Date Tested:	August 30, 2024
Lab No:	G09645	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: October 1, 2024

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09650
Granular Type : 19mm Crushed Concrete	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Source "A"		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	99.4	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	17.5	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	11.2	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	10.1	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ August 29, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	19mm Crushed Concrete
Client:	N/A	Sampled By:	August 16, 2024
Project Description:	N/A	Date Sampled:	August 26, 2024
Source	Source "A"	Date Tested:	Granular A - OPSS 1010
Sampled Location:	Source "A"	Specification:	
Lab No.	G09650		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	86.2	85	100	
16	75.1			
13.2	68.1	65	90	
12.5	65.8			
9.5	55.8	50	73	
4.75	40.1	35	55	
2.36	32.3			
1.18	26.6	15	40	
0.6	21.0			
0.3	14.1	5	22	
0.15	8.5			
0.075	5.9	2	8	

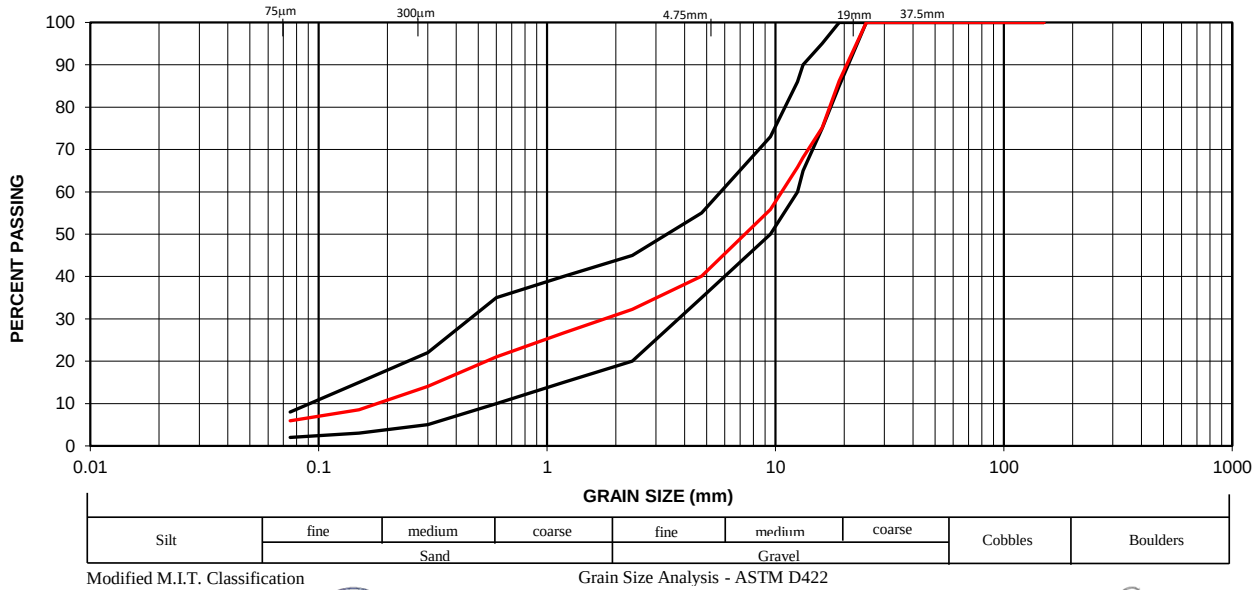
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	18.1
Crushed Particles (%):	99.4
Percent Deleterious (%):	0.92

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

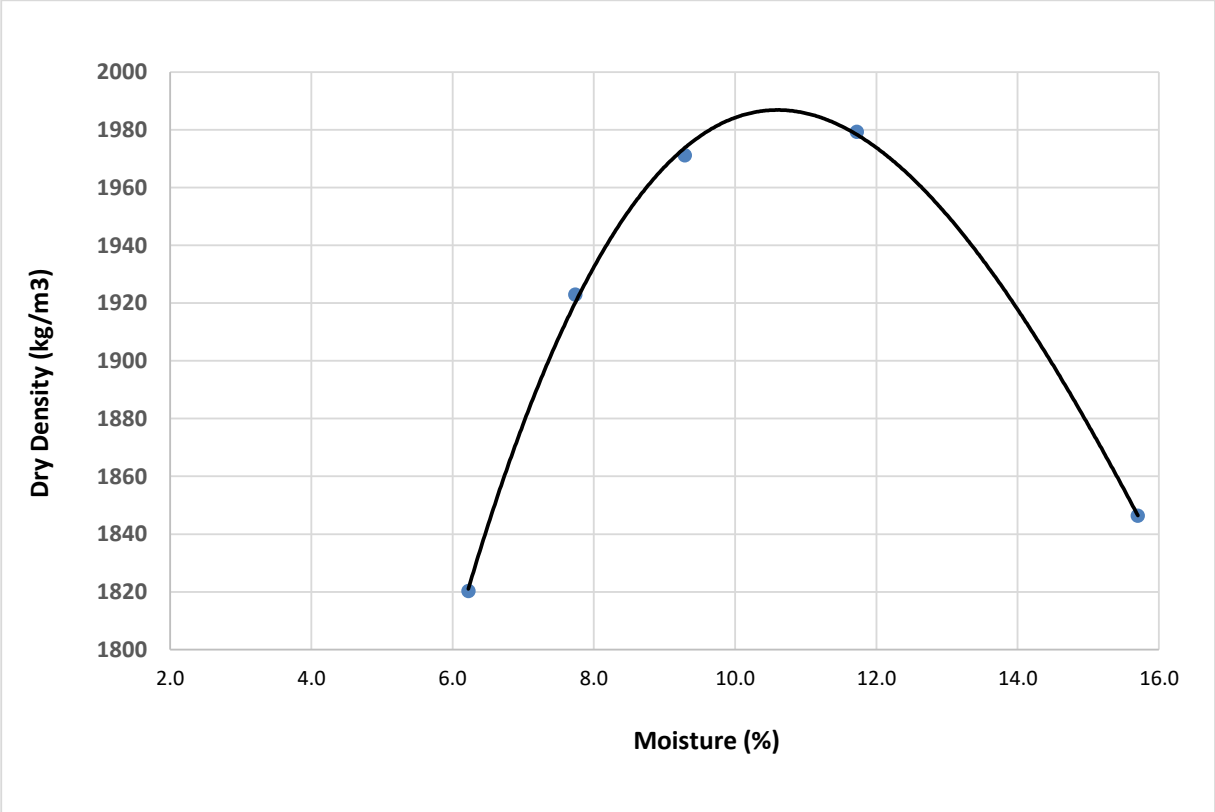
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**Gran A-Recycled Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "A"	Date Tested:	August 26, 2024
Sampled Location:	Source "A"	Specification:	LS-706
Lab No.	G09650		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1820	1923	1971	1979	1846
Moisture Content (%)	6.2	7.7	9.3	11.7	15.7



Maximum Dry Density	**1987 Kg/m3**
Optimum Moisture Content	**10.6 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	19mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Source "A"	Date Tested:	August 28, 2024
Lab No:	G09650	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

DETERMINATION OF AMOUNT OF CONTAMINATION OF COARSE AGGREGATE
(LS-630, R33)

Testing Laboratory:	Telephone No.:		Fax No.:
Engtec Consulting Inc.	***905-856-2988***		***905-896-2989***
Sampled By (Print Name):	Date Sampled: (YY/MM/DD)		**Engte Lab. #G09650**
Client	**24-08-16**		
Granular Type:	Lot No.:	Quantity (tonnes):	
19mm Crushed Concrete	N/A	N/A	
Source Name/Location:		Aggregate Inventory Number (AIN):	N/A
Source "A"			

Laboratory Sample No.	Largest Particle Size (>95% Passing Sieve)	Mass of Sample, g A	Mass of Wood, g B	Type of Contaminant	Mass of Contaminant, g C	% Wood (B*100/A)	% Contaminant (C*100/A)	
G09650	19mm.	2152.8	0	Clay Bicks	19.8	0	0.92	

Remarks: No wood Contamination Detected.

Date: August 26,2024

Operator: Leonardo Pilapil

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09648
Granular Type : 19mm Crushed Concrete	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Source "B"		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	99.0	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	18.4	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	10.9	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	10.6	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ August 28, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	19mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "B"	Date Tested:	August 26, 2024
Sampled Location:	Source "B"	Specification:	Granular A - OPSS 1010
Lab No.	G09648		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	95.9	85	100	
16	86.9			
13.2	78.7	65	90	
12.5	75.8			
9.5	63.4	50	73	
4.75	43.9	35	55	
2.36	33.6			
1.18	26.3	15	40	
0.6	20.3			
0.3	14.9	5	22	
0.15	11.0			
0.075	7.2	2	8	

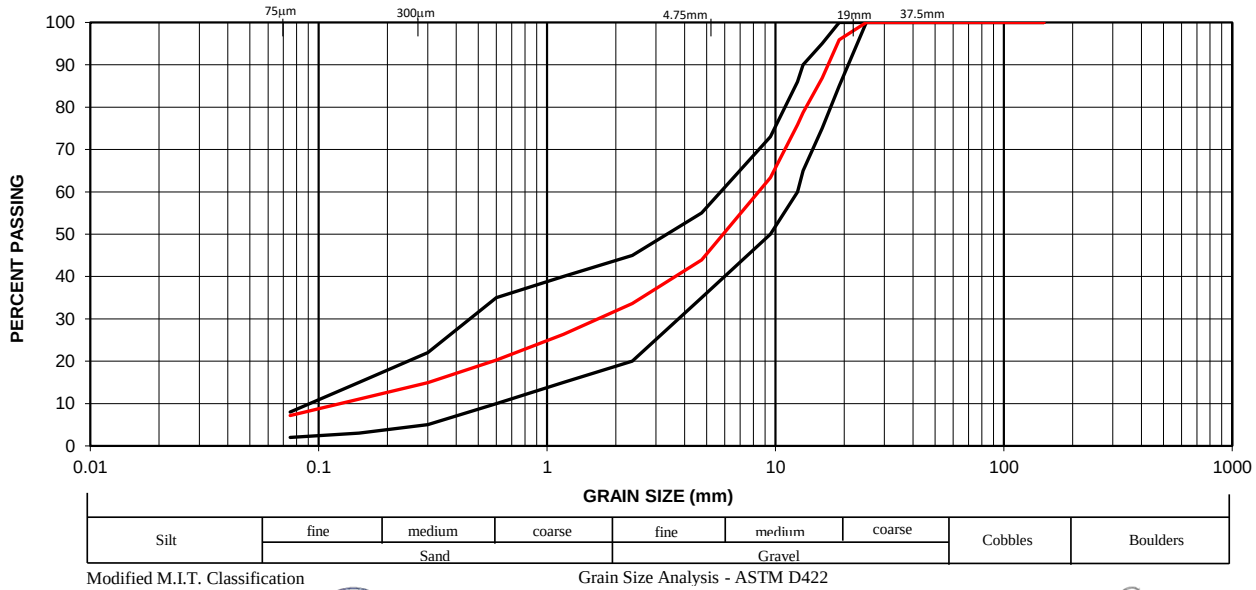
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	18.6
Crushed Particles (%):	99.0
Percent Deleterious (%):	0.48

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

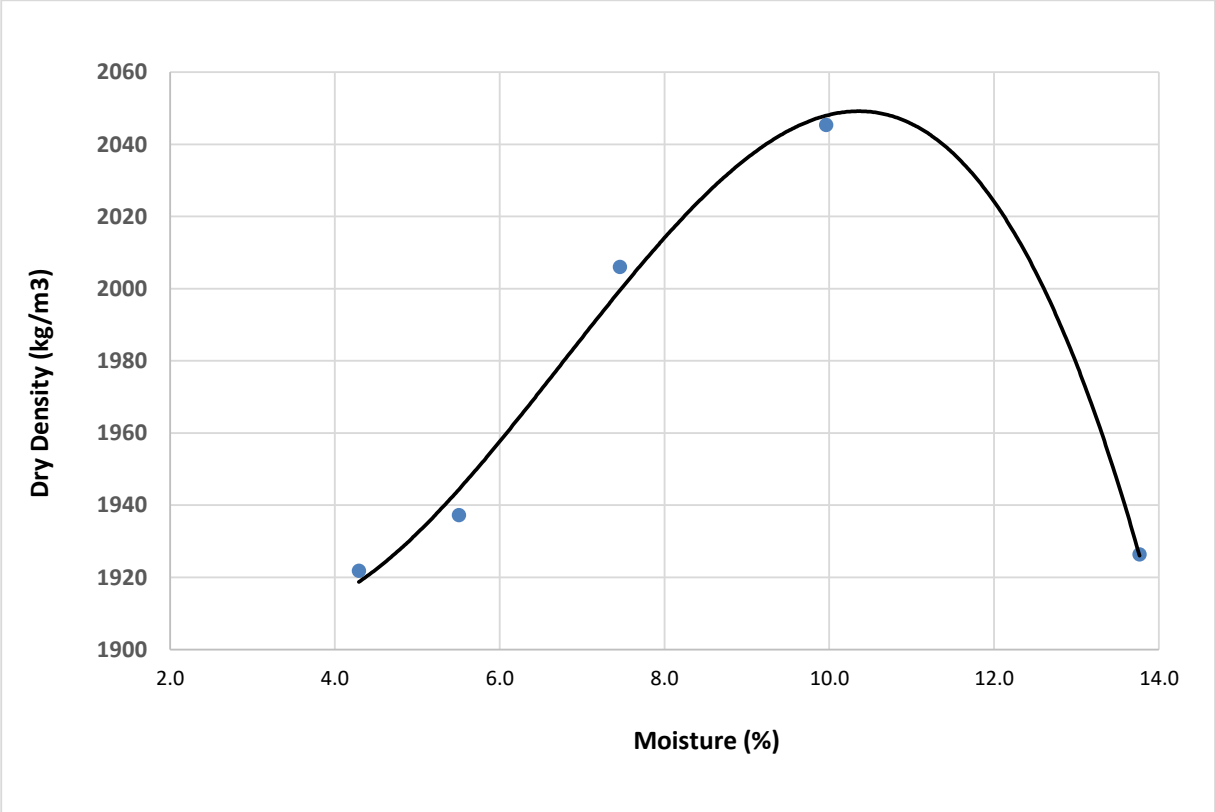
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**19mm Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "B"	Date Tested:	August 26, 2024
Sampled Location:	Source "B"	Specification:	LS-706
Lab No.	G09648		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	1922	1937	2006	2045	1926
Moisture Content (%)	4.3	5.5	7.5	10.0	13.8



Maximum Dry Density	**2049 Kg/m3**
Optimum Moisture Content	**10.4 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	19mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Source "B"	Date Tested:	August 27, 2024
Lab No:	G09648	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

DETERMINATION OF AMOUNT OF CONTAMINATION OF COARSE AGGREGATE
(LS-630, R33)

Testing Laboratory:	Telephone No.:		Fax No.:
Engtec Consulting Inc.	***905-856-2988***		***905-896-2989***
Sampled By (Print Name):	Date Sampled: (YY/MM/DD)		**Engte Lab. #G09648**
Client	**24-08-16**		
Granular Type:	Lot No.:	Quantity (tonnes):	
19mm Crushed Concrete	N/A	N/A	
Source Name/Location:		Aggregate Inventory Number (AIN):	N/A
Source "B"			

Laboratory Sample No.	Largest Particle Size (>95% Passing Sieve)	Mass of Sample, g A	Mass of Wood, g B	Type of Contaminant	Mass of Contaminant, g C	% Wood (B*100/A)	% Contaminant (C*100/A)	
G09648	19mm.	2268.3	0	Clay Bicks	10.9	0	0.48	

Remarks: No wood Contamination Detected.

Date: August 26,2024

Operator: Leonardo Pilapil

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 12	Engtec Lab # G09629
Granular Type : 19mm Crushed Concrete	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Source "C"		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	99.0	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	17.8	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	12.1	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	8.0	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ August 16, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

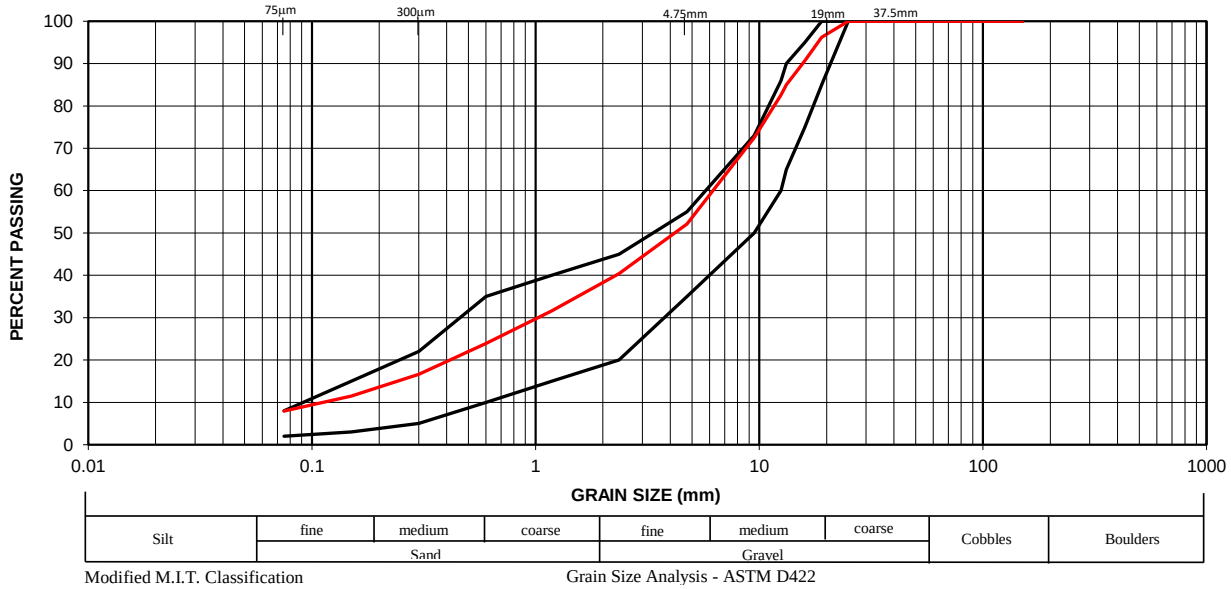
Project No.	ET24-1327A	Material	19mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source "C"	Date Tested:	August 14, 2024
Sampled Location:	Source "C"	Specification:	Granular A - OPSS 1010
Lab No.	G09629		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	96.2	85	100	
16	90.7			
13.2	85.0	65	90	
12.5	82.6			
9.5	72.5	50	73	
4.75	52.1	35	55	
2.36	40.4			
1.18	31.6	15	40	
0.6	23.9			
0.3	16.7	5	22	
0.15	11.5			
0.075	7.9	2	8	

Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	17.0
Crushed Particles (%):	99
Percent Deleterious (%):	0.86

Additional Comments



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal, Engtec Consulting Inc.

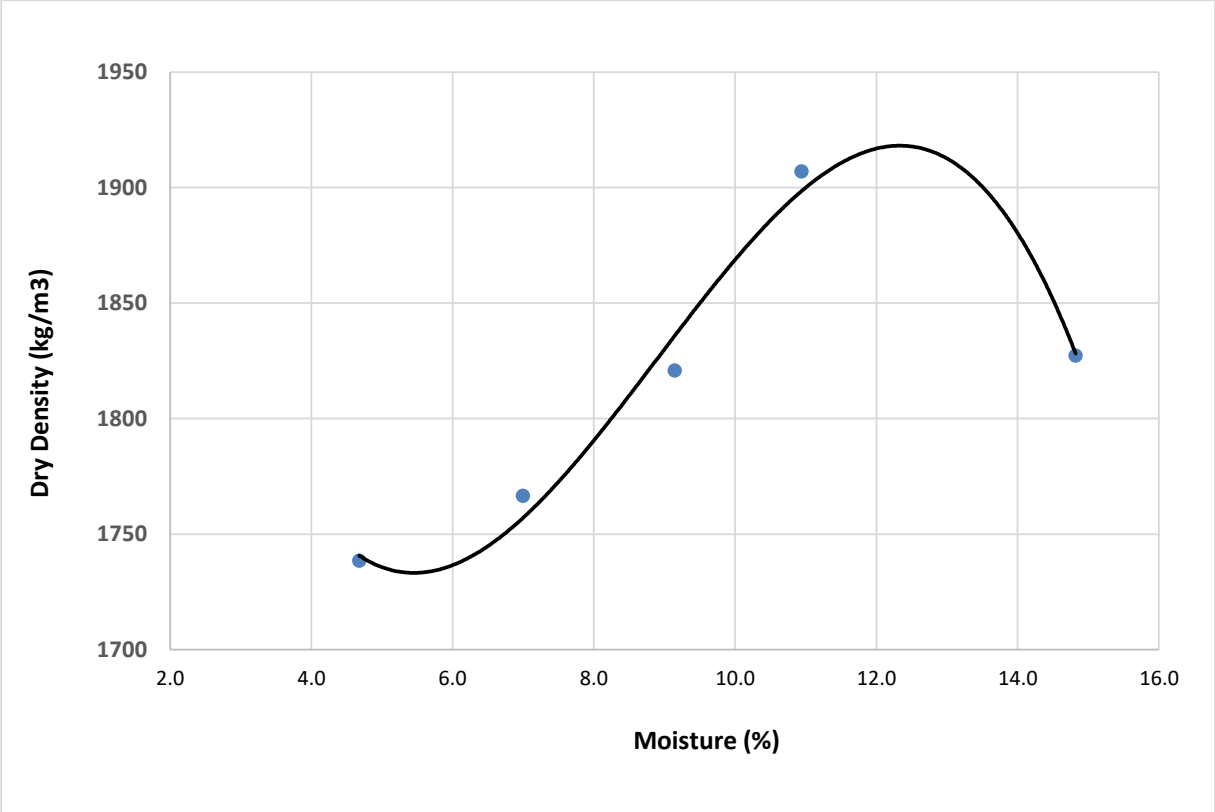
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**19mm Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source "C"	Date Tested:	August 15, 2024
Sampled Location:	Source "C"	Specification:	LS-706
Lab No.	G09629		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	1738	1767	1821	1907	1827
Moisture Content (%)	4.7	7.0	9.1	10.9	14.8



Maximum Dry Density	**1920 Kg/m3**
Optimum Moisture Content	**12.4 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	19mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 12,2024
Source:	Source "C"	Date Tested:	August 29, 2024
Lab No:	G09629	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

DETERMINATION OF AMOUNT OF CONTAMINATION OF COARSE AGGREGATE
(LS-630, R33)

Testing Laboratory:	Telephone No.:		Fax No.:
Engtec Consulting Inc.	***905-856-2988***		***905-896-2989***
Sampled By (Print Name):	Date Sampled: (YY/MM/DD)		**Engte Lab. #G09629**
Client	**24-08-12**		
Granular Type:	Lot No.:	Quantity (tonnes):	
19mm Crushed Concrete	N/A	N/A	
Source Name/Location:		Aggregate Inventory Number (AIN):	N/A
Source "C"			

Laboratory Sample No.	Largest Particle Size (>95% Passing Sieve)	Mass of Sample, g A	Mass of Wood, g B	Type of Contaminant	Mass of Contaminant, g C	% Wood (B*100/A)	% Contaminant (C*100/A)	
G09629	19mm.	2085.7	0	Clay Bicks/Tiles	17.9	0	0.86	

Remarks: No wood Contamination Detected.

Date: August 14,2024

Operator: Leonardo Pilapil

Virgin Granular B
50mm Crusher Run Limestone
50mm Crushed Concrete

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09773
Granular Type : Granular B Type II - OPSS.MUNI 1010	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Lafarge - Caledon - Pinkney		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	85.8	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	20.6	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	15.1	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	0	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ September 5, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	Granular B Type II - OPSS.MUNI 1010
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon - Pinkney	Date Tested:	September 4, 2024
Sampled Location:	Lafarge - Caledon - Pinkney	Specification:	Granular B Type II - OPSS.MUNI 1010
Lab No.	G09773		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0	100	100	
75	100.0			
53	99.0			
37.5	82.7			
26.5	70.0	50	100	
25	67.8			
19	58.7			
16	50.3			
13.2	47.2			
12.5	45.2			
9.5	36.7			
4.75	27.2	20	55	
2.36	20.8			
1.18	16.8	10	40	
0.6	13.8			
0.3	11.4	5	22	
0.15	9.5			
0.075	7.2	0	10	

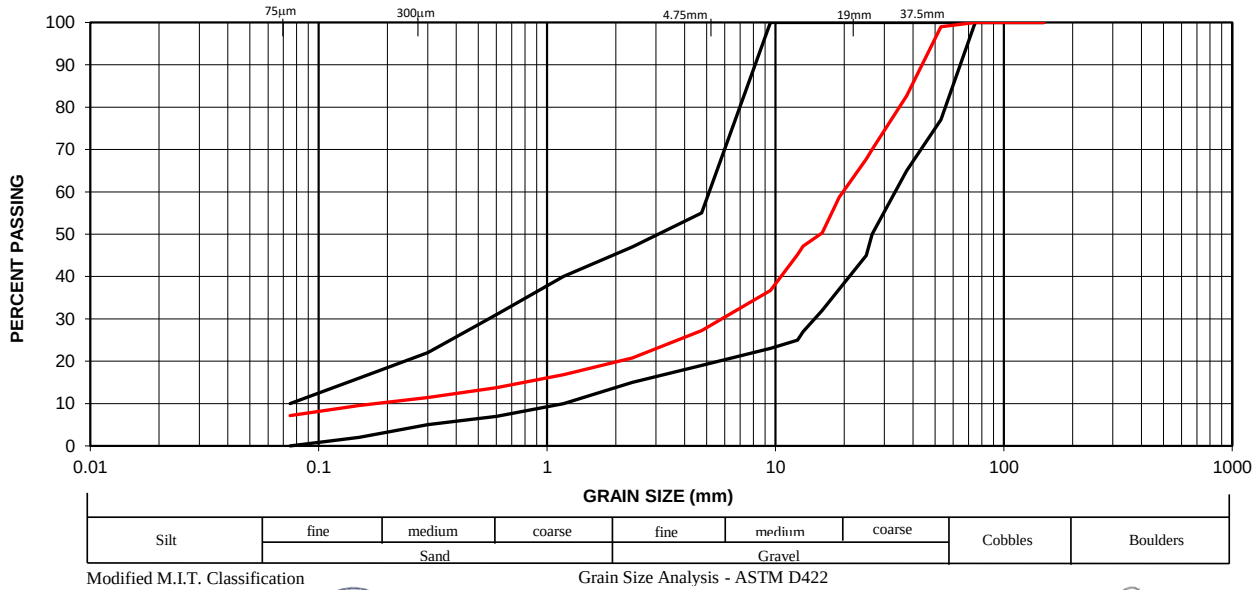
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	0
Crushed Particles (%):	85.8
Percent Deleterious (%):	0

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

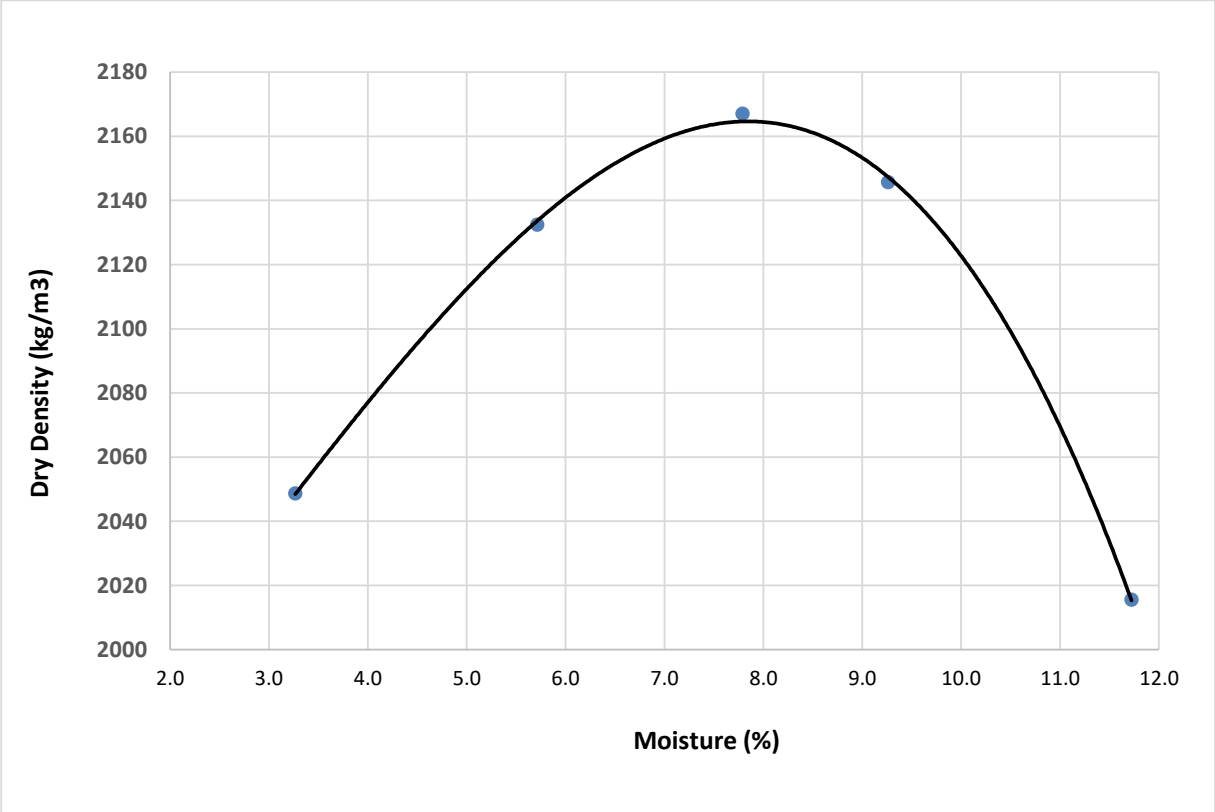
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**Granular B Type II - OPSS MUNI 1010**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon - Pinkney	Date Tested:	September 4, 2024
Sampled Location:	Lafarge - Caledon - Pinkney	Specification:	LS-706
Lab No.	G09773		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	2049	2132	2167	2146	2016
Moisture Content (%)	3.3	5.7	7.8	9.3	11.7



Maximum Dry Density	**2165 Kg/m3**
Optimum Moisture Content	**7.8 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	Gran B Type II-OPSS.Muni 1010
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Lafarge Caledon (Pinkney)	Date Tested:	September 4, 2024
Lab No:	G09773	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09646
Granular Type : 50mm Crusher Run Limestone	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Lafarge - Dundas		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	100	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	16.5	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	12.6	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	0	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. — PRINT NAME

SIGNATURE

September 5, 2024 — DATE

Received by (Contract Administrator Representative):

PRINT NAME | SIGNATURE | DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	50mm Crusher Run Limestone
Client:	N/A	Sampled By:	Client
Project Description:	N/A	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	September 3, 2024
Sampled Location:	Lafarge - Dundas	Specification:	Granular B Type II - OPSS.MUNI 1010
Lab No.	G09646		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0	100	100	
75	100.0			
53	96.1			
37.5	82.2			
26.5	69.8	50	100	
25	67.8			
19	59.9			
16	55.7			
13.2	51.0			
12.5	49.6			
9.5	43.4			
4.75	32.8	20	55	
2.36	24.9			
1.18	18.8	10	40	
0.6	15.0			
0.3	12.5	5	22	
0.15	9.9			
0.075	7.7	0	10	

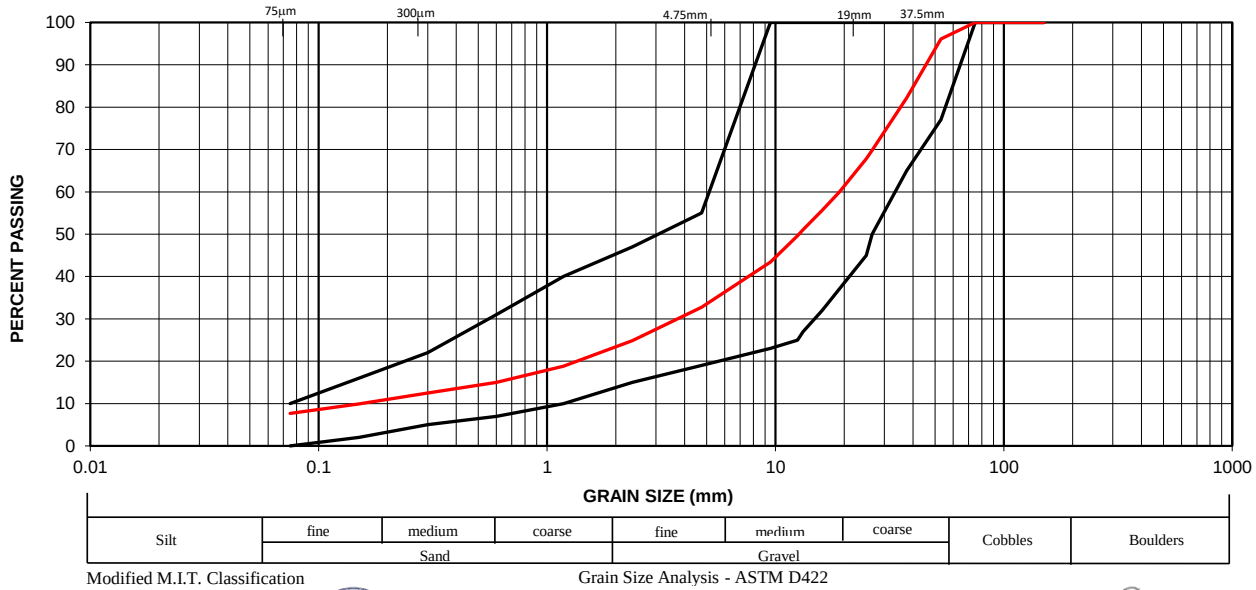
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	0
Crushed Particles (%):	100
Percent Deleterious (%):	0

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

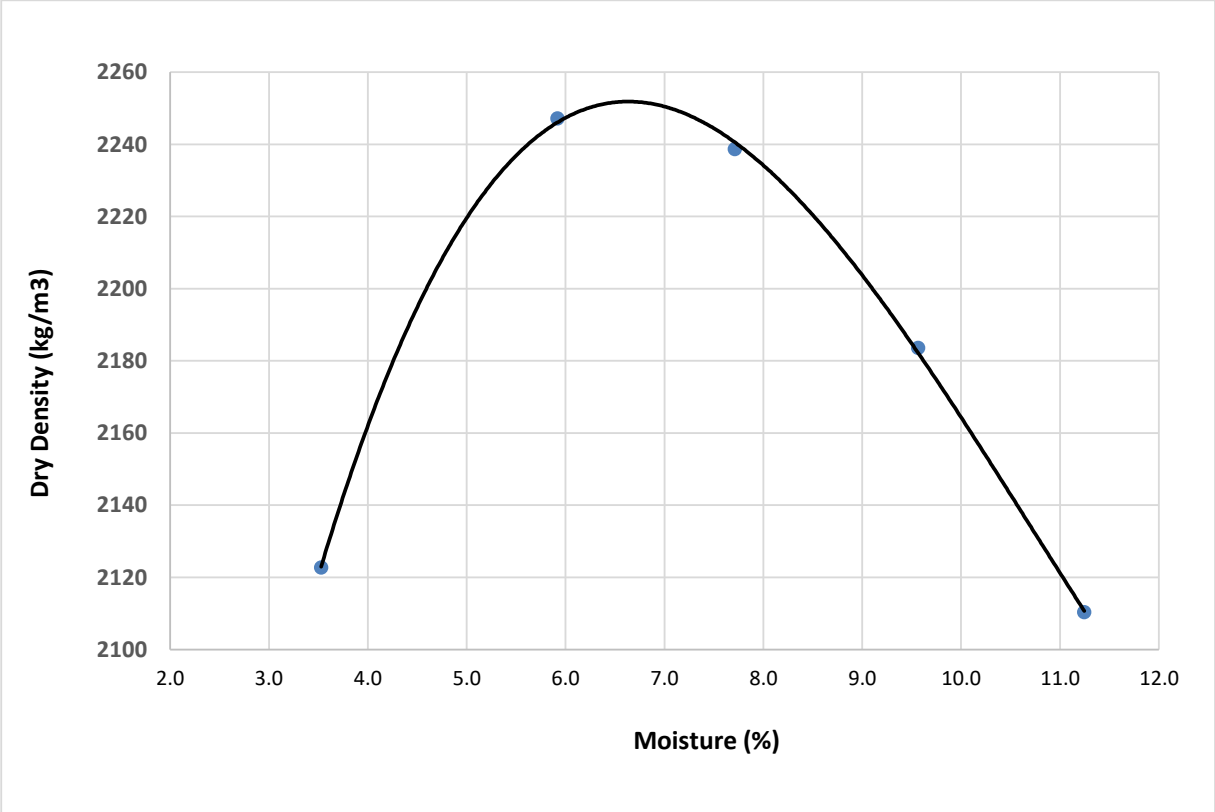
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**50mm Crusher Run Limestone**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	September 3, 2024
Sampled Location:	Lafarge - Dundas	Specification:	LS-706
Lab No.	G09646		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	2123	2247	2239	2184	2110
Moisture Content (%)	3.5	5.9	7.7	9.6	11.2



Maximum Dry Density	**2254 Kg/m3**
Optimum Moisture Content	**6.6 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	50mm Crusher Run Limestone
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Lafarge -Dundas Quarry	Date Tested:	August 30, 2024
Lab No:	G09646	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: October 1, 2024

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09651
Granular Type : 50mm Crushed Concrete	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Source "A"		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	99.1	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	18.1	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	11.5	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	10.4	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ August 29, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "A"	Date Tested:	August 26, 2024
Sampled Location:	Source "A"	Specification:	Granular B - Type II - OPSS 1010
Lab No.	G09651		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0	100	100	
75	100.0			
53	97.9			
37.5	84.2			
26.5	75.5	50	100	
25	74.5			
19	70.2			
16	67.6			
13.2	64.5			
12.5	63.2			
9.5	57.3			
4.75	46.0	20	55	
2.36	39.7			
1.18	35.2	10	40	
0.6	30.4			
0.3	21.6	5	22	
0.15	17.5			
0.075	7.6	0	10	

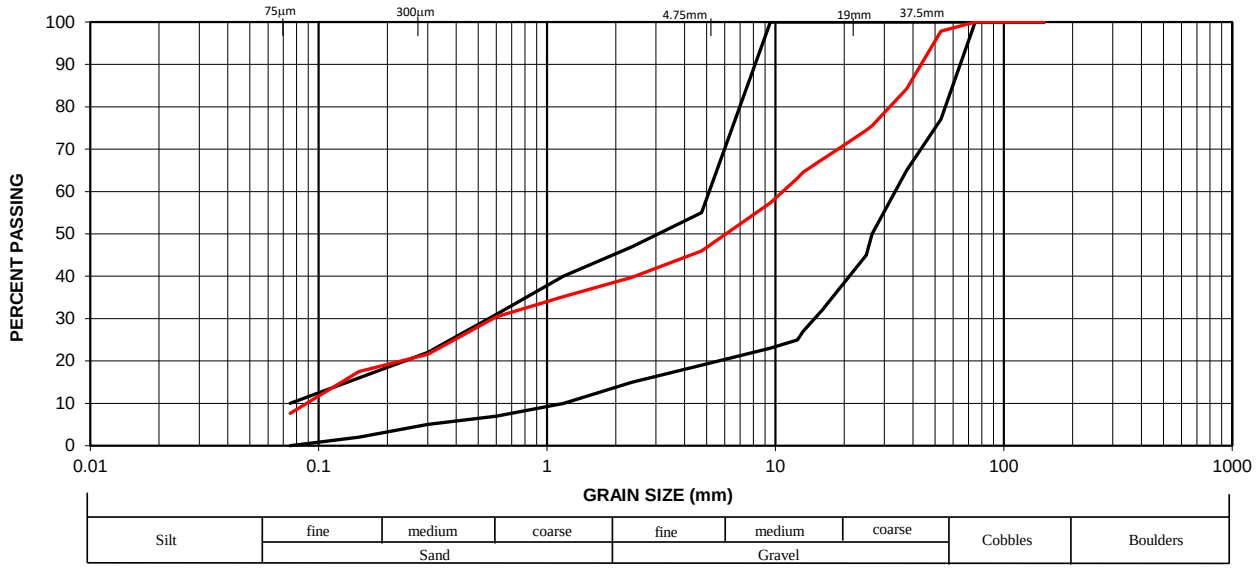
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	21.4
Crushed Particles (%):	99.1
Percent Deleterious (%):	0.86

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "A"	Date Tested:	August 26, 2024
Sampled Location:	Source "A"	Specification:	Granular B - Type I - OPSS 1010
Lab No.	G09651		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0	100	100	
106	100.0			
75	100.0			
53	97.9			
37.5	84.2			
26.5	75.5	50	100	
25	74.5			
19	70.2			
16	67.6			
13.2	64.5			
12.5	63.2			
9.5	57.3			
4.75	46.0	20	100	
2.36	39.7			
1.18	35.2	10	100	
0.6	30.4			
0.3	21.6	2	65	
0.15	17.5			
0.075	7.6	0	8	

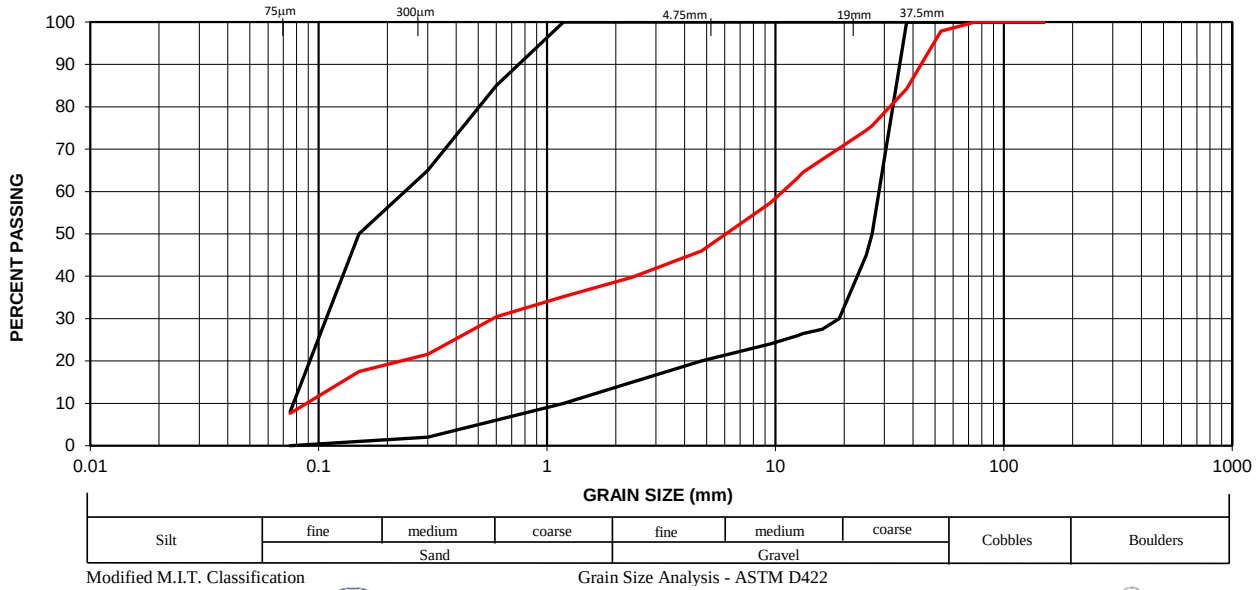
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	10.4
Crushed Particles (%):	99.1
Percent Deleterious (%):	0.86

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

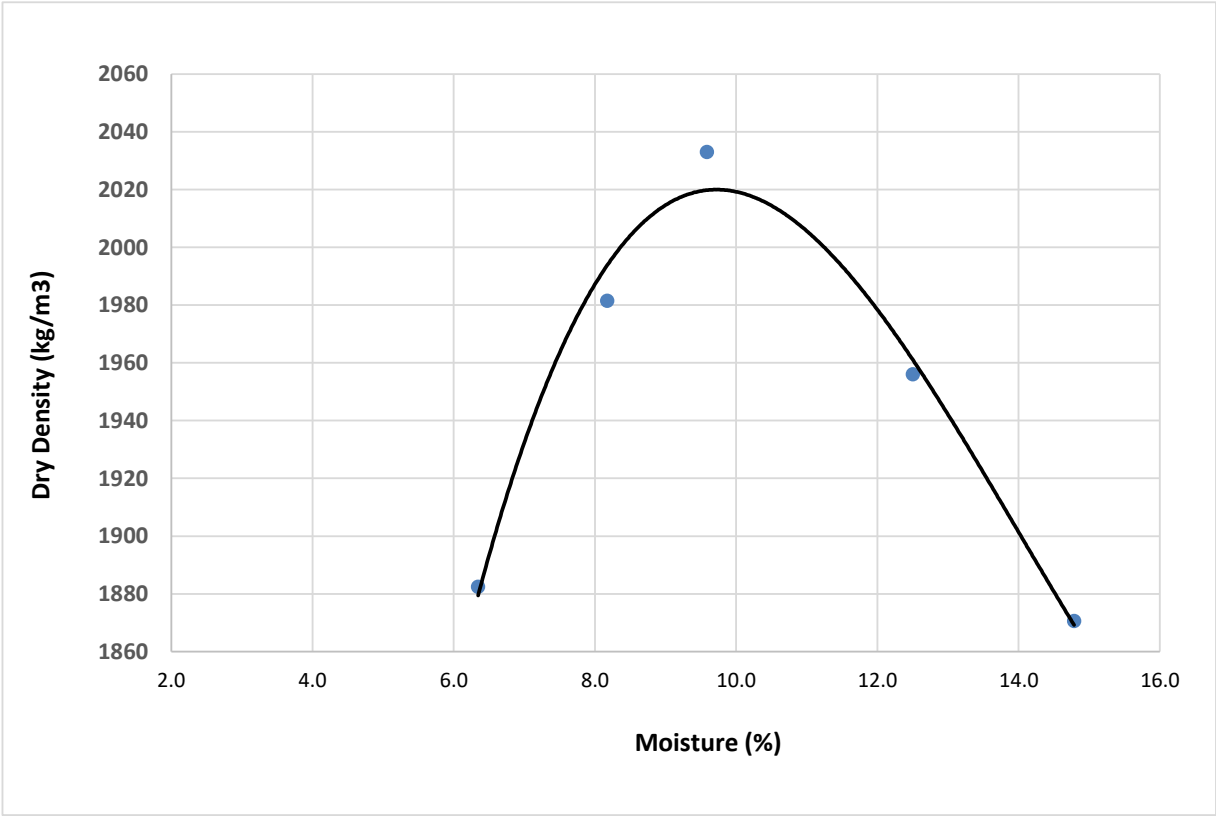
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**50mm Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "A"	Date Tested:	August 26, 2024
Sampled Location:	Source "A"	Specification:	LS-706
Lab No.	G09651		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1882	1981	2033	1956	1871
Moisture Content (%)	6.3	8.2	9.6	12.5	14.8



Maximum Dry Density	**2020 Kg/m3**
Optimum Moisture Content	**9.7 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
2447 Anson drive, Mississauga
Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	Gran B-Recycled Crushed Concrete
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Source "A"	Date Tested:	August 28, 2024
Lab No:	G09651	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

DETERMINATION OF AMOUNT OF CONTAMINATION OF COARSE AGGREGATE
(LS-630, R33)

Testing Laboratory:	Telephone No.:		Fax No.:
Engtec Consulting Inc.	***905-856-2988***		***905-896-2989***
Sampled By (Print Name):	Date Sampled: (YY/MM/DD)		**Engte Lab. #G09651**
Client	**24-08-16**		
Granular Type:	Lot No.:	Quantity (tonnes):	
Gran B-Recycled Crushed Concrete	N/A	N/A	
Source Name/Location:		Aggregate Inventory Number (AIN):	N/A
Source "A"			

Laboratory Sample No.	Largest Particle Size (>95% Passing Sieve)	Mass of Sample, g A	Mass of Wood, g B	Type of Contaminant	Mass of Contaminant, g C	% Wood (B*100/A)	% Contaminant (C*100/A)	
G09651	50mm.	2224.9	0	Clay Bicks	19.1	0	0.86	

Remarks: No wood Contamination Detected.

Date: August 26,2024

Operator: Leonardo Pilapil

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 16	Engtec Lab # G09649
Granular Type : 50mm Crushed Concrete	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Source "B"		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	98.9	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	17.9	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	10.2	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	9.8	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ August 28, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	Gran B-Recycled Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "B"	Date Tested:	August 26, 2024
Sampled Location:	Source "B"	Specification:	Granular B - Type II - OPSS 1010
Lab No.	G09649		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0	100	100	
75	100.0			
53	98.2			
37.5	95.7			
26.5	90.9	50	100	
25	89.2			
19	82.2			
16	76.1			
13.2	70.4			
12.5	68.0			
9.5	58.0			
4.75	41.8	20	55	
2.36	33.2			
1.18	26.0	10	40	
0.6	19.4			
0.3	13.5	5	22	
0.15	9.5			
0.075	6.4	0	10	

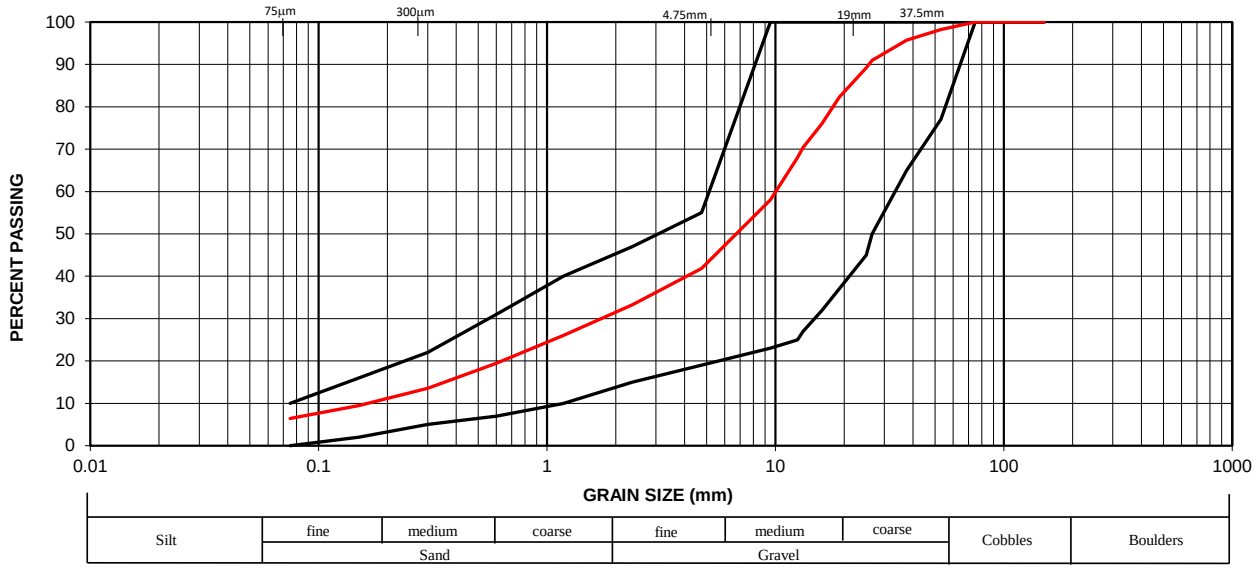
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	22.8
Crushed Particles (%):	98.9
Percent Deleterious (%):	0.41

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "B"	Date Tested:	August 26, 2024
Sampled Location:	Source "B"	Specification:	Granular B - Type I - OPSS 1010
Lab No.	G09649		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0	100	100	
106	100.0			
75	100.0			
53	98.2			
37.5	95.7			
26.5	90.9	50	100	
25	89.2			
19	82.2			
16	76.1			
13.2	70.4			
12.5	68.0			
9.5	58.0			
4.75	41.8	20	100	
2.36	33.2			
1.18	26.0	10	100	
0.6	19.4			
0.3	13.5	2	65	
0.15	9.5			
0.075	6.4	0	8	

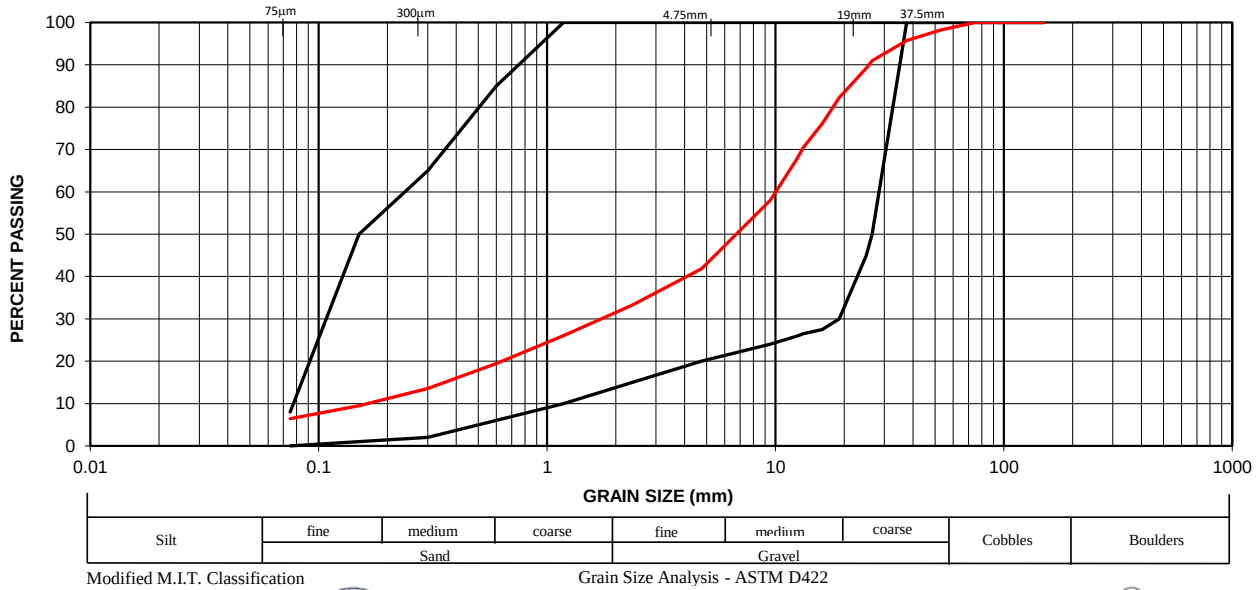
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	9.8
Crushed Particles (%):	98.9
Percent Deleterious (%):	0.41

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

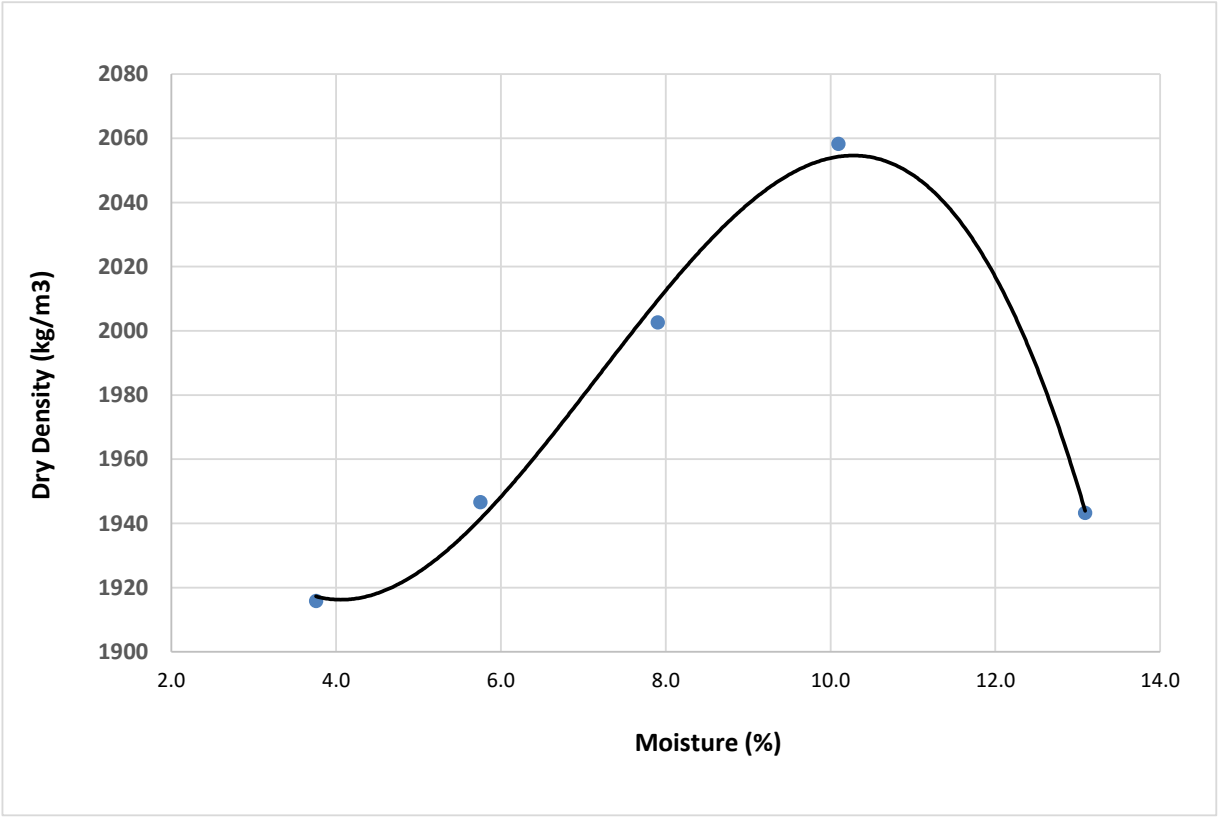
Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**50mm Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source "B"	Date Tested:	August 26, 2024
Sampled Location:	Source "B"	Specification:	LS-706
Lab No.	G09649		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1916	1947	2003	2058	1943
Moisture Content (%)	3.8	5.7	7.9	10.1	13.1



Maximum Dry Density	**2055 Kg/m3**
Optimum Moisture Content	**10.6 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
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Ontario,L5S 1G1
Tel: (905) 856-2988
Fax: (905) 856-2989

Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 16,2024
Source:	Source "B"	Date Tested:	August 27, 2024
Lab No:	G09649	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

DETERMINATION OF AMOUNT OF CONTAMINATION OF COARSE AGGREGATE
(LS-630, R33)

Testing Laboratory:	Telephone No.:		Fax No.:
Engtec Consulting Inc.	***905-856-2988***		***905-896-2989***
Sampled By (Print Name):	Date Sampled: (YY/MM/DD)		**Engte Lab. #G09649**
Client	**24-08-16**		
Granular Type:	Lot No.:	Quantity (tonnes):	
50mm Crushed Concrete	N/A	N/A	
Source Name/Location:		Aggregate Inventory Number (AIN):	N/A
Source "B"			

Laboratory Sample No.	Largest Particle Size (>95% Passing Sieve)	Mass of Sample, g A	Mass of Wood, g B	Type of Contaminant	Mass of Contaminant, g C	% Wood (B*100/A)	% Contaminant (C*100/A)	
G09649	50mm.	2285.9	0	Clay Bicks/ Tiles	9.4	0	0.41	

Remarks: No wood Contamination Detected.

Date: August 26,2024

Operator: Leonardo Pilapil

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – GRANULARS

Physical Properties

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory: **Engtec Consulting Inc.**		Telephone No.: **905-856-2988**	Fax No.: **905-856-2989**
Sampled by (Print Name): Client		Date Sampled: (YY/MM /DD) 24 / 08 / 12	Engtec Lab # G09630
Granular Type : 50mm Crushed Concrete	Lot No.: N/A	Quantity (tonnes): N/A	
Source Name/ Location: Source "C"		Aggregate Inventory Number (AIN):	

Laboratory Test and Number	Requirement						Test Result		
	Granular A	Granular B Type I, III	Granular B Type II	Granular M	Granular O	SSM	Reference Material	Sample	Meets Requirement (Y / N)
Percent Crushed Particles, % maximum. LS-607	60	–	--	60	100	–	-	98.8	Y
Freeze-Thaw Loss, % maximum, LS-614	–	–	–	–	15	–	-	N/T	N/A
Micro-Deval Abrasion Loss, Coarse Aggregate, % maximum, LS-618	25	30 (Note 1)	30	25	21	30 (Note 1)	12.9	18.3	Y
Micro-Deval Abrasion Loss, Fine Aggregate, % maximum, LS-619	30	35	35	30	25	–	15.8	11.2	Y
Asphalt Coated Particles, % Maximum, LS-621	30	30	0	30	0	0	-	8.7	Y
Amount of Contamination, LS-630	Note 2							Attach Report	N/A
Plastic Fines, LS-631	NP (Non-Plastic)							NP	Y
Determination of Permeability, *k*, LS-709	(Note 3)							N/T	N/A

Note 1: The coarse aggregate micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 sieve.

Note 2: Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass and/or ceramic material. Granular A, O, B Type I, B Type III, and M shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.

Note 3: For materials north of the French/Mattawa Rivers only, the coefficient of permeability, *k*, shall be greater than 1.0 X 10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for *k*, shall be acceptable provided that such testing has been done within five years of the material being used and field performance has continually been shown to be satisfactory.

Issued by (Testing Laboratory Representative):

Salman Bhutta, Ph.D., P.Eng. _____ August 15, 2024

PRINT NAME SIGNATURE DATE

Received by (Contract Administrator Representative):

_____ _____ _____

PRINT NAME SIGNATURE DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Engtec Consulting Inc.
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Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

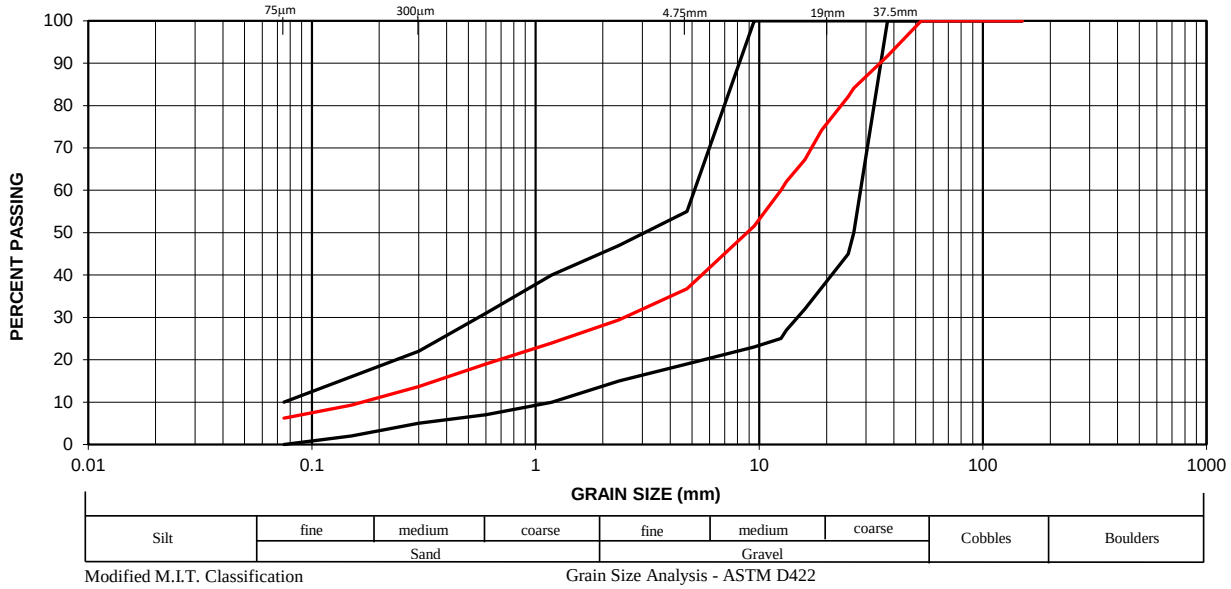
Project No.	ET24-1327A	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source "C"	Date Tested:	August 15, 2024
Sampled Location:	Source "C"	Specification:	Granular B - Type II - OPSS 1010
Lab No.	G09630		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0	100	100	
75	100.0			
53	100.0			
37.5	91.7			
26.5	84.1	50	100	
25	82.1			
19	74.2			
16	67.2			
13.2	62.0			
12.5	60.1			
9.5	51.6			
4.75	36.8	20	55	
2.36	29.4			
1.18	23.9	10	40	
0.6	19.0			
0.3	13.7	5	22	
0.15	9.3			
0.075	6.2	0	10	

Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	8.7
Crushed Particles (%):	98.8
Percent Deleterious (%):	0.93

Additional Comments



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal, Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
1-2447 Anson Drive, Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

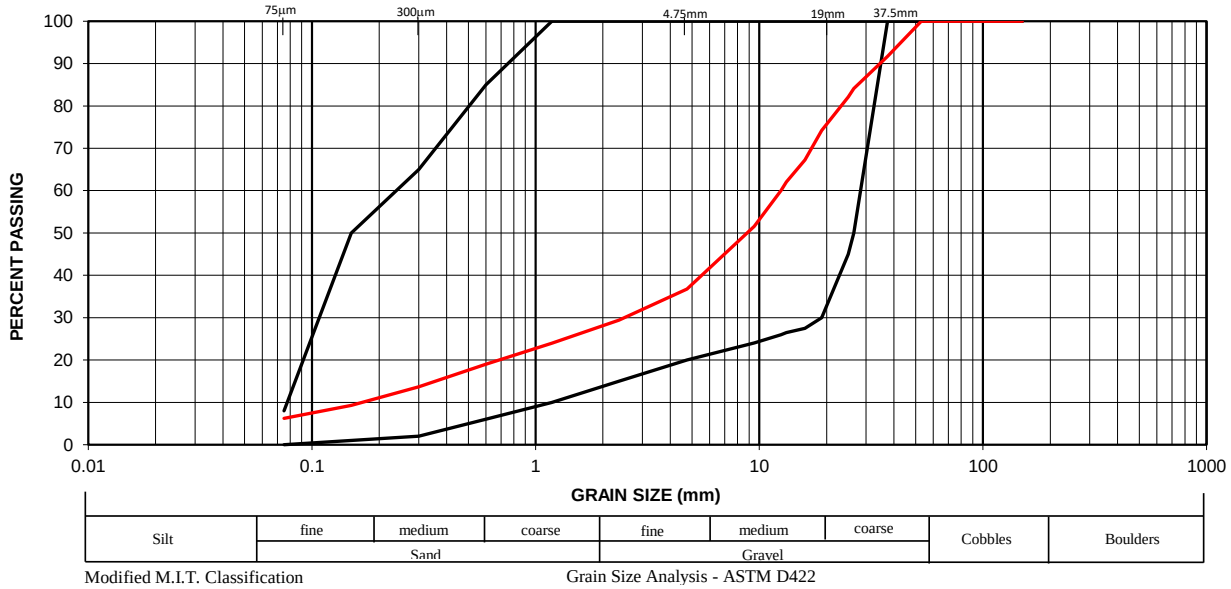
Project No.	ET24-1327A	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source "C"	Date Tested:	August 15, 2024
Sampled Location:	Source "C"	Specification:	Granular B - Type I - OPSS 1010
Lab No.	G09630		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0	100	100	
106	100.0			
75	100.0			
53	100.0			
37.5	91.7			
26.5	84.1	50	100	
25	82.1			
19	74.2			
16	67.2			
13.2	62.0			
12.5	60.1			
9.5	51.6			
4.75	36.8	20	100	
2.36	29.4			
1.18	23.9	10	100	
0.6	19.0			
0.3	13.7	2	65	
0.15	9.3			
0.075	6.2	0	8	

Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	18.7
Crushed Particles (%):	98.8
Percent Deleterious (%):	0.93

Additional Comments



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal, Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

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Ontario, L5S 1G1
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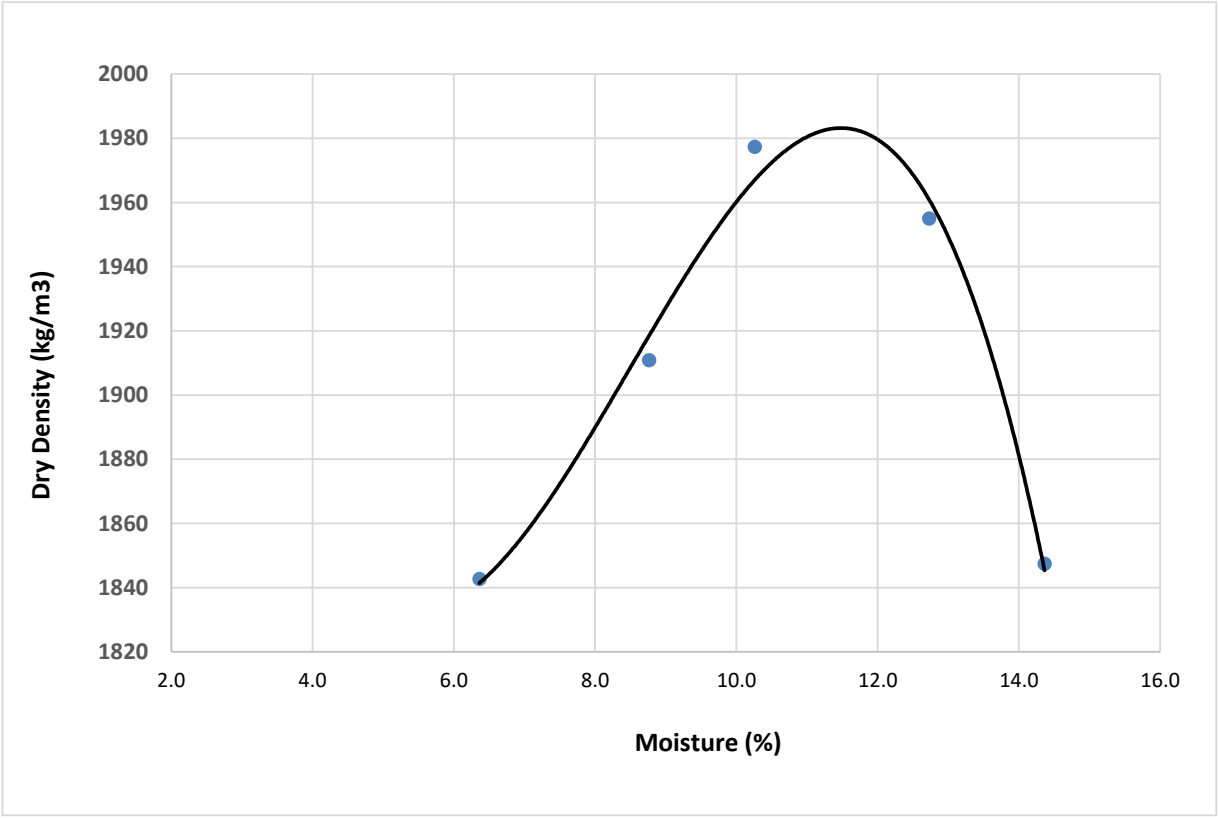
Standard Proctor

Project No.	ET24 - 1327A	Material	**50mm Crushed Concrete**
Client:	N/A	Sampled By:	Client-
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source "C"	Date Tested:	August 15, 2024
Sampled Location:	Source "C"	Specification:	LS-706
Lab No.	G09630		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1843	1911	1977	1955	1847
Moisture Content (%)	6.4	8.8	10.3	12.7	14.4



Maximum Dry Density	**1984 Kg/m3**
Optimum Moisture Content	**11.5 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Determination of Presence of Plastic Fines in Aggregate (LS-631)

Job No:	ET24-1327A	Material Type:	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project:	TARBA	Date Sampled:	August 12,2024
Source:	Source "C"	Date Tested:	August 29, 2024
Lab No:	G09630	Tested By:	Leo

Test Sample Preparation: [ ] As received [X] Air Dry [ ] Oven dry @ 60 C

Trial No.	Initial Roll: Able to roll to 3mm dia.			Re-Roll: Able to roll to 3mm dia.		Result	
1		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
2		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	
3		Yes	Remould and repeat		Yes		Plastic (P)
				X	No		Non-Plastic (P)
	X	No				X	

Report:
The material finer than 425 µm from the sample tested is [X] Non-Plastic (NP) [ ] Plastic (P)

Notes:

1 The boxes provided under each trial in the reporting form shall be checked off appropriately at the end of each repeat
2 During any of the three trials, if the specimen can be rolled to a 3mm thread, remoulded and rolled again to a 3mm thread, report the material as plastic (P)
3 After all three trials, if the specimen cannot be rolled and crumbling occurs when it has adiameter greater than 3mm, report the material as non-pastic (NP)

Lab Supervisor: Leonardo Pilapil,C.E.T

Approved by: Salman Bhutta Ph.D., P.Eng.
Date Approved: September 19,2024

DETERMINATION OF AMOUNT OF CONTAMINATION OF COARSE AGGREGATE
(LS-630, R33)

Testing Laboratory:	Telephone No.:		Fax No.:
Engtec Consulting Inc.	***905-856-2988***		***905-896-2989***
Sampled By (Print Name):	Date Sampled: (YY/MM/DD)		**Engte Lab. #G09630**
Client	**24-08-12**		
Granular Type:	Lot No.:	Quantity (tonnes):	
50mm Crushed Concrete	N/A	N/A	
Source Name/Location:		Aggregate Inventory Number (AIN):	N/A
Source "C"			

Laboratory Sample No.	Largest Particle Size (>95% Passing Sieve)	Mass of Sample, g A	Mass of Wood, g B	Type of Contaminant	Mass of Contaminant, g C	% Wood (B*100/A)	% Contaminant (C*100/A)	
G09630	50mm.	2262.1	0	Clay Bicks/Tiles	21	0	0.93	

Remarks: No wood Contamination Detected.

Date: August 14,2024

Operator: Leonardo Pilapil

Appendix B

AASHTO T 307-2021, "Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials" – Test Reports

Engtec Consulting Inc.
12-100 Hanlan Road, Vaughan
Ontario, L4L 4V8
Tel: (905) 856-2988
Fax: (905) 856-2989

Project No: ET24-1327A

September 27, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
Virgin Granular A - Lafarge Caledon

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.4	48.5
2	20.7	40.2	69.9
3	20.7	57.3	87.7
4	34.5	32.9	85.8
5	34.5	62.2	104.2
6	34.5	93.0	120.2
7	68.9	62.0	158.0
8	68.9	123.9	180.2
9	68.9	185.9	187.2
10	103.4	62.0	184.3
11	103.4	92.9	189.3
12	103.4	185.8	223.6
13	137.9	93.0	232.4
14	137.9	124.0	240.6
15	137.9	247.9	283.3

2447 Anson Drive, Mississauga, ON, L5S 1G1
www.engtec.ca

APPENDIX A

Resilient Modulus General Report

2447 Anson Drive, Mississauga, ON, L5S 1G1
www.engtec.ca

Engtec Consulting Inc.
2447-Anson Drive
Mississauga,Ontario
L5S 1G1
Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	Virgin Granular A - Lafarge Caledon
Sample Number	P02695	Supplier	Lafarage Pinkney
Client	TARBA	Testing Date	September 25, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.389	0.38	0.008	20.8	20.4	0.4	0.126	0.042	48.6
	97		0.388	0.379	0.008				0.126	0.042	48.3
	98		0.388	0.38	0.009				0.126	0.042	48.5
	99		0.387	0.379	0.008				0.126	0.042	48.6
	100		0.388	0.380	0.008				0.127	0.042	48.4
	Average		**0.388**	**0.380**	**0.008**				**0.126**	**0.042**	**48.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.13**
2	96	20.7	0.769	0.746	0.023	41.4	40.2	1.3	0.172	0.057	69.7
	97		0.775	0.751	0.024				0.173	0.058	70.1
	98		0.772	0.748	0.024				0.172	0.057	69.9
	99		0.771	0.747	0.024				0.172	0.057	69.8
	100		0.771	0.748	0.023				0.172	0.057	70.0
	Average		**0.772**	**0.748**	**0.024**				**0.172**	**0.057**	**69.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.16**
3	96	20.7	1.148	1.060	0.088	62.0	57.3	4.7	0.195	0.065	87.5
	97		1.171	1.082	0.089				0.198	0.066	88.1
	98		1.144	1.057	0.087				0.195	0.065	87.3
	99		1.157	1.069	0.088				0.196	0.065	87.8
	100		1.155	1.066	0.089				0.196	0.065	87.8
	Average		**1.155**	**1.067**	**0.088**				**0.196**	**0.065**	**87.7**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.31**
4	96	34.5	0.676	0.61	0.066	36.4	32.9	3.6	0.115	0.038	85.5
	97		0.677	0.611	0.065				0.115	0.038	85.6
	98		0.684	0.619	0.065				0.116	0.039	86.1
	99		0.677	0.612	0.065				0.115	0.038	85.9
	100		0.677	0.611	0.067				0.115	0.038	85.7
	Average		**0.678**	**0.613**	**0.066**				**0.115**	**0.038**	**85.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.24**
5	96	34.5	1.286	1.157	0.129	69.2	62.2	6.9	0.179	0.060	104.1
	97		1.289	1.161	0.129				0.179	0.060	104.3
	98		1.288	1.159	0.129				0.179	0.060	104.2
	99		1.287	1.159	0.129				0.179	0.060	104.2
	100		1.291	1.162	0.129				0.179	0.060	104.4
	Average		**1.288**	**1.160**	**0.129**				**0.179**	**0.060**	**104.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**
6	96	34.5	1.925	1.733	0.192	103.3	93	10.3	0.232	0.077	120.3
	97		1.924	1.731	0.193				0.232	0.077	120.0
	98		1.922	1.73	0.192				0.232	0.077	120.2
	99		1.925	1.733	0.192				0.232	0.077	120.2
	100		1.926	1.734	0.192				0.232	0.077	120.3
	Average		**1.924**	**1.732**	**0.192**				**0.232**	**0.0770**	**120.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.12**
7	96	68.9	1.282	1.154	0.128	68.9	62.0	6.9	0.118	0.039	158.0
	97		1.283	1.155	0.128				0.118	0.039	157.8
	98		1.283	1.154	0.129				0.118	0.039	158.1
	99		1.284	1.155	0.128				0.118	0.039	157.9
	100		1.284	1.156	0.128				0.118	0.039	158.0
	Average		**1.250**	**1.155**	**0.128**				**0.118**	**0.039**	**158.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**

Engtec Consulting Inc.
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Mississauga,Ontario
L5S 1G1
Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	Virgin Granular A - Lafarge Caledon
Sample Number	P02695	Supplier	Lafarage Pinkney
Client	TARBA	Testing Date	September 25, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.565	2.307	0.258	137.8	123.9	13.8	0.206	0.069	180.3
	97		2.567	2.31	0.257				0.206	0.069	180.2
	98		2.565	2.308	0.257				0.206	0.069	180.1
	99		2.566	2.309	0.258				0.207	0.069	180.0
	100		2.567	2.309	0.258				0.206	0.069	180.2
	Average		**2.566**	**2.309**	**0.258**				**0.206**	**0.069**	**180.2**
	STDEV.		**0.001**	**0.001**	**0.001**				**0.000**	**0.000**	**0.114**
9	96	68.9	3.849	3.463	0.386	206.6	185.9	20.7	0.298	0.099	187.3
	97		3.851	3.465	0.386				0.298	0.099	187.5
	98		3.845	3.460	0.386				0.298	0.099	187.1
	99		3.845	3.459	0.386				0.298	0.099	186.9
	100		3.848	3.462	0.386				0.298	0.099	187.2
	Average		**3.848**	**3.462**	**0.386**				**0.298**	**0.099**	**187.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.22**
10	96	103.4	1.283	1.156	0.128	68.8	62.0	6.9	0.101	0.034	184.1
	97		1.283	1.156	0.128				0.101	0.034	184.3
	98		1.281	1.152	0.128				0.101	0.034	184.3
	99		1.282	1.154	0.128				0.101	0.034	184.5
	100		1.281	1.153	0.128				0.101	0.034	184.5
	Average		**1.282**	**1.154**	**0.128**				**0.101**	**0.034**	**184.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.17**
11	96	103.4	1.924	1.731	0.192	103.2	92.9	10.3	0.147	0.049	189.1
	97		1.922	1.73	0.192				0.147	0.049	189.3
	98		1.922	1.729	0.193				0.147	0.049	189.5
	99		1.926	1.734	0.191				0.148	0.049	189.3
	100		1.923	1.731	0.192				0.147	0.049	189.1
	Average		**1.923**	**1.731**	**0.192**				**0.147**	**0.049**	**189.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.17**
12	96	103.4	3.848	3.462	0.386	206.6	185.8	20.7	0.250	0.083	223.2
	97		3.849	3.462	0.387				0.250	0.083	223.5
	98		3.849	3.463	0.386				0.249	0.083	223.8
	99		3.843	3.457	0.386				0.249	0.083	223.5
	100		3.849	3.464	0.385				0.249	0.083	224.2
	Average		**3.848**	**3.462**	**0.386**				**0.249**	**0.083**	**223.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.38**
13	96	137.9	1.923	1.73	0.192	103.3	93	10.3	0.120	0.040	232.3
	97		1.928	1.736	0.192				0.120	0.040	232.6
	98		1.926	1.733	0.193				0.120	0.040	232.3
	99		1.925	1.732	0.193				0.120	0.040	232.8
	100		1.923	1.731	0.193				0.120	0.040	232.2
	Average		**1.925**	**1.732**	**0.193**				**0.120**	**0.040**	**232.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.25**
14	96	137.9	2.569	2.312	0.257	137.8	124	13.8	0.155	0.052	240.3
	97		2.565	2.308	0.257				0.155	0.052	240.5
	98		2.567	2.309	0.257				0.154	0.051	240.8
	99		2.565	2.308	0.257				0.155	0.052	240.4
	100		2.568	2.313	0.255				0.155	0.052	240.9
	Average		**2.567**	**2.310**	**0.257**				**0.155**	**0.052**	**240.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.26**

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Mississauga,Ontario
L5S 1G1
Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	Virgin Granular A - Lafarge Caledon
Sample Number	P02695	Supplier	Lafarage Pinkney
Client	TARBA	Testing Date	September 25, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.133	4.619	0.514	275.5	247.9	27.6	0.263	0.088	283.2
	97		5.130	4.616	0.514				0.263	0.088	283.0
	98		5.135	4.621	0.514				0.263	0.088	283.4
	99		5.134	4.620	0.514				0.262	0.087	283.7
	100		5.129	4.616	0.514				0.262	0.087	283.4
	Average		**5.132**	**4.618**	**0.514**				**0.263**	**0.088**	**283.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.26**

APPENDIX B

Recompacted Specimen Information

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2447 Anson Drive
Mississauga, Ontario
L5S 1G1
Tel: (905) 856-2988

Sample Number	P02695	Material Type	Granular A - Sand and Gravel
Testing Date	September 25, 2024	Supplier	Lafarge Pinkney

TEST INFORMATION	
Preconditioning- Greater than 5 % Permanent Strain	NO
Testing- Greater Than 5% permanent Strain	NO
Testing- Number of Load Sequences Completed	YES
SPECIMEN INFO.	
Average Diameter, mm	155.3
Membrane Thickness, mm	0.63
Net Diameter, mm	154.0
Height of Specimen, Cap and Base, mm	382.4
Height of Cap and Base, mm	82.4
Initial Length L_0, mm	300
Initial Area, A_0, mm^2	18627
Initial Volume,V_0, cm^3	5588
SPECIMEN WEIGHT	
Initial Weight of Container and Soil, g.	20410
Final Weight of Container and Soil, g.	6410
Weight of Wet Soil Used, g.	14000
MATERIAL PROPERTIES	
In Situ Moisture Content (Nuclear), %	N/A
In Situ Weight Density (Nuclear), Kg/m^3	N/A
Optimum moisture Content, %	8.3
Max Dry Density, Kg/m^3	2148
SPECIMEN PROPERTIES	
Compaction Moisture Content, %	8.1
Moisture Content after Resilient Modulus Testing, %	6.9
Compaction Dry Density, Kg/m^3	2318
QUICK SHEAR TEST	
Stress-Strain Plot Attached	YES
Triaxial Shear Maximum Strength, KPa	388.4
Specimen Fail During Triaxial Shear	Bulge

GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**September 27, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Lafarge Pinkney - Granular A-3.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)
Material :Virgin Granular A - Lafarge Caledon

Specimen Information

Identification: P02696
Conditioning time:
Properties/Comments:
Max Dry Density = 2148 Kg/m3
OMC = 8.3 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	154.0	154.0	154.0	154.0	154.0	154.0	154.00	
Hight(mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 14.000 Cross-sectional area (mm²): 18626.5
Density (kg/m³): 2505 Volume (cc): 5588.0

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Wednesday September 25 2024 at 3:24 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	283.2	283.0	283.4	283.7	283.4	283.3	0.245
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.003
Cyclic Axial Stress (kPa):	248.0	247.8	248.1	248.0	247.8	247.9	0.136
Maximum Axial Stress (kPa):	275.6	275.4	275.7	275.6	275.4	275.5	0.135
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.6	27.6	27.6	0.007
Recoverable Axial Strain (%):	0.088	0.088	0.088	0.087	0.087	0.088	0.000
Permanent Axial Strain (%):	0.686	0.686	0.686	0.687	0.687	0.686	0.001
Cyclic Axial Load (kN):	4.619	4.616	4.621	4.620	4.616	4.618	0.003
Maximum Axial Load (kN):	5.133	5.130	5.135	5.134	5.129	5.132	0.003
Contact Axial Load (kN):	0.514	0.514	0.514	0.514	0.514	0.514	0.000
Recoverable Axial Deformation (mm):	0.263	0.263	0.263	0.262	0.262	0.263	0.000
Permanent Axial Deformation (mm):	2.057	2.058	2.059	2.060	2.061	2.059	0.002

Shear Test Data

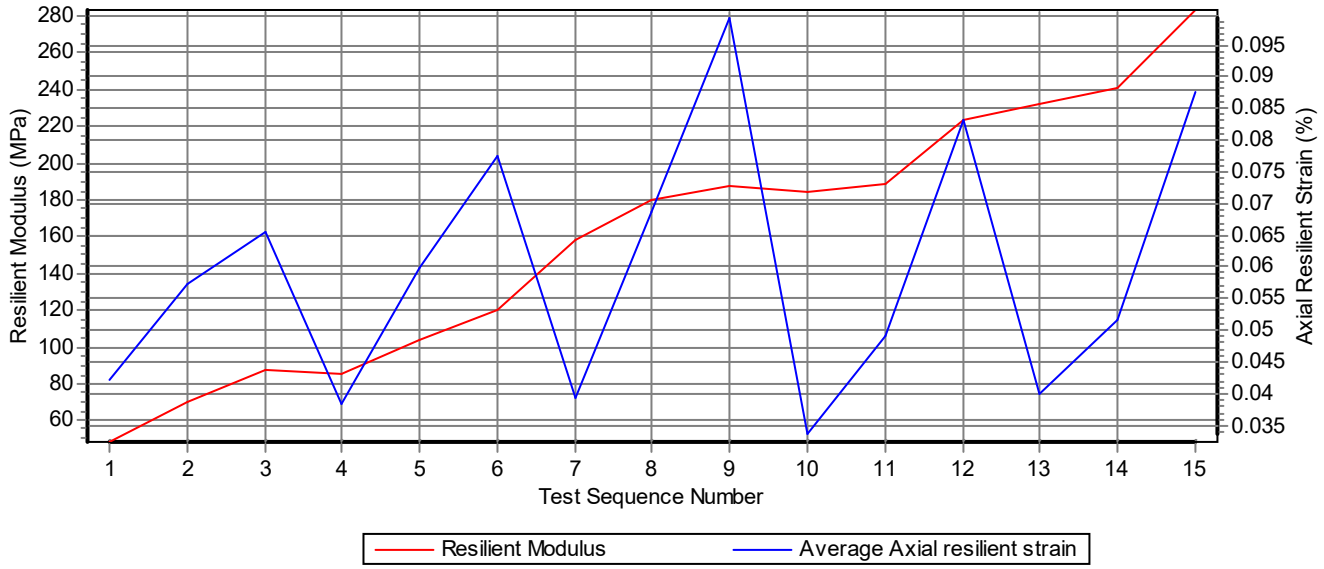
Start date & time: Wednesday September 25 2024 at 4:01 PM
Timer (sec): 266.8

	Current	Peak
Axial Load (kN):	7.014	7.234
Peak Stress (kPa):	376.6	388.4
Confining pressure (kPa):	34.5	

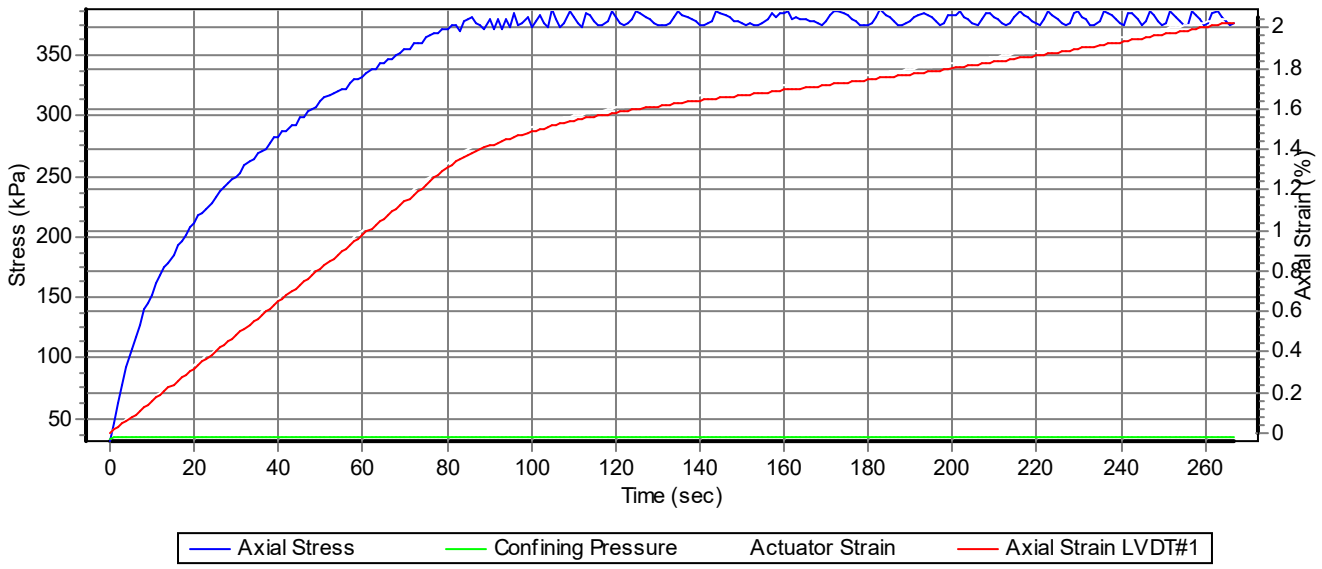
Strain (%)	Current	At Peak Load
Actuator:	2.05	1.98
Averaged Axial:	2.03	1.96

Deformation (mm)	Current	At Peak Load
Actuator:	6.159	5.954
Averaged Axial:	6.083	5.879
Axial LVDT #1:	6.083	5.879

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
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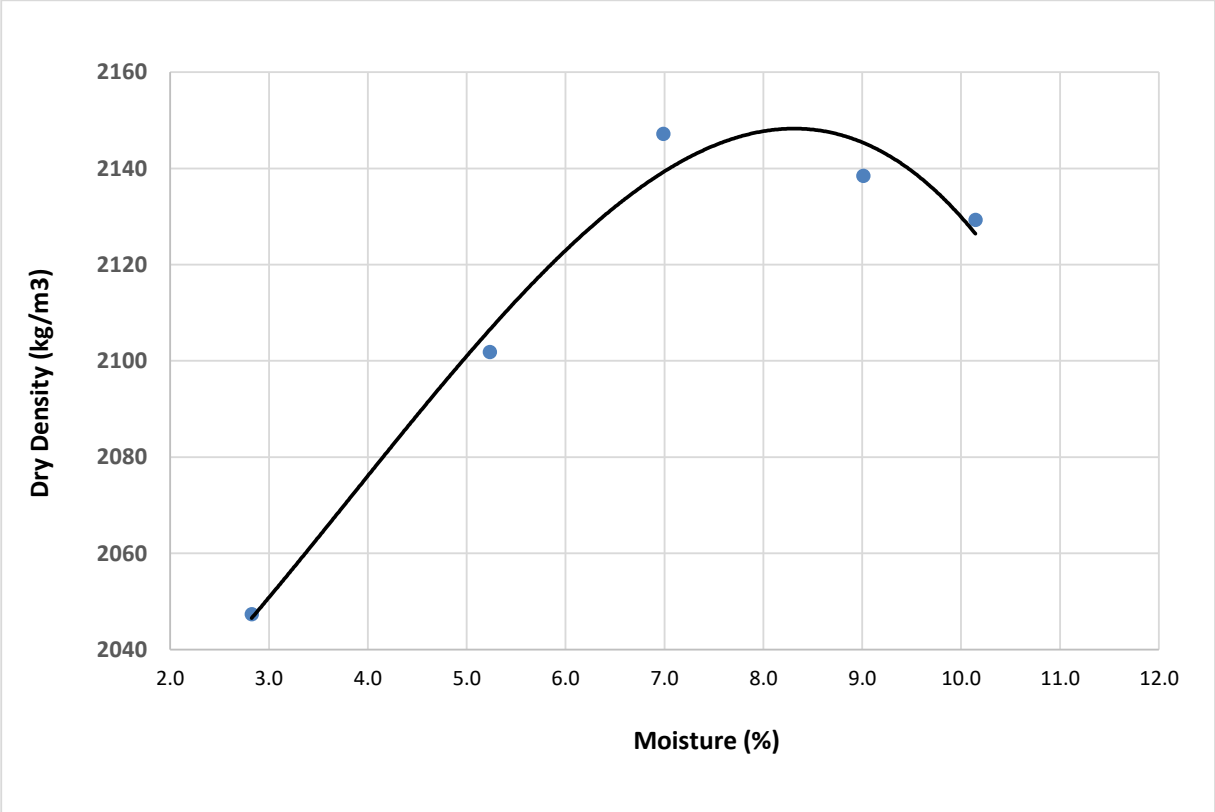
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**Granular A - Sand and Gravel**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon	Date Tested:	September 2, 2024
Sampled Location:	Lafarge - Caledon	Specification:	LS-706
Lab No.	G09647		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	2047	2102	2147	2138	2129
Moisture Content (%)	2.8	5.2	7.0	9.0	10.1



Maximum Dry Density	**2148 Kg/m3**
Optimum Moisture Content	**8.3 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	Granular A - Sand and Gravel
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon	Date Tested:	September 2, 2024
Sampled Location:	Lafarge - Caledon	Specification:	OPSS.MUNI 1010
Lab No.	G09647		

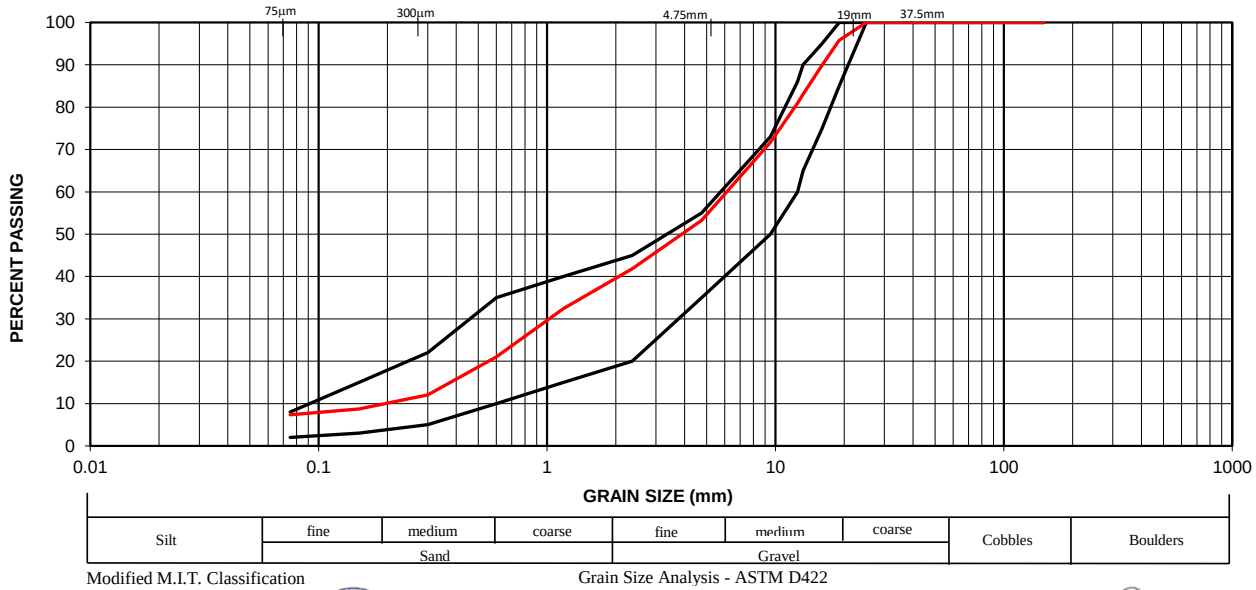
Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	95.8	85	100	
16	89.9			
13.2	83.0	65	90	
12.5	80.9			
9.5	71.7	50	73	
4.75	53.2	35	55	
2.36	41.8			
1.18	32.4	15	40	
0.6	21.0			
0.3	12.0	5	22	
0.15	8.7			
0.075	7.3	2	8	

Note: * - Out of Specification

Physical Properties
Asphalt Coated Particles (%):
Crushed Particles (%):
Percent Deleterious (%):

Additional Comments

Equipment Used
#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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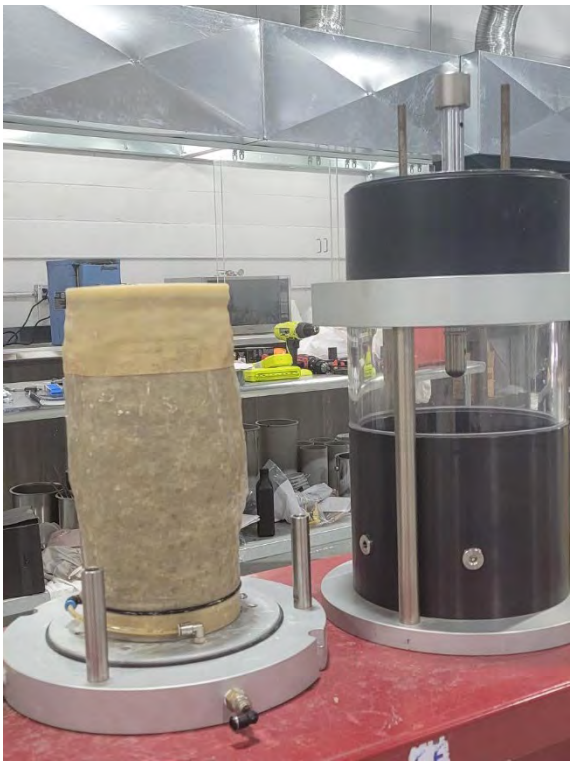
Before Testing



After Testing

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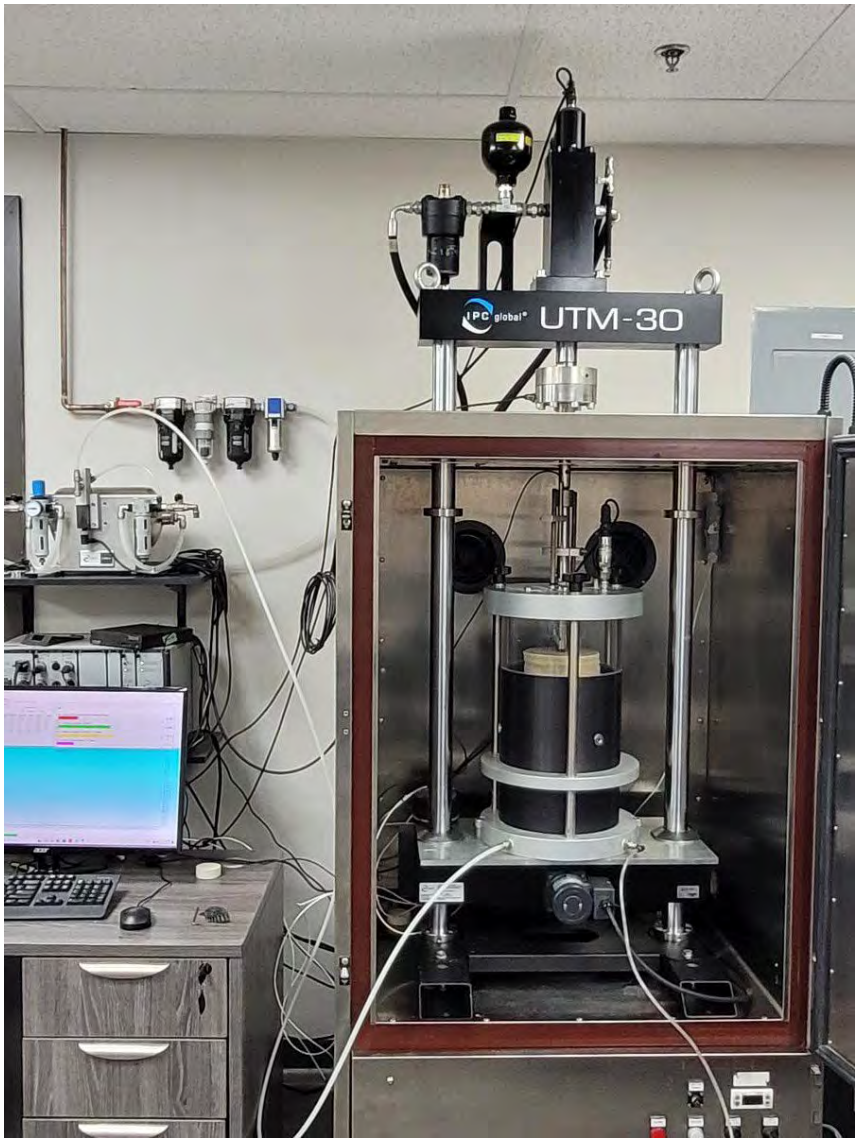

Specimen and Triaxial cell Setup

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Engtec Consulting Inc.
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Fax: (905) 856-2989

Project No: ET24-1327A

September 30, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
19 mm Crusher Run Limestone - Lafarge Dundas

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.2	44.3
2	20.7	38.5	64.3
3	20.7	55.6	86.4
4	34.5	32.2	65.4
5	34.5	61.9	98.5
6	34.5	93.0	122.0
7	68.9	61.9	136.4
8	68.9	124.0	164.2
9	68.9	185.9	184.4
10	103.4	61.9	169.4
11	103.4	93.0	187.0
12	103.4	185.9	219.7
13	137.9	93.1	232.8
14	137.9	124.0	252.8
15	137.9	247.9	296.7

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APPENDIX A

Resilient Modulus General Report

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Engtec Consulting Inc.
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	19 mm CRL
Sample Number	P02700	Supplier	Lafarge Dundas
Client	TARBA	Testing Date	September 23, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.306	0.298	0.009	20.8	20.2	0.5	0.088	0.030	43.8
	97		0.311	0.303	0.008				0.088	0.030	44.4
	98		0.310	0.302	0.008				0.087	0.029	44.4
	99		0.310	0.302	0.008				0.087	0.029	44.5
	100		0.311	0.303	0.008				0.088	0.030	44.6
	Average		**0.310**	**0.302**	**0.008**				**0.088**	**0.029**	**44.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.32**
2	96	20.7	0.610	0.569	0.040	41.2	38.5	2.7	0.114	0.038	63.9
	97		0.614	0.575	0.040				0.115	0.038	64.4
	98		0.626	0.584	0.041				0.116	0.038	65.0
	99		0.618	0.578	0.041				0.115	0.038	64.5
	100		0.603	0.562	0.041				0.114	0.038	63.5
	Average		**0.614**	**0.574**	**0.040**				**0.115**	**0.038**	**64.3**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.55**
3	96	20.7	0.923	0.828	0.094	62.0	55.6	6.3	0.123	0.041	86.6
	97		0.920	0.826	0.094				0.123	0.041	86.3
	98		0.926	0.832	0.094				0.124	0.042	86.3
	99		0.922	0.828	0.094				0.124	0.042	86.2
	100		0.926	0.831	0.094				0.124	0.042	86.3
	Average		**0.923**	**0.829**	**0.094**				**0.124**	**0.041**	**86.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.18**
4	96	34.5	0.510	0.478	0.033	34.3	32.2	2.2	0.094	0.031	65.3
	97		0.517	0.484	0.033				0.095	0.032	65.7
	98		0.506	0.473	0.032				0.094	0.031	65.0
	99		0.520	0.488	0.032				0.095	0.032	65.8
	100		0.506	0.474	0.033				0.094	0.031	65.0
	Average		**0.512**	**0.479**	**0.032**				**0.094**	**0.032**	**65.4**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.39**
5	96	34.5	1.022	0.918	0.104	68.9	61.9	6.9	0.120	0.040	98.4
	97		1.027	0.924	0.103				0.121	0.040	98.4
	98		1.029	0.922	0.103				0.121	0.040	98.3
	99		1.027	0.926	0.103				0.121	0.040	98.6
	100		1.026	0.924	0.102				0.121	0.040	98.7
	Average		**1.026**	**0.923**	**0.103**				**0.121**	**0.040**	**98.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.16**
6	96	34.5	1.538	1.385	0.154	103.3	93	10.3	0.147	0.049	121.5
	97		1.539	1.386	0.153				0.146	0.049	122.0
	98		1.538	1.386	0.153				0.146	0.049	122.1
	99		1.540	1.386	0.154				0.146	0.049	122.2
	100		1.540	1.386	0.153				0.146	0.049	122.3
	Average		**1.539**	**1.386**	**0.153**				**0.147**	**0.0488**	**122.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.30**
7	96	68.9	1.027	0.923	0.103	68.8	61.9	6.9	0.087	0.029	136.3
	97		1.026	0.923	0.103				0.087	0.029	136.0
	98		1.026	0.923	0.103				0.087	0.029	136.3
	99		1.026	0.924	0.102				0.087	0.029	137.0
	100		1.024	0.922	0.102				0.087	0.029	136.6
	Average		**1.250**	**0.923**	**0.103**				**0.087**	**0.029**	**136.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.36**

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Mississauga,Ontario
L5S 1G1
Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	19 mm CRL
Sample Number	P02700	Supplier	Lafarge Dundas
Client	TARBA	Testing Date	September 23, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.053	1.848	0.205	137.8	124	13.8	0.145	0.048	164.2
	97		2.052	1.846	0.206				0.145	0.048	164.1
	98		2.056	1.852	0.205				0.145	0.048	164.8
	99		2.049	1.843	0.206				0.145	0.048	164.0
	100		2.055	1.850	0.206				0.146	0.049	164.0
	Average		**2.053**	**1.848**	**0.205**				**0.145**	**0.048**	**164.2**
	STDEV.		**0.003**	**0.003**	**0.000**				**0.000**	**0.000**	**0.338**
9	96	68.9	3.079	2.770	0.309	206.7	185.9	20.7	0.194	0.065	184.2
	97		3.081	2.773	0.309				0.194	0.065	184.8
	98		3.078	2.769	0.309				0.194	0.065	184.2
	99		3.080	2.771	0.310				0.194	0.065	184.4
	100		3.079	2.770	0.310				0.194	0.065	184.6
	Average		**3.079**	**2.771**	**0.309**				**0.194**	**0.065**	**184.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.27**
10	96	103.4	1.030	0.926	0.103	68.9	61.9	6.9	0.070	0.023	169.8
	97		1.025	0.922	0.103				0.070	0.023	169.8
	98		1.026	0.923	0.103				0.070	0.023	169.5
	99		1.025	0.922	0.103				0.070	0.023	168.7
	100		1.026	0.922	0.102				0.070	0.023	169.4
	Average		**1.026**	**0.923**	**0.103**				**0.070**	**0.023**	**169.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.45**
11	96	103.4	1.538	1.385	0.153	103.3	93	10.3	0.095	0.032	187.1
	97		1.543	1.390	0.154				0.096	0.032	187.1
	98		1.538	1.385	0.154				0.095	0.032	186.9
	99		1.543	1.390	0.154				0.096	0.032	187.0
	100		1.537	1.382	0.154				0.095	0.032	187.0
	Average		**1.540**	**1.386**	**0.154**				**0.096**	**0.032**	**187.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.10**
12	96	103.4	3.076	2.768	0.309	206.6	185.9	20.7	0.162	0.054	219.1
	97		3.080	2.772	0.309				0.162	0.054	219.8
	98		3.081	2.772	0.308				0.162	0.054	219.6
	99		3.077	2.770	0.308				0.162	0.054	219.8
	100		3.080	2.772	0.308				0.162	0.054	220.0
	Average		**3.079**	**2.771**	**0.308**				**0.162**	**0.054**	**219.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.34**
13	96	137.9	1.540	1.387	0.152	103.3	93.1	10.3	0.077	0.026	232.8
	97		1.540	1.386	0.154				0.077	0.026	232.5
	98		1.542	1.388	0.154				0.077	0.026	232.6
	99		1.541	1.387	0.154				0.077	0.026	232.8
	100		1.538	1.386	0.153				0.077	0.026	233.4
	Average		**1.540**	**1.387**	**0.153**				**0.077**	**0.026**	**232.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.36**
14	96	137.9	2.054	1.849	0.206	137.8	124	13.8	0.094	0.031	252.2
	97		2.053	1.846	0.206				0.094	0.031	252.6
	98		2.054	1.849	0.206				0.094	0.031	253.0
	99		2.054	1.848	0.206				0.094	0.031	253.5
	100		2.054	1.847	0.206				0.094	0.031	252.6
	Average		**2.054**	**1.848**	**0.206**				**0.094**	**0.031**	**252.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.52**

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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	19 mm CRL
Sample Number	P02700	Supplier	Lafarge Dundas
Client	TARBA	Testing Date	September 23, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	4.105	3.694	0.411	275.5	247.9	27.6	0.161	0.054	296.1
	97		4.106	3.694	0.412				0.160	0.054	297.0
	98		4.105	3.693	0.412				0.160	0.054	297.0
	99		4.103	3.691	0.412				0.160	0.054	296.7
	100		4.106	3.694	0.412				0.161	0.054	296.6
	Average		**4.105**	**3.693**	**0.412**				**0.160**	**0.054**	**296.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.36**

APPENDIX B

Recompacted Specimen Information

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L5S 1G1
Tel: (905) 856-2988

Sample Number	P02700	Material Type	19mm CRL
Testing Date	September 23, 2024	Supplier	Lafarge Dundas

TEST INFORMATION	
Preconditioning- Greater than 5 % Permanent Strain	NO
Testing- Greater Than 5% permanent Strain	NO
Testing- Number of Load Sequences Completed	YES
SPECIMEN INFO.	
Average Diameter, mm	155.3
Membrane Thickness, mm	0.63
Net Diameter, mm	154.0
Height of Specimen, Cap and Base, mm	382.4
Height of Cap and Base, mm	82.4
Initial Length L_0, mm	300
Initial Area, A_0, mm^2	18627
Initial Volume,V_0, cm^3	5588
SPECIMEN WEIGHT	
Initial Weight of Container and Soil, g.	17782.7
Final Weight of Container and Soil, g.	4153
Weight of Wet Soil Used, g.	13629.7
MATERIAL PROPERTIES	
In Situ Moisture Content (Nuclear), %	N/A
In Situ Weight Density (Nuclear), Kg/m^3	N/A
Optimum moisture Content, %	7.8
Max Dry Density, Kg/m^3	2260
SPECIMEN PROPERTIES	
Compaction Moisture Content, %	7.0
Moisture Content after Resilient Modulus Testing, %	5.2
Compaction Dry Density, Kg/m^3	2280
QUICK SHEAR TEST	
Stress-Strain Plot Attached	YES
Triaxial Shear Maximum Strength, KPa	278.5
Specimen Fail During Triaxial Shear	Bulge

GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**September 27, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Lafarge Dundas-Granular A.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)
Sample ID:19mm CRL- Lafarge Dundas

Specimen Information

Identification: P026700
Conditioning time:
Properties/Comments:
Max Dry Density = 2260 Kg/m3
OMC = 7.8 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	154.0	154.0	154.0	154.0	154.0	154.0	154.00	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 13.612 Cross-sectional area (mm²): 18626.5
Density (kg/m³): 2436 Volume (cc): 5588.0

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Monday September 23 2024 at 5:05 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	296.1	297.0	297.0	296.7	296.6	296.7	0.360
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.008
Cyclic Axial Stress (kPa):	247.9	247.9	247.8	247.7	247.9	247.9	0.089
Maximum Axial Stress (kPa):	275.5	275.6	275.5	275.3	275.6	275.5	0.098
Contact Axial Stress (kPa):	27.6	27.6	27.7	27.6	27.7	27.6	0.020
Recoverable Axial Strain (%):	0.054	0.054	0.054	0.054	0.054	0.054	0.000
Permanent Axial Strain (%):	0.745	0.746	0.746	0.746	0.746	0.746	0.000
Cyclic Axial Load (kN):	3.694	3.694	3.693	3.691	3.694	3.693	0.000
Maximum Axial Load (kN):	4.105	4.106	4.105	4.103	4.106	4.105	0.000
Contact Axial Load (kN):	0.411	0.412	0.412	0.412	0.412	0.412	0.000
Recoverable Axial Deformation (mm):	0.161	0.160	0.160	0.160	0.160	0.000	0.000
Permanent Axial Deformation (mm):	2.236	2.237	2.238	2.238	2.239	2.238	0.001

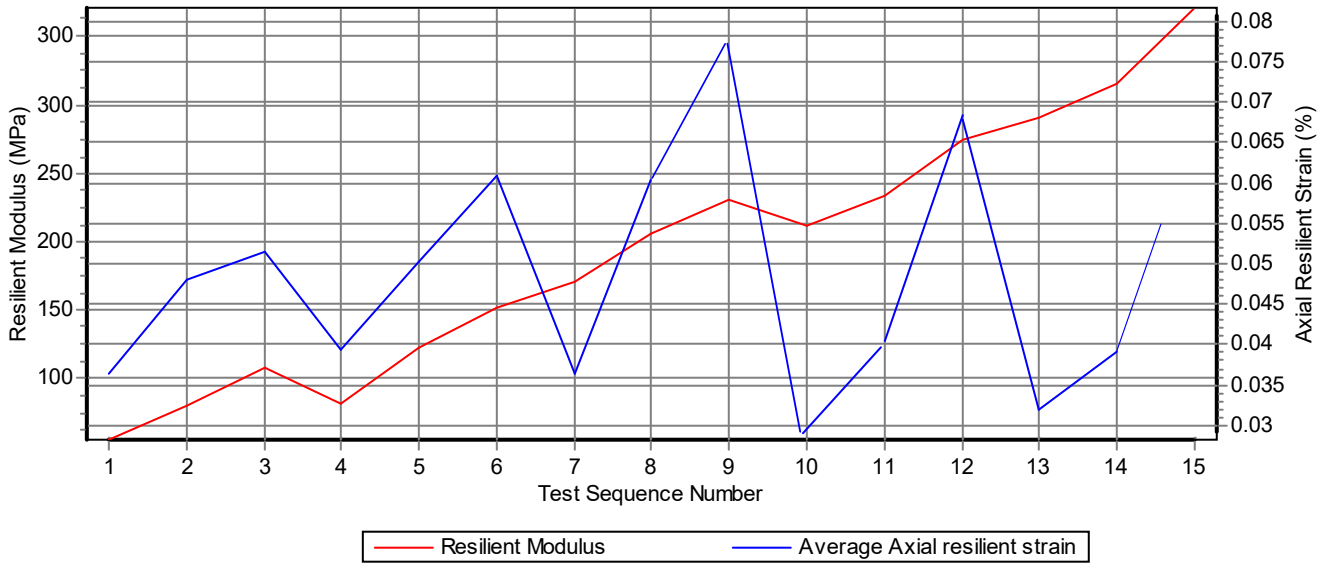
Shear Test Data

Start date & time: Monday September 23 2024 at 5:42 PM
Timer (sec): 299.8

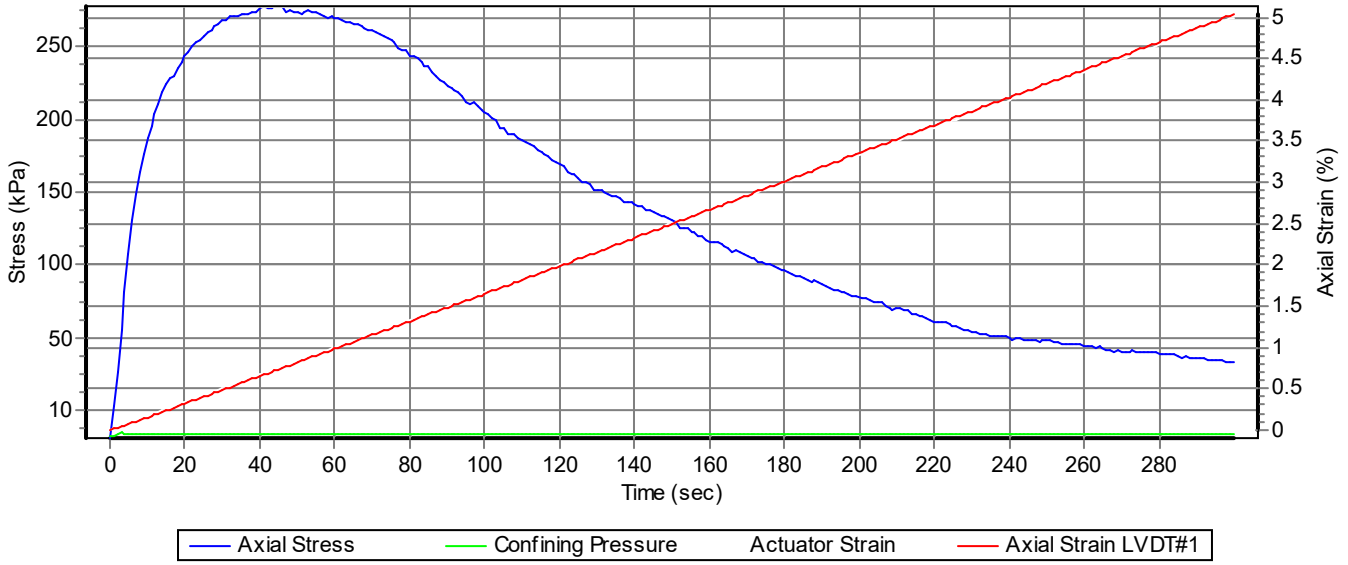
	Current	Peak
Axial Load (kN):	1.556	6.119
Peak Stress (kPa):	83.6	278.5
Confining pressure (kPa):	34.5	

Strain (%)	Current	At Peak Load
Actuator:	4.99	0.74
Averaged Axial:	5.04	0.73

Deformation (mm)	Current	At Peak Load
Actuator:	14.983	2.229
Averaged Axial:	15.109	2.189
Axial LVDT #1:	15.109	2.189



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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Engtec Consulting Inc.
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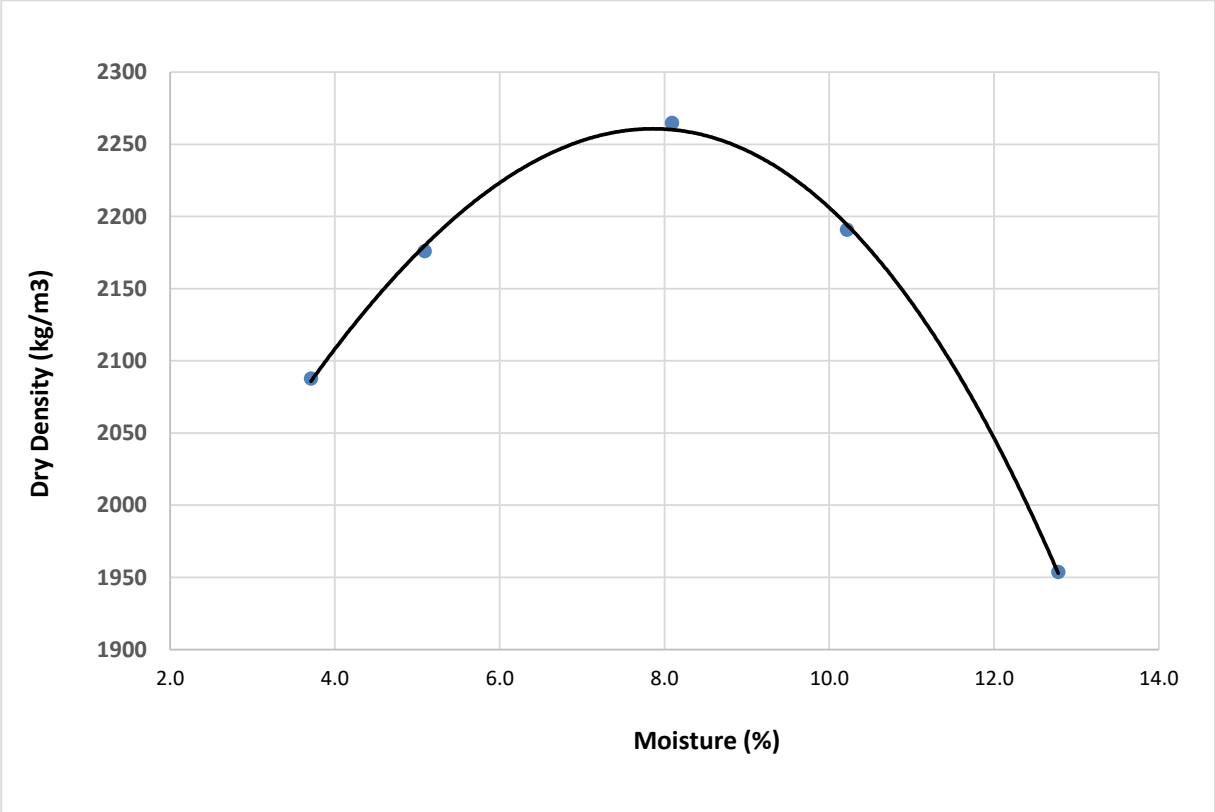
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**19mm CRL**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	August 31, 2024
Sampled Location:	Lafarge - Dundas	Specification:	LS-706
Lab No.	G09645		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	2088	2176	2265	2191	1954
Moisture Content (%)	3.7	5.1	8.1	10.2	12.8



Maximum Dry Density	**2260 Kg/m3**
Optimum Moisture Content	**7.8 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	19mm CRL
Client:	N/A	Sampled By:	Client
Project Description:	N/A	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	August 30, 2024
Sampled Location:	Lafarge - Dundas	Specification:	Granular A - OPSS 1010
Lab No.	G09645		

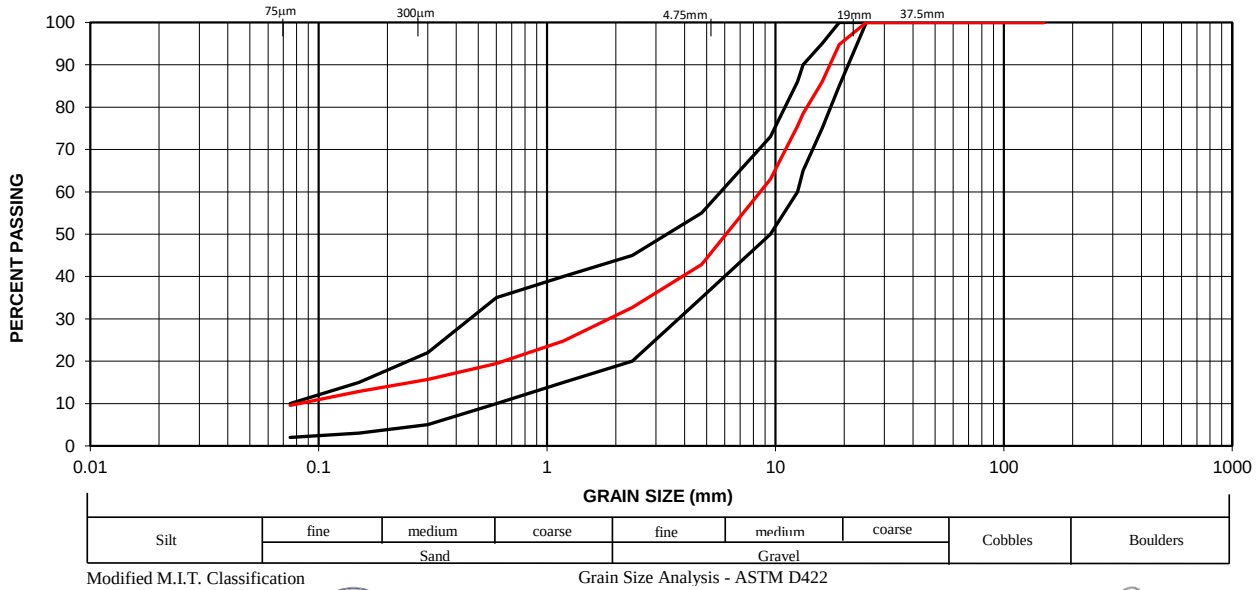
Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	94.8	85	100	
16	86.0			
13.2	78.5	65	90	
12.5	75.5			
9.5	62.9	50	73	
4.75	42.8	35	55	
2.36	32.7			
1.18	24.8	15	40	
0.6	19.5			
0.3	15.7	5	22	
0.15	12.9			
0.075	9.6	2	10	

Note: * - Out of Specification

Physical Properties
Asphalt Coated Particles (%):
Crushed Particles (%):
Percent Deleterious (%):

Additional Comments

Equipment Used
#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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Before Testing

After Testing

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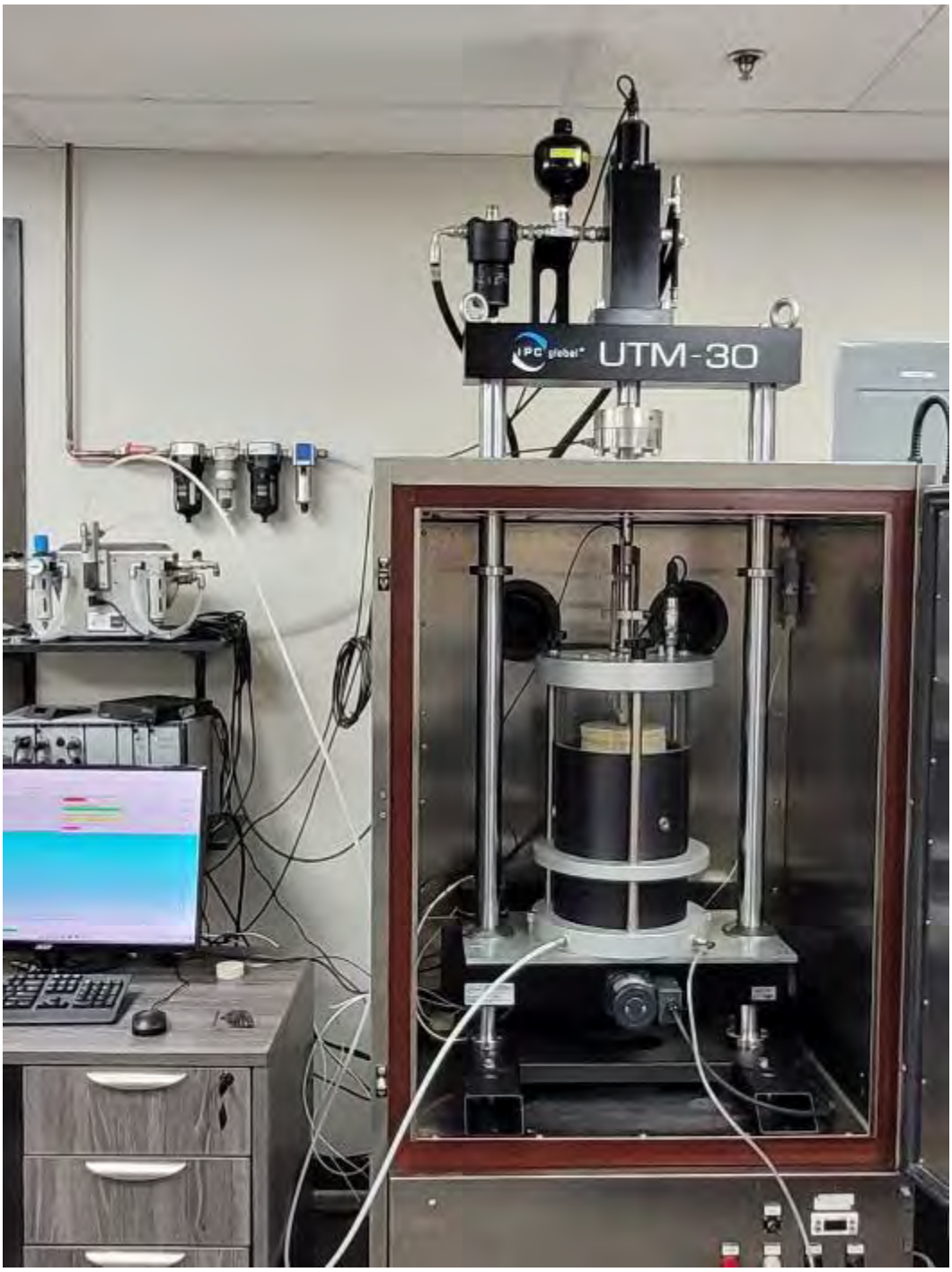

Specimen and Triaxial cell Setup

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Engtec Consulting Inc.
12-100 Hanlan Road, Vaughan
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Fax: (905) 856-2989

Project No: ET24-1327A

September 26, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
19mm Crushed Concrete – Granular A - Supplier A

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.0	67.9
2	20.7	37.6	94.6
3	20.7	55.8	107.3
4	34.5	31.4	79.5
5	34.5	61.8	112.2
6	34.5	93.0	128.7
7	68.9	61.9	98.5
8	68.9	123.9	150.9
9	68.9	185.9	166.8
10	103.4	62.0	116.1
11	103.4	93.1	138.1
12	103.4	185.9	199.8
13	137.9	93.1	174.0
14	137.9	124.1	200.4
15	137.9	248.0	269.8

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APPENDIX A

Resilient Modulus General Report

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Engtec Consulting Inc.
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A - Source A
Sample Number	P02698	Supplier	D.Crupi and Sons
Client	TARBA	Testing Date	Thursday, September 19, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.386	0.373	0.013	20.7	20	0.7	0.089	0.030	68.2
	97		0.386	0.373	0.013				0.089	0.030	67.9
	98		0.379	0.367	0.012				0.088	0.029	67.7
	99		0.378	0.366	0.012				0.088	0.029	67.7
	100		0.384	0.371	0.012				0.088	0.029	68.2
	Average		**0.383**	**0.370**	**0.012**				**0.088**	**0.029**	**67.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.25**
2	96	20.7	0.773	0.701	0.072	41.4	37.6	3.8	0.120	0.040	94.4
	97		0.762	0.692	0.07				0.119	0.040	94.4
	98		0.763	0.692	0.071				0.119	0.040	94.5
	99		0.769	0.699	0.071				0.119	0.040	95.1
	100		0.765	0.693	0.071				0.119	0.040	94.7
	Average		**0.766**	**0.695**	**0.071**				**0.119**	**0.040**	**94.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.29**
3	96	20.7	1.149	1.034	0.115	62.1	55.8	6.2	0.156	0.052	107.4
	97		1.149	1.035	0.114				0.156	0.052	107.3
	98		1.148	1.033	0.115				0.156	0.052	107.2
	99		1.148	1.033	0.115				0.156	0.052	107.4
	100		1.148	1.032	0.116				0.156	0.052	107.2
	Average		**1.148**	**1.033**	**0.115**				**0.156**	**0.052**	**107.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.10**
4	96	34.5	0.636	0.579	0.057	34.5	31.4	3.1	0.118	0.039	79.3
	97		0.644	0.587	0.057				0.119	0.040	79.7
	98		0.634	0.576	0.057				0.118	0.039	79.5
	99		0.643	0.586	0.057				0.119	0.040	79.8
	100		0.632	0.575	0.057				0.117	0.039	79.4
	Average		**0.638**	**0.581**	**0.057**				**0.118**	**0.039**	**79.5**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.21**
5	96	34.5	1.273	1.144	0.129	68.8	61.8	7	0.165	0.055	112.5
	97		1.272	1.144	0.128				0.165	0.055	112.2
	98		1.27	1.141	0.129				0.165	0.055	111.9
	99		1.271	1.142	0.129				0.165	0.055	112.0
	100		1.276	1.147	0.129				0.165	0.055	112.6
	Average		**1.272**	**1.144**	**0.129**				**0.165**	**0.055**	**112.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.30**
6	96	34.5	1.912	1.722	0.19	103.3	93	10.3	0.217	0.072	128.8
	97		1.912	1.722	0.19				0.217	0.072	128.7
	98		1.91	1.719	0.191				0.217	0.072	128.7
	99		1.912	1.723	0.19				0.217	0.072	128.6
	100		1.913	1.723	0.19				0.217	0.072	128.8
	Average		**1.912**	**1.722**	**0.190**				**0.217**	**0.0720**	**128.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.08**
7	96	68.9	1.276	1.147	0.129	68.8	61.9	6.9	0.189	0.063	98.5
	97		1.273	1.145	0.128				0.189	0.063	98.4
	98		1.274	1.145	0.129				0.188	0.063	98.6
	99		1.275	1.146	0.128				0.189	0.063	98.4
	100		1.273	1.145	0.128				0.188	0.063	98.6
	Average		**1.250**	**1.146**	**0.128**				**0.189**	**0.063**	**98.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.10**

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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A - Source A
Sample Number	P02698	Supplier	D.Crupi and Sons
Client	TARBA	Testing Date	Thursday, September 19, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.551	2.295	0.256	137.7	123.9	13.8	0.246	0.082	151.0
	97		2.546	2.291	0.256				0.246	0.082	150.9
	98		2.547	2.291	0.256				0.246	0.082	150.9
	99		2.551	2.295	0.256				0.247	0.082	150.9
	100		2.55	2.293	0.256				0.247	0.082	150.7
	Average		**2.549**	**2.293**	**0.256**				**0.246**	**0.082**	**150.9**
	STDEV.		**0.002**	**0.002**	**0.000**				**0.001**	**0.000**	**0.110**
9	96	69	3.822	3.441	0.382	206.5	185.9	20.7	0.335	0.112	166.6
	97		3.823	3.440	0.383				0.335	0.112	166.5
	98		3.822	3.439	0.383				0.334	0.111	166.8
	99		3.824	3.440	0.383				0.334	0.111	167.1
	100		3.82	3.437	0.383				0.333	0.111	167.2
	Average		**3.822**	**3.439**	**0.383**				**0.334**	**0.111**	**166.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.30**
10	96	103.4	1.273	1.146	0.128	68.9	62.0	6.9	0.160	0.053	115.8
	97		1.275	1.147	0.128				0.161	0.054	115.8
	98		1.275	1.149	0.126				0.160	0.053	116.3
	99		1.274	1.147	0.126				0.160	0.053	116.2
	100		1.276	1.148	0.127				0.160	0.053	116.3
	Average		**1.275**	**1.147**	**0.127**				**0.160**	**0.053**	**116.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.26**
11	96	103.4	1.915	1.723	0.192	103.3	93.1	10.3	0.203	0.068	137.8
	97		1.914	1.724	0.19				0.202	0.067	138.1
	98		1.913	1.724	0.188				0.202	0.067	138.3
	99		1.911	1.72	0.191				0.202	0.067	138.2
	100		1.91	1.72	0.19				0.202	0.067	138.0
	Average		**1.913**	**1.722**	**0.190**				**0.202**	**0.067**	**138.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.19**
12	96	103.4	3.825	3.442	0.383	206.6	185.9	20.7	0.280	0.093	199.5
	97		3.823	3.439	0.384				0.279	0.093	199.7
	98		3.828	3.445	0.383				0.279	0.093	199.9
	99		3.822	3.441	0.382				0.279	0.093	200.0
	100		3.819	3.435	0.384				0.279	0.093	199.9
	Average		**3.823**	**3.440**	**0.383**				**0.279**	**0.093**	**199.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.20**
13	96	137.9	1.913	1.723	0.191	103.4	93.1	10.3	0.161	0.054	173.7
	97		1.914	1.723	0.191				0.161	0.054	173.7
	98		1.911	1.721	0.19				0.161	0.054	173.8
	99		1.914	1.724	0.19				0.160	0.053	174.2
	100		1.912	1.723	0.189				0.160	0.053	174.4
	Average		**1.913**	**1.723**	**0.190**				**0.161**	**0.054**	**174.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.32**
14	96	137.9	2.547	2.293	0.254	137.9	124.1	13.7	0.186	0.062	200.0
	97		2.556	2.301	0.255				0.186	0.062	200.4
	98		2.546	2.293	0.253				0.186	0.062	200.3
	99		2.550	2.296	0.255				0.186	0.062	200.4
	100		2.552	2.297	0.255				0.185	0.062	200.7
	Average		**2.550**	**2.296**	**0.254**				**0.186**	**0.062**	**200.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.25**

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A - Source A
Sample Number	P02698	Supplier	D.Crupi and Sons
Client	TARBA	Testing Date	Thursday, September 19, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.101	4.591	0.510	275.6	248	27.6	0.276	0.092	269.6
	97		5.099	4.588	0.511				0.276	0.092	269.8
	98		5.101	4.591	0.510				0.276	0.092	269.9
	99		5.097	4.586	0.511				0.276	0.092	269.8
	100		5.098	4.588	0.511				0.275	0.092	270.1
	Average		**5.099**	**4.589**	**0.511**				**0.276**	**0.092**	**269.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.18**

APPENDIX B

Recompacted Specimen Information

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2447 Anson Drive
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Tel: (905) 856-2988

Sample Number	P02698	Material Type	19mm Crushed Concrete - Granular A
Testing Date	September 19, 2024	Supplier	Source A

TEST INFORMATION	
Preconditioning- Greater than 5 % Permanent Strain	NO
Testing- Greater Than 5% permanent Strain	NO
Testing- Number of Load Sequences Completed	YES
SPECIMEN INFO.	
Average Diameter, mm	155.3
Membrane Thickness, mm	0.63
Net Diameter, mm	154.0
Height of Specimen, Cap and Base, mm	382.4
Height of Cap and Base, mm	82.4
Initial Length L_0, mm	300
Initial Area, A_0, mm^2	18627
Initial Volume,V_0, cm^3	5588
SPECIMEN WEIGHT	
Initial Weight of Container and Soil, g.	15648
Final Weight of Container and Soil, g.	3429
Weight of Wet Soil Used, g.	12219
MATERIAL PROPERTIES	
In Situ Moisture Content (Nuclear), %	N/A
In Situ Weight Density (Nuclear), Kg/m^3	N/A
Optimum moisture Content, %	10.6
Max Dry Density, Kg/m^3	1987
SPECIMEN PROPERTIES	
Compaction Moisture Content, %	10.5
Moisture Content after Resilient Modulus Testing, %	9.1
Compaction Dry Density, Kg/m^3	1979
QUICK SHEAR TEST	
Stress-Strain Plot Attached	YES
Triaxial Shear Maximum Strength, KPa	196.2
Specimen Fail During Triaxial Shear	Bulge

GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Thursday, September 26, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Dcrupi- Granular A.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)
Material: 19mm Crushed Concrete - Granular A - Source A

Specimen Information

Identification: P02698
Conditioning time:
Properties/Comments:
Max Dry Density = 1987 Kg/m3
OMC = 10.6 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	153.5	153.5	153.5	153.5	153.5	153.5	153.50	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 12.209
Cross-sectional area (mm²): 18505.7
Density (kg/m³): 2199
Volume (cc): 5551.7

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Saturday September 21 2024 at 5:10 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	269.6	269.8	269.9	269.8	270.1	269.9	0.195
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.008
Cyclic Axial Stress (kPa):	248.1	247.9	248.1	247.8	247.9	248.0	0.109
Maximum Axial Stress (kPa):	275.6	275.5	275.6	275.4	275.5	275.6	0.085
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.6	27.6	27.6	0.024
Recoverable Axial Strain (%):	0.092	0.092	0.092	0.092	0.092	0.092	0.000
Permanent Axial Strain (%):	4.528	4.529	4.530	4.531	4.533	4.530	0.002
Cyclic Axial Load (kN):	4.591	4.588	4.591	4.586	4.588	4.589	0.002
Maximum Axial Load (kN):	5.101	5.099	5.101	5.097	5.098	5.099	0.002
Contact Axial Load (kN):	0.510	0.511	0.510	0.511	0.511	0.511	0.000
Recoverable Axial Deformation (mm):	0.276	0.276	0.276	0.276	0.275	0.276	0.000
Permanent Axial Deformation (mm):	13.584	13.587	13.591	13.594	13.598	13.591	0.005

Shear Test Data

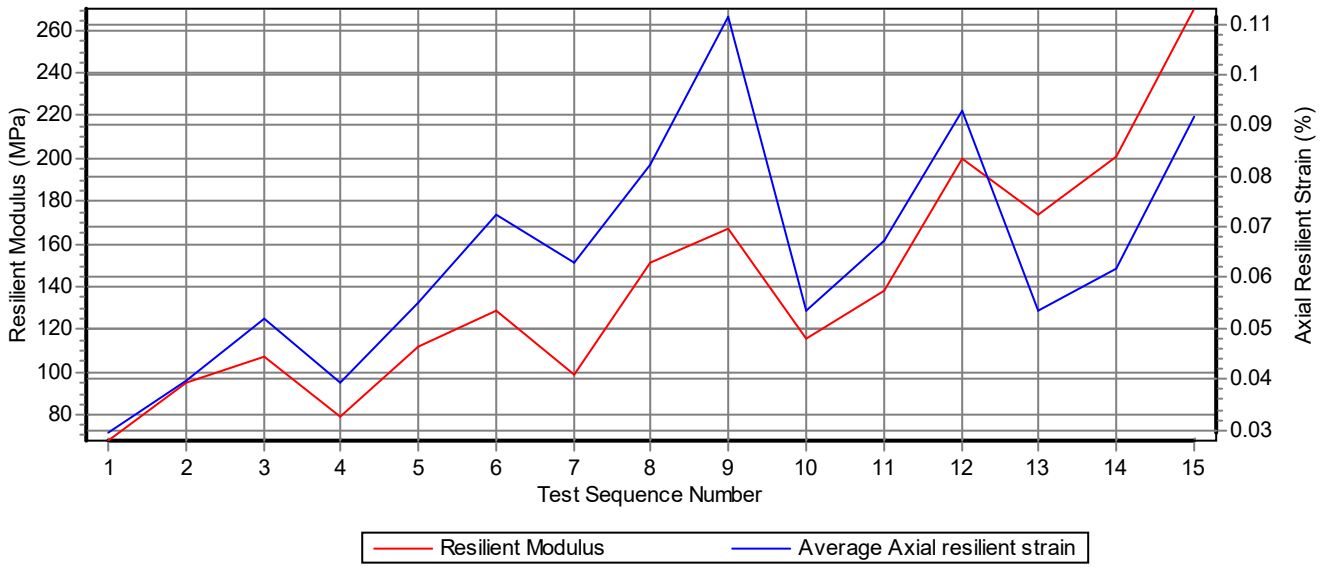
Start date & time: Saturday September 21 2024 at 5:47 PM
Timer (sec): 299.8

	Current	Peak
Axial Load (kN):	2.382	3.630
Peak Stress (kPa):	128.7	196.2
Confining pressure (kPa):	34.5	

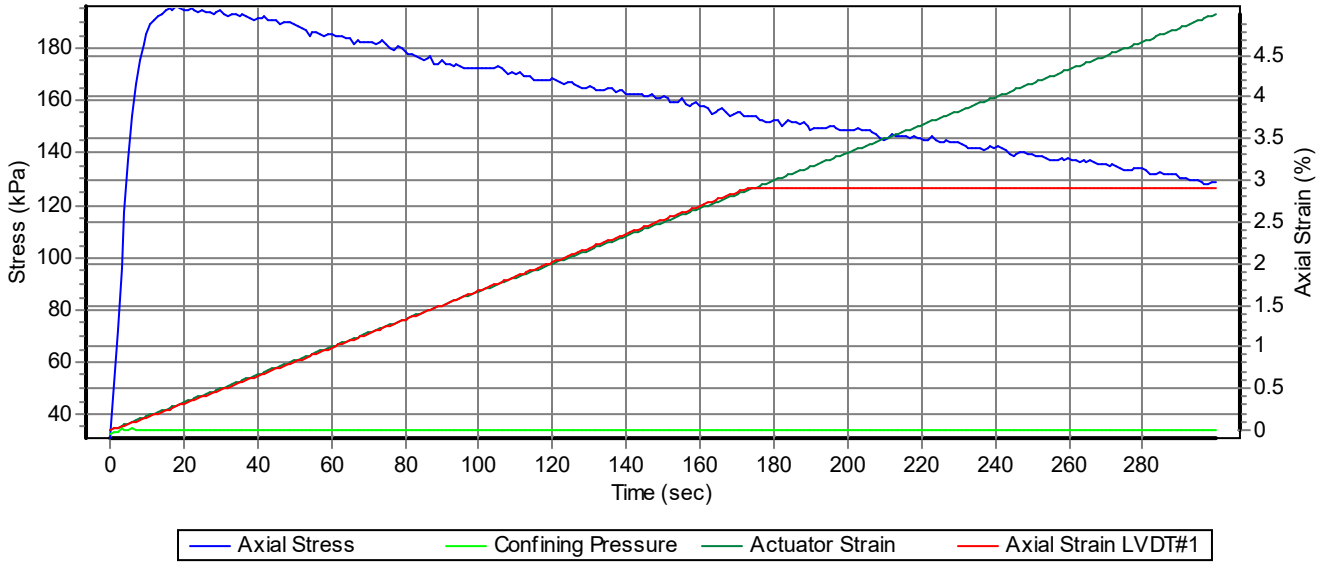
Strain (%)	Current	At Peak Load
Actuator:	4.99	0.31
Averaged Axial:	2.92	0.30

Deformation (mm)	Current	At Peak Load
Actuator:	14.985	0.940
Averaged Axial:	8.746	0.892
Axial LVDT #1:	8.746	0.892

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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Engtec Consulting Inc.
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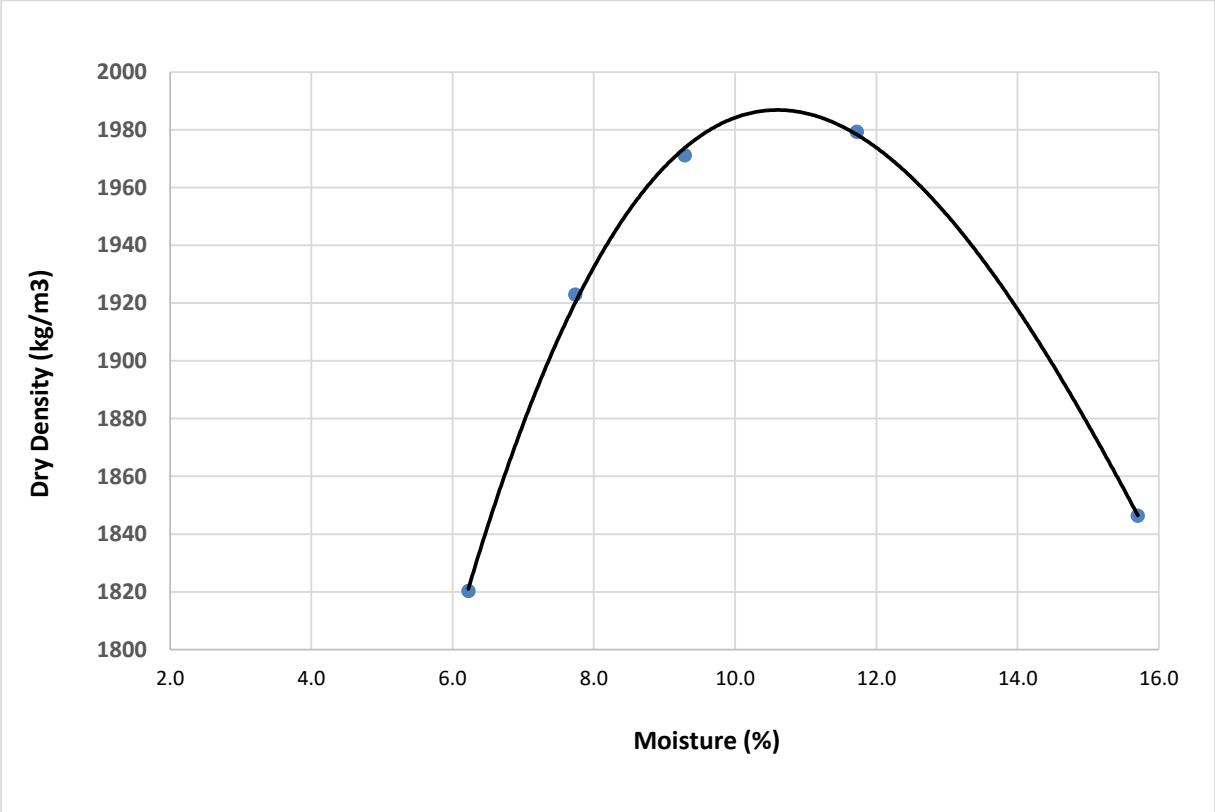
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**19mm CC - Granular A - Source A**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source A	Date Tested:	August 26, 2024
Sampled Location:	Source A	Specification:	LS-706
Lab No.	G09650		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1820	1923	1971	1979	1846
Moisture Content (%)	6.2	7.7	9.3	11.7	15.7



Maximum Dry Density	**1987 Kg/m3**
Optimum Moisture Content	**10.6 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Grain Size Analysis

Project No.	ET24-1327A	Material	19mm CC - Granular A - Source A
Client:	N/A	Sampled By:	Client
Project Description:	N/A	Date Sampled:	August 16, 2024
Source	Source A	Date Tested:	August 26, 2024 Granular A - OPSS
Sampled Location:	Source A	Specification:	1010
Lab No.	G09650		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	86.2	85	100	
16	75.1			
13.2	68.1	65	90	
12.5	65.8			
9.5	55.8	50	73	
4.75	40.1	35	55	
2.36	32.3			
1.18	26.6	15	40	
0.6	21.0			
0.3	14.1	5	22	
0.15	8.5			
0.075	5.9	2	8	

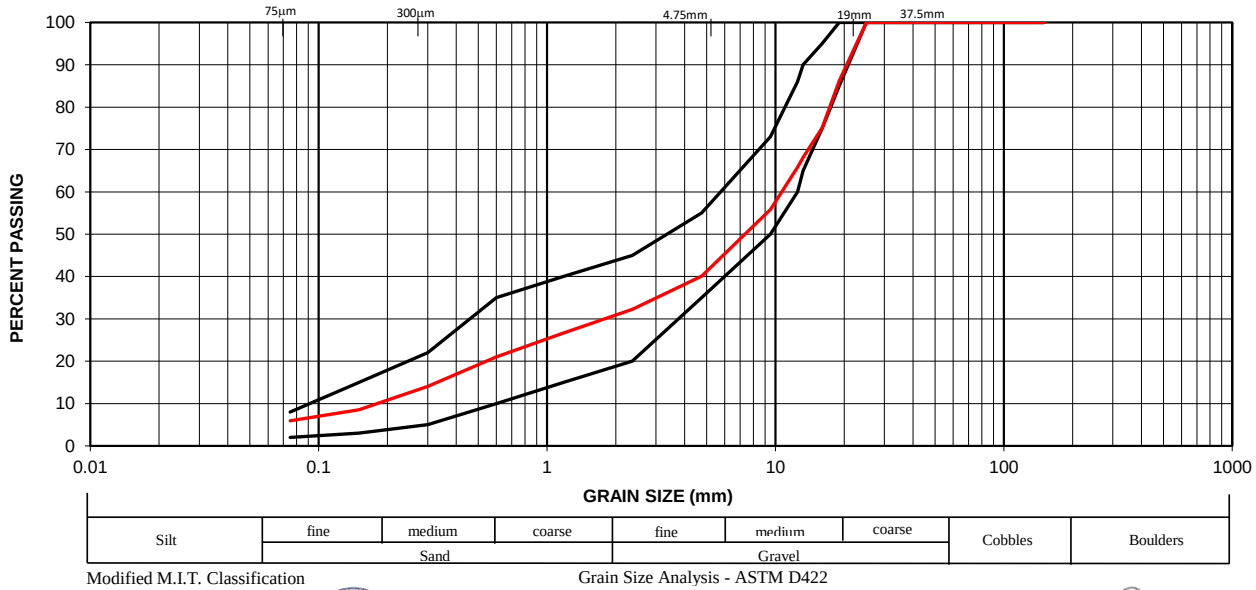
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	10.1
Crushed Particles (%):	99.4
Percent Deleterious (%):	0.92

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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Before Testing

After Testing

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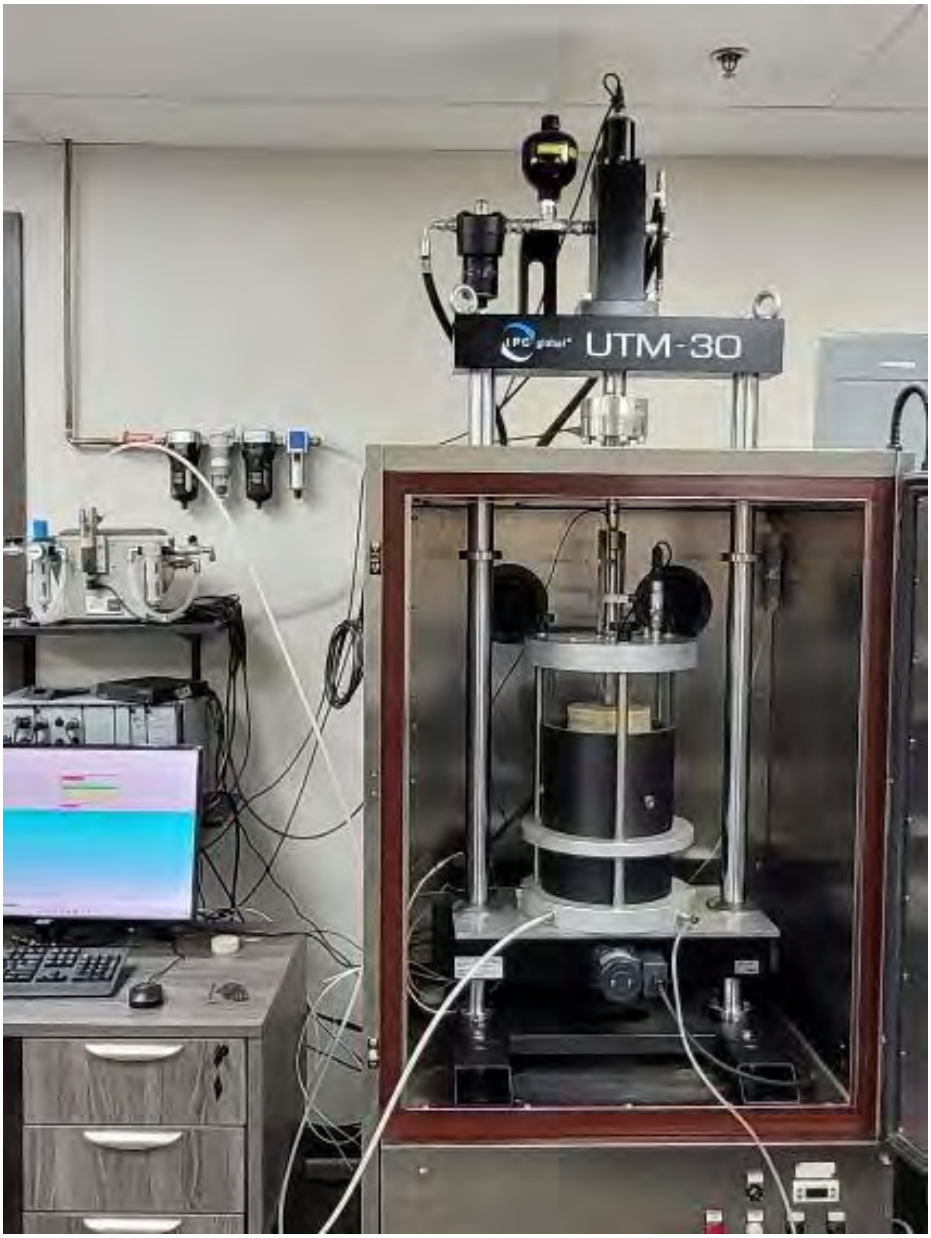

Specimen and Triaxial cell Setup

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Fax: (905) 856-2989

Project No: ET24-1327A

September 26, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
19 mm Crushed Concrete - Source B

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	19.1	79.8
2	20.7	37.2	92.7
3	20.7	55.8	119.0
4	34.5	30.8	96.1
5	34.5	61.8	125.9
6	34.5	93.0	153.1
7	68.9	61.9	136.0
8	68.9	124.0	185.8
9	68.9	185.8	218.2
10	103.4	62.0	162.9
11	103.4	93.1	183.1
12	103.4	185.9	240.8
13	137.9	93.2	227.1
14	137.9	123.9	249.1
15	137.9	247.9	307.9

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APPENDIX A

Resilient Modulus General Report

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A
Sample Number	P02702	Supplier	Source B
Client	TARBA	Testing Date	Saturday, September 21, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.378	0.351	0.027	20.6	19.1	1.5	0.071	0.024	79.2
	97		0.393	0.365	0.028				0.073	0.024	80.1
	98		0.378	0.351	0.027				0.071	0.024	79.5
	99		0.388	0.361	0.028				0.072	0.024	80.2
	100		0.379	0.352	0.028				0.071	0.024	79.8
	Average		**0.383**	**0.356**	**0.028**				**0.072**	**0.024**	**79.8**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.42**
2	96	20.7	0.772	0.695	0.077	41.3	37.2	4.1	0.121	0.040	92.7
	97		0.768	0.691	0.077				0.120	0.040	92.6
	98		0.766	0.689	0.077				0.120	0.040	92.4
	99		0.773	0.696	0.077				0.120	0.040	93.2
	100		0.769	0.692	0.077				0.120	0.040	92.8
	Average		**0.770**	**0.693**	**0.077**				**0.120**	**0.040**	**92.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.30**
3	96	20.7	1.157	1.041	0.116	62.0	55.8	6.2	0.141	0.047	119.0
	97		1.154	1.039	0.115				0.141	0.047	118.9
	98		1.154	1.039	0.115				0.141	0.047	118.9
	99		1.155	1.040	0.115				0.141	0.047	119.0
	100		1.156	1.041	0.115				0.141	0.047	119.0
	Average		**1.155**	**1.040**	**0.115**				**0.141**	**0.047**	**119.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.05**
4	96	34.5	0.648	0.58	0.068	34.5	30.8	3.7	0.097	0.032	96.1
	97		0.642	0.573	0.069				0.096	0.032	96.1
	98		0.639	0.57	0.069				0.096	0.032	96.1
	99		0.639	0.572	0.068				0.096	0.032	96.2
	100		0.642	0.573	0.069				0.096	0.032	96.1
	Average		**0.642**	**0.574**	**0.069**				**0.096**	**0.032**	**96.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.04**
5	96	34.5	1.282	1.153	0.129	68.8	61.8	6.9	0.148	0.049	125.6
	97		1.281	1.152	0.129				0.147	0.049	125.9
	98		1.279	1.149	0.13				0.147	0.049	125.7
	99		1.281	1.152	0.129				0.147	0.049	125.9
	100		1.282	1.153	0.13				0.147	0.049	126.3
	Average		**1.281**	**1.152**	**0.129**				**0.147**	**0.049**	**125.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.27**
6	96	34.5	1.923	1.732	0.192	103.3	93	10.3	0.182	0.061	153.1
	97		1.922	1.73	0.192				0.182	0.061	152.7
	98		1.921	1.729	0.191				0.182	0.061	153.0
	99		1.926	1.736	0.19				0.182	0.061	153.7
	100		1.926	1.735	0.191				0.182	0.061	153.0
	Average		**1.924**	**1.732**	**0.191**				**0.182**	**0.0610**	**153.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.37**
7	96	68.9	1.28	1.151	0.129	68.8	61.9	6.9	0.136	0.045	135.9
	97		1.284	1.155	0.129				0.137	0.046	136.2
	98		1.282	1.153	0.129				0.137	0.046	136.0
	99		1.281	1.152	0.129				0.137	0.046	135.9
	100		1.285	1.156	0.129				0.137	0.046	136.1
	Average		**1.282**	**1.153**	**0.129**				**0.137**	**0.046**	**136.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.13**

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A
Sample Number	P02702	Supplier	Source B
Client	TARBA	Testing Date	Saturday, September 21, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.564	2.306	0.257	137.8	124	13.8	0.200	0.067	185.9
	97		2.57	2.315	0.255				0.200	0.067	186.0
	98		2.567	2.309	0.258				0.200	0.067	185.5
	99		2.565	2.307	0.257				0.200	0.067	185.7
	100		2.568	2.312	0.257				0.200	0.067	186.1
	Average		**2.567**	**2.310**	**0.257**				**0.200**	**0.067**	**185.8**
	STDEV.		**0.002**	**0.004**	**0.001**				**0.000**	**0.000**	**0.241**
9	96	68.9	3.848	3.465	0.385	206.5	185.8	20.7	0.256	0.085	218.3
	97		3.852	3.464	0.385				0.256	0.085	218.3
	98		3.85	3.465	0.385				0.256	0.085	218.2
	99		3.848	3.462	0.386				0.256	0.085	217.8
	100		3.846	3.461	0.385				0.256	0.085	218.2
	Average		**3.849**	**3.463**	**0.385**				**0.256**	**0.085**	**218.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**
10	96	103.4	1.281	1.153	0.128	68.9	62.0	6.9	0.114	0.038	163.2
	97		1.281	1.152	0.129				0.114	0.038	162.7
	98		1.283	1.154	0.129				0.114	0.038	162.7
	99		1.280	1.152	0.128				0.114	0.038	162.9
	100		1.283	1.154	0.129				0.114	0.038	162.9
	Average		**1.282**	**1.153**	**0.129**				**0.114**	**0.038**	**162.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.20**
11	96	103.4	1.927	1.735	0.192	103.3	93.1	10.3	0.153	0.051	183.0
	97		1.929	1.737	0.192				0.153	0.051	182.7
	98		1.924	1.733	0.191				0.152	0.051	183.1
	99		1.921	1.729	0.192				0.152	0.051	183.3
	100		1.924	1.732	0.191				0.152	0.051	183.4
	Average		**1.925**	**1.733**	**0.192**				**0.152**	**0.051**	**183.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.27**
12	96	103.4	3.853	3.468	0.385	206.6	185.9	20.7	0.232	0.077	240.8
	97		3.842	3.456	0.386				0.231	0.077	240.5
	98		3.850	3.464	0.386				0.231	0.077	241.1
	99		3.846	3.459	0.387				0.231	0.077	240.9
	100		3.848	3.462	0.386				0.231	0.077	240.9
	Average		**3.848**	**3.462**	**0.386**				**0.231**	**0.077**	**240.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.22**
13	96	137.9	1.923	1.733	0.189	103.4	93.2	10.2	0.123	0.041	226.8
	97		1.925	1.733	0.193				0.123	0.041	226.6
	98		1.927	1.735	0.192				0.123	0.041	227.3
	99		1.923	1.732	0.191				0.123	0.041	227.2
	100		1.926	1.736	0.191				0.123	0.041	227.8
	Average		**1.925**	**1.734**	**0.191**				**0.123**	**0.041**	**227.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.47**
14	96	137.9	2.569	2.312	0.257	137.8	123.9	13.8	0.150	0.050	248.8
	97		2.566	2.309	0.258				0.149	0.050	248.7
	98		2.568	2.310	0.258				0.149	0.050	249.4
	99		2.564	2.307	0.257				0.149	0.050	249.6
	100		2.564	2.306	0.258				0.149	0.050	249.2
	Average		**2.566**	**2.309**	**0.258**				**0.149**	**0.050**	**249.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.38**

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A
Sample Number	P02702	Supplier	Source B
Client	TARBA	Testing Date	Saturday, September 21, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.134	4.620	0.514	275.5	247.9	27.6	0.242	0.081	307.5
	97		5.131	4.616	0.514				0.241	0.080	308.4
	98		5.133	4.619	0.515				0.242	0.081	308.0
	99		5.130	4.616	0.514				0.242	0.081	307.7
	100		5.133	4.617	0.515				0.242	0.081	307.8
	Average		**5.132**	**4.618**	**0.514**				**0.242**	**0.081**	**307.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.34**

APPENDIX B

Recompacted Specimen Information

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Mississauga, Ontario
L5S 1G1
Tel: (905) 856-2988

Sample Number	P02702	Material Type	19mm CC - Granular A
Testing Date	September 21, 2024	Supplier	Source B
TEST INFORMATION			
Preconditioning- Greater than 5 % Permanent Strain			NO
Testing- Greater Than 5% permanent Strain			NO
Testing- Number of Load Sequences Completed			YES
SPECIMEN INFO.			
Average Diameter, mm			155.3
Membrane Thickness, mm			0.63
Net Diameter, mm			154.0
Height of Specimen, Cap and Base, mm			382.4
Height of Cap and Base, mm			82.4
Initial Length L_0, mm			300
Initial Area, A_0, mm^2			18627
Initial Volume,V_0, cm^3			5588
SPECIMEN WEIGHT			
Initial Weight of Container and Soil, g.			18162.6
Final Weight of Container and Soil, g.			5526.1
Weight of Wet Soil Used, g.			12636.5
MATERIAL PROPERTIES			
In Situ Moisture Content (Nuclear), %			N/A
In Situ Weight Density (Nuclear), Kg/m^3			N/A
Optimum moisture Content, %			10.4
Max Dry Density, Kg/m^3			2049
SPECIMEN PROPERTIES			
Compaction Moisture Content, %			9.8
Moisture Content after Resilient Modulus Testing, %			7.3
Compaction Dry Density, Kg/m^3			2060
QUICK SHEAR TEST			
Stress-Strain Plot Attached			YES
Triaxial Shear Maximum Strength, KPa			197.6
Specimen Fail During Triaxial Shear			Bulge
GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Thursday, September 26, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Pave AL- Granular A.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA) Material: 19mm Crushed Concrete - Granular A - Source B

Specimen Information

Identification: P026702
Conditioning time:
Properties/Comments:
Max Dry Density = 2049 Kg/m3
OMC = 10.4 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	154.0	154.0	154.0	154.0	154.0	154.0	154.00	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 12.637 Cross-sectional area (mm²): 18626.5
Density (kg/m³): 2262 Volume (cc): 5588.0

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Tuesday September 24 2024 at 4:48 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	307.5	308.4	308.0	307.7	307.8	307.9	0.358
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.008
Cyclic Axial Stress (kPa):	248.0	247.8	248.0	247.8	247.9	247.9	0.085
Maximum Axial Stress (kPa):	275.6	275.5	275.6	275.4	275.6	275.5	0.089
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.6	27.7	27.6	0.026
Recoverable Axial Strain (%):	0.081	0.080	0.081	0.081	0.081	0.081	0.000
Permanent Axial Strain (%):	1.435	1.436	1.436	1.437	1.437	1.436	0.001
Cyclic Axial Load (kN):	4.620	4.616	4.619	4.616	4.617	4.618	0.002
Maximum Axial Load (kN):	5.134	5.131	5.133	5.130	5.133	5.132	0.002
Contact Axial Load (kN):	0.514	0.514	0.515	0.514	0.515	0.515	0.000
Recoverable Axial Deformation (mm):	0.242	0.241	0.242	0.242	0.242	0.242	0.000
Permanent Axial Deformation (mm):	4.305	4.307	4.308	4.310	4.311	4.308	0.003

Shear Test Data

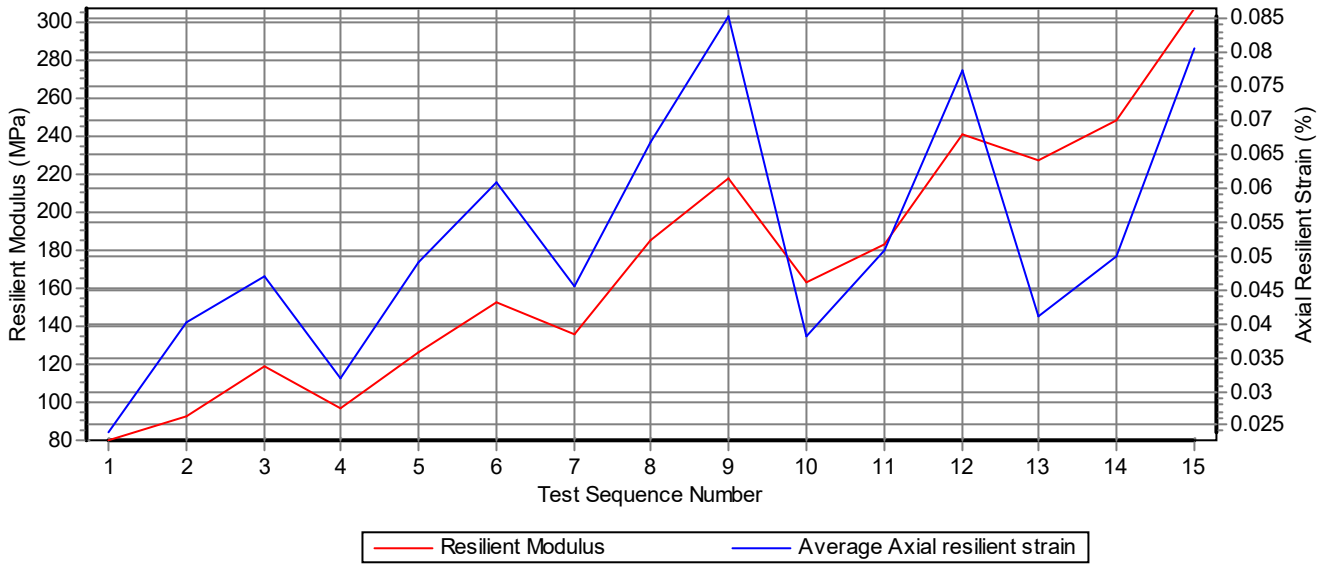
Start date & time: Tuesday September 24 2024 at 5:25 PM
Timer (sec): 299.8

	Current	Peak
Axial Load (kN):	1.701	3.681
Peak Stress (kPa):	91.3	197.6
Confining pressure (kPa):	34.5	

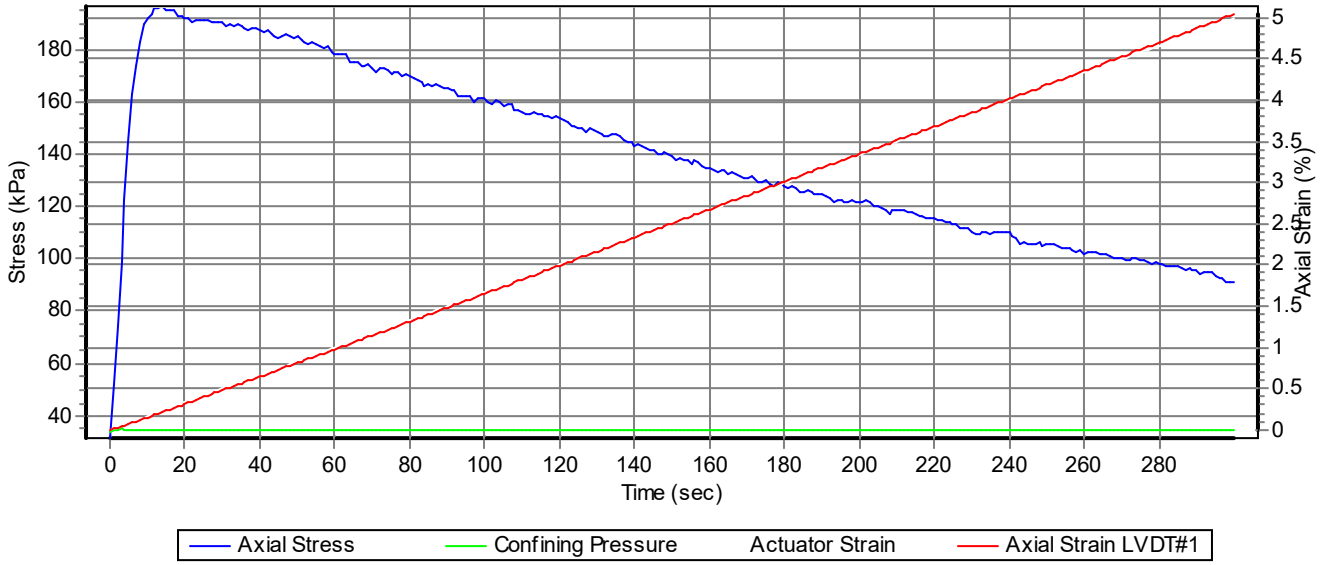
Strain (%)	Current	At Peak Load
Actuator:	4.99	0.23
Averaged Axial:	5.04	0.21

Deformation (mm)	Current	At Peak Load
Actuator:	14.983	0.679
Averaged Axial:	15.116	0.636
Axial LVDT #1:	15.116	0.636

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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Grain Size Analysis

Project No.	ET24-1327A	Material	19mm CC - Granular A
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source B	Date Tested:	August 26, 2024
Sampled Location:	Source B	Specification:	Granular A - OPSS 1010
Lab No.	G09648		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	95.9	85	100	
16	86.9			
13.2	78.7	65	90	
12.5	75.8			
9.5	63.4	50	73	
4.75	43.9	35	55	
2.36	33.6			
1.18	26.3	15	40	
0.6	20.3			
0.3	14.9	5	22	
0.15	11.0			
0.075	7.2	2	8	

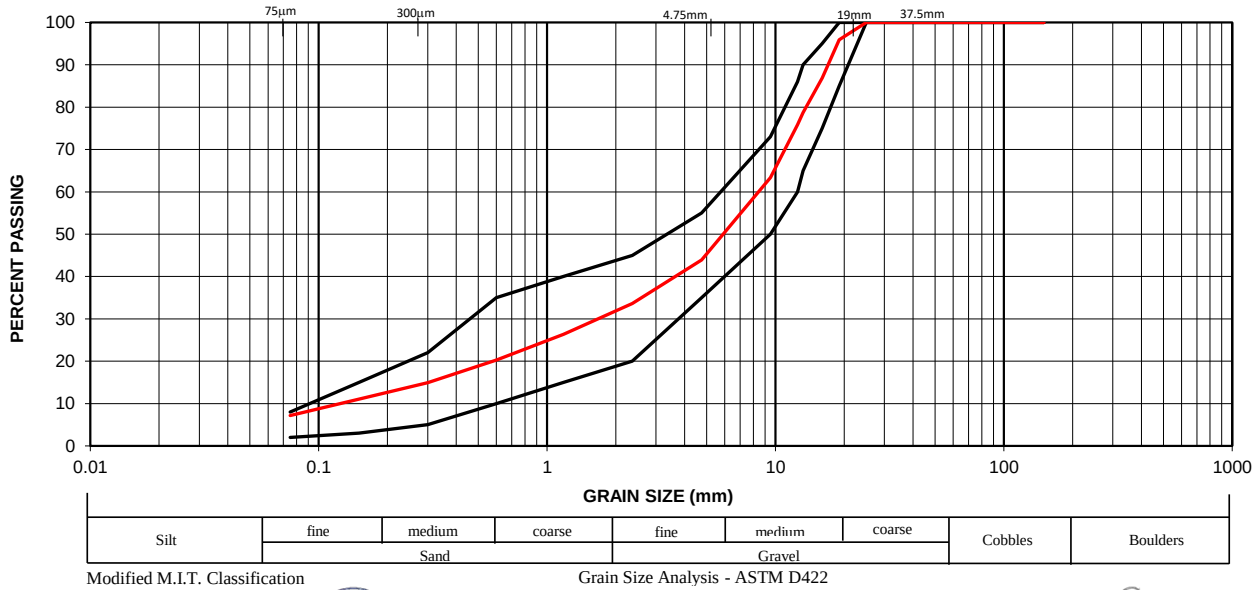
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	10.6
Crushed Particles (%):	99.0
Percent Deleterious (%):	0.48

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

Engtec Consulting Inc.
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Ontario, L5S 1G1
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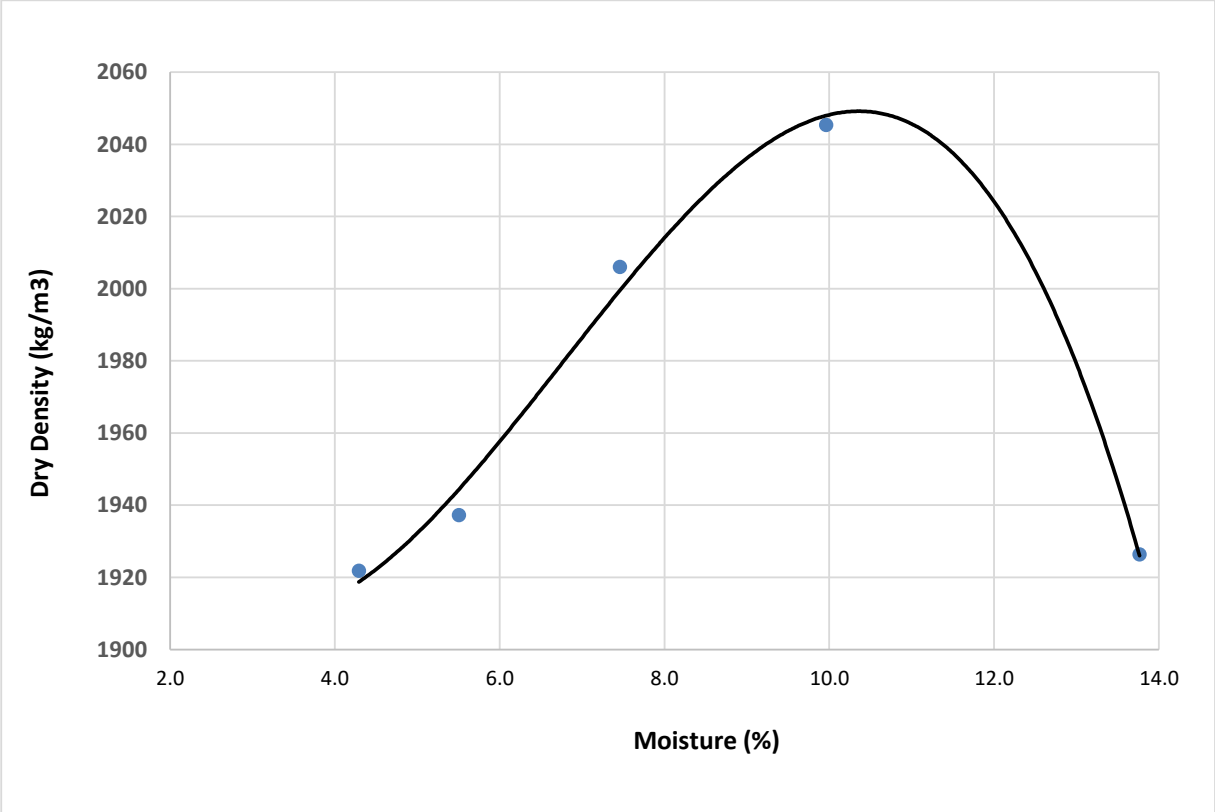
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**19mm Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source B	Date Tested:	August 26, 2024
Sampled Location:	Source B	Specification:	LS-706
Lab No.	G09648		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1922	1937	2006	2045	1926
Moisture Content (%)	4.3	5.5	7.5	10.0	13.8



Maximum Dry Density	**2049 Kg/m3**
Optimum Moisture Content	**10.4 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

APPENDIX E

Photographs of the Sample Setup

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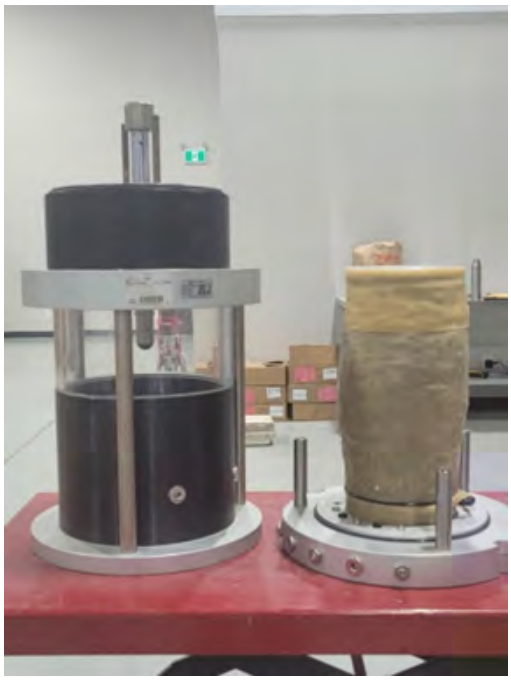
Before Testing



After Testing

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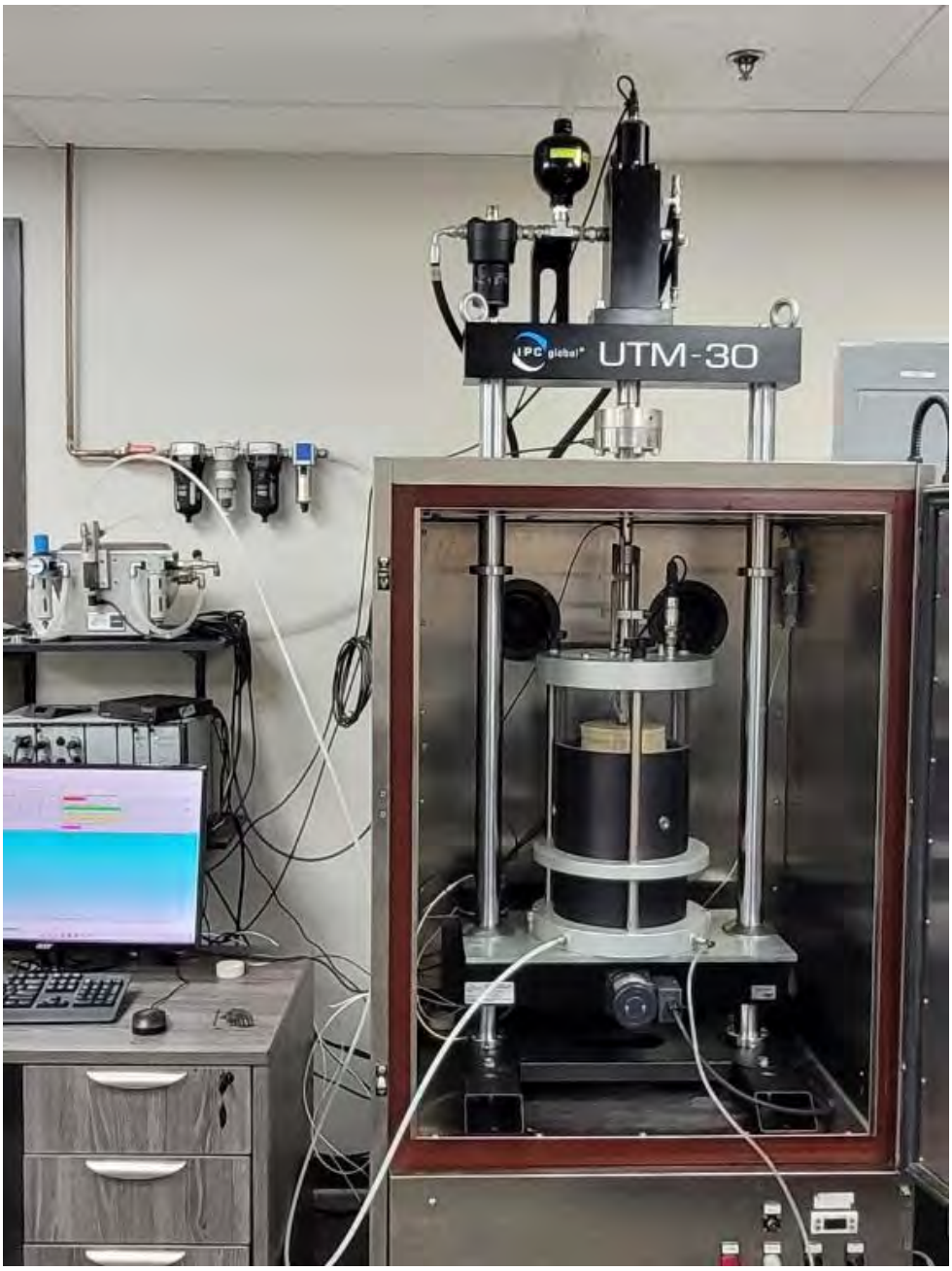

Specimen and Triaxial cell Setup

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Project No: ET24-1327A

September 24, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
19mm Crushed Concrete - Source C

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	19.3	48.9
2	20.7	37.2	86.8
3	20.7	55.8	110.6
4	34.5	30.8	74.7
5	34.5	61.6	117.2
6	34.5	93.0	141.0
7	68.9	62.0	120.0
8	68.9	124.1	171.1
9	68.9	185.9	194.0
10	103.4	62.0	135.9
11	103.4	93	158.6
12	103.4	186.0	223.1
13	137.9	93.1	193.1
14	137.9	124.1	219.8
15	137.9	248.0	282.1

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APPENDIX A

Resilient Modulus General Report

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A
Sample Number	P02696	Supplier	Source C
Client	TARBA	Testing Date	Tuesday, September 19, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.381	0.354	0.027	20.7	19.3	1.4	0.113	0.039	48.4
	97		0.375	0.350	0.026				0.112	0.039	48.3
	98		0.396	0.368	0.039				0.114	0.040	49.8
	99		0.395	0.367	0.027				0.114	0.040	49.6
	100		0.386	0.359	0.027				0.114	0.039	48.5
	Average		**0.387**	**0.360**	**0.029**				**0.113**	**0.039**	**48.9**
	STDEV.		**0.01**	**0.01**	**0.01**				**0.00**	**0.00**	**0.72**
2	96	20.7	0.773	0.697	0.075	41.3	37.2	4.1	0.124	0.043	86.8
	97		0.767	0.69	0.077				0.123	0.043	86.5
	98		0.767	0.691	0.076				0.123	0.043	86.9
	99		0.771	0.694	0.077				0.123	0.043	86.8
	100		0.768	0.692	0.076				0.123	0.043	86.8
	Average		**0.769**	**0.693**	**0.076**				**0.123**	**0.043**	**86.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.15**
3	96	20.7	1.154	1.040	0.114	62.0	55.8	6.2	0.144	0.050	110.9
	97		1.156	1.040	0.115				0.145	0.050	110.9
	98		1.153	1.037	0.116				0.145	0.050	110.3
	99		1.159	1.044	0.115				0.145	0.051	110.8
	100		1.156	1.040	0.116				0.145	0.051	110.2
	Average		**1.156**	**1.040**	**0.115**				**0.145**	**0.050**	**110.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.34**
4	96	34.5	0.644	0.579	0.065	34.2	30.8	3.5	0.120	0.042	74.7
	97		0.639	0.575	0.065				0.119	0.041	74.6
	98		0.646	0.581	0.065				0.120	0.042	74.7
	99		0.638	0.573	0.065				0.119	0.041	74.5
	100		0.646	0.58	0.065				0.119	0.042	74.8
	Average		**0.643**	**0.578**	**0.065**				**0.119**	**0.042**	**74.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**
5	96	34.5	1.282	1.154	0.128	68.4	61.6	6.9	0.152	0.053	117.1
	97		1.282	1.154	0.128				0.152	0.053	117.1
	98		1.287	1.159	0.128				0.152	0.053	117.4
	99		1.274	1.147	0.128				0.151	0.053	116.9
	100		1.284	1.156	0.128				0.152	0.053	117.5
	Average		**1.282**	**1.154**	**0.128**				**0.152**	**0.053**	**117.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.24**
6	96	34.5	1.924	1.732	0.192	103.3	93	10.3	0.189	0.066	140.9
	97		1.926	1.734	0.192				0.189	0.066	141.1
	98		1.923	1.732	0.192				0.190	0.066	140.8
	99		1.925	1.733	0.192				0.189	0.066	141.3
	100		1.925	1.732	0.192				0.189	0.066	140.9
	Average		**1.925**	**1.733**	**0.192**				**0.189**	**0.0660**	**141.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.20**
7	96	68.9	1.282	1.154	0.128	68.8	62.0	6.9	0.109	0.052	119.8
	97		1.283	1.154	0.128				0.109	0.052	119.8
	98		1.283	1.155	0.128				0.110	0.052	120.1
	99		1.282	1.155	0.128				0.110	0.052	120.0
	100		1.281	1.154	0.128				0.109	0.051	120.3
	Average		**1.250**	**1.154**	**0.128**				**0.109**	**0.052**	**120.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A
Sample Number	P02696	Supplier	Source C
Client	TARBA	Testing Date	Tuesday, September 19, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.57	2.313	0.257	137.9	124.1	13.9	0.208	0.073	171.3
	97		2.565	2.307	0.258				0.208	0.072	171.1
	98		2.562	2.304	0.258				0.208	0.072	171.0
	99		2.569	2.311	0.258				0.208	0.073	170.9
	100		2.566	2.309	0.257				0.208	0.073	171.0
	Average		**2.566**	**2.309**	**0.258**				**0.208**	**0.073**	**171.1**
	STDEV.		**0.003**	**0.003**	**0.001**				**0.000**	**0.001**	**0.152**
9	96	68.9	3.849	3.465	0.385	206.6	185.9	20.7	0.275	0.096	193.8
	97		3.849	3.464	0.385				0.275	0.096	194.0
	98		3.85	3.465	0.385				0.275	0.096	194.1
	99		3.847	3.462	0.385				0.275	0.096	194.0
	100		3.846	3.461	0.385				0.275	0.096	194.1
	Average		**3.848**	**3.463**	**0.385**				**0.275**	**0.096**	**194.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.12**
10	96	103.4	1.284	1.156	0.128	68.9	62.0	6.9	0.131	0.046	135.9
	97		1.282	1.153	0.13				0.131	0.046	135.7
	98		1.281	1.151	0.129				0.131	0.046	135.9
	99		1.283	1.154	0.129				0.131	0.046	136.1
	100		1.28	1.151	0.129				0.131	0.045	135.9
	Average		**1.282**	**1.153**	**0.129**				**0.131**	**0.046**	**135.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.14**
11	96	103.3	1.924	1.733	0.192	103.3	93	10.3	0.169	0.059	158.4
	97		1.925	1.733	0.192				0.168	0.059	158.6
	98		1.924	1.733	0.192				0.168	0.059	158.5
	99		1.926	1.728	0.193				0.168	0.059	158.5
	100		1.924	1.734	0.192				0.168	0.059	158.8
	Average		**1.925**	**1.732**	**0.192**				**0.168**	**0.059**	**158.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.15**
12	96	103.4	3.848	3.463	0.385	206.6	186	20.7	0.240	0.083	222.7
	97		3.849	3.464	0.385				0.239	0.083	222.9
	98		3.852	3.467	0.385				0.239	0.083	223.2
	99		3.848	3.463	0.385				0.239	0.083	223.3
	100		3.848	3.463	0.385				0.239	0.083	223.4
	Average		**3.849**	**3.464**	**0.385**				**0.239**	**0.083**	**223.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.29**
13	96	137.9	1.924	1.732	0.192	103.4	93.1	10.3	0.139	0.048	192.6
	97		1.925	1.734	0.191				0.138	0.048	193.1
	98		1.924	1.733	0.192				0.138	0.048	193.0
	99		1.926	1.735	0.192				0.138	0.048	193.0
	100		1.928	1.736	0.192				0.138	0.048	193.6
	Average		**1.925**	**1.734**	**0.192**				**0.138**	**0.048**	**193.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.36**
14	96	137.9	2.565	2.307	0.258	137.8	124.1	13.8	0.162	0.056	219.3
	97		2.568	2.311	0.257				0.162	0.056	219.9
	98		2.564	2.308	0.257				0.162	0.056	219.8
	99		2.567	2.310	0.257				0.162	0.056	220.0
	100		2.568	2.311	0.257				0.162	0.056	220.0
	Average		**2.566**	**2.309**	**0.257**				**0.162**	**0.056**	**219.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.29**

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Project Nubmer	ET24-1327A	Material Type	19mm Crushed Concrete - Granular A
Sample Number	P02696	Supplier	Source C
Client	TARBA	Testing Date	Tuesday, September 19, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.128	4.614	0.514	275.5	248	27.6	0.253	0.088	281.4
	97		5.138	4.623	0.514				0.252	0.088	282.1
	98		5.131	4.617	0.514				0.252	0.088	282.2
	99		5.133	4.619	0.514				0.252	0.088	282.3
	100		5.133	4.619	0.514				0.252	0.088	282.6
	Average		**5.133**	**4.618**	**0.514**				**0.252**	**0.088**	**282.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.44**

APPENDIX B

Recompacted Specimen Information

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Sample Number	P02696	Material Type	19mm Crushed Concrete - Granular A
Testing Date	September 19, 2024	Supplier	Source C
TEST INFORMATION			
Preconditioning- Greater than 5 % Permanent Strain			NO
Testing- Greater Than 5% permanent Strain			NO
Testing- Number of Load Sequences Completed			YES
SPECIMEN INFO.			
Average Diameter, mm			155.3
Membrane Thickness, mm			0.63
Net Diameter, mm			154.0
Height of Specimen, Cap and Base, mm			382.4
Height of Cap and Base, mm			82.4
Initial Length L_0, mm			300
Initial Area, A_0, mm^2			18627
Initial Volume,V_0, cm^3			5588
SPECIMEN WEIGHT			
Initial Weight of Container and Soil, g.			18091
Final Weight of Container and Soil, g.			6030
Weight of Wet Soil Used, g.			12061
MATERIAL PROPERTIES			
In Situ Moisture Content (Nuclear), %			N/A
In Situ Weight Density (Nuclear), Kg/m^3			N/A
Optimum moisture Content, %			12.4
Max Dry Density, Kg/m^3			1920
SPECIMEN PROPERTIES			
Compaction Moisture Content, %			11.8
Moisture Content after Resilient Modulus Testing, %			9.8
Compaction Dry Density, Kg/m^3			1931
QUICK SHEAR TEST			
Stress-Strain Plot Attached			YES
Triaxial Shear Maximum Strength, KPa			254
Specimen Fail During Triaxial Shear			Bulge
GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Wednesday, September 25, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Strada-Granular A.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA) Material: 19mm Crushed Concrete - Granular A - Source C

Specimen Information

Identification: P02696
Conditioning time:
Properties/Comments:
Max Dry Density = 1920 Kg/m3
OMC = 12.4 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	154.0	154.0	154.0	154.0	154.0	154.0	154.00	
Hight (mm)	287.0	287.0	287.0	287.0	287.0	287.0	287.00	

Mass (kg): 12.253
Cross-sectional area (mm²): 18626.5
Density (kg/m³): 2292
Volume (cc): 5345.8

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Thursday September 19 2024 at 6:01 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	281.4	282.1	282.2	282.3	282.6	282.1	0.451
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.006
Cyclic Axial Stress (kPa):	247.7	248.2	247.9	248.0	248.0	248.0	0.188
Maximum Axial Stress (kPa):	275.3	275.8	275.4	275.6	275.6	275.5	0.188
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.6	27.6	27.6	0.013
Recoverable Axial Strain (%):	0.088	0.088	0.088	0.088	0.088	0.088	0.000
Permanent Axial Strain (%):	2.017	2.018	2.019	2.019	2.020	2.019	0.001
Cyclic Axial Load (kN):	4.614	4.623	4.617	4.619	4.619	4.618	0.003
Maximum Axial Load (kN):	5.128	5.138	5.131	5.133	5.133	5.132	0.003
Contact Axial Load (kN):	0.514	0.514	0.514	0.514	0.514	0.514	0.000
Recoverable Axial Deformation (mm):	0.253	0.252	0.252	0.252	0.252	0.252	0.000
Permanent Axial Deformation (mm):	5.788	5.791	5.793	5.795	5.798	5.793	0.004

Shear Test Data

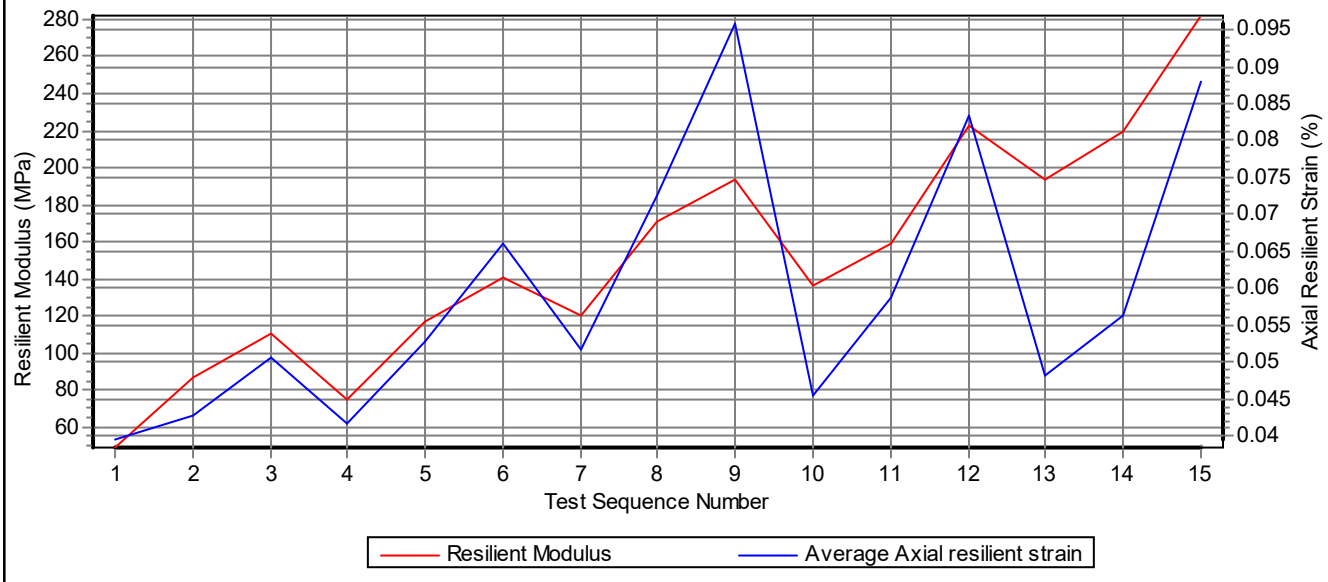
Start date & time: Thursday September 19 2024 at 6:38 PM
Timer (sec): 299.8

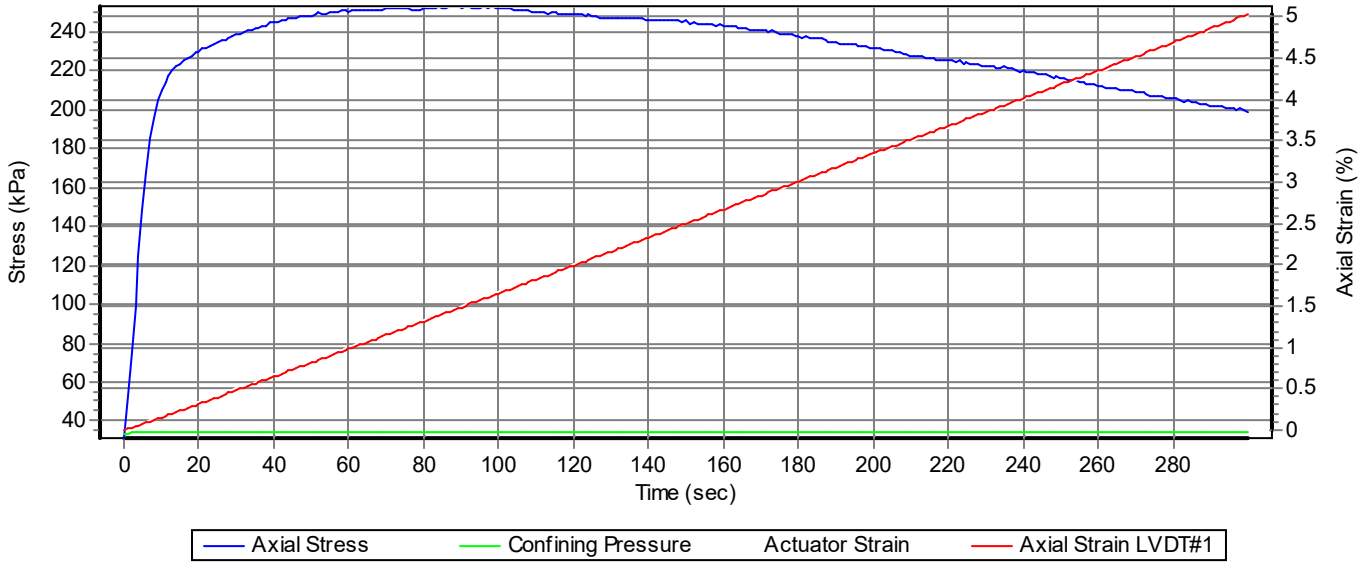
	Current	Peak
Axial Load (kN):	3.705	4.730
Peak Stress (kPa):	198.9	254.0
Confining pressure (kPa):	34.5	

Strain (%)	Current	At Peak Load
Actuator:	4.99	1.62
Averaged Axial:	5.03	1.61

Deformation (mm)	Current	At Peak Load
Actuator:	14.331	4.645
Averaged Axial:	14.431	4.610
Axial LVDT #1:	14.431	4.610

Unbound Material Resilient Modulus and Shear Test




Stress (kPa)
240
220
200
180
160
140
120
100
80
60
40
Axial Strain (%)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
Time (sec)
Axial Stress
Confining Pressure
Actuator Strain
Axial Strain LVDT#1

APPENDIX D

Standard Proctor and Gradation Results

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Grain Size Analysis

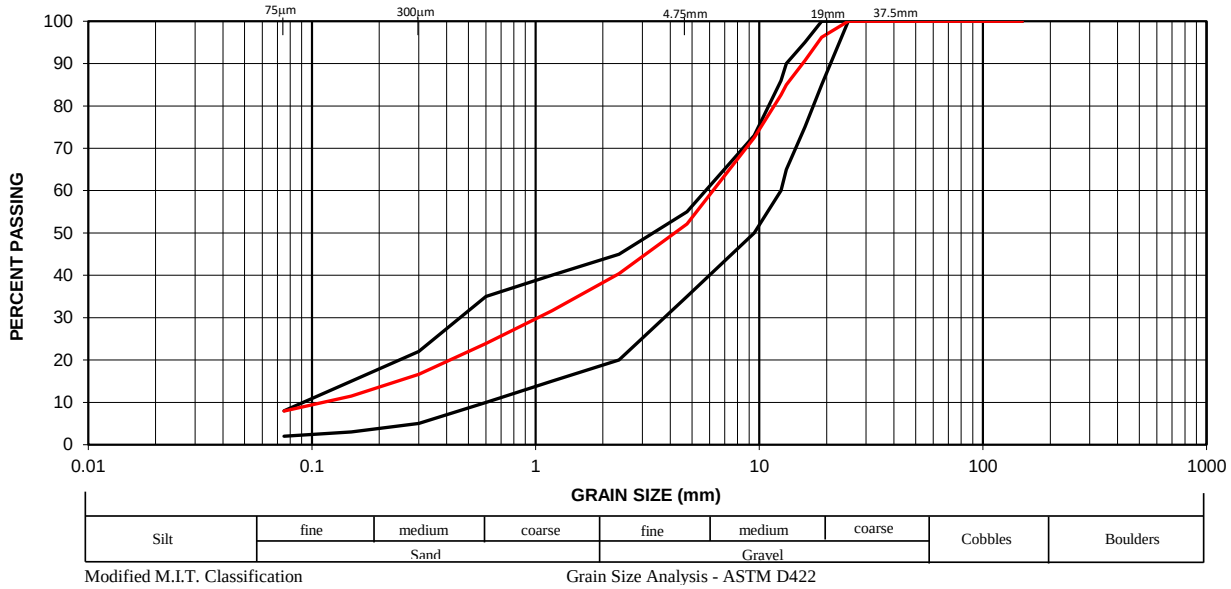
Project No.	ET24-1327A	Material	19mm Crushed Concrete - Granular A - Source
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source C Pad	Date Tested:	August 14, 2024
Sampled Location:	Pad	Specification:	Granular A - OPSS 1010
Lab No.	G09629		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	96.2	85	100	
16	90.7			
13.2	85.0	65	90	
12.5	82.6			
9.5	72.5	50	73	
4.75	52.1	35	55	
2.36	40.4			
1.18	31.6	15	40	
0.6	23.9			
0.3	16.7	5	22	
0.15	11.5			
0.075	7.9	2	8	

Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	8.0
Crushed Particles (%):	0.86
Percent Deleterious (%):	99.0

Additional Comments



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal, Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

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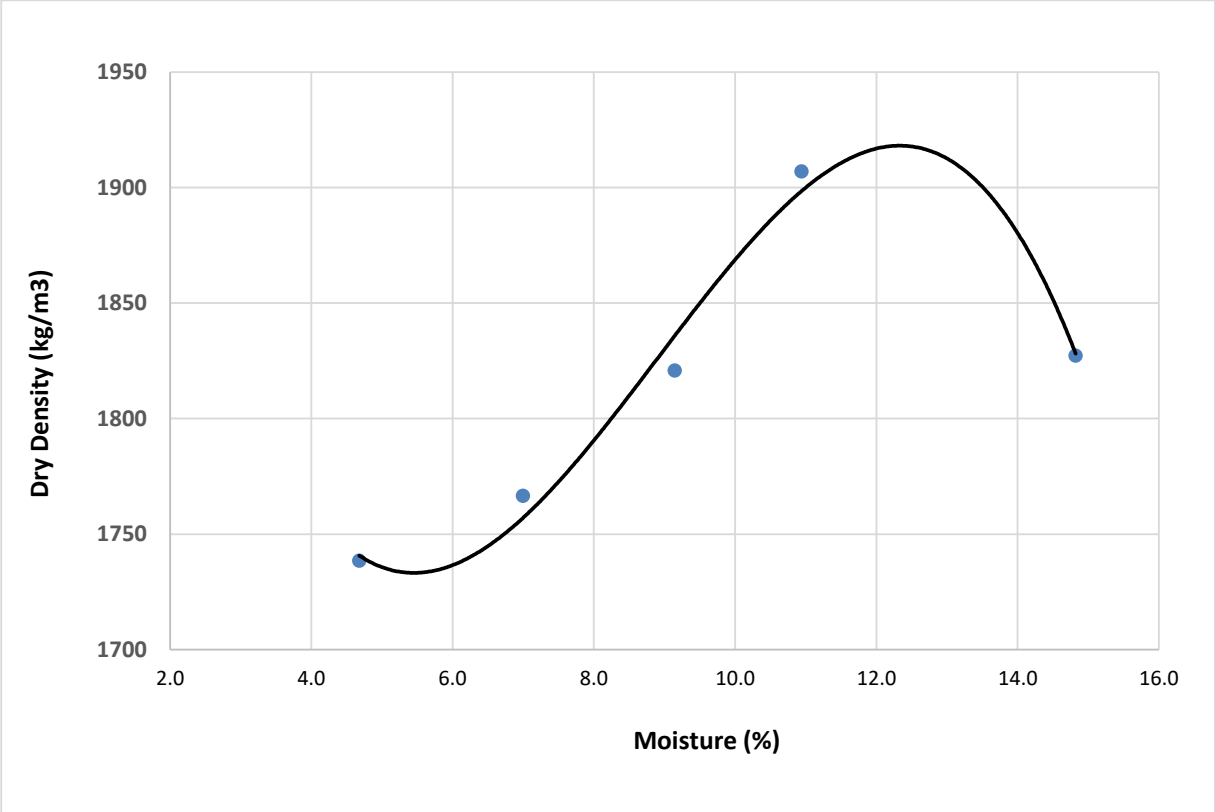
Standard Proctor

Project No.	ET24 -1327A	Material	19mm Crushed Concrete - Granular A
Client:	N/A	Sampled By:	Client- Greg R
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source C	Date Tested:	August 15, 2024
Sampled Location:	Source C	Specification:	LS-706
Lab No.	G09629		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1738	1767	1821	1907	1827
Moisture Content (%)	4.7	7.0	9.1	10.9	14.8



Maximum Dry Density	**1920 Kg/m3**
Optimum Moisture Content	**12.4 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

APPENDIX E

Photographs of the Sample Setup

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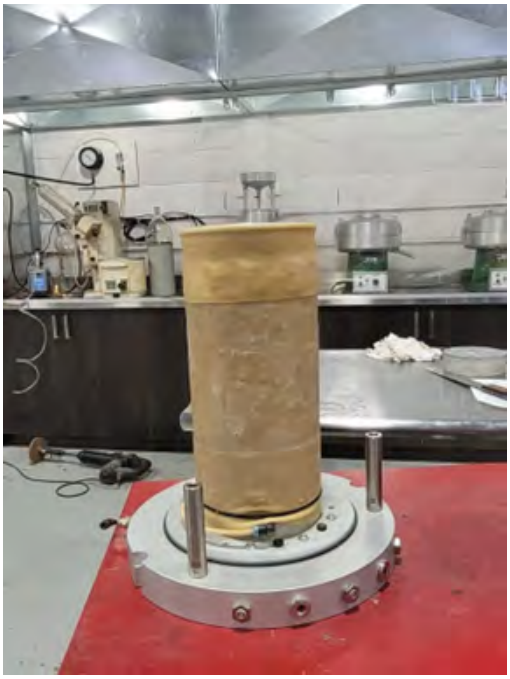

Before Testing

After Testing

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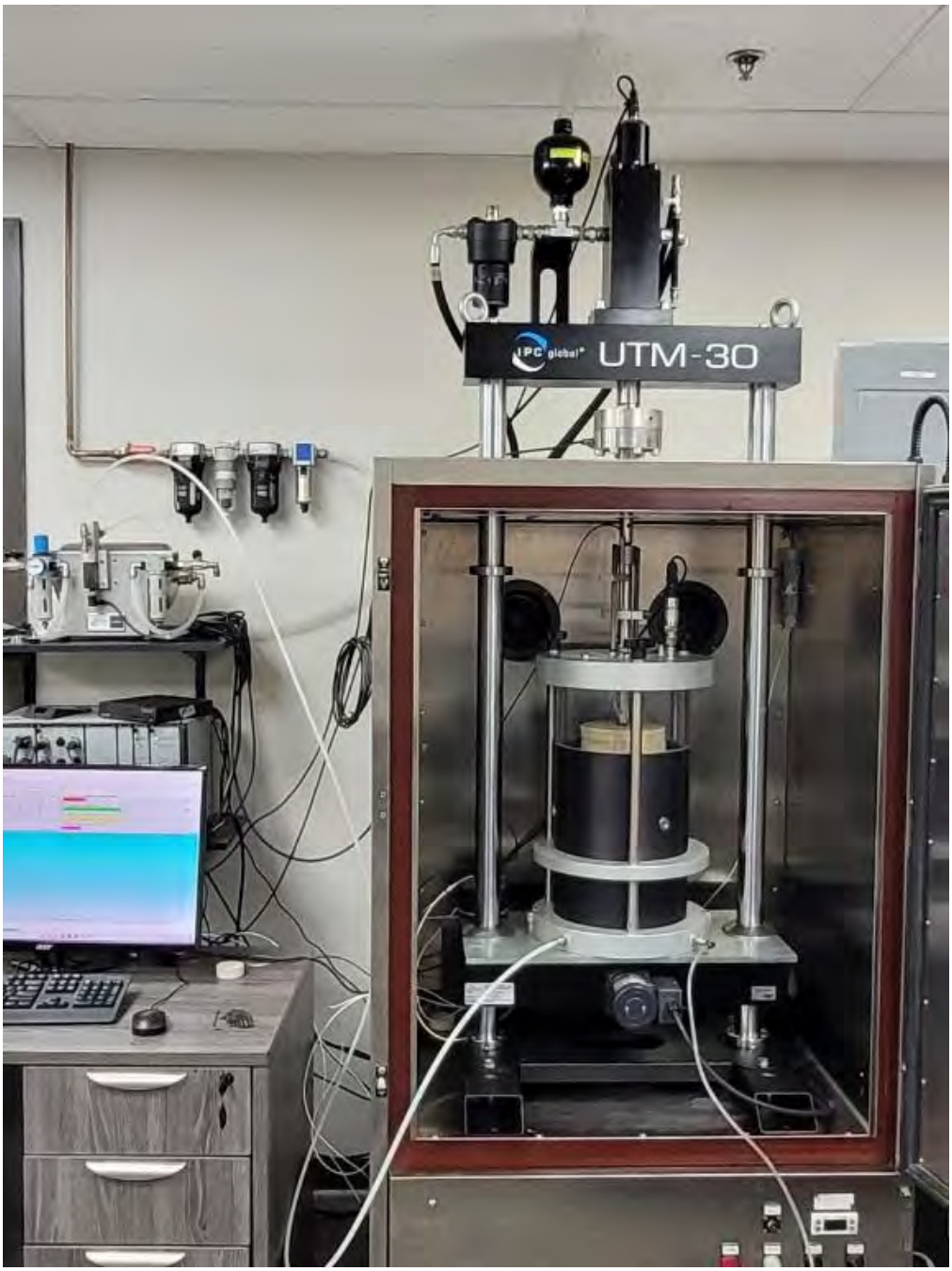

Specimen and Triaxial Cell Setup

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Engtec Consulting Inc.
12-100 Hanlan Road, Vaughan
Ontario, L4L 4V8
Tel: (905) 856-2988
Fax: (905) 856-2989

Project No: ET24-1327A

October 1, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
Virgin Granular B - Type II - Lafarge Caledon

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.1	58.5
2	20.7	40.1	88.4
3	20.7	60.5	116.6
4	34.5	31.8	90.0
5	34.5	61.9	124.0
6	34.5	92.9	150.6
7	68.9	61.9	143.5
8	68.9	123.9	190.7
9	68.9	185.8	203.3
10	103.4	62.0	147.0
11	103.4	93	170.0
12	103.4	185.8	224.9
13	137.9	93.0	188.3
14	137.9	123.9	211.7
15	137.9	248.0	266.9

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APPENDIX A

Resilient Modulus General Report

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Engtec Consulting Inc.
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Mississauga,Ontario
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	Granular B - Type II - Sand and Gravel
Sample Number	P02704	Supplier	Caledon
Client	TARBA	Testing Date	Saturday, September 28, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.360	0.347	0.013	20.9	20.1	0.8	0.089	0.030	58.4
	97		0.357	0.344	0.013				0.089	0.030	58.2
	98		0.356	0.344	0.013				0.088	0.030	58.6
	99		0.357	0.344	0.013				0.088	0.030	58.7
	100		0.359	0.346	0.014				0.089	0.030	58.7
	Average		**0.358**	**0.345**	**0.013**				**0.089**	**0.030**	**58.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.20**
2	96	20.7	0.723	0.692	0.031	42	40.1	1.9	0.117	0.039	89.1
	97		0.723	0.690	0.034				0.118	0.039	88.3
	98		0.720	0.687	0.033				0.117	0.039	88.3
	99		0.717	0.683	0.033				0.117	0.039	87.9
	100		0.719	0.686	0.032				0.116	0.039	88.6
	Average		**0.720**	**0.688**	**0.033**				**0.117**	**0.039**	**88.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.44**
3	96	20.7	1.081	0.999	0.082	65.8	60.5	5.3	0.131	0.044	114.5
	97		1.121	1.032	0.089				0.133	0.044	116.0
	98		1.145	1.056	0.089				0.134	0.044	117.7
	99		1.137	1.043	0.094				0.132	0.044	117.9
	100		1.152	1.051	0.101				0.134	0.044	117.0
	Average		**1.127**	**1.036**	**0.091**				**0.133**	**0.044**	**116.6**
	STDEV.		**0.03**	**0.02**	**0.01**				**0.00**	**0.00**	**1.38**
4	96	34.5	0.597	0.543	0.054	35.1	31.8	3.3	0.091	0.031	90.2
	97		0.603	0.543	0.060				0.091	0.031	89.5
	98		0.602	0.546	0.055				0.091	0.031	90.6
	99		0.602	0.544	0.057				0.091	0.031	89.7
	100		0.603	0.546	0.056				0.091	0.031	90.1
	Average		**0.601**	**0.544**	**0.056**				**0.091**	**0.031**	**90.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.40**
5	96	34.5	1.180	1.060	0.119	68.9	61.9	6.9	0.129	0.043	124.0
	97		1.181	1.064	0.118				0.129	0.043	124.2
	98		1.180	1.060	0.119				0.129	0.043	124.0
	99		1.177	1.058	0.118				0.128	0.043	123.9
	100		1.182	1.064	0.119				0.129	0.043	124.2
	Average		**1.180**	**1.061**	**0.118**				**0.129**	**0.043**	**124.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.12**
6	96	34.5	1.767	1.590	0.176	103.1	92.9	10.3	0.158	0.053	150.6
	97		1.770	1.594	0.175				0.158	0.053	150.8
	98		1.766	1.590	0.176				0.158	0.053	150.4
	99		1.772	1.595	0.176				0.158	0.053	150.9
	100		1.763	1.586	0.177				0.158	0.053	150.3
	Average		**1.768**	**1.591**	**0.176**				**0.158**	**0.0528**	**150.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.28**
7	96	68.9	1.180	1.062	0.119	68.8	61.9	6.9	0.111	0.037	143.7
	97		1.178	1.060	0.119				0.111	0.037	143.2
	98		1.180	1.061	0.119				0.111	0.037	143.7
	99		1.178	1.060	0.119				0.111	0.037	143.3
	100		1.180	1.061	0.119				0.111	0.037	143.5
	Average		**1.250**	**1.061**	**0.119**				**0.111**	**0.037**	**143.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**

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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	Granular B - Type II - Sand and Gravel
Sample Number	P02704	Supplier	Caledon
Client	TARBA	Testing Date	Saturday, September 28, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.361	2.124	0.237	137.8	123.9	13.8	0.167	0.056	190.8
	97		2.358	2.121	0.237				0.168	0.056	190.3
	98		2.366	2.129	0.237				0.168	0.056	190.9
	99		2.358	2.120	0.238				0.167	0.056	190.6
	100		2.361	2.124	0.238				0.168	0.056	190.7
	Average		**2.361**	**2.124**	**0.237**				**0.167**	**0.056**	**190.7**
	STDEV.		**0.003**	**0.003**	**0.001**				**0.001**	**0.000**	**0.257**
9	96	68.9	3.538	3.182	0.356	206.5	185.8	20.7	0.235	0.079	203.3
	97		3.538	3.184	0.354				0.235	0.079	203.3
	98		3.544	3.188	0.356				0.235	0.079	203.5
	99		3.536	3.181	0.356				0.235	0.079	203.1
	100		3.535	3.181	0.354				0.235	0.079	203.1
	Average		**3.538**	**3.183**	**0.355**				**0.235**	**0.079**	**203.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.15**
10	96	103.4	1.180	1.061	0.119	68.9	62.0	6.9	0.108	0.036	146.7
	97		1.181	1.061	0.119				0.108	0.036	147.0
	98		1.182	1.063	0.119				0.108	0.036	147.0
	99		1.181	1.062	0.119				0.108	0.036	147.1
	100		1.181	1.062	0.119				0.108	0.036	147.1
	Average		**1.181**	**1.062**	**0.119**				**0.108**	**0.036**	**147.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.19**
11	96	103.4	1.769	1.593	0.176	103.3	93	10.3	0.047	0.055	169.7
	97		1.771	1.595	0.176				0.047	0.055	170.2
	98		1.771	1.594	0.178				0.047	0.055	169.9
	99		1.769	1.594	0.176				0.047	0.055	170.0
	100		1.770	1.593	0.177				0.047	0.055	170.2
	Average		**1.770**	**1.594**	**0.176**				**0.047**	**0.055**	**170.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.20**
12	96	103.4	3.536	3.181	0.355	206.6	185.8	20.7	0.212	0.070	224.9
	97		3.540	3.184	0.356				0.213	0.071	224.9
	98		3.542	3.186	0.356				0.213	0.071	225.0
	99		3.539	3.184	0.355				0.213	0.071	224.8
	100		3.539	3.183	0.356				0.212	0.070	225.1
	Average		**3.539**	**3.184**	**0.355**				**0.213**	**0.071**	**224.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**
13	96	137.9	1.770	1.594	0.178	103.3	93	10.3	0.127	0.043	188.2
	97		1.769	1.594	0.176				0.127	0.043	188.0
	98		1.775	1.598	0.178				0.128	0.043	188.1
	99		1.768	1.591	0.176				0.127	0.043	188.6
	100		1.769	1.594	0.174				0.127	0.043	188.7
	Average		**1.770**	**1.594**	**0.176**				**0.127**	**0.043**	**188.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.33**
14	96	137.9	2.366	2.130	0.237	137.7	123.9	13.8	0.151	0.050	211.7
	97		2.356	2.119	0.236				0.150	0.050	211.5
	98		2.363	2.127	0.236				0.151	0.050	211.8
	99		2.359	2.122	0.237				0.150	0.050	211.9
	100		2.357	2.121	0.236				0.150	0.050	211.8
	Average		**2.360**	**2.124**	**0.236**				**0.150**	**0.050**	**211.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.14**

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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	Granular B - Type II - Sand and Gravel
Sample Number	P02704	Supplier	Caledon
Client	TARBA	Testing Date	Saturday, September 28, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	4.718	4.244	0.473	275.6	248	27.6	0.239	0.080	266.7
	97		4.726	4.253	0.474				0.239	0.080	266.9
	98		4.725	4.252	0.473				0.239	0.080	266.9
	99		4.720	4.245	0.474				0.239	0.080	266.9
	100		4.724	4.250	0.474				0.239	0.080	266.9
	Average		**4.723**	**4.249**	**0.474**				**0.239**	**0.080**	**266.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.12**

APPENDIX B

Recompacted Specimen Information

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2447 Anson Drive
Mississauga, Ontario
L5S 1G1
Tel: (905) 856-2988

Sample Number	P02704	Material Type	Granular B - Type II - Sand and Gravel
Testing Date	September 28, 2024	Supplier	Lafarge Caledon

TEST INFORMATION	
Preconditioning- Greater than 5 % Permanent Strain	NO
Testing- Greater Than 5% permanent Strain	NO
Testing- Number of Load Sequences Completed	YES
SPECIMEN INFO.	
Average Diameter, mm	155.3
Membrane Thickness, mm	0.63
Net Diameter, mm	154.0
Height of Specimen, Cap and Base, mm	382.4
Height of Cap and Base, mm	82.4
Initial Length L_0, mm	300
Initial Area, A_0, mm^2	18627
Initial Volume,V_0, cm^3	5588
SPECIMEN WEIGHT	
Initial Weight of Container and Soil, g.	19233
Final Weight of Container and Soil, g.	5978
Weight of Wet Soil Used, g.	13255
MATERIAL PROPERTIES	
In Situ Moisture Content (Nuclear), %	N/A
In Situ Weight Density (Nuclear), Kg/m^3	N/A
Optimum moisture Content, %	7.8
Max Dry Density, Kg/m^3	2202
SPECIMEN PROPERTIES	
Compaction Moisture Content, %	7.4
Moisture Content after Resilient Modulus Testing, %	5.9
Compaction Dry Density, Kg/m^3	2209
QUICK SHEAR TEST	
Stress-Strain Plot Attached	YES
Triaxial Shear Maximum Strength, KPa	246.3
Specimen Fail During Triaxial Shear	Bulge

GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Sunday, September 29, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\ Lafarge Pinkney - Granular B.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)
Sample ID: Granular B - Type II - Sand and Gravel -
Lafarge Caledon

Specimen Information

Identification: P02704
Conditioning time:
Properties/Comments:
Max Dry Density = 2202 Kg/m3
OMC = 7.8 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	153.5	153.5	153.5	153.5	153.5	153.5	153.50	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 13.255 Cross-sectional area (mm²): 18505.7
Density (kg/m³): 2374 Volume (cc): 5551.7

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Friday September 20 2024 at 1:00 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	266.7	266.9	266.9	266.9	266.9	266.9	0.120
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.005
Cyclic Axial Stress (kPa):	247.7	248.2	248.2	247.8	248.0	248.0	0.211
Maximum Axial Stress (kPa):	275.3	275.8	275.8	275.5	275.7	275.6	0.204
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.7	27.6	27.6	0.028
Recoverable Axial Strain (%):	0.080	0.080	0.080	0.080	0.080	0.080	0.000
Permanent Axial Strain (%):	1.000	1.000	1.001	1.002	1.003	1.001	0.001
Cyclic Axial Load (kN):	4.244	4.253	4.252	4.245	4.250	4.249	0.004
Maximum Axial Load (kN):	4.718	4.726	4.725	4.720	4.724	4.723	0.004
Contact Axial Load (kN):	0.473	0.474	0.473	0.474	0.474	0.474	0.001
Recoverable Axial Deformation (mm):	0.239	0.239	0.239	0.239	0.239	0.239	0.000
Permanent Axial Deformation (mm):	2.999	3.001	3.004	3.006	3.008	3.003	0.004

Shear Test Data

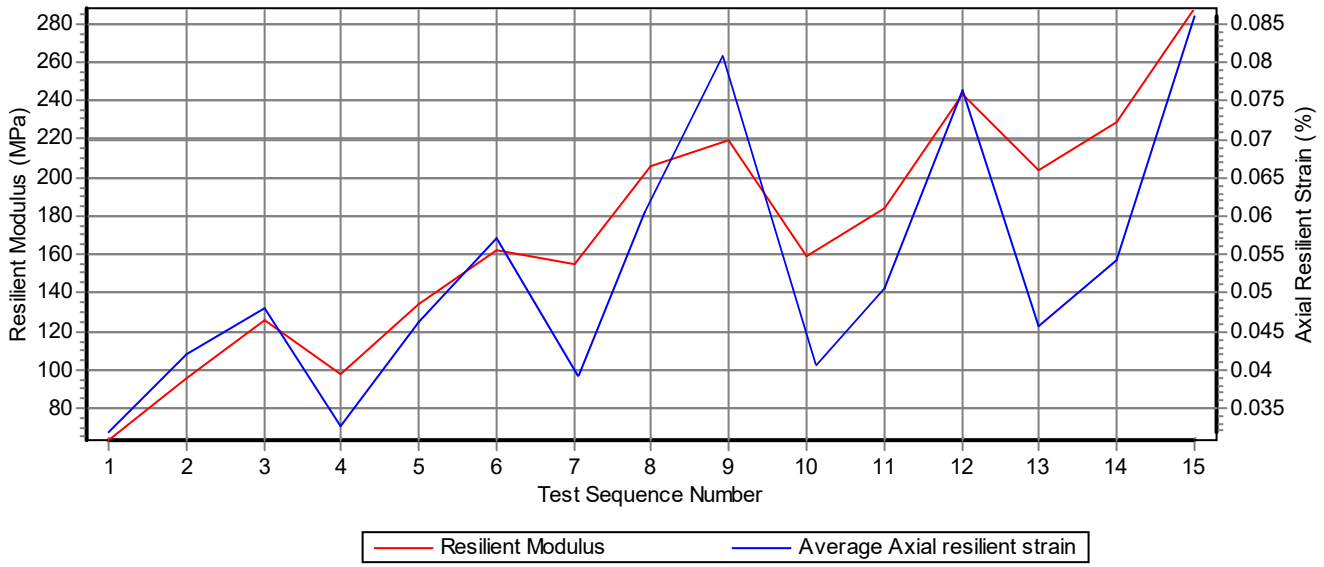
Start date & time: Friday September 20 2024 at 1:37 PM
Timer (sec): 299.8

	Current	Peak
Axial Load (kN):	3.393	5.299
Peak Stress (kPa):	183.3	246.3
Confining pressure (kPa):	34.5	

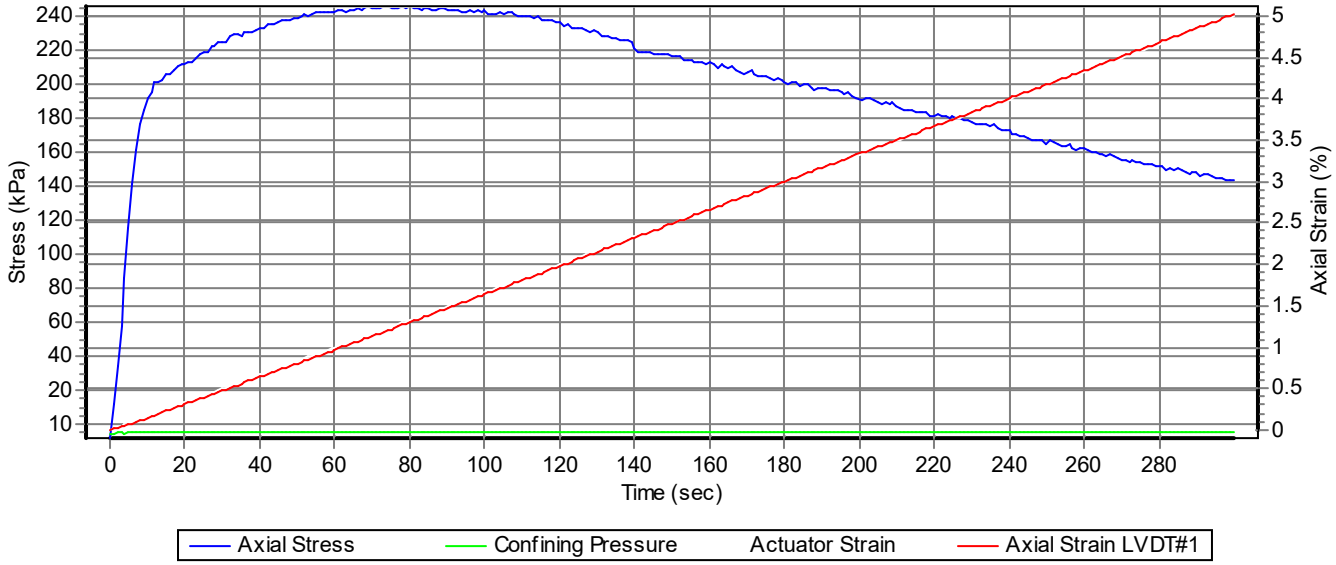
Strain (%)	Current	At Peak Load
Actuator:	4.99	1.14
Averaged Axial:	5.02	1.11

Deformation (mm)	Current	At Peak Load
Actuator:	14.980	3.406
Averaged Axial:	15.070	3.319
Axial LVDT #1:	15.070	3.319

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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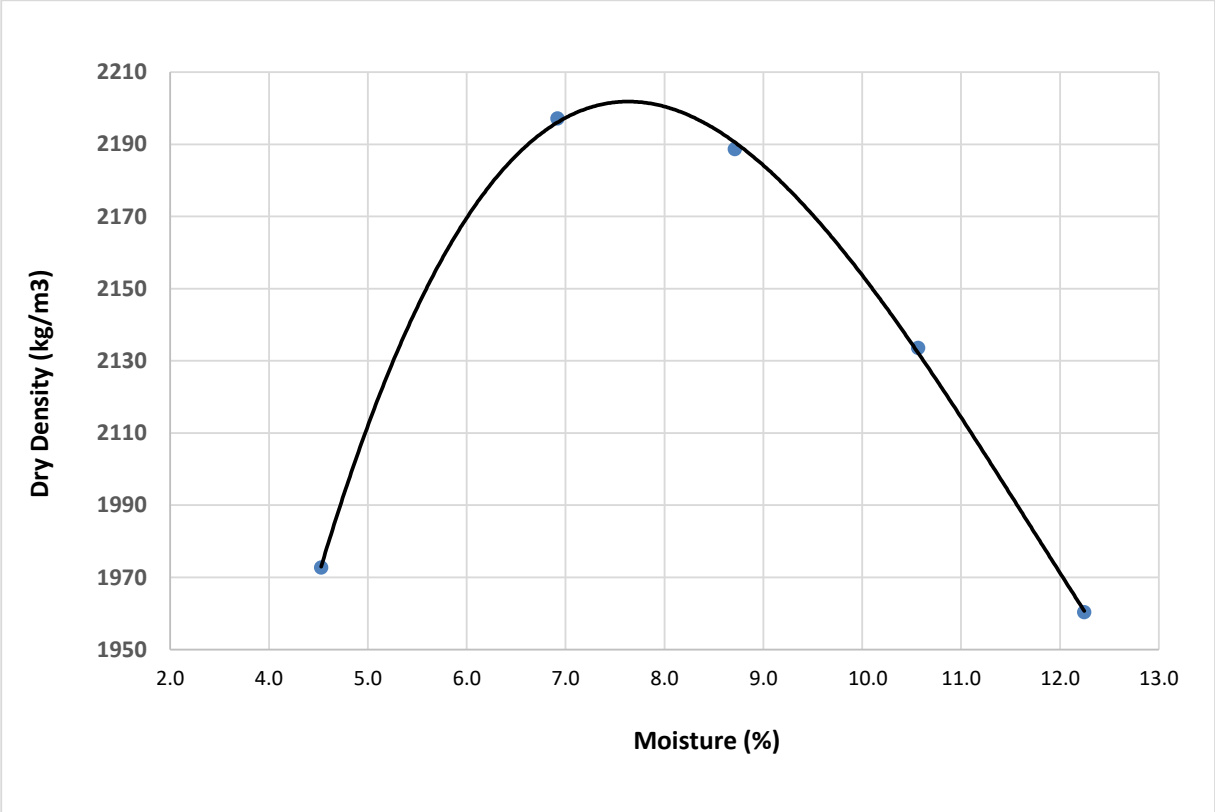
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**Granular B - Type II**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon	Date Tested:	September 3, 2024
Sampled Location:	Lafarge - Caledon	Specification:	LS-706
Lab No.	G09653		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1977	2196	2189	2134	1961
Moisture Content (%)	5.5	6.9	8.7	10.6	12.2



Maximum Dry Density	**2202 Kg/m3**
Optimum Moisture Content	**7.8 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Grain Size Analysis

Project No.	ET24-1327A	Material	Granular B-Type II - Sand and Gravel
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Caledon	Date Tested:	September 2, 2024
Sampled Location:	Lafarge - Caledon	Specification:	OPSS.MUNI 1010
Lab No.	G09647		

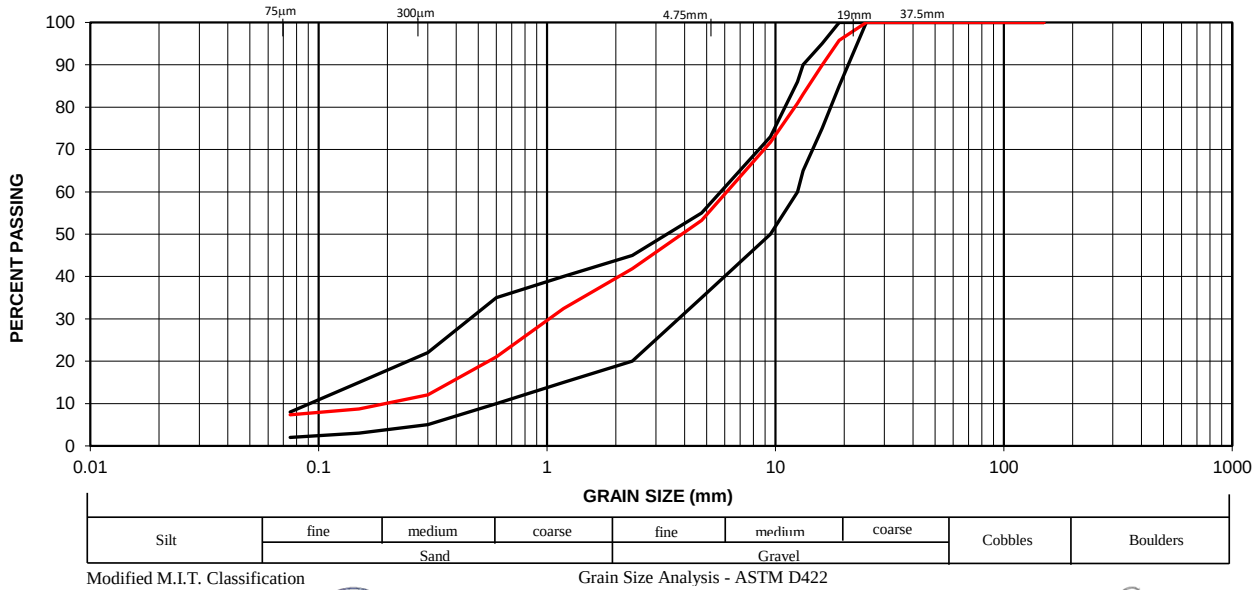
Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0			
75	100.0			
53	100.0			
37.5	100.0			
26.5	100.0	100	100	
25	100.0			
19	95.8	85	100	
16	89.9			
13.2	83.0	65	90	
12.5	80.9			
9.5	71.7	50	73	
4.75	53.2	35	55	
2.36	41.8			
1.18	32.4	15	40	
0.6	21.0			
0.3	12.0	5	22	
0.15	8.7			
0.075	7.3	2	8	

Note: * - Out of Specification

Physical Properties
Asphalt Coated Particles (%):
Crushed Particles (%):
Percent Deleterious (%):

Additional Comments

Equipment Used
#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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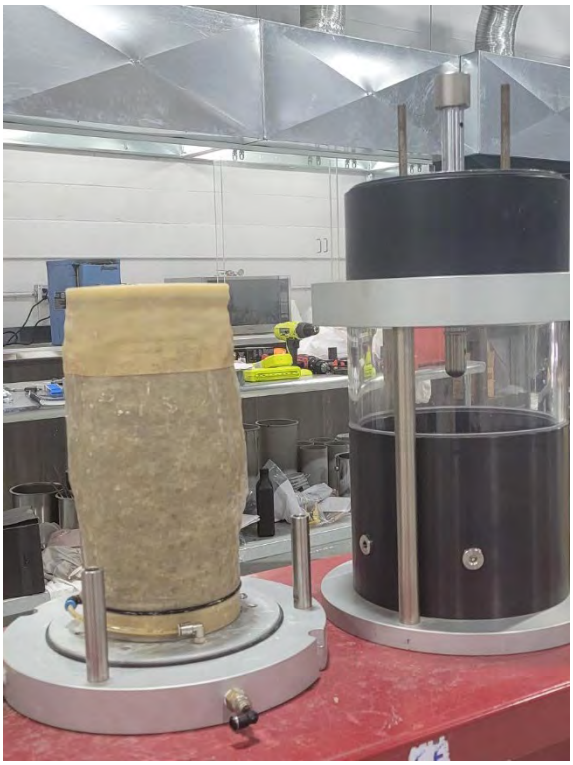
Before Testing



After Testing

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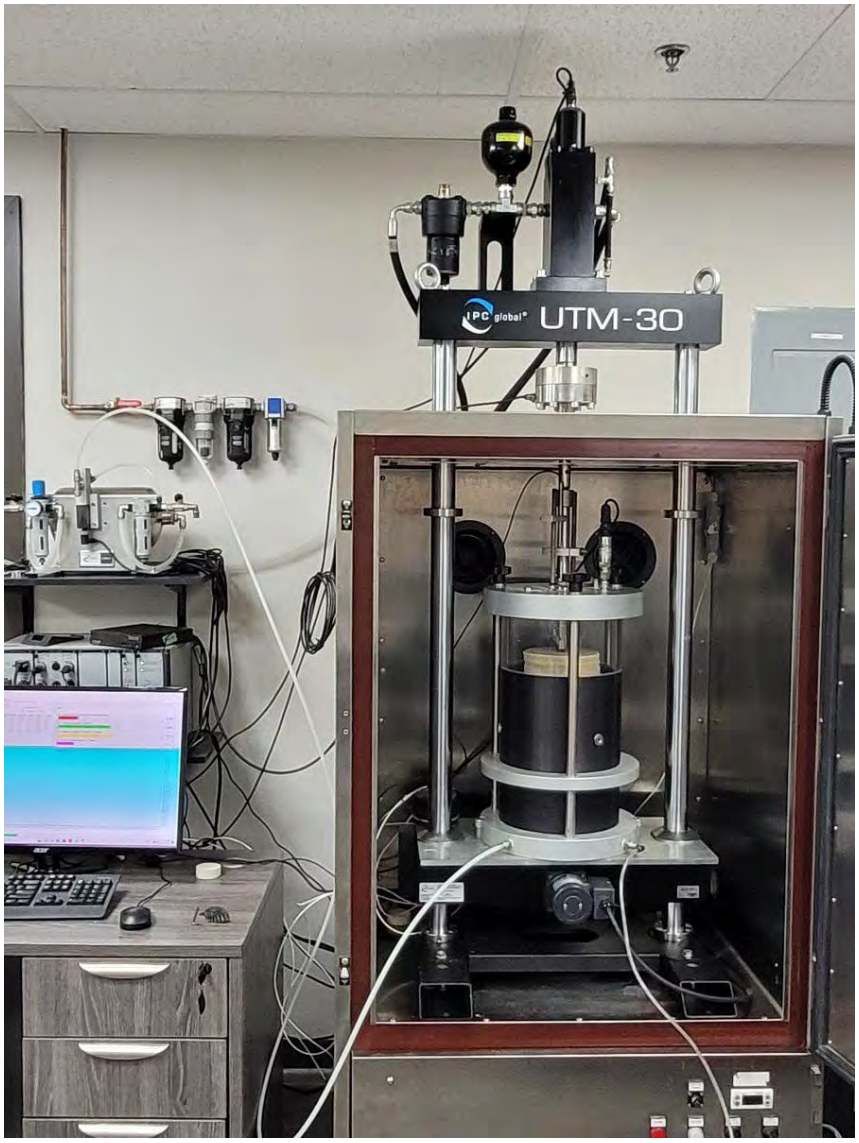

Specimen and Triaxial cell Setup

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Project No: ET24-1327A

September 29, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate AASHTO – T 307-17
50mm Crusher Run Limestone - Lafarge Dandas

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.1	58.2
2	20.7	40.0	84.3
3	20.7	56.4	113.3
4	34.5	30.9	85.8
5	34.5	63.2	129.3
6	34.5	93.0	160.1
7	68.9	61.9	179.1
8	68.9	123.9	215.5
9	68.9	185.4	242.1
10	103.4	62.0	222.4
11	103.4	92.9	245.5
12	103.4	185.9	288.3
13	137.9	93.0	305.6
14	137.9	124.1	331.8
15	137.9	248.0	389.4

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APPENDIX A

Resilient Modulus General Report

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Project Nubmer	ET24-1327A	Material Type	50mm Crusher Run Limestone
Sample Number	P02701	Supplier	Lafarge Dundas
Client	TARBA	Testing Date	September 26, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.402	0.392	0.012	20.7	20.1	0.7	0.116	0.039	57.4
	97		0.408	0.398	0.011				0.116	0.039	58.3
	98		0.406	0.396	0.011				0.114	0.038	58.3
	99		0.407	0.396	0.011				0.114	0.038	58.4
	100		0.408	0.398	0.011				0.116	0.039	58.5
	Average		**0.407**	**0.396**	**0.011**				**0.115**	**0.038**	**58.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.42**
2	96	20.7	0.800	0.747	0.053	41.9	40	2.0	0.150	0.050	83.9
	97		0.806	0.755	0.053				0.151	0.050	84.5
	98		0.821	0.767	0.054				0.152	0.050	85.3
	99		0.812	0.758	0.054				0.151	0.050	84.6
	100		0.792	0.738	0.054				0.150	0.050	83.4
	Average		**0.806**	**0.753**	**0.053**				**0.151**	**0.050**	**84.3**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.73**
3	96	20.7	1.212	1.087	0.124	62.4	56.4	6	0.162	0.054	113.7
	97		1.208	1.084	0.124				0.162	0.054	113.3
	98		1.216	1.092	0.123				0.163	0.055	113.3
	99		1.210	1.087	0.123				0.163	0.055	113.1
	100		1.215	1.091	0.124				0.163	0.055	113.3
	Average		**1.212**	**1.088**	**0.123**				**0.162**	**0.054**	**113.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.23**
4	96	34.5	0.67	0.63	0.04	34.4	30.9	3.5	0.124	0.041	85.7
	97		0.68	0.64	0.04				0.125	0.042	86.2
	98		0.66	0.62	0.04				0.123	0.041	85.4
	99		0.68	0.64	0.04				0.125	0.042	86.4
	100		0.66	0.62	0.04				0.123	0.041	85.3
	Average		**0.672**	**0.629**	**0.043**				**0.124**	**0.041**	**85.8**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.51**
5	96	34.5	1.342	1.205	0.137	70.1	63.2	6.9	0.158	0.053	129.2
	97		1.348	1.213	0.135				0.159	0.053	129.2
	98		1.350	1.210	0.135				0.159	0.053	129.0
	99		1.348	1.215	0.135				0.159	0.053	129.4
	100		1.347	1.213	0.134				0.159	0.053	129.6
	Average		**1.347**	**1.211**	**0.135**				**0.158**	**0.053**	**129.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**
6	96	34.5	2.019	1.818	0.202	103.3	93	10.3	0.193	0.064	159.5
	97		2.020	1.820	0.201				0.192	0.064	160.1
	98		2.019	1.819	0.201				0.192	0.064	160.2
	99		2.021	1.819	0.203				0.192	0.064	160.3
	100		2.021	1.820	0.201				0.192	0.064	160.5
	Average		**2.020**	**1.819**	**0.201**				**0.192**	**0.0641**	**160.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.40**
7	96	68.9	1.348	1.212	0.135	68.8	61.9	6.9	0.114	0.038	178.9
	97		1.346	1.212	0.135				0.114	0.038	178.5
	98		1.347	1.212	0.135				0.114	0.038	178.9
	99		1.347	1.213	0.134				0.114	0.038	179.8
	100		1.344	1.210	0.134				0.114	0.038	179.2
	Average		**1.347**	**1.211**	**0.135**				**0.114**	**0.038**	**179.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.47**

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Project Nubmer	ET24-1327A	Material Type	50mm Crusher Run Limestone
Sample Number	P02701	Supplier	Lafarge Dundas
Client	TARBA	Testing Date	September 26, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	69	2.694	2.426	0.269	137.8	123.9	13.9	0.190	0.063	215.5
	97		2.693	2.423	0.270				0.190	0.063	215.4
	98		2.699	2.431	0.269				0.190	0.063	216.3
	99		2.689	2.419	0.270				0.190	0.063	215.3
	100		2.697	2.428	0.270				0.191	0.064	215.3
	Average		**2.695**	**2.425**	**0.269**				**0.190**	**0.063**	**215.5**
	STDEV.		**0.004**	**0.004**	**0.001**				**0.000**	**0.000**	**0.443**
9	96	69	4.041	3.636	0.405	206.2	185.4	20.7	0.254	0.085	241.7
	97		4.044	3.639	0.405				0.254	0.085	242.6
	98		4.039	3.634	0.405				0.254	0.085	241.8
	99		4.043	3.637	0.406				0.254	0.085	242.0
	100		4.041	3.635	0.406				0.254	0.085	242.3
	Average		**4.042**	**3.636**	**0.406**				**0.254**	**0.085**	**242.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.35**
10	96	103.4	1.351	1.216	0.135	68.9	62.0	6.9	0.092	0.030	222.9
	97		1.345	1.210	0.135				0.091	0.030	222.8
	98		1.347	1.212	0.135				0.092	0.030	222.5
	99		1.345	1.210	0.135				0.092	0.030	221.4
	100		1.346	1.211	0.134				0.092	0.030	222.3
	Average		**1.347**	**1.211**	**0.135**				**0.092**	**0.030**	**222.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.58**
11	96	103.4	2.019	1.818	0.201	103.3	92.9	10.3	0.125	0.042	245.6
	97		2.025	1.824	0.202				0.126	0.042	245.6
	98		2.019	1.818	0.202				0.125	0.042	245.3
	99		2.025	1.824	0.203				0.126	0.042	245.5
	100		2.017	1.814	0.202				0.125	0.042	245.5
	Average		**2.021**	**1.819**	**0.202**				**0.125**	**0.042**	**245.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.13**
12	96	103.4	4.037	3.633	0.405	206.6	185.9	20.7	0.213	0.071	287.6
	97		4.043	3.638	0.405				0.213	0.071	288.5
	98		4.044	3.638	0.404				0.213	0.071	288.2
	99		4.038	3.635	0.404				0.213	0.071	288.4
	100		4.043	3.638	0.404				0.213	0.071	288.8
	Average		**4.041**	**3.637**	**0.405**				**0.213**	**0.071**	**288.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.44**
13	96	137.9	2.021	1.821	0.200	103.4	93	10.3	0.101	0.034	305.6
	97		2.021	1.820	0.202				0.101	0.034	305.1
	98		2.023	1.822	0.202				0.101	0.034	305.3
	99		2.022	1.821	0.202				0.101	0.034	305.6
	100		2.019	1.819	0.201				0.101	0.034	306.4
	Average		**2.021**	**1.820**	**0.201**				**0.101**	**0.034**	**305.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.48**
14	96	137.9	2.696	2.427	0.270	137.8	124.1	13.8	0.124	0.041	331.0
	97		2.694	2.423	0.270				0.124	0.041	331.6
	98		2.696	2.427	0.270				0.124	0.041	332.1
	99		2.696	2.426	0.271				0.123	0.041	332.7
	100		2.695	2.424	0.271				0.124	0.041	331.5
	Average		**2.696**	**2.425**	**0.270**				**0.124**	**0.041**	**331.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.68**

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Project Nubmer	ET24-1327A	Material Type	50mm Crusher Run Limestone
Sample Number	P02701	Supplier	Lafarge Dundas
Client	TARBA	Testing Date	September 26, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.388	4.848	0.540	275.5	248	27.6	0.211	0.070	388.6
	97		5.390	4.849	0.541				0.210	0.070	389.8
	98		5.388	4.847	0.541				0.210	0.070	389.8
	99		5.385	4.845	0.541				0.210	0.070	389.4
	100		5.390	4.849	0.541				0.211	0.070	389.2
	Average		**5.388**	**4.847**	**0.541**				**0.210**	**0.070**	**389.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.48**

APPENDIX B

Recompacted Specimen Information

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Engtec Consulting Inc.
2447 Anson Drive
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Tel: (905) 856-2988

Sample Number	P02701	Material Type	50mm Crusher Run Limestone
Testing Date	September 26, 2024	Supplier	Lafarge Dundas
TEST INFORMATION			
Preconditioning- Greater than 5 % Permanent Strain			NO
Testing- Greater Than 5% permanent Strain			NO
Testing- Number of Load Sequences Completed			YES
SPECIMEN INFO.			
Average Diameter, mm			155.3
Membrane Thickness, mm			0.63
Net Diameter, mm			154.0
Height of Specimen, Cap and Base, mm			382.4
Height of Cap and Base, mm			82.4
Initial Length L_0, mm			300
Initial Area, A_0, mm^2			18627
Initial Volume,V_0, cm^3			5588
SPECIMEN WEIGHT			
Initial Weight of Container and Soil, g.			19935
Final Weight of Container and Soil, g.			6483.7
Weight of Wet Soil Used, g.			13451.3
MATERIAL PROPERTIES			
In Situ Moisture Content (Nuclear), %			N/A
In Situ Weight Density (Nuclear), Kg/m^3			N/A
Optimum moisture Content, %			6.6
Max Dry Density, Kg/m^3			2254
SPECIMEN PROPERTIES			
Compaction Moisture Content, %			6.4
Moisture Content after Resilient Modulus Testing, %			4.9
Compaction Dry Density, Kg/m^3			2262
QUICK SHEAR TEST			
Stress-Strain Plot Attached			YES
Triaxial Shear Maximum Strength, KPa			330.7
Specimen Fail During Triaxial Shear			Bulge
GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Friday, September 27, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Lafarge Dundas-Granular B-2.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)=
Sample ID: 50mm Crusher Run Limestone - Lafarge Dundas

Specimen Information

Identification: P02701
Conditioning time:
Properties/Comments:
Max Dry Density = 2254 Kg/m3
OMC = 6.6 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	154.0	154.0	154.0	154.0	154.0	154.0	154.00	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 13.445
Cross-sectional area (mm²): 18626.5
Density (kg/m³): 2402
Volume (cc): 5588.0

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Thursday September 26 2024 at 12:34 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	388.6	389.7	389.7	389.4	389.2	389.4	0.480
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.009
Cyclic Axial Stress (kPa):	247.8	248.7	247.9	247.8	248.0	248.0	0.371
Maximum Axial Stress (kPa):	275.4	276.2	275.5	275.4	275.6	275.6	0.350
Contact Axial Stress (kPa):	27.6	27.6	27.5	27.6	27.6	27.6	0.038
Recoverable Axial Strain (%):	0.064	0.064	0.064	0.064	0.064	0.064	0.000
Permanent Axial Strain (%):	0.847	0.848	0.848	0.849	0.850	0.848	0.000
Cyclic Axial Load (kN):	4.848	4.849	4.847	4.845	4.849	4.847	0.000
Maximum Axial Load (kN):	5.388	5.390	5.388	5.385	5.390	5.388	0.000
Contact Axial Load (kN):	0.540	0.541	0.541	0.541	0.541	0.541	0.000
Recoverable Axial Deformation (mm):	0.191	0.190	0.190	0.190	0.190	0.190	0.000
Permanent Axial Deformation (mm):	2.127	2.128	2.127	2.127	2.128	2.128	0.001

Shear Test Data

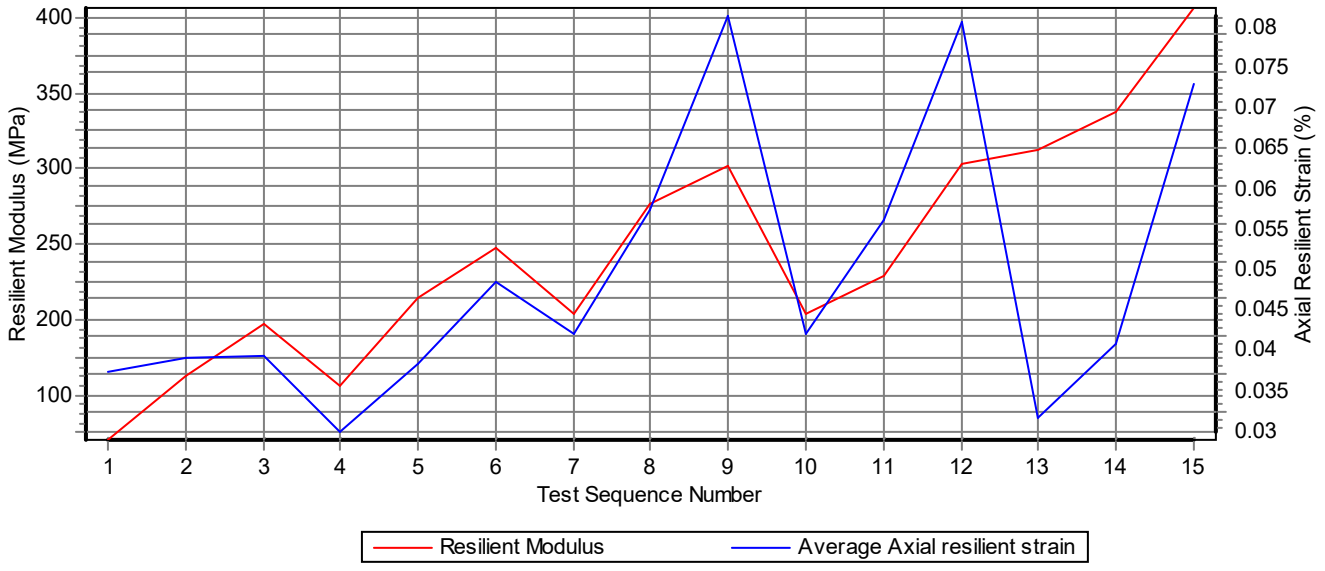
Start date & time: Thursday September 26 2024 at 1:11 PM
Timer (sec): 299.8

	Current	Peak
Axial Load (kN):	1.599	6.365
Peak Stress (kPa):	84.5	330.7
Confining pressure (kPa):	34.5	

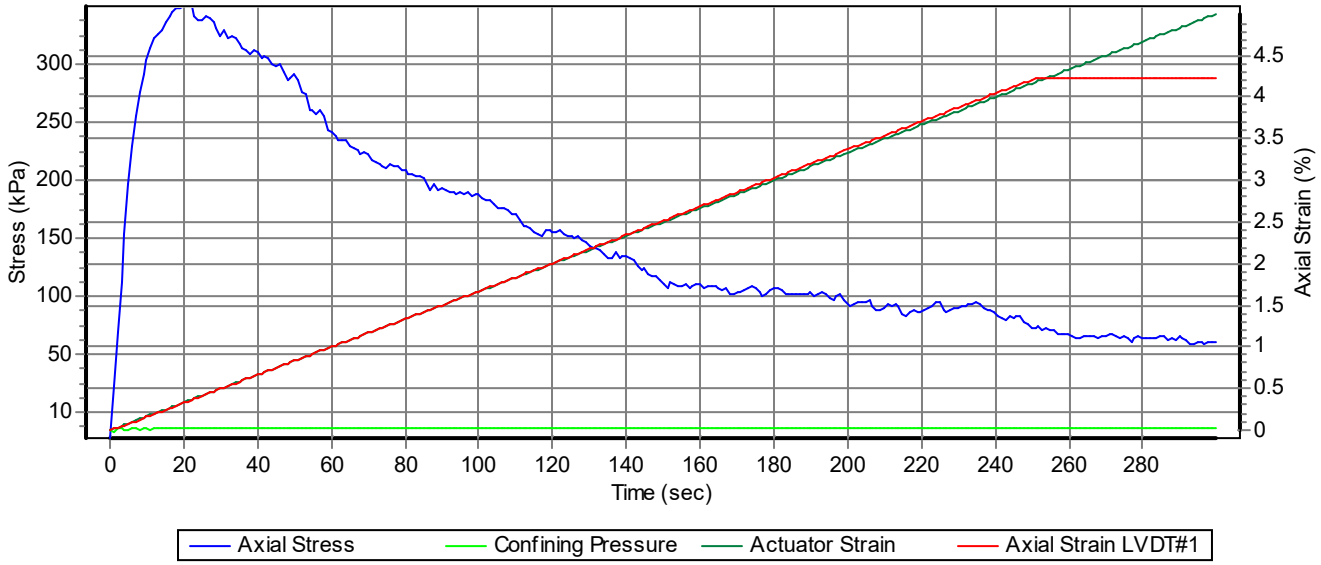
Strain (%)	Current	At Peak Load
Actuator:	4.99	0.37
Averaged Axial:	4.24	0.37

Deformation (mm)	Current	At Peak Load
Actuator:	14.980	1.117
Averaged Axial:	12.710	1.099
Axial LVDT #1:	12.710	1.099

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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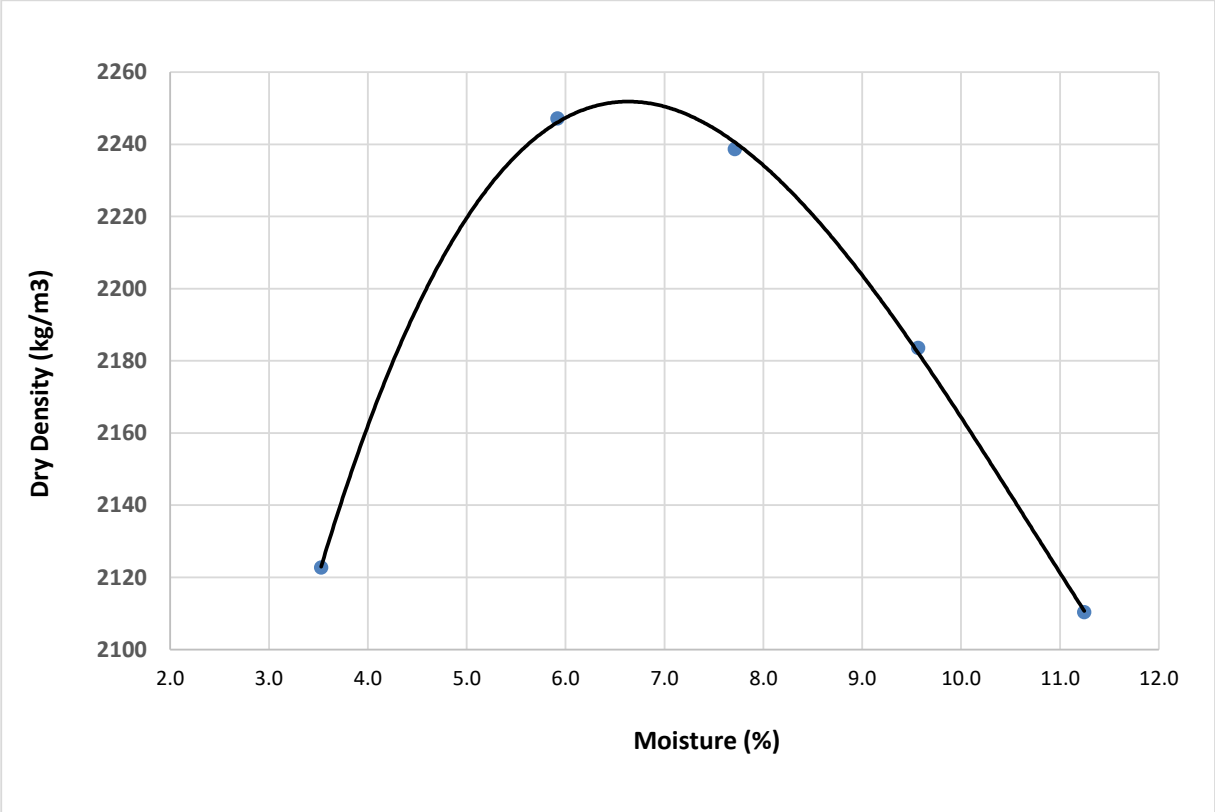
Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**50mm Crusher Run Limestone**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	September 3, 2024
Sampled Location:	Lafarge - Dundas	Specification:	LS-706
Lab No.	G09646		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	2123	2247	2239	2184	2110
Moisture Content (%)	3.5	5.9	7.7	9.6	11.2



Maximum Dry Density	**2254 Kg/m3**
Optimum Moisture Content	**6.6 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
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Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	50mm Crusher Run Limestone
Client:	N/A	Sampled By:	Client
Project Description:	N/A	Date Sampled:	August 16, 2024
Source	Lafarge - Dundas	Date Tested:	September 3, 2024
Sampled Location:	Lafarge - Dundas	Specification:	Granular B - Type II - OPSS 1010
Lab No.	G09645		

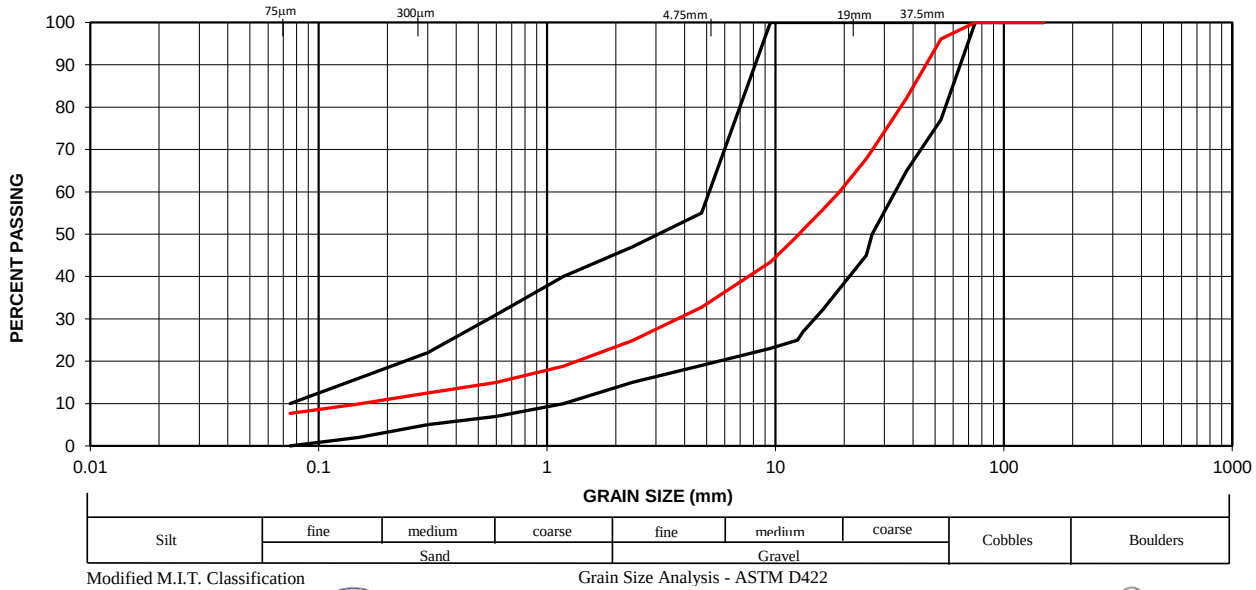
Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0			
106	100.0	100	100	
75	100.0			
53	96.1			
37.5	82.2			
26.5	69.8	50	100	
25	67.8			
19	59.9			
16	55.7			
13.2	51.0			
12.5	49.6			
9.5	43.4			
4.75	32.8	20	55	
2.36	24.9			
1.18	18.8	10	40	
0.6	15.0			
0.3	12.5	5	22	
0.15	9.9			
0.075	7.7	0	10	

Note: * - Out of Specification

Physical Properties
Asphalt Coated Particles (%):
Crushed Particles (%):
Percent Deleterious (%):

Additional Comments

Equipment Used
#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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Before Testing

After Testing

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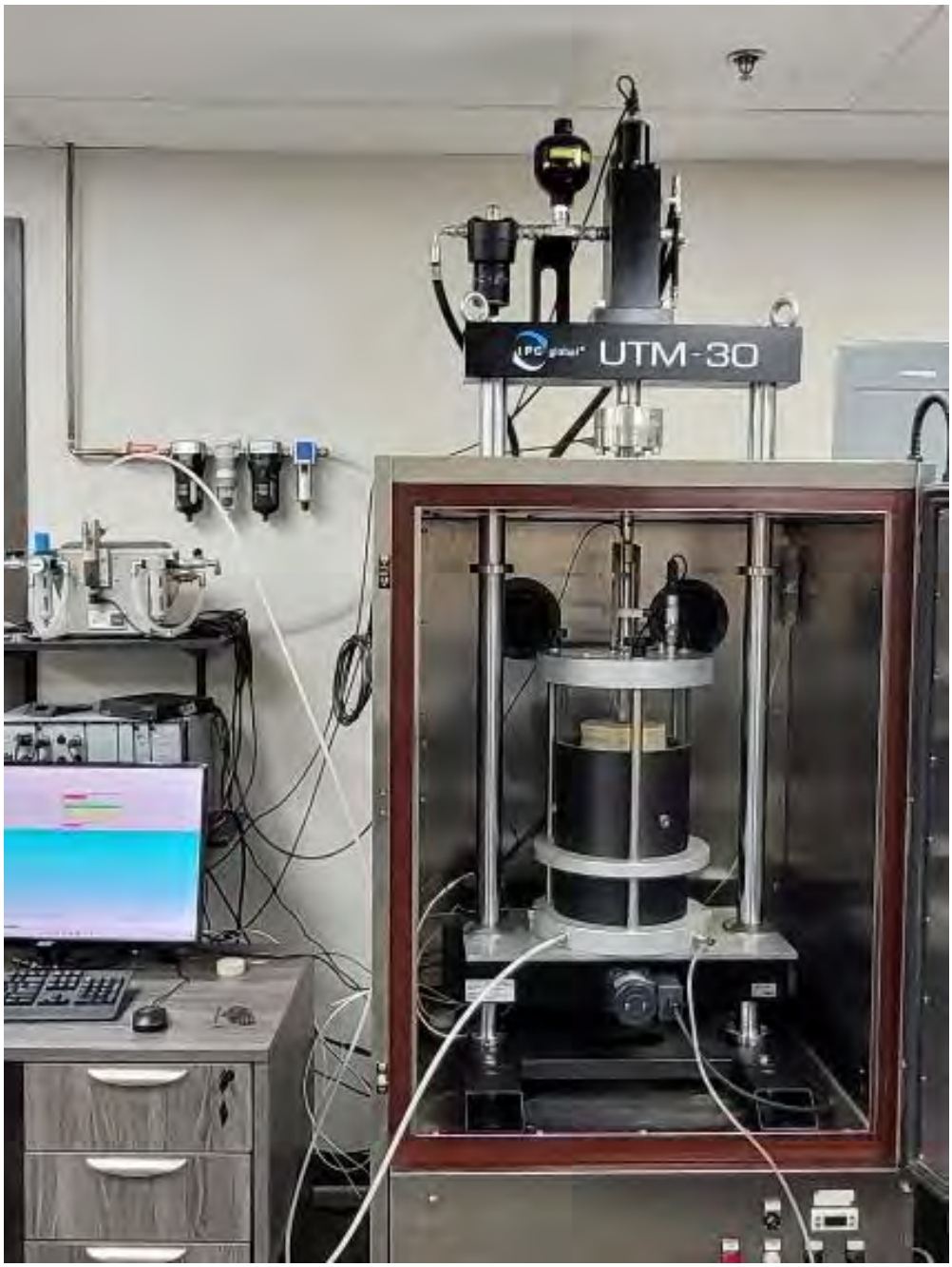

Specimen and Triaxial Cell Setup

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Engtec Consulting Inc.
12-100 Hanlan Road, Vaughan
Ontario, L4L 4V8
Tel: (905) 856-2988
Fax: (905) 856-2989

Project No: ET24-1327A

September 26, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
50mm Crushed Concrete – Source A

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.1	80.7
2	20.7	37.8	101.3
3	20.7	55.8	107.1
4	34.5	31.9	92.8
5	34.5	61.8	115.9
6	34.5	93.0	132.6
7	69.0	61.9	113.9
8	69.0	123.9	162.4
9	69.0	185.9	178.4
10	103.4	62.0	119.8
11	103.4	93.1	145.9
12	103.4	186.0	209.4
13	137.9	93.1	182.4
14	137.9	124.1	210.9
15	137.9	247.9	270.6

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APPENDIX A

Resilient Modulus General Report

2447 Anson Drive, Mississauga, ON, L5S 1G1
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Engtec Consulting Inc.
2447-Anson Drive
Mississauga,Ontario
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02699	Supplier	Source A
Client	TARBA	Testing Date	Friday, September 20, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.385	0.375	0.01	20.7	20.1	0.5	0.075	0.025	80.7
	97		0.386	0.376	0.01				0.075	0.025	81.0
	98		0.385	0.375	0.01				0.075	0.025	80.3
	99		0.386	0.375	0.01				0.075	0.025	80.6
	100		0.385	0.375	0.01				0.075	0.025	81.0
	Average		**0.385**	**0.375**	**0.010**				**0.075**	**0.025**	**80.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.29**
2	96	20.7	0.767	0.706	0.061	41.3	37.8	3.3	0.112	0.037	101.5
	97		0.769	0.707	0.062				0.113	0.038	101.2
	98		0.771	0.71	0.061				0.113	0.038	101.3
	99		0.777	0.715	0.062				0.113	0.038	101.8
	100		0.767	0.705	0.062				0.113	0.038	100.9
	Average		**0.770**	**0.709**	**0.062**				**0.113**	**0.038**	**101.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.34**
3	96	20.7	1.156	1.039	0.116	62.0	55.8	6.2	0.156	0.052	107.0
	97		1.155	1.040	0.115				0.157	0.052	107.0
	98		1.157	1.042	0.115				0.156	0.052	107.2
	99		1.154	1.038	0.116				0.156	0.052	107.3
	100		1.154	1.038	0.116				0.156	0.052	107.1
	Average		**1.155**	**1.039**	**0.116**				**0.156**	**0.052**	**107.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.13**
4	96	34.5	0.651	0.601	0.05	34.6	31.9	2.7	0.104	0.035	93.1
	97		0.623	0.574	0.049				0.101	0.034	91.7
	98		0.652	0.602	0.05				0.104	0.035	93.4
	99		0.643	0.593	0.049				0.103	0.034	92.8
	100		0.651	0.601	0.049				0.104	0.035	93.1
	Average		**0.644**	**0.594**	**0.049**				**0.103**	**0.035**	**92.8**
	STDEV.		**0.01**	**0.01**	**0.00**				**0.00**	**0.00**	**0.66**
5	96	34.5	1.281	1.152	0.129	68.8	61.9	6.9	0.160	0.053	115.8
	97		1.279	1.151	0.128				0.160	0.053	115.8
	98		1.283	1.154	0.129				0.160	0.053	116.0
	99		1.279	1.151	0.128				0.160	0.053	115.9
	100		1.282	1.155	0.127				0.160	0.053	116.2
	Average		**1.281**	**1.153**	**0.128**				**0.160**	**0.053**	**115.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.17**
6	96	34.5	1.922	1.73	0.192	103.3	93	10.3	0.210	0.070	132.6
	97		1.923	1.732	0.191				0.211	0.070	132.4
	98		1.929	1.737	0.192				0.211	0.070	132.6
	99		1.924	1.734	0.191				0.210	0.070	132.7
	100		1.921	1.729	0.192				0.210	0.070	132.6
	Average		**1.924**	**1.732**	**0.192**				**0.210**	**0.0700**	**132.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**
7	96	69	1.281	1.154	0.128	68.8	61.9	6.9	0.163	0.054	113.8
	97		1.285	1.156	0.129				0.163	0.054	113.9
	98		1.28	1.151	0.129				0.163	0.054	113.9
	99		1.282	1.154	0.127				0.163	0.054	114.0
	100		1.284	1.155	0.129				0.163	0.054	114.1
	Average		**1.282**	**1.154**	**0.128**				**0.163**	**0.054**	**113.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**

Engtec Consulting Inc.
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Mississauga,Ontario
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02699	Supplier	Source A
Client	TARBA	Testing Date	Friday, September 20, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	69	2.563	2.306	0.257	137.7	123.9	13.8	0.229	0.076	162.3
	97		2.563	2.305	0.258				0.229	0.076	162.1
	98		2.567	2.311	0.257				0.229	0.076	162.8
	99		2.564	2.307	0.257				0.229	0.076	162.3
	100		2.57	2.312	0.258				0.229	0.076	162.5
	Average		**2.565**	**2.308**	**0.257**				**0.229**	**0.076**	**162.4**
	STDEV.		**0.003**	**0.003**	**0.001**				**0.000**	**0.000**	**0.265**
9	96	69	3.849	3.462	0.387	206.7	185.9	20.7	0.313	0.104	178.0
	97		3.85	3.463	0.387				0.314	0.105	177.7
	98		3.851	3.464	0.386				0.313	0.104	178.2
	99		3.851	3.467	0.384				0.312	0.104	178.8
	100		3.846	3.460	0.386				0.311	0.104	179.1
	Average		**3.849**	**3.463**	**0.386**				**0.313**	**0.104**	**178.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.58**
10	96	103.4	1.283	1.156	0.127	68.9	62.0	6.9	0.155	0.052	119.8
	97		1.278	1.149	0.129				0.155	0.052	119.3
	98		1.285	1.157	0.128				0.155	0.052	119.9
	99		1.283	1.155	0.129				0.155	0.052	119.9
	100		1.284	1.154	0.129				0.155	0.052	120.2
	Average		**1.283**	**1.154**	**0.128**				**0.155**	**0.052**	**119.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.33**
11	96	103.4	1.927	1.735	0.192	103.4	93.1	10.3	0.192	0.064	145.7
	97		1.927	1.738	0.189				0.192	0.064	146.0
	98		1.927	1.734	0.193				0.191	0.064	145.8
	99		1.922	1.729	0.193				0.191	0.064	145.8
	100		1.93	1.737	0.193				0.191	0.064	146.1
	Average		**1.927**	**1.735**	**0.192**				**0.191**	**0.064**	**145.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.16**
12	96	103.4	3.849	3.464	0.385	206.6	186	20.6	0.267	0.089	208.8
	97		3.848	3.465	0.384				0.266	0.089	209.4
	98		3.844	3.46	0.384				0.266	0.089	209.1
	99		3.848	3.464	0.384				0.266	0.089	209.7
	100		3.850	3.465	0.385				0.266	0.089	209.8
	Average		**3.848**	**3.464**	**0.384**				**0.266**	**0.089**	**209.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.42**
13	96	137.9	1.925	1.732	0.193	103.3	93.1	10.3	0.154	0.051	181.7
	97		1.929	1.738	0.191				0.153	0.051	182.3
	98		1.922	1.73	0.192				0.153	0.051	182.5
	99		1.924	1.733	0.19				0.153	0.051	182.7
	100		1.924	1.733	0.192				0.153	0.051	182.9
	Average		**1.925**	**1.733**	**0.192**				**0.153**	**0.051**	**182.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.46**
14	96	137.9	2.569	2.316	0.253	137.8	124.1	13.8	0.177	0.059	210.8
	97		2.570	2.314	0.256				0.177	0.059	211.0
	98		2.563	2.305	0.258				0.176	0.059	210.5
	99		2.565	2.308	0.257				0.176	0.059	211.1
	100		2.568	2.311	0.258				0.176	0.059	210.9
	Average		**2.567**	**2.311**	**0.256**				**0.176**	**0.059**	**210.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.23**

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Mississauga,Ontario
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02699	Supplier	Source A
Client	TARBA	Testing Date	Friday, September 20, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.131	4.616	0.515	275.5	247.9	27.6	0.275	0.092	270.2
	97		5.135	4.621	0.514				0.275	0.092	270.5
	98		5.132	4.617	0.515				0.275	0.092	270.6
	99		5.133	4.618	0.514				0.275	0.092	270.9
	100		5.129	4.616	0.514				0.274	0.092	271.0
	Average		**5.132**	**4.618**	**0.514**				**0.275**	**0.092**	**270.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.32**

APPENDIX B

Recompacted Specimen Information

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Engtec Consulting Inc.
2447 Anson Drive
Mississauga, Ontario
L5S 1G1
Tel: (905) 856-2988

Sample Number	P02699	Material Type	50mm Crushed Concrete
Testing Date	September 20, 2024	Supplier	Source A
TEST INFORMATION			
Preconditioning- Greater than 5 % Permanent Strain			NO
Testing- Greater Than 5% permanent Strain			NO
Testing- Number of Load Sequences Completed			YES
SPECIMEN INFO.			
Average Diameter, mm			155.3
Membrane Thickness, mm			0.63
Net Diameter, mm			154.0
Height of Specimen, Cap and Base, mm			382.4
Height of Cap and Base, mm			82.4
Initial Length L_0, mm			300
Initial Area, A_0, mm^2			18627
Initial Volume,V_0, cm^3			5588
SPECIMEN WEIGHT			
Initial Weight of Container and Soil, g.			17699
Final Weight of Container and Soil, g.			5310
Weight of Wet Soil Used, g.			12389
MATERIAL PROPERTIES			
In Situ Moisture Content (Nuclear), %			N/A
In Situ Weight Density (Nuclear), Kg/m^3			N/A
Optimum moisture Content, %			9.7
Max Dry Density, Kg/m^3			2020
SPECIMEN PROPERTIES			
Compaction Moisture Content, %			9.6
Moisture Content after Resilient Modulus Testing, %			9.4
Compaction Dry Density, Kg/m^3			2023
QUICK SHEAR TEST			
Stress-Strain Plot Attached			YES
Triaxial Shear Maximum Strength, KPa			208.2
Specimen Fail During Triaxial Shear			Bulge
GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Thursday, September 26, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Dcrupi- Granular B.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)
Material: 50mm Crushed Concrete - Source A

Specimen Information

Identification: P02699
Conditioning time:
Properties/Comments:
Max Dry Density = 2020 Kg/m3
OMC = 9.7 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	154.0	154.0	154.0	154.0	154.0	154.0	154.00	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 12.389
Cross-sectional area (mm²): 18626.5
Density (kg/m³): 2216
Volume (cc): 5588.0

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Monday September 23 2024 at 12:59 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	270.2	270.5	270.6	270.9	271.0	270.6	0.320
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.008
Cyclic Axial Stress (kPa):	247.8	248.1	247.9	248.0	247.8	247.9	0.120
Maximum Axial Stress (kPa):	275.5	275.7	275.5	275.6	275.4	275.5	0.123
Contact Axial Stress (kPa):	27.6	27.6	27.7	27.6	27.6	27.6	0.039
Recoverable Axial Strain (%):	0.092	0.092	0.092	0.092	0.091	0.092	0.000
Permanent Axial Strain (%):	3.812	3.814	3.815	3.816	3.818	3.815	0.002
Cyclic Axial Load (kN):	4.616	4.621	4.617	4.618	4.616	4.618	0.002
Maximum Axial Load (kN):	5.131	5.135	5.132	5.133	5.129	5.132	0.002
Contact Axial Load (kN):	0.515	0.514	0.515	0.514	0.514	0.515	0.001
Recoverable Axial Deformation (mm):	0.275	0.275	0.275	0.275	0.274	0.275	0.000
Permanent Axial Deformation (mm):	11.436	11.441	11.445	11.449	11.454	11.445	0.007

Shear Test Data

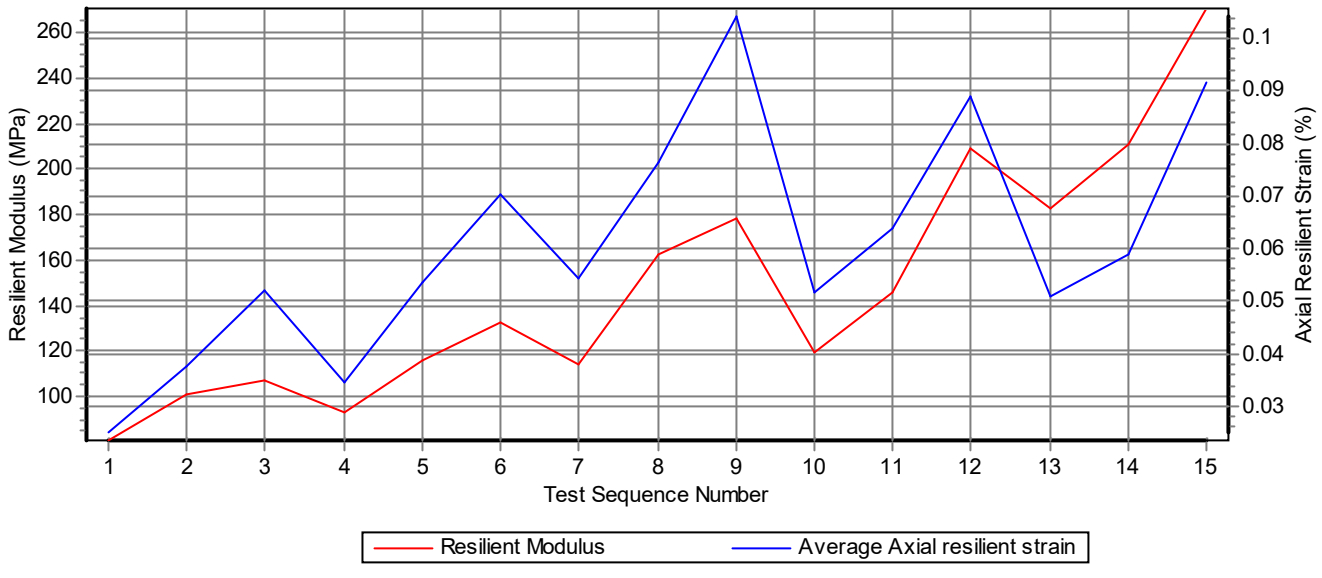
Start date & time: Monday September 23 2024 at 1:36 PM
Timer (sec): 299.8

	Current	Peak
Axial Load (kN):	2.411	3.877
Peak Stress (kPa):	129.4	208.2
Confining pressure (kPa):	34.5	

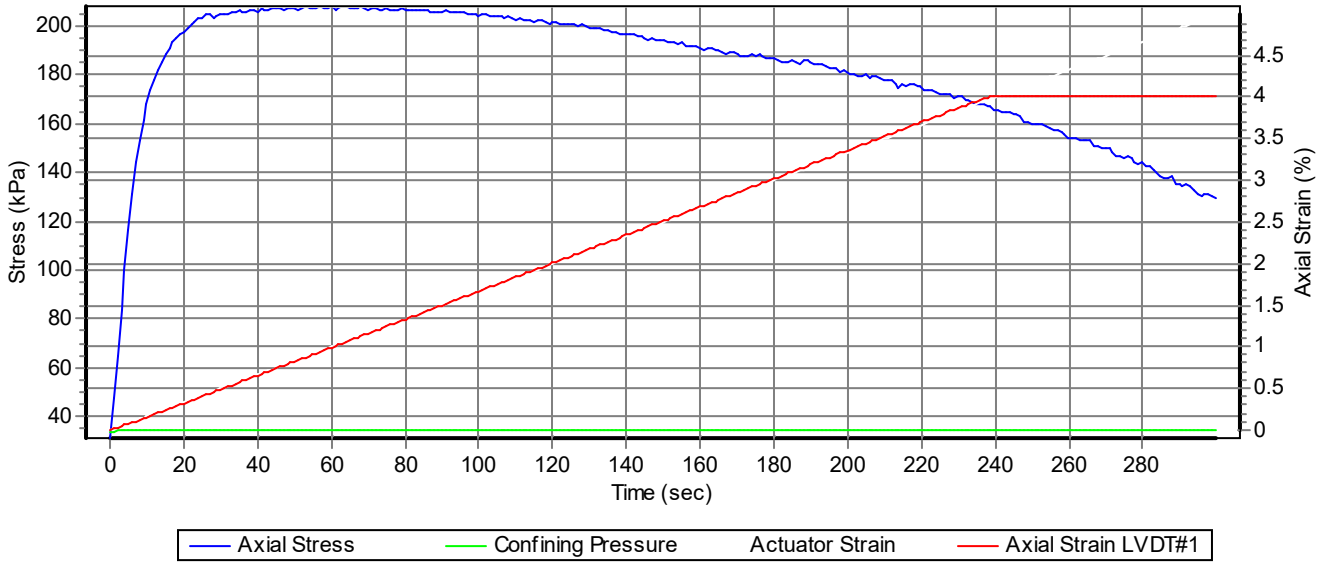
Strain (%)	Current	At Peak Load
Actuator:	4.99	0.94
Averaged Axial:	4.00	0.93

Deformation (mm)	Current	At Peak Load
Actuator:	14.982	2.826
Averaged Axial:	12.001	2.804
Axial LVDT #1:	12.001	2.804

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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Engtec Consulting Inc.
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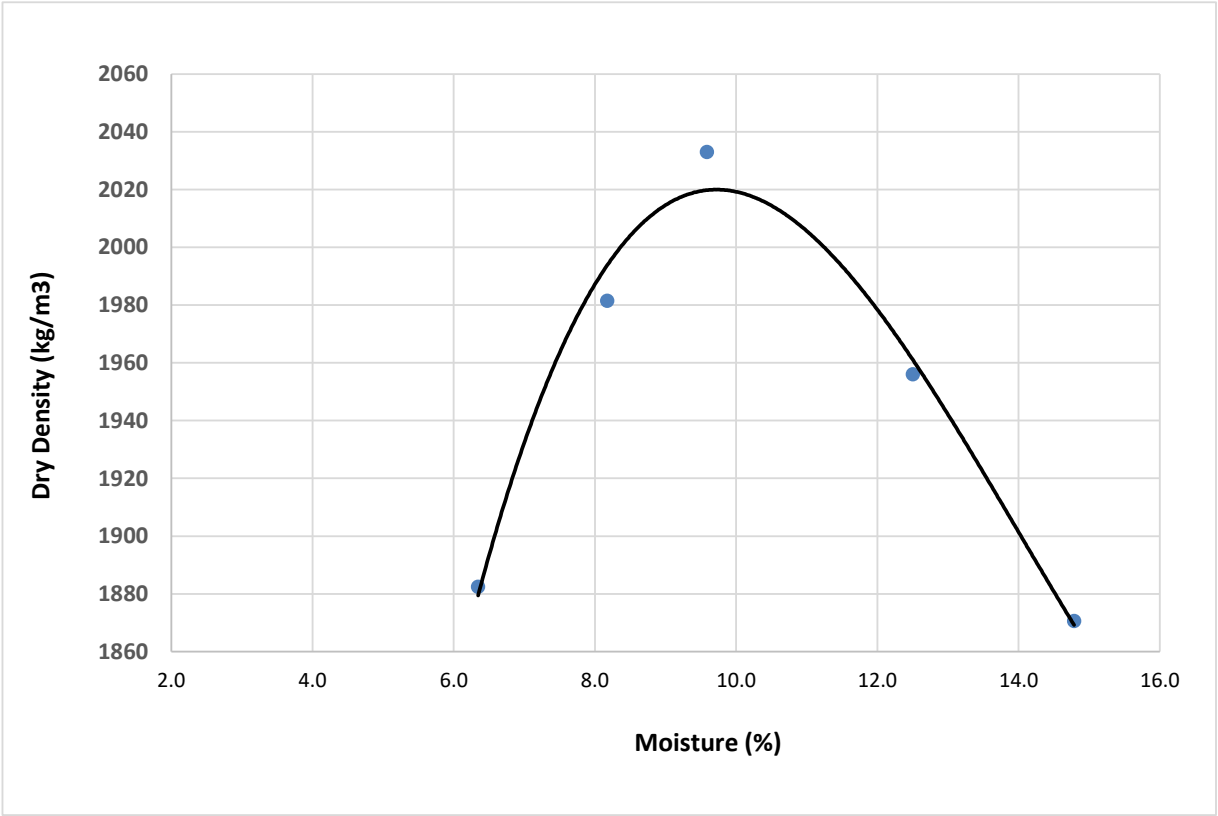
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source A	Date Tested:	August 26, 2024
Sampled Location:	Source A	Specification:	LS-706
Lab No.	G09651		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1882	1981	2033	1956	1871
Moisture Content (%)	6.3	8.2	9.6	12.5	14.8



Maximum Dry Density	**2020 Kg/m3**
Optimum Moisture Content	**9.7 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Grain Size Analysis

Project No.	ET24-1327	Material	Granular B Recycled
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source A	Date Tested:	August 26, 2024
Sampled Location:	Source A	Specification:	Granular B - Type I - OPSS 1010
Lab No.	G09651		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0	100	100	
106	100.0			
75	100.0			
53	97.9			
37.5	84.2			
26.5	75.5	50	100	
25	74.5			
19	70.2			
16	67.6			
13.2	64.5			
12.5	63.2			
9.5	57.3			
4.75	46.0	20	100	
2.36	39.7			
1.18	35.2	10	100	
0.6	30.4			
0.3	24.8	2	65	
0.15	19.0			
0.075	13.8	0	8	*

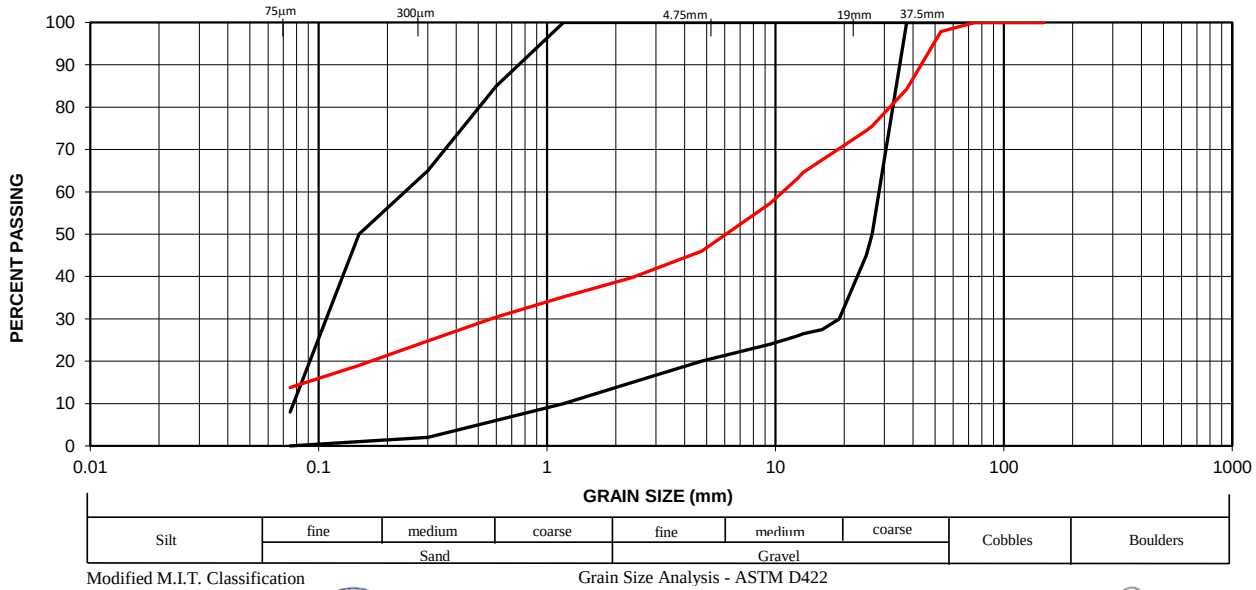
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	10.4
Crushed Particles (%):	99.1
Percent Deleterious (%):	0.86

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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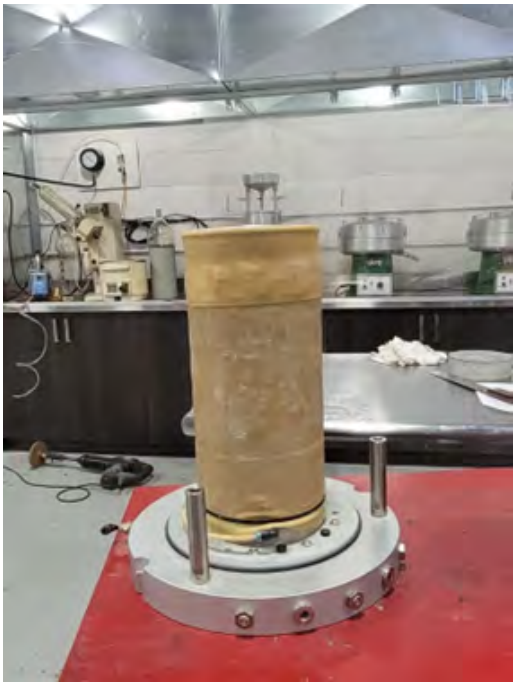

Before Testing

After Testing

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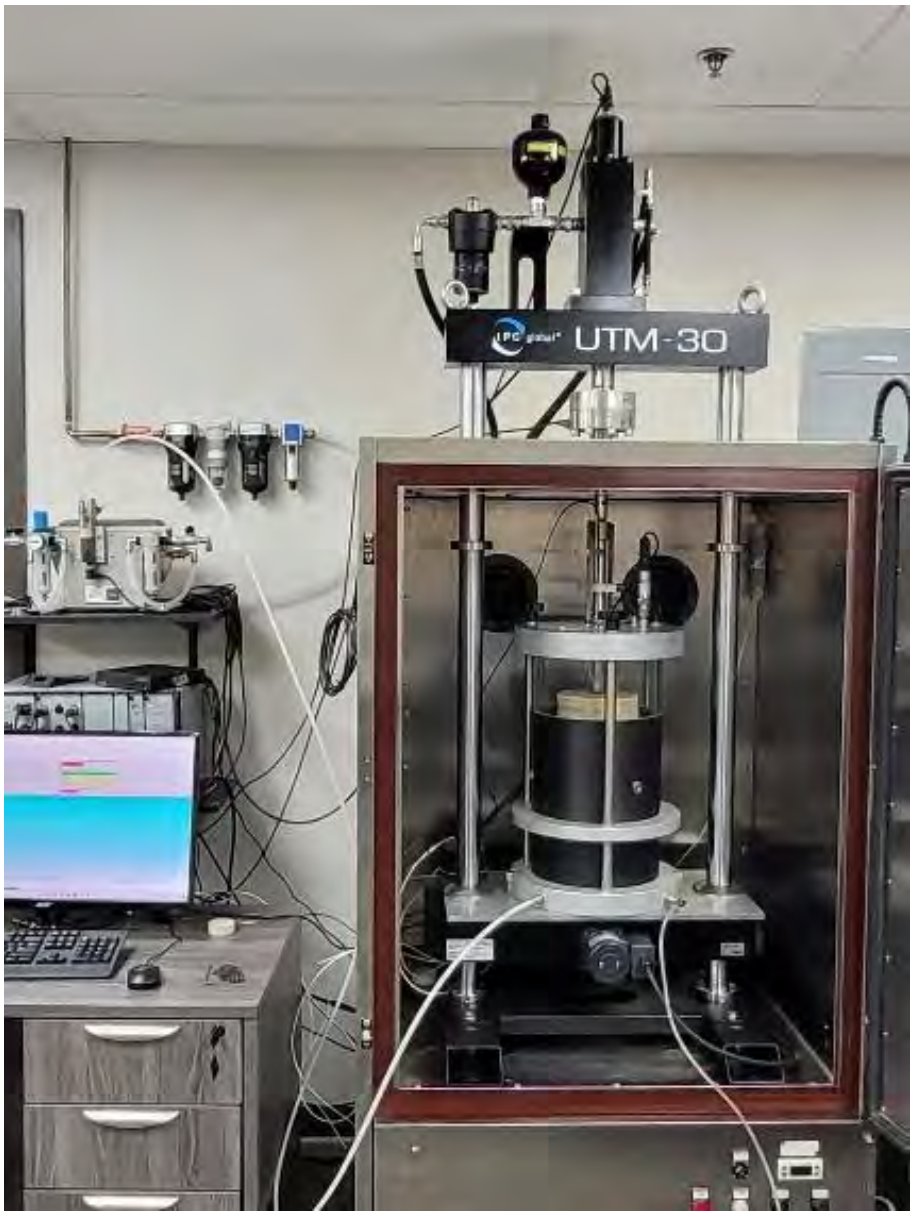

Specimen and Triaxial cell Setup

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Tel: (905) 856-2988
Fax: (905) 856-2989

Project No: ET24-1327A

September 26, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
50mm Crushed Concrete - Source B

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.2	135.4
2	20.7	38.3	123.7
3	20.7	55.9	104.3
4	34.5	32.4	119.9
5	34.5	62.0	115.1
6	34.5	93.0	135.3
7	68.9	62.0	157.6
8	68.9	124.0	196.2
9	68.9	185.8	221.9
10	103.4	61.9	209.8
11	103.4	93.1	232.6
12	103.4	185.9	279.2
13	137.9	93.1	292.6
14	137.9	124.0	314.7
15	137.9	248.0	355.9

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APPENDIX A

Resilient Modulus General Report

2447 Anson Drive, Mississauga, ON, L5S 1G1
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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02703	Supplier	Source B
Client	TARBA	Testing Date	Sunday, September 25, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.388	0.376	0.012	20.8	20.2	0.6	0.045	0.015	136.5
	97		0.384	0.373	0.011				0.045	0.015	135.2
	98		0.386	0.374	0.012				0.045	0.015	135.0
	99		0.385	0.374	0.012				0.045	0.015	135.5
	100		0.384	0.373	0.012				0.045	0.015	134.6
	Average		**0.385**	**0.374**	**0.012**				**0.045**	**0.015**	**135.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.72**
2	96	20.7	0.762	0.708	0.054	41.3	38.3	2.9	0.093	0.031	123.1
	97		0.759	0.705	0.054				0.092	0.031	123.9
	98		0.763	0.709	0.054				0.093	0.031	123.9
	99		0.768	0.714	0.054				0.093	0.031	124.2
	100		0.765	0.711	0.054				0.093	0.031	123.6
	Average		**0.763**	**0.709**	**0.054**				**0.093**	**0.031**	**123.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.42**
3	96	20.7	1.150	1.034	0.115	62.1	55.9	6.2	0.160	0.053	104.5
	97		1.148	1.034	0.115				0.160	0.053	104.5
	98		1.150	1.035	0.115				0.161	0.054	104.3
	99		1.148	1.033	0.115				0.161	0.054	104.2
	100		1.150	1.034	0.116				0.161	0.054	104.0
	Average		**1.149**	**1.034**	**0.115**				**0.161**	**0.054**	**104.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**
4	96	34.5	0.639	0.599	0.04	34.5	32.4	2.1	0.081	0.027	119.7
	97		0.638	0.599	0.04				0.081	0.027	119.7
	98		0.638	0.598	0.04				0.081	0.027	120.0
	99		0.637	0.597	0.039				0.081	0.027	119.6
	100		0.639	0.6	0.04				0.081	0.027	120.3
	Average		**0.638**	**0.599**	**0.040**				**0.081**	**0.027**	**119.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.29**
5	96	34.5	1.274	1.146	0.128	68.9	62.0	6.9	0.162	0.054	114.8
	97		1.277	1.15	0.128				0.161	0.054	115.4
	98		1.271	1.144	0.127				0.161	0.054	114.9
	99		1.275	1.149	0.126				0.161	0.054	115.4
	100		1.275	1.149	0.126				0.162	0.054	115.1
	Average		**1.274**	**1.148**	**0.127**				**0.161**	**0.054**	**115.1**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.28**
6	96	34.5	1.914	1.724	0.19	103.3	93	10.3	0.207	0.069	135.0
	97		1.911	1.721	0.191				0.207	0.069	134.9
	98		1.913	1.723	0.19				0.206	0.069	135.3
	99		1.912	1.721	0.19				0.205	0.069	135.8
	100		1.911	1.72	0.191				0.205	0.069	135.7
	Average		**1.912**	**1.722**	**0.190**				**0.206**	**0.0690**	**135.3**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.40**
7	96	68.9	1.274	1.146	0.128	68.9	62.0	6.9	0.118	0.039	157.5
	97		1.278	1.15	0.128				0.118	0.039	157.5
	98		1.271	1.144	0.127				0.118	0.039	157.7
	99		1.275	1.148	0.127				0.118	0.039	157.7
	100		1.274	1.147	0.128				0.118	0.039	157.7
	Average		**1.274**	**1.147**	**0.128**				**0.118**	**0.039**	**157.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**

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Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02703	Supplier	Source B
Client	TARBA	Testing Date	Sunday, September 22, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.553	2.297	0.257	137.7	124	13.8	0.190	0.063	196.1
	97		2.546	2.29	0.258				0.190	0.063	195.9
	98		2.553	2.304	2.297				0.190	0.063	196.1
	99		2.547	2.311	2.292				0.189	0.063	196.3
	100		2.547	2.309	2.292				0.189	0.063	196.5
	Average		**2.549**	**2.302**	**1.479**				**0.190**	**0.063**	**196.2**
	STDEV.		**0.003**	**0.009**	**1.115**				**0.001**	**0.000**	**0.228**
9	96	68.9	3.822	3.439	0.383	206.5	185.8	20.7	0.251	0.084	221.8
	97		3.821	3.437	0.384				0.251	0.084	221.6
	98		3.822	3.439	0.383				0.251	0.084	221.8
	99		3.822	3.438	0.384				0.251	0.084	221.9
	100		3.822	3.440	0.382				0.251	0.084	222.2
	Average		**3.822**	**3.439**	**0.383**				**0.251**	**0.084**	**221.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.22**
10	96	103.4	1.274	1.146	0.128	68.8	61.9	6.9	0.089	0.030	209.8
	97		1.274	1.148	0.126				0.089	0.030	209.8
	98		1.275	1.147	0.127				0.089	0.030	209.4
	99		1.274	1.145	0.128				0.088	0.029	210.2
	100		1.273	1.145	0.128				0.089	0.030	209.8
	Average		**1.274**	**1.146**	**0.127**				**0.089**	**0.030**	**209.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.28**
11	96	103.4	1.911	1.721	0.19	103.3	93.1	10.3	0.120	0.040	232.5
	97		1.914	1.724	0.19				0.120	0.040	232.2
	98		1.914	1.725	0.189				0.120	0.040	232.5
	99		1.911	1.721	0.19				0.120	0.040	232.6
	100		1.913	1.723	0.19				0.120	0.040	233.2
	Average		**1.913**	**1.723**	**0.190**				**0.120**	**0.040**	**232.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.37**
12	96	103.4	3.824	3.441	0.383	206.6	185.9	20.7	0.200	0.067	279.2
	97		3.821	3.438	0.383				0.200	0.067	279.0
	98		3.825	3.442	0.383				0.200	0.067	279.1
	99		3.824	3.441	0.383				0.200	0.067	279.2
	100		3.821	3.438	0.383				0.200	0.067	279.3
	Average		**3.823**	**3.440**	**0.383**				**0.200**	**0.067**	**279.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**
13	96	137.9	1.913	1.722	0.191	103.4	93.1	10.3	0.096	0.032	292.3
	97		1.914	1.724	0.19				0.096	0.032	292.3
	98		1.915	1.724	0.191				0.096	0.032	292.3
	99		1.91	1.719	0.19				0.095	0.032	292.9
	100		1.912	1.722	0.19				0.095	0.032	293.1
	Average		**1.913**	**1.722**	**0.190**				**0.096**	**0.032**	**292.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.39**
14	96	137.9	2.549	2.294	0.255	137.8	124	13.8	0.118	0.039	314.4
	97		2.553	2.298	0.256				0.118	0.039	315.1
	98		2.549	2.294	0.255				0.118	0.039	314.1
	99		2.550	2.296	0.254				0.118	0.039	315.3
	100		2.551	2.295	0.256				0.118	0.039	314.8
	Average		**2.550**	**2.295**	**0.255**				**0.118**	**0.039**	**314.7**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.49**

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Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02703	Supplier	Source B
Client	TARBA	Testing Date	Sunday, September 22, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.098	4.587	0.511	275.6	248	27.6	0.209	0.070	356.1
	97		5.102	4.591	0.511				0.209	0.070	356.0
	98		5.100	4.589	0.511				0.209	0.070	355.7
	99		5.098	4.588	0.510				0.209	0.070	355.8
	100		5.100	4.589	0.511				0.209	0.070	355.8
	Average		**5.100**	**4.589**	**0.511**				**0.209**	**0.070**	**355.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.16**

APPENDIX B

Recompacted Specimen Information

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Engtec Consulting Inc.
2447 Anson Drive
Mississauga, Ontario
L5S 1G1
Tel: (905) 856-2988

Sample Number	P02703	Material Type	Granular B - Type 1
Testing Date	September 25, 2024	Supplier	Pave AL
TEST INFORMATION			
Preconditioning- Greater than 5 % Permanent Strain			NO
Testing- Greater Than 5% permanent Strain			NO
Testing- Number of Load Sequences Completed			YES
SPECIMEN INFO.			
Average Diameter, mm			155.3
Membrane Thickness, mm			0.63
Net Diameter, mm			154.0
Height of Specimen, Cap and Base, mm			382.4
Height of Cap and Base, mm			82.4
Initial Length L_0, mm			300
Initial Area, A_0, mm^2			18627
Initial Volume,V_0, cm^3			5588
SPECIMEN WEIGHT			
Initial Weight of Container and Soil, g.			18366.8
Final Weight of Container and Soil, g.			5753.8
Weight of Wet Soil Used, g.			12613
MATERIAL PROPERTIES			
In Situ Moisture Content (Nuclear), %			N/A
In Situ Weight Density (Nuclear), Kg/m^3			N/A
Optimum moisture Content, %			10.6
Max Dry Density, Kg/m^3			2055
SPECIMEN PROPERTIES			
Compaction Moisture Content, %			9.9
Moisture Content after Resilient Modulus Testing, %			7.5
Compaction Dry Density, Kg/m^3			2054
QUICK SHEAR TEST			
Stress-Strain Plot Attached			YES
Triaxial Shear Maximum Strength, KPa			183.2
Specimen Fail During Triaxial Shear			Bulge
GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Thursday, September 26, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Pave AL- Granular B.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)
Material: Crushed Concrete - Pave-Al - Granular B

Specimen Information

Identification: P026703
Conditioning time:
Properties/Comments:
Max Dry Density = 2055 Kg/m3
OMC = 10.6 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	153.5	153.5	153.5	153.5	153.5	153.5	153.50	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 12.620 Cross-sectional area (mm²): 18505.7
Density (kg/m³): 2273 Volume (cc): 5551.7

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Wednesday September 25 2024 at 11:25 AM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	356.1	356.0	355.7	355.8	355.8	355.9	0.153
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.006
Cyclic Axial Stress (kPa):	247.9	248.1	248.0	247.9	248.0	248.0	0.075
Maximum Axial Stress (kPa):	275.5	275.7	275.6	275.5	275.6	275.6	0.099
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.6	27.6	27.6	0.028
Recoverable Axial Strain (%):	0.070	0.070	0.070	0.070	0.070	0.070	0.000
Permanent Axial Strain (%):	1.541	1.541	1.542	1.542	1.543	1.542	0.001
Cyclic Axial Load (kN):	4.587	4.591	4.589	4.588	4.589	4.589	0.001
Maximum Axial Load (kN):	5.098	5.102	5.100	5.098	5.100	5.100	0.002
Contact Axial Load (kN):	0.511	0.511	0.511	0.510	0.511	0.511	0.001
Recoverable Axial Deformation (mm):	0.209	0.209	0.209	0.209	0.209	0.209	0.000
Permanent Axial Deformation (mm):	4.622	4.624	4.625	4.627	4.628	4.625	0.002

Shear Test Data

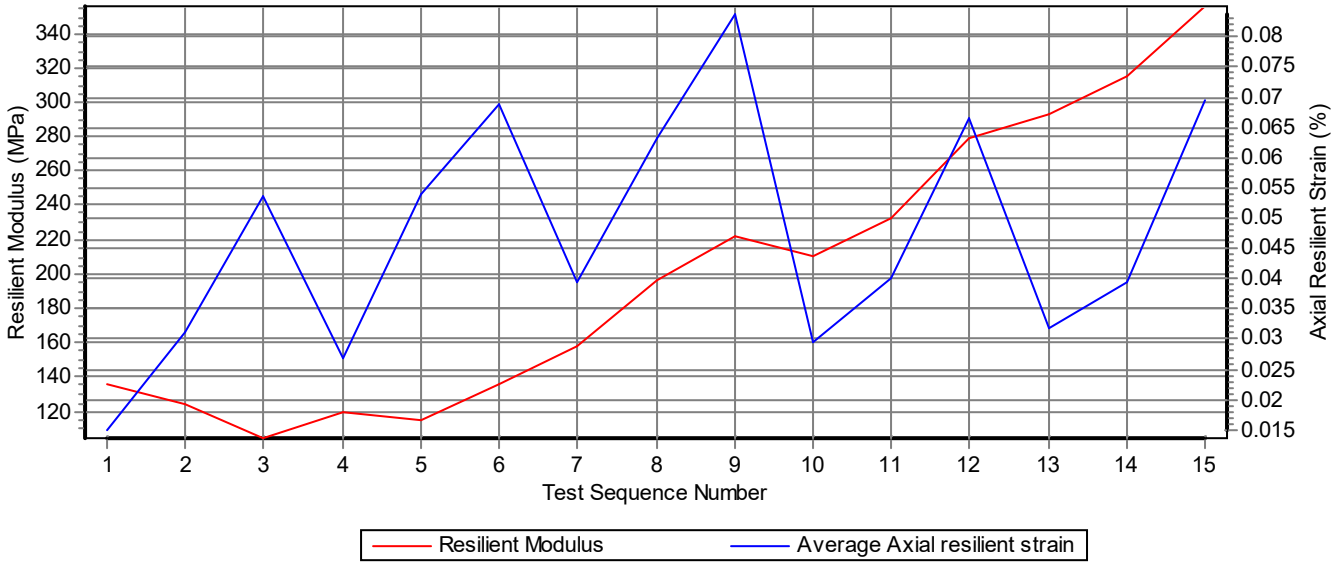
Start date & time: Wednesday September 25 2024 at 12:02 PM
Timer (sec): 299.8

	Current	Peak
Axial Load (kN):	1.231	3.390
Peak Stress (kPa):	66.5	183.2
Confining pressure (kPa):	34.5	

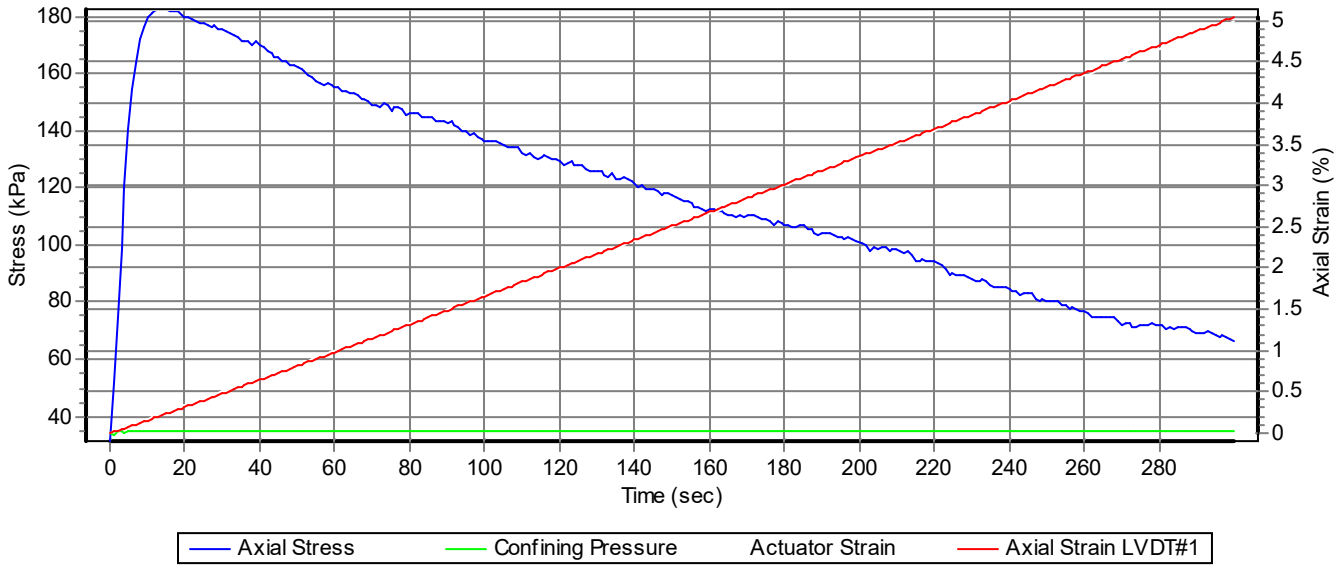
Strain (%)	Current	At Peak Load
Actuator:	4.99	0.25
Averaged Axial:	5.04	0.23

Deformation (mm)	Current	At Peak Load
Actuator:	14.981	0.736
Averaged Axial:	15.116	0.685
Axial LVDT #1:	15.116	0.685

Unbound Material Resilient Modulus and Shear Test



Unbound Material Resilient Modulus and Shear Test



APPENDIX D

Standard Proctor and Gradation Results

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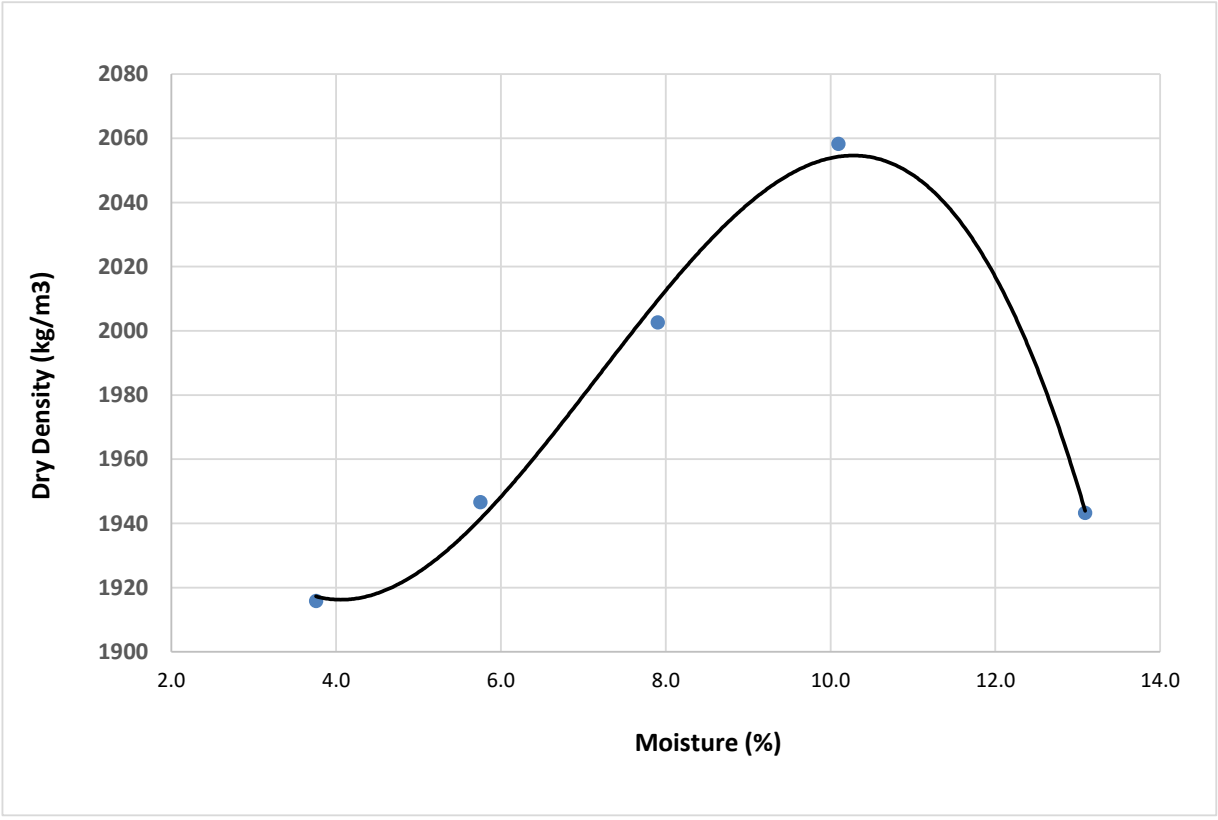
Engtec Consulting Inc.
1-2447 Anson Drive ,Mississauga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Standard Proctor

Project No.	ET24 -1327A	Material	**50mm Crushed Concrete**
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source B	Date Tested:	August 26, 2024
Sampled Location:	Source B	Specification:	LS-706
Lab No.	G09649		

Point No.	1	2	3	4	5
Dry Density (kg/m^3)	1916	1947	2003	2058	1943
Moisture Content (%)	3.8	5.7	7.9	10.1	13.1



Maximum Dry Density	**2055 Kg/m3**
Optimum Moisture Content	**10.6 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

Engtec Consulting Inc.
1-2447 Anson Drive, Mississuaga
Ontario, L5S 1G1
Telephone: (905) 856-2988
Fax: (905) 856-2989

Grain Size Analysis

Project No.	ET24-1327A	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 16, 2024
Source	Source B	Date Tested:	August 26, 2024
Sampled Location:	Source B	Specification:	Granular B - Type II - OPSS 1010
Lab No.	G09649		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0	100	100	
106	100.0			
75	100.0			
53	98.2			
37.5	95.7			
26.5	90.9	50	100	
25	89.2			
19	82.2			
16	76.1			
13.2	70.4			
12.5	68.0			
9.5	58.0			
4.75	41.8	20	100	
2.36	33.2			
1.18	26.0	10	100	
0.6	19.4			
0.3	13.5	2	65	
0.15	9.5			
0.075	6.4	0	8	

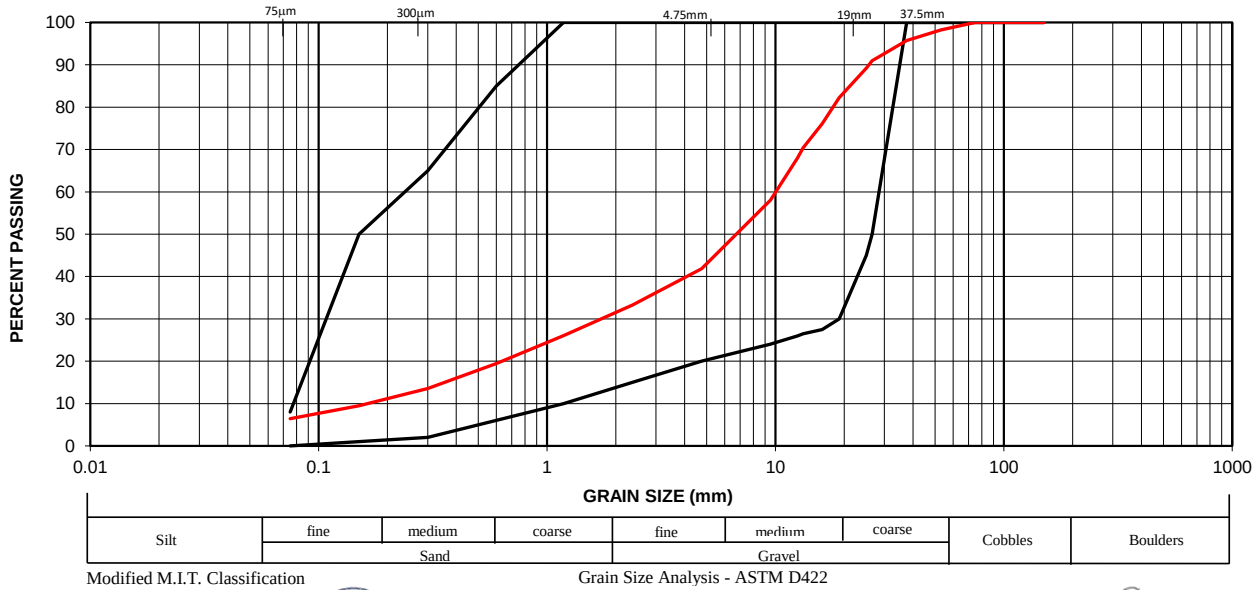
Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	9.8
Crushed Particles (%):	98.9
Percent Deleterious (%):	0.41

Additional Comments

Equipment Used

#33,#136,#34,#35, #36,#41,#37,#48,#38



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal,Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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Before Testing

After Testing

2447 Anson Drive, Mississauga, ON, L5S 1G1
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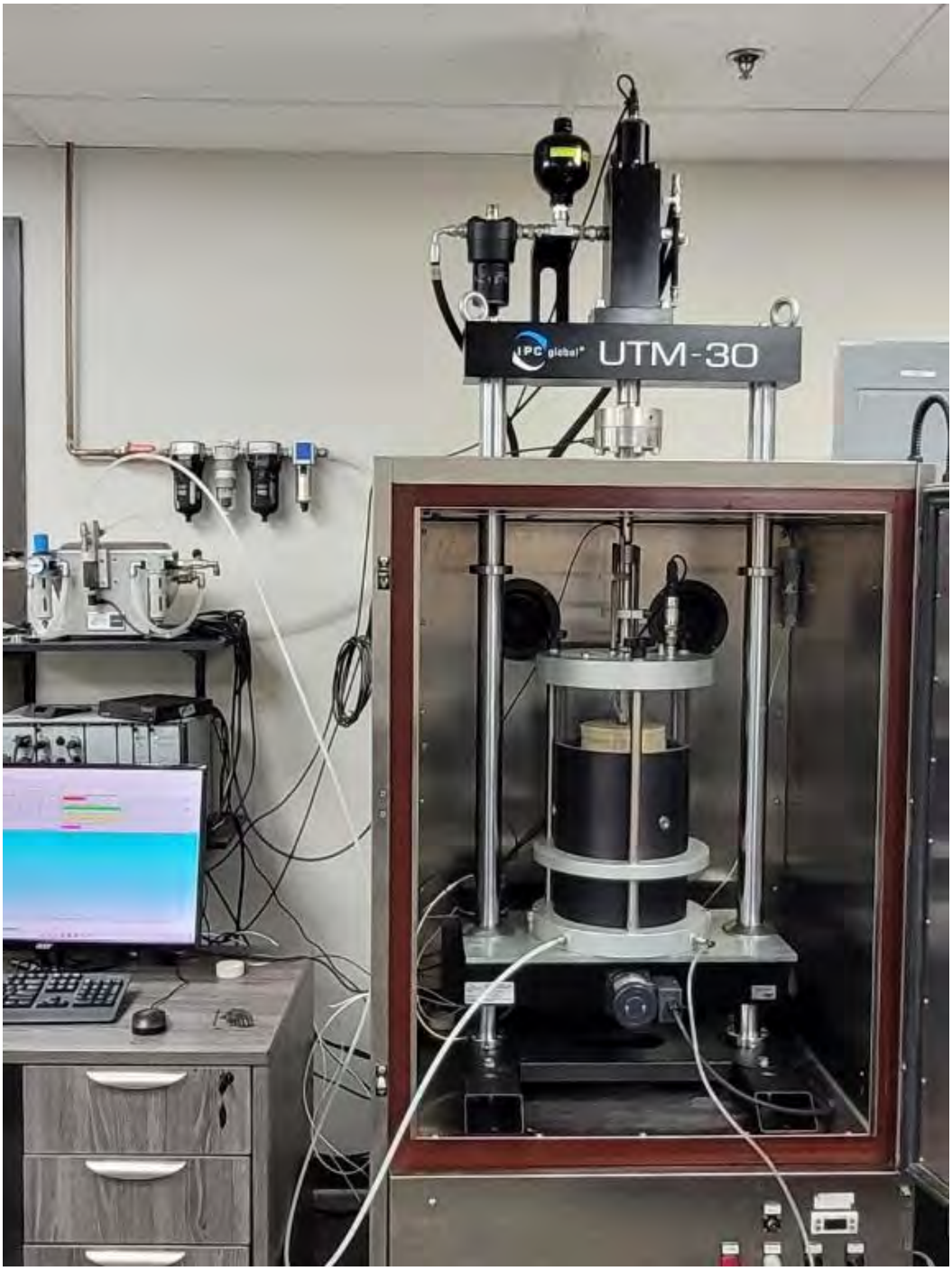

Specimen and Triaxial Cell Setup

2447 Anson Drive, Mississauga, ON, L5S 1G1
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Engtec Consulting Inc.
12-100 Hanlan Road, Vaughan
Ontario, L4L 4V8
Tel: (905) 856-2988
Fax: (905) 856-2989

Project No: ET24-1327A

September 25, 2024

Raly Chakarova
Executive Director, TARBA
Toronto and Area Road Builders Association
5045 Orbitor Drive, Unit 12, Suite 300
Mississauga, ON
L4W 4Y4

Email: raly@tarba.org

Dear Raly:

Resilient Modulus of Soils and Aggregate - AASHTO – T 307-17
50mm Crushed Concrete - Source C

Engtec Consulting Inc. undertook the Resilient Modulus Test using the UTM-30 Hydraulic machine and attached Triaxial Cell for the subject Granular material at our laboratory located in Mississauga, Ontario. The test specimen was prepared in our lab at the Proctor Optimum Moisture Content (OMC) and Maximum Dry Density. Based upon the gradation, the subject material was classified as Type 1 and therefore tested according to the confining and axial deviator stresses as per AASHTO-T 307-19 Section 9, Table 2. According to the AASHTO-T 307-19 requirements of reporting, this submission includes the Resilient Modulus General Report (Appendix A), Recompacted Specimen Information Report (Appendix B), Shear Test Report (Appendix C), Standard Proctor Report (Appendix D), and Photographs of the Sample Setup (Appendix E). Based upon our analysis of the data, the Average Resilient Modulus as a function of Confining Pressure and Applied Axial Stress is indicated in Table 1 in this submission.

We trust that this information is satisfactory for your purposes. If there are any questions on this submission or require additional testing, please do not hesitate to contact the undersigned.

Yours truly

Mazen Fallaha, P.Eng.
Technical Manager
Engtec Consulting Inc.

Salman Bhutta, Ph.D., P.Eng.
Principal
Engtec Consulting Inc.

Table 1: Average Resilient Modulus as a Function of Confining Pressure and Axial Stress.

Sequence Number	Confining Pressure, (KPa)	Cyclic Axial Stress (KPa)	Resilient Modulus (MPa)
1	20.7	20.1	63.2
2	20.7	40.1	95.5
3	20.7	60.5	126.0
4	34.5	31.8	97.2
5	34.5	61.9	134.0
6	34.5	92.9	162.6
7	68.9	61.9	155.0
8	68.9	123.9	205.9
9	68.9	185.8	219.6
10	103.4	62	158.8
11	103.4	93	183.6
12	103.4	185.8	242.9
13	137.9	93	203.4
14	137.9	123.9	228.6
15	137.9	248.0	288.2

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APPENDIX A

Resilient Modulus General Report

2447 Anson Drive, Mississauga, ON, L5S 1G1
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Engtec Consulting Inc.
2447-Anson Drive
Mississauga,Ontario
L5s 1G1
Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02697	Supplier	Source C
Client	TARBA	Testing Date	Wednesday, September 20, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
1	96	20.7	0.389	0.375	0.014	20.9	20.1	0.8	0.096	0.032	63.1
	97		0.386	0.372	0.014				0.096	0.032	62.9
	98		0.385	0.371	0.014				0.095	0.032	63.3
	99		0.386	0.372	0.014				0.095	0.032	63.4
	100		0.388	0.374	0.015				0.096	0.032	63.4
	Average		**0.387**	**0.373**	**0.014**				**0.096**	**0.032**	**63.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.22**
2	96	20.7	0.781	0.747	0.034	42	40.1	1.9	0.126	0.042	96.2
	97		0.781	0.745	0.037				0.127	0.042	95.4
	98		0.778	0.742	0.036				0.126	0.042	95.4
	99		0.774	0.738	0.036				0.126	0.042	94.9
	100		0.776	0.741	0.035				0.125	0.042	95.7
	Average		**0.778**	**0.743**	**0.036**				**0.126**	**0.042**	**95.5**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.48**
3	96	20.7	1.167	1.079	0.089	65.8	60.5	5.3	0.141	0.047	123.7
	97		1.211	1.115	0.096				0.144	0.048	125.3
	98		1.237	1.141	0.096				0.145	0.048	127.1
	99		1.228	1.126	0.102				0.143	0.048	127.3
	100		1.244	1.135	0.109				0.145	0.048	126.4
	Average		**1.217**	**1.119**	**0.098**				**0.144**	**0.048**	**126.0**
	STDEV.		**0.03**	**0.02**	**0.01**				**0.00**	**0.00**	**1.49**
4	96	34.5	0.645	0.586	0.058	35.1	31.8	3.3	0.098	0.033	97.4
	97		0.651	0.586	0.065				0.098	0.033	96.7
	98		0.65	0.59	0.059				0.098	0.033	97.8
	99		0.65	0.588	0.062				0.098	0.033	96.9
	100		0.651	0.59	0.061				0.098	0.033	97.3
	Average		**0.649**	**0.588**	**0.061**				**0.098**	**0.033**	**97.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.43**
5	96	34.5	1.274	1.145	0.129	68.9	61.9	6.9	0.139	0.046	133.9
	97		1.276	1.149	0.127				0.139	0.046	134.1
	98		1.274	1.145	0.128				0.139	0.046	133.9
	99		1.271	1.143	0.127				0.138	0.046	133.8
	100		1.277	1.149	0.128				0.139	0.046	134.1
	Average		**1.274**	**1.146**	**0.128**				**0.139**	**0.046**	**134.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.13**
6	96	34.5	1.908	1.717	0.19	103.1	92.9	10.3	0.171	0.057	162.6
	97		1.912	1.722	0.189				0.171	0.057	162.9
	98		1.907	1.717	0.19				0.171	0.057	162.4
	99		1.914	1.723	0.19				0.171	0.057	163.0
	100		1.904	1.713	0.191				0.171	0.057	162.3
	Average		**1.909**	**1.718**	**0.190**				**0.171**	**0.0570**	**162.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.30**
7	96	68.9	1.274	1.147	0.128	68.8	61.9	6.9	0.120	0.040	155.2
	97		1.272	1.145	0.128				0.120	0.040	154.7
	98		1.274	1.146	0.128				0.120	0.040	155.2
	99		1.272	1.145	0.128				0.120	0.040	154.8
	100		1.274	1.146	0.128				0.120	0.040	155.0
	Average		**1.250**	**1.146**	**0.128**				**0.120**	**0.040**	**155.0**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.23**

Engtec Consulting Inc.
2447-Anson Drive
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L5S 1G1
Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02697	Supplier	Source C
Client	TARBA	Testing Date	Wednesday, September 20, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
8	96	68.9	2.55	2.294	0.256	137.8	123.9	13.8	0.180	0.060	206.1
	97		2.547	2.291	0.256				0.181	0.060	205.5
	98		2.555	2.299	0.256				0.181	0.060	206.2
	99		2.547	2.29	0.257				0.180	0.060	205.8
	100		2.55	2.294	0.257				0.181	0.060	206.0
	Average		**2.550**	**2.294**	**0.256**				**0.181**	**0.060**	**205.9**
	STDEV.		**0.003**	**0.004**	**0.001**				**0.001**	**0.000**	**0.277**
9	96	68.9	3.821	3.437	0.384	206.5	185.8	20.7	0.254	0.085	219.6
	97		3.821	3.439	0.382				0.254	0.085	219.6
	98		3.827	3.443	0.384				0.254	0.085	219.8
	99		3.819	3.435	0.384				0.254	0.085	219.4
	100		3.818	3.435	0.382				0.254	0.085	219.4
	Average		**3.821**	**3.438**	**0.383**				**0.254**	**0.085**	**219.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.17**
10	96	103.4	1.274	1.146	0.129	68.9	62.0	6.9	0.117	0.039	158.4
	97		1.275	1.146	0.129				0.117	0.039	158.8
	98		1.277	1.148	0.129				0.117	0.039	158.8
	99		1.275	1.147	0.128				0.117	0.039	158.9
	100		1.275	1.147	0.128				0.117	0.039	158.9
	Average		**1.275**	**1.147**	**0.129**				**0.117**	**0.039**	**158.8**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**
11	96	103.4	1.91	1.72	0.19	103.3	93	10.3	0.051	0.059	183.3
	97		1.913	1.723	0.19				0.051	0.059	183.8
	98		1.913	1.721	0.192				0.051	0.059	183.5
	99		1.91	1.721	0.19				0.051	0.059	183.6
	100		1.912	1.72	0.191				0.051	0.059	183.8
	Average		**1.912**	**1.721**	**0.191**				**0.051**	**0.059**	**183.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.21**
12	96	103.4	3.819	3.436	0.383	206.6	185.8	20.7	0.229	0.076	242.9
	97		3.823	3.439	0.384				0.230	0.077	242.9
	98		3.825	3.441	0.384				0.230	0.077	243.0
	99		3.822	3.439	0.383				0.230	0.077	242.8
	100		3.822	3.438	0.384				0.229	0.076	243.1
	Average		**3.822**	**3.439**	**0.384**				**0.230**	**0.077**	**242.9**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.11**
13	96	137.9	1.912	1.721	0.192	103.3	93	10.3	0.137	0.046	203.3
	97		1.911	1.722	0.19				0.137	0.046	203.0
	98		1.917	1.726	0.192				0.138	0.046	203.1
	99		1.909	1.718	0.19				0.137	0.046	203.7
	100		1.91	1.722	0.188				0.137	0.046	203.8
	Average		**1.912**	**1.722**	**0.190**				**0.137**	**0.046**	**203.4**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.36**
14	96	137.9	2.555	2.300	0.256	137.7	123.9	13.8	0.163	0.054	228.6
	97		2.544	2.288	0.255				0.162	0.054	228.4
	98		2.552	2.297	0.255				0.163	0.054	228.7
	99		2.548	2.292	0.256				0.162	0.054	228.8
	100		2.546	2.291	0.255				0.162	0.054	228.7
	Average		**2.549**	**2.294**	**0.255**				**0.162**	**0.054**	**228.6**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.15**

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Tel: (905) 856-2988

Project Nubmer	ET24-1327A	Material Type	50mm Crushed Concrete
Sample Number	P02697	Supplier	Source C
Client	TARBA	Testing Date	Wednesday, September 20, 2024

Resilient Modulus Testing

Sequence Number	Sycle Number	Confining Pressure, (KPa)	Maximum Axial Load (KN)	Cycle Axial Load (KN)	Contact Axial Load (KN)	Maximum Axial Stress (KPa)	Cycle Axial Stress (KPa)	Contact Axial Stress (KPa)	Average Recoverable Deformation (mm)	Resilient Strain %	Resilient Modulus (MPa)
15	96	137.9	5.095	4.584	0.511	275.6	248	27.6	0.258	0.086	288.0
	97		5.104	4.593	0.512				0.258	0.086	288.2
	98		5.103	4.592	0.511				0.258	0.086	288.3
	99		5.098	4.585	0.512				0.258	0.086	288.3
	100		5.102	4.590	0.512				0.258	0.086	288.3
	Average		**5.100**	**4.589**	**0.512**				**0.258**	**0.086**	**288.2**
	STDEV.		**0.00**	**0.00**	**0.00**				**0.00**	**0.00**	**0.13**

APPENDIX B

Recompacted Specimen Information

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Mississauga, Ontario
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Tel: (905) 856-2988

Sample Number	P02697	Material Type	50mm Crushed Concrete
Testing Date	September 20, 2024	Supplier	Source C
TEST INFORMATION			
Preconditioning- Greater than 5 % Permanent Strain			NO
Testing- Greater Than 5% permanent Strain			NO
Testing- Number of Load Sequences Completed			YES
SPECIMEN INFO.			
Average Diameter, mm			155.3
Membrane Thickness, mm			0.63
Net Diameter, mm			154.0
Height of Specimen, Cap and Base, mm			382.4
Height of Cap and Base, mm			82.4
Initial Length L_0, mm			300
Initial Area, A_0, mm^2			18627
Initial Volume,V_0, cm^3			5588
SPECIMEN WEIGHT			
Initial Weight of Container and Soil, g.			19288
Final Weight of Container and Soil, g.			6445.9
Weight of Wet Soil Used, g.			12842.1
MATERIAL PROPERTIES			
In Situ Moisture Content (Nuclear), %			N/A
In Situ Weight Density (Nuclear), Kg/m^3			N/A
Optimum moisture Content, %			11.5
Max Dry Density, Kg/m^3			1984
SPECIMEN PROPERTIES			
Compaction Moisture Content, %			10.8
Moisture Content after Resilient Modulus Testing, %			9.7
Compaction Dry Density, Kg/m^3			2074
QUICK SHEAR TEST			
Stress-Strain Plot Attached			YES
Triaxial Shear Maximum Strength, KPa			286.3
Specimen Fail During Triaxial Shear			Bulge
GENERAL REMARKS:			
Reviewed By:	**Mazen Fallaha**	**Date:**	**Wednesday, September 25, 2024**

APPENDIX C

Shear Test Result

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Unbound Material Resilient Modulus and Shear Test

Data file name: C:\IPCglobal UTS\039 Unbound Resilent Modulus Test\Data\TARBA\Strada-Granular B.D039
Test method: US: AASHTO T307 / TP46 : Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials
Material type: Base/Subbase material (AASHTO TP46, T307)
Project: ET24-1327A
Operator: Mazen Fallaha
Comments: Client: Toronto and Area Road Builder Association (TARBA)==
Material: 50mm Crushed Concrete- Source C - Granular B-TII

Specimen Information

Identification: P02697
Conditioning time:
Properties/Comments:
Max Dry Density = 1984 Kg/m3
OMC = 11.5 %

Dimensions	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Average	Std Dev.
Diameter (mm)	153.5	153.5	153.5	153.5	153.5	153.5	153.50	
Hight (mm)	300.0	300.0	300.0	300.0	300.0	300.0	300.00	

Mass (kg): 12.840
Cross-sectional area (mm²): 18505.7
Density (kg/m³): 2313
Volume (cc): 5551.7

Resilient Modulus test parameters

Waveshape: Haversine
Load duration (msec): 100
Cycle duration (msec): 900
Conditioning cycles: 500
Test cycles: 100
Permanent axial strain limit (%): 5

Shear test parameters

Shear confining stress (kPa): 34.5
Shear rate (mm/min): 1.0
Shear termination strain (%): 5

Resilient ModulusTest Data

Start date & time: Friday September 20 2024 at 1:00 PM

Test Sequence 15	Cycle 96	Cycle 97	Cycle 98	Cycle 99	Cycle 100	Average	Std Dev
Resilient Modulus (MPa):	288.0	288.2	288.3	288.3	288.3	288.2	0.103
Confining Pressure (kPa):	137.9	137.9	137.9	137.9	137.9	137.9	0.005
Cyclic Axial Stress (kPa):	247.7	248.2	248.2	247.8	248.0	248.0	0.211
Maximum Axial Stress (kPa):	275.3	275.8	275.8	275.5	275.7	275.6	0.204
Contact Axial Stress (kPa):	27.6	27.6	27.6	27.7	27.6	27.6	0.028
Recoverable Axial Strain (%):	0.086	0.086	0.086	0.086	0.086	0.086	0.000
Permanent Axial Strain (%):	1.000	1.000	1.001	1.002	1.003	1.001	0.001
Cyclic Axial Load (kN):	4.584	4.593	4.592	4.585	4.590	4.589	0.004
Maximum Axial Load (kN):	5.095	5.104	5.103	5.098	5.102	5.100	0.004
Contact Axial Load (kN):	0.511	0.512	0.511	0.512	0.512	0.512	0.001
Recoverable Axial Deformation (mm):	0.258	0.258	0.258	0.258	0.258	0.258	0.000
Permanent Axial Deformation (mm):	2.999	3.001	3.004	3.006	3.008	3.003	0.004

Shear Test Data

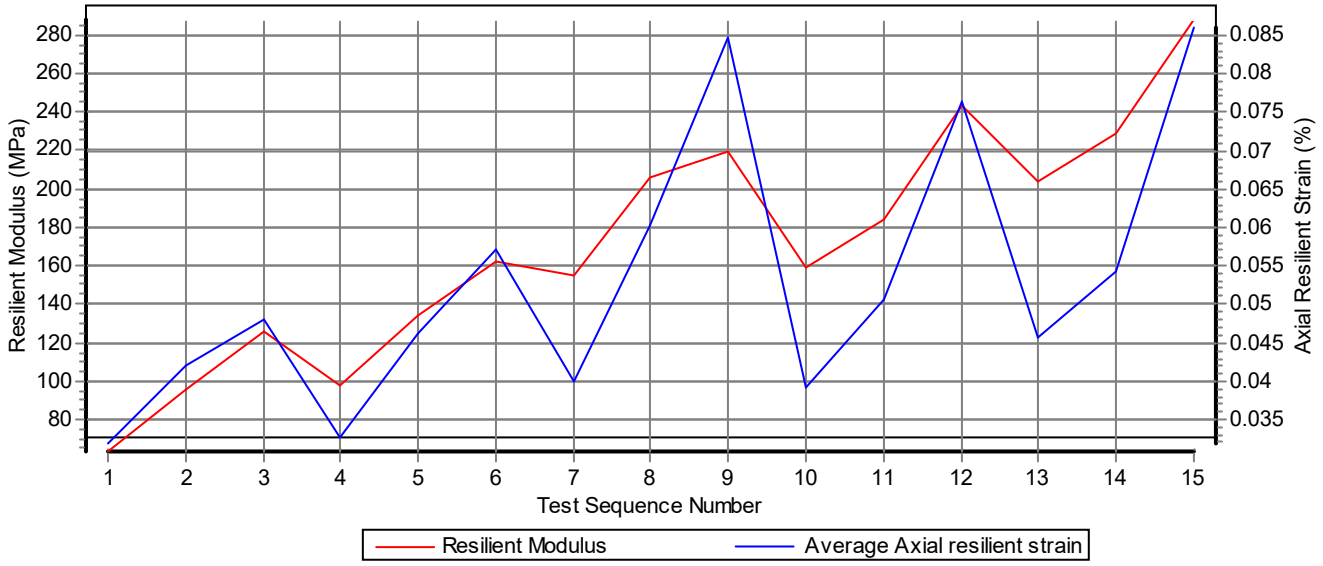
Start date & time: Friday September 20 2024 at 1:37 PM
Timer (sec): 299.8

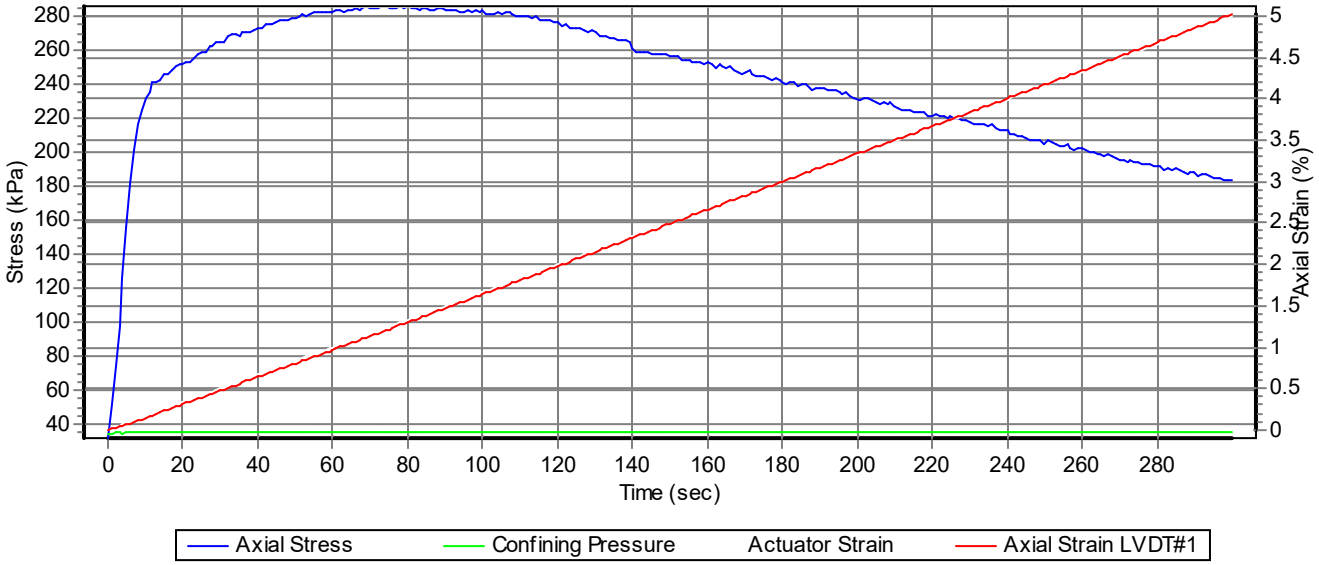
	Current	Peak
Axial Load (kN):	3.393	5.299
Peak Stress (kPa):	183.3	286.3
Confining pressure (kPa):	34.5	

Strain (%)	Current	At Peak Load
Actuator:	4.99	1.14
Averaged Axial:	5.02	1.11

Deformation (mm)	Current	At Peak Load
Actuator:	14.980	3.406
Averaged Axial:	15.070	3.319
Axial LVDT #1:	15.070	3.319

Unbound Material Resilient Modulus and Shear Test




Stress (kPa)
Axial Strain (%)
Time (sec)
Axial Stress
Confining Pressure
Actuator Strain
Axial Strain LVDT#1

APPENDIX D

Standard Proctor and Gradation Results

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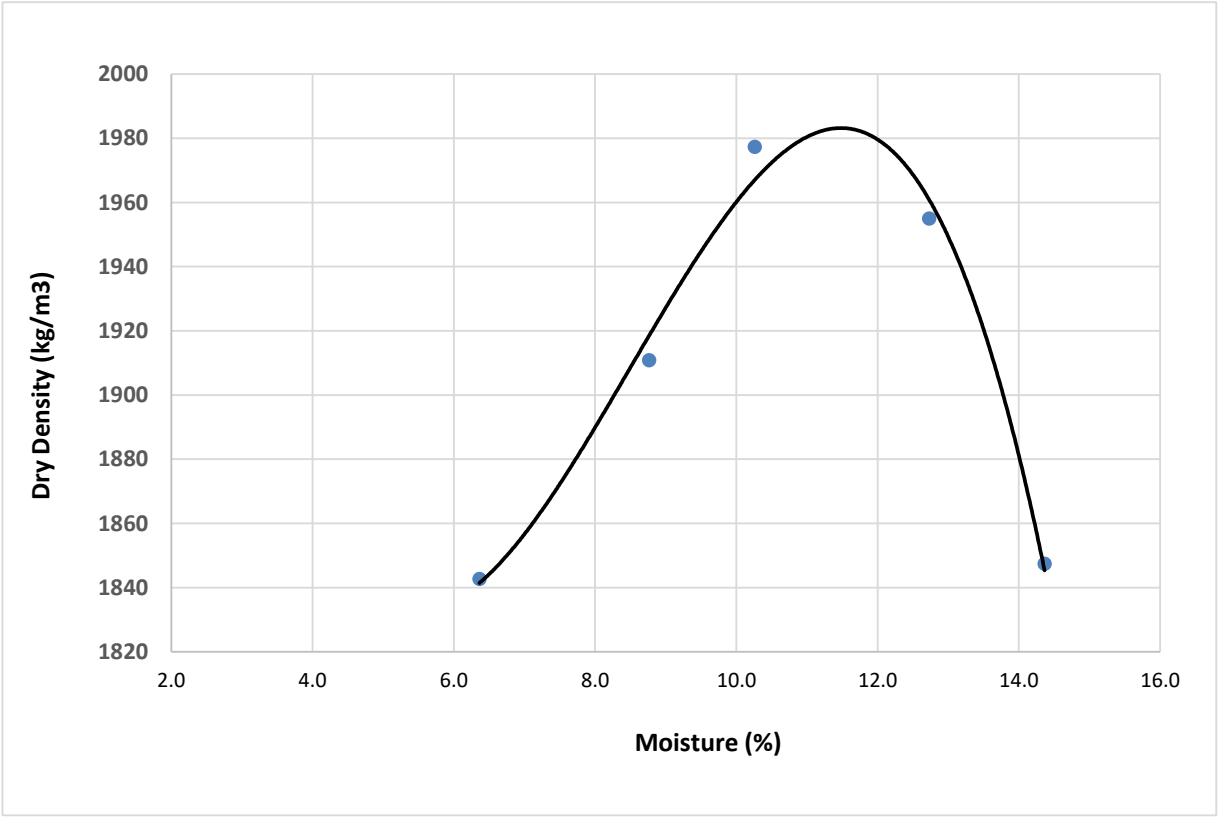
Standard Proctor

Project No.	ET24 - 1327A	Material	**50mm Crushed Concrete**
Client:	N/A	Sampled By:	Client- Greg R
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source C	Date Tested:	August 15, 2024
Sampled Location:	Source C	Specification:	LS-706
Lab No.	G09630		

Point No.	**1**	**2**	**3**	**4**	**5**
Dry Density (kg/m^3)	1843	1911	1977	1955	1847
Moisture Content (%)	6.4	8.8	10.3	12.7	14.4



Maximum Dry Density	**1984 Kg/m3**
Optimum Moisture Content	**11.5 %**

Name of the Operator: Leonardo Pilapil, C.E.T

Project Manager: Salman Bhutta, PhD. ,P.Eng.

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Grain Size Analysis

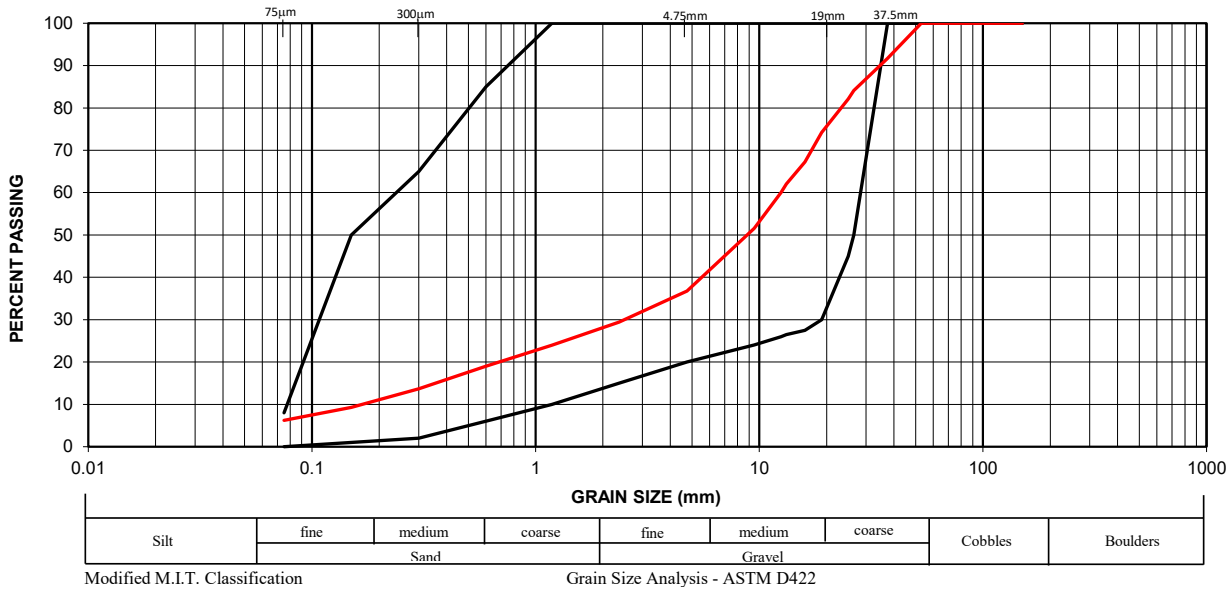
Project No.	ET24-1327A	Material	50mm Crushed Concrete
Client:	N/A	Sampled By:	Client
Project Description:	Granular Base Study	Date Sampled:	August 12, 2024
Source	Source C	Date Tested:	August 15, 2024
Sampled Location:	Pad	Specification:	Granular B - Type I - OPSS 1010
Lab No.	G09630		

Sieve Size (mm)	Percent Passing	Specification		Note
		Minimum	Maximum	
150	100.0	100	100	
106	100.0			
75	100.0			
53	100.0			
37.5	91.7			
26.5	84.1	50	100	
25	82.1			
19	74.2			
16	67.2			
13.2	62.0			
12.5	60.1			
9.5	51.6			
4.75	36.8	20	100	
2.36	29.4			
1.18	23.9	10	100	
0.6	19.0			
0.3	13.7	2	65	
0.15	9.3			
0.075	6.2	0	8	

Note: * - Out of Specification

Physical Properties	
Asphalt Coated Particles (%):	8.7
Crushed Particles (%):	0.93
Percent Deleterious (%):	98.8

Additional Comments



Modified M.I.T. Classification

Grain Size Analysis - ASTM D422

Project PM: Salman Bhutta, P.hD.,P.Eng.
Principal, Engtec Consulting Inc.

Reported By: Leonardo Pilapil, CET
Engtec Consulting Inc.

APPENDIX E

Photographs of the Sample Setup

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Before Testing

After Testing

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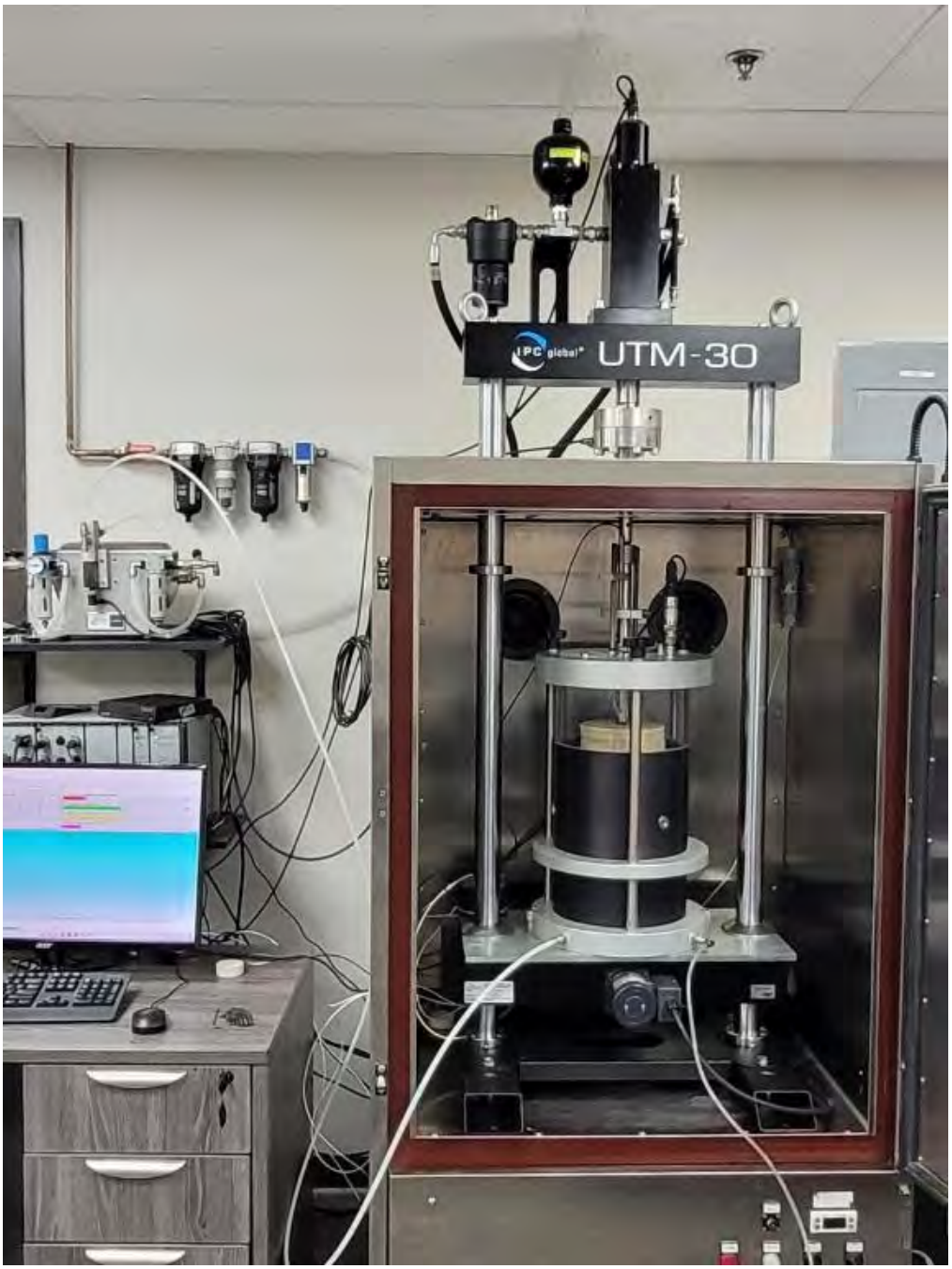

Specimen and Triaxial cell Setup

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