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IBI Group Inc.

# Geotechnical Investigation Report McDonald's on Regent Avenue in Winnipeg, MB

**Prepared for:**

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**Project Number:**
0198 001 00

**Date:**
April 7, 2015

**TREK GEOTECHNICAL** Quality Engineering | Valued Relationships

April 7, 2015 Our File No. 0198 001 00

Tony Withall
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**RE: McDonald's on Regent Avenue in Winnipeg, MB**

**Geotechnical Investigation Report**

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TREK Geotechnical Inc. is pleased to submit our Geotechnical Investigation Report for the new McDonald's Restaurant on Regent Avenue located in Winnipeg, Manitoba.

Please contact Ryan Belbas of our office if you have any questions. Thank you for the opportunity to work with you on this assignment.

Sincerely,

**TREK Geotechnical Inc.**
**Per:**

RBelbas

Ryan Belbas, M.Sc., P.Eng.
Geotechnical Engineer
Tel: 204.975.9433 Ext. 113

KMS:rb
Encl.

## Revision History

| Revision No. | Author | Issue Date | Description |
|---|---|---|---|
| 0 | RB | April 7, 2015 | Final Report |

## Authorization Signature

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APEGM
Certificate of Authorization
Trek Geotechnical Inc.
No. 4877 Date: April 7/15.

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# 1.0 Introduction

This report summarizes the results of the geotechnical investigation completed by TREK Geotechnical Inc. (TREK) for a McDonald's restaurant proposed at 1459 Regent Avenue in Winnipeg, Manitoba. The terms of reference for the investigation are included in our proposal to Mr. Tony Withall of IBI Group Inc. (IBI) dated February 17th, 2015. The scope of work includes a sub-surface investigation, laboratory testing, and provision of recommendations for the design and construction of foundations, concrete floor slabs (including exterior slabs) and pavements. Other considerations such as site drainage, concrete specifications, materials testing, and inspection requirements are also included.

# 2.0 Background and Existing Information

TREK understands that the proposed McDonald's development will consist of a single storey restaurant building (469 square metres in size) with an asphalt paved drive-thru and parking lot. Exterior structures such as concrete pads, a canopy, light standards, menu boards, and a McDonald's restaurant sign will also be constructed as part of the development. The foundation loads are unknown at the time of this report, but are anticipated to be relatively light.

The proposed development is located within the existing asphalt paved parking lot of the former Park (Mazda) Pontiac Auto Dealership. There is currently overhead lighting within the footprint of the proposed building and parking lot. A large Quonset hut is located at north end of the property and overlaps a portion of the proposed parking lot and drive-thru.

# 3.0 Field Program

## 3.1 Sub-surface Investigation

A sub-surface investigation was undertaken on March 12th, 2015 under the supervision of TREK personnel to determine the soil stratigraphy and groundwater conditions at the site. Nine test holes (THs) were drilled at the locations shown on Figure 01 using a Soilmec STM-20 truck-mounted piling rig equipped with a 400 mm diameter auger. THs 15-01 to 15-04 were drilled within the vicinity of the proposed building footprint and restaurant sign to evaluate deep foundation alternatives for these structures. TH 15-02 was drilled to power auger refusal which occurred at 18.3 m below ground surface (bgs), and THs 15-01, 15-03 and 15-04 were drilled a depth of about 9 m bgs. The remaining test holes (15-05 to 15-09) were drilled within the proposed drive-through and parking areas to depth of about 3 m to obtain additional information relative to pavement design.

THs 15-05 and 15-06 were relocated when power auger refusal was encountered at a depth of about 0.3 and 0.8 m bgs respectively at their original locations (THs 15-05A and 15-06A); the obstructions at these locations were not identified. TH 15-09 was relocated when what appeared to be bedding sand was encountered at the original location (TH 15-09A). The locations for THs 15-05A, 06A and 09A are shown on Figure 01; logs are not provided for these three abandoned test holes.

Sub-surface soils observed during the drilling were visually classified based on the Unified Soil Classification System (USCS). Samples retrieved during drilling included disturbed auger cutting samples and relatively undisturbed Shelby tube samples. All samples retrieved during drilling were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted of moisture content determination on all samples and unconfined compressive strength testing and bulk unit weight measurements on selected Shelby tube samples.

Test hole locations were based on the proposed locations provided by IBI and are shown on Figure 01. The test hole elevations were surveyed using a rod and level and are relative to the arrowhead marker on the top of the fire hydrant located southwest of the site (denoted as TBM 1 on Figure 01) and assigned an elevation of 100.0 m. Test hole logs are attached which include a description of the soil units encountered and other pertinent information such as groundwater conditions and a summary of the laboratory testing results.

## 3.2 Sub-surface Conditions

### *3.2.1 Soil Stratigraphy*

A brief description of the soil units encountered during drilling is provided below. All interpretations of soil stratigraphy for the purposes of design should refer to the detailed information provided on the attached test hole logs.

The ground was frozen at all test hole locations at the time of drilling to a maximum depth of 2 m. Asphalt was encountered at the ground surface in all test holes which were drilled through the existing parking lot. The asphalt is about 50 mm thick and is underlain by a granular (base) material consisting of either crushed limestone or sand and gravel fill, which ranges in thickness from about 125 to 250 mm. Clay fill was encountered below the granular base in all test holes (except TH 15-06, where native clay was encountered below the base layer) and varied in thickness between 0.4 and 1.1 m. A relatively thin layer of silt (< 0.3 m thick) was encountered in THs 15-01 to 15-04 and TH 15-08 at depths ranging from 1.1 to 1.8 m. Native high plastic silty clay was encountered at depths varying between 0.3 and 1.2 m and extended to the depth of exploration (< 9 m) in all test holes except TH 15-02. The silty clay is generally stiff becoming firm with depth. Silt till was encountered at a depth of 14.5 m in TH 15-02 and extended to bedrock at a depth of 16.7 m. The silt till is generally loose and moist, becoming wet with depth. The bedrock was highly fractured and was present to power auger refusal which occurred at a depth of 18.3 m.

#### 3.2.2 *Groundwater Conditions*

Groundwater seepage was encountered in TH 15-02 within the till at about 15 m bgs. The water level in the test hole was measured at 10.1 m below the ground surface approximately 10 minutes after completion of drilling. Sloughing of the silt till in TH 15-02 was also observed. The test hole was open to approximately 16.2 m below ground surface immediately after drilling was completed.

The groundwater observations made during drilling are short term and should not be considered reflective of (static) groundwater levels at the site which would require monitoring over an extended period of time to determine. It is important to recognize that groundwater conditions may vary seasonally, annually, or as a result of construction activities.

## 4.0 Foundation Recommendations

Based on the sub-surface conditions encountered during drilling and the laboratory test results, suitable foundation types for the site include:

- cast-in-place concrete friction piles
- driven precast concrete piles

Limit state design and construction recommendations in accordance with the National Building Code of Canada (NBCC 2010) for these pile types are provided below.

It should be noted that obstructions were encountered at shallow depths in two test holes (THs 15-05 and 15-06). In this regard, the contractor should be prepared to remove any obstructions if encountered at pile locations.

### 4.1 Limit States Design

Limit states design recommendations for deep foundations in accordance with the National Building Code of Canada (NBCC 2010) are provided below. Limit states design requires consideration of distinct loading scenarios comparing the structural loads to the foundation bearing capacity using resistance and load factors that are based on reliability criteria. Two general design scenarios are evaluated corresponding to the serviceability and ultimate capacity requirements.

The **Ultimate Limit State (ULS)** is concerned with ensuring that the maximum structural loads do not exceed the nominal (ultimate) capacity of the foundation units. The ULS foundation bearing capacity is obtained by multiplying the nominal (ultimate) bearing capacity by a resistance factor (reduction factor), which is then compared to the factored (increased) structural loads. The ULS bearing capacity must be greater or equal to the maximum factored load. Table 4-1 summarizes the resistance factors that can be used for the design of foundations as per the NBCC (2010) depending upon the method of analysis and verification testing completed during construction.

The **Service Limit State (SLS)** is concerned with limiting deformation or settlement of the foundation under service loading conditions such that the integrity of the structure will not be impacted. The SLS should generally be analysed by calculating the settlement resulting from applied service loads and comparing this to the settlement tolerance of the structure. However, the settlement tolerance of the structure is typically not yet defined at the preliminary design stage. As such, SLS bearing capacities (or unit resistances) are provided that are developed on the basis of limiting settlement to approximately 25 mm or less. A more detailed settlement analysis should be conducted to refine the estimated settlement and/or adjust the SLS capacity if a more stringent settlement tolerance is required.

**Table 4-1. ULS Resistance Factors for Deep Foundations (NBCC 2010)**

| Bearing Resistance to Axial Load for Deep Foundations (Analysis Methods) | Resistance Factor |
|---|---|
| Semi-empirical analysis using laboratory and *in-situ* test data | 0.4 |
| Analysis using dynamic monitoring results | 0.5 |
| Analysis using static loading test results | 0.6 |
| Uplift resistance by semi-empirical analysis. | 0.3 |
| Uplift resistance using loading test results. | 0.4 |

It should be noted that to use resistance factors of $\phi$ = 0.6 and $\phi$ = 0.4 for resistance to axial-compression and axial-uplift loads, respectively, a static load test must be performed. However, it is unlikely that a static load test would be cost-effective for this project. Additionally, if PDA testing and CAPWAP analysis is performed on driven piles, a resistance factor of 0.5 can be used for design of the factored ULS capacities.

## 4.2 Cast-In-Place Concrete Friction Piles

Cast-in-place concrete (CIPC) friction piles are a suitable foundation type for the site. This pile type will derive a majority of its resistance in shaft friction (adhesion) with a relatively small contribution from end bearing. Table 4-2 provides the recommended ULS and SLS unit axial resistance values for shaft adhesion and end bearing. The SLS capacity is settlement-dependent and is based on a maximum settlement of 10 mm.

**Table 4-2. Recommended ULS and SLS Resistances for CIPC Friction Piles (NBCC 2010)**

| Pile Depth Below Final Grade (m) | Estimated Local Elevation[1] (m) | ULS Axial Unit Resistance (kPa) | | | SLS Axial-Compressive Unit Resistance Shaft Adhesion (kPa) |
|---|---|---|---|---|---|
| | | Compression $\phi = 0.4$ | | Uplift $\phi = 0.3$ | |
| | | Shaft Adhesion | End Bearing | Shaft Adhesion | |
| 0 to 1.5 | 99.3 to 97.8 | 0 | 0 | 0 | 0 |
| 1.5 to 13 | 97.8 to 86.3 | 16 | 80 | 12 | 15 |

*Note 1: Local elevation relative to top of fire hydrant (Elev. 100.0 m).*

CIPC Friction Pile Design Recommendations:

1. The weight of the embedded portion of the pile may be neglected.
2. The piles should have a minimum shaft diameter of 406 mm.
3. For piles supporting heated structures (excluding perimeter piles), shaft adhesion in compression and uplift within the upper 1.5 m below final grade should be neglected. For piles subjected to freezing conditions, shaft adhesion in compression and uplift within the upper 2.5 m below final grade should be neglected.
4. Pile lengths should be limited to a depth of 13 m below existing ground surface (approximate Elev. 86.3 m) to avoid penetrating into the silt till and to protect against heaving at the base of the pile shaft.
5. Piles subjected to freezing conditions should be designed with adequate length to resist ad-freezing and uplift forces related to frost action (see Section 4.5).
6. Piles should have a minimum spacing of 3 pile diameters measured centre to centre. If a closer spacing is required, TREK should be contacted to provide an efficiency (reduction) factor to account for potential group effects.
7. Piles require steel reinforcement designed by a qualified structural engineer for the anticipated axial (compression and uplift), lateral and bending loads induced from the structure.

CIPC Friction Pile Installation Recommendations:

1. Temporary steel casings (*i.e.* sleeves) should be available and used if sloughing of the pile hole occurs and/or to control groundwater seepage if encountered. Care should be taken in removing sleeves to prevent sloughing (necking) of the shaft walls and a reduction in the cross-sectional area of the pile.
2. Concrete should be placed in one continuous operation immediately after the completion of drilling the pile hole to avoid construction problems such as sloughing or caving of the pile hole and groundwater seepage. Concrete should be poured under dry conditions. If groundwater is encountered it should be controlled and removed. If water cannot be controlled and removed, the concrete should be placed using tremie methods.

3. Concrete placed by free-fall methods should be directed through the middle of the pile shaft and steel reinforcing cage to prevent striking of the drilled shaft walls to protect against soil contamination of the concrete.

## 4.3 Driven Precast Prestressed Concrete Hexagonal Piles

Driven precast prestressed concrete hexagonal (PPCH) piles driven to practical refusal are considered to be a suitable pile type for the site. This pile type will derive a majority of its resistance in end bearing with a relatively small contribution from shaft adhesion. The recommended SLS and factored ULS capacities for PPCH piles driven to practical refusal are provided in Table 4-3. The SLS capacity is settlement-dependent and is based on a maximum settlement of 25 mm or less.

Power auger refusal is often a good indicator of practical refusal depth for this type of driven pile. However, due to the inherently variable conditions of the glacial till and bedrock underlying Winnipeg, the depth to practical refusal should be expected to vary across the site and may be deeper than the depth of power auger refusal encountered at TH15-02.

**Table 4-3. Recommended ULS and SLS Pile Resistances for Driven PPCH Piles**

| Pile Size (mm) | Refusal Criteria (Blows/ 25mm) | ULS Axial Resistance | | | SLS Axial-Compressive Capacity (kN) |
|---|---|---|---|---|---|
| | | Compression Capacity (kN) | | | |
| | | $\phi = 0.4$ | $\phi = 0.5$ | $\phi = 0.6$ | |
| 305 | 5 | 550 | 690 | 825 | 445 |
| 356 | 8 | 770 | 965 | 1,155 | 625 |
| 406 | 12 | 990 | 1,240 | 1,485 | 800 |

The piles should be driven to at least three consecutive sets of the refusal criteria outlined in Table 4-3, using a diesel hammer having a minimum rated energy of 40 kJ or a hydraulic drop hammer having a minimum rated energy of 20 kJ.

Driven PPCH Pile Design Recommendations:

1. The weight of the embedded portion of the pile may be neglected.
2. Pile spacing should not be less than 2.5 pile diameters. If a closer spacing is required, TREK should be contacted to provide an efficiency (reduction) factor to account for potential group effects.
3. Shaft adhesion of 12 kPa for the clay can be used to design for uplift resistance. For piles supporting heated structures (excluding perimeter piles), uplift resistance within the upper 1.5 m below final grade should be neglected. For piles subjected to freezing conditions, uplift resistance within the upper 2.5 m below final grade should be neglected. If pre-boring is completed (see below) and the length of the pre-bore hole is deeper than 1.5 m for piles supporting heated structures and 2.5 m for piles subjected to freezing conditions, the entire pre-bore length should be neglected from uplift resistance. The uplift resistance was determined using a resistance factor of 0.3.

4. To aid in pile alignment and to reduce pile heave during driving, pre-boring should be undertaken. A typical pre-bore length for this pile type is about 3 m; however, once the pile design is complete, TREK can assist in developing an appropriate pre-bore plan for the piles prior to construction. The pre-bore diameter should be no more than 50 mm larger than the pile diameter.
5. The piles must be designed to withstand design loads, handling stresses, and driving stresses.

<u>Driven PPCH Pile Installation Recommendations</u>

1. The pile-driving hammer should have the capability of adjusting the delivered energy to operate at higher settings during driving if the delivered energy is not sufficient to mobilize the ultimate pile capacity. The driving system should also have the capability of adjusting the delivered energy to operate at lower settings during easy driving and to prevent pile damage upon sudden pile refusal.
2. The pile-driving hammer should be equipped with a pile cushion to protect the pile head from damage during driving from direct impact with the steel driving helmet. The pile cushion should consist of a minimum of 100 mm of compressible material such as plywood or hardwood (*e.g.* oak). The pile cushion should fit tightly inside the pile helmet.
3. The piles should be cured for at least 7 days prior to driving.
4. Piles should be driven continuously once driving is initiated to the required refusal criteria.
5. Where a steel follower is required to install piles below the ground surface, the refusal criteria should be increased by 50% in order to account for additional energy losses through the use of the follower.
6. Re-driving of all piles in groups should be specified along with the requirement to monitor for pile heave. All piles exhibiting heave of 6 mm or more should be re-driven to a minimum of one set of the practical refusal criteria.
7. Pile verticality (plumbness) should be measured on all piles after practical refusal has been achieved to check if verticality is within the limits of the structural design. It is common local practice to specify a maximum acceptable percentage that the pile can be out of vertical plumbness (*e.g.* 2% out of plumb).
8. Inspection of all driven piles should be performed by TREK Geotechnical personnel to confirm that the refusal criteria have been met and to record that pile installation has been completed according to the design.
9. Any piles damaged, out of plumb an excessive amount, or reaching premature refusal may need to be replaced. The structural designer will have to assess non-conforming piles to determine if they are acceptable. PDA testing with CAPWAP analysis is recommended for any piles that are suspected to not meet the design capacity or to be damaged if a structural solution is not possible.

## 4.4 Lateral Pile Analysis

The soil response (sub-grade reaction) to lateral loads can be modeled in a simplified manner that assumes the soil around a pile can be simulated by a series of horizontal springs for the preliminary design of pile foundations. The soil behaviour can be estimated using an equivalent spring constant referred to as the lateral sub-grade reaction modulus ($k_s$). Table 4-4 provides the recommended sub-grade reaction modulus for the preliminary lateral load analysis. The majority of lateral resistance will typically be offered by the upper 5 to 10 m of soil, depending on the relative stiffness of the pile and soil units. Void spaces surrounding piles due to pre-boring activities should be in-filled with lean-mix concrete to ensure compliance with the surrounding soil. If in-filling is not completed, the depth of the pre-bore should be neglected from lateral pile resistance calculations.

**Table 4-4. Recommended Values for Lateral Subgrade Reaction Modulus ($K_s$)**

| Depth Below Final Grade (m) | Estimated Local Elevation[1] (m) | $K_s$ ($kN/m^3$) |
|---|---|---|
| 0 to 1.5 (or to depth of pre-bore) | 99.3 to 97.8 (or base elevation of pre-bore) | 0 |
| 1.5 (or to depth of pre-bore) to 14.5 | 97.8 (or base elevation of pre-bore) to 84.8 | $3,300/d^2$ |
| > 14.5 | < 84.8 | $18,800/d^2$ |

*Note 1: Local elevation relative to arrowhead marker at top of fire hydrant (Elev. 100.0 m).*
*Note 2: d = pile diameter.*

As part of detailed design, a more rigorous lateral pile analysis that incorporates the material and section properties of the pile, final lateral deflection criteria and a more realistic elastic-plastic model of the soil response to loading should be carried out by TREK once the final design grades are determined to confirm the lateral load capacity of the piles.

## 4.5 Ad-freezing Effects

For piles subjected to freezing conditions, the piles should be designed to resist ad-freezing and uplift forces related to frost action acting along the vertical faces of the pile and pile cap within the depth of frost penetration (2.5 m below ground surface). In this regard, piles may be subject to an ad-freeze bond stress of 65 kPa within the depth of frost penetration. These forces will be resisted by structural dead loads and uplift resistance provided by the length of the pile below the depth of frost penetration. Alternatively, measures such as flat lying rigid polystyrene insulation could be considered to reduce frost penetration depths and thereby ad-freezing effects and uplift forces.

## 4.6 Grade Beams and Pile Caps

A minimum void space of 150 mm underneath all grade beams and pile caps should be provided to avoid uplift pressures from developing on the underside of the pile cap as a result of swelling or frost action. The void space can consist of a compressible layer (*e.g.* low density polystyrene) to permit heave without engaging the grade beam or pile cap. Excavations for grade beams and pile caps should be backfilled with highly plastic clay and compacted to a minimum of 95% of the Standard Proctor Maximum Dry Density (SPMDD).

### 4.7 Foundation Concrete

All foundation concrete should be designed by a qualified structural engineer for the anticipated axial (compression and uplift), lateral, and bending loads from the structure. Based on local experience gathered through previous work in Winnipeg, the degree of exposure for concrete subjected to sulphate attack is classified as severe according to Table 3, CSA A23.1-09 (Concrete Materials and Methods of Concrete Construction). Accordingly, all concrete in contact with the native soil should be made with high sulphate-resistant cement (HS or HSb). Furthermore, the concrete should have a minimum specified 56-day compressive strength of 32 MPa and have a maximum water to cement ratio of 0.45 in accordance with Table 2, CSA A23.1-09 for concrete with severe sulphate exposure (S2). Concrete that may be exposed to freezing and thawing should be adequately air entrained to improve freeze-thaw durability in accordance with Table 4, CSA A23.1-09.

### 4.8 Foundation Inspection

Based on the Sections *4.2.2.3 Field Review* and *4.2.2.4 Altered Sub-surface Condition* of the NBCC, TREK recommends full-time inspection of all deep foundation units (*i.e.* piles). TREK personnel are familiar with the sub-surface conditions at the site and have experience in deep foundation construction and should be retained to perform inspection services.

## 5.0 Floor Slabs

### 5.1 Structural Floor Slabs

If floor slabs cannot tolerate movements, a structural floor slab will be required. A minimum void space of 150 mm is recommended beneath the structural floor slab to accommodate volumetric changes in the underlying sub-grade soils (*i.e.* swelling, shrinkage, and thermal expansion and contraction in unheated areas). The void space can consist of a compressible layer (*e.g.* low density polystyrene) to permit sub-grade soil movements without engaging the floor slab, or alternatively a crawl space. A vapour barrier below the slab is also recommended to minimize long-term moisture changes within the sub-grade soils.

### 5.2 Grade-Supported Floor Slabs

If some movement of the floor can be tolerated, a grade-supported floor slab can be used. Vertical deformation of grade supported slabs should be expected due to moisture and volume changes of the underlying clay and silt soils. Although the magnitude of this movement is difficult to predict, vertical displacements of 50 to 100 mm are possible. Floor slabs in unheated areas will be subject to additional movements from freeze / thaw of the sub-grade soils.

1. For best long-term performance, organics, fill materials, silt, and any other deleterious material should be stripped such that the sub-grade consists of native silty clay. However, depending on final grades it may not be economical to entirely remove these layers. In this regard, the sub-

grade may consist of the existing fill, provided it is proof-rolled to confirm competency and all soft and silt areas are mitigated appropriately (described below).

2. Excavation should be completed with a backhoe equipped with a smooth bucket and operating from the edge of the excavation in order to minimize disturbance to the exposed sub-grade.
3. After excavation, the sub-grade should be inspected by qualified geotechnical personnel. The sub-grade should be proof-rolled with a fully loaded tandem axle truck to detect soft areas or silt. Soft and /or silt areas should be repaired as per directions provided by a geotechnical engineer. This will likely consist of excavating an additional 300 to 600 mm and placing a non-woven geotextile on the sub-grade and backfilling with a 50 mm down crushed limestone sub-base. The crushed limestone should be placed in lifts no greater than 150 mm and compacted to a minimum of 95% of the SPMDD.
4. The sub-grade should be protected from freezing, drying, or inundation with water. If any of these conditions occur, the sub-grade should be scarified, moisture conditioned as appropriate, and re-compacted to a minimum of 95% of the SPMDD.
5. In heated areas, the floor slab should be placed on a 150 mm thick granular base constructed of 50 mm down crushed limestone underlying a 150 mm thick base consisting of 20 mm down crushed limestone. In unheated areas (*e.g.* exterior slabs) the thickness of 50 mm down crushed limestone sub-base should be increased to 250 mm. The crushed limestone should be placed in lifts no greater than 150 mm and compacted to 98% of the SPMDD.
6. All sub-base and base materials should be well-graded and free-draining.
7. A vapour barrier should be placed above the granular base and beneath the floor slab.
8. Floor slabs should be designed to resist all structural loads and to minimize slab cracking associated with movements as a result of swelling, shrinkage, and thermal expansion and contraction of the sub-grade soils.

# 6.0 Pavement Design

Recommendations for asphalt pavements for car parking areas and areas that will be subjected to heavier vehicular loads are provided in Table 6-1 and additional recommendations for sub-grade and base preparation are provided below.

**Table 6-1. Recommended Sections for Asphalts Pavements**

| Material | Layer Thickness | | Compaction Requirements |
|---|---|---|---|
| | Car Parking Areas | Heavy Vehicular Loads | |
| Asphalt | 75 mm | 75 mm | 98% Marshall Density |
| 20 mm down crushed limestone | 150 mm | 150 mm | 98% of the SPMDD |
| 50 mm down crushed limestone | 250 mm | 350 mm | 98% of the SPMDD |
| Non-Woven Geotextile (Geotex 801 or equivalent) | Optional | Required | Install as per manufacturer's recommendations |

1. For best long-term performance, organics, fill soils, and any other deleterious material should be stripped such that the sub-grade consists of native silty clay. Depending on final grades however it may not be economical to remove these layers in their entirety. In this regard, the sub-grade may consist of the existing fill, provided it is proof-rolled to confirm competency and all soft and silt areas are mitigated appropriately (discussed below).
2. Excavation should be completed with a backhoe equipped with a smooth bucket and operating from the edge of the excavation in order to minimize disturbance to the exposed sub-grade.
3. After excavation, the sub-grade should be inspected by qualified geotechnical personnel. The sub-grade should be proof-rolled with a fully loaded tandem axle truck to detect soft areas or silt. Soft and /or silt areas should be repaired as per directions provided by a geotechnical engineer. This will likely consist of excavating an additional 300 to 600 mm and placing a non-woven geotextile on the sub-grade and backfilling with a 50 mm down crushed limestone sub-base. The crushed limestone should be placed in lifts no greater than 150 mm and compacted to a minimum of 95% of the SPMDD.
4. The sub-grade should be protected from freezing, drying, or inundation with water. If any of these conditions occur the sub-grade should be scarified, moisture conditioned as appropriate, and re-compacted to a minimum of 95% of the SPMDD.

## 7.0 Site Drainage

Drainage adjacent to structures and exterior slabs should promote runoff away from the structures. A minimum gradient of about 2% should be used for both landscaped and paved areas and maintained throughout the life of the structures. Water discharge from roof leaders should be directed away from the structures.

## 8.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If sub-surface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

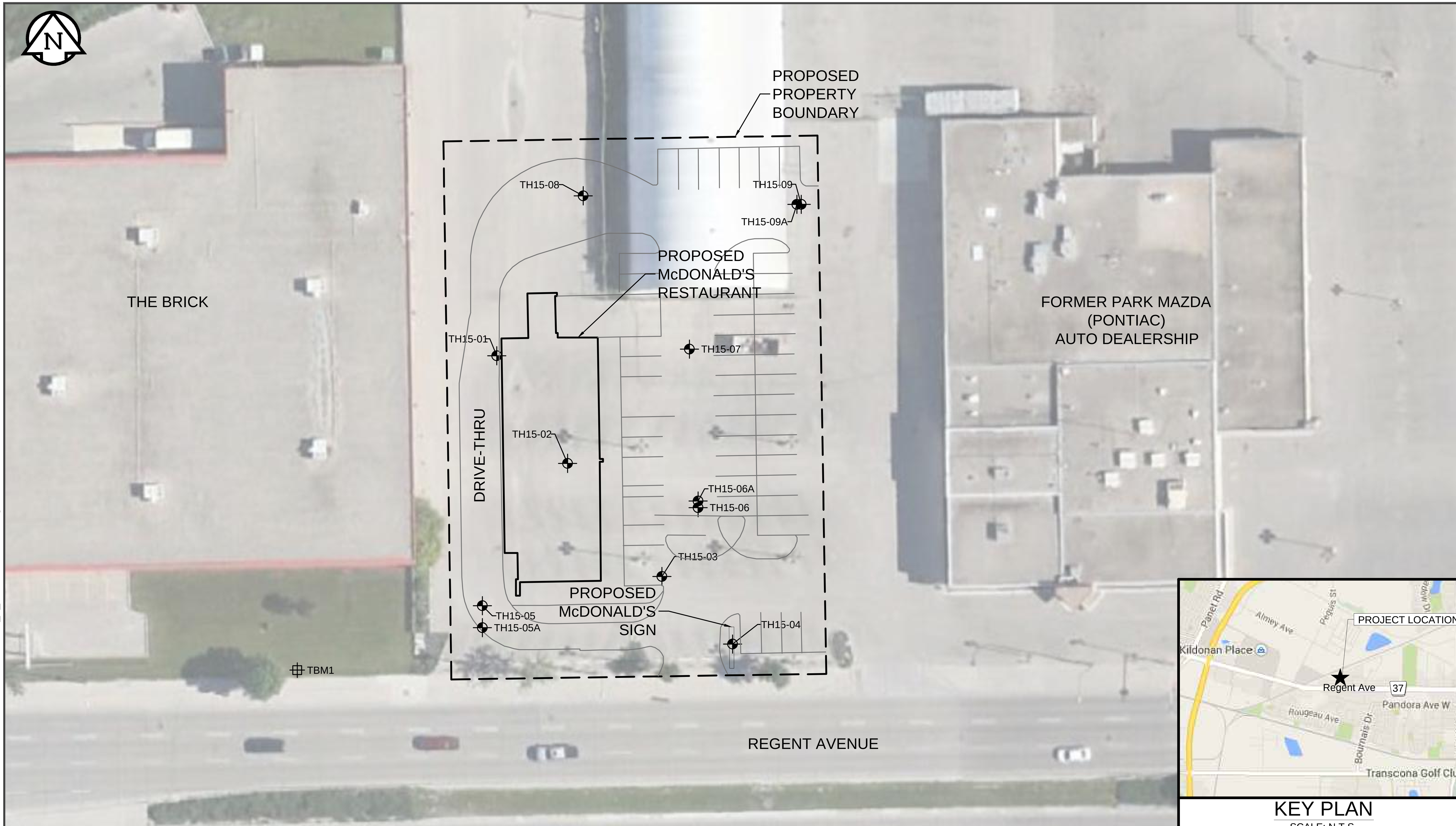
All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work, or a mutually executed standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of IBI Group Inc. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

# Figures

TREK GEOTECHNICAL

**0198 001 00**
IBI Group Inc.
McDonald's on Regent Avenue in Winnipeg, MB.




0 5 10 15 20m
SCALE : 1:500 (279mm x 432mm)

LEGEND :

- TEST HOLE (TREK, MARCH 12, 2015)
- TBM1 (ARROWHEAD AT TOP OF FIRE HYDRANT) - ELEV. 100.0m

NOTES :

1. AERIAL IMAGE FROM GOOGLE AERTH JUNE 22, 2012

Figure 01
Test Hole Location Plan

Tabloid (279mm x 432mm)
PLOT: 4/7/2015 8:49:14 AM
FILE NAME: FIG 001 2015-04-06 Site Plan 0_E_HA 0198 001 00.dwg

# Test Hole Logs

# EXPLANATION OF FIELD AND LABORATORY TESTING

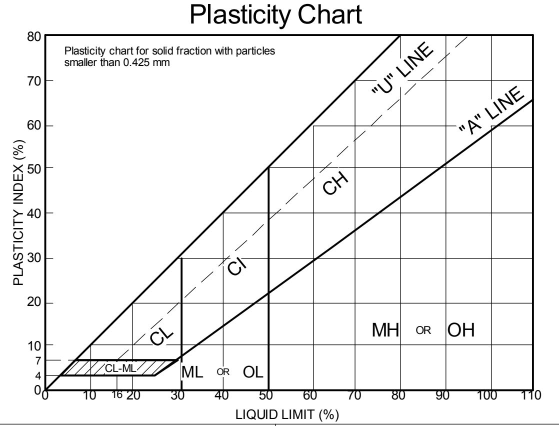
TREK GEOTECHNICAL

**GENERAL NOTES**

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

| Major Divisions | | | USCS Classification | Symbols | Typical Names | Laboratory Classification Criteria | | |
|---|---|---|---|---|---|---|---|---|
| Coarse-Grained soils (More than half the material is larger than No. 200 sieve size) | Gravels (More than half of coarse fraction is larger than 4.75 mm) | Clean gravel (Little or no fines) | GW | | Well-graded gravels, gravel-sand mixtures, little or no fines | Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent....... GW, GP, SW, SP; More than 12 percent....... GM, GC, SM, SC; 6 to 12 percent...... Borderline case4s requiring dual symbols* | $C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 | |
| | | | GP | | Poorly-graded gravels, gravel-sand mixtures, little or no fines | | Not meeting all gradation requirements for GW | |
| | | Gravel with fines (Appreciable amount of fines) | GM | | Silty gravels, gravel-sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | GC | | Clayey gravels, gravel-sand-silt mixtures | | Atterberg limits above "A" line or P.I. greater than 7 | |
| | Sands (More than half of coarse fraction is smaller than 4.75 mm) | Clean sands (Little or no fines) | SW | | Well-graded sands, gravelly sands, little or no fines | | $C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 | |
| | | | SP | | Poorly-graded sands, gravelly sands, little or no fines | | Not meeting all gradation requirements for SW | |
| | | Sands with fines (Appreciable amount of fines) | SM | | Silty sands, sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | SC | | Clayey sands, sand-clay mixtures | | Atterberg limits above "A" line or P.I. greater than 7 | |
| Fine-Grained soils (More than half the material is smaller than No. 200 sieve size) | Silts and Clays (Liquid limit less than 50) | | ML | | Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity | Plasticity Chart | | |
| | | | CL | | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | | | |
| | | | OL | | Organic silts and organic silty clays of low plasticity | | | |
| | Silts and Clays (Liquid limit greater than 50) | | MH | | Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts | | | |
| | | | CH | | Inorganic clays of high plasticity, fat clays | | | |
| | | | OH | | Organic clays of medium to high plasticity, organic silts | | | |
| | Highly Organic Soils | | Pt | | Peat and other highly organic soils | Von Post Classification Limit | Strong colour or odour, and often fibrous texture | |

## Plasticity Chart




| Material | | Particle Size: mm | Particle Size: ASTM Sieve sizes |
|---|---|---|---|
| Sand | Coarse | 2.00 to 4.75 | #10 to #4 |
| | Medium | 0.425 to 2.00 | #40 to #10 |
| | Fine | 0.075 to 0.425 | #200 to #40 |
| Silt or Clay | | < 0.075 | < #200 |

| Material | | Particle Size: mm | Particle Size: ASTM Sieve Sizes |
|---|---|---|---|
| Boulders | | > 300 | > 12 in. |
| Cobbles | | 75 to 300 | 3 in. to 12 in. |
| Gravel | Coarse | 19 to 75 | 3/4 in. to 3 in. |
| | Fine | 4.75 to 19 | #4 to 3/4 in. |

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

**Other Symbol Types**

| | | | | | |
|---|---|---|---|---|---|
| | Asphalt | | Bedrock (undifferentiated) | | Cobbles |
| | Concrete | | Limestone Bedrock | | Boulders and Cobbles |
| | Fill | | Cemented Shale | | Silt Till |
| | | | Non-Cemented Shale | | Clay Till |

# EXPLANATION OF FIELD AND LABORATORY TESTING

TREK GEOTECHNICAL

## LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level After Drilling as Indicated on Test Hole Logs

## FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

| TERM | EXAMPLES | PERCENTAGE |
|---|---|---|
| and | and CLAY | 35 to 50 percent |
| "y" or "ey" | clayey, silty | 20 to 35 percent |
| some | some silt | 10 to 20 percent |
| trace | trace gravel | 1 to 10 percent |

## TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

| Descriptive Terms | SPT (N) (Blows/300 mm) |
|---|---|
| Very loose | < 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very dense | > 50 |

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

| Descriptive Terms | SPT (N) (Blows/300 mm) |
|---|---|
| Very soft | < 2 |
| Soft | 2 to 4 |
| Firm | 4 to 8 |
| Stiff | 8 to 15 |
| Very stiff | 15 to 30 |
| Hard | > 30 |

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

| Descriptive Terms | Undrained Shear Strength (kPa) |
|---|---|
| Very soft | < 12 |
| Soft | 12 to 25 |
| Firm | 25 to 50 |
| Stiff | 50 to 100 |
| Very stiff | 100 to 200 |
| Hard | > 200 |

# Sub-Surface Log



TREK GEOTECHNICAL

| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.18 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.1 | | ASPHALT | | |
| 99.0 | | CRUSHED LIMESTONE - 25 mm down | Grab | G18 |
| 98.1 | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics, trace wood pieces - black, frozen, moist, medium plasticity | Grab | G19 |
| 98.0 | | SILT - some clay, light grey, frozen, moist, medium plasticity | Grab | G20 |
| 89.9 | | CLAY - silty, trace silt inclusions (< 15 mm dia.), trace sulphates - mottled brown and grey - frozen to 2.0 m - moist - high plasticity<br>- firm to stiff below 2.0 m<br>- trace sand below 8.2 m | Grab / Shelby Tube | G21, G22, T23, G24, T25, G26 |

Plot headings: Bulk Unit Wt (kN/m$^3$) 16 17 18 19 20 21; Particle Size (%) 0 20 40 60 80 100; PL MC LL 0 20 40 60 80 100; Undrained Shear Strength (kPa), Test Type: △ Torvane △, ✽ Pocket Pen. ✽, ⊠ Qu ⊠, ○ Field Vane ○; 0 25 50 75 100 125

Depth scale: 1 2 3 4 5 6 7 8 9

END OF TEST HOLE AT 9.1 m IN CLAY
Notes:
1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log



TREK GEOTECHNICAL

| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.27 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) Split Barrel (SB) Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number | Bulk Unit Wt (kN/m³) 16–21 / Particle Size (%) 0–100 / PL MC LL 0–100 | Undrained Shear Strength (kPa) 0–125 (Test Type: △ Torvane △, ✿ Pocket Pen. ✿, ⊠ Qu ⊠, ○ Field Vane ○) |
|---|---|---|---|---|---|---|
| 99.2 | | ASPHALT | | | | |
| 99.0 | | CRUSHED LIMESTONE - 25 mm down | Grab | G01 | | |
| | | CLAY (FILL) - silty, trace organics<br>- black, frozen, moist, medium plasticity | Grab | G02 | | |
| 98.2 | 1 | CLAY - silty<br>- dark brown<br>- frozen, moist, high plasticity | Grab | G03 | | |
| | | | Grab | G04 | | |
| 97.6 | | SILT - trace clay, light brown, dry to moist, compact, low plasticity | Grab | G05 | | |
| 97.3 | 2 | CLAY - silty, trace silt inclusions (< 15 mm dia.), trace sulphates<br>- mottled brown and grey<br>- moist, firm to stiff<br>- high plasticity | | | | |
| | 3 | | Grab | G06 | | |
| | | | Shelby Tube | T07 | | |
| | 4 | | | | | |
| | | - trace gravel at 4.6 m | Grab | G08 | | |
| | 5 | | | | | |
| | 6 | | Grab | G09 | | |
| | 7 | | Grab | G10 | | |
| | 8 | | | | | |
| | 9 | - trace till inclusions (< 5 mm dia.), grey, firm below 9.1 m | | | | |
| | 10 | | Shelby Tube | T11 | | |

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log

TREK GEOTECHNICAL

| Elevation (m) | Depth (m) | Soil Symbol | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|---|
| | 12 | | - soft below 12.2 m | | G12 |
| | 13 | | | | |
| | 14 | | | | G13 |
| 84.8 | | | SILT (TILL) - some clay to clayey, trace to some sand, trace gravel<br>- grey<br>- moist, loose<br>- medium plasticity<br>- some gravel to gravelly, some sand, trace cobbles, trace boulders below 15.2 m<br>- wet | | G14 |
| | 15 | | | | G15 |
| | 16 | | | | G16 |
| 82.5 | | | LIMESTONE BEDROCK (FRACTURED) | | |
| | 17 | | | | |
| | 18 | | | | G17 |
| 81.0 | | | | | |

Chart headings: Bulk Unit Wt (kN/m³) 16 17 18 19 20 21; Particle Size (%) 0 20 40 60 80 100; PL MC LL 0 20 40 60 80 100; Undrained Shear Strength (kPa); Test Type: △ Torvane △, ✤ Pocket Pen. ✤, ☒ Qu ☒, ○ Field Vane ○; 0 25 50 75 100 125

POWER AUGER REFUSAL AT 18.3 m in FRACTURED BEDROCK

Notes:

1. Seepage observed at 16.8 m. Water level measured at 10.1 m approximately 10 minutes after completion of drilling.
2. Test hole open to 16.2 m after completion of drilling.
3. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log



TREK GEOTECHNICAL

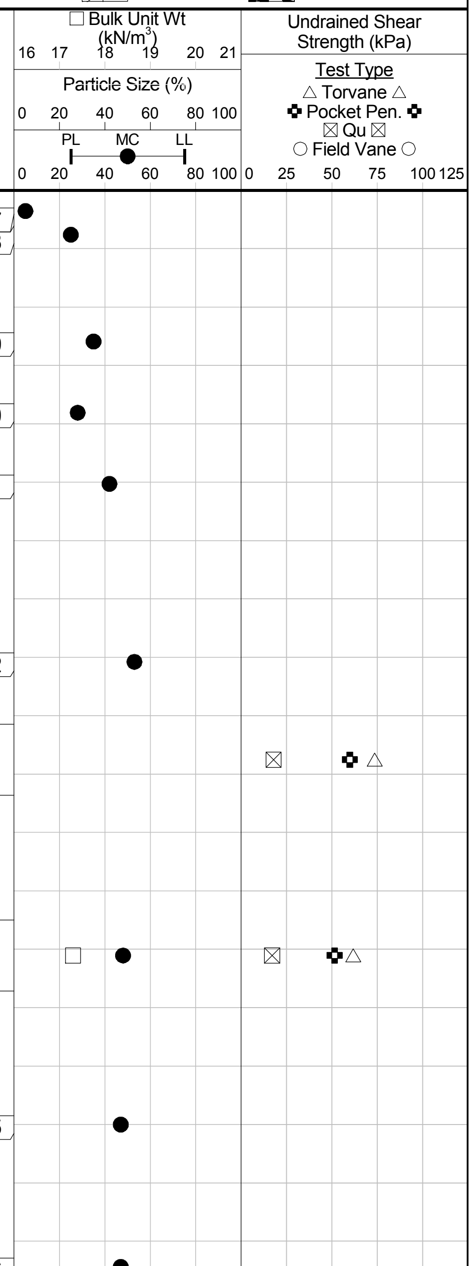
| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.35 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION |
|---|---|---|
| 99.3 | | ASPHALT |
| 99.2 | | CRUSHED LIMESTONE - 25 mm down |
| | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics<br>- dark brown and grey<br>- frozen, moist, high plasticity |
| 98.1 | | CLAY - silty<br>- grey, frozen, moist, high plasticity |
| 97.7 | | SILT - trace to some clay, light brown and grey, moist, firm, low to medium plasticity |
| 97.5 | | CLAY - silty, trace silt inclusions (< 5 mm dia.), trace sulphates<br>- mottled grey and brown<br>- moist, stiff<br>- high plasticity |
| | 4 | - trace sand, trace gravel below 4.0 m |
| | 8.8 | - grey, firm below 8.8 m |
| 90.1 | | END OF TEST HOLE AT 9.3 m IN CLAY |

| Sample Type | Sample Number |
|---|---|
| Grab | G27 |
| Grab | G28 |
| Grab | G29 |
| Grab | G30 |
| Grab | G31 |
| Grab | G32 |
| Shelby Tube | T33 |
| Shelby Tube | T34 |
| Grab | G35 |
| Grab | G36 |




END OF TEST HOLE AT 9.3 m IN CLAY

Notes:
1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log



| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.30 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.2 | | ASPHALT | | |
| 99.0 | | CRUSHED LIMESTONE - 25 mm down | Grab | G37 |
| 98.4 | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics - black, frozen, moist, high plasticity | Grab | G38 |
| 98.1 | 1 | CLAY - silty, dark grey, frozen, moist | | |
| 97.9 | | SILT - some clay, light grey, frozen, moist | Grab | G39 |
| 97.5 | | CLAY - silty, trace silt inclusions (< 5 mm dia.), trace sulphates - mottled brown and grey, frozen, moist, high plasticity | Grab | G40 |
| 97.2 | 2 | SILT - some clay, brown, moist, firm, low plasticity | Grab | G41 |
| | | CLAY - silty, trace silt inclusions (< 5 mm dia.), trace sulphates - mottled brown and grey - moist, stiff - high plasticity | | |
| | 4 | | Grab | G42 |
| | 5.5 | | Grab | G43 |
| | 6 | - trace sand, trace gravel below 5.9 m | | |
| | 7.5 | | Grab | G44 |
| | 8.5 | - grey, firm to stiff below 8.5 m | | |
| 90.2 | 9 | | Shelby Tube | T45 |

Chart columns: Bulk Unit Wt (kN/m³) 16 17 18 19 20 21; Particle Size (%) 0 20 40 60 80 100; PL MC LL 0 20 40 60 80 100; Undrained Shear Strength (kPa) 0 25 50 75 100 125; Test Type: △ Torvane △, ✪ Pocket Pen. ✪, ☒ Qu ☒, ○ Field Vane ○

END OF TEST HOLE AT 9.1 m IN CLAY
Notes:
1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log

TREK GEOTECHNICAL

| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.40 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa) — Test Type: △ Torvane △, ✪ Pocket Pen. ✪, ⊠ Qu ⊠, ○ Field Vane ○: 0 25 50 75 100 125

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.3 | | ASPHALT | | |
| 99.1 | | CRUSHED LIMESTONE - 25 mm down | Grab | G46 |
| 98.5 | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics<br>- dark grey, moist, frozen | Grab | G47 |
| | 1 | CLAY - silty, trace silt inclusions (< 5 mm dia.), trace sulphates<br>- mottled brown and grey<br>- frozen to 1.8 m<br>- moist<br>- high plasticity<br>- stiff below 1.8 m | Grab | G48 |
| | 2 | | | |
| | 3 | | Grab | G49 |
| | 4 | | Grab | G50 |
| 94.8 | | | | |

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:

1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.



**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log



TREK GEOTECHNICAL

| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.15 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Column headings: Elevation (m) | Depth (m) | Soil Symbol | MATERIAL DESCRIPTION | Sample Type | Sample Number | ☐ Bulk Unit Wt ($kN/m^3$) 16 17 18 19 20 21; Particle Size (%) 0 20 40 60 80 100; PL MC LL 0 20 40 60 80 100 | Undrained Shear Strength (kPa), Test Type: △ Torvane △, Pocket Pen., ☒ Qu ☒, ○ Field Vane ○; 0 25 50 75 100 125

| Elevation (m) | Depth (m) | Material Description | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.1 | | ASPHALT | | |
| 98.9 | | CRUSHED LIMESTONE - 25 mm down | | |
| | | CLAY - silty<br>- dark grey<br>- frozen to 1.8 m<br>- moist<br>- high plasticity | Grab | G64 |
| | | - mottled brown and grey, stiff below 1.8 m | Grab | G65 |
| | | | Grab | G66 |
| 94.6 | | | | |

Depth scale: 1, 2, 3, 4

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:

1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log



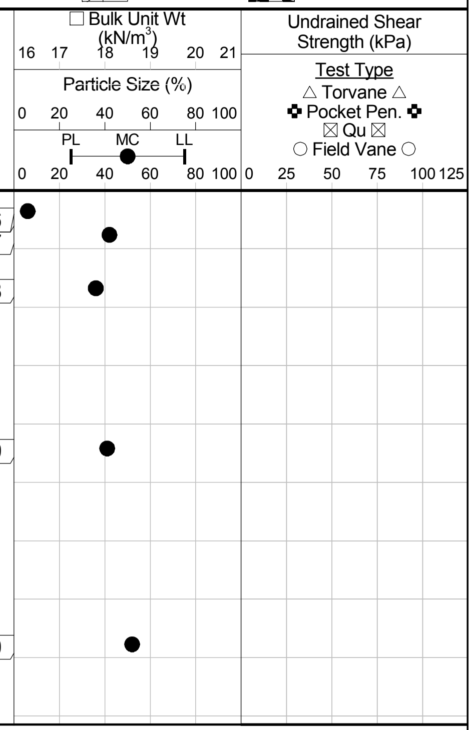
TREK GEOTECHNICAL

| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.14 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.1 | | ASPHALT | | |
| 98.9 | | SAND AND GRAVEL (FILL) - 25 mm down | G | G56 |
| 98.5 | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics, black, frozen, moist | G | G57 |
| | | CLAY - silty<br>- grey, frozen to 1.5 m, moist, high plasticity<br><br>- trace silt inclusions (< 5 mm dia.), trace sulphates, mottled grown and grey, stiff below 1.5 m | G | G58 |
| | | | G | G59 |
| | | | G | G60 |
| 94.6 | | | | |




END OF TEST HOLE AT 4.6 m IN CLAY
Notes:
1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

| | | | | | |
|---|---|---|---|---|---|
| **Logged By:** | Ryan Belbas | **Reviewed By:** | Ken Skaftfeld | **Project Engineer:** | Ryan Belbas |

TREK GEOTECHNICAL

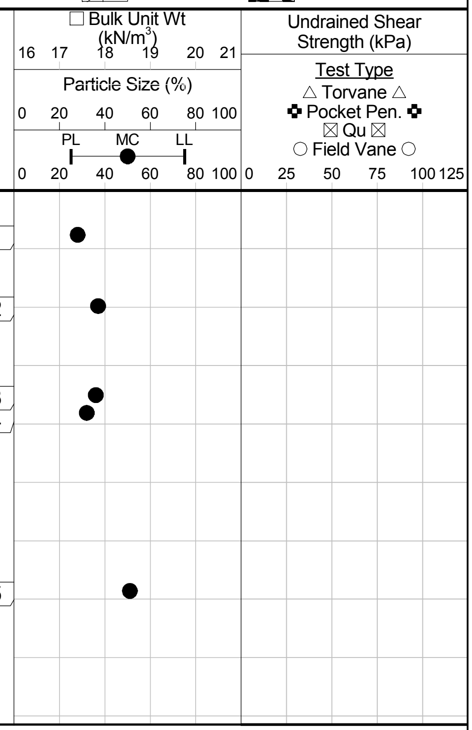
# Sub-Surface Log

**Client:** IBI Group
**Project Name:** McDonald's on Regent Avenue, Winnipeg, MB
**Contractor:** Subterranean Ltd.
**Method:** Soilmec STM-20
**Project Number:** 0198 001 00
**Location:** See Test Hole Location Plan (Figure 01)
**Ground Elevation:** 99.44 m
**Date Drilled:** March 12, 2015

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.4 | | ASPHALT | | |
| 99.2 | | CRUSHED LIMESTONE - 25 mm down | G | G51 |
| 98.7 | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics, dark brown, frozen, moist | | |
| | 1 | CLAY - silty<br>- mottled brown and grey<br>- frozen<br>- moist, high plasticity | G | G52 |
| 97.6 | | | G | G53 |
| 97.5 | 2 | SILT - some clay, light grey and brown, moist, compact, low to medium plasticity | G | G54 |
| | | CLAY - silty, trace silt inclusions (< 6 mm dia.), trace sulphates<br>- mottled brown and grey<br>- moist, stiff<br>- high plasticity | | |
| | 3 | | G | G55 |
| | 4 | | | |
| 94.9 | | | | |




END OF TEST HOLE AT 4.6 m IN CLAY
Notes:
1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Sub-Surface Log



TREK GEOTECHNICAL

| | | | |
|---|---|---|---|
| **Client:** | IBI Group | **Project Number:** | 0198 001 00 |
| **Project Name:** | McDonald's on Regent Avenue, Winnipeg, MB | **Location:** | See Test Hole Location Plan (Figure 01) |
| **Contractor:** | Subterranean Ltd. | **Ground Elevation:** | 99.19 m |
| **Method:** | Soilmec STM-20 | **Date Drilled:** | March 12, 2015 |

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

| Elevation (m) | Depth (m) | MATERIAL DESCRIPTION | Sample Type | Sample Number |
|---|---|---|---|---|
| 99.1 | | ASPHALT | | |
| 99.0 | | CLAY AND SAND (FILL) - trace gravel | | |
| 98.6 | | CLAY (FILL) - silty, trace sand, trace gravel, trace organics<br>- black, frozen, moist, medium plasticity | | |
| | 1 | CLAY - silty<br>- dark grey<br>- frozen to 2.0 m<br>- moist<br>- medium plascicity | G | G61 |
| | 2 | - trace silt inclusions (< 5 mm dia.), trace sulphates, mottled brown and grey, stiff, high plasticity below 2.0 m | G | G62 |
| | 3 | | | |
| | 4 | | G | G63 |
| 94.3 | | | | |

Chart columns: Bulk Unit Wt (kN/m³) 16 17 18 19 20 21; Particle Size (%) 0 20 40 60 80 100; PL MC LL 0 20 40 60 80 100; Undrained Shear Strength (kPa) — Test Type: △ Torvane △, ✪ Pocket Pen. ✪, ⊠ Qu ⊠, ○ Field Vane ○ — 0 25 50 75 100 125

END OF TEST HOLE AT 4.9 m IN CLAY
Notes:
1. No seepage or sloughing observed.
2. Test hole backfilled with auger cuttings and topped with sand and gravel.

**Logged By:** Ryan Belbas **Reviewed By:** Ken Skaftfeld **Project Engineer:** Ryan Belbas

# Appendix A

# Laboratory Testing Results

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# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |
| | |
| **Test Hole** | TH15-02 |
| **Sample #** | T7 |
| **Depth (m)** | 3.0 - 3.6 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 520

| **Bottom - 3.57 m** | 3.415 m | 3.26 m | **Top - 3.05 m** |
|---|---|---|---|
| Kept | Qu<br>$\gamma_{Bulk}$ | Pp<br>Tv<br>Visual<br>Moisture Content | Slough |
| 155 mm | 160 mm | 190 mm | 15 mm |

## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace roots | |
| Trace silt inclusions (<5mm) | |
| Trace oxidation | |
| **Color** | Grey |
| **Moisture** | Moist |
| **Consistency** | Stiff |
| **Plasticity** | High plasticity |
| **Structure** | Blocky |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.6 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 58.8 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 0.50 |
| | **2** | 0.75 |
| | **3** | 1.25 |
| | **Average** | 0.83 |
| **Undrained Shear Strength (kPa)** | | 40.9 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | F142 |
| **Mass tare (g)** | 8.5 |
| **Mass wet + tare (g)** | 356.4 |
| **Mass dry + tare (g)** | 237.1 |
| **Moisture %** | 52.2% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1052.50 |
| **Length (mm)** | **1** | 149.91 |
| | **2** | 150.18 |
| | **3** | 150.10 |
| | **4** | 150.39 |
| **Average Length (m)** | | 0.150 |
| **Diam. (mm)** | **1** | 72.00 |
| | **2** | 71.33 |
| | **3** | 72.03 |
| | **4** | 72.04 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.09E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 17.0 |
| **Bulk Unit Weight (pcf)** | | 107.9 |
| **Dry Unit Weight ($kN/m^3$)** | | 11.1 |
| **Dry Unit Weight (pcf)** | | 70.9 |

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# Unconfined Compressive Strength
**ASTM D2166**

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-02 |
| **Sample #** | T7 |
| **Depth (m)** | 3.0 - 3.6 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Unconfined Strength

| | kPa | ksf |
|---|---|---|
| **Max $q_u$** | 45.6 | 1.0 |
| **Max $S_u$** | 22.8 | 0.5 |

## Specimen Data

**Description** Clay - Silty, Trace roots , Trace silt inclusions (<5mm), Trace oxidation, Grey , Moist, Stiff, High plasticity, Blocky,

| | | | | | |
|---|---|---|---|---|---|
| **Length** | 150.1 | (mm) | **Moisture %** | 52% | |
| **Diameter** | 71.9 | (mm) | **Bulk Unit Wt.** | 17.0 | (kN/m$^3$) |
| **L/D Ratio** | 2.1 | | **Dry Unit Wt.** | 11.1 | (kN/m$^3$) |
| **Initial Area** | 0.00405 | (m$^2$) | **Liquid Limit** | - | |
| **Load Rate** | 1.00 | (%/min) | **Plastic Limit** | - | |
| | | | **Plasticity Index** | - | |

## Undrained Shear Strength Tests

### Torvane

| **Reading** | **Undrained Shear Strength** | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.60 | 58.8 | 1.23 |
| **Vane Size** | | |
| m | | |

### Pocket Penetrometer

| **Reading** | **Undrained Shear Strength** | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.50 | 24.5 | 0.51 |
| 0.75 | 36.8 | 0.77 |
| 1.25 | 61.3 | 1.28 |
| **0.83** | **40.9** | **0.85** |

## Failure Geometry

Sketch:

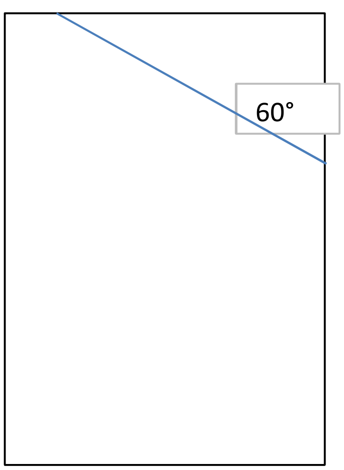


Photo:

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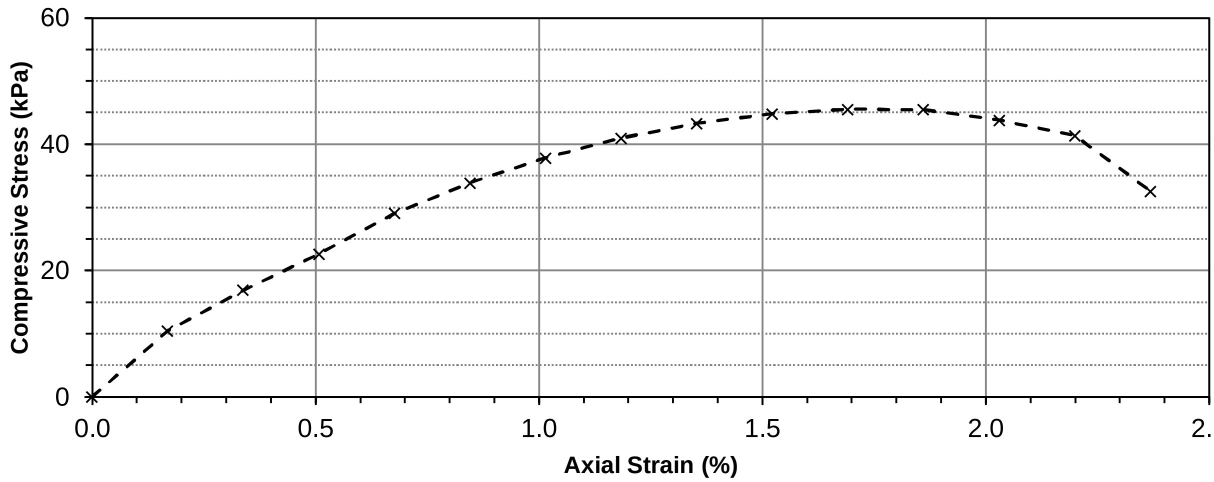
# Unconfined Compressive Strength
**ASTM D2166**

**Project No.** 0198 001 00
**Client** IBI Group
**Project** McDonalds on Regent

## Unconfined Compression Test Graph




## Unconfined Compression Test Data

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.0000 | 0.00 | 0.004055 | 0.0 | 0.00 | 0.00 |
| 10 | 13 | 0.2540 | 0.17 | 0.004061 | 42.5 | 10.47 | 5.24 |
| 20 | 21 | 0.5080 | 0.34 | 0.004068 | 68.8 | 16.91 | 8.45 |
| 30 | 28 | 0.7620 | 0.51 | 0.004075 | 92.3 | 22.65 | 11.32 |
| 40 | 36 | 1.0160 | 0.68 | 0.004082 | 118.7 | 29.07 | 14.54 |
| 50 | 42 | 1.2700 | 0.85 | 0.004089 | 138.5 | 33.86 | 16.93 |
| 60 | 47 | 1.5240 | 1.02 | 0.004096 | 155.0 | 37.83 | 18.92 |
| 70 | 51 | 1.7780 | 1.18 | 0.004103 | 168.1 | 40.98 | 20.49 |
| 80 | 54 | 2.0320 | 1.35 | 0.004110 | 178.0 | 43.31 | 21.66 |
| 90 | 56 | 2.2860 | 1.52 | 0.004117 | 184.6 | 44.85 | 22.42 |
| 100 | 57 | 2.5400 | 1.69 | 0.004124 | 187.9 | 45.57 | 22.78 |
| 110 | 57 | 2.7940 | 1.86 | 0.004131 | 187.9 | 45.49 | 22.74 |
| 120 | 55 | 3.0480 | 2.03 | 0.004139 | 181.4 | 43.82 | 21.91 |
| 130 | 52 | 3.3020 | 2.20 | 0.004146 | 171.4 | 41.35 | 20.68 |
| 140 | 41 | 3.5560 | 2.37 | 0.004153 | 135.2 | 32.55 | 16.28 |

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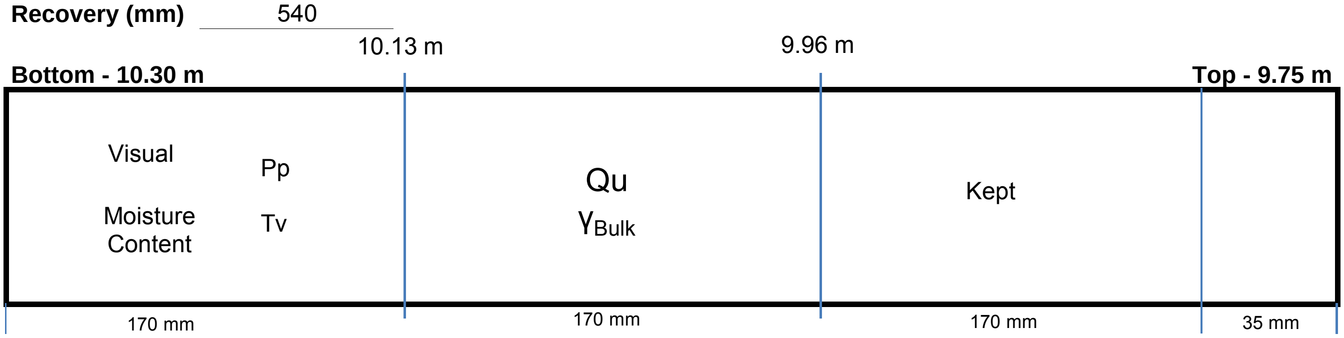
# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |
| | |
| **Test Hole** | TH15-02 |
| **Sample #** | T11 |
| **Depth (m)** | 9.8 - 10.3 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 540




## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace silt inclusions (<10mm) | |
| Trace sand | |
| Trace gravel (<10mm) | |
| | |
| | |
| | |
| **Color** | Grey |
| **Moisture** | Moist |
| **Consistency** | Firm - Stiff |
| **Plasticity** | High plasticity |
| **Structure** | Homogenous |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.54 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 53.0 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 0.60 |
| | **2** | 0.60 |
| | **3** | 0.75 |
| | **Average** | 0.65 |
| **Undrained Shear Strength (kPa)** | | 31.9 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | E57 |
| **Mass tare (g)** | 8.8 |
| **Mass wet + tare (g)** | 362.5 |
| **Mass dry + tare (g)** | 248.9 |
| **Moisture %** | 47.3% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1093.10 |
| **Length (mm)** | **1** | 150.76 |
| | **2** | 150.77 |
| | **3** | 150.50 |
| | **4** | 150.80 |
| **Average Length (m)** | | 0.151 |
| **Diam. (mm)** | **1** | 72.19 |
| | **2** | 71.30 |
| | **3** | 71.21 |
| | **4** | 71.40 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.06E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 17.7 |
| **Bulk Unit Weight (pcf)** | | 112.7 |
| **Dry Unit Weight ($kN/m^3$)** | | 12.0 |
| **Dry Unit Weight (pcf)** | | 76.5 |

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# Unconfined Compressive Strength
**ASTM D2166**

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-02 |
| **Sample #** | T11 |
| **Depth (m)** | 9.8 - 10.3 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Unconfined Strength

| | kPa | ksf |
|---|---|---|
| **Max $q_u$** | 90.1 | 1.9 |
| **Max $S_u$** | 45.1 | 0.9 |

## Specimen Data

**Description** Clay - Silty, Trace silt inclusions (<10mm), Trace sand , Trace gravel (<10mm), Grey, Moist, Firm - Stiff, High plasticity, Homogenous,

| | | | | | |
|---|---|---|---|---|---|
| **Length** | 150.7 | (mm) | **Moisture %** | 47% | |
| **Diameter** | 71.5 | (mm) | **Bulk Unit Wt.** | 17.7 | ($kN/m^3$) |
| **L/D Ratio** | 2.1 | | **Dry Unit Wt.** | 12.0 | ($kN/m^3$) |
| **Initial Area** | 0.00402 | ($m^2$) | **Liquid Limit** | - | |
| **Load Rate** | 1.00 | (%/min) | **Plastic Limit** | - | |
| | | | **Plasticity Index** | - | |

## Undrained Shear Strength Tests

### Torvane

| **Reading** | **Undrained Shear Strength** | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.54 | 53.0 | 1.11 |
| **Vane Size** | | |
| m | | |

### Pocket Penetrometer

| **Reading** | **Undrained Shear Strength** | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.60 | 29.4 | 0.61 |
| 0.60 | 29.4 | 0.61 |
| 0.75 | 36.8 | 0.77 |
| **0.65** | **31.9** | **0.67** |

## Failure Geometry

Sketch:

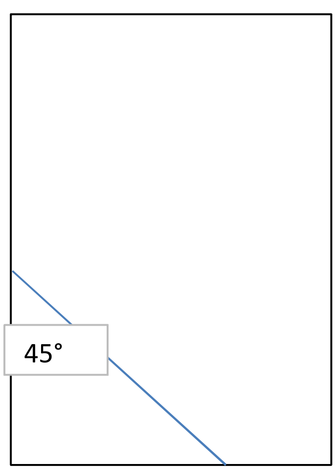


Photo:

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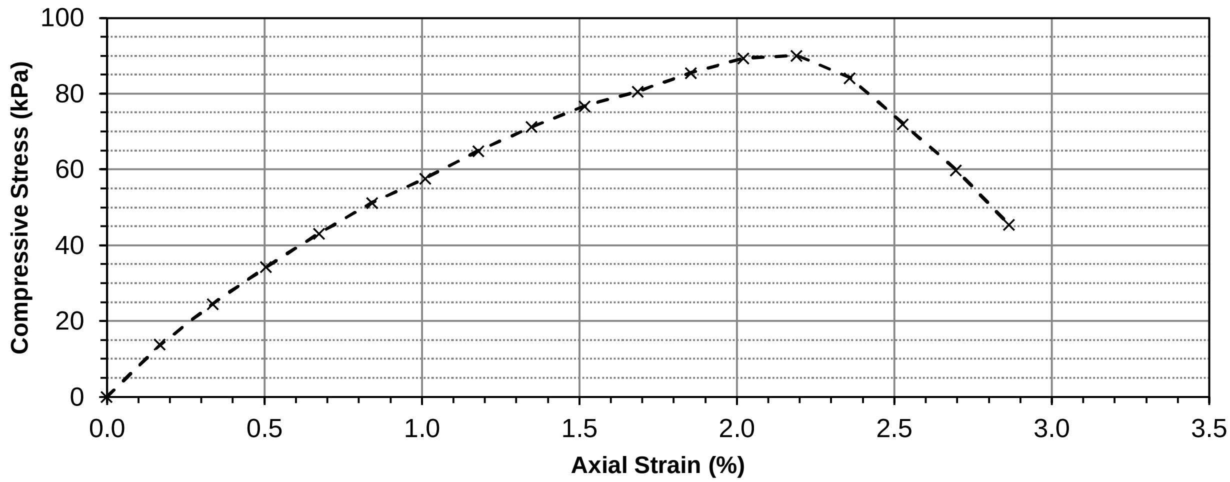
# Unconfined Compressive Strength
**ASTM D2166**

**Project No.** 0198 001 00
**Client** IBI Group
**Project** McDonalds on Regent

## Unconfined Compression Test Graph




## Unconfined Compression Test Data

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.0000 | 0.00 | 0.004018 | 0.0 | 0.00 | 0.00 |
| 10 | 17 | 0.2540 | 0.17 | 0.004025 | 55.7 | 13.83 | 6.91 |
| 20 | 30 | 0.5080 | 0.34 | 0.004032 | 98.9 | 24.54 | 12.27 |
| 30 | 42 | 0.7620 | 0.51 | 0.004038 | 138.5 | 34.29 | 17.14 |
| 40 | 53 | 1.0160 | 0.67 | 0.004045 | 174.7 | 43.19 | 21.60 |
| 50 | 63 | 1.2700 | 0.84 | 0.004052 | 207.7 | 51.27 | 25.63 |
| 60 | 71 | 1.5240 | 1.01 | 0.004059 | 234.1 | 57.68 | 28.84 |
| 70 | 80 | 1.7780 | 1.18 | 0.004066 | 263.8 | 64.88 | 32.44 |
| 80 | 88 | 2.0320 | 1.35 | 0.004073 | 290.2 | 71.24 | 35.62 |
| 90 | 95 | 2.2860 | 1.52 | 0.004080 | 313.2 | 76.77 | 38.38 |
| 100 | 100 | 2.5400 | 1.69 | 0.004087 | 329.7 | 80.67 | 40.34 |
| 110 | 106 | 2.7940 | 1.85 | 0.004094 | 349.9 | 85.47 | 42.73 |
| 120 | 111 | 3.0480 | 2.02 | 0.004101 | 366.8 | 89.43 | 44.72 |
| 130 | 112 | 3.3020 | 2.19 | 0.004108 | 370.1 | 90.10 | 45.05 |
| 140 | 105 | 3.5560 | 2.36 | 0.004115 | 346.6 | 84.22 | 42.11 |
| 150 | 90 | 3.8100 | 2.53 | 0.004122 | 296.7 | 71.99 | 35.99 |
| 160 | 75 | 4.0640 | 2.70 | 0.004129 | 247.3 | 59.88 | 29.94 |
| 170 | 57 | 4.3180 | 2.87 | 0.004136 | 187.9 | 45.43 | 22.72 |

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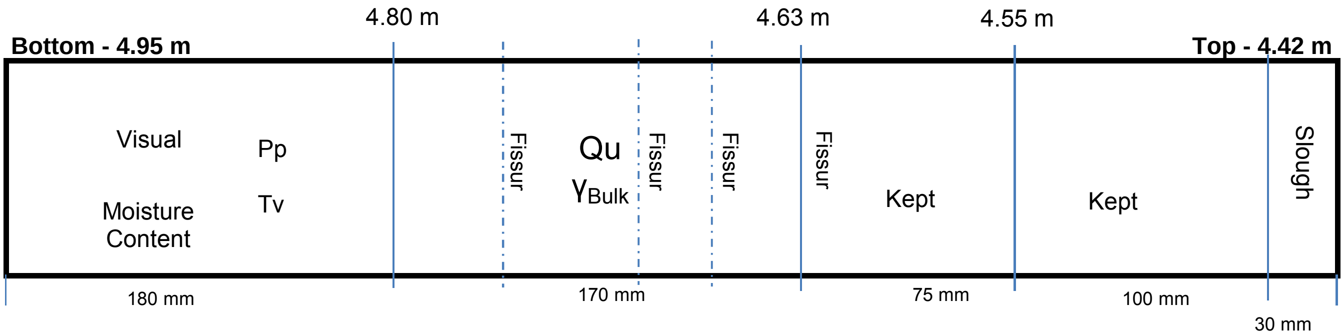
# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-01 |
| **Sample #** | T23 |
| **Depth (m)** | 4.4 - 5.0 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 555




## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace organics | |
| Trace silt inclusions (<15mm) | |
| Trace oxidation | |
| Trace sulfide inclusion (<25mm) | |
| Trace gravel (<10mm) | |
| Trace sand | |
| **Color** | Mottled grey & brown |
| **Moisture** | Moist |
| **Consistency** | Stiff |
| **Plasticity** | High plasticity |
| **Structure** | Homogenous |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.8 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 78.5 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 1.40 |
| | **2** | 1.30 |
| | **3** | 1.50 |
| | **Average** | 1.40 |
| **Undrained Shear Strength (kPa)** | | 68.6 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | F7 |
| **Mass tare (g)** | 8.4 |
| **Mass wet + tare (g)** | 393.0 |
| **Mass dry + tare (g)** | 266.6 |
| **Moisture %** | 49.0% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1074.90 |
| **Length (mm)** | **1** | 151.52 |
| | **2** | 151.52 |
| | **3** | 151.38 |
| | **4** | 151.65 |
| **Average Length (m)** | | 0.152 |
| **Diam. (mm)** | **1** | 72.35 |
| | **2** | 71.61 |
| | **3** | 72.64 |
| | **4** | 72.73 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.23E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 16.9 |
| **Bulk Unit Weight (pcf)** | | 107.8 |
| **Dry Unit Weight ($kN/m^3$)** | | 11.4 |
| **Dry Unit Weight (pcf)** | | 72.4 |

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# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-01 |
| **Sample #** | T25 |
| **Depth (m)** | 7.6 - 8.3 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 715

| **Bottom - 8.34 m** | 8.19 m | 8.02 m | 7.85 m | **Top - 7.62 m** |
|---|---|---|---|---|
| Kept | Qu<br>$\gamma_{Bulk}$ | Fissur | Visual<br>Moisture Content | Pp<br>Tv |
| 155 mm | 170 mm | | 170 mm | 225 mm |

## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace roots | |
| Trace silt inclusions (<10mm) | |
| Trace sand | |
| | |
| | |
| | |
| **Color** | Mottled grey & brown |
| **Moisture** | Moist |
| **Consistency** | Firm - Stiff |
| **Plasticity** | High plasticity |
| **Structure** | Blocky |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.69 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 67.7 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 1.30 |
| | **2** | 1.00 |
| | **3** | 1.20 |
| | **Average** | 1.17 |
| **Undrained Shear Strength (kPa)** | | 57.2 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | W79 |
| **Mass tare (g)** | 8.4 |
| **Mass wet + tare (g)** | 402.7 |
| **Mass dry + tare (g)** | 272.9 |
| **Moisture %** | 49.1% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1089.80 |
| **Length (mm)** | **1** | 149.27 |
| | **2** | 149.37 |
| | **3** | 150.08 |
| | **4** | 149.97 |
| **Average Length (m)** | | 0.150 |
| **Diam. (mm)** | **1** | 71.23 |
| | **2** | 72.06 |
| | **3** | 71.36 |
| | **4** | 71.55 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.02E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 17.8 |
| **Bulk Unit Weight (pcf)** | | 113.1 |
| **Dry Unit Weight ($kN/m^3$)** | | 11.9 |
| **Dry Unit Weight (pcf)** | | 75.8 |

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# Unconfined Compressive Strength
**ASTM D2166**

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-01 |
| **Sample #** | T25 |
| **Depth (m)** | 7.6 - 8.3 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 17-Mar-15 |
| **Technician** | Daniel Wiebe |

## Unconfined Strength

| | kPa | ksf |
|---|---|---|
| **Max $q_u$** | 83.5 | 1.7 |
| **Max $S_u$** | 41.7 | 0.9 |

## Specimen Data

**Description** Clay - Silty, Trace roots, Trace silt inclusions (<10mm), Trace sand, Mottled grey & brown , Moist, Firm - Stiff, High plasticity, Blocky,

| | | | | | |
|---|---|---|---|---|---|
| **Length** | 149.7 | (mm) | **Moisture %** | 49% | |
| **Diameter** | 71.6 | (mm) | **Bulk Unit Wt.** | 17.8 | ($kN/m^3$) |
| **L/D Ratio** | 2.1 | | **Dry Unit Wt.** | 11.9 | ($kN/m^3$) |
| **Initial Area** | 0.00402 | ($m^2$) | **Liquid Limit** | - | |
| **Load Rate** | 1.00 | (%/min) | **Plastic Limit** | - | |
| | | | **Plasticity Index** | - | |

## Undrained Shear Strength Tests

### Torvane

| Reading | Undrained Shear Strength | |
|---|---|---|
| tsf | kPa | ksf |
| 0.69 | 67.7 | 1.41 |
| **Vane Size** | | |
| m | | |

### Pocket Penetrometer

| Reading | Undrained Shear Strength | |
|---|---|---|
| tsf | kPa | ksf |
| 1.30 | 63.8 | 1.33 |
| 1.00 | 49.1 | 1.02 |
| 1.20 | 58.9 | 1.23 |
| **1.17** | **57.2** | **1.20** |

## Failure Geometry

Sketch:

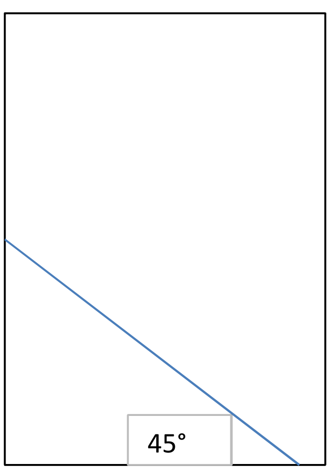


Photo:

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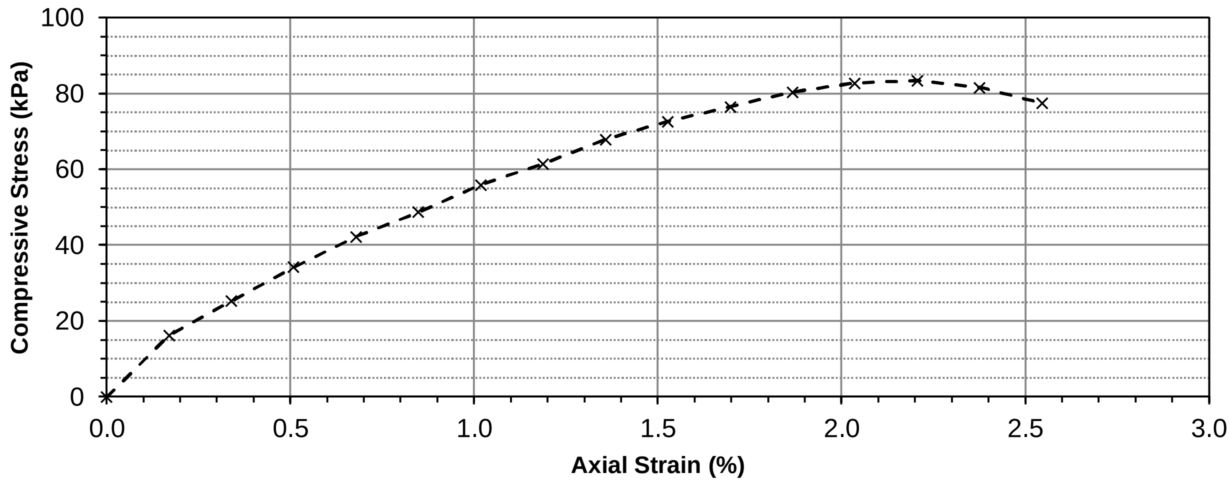
# Unconfined Compressive Strength
**ASTM D2166**

**Project No.** 0198 001 00
**Client** IBI Group
**Project** McDonalds on Regent

## Unconfined Compression Test Graph




## Unconfined Compression Test Data

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.0000 | 0.00 | 0.004021 | 0.0 | 0.00 | 0.00 |
| 10 | 20 | 0.2540 | 0.17 | 0.004028 | 65.5 | 16.26 | 8.13 |
| 20 | 31 | 0.5080 | 0.34 | 0.004034 | 102.2 | 25.34 | 12.67 |
| 30 | 42 | 0.7620 | 0.51 | 0.004041 | 138.5 | 34.26 | 17.13 |
| 40 | 52 | 1.0160 | 0.68 | 0.004048 | 171.4 | 42.35 | 21.17 |
| 50 | 60 | 1.2700 | 0.85 | 0.004055 | 197.8 | 48.78 | 24.39 |
| 60 | 69 | 1.5240 | 1.02 | 0.004062 | 227.5 | 56.00 | 28.00 |
| 70 | 76 | 1.7780 | 1.19 | 0.004069 | 250.6 | 61.58 | 30.79 |
| 80 | 84 | 2.0320 | 1.36 | 0.004076 | 276.9 | 67.94 | 33.97 |
| 90 | 90 | 2.2860 | 1.53 | 0.004083 | 296.7 | 72.67 | 36.34 |
| 100 | 95 | 2.5400 | 1.70 | 0.004090 | 313.2 | 76.57 | 38.29 |
| 110 | 100 | 2.7940 | 1.87 | 0.004097 | 329.7 | 80.47 | 40.23 |
| 120 | 103 | 3.0480 | 2.04 | 0.004104 | 339.8 | 82.79 | 41.40 |
| 130 | 104 | 3.3020 | 2.21 | 0.004111 | 343.2 | 83.47 | 41.73 |
| 140 | 102 | 3.5560 | 2.38 | 0.004119 | 336.4 | 81.68 | 40.84 |
| 150 | 97 | 3.8100 | 2.55 | 0.004126 | 319.8 | 77.52 | 38.76 |

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# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-03 |
| **Sample #** | T33 |
| **Depth (m)** | 4.6 - 5.1 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 18-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 475

| Bottom - 5.05 m | 4.88 m | 4.72 m | | Top - 4.57 m |
|---|---|---|---|---|
| Kept | Qu<br>$\gamma_{Bulk}$ | Visual<br>Moisture Content | Pp<br>Tv | |
| 165 mm | 160 mm | 100 mm | | 50 mm |

## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace silt inclusions (<3mm) | |
| Trace precipitate | |
| **Color** | Mottled grey & brown |
| **Moisture** | Moist |
| **Consistency** | Firm |
| **Plasticity** | High plasticity |
| **Structure** | Laminations |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.75 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 73.6 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 1.20 |
| | **2** | 1.20 |
| | **3** | 1.25 |
| | **Average** | 1.22 |
| **Undrained Shear Strength (kPa)** | | 59.7 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | A23 |
| **Mass tare (g)** | 8.5 |
| **Mass wet + tare (g)** | 408.4 |
| **Mass dry + tare (g)** | 264.8 |
| **Moisture %** | 56.0% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1037.60 |
| **Length (mm)** | **1** | 149.76 |
| | **2** | 149.85 |
| | **3** | 149.86 |
| | **4** | 150.07 |
| **Average Length (m)** | | 0.150 |
| **Diam. (mm)** | **1** | 72.87 |
| | **2** | 72.03 |
| | **3** | 71.81 |
| | **4** | 72.16 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.14E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 16.6 |
| **Bulk Unit Weight (pcf)** | | 105.5 |
| **Dry Unit Weight ($kN/m^3$)** | | 10.6 |
| **Dry Unit Weight (pcf)** | | 67.6 |

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# Unconfined Compressive Strength

**ASTM D2166**

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-03 |
| **Sample #** | T33 |
| **Depth (m)** | 4.6 - 5.1 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 18-Mar-15 |
| **Technician** | Daniel Wiebe |

## Unconfined Strength

| | kPa | ksf |
|---|---|---|
| **Max $q_u$** | 35.8 | 0.7 |
| **Max $S_u$** | 17.9 | 0.4 |

## Specimen Data

**Description** Clay - Silty, Trace silt inclusions (<3mm), Trace precipitate , Mottled grey & brown, Moist, Firm, High plasticity, Laminations,

| | | | | | |
|---|---|---|---|---|---|
| **Length** | 149.9 | (mm) | **Moisture %** | 56% | |
| **Diameter** | 72.2 | (mm) | **Bulk Unit Wt.** | 16.6 | ($kN/m^3$) |
| **L/D Ratio** | 2.1 | | **Dry Unit Wt.** | 10.6 | ($kN/m^3$) |
| **Initial Area** | 0.00410 | ($m^2$) | **Liquid Limit** | - | |
| **Load Rate** | 1.00 | (%/min) | **Plastic Limit** | - | |
| | | | **Plasticity Index** | - | |

## Undrained Shear Strength Tests

### Torvane

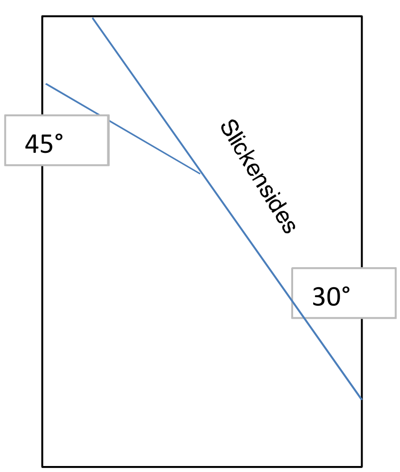
| **Reading** | **Undrained Shear Strength** | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.75 | 73.6 | 1.54 |
| **Vane Size** | | |
| m | | |

### Pocket Penetrometer

| **Reading** | **Undrained Shear Strength** | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 1.20 | 58.9 | 1.23 |
| 1.20 | 58.9 | 1.23 |
| 1.25 | 61.3 | 1.28 |
| **1.22** | **59.7** | **1.25** |

## Failure Geometry

Sketch:

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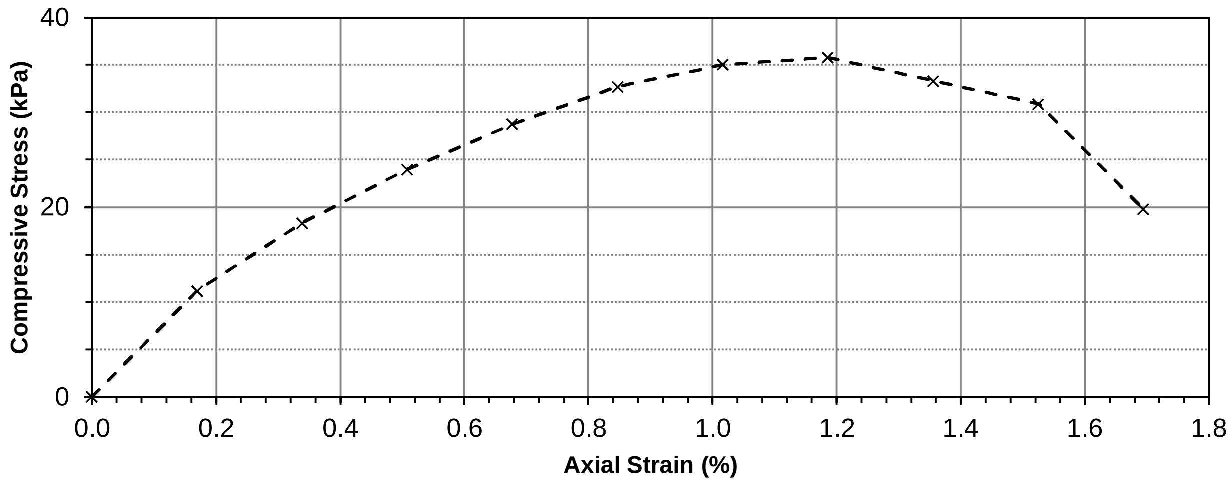
# Unconfined Compressive Strength
**ASTM D2166**

**Project No.** 0198 001 00
**Client** IBI Group
**Project** McDonalds on Regent

## Unconfined Compression Test Graph




## Unconfined Compression Test Data

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.0000 | 0.00 | 0.004096 | 0.0 | 0.00 | 0.00 |
| 10 | 14 | 0.2540 | 0.17 | 0.004103 | 45.8 | 11.17 | 5.58 |
| 20 | 23 | 0.5080 | 0.34 | 0.004110 | 75.3 | 18.33 | 9.17 |
| 30 | 30 | 0.7620 | 0.51 | 0.004117 | 98.9 | 24.03 | 12.01 |
| 40 | 36 | 1.0160 | 0.68 | 0.004124 | 118.7 | 28.78 | 14.39 |
| 50 | 41 | 1.2700 | 0.85 | 0.004131 | 135.2 | 32.72 | 16.36 |
| 60 | 44 | 1.5240 | 1.02 | 0.004138 | 145.1 | 35.05 | 17.53 |
| 70 | 45 | 1.7780 | 1.19 | 0.004145 | 148.3 | 35.79 | 17.89 |
| 80 | 42 | 2.0320 | 1.36 | 0.004152 | 138.5 | 33.35 | 16.67 |
| 90 | 39 | 2.2860 | 1.53 | 0.004160 | 128.6 | 30.92 | 15.46 |
| 100 | 25 | 2.5400 | 1.69 | 0.004167 | 82.4 | 19.78 | 9.89 |

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# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-03 |
| **Sample #** | T34 |
| **Depth (m)** | 6.2 - 6.7 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 18-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 503

**Bottom - 6.75 m** | 6.58 m | 6.41 m | **Top - 6.25 m**

| Kept | Qu<br>$\gamma_{Bulk}$ | Visual<br>Moisture Content<br>Pp<br>Tv | |
|---|---|---|---|
| 170 mm | 173 mm | 120 mm | 40 mm |

## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace silt inclusions (<20mm) | |
| Trace sand (<3mm) | |
| **Color** | Mottled grey & brown |
| **Moisture** | Moist |
| **Consistency** | Firm |
| **Plasticity** | High plasticity |
| **Structure** | Blocky |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.63 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 61.8 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 1.00 |
| | **2** | 0.90 |
| | **3** | 1.25 |
| | **Average** | 1.05 |
| **Undrained Shear Strength (kPa)** | | 51.5 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | F91 |
| **Mass tare (g)** | 8.4 |
| **Mass wet + tare (g)** | 437.6 |
| **Mass dry + tare (g)** | 298.4 |
| **Moisture %** | 48.0% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1076.20 |
| **Length (mm)** | **1** | 149.60 |
| | **2** | 149.63 |
| | **3** | 149.07 |
| | **4** | 149.34 |
| **Average Length (m)** | | 0.149 |
| **Diam. (mm)** | **1** | 72.38 |
| | **2** | 71.99 |
| | **3** | 72.29 |
| | **4** | 72.08 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.11E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 17.3 |
| **Bulk Unit Weight (pcf)** | | 109.9 |
| **Dry Unit Weight ($kN/m^3$)** | | 11.7 |
| **Dry Unit Weight (pcf)** | | 74.2 |

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# Unconfined Compressive Strength
**ASTM D2166**

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |

| | |
|---|---|
| **Test Hole** | TH15-03 |
| **Sample #** | T34 |
| **Depth (m)** | 6.2 - 6.7 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 18-Mar-15 |
| **Technician** | Daniel Wiebe |

## Unconfined Strength

| | kPa | ksf |
|---|---|---|
| **Max $q_u$** | 34.3 | 0.7 |
| **Max $S_u$** | 17.1 | 0.4 |

## Specimen Data

**Description** Clay - Silty, Trace silt inclusions (<20mm), Trace sand (<3mm) , Mottled grey & brown, Moist, Firm, High plasticity, Blocky,

| | | | | | |
|---|---|---|---|---|---|
| **Length** | 149.4 | (mm) | **Moisture %** | 48% | |
| **Diameter** | 72.2 | (mm) | **Bulk Unit Wt.** | 17.3 | ($kN/m^3$) |
| **L/D Ratio** | 2.1 | | **Dry Unit Wt.** | 11.7 | ($kN/m^3$) |
| **Initial Area** | 0.00409 | ($m^2$) | **Liquid Limit** | - | |
| **Load Rate** | 1.00 | (%/min) | **Plastic Limit** | - | |
| | | | **Plasticity Index** | - | |

## Undrained Shear Strength Tests

### Torvane

| Reading | Undrained Shear Strength | |
|---|---|---|
| tsf | kPa | ksf |
| 0.63 | 61.8 | 1.29 |
| **Vane Size** | | |
| m | | |

### Pocket Penetrometer

| Reading | Undrained Shear Strength | |
|---|---|---|
| tsf | kPa | ksf |
| 1.00 | 49.1 | 1.02 |
| 0.90 | 44.1 | 0.92 |
| 1.25 | 61.3 | 1.28 |
| **1.05** | **51.5** | **1.08** |

## Failure Geometry

Sketch:

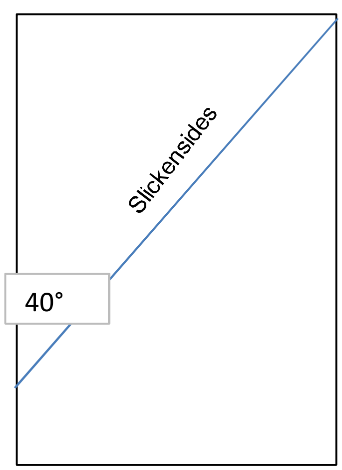


Photo:

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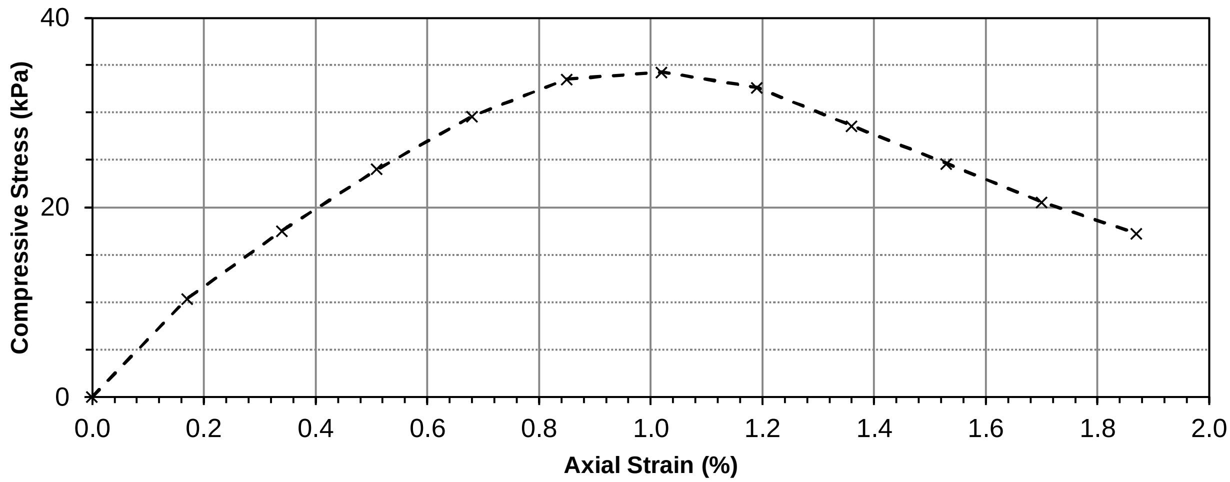
# Unconfined Compressive Strength

**ASTM D2166**

**Project No.** 0198 001 00
**Client** IBI Group
**Project** McDonalds on Regent

## Unconfined Compression Test Graph




## Unconfined Compression Test Data

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.0000 | 0.00 | 0.004092 | 0.0 | 0.00 | 0.00 |
| 10 | 13 | 0.2540 | 0.17 | 0.004099 | 42.5 | 10.38 | 5.19 |
| 20 | 22 | 0.5080 | 0.34 | 0.004106 | 72.1 | 17.55 | 8.77 |
| 30 | 30 | 0.7620 | 0.51 | 0.004113 | 98.9 | 24.05 | 12.03 |
| 40 | 37 | 1.0160 | 0.68 | 0.004120 | 122.0 | 29.60 | 14.80 |
| 50 | 42 | 1.2700 | 0.85 | 0.004128 | 138.5 | 33.55 | 16.77 |
| 60 | 43 | 1.5240 | 1.02 | 0.004135 | 141.8 | 34.29 | 17.14 |
| 70 | 41 | 1.7780 | 1.19 | 0.004142 | 135.2 | 32.64 | 16.32 |
| 80 | 36 | 2.0320 | 1.36 | 0.004149 | 118.7 | 28.60 | 14.30 |
| 90 | 31 | 2.2860 | 1.53 | 0.004156 | 102.2 | 24.60 | 12.30 |
| 100 | 26 | 2.5400 | 1.70 | 0.004163 | 85.7 | 20.59 | 10.29 |
| 110 | 22 | 2.7940 | 1.87 | 0.004170 | 72.1 | 17.28 | 8.64 |

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# Shelby Tube Visual

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |
| | |
| **Test Hole** | TH15-04 |
| **Sample #** | T45 |
| **Depth (m)** | 8.5 - 9.1 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 18-Mar-15 |
| **Technician** | Daniel Wiebe |

## Tube Extraction

**Recovery (mm)** 525

| **Bottom - 9.05 m** | 8.90 m | 8.73 m | **Top - 8.53 m** |
|---|---|---|---|
| Visual, Moisture Content, Pp, Tv | Qu, $\gamma_{Bulk}$ | Kept | |
| 160 mm | 170 mm | 165 mm | 30 mm |

## Visual Classification

| | |
|---|---|
| **Material** | Clay |
| **Composition** | Silty |
| Trace gravel (<10mm) | |
| Trace silt inclusions (<25mm) | |
| Trace sand | |
| **Color** | Grey |
| **Moisture** | Moist |
| **Consistency** | Firm - Stiff |
| **Plasticity** | High plasticity |
| **Structure** | Homogenous |
| **Gradation** | |

## Torvane

| | |
|---|---|
| **Reading** | 0.63 |
| **Vane Size (s,m,l)** | m |
| **Undrained Shear Strength (kPa)** | 61.8 |

## Pocket Penetrometer

| | | |
|---|---|---|
| **Reading** | **1** | 0.90 |
| | **2** | 0.75 |
| | **3** | 0.70 |
| | **Average** | 0.78 |
| **Undrained Shear Strength (kPa)** | | 38.4 |

## Moisture Content

| | |
|---|---|
| **Tare ID** | Z119 |
| **Mass tare (g)** | 8.4 |
| **Mass wet + tare (g)** | 355.4 |
| **Mass dry + tare (g)** | 241.8 |
| **Moisture %** | 48.7% |

## Unit Weight

| | | |
|---|---|---|
| **Bulk Weight (g)** | | 1092.20 |
| **Length (mm)** | **1** | 149.98 |
| | **2** | 150.05 |
| | **3** | 150.57 |
| | **4** | 150.31 |
| **Average Length (m)** | | 0.150 |
| **Diam. (mm)** | **1** | 71.71 |
| | **2** | 71.45 |
| | **3** | 71.48 |
| | **4** | 71.73 |
| **Average Diameter (m)** | | 0.072 |
| **Volume ($m^3$)** | | 6.05E-04 |
| **Bulk Unit Weight ($kN/m^3$)** | | 17.7 |
| **Bulk Unit Weight (pcf)** | | 112.8 |
| **Dry Unit Weight ($kN/m^3$)** | | 11.9 |
| **Dry Unit Weight (pcf)** | | 75.8 |

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# Unconfined Compressive Strength
**ASTM D2166**

| | |
|---|---|
| **Project No.** | 0198 001 00 |
| **Client** | IBI Group |
| **Project** | McDonalds on Regent |
| | |
| **Test Hole** | TH15-04 |
| **Sample #** | T45 |
| **Depth (m)** | 8.5 - 9.1 |
| **Sample Date** | 12-Mar-15 |
| **Test Date** | 18-Mar-15 |
| **Technician** | Daniel Wiebe |

## Unconfined Strength

| | kPa | ksf |
|---|---|---|
| **Max $q_u$** | 106.5 | 2.2 |
| **Max $S_u$** | 53.2 | 1.1 |

## Specimen Data

**Description** Clay - Silty, Trace gravel (<10mm), Trace silt inclusions (<25mm), Trace sand, Grey, Moist, Firm - Stiff, High plasticity, Homogenous,

| | | | | | |
|---|---|---|---|---|---|
| **Length** | 150.2 | (mm) | **Moisture %** | 49% | |
| **Diameter** | 71.6 | (mm) | **Bulk Unit Wt.** | 17.7 | ($kN/m^3$) |
| **L/D Ratio** | 2.1 | | **Dry Unit Wt.** | 11.9 | ($kN/m^3$) |
| **Initial Area** | 0.00403 | ($m^2$) | **Liquid Limit** | - | |
| **Load Rate** | 1.00 | (%/min) | **Plastic Limit** | - | |
| | | | **Plasticity Index** | - | |

## Undrained Shear Strength Tests

### Torvane

| Reading | Undrained Shear Strength | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.63 | 61.8 | 1.29 |

**Vane Size**
m

### Pocket Penetrometer

| Reading | Undrained Shear Strength | |
|---|---|---|
| **tsf** | **kPa** | **ksf** |
| 0.90 | 44.1 | 0.92 |
| 0.75 | 36.8 | 0.77 |
| 0.70 | 34.3 | 0.72 |
| **0.78** | **38.4** | **0.80** |

## Failure Geometry

Sketch:

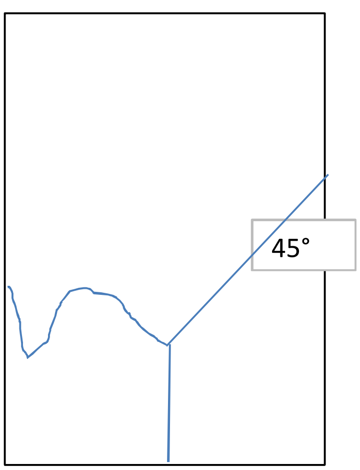


Photo:

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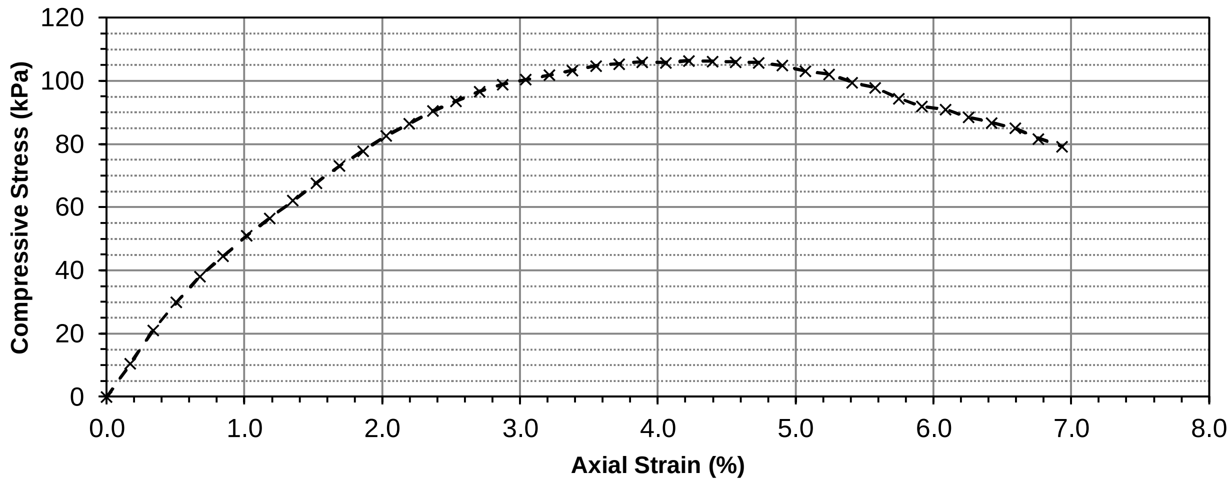
# Unconfined Compressive Strength
**ASTM D2166**

**Project No.** 0198 001 00
**Client** IBI Group
**Project** McDonalds on Regent

## Unconfined Compression Test Graph




## Unconfined Compression Test Data

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.0000 | 0.00 | 0.004026 | 0.0 | 0.00 | 0.00 |
| 10 | 13 | 0.2540 | 0.17 | 0.004032 | 42.5 | 10.55 | 5.27 |
| 20 | 26 | 0.5080 | 0.34 | 0.004039 | 85.7 | 21.22 | 10.61 |
| 30 | 37 | 0.7620 | 0.51 | 0.004046 | 122.0 | 30.15 | 15.07 |
| 40 | 47 | 1.0160 | 0.68 | 0.004053 | 155.0 | 38.24 | 19.12 |
| 50 | 55 | 1.2700 | 0.85 | 0.004060 | 181.4 | 44.67 | 22.33 |
| 60 | 63 | 1.5240 | 1.01 | 0.004067 | 207.7 | 51.08 | 25.54 |
| 70 | 70 | 1.7780 | 1.18 | 0.004074 | 230.8 | 56.65 | 28.32 |
| 80 | 77 | 2.0320 | 1.35 | 0.004081 | 253.9 | 62.21 | 31.10 |
| 90 | 84 | 2.2860 | 1.52 | 0.004088 | 276.9 | 67.75 | 33.88 |
| 100 | 91 | 2.5400 | 1.69 | 0.004095 | 300.0 | 73.27 | 36.64 |
| 110 | 97 | 2.7940 | 1.86 | 0.004102 | 319.8 | 77.97 | 38.99 |
| 120 | 103 | 3.0480 | 2.03 | 0.004109 | 339.8 | 82.70 | 41.35 |
| 130 | 108 | 3.3020 | 2.20 | 0.004116 | 356.7 | 86.65 | 43.33 |
| 140 | 113 | 3.5560 | 2.37 | 0.004123 | 373.5 | 90.58 | 45.29 |
| 150 | 117 | 3.8100 | 2.54 | 0.004130 | 387.0 | 93.69 | 46.84 |
| 160 | 121 | 4.0640 | 2.71 | 0.004137 | 400.4 | 96.78 | 48.39 |
| 170 | 124 | 4.3180 | 2.87 | 0.004145 | 410.5 | 99.05 | 49.52 |
| 180 | 126 | 4.5720 | 3.04 | 0.004152 | 417.2 | 100.49 | 50.25 |
| 190 | 128 | 4.8260 | 3.21 | 0.004159 | 424.0 | 101.94 | 50.97 |
| 200 | 130 | 5.0800 | 3.38 | 0.004166 | 430.7 | 103.38 | 51.69 |
| 210 | 132 | 5.3340 | 3.55 | 0.004174 | 437.5 | 104.82 | 52.41 |
| 220 | 133 | 5.5880 | 3.72 | 0.004181 | 440.8 | 105.43 | 52.72 |
| 230 | 134 | 5.8420 | 3.89 | 0.004188 | 444.2 | 106.05 | 53.03 |

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## Unconfined Compression Test Data (cont'd)

| Deformation Dial Reading | Load Ring Dial Reading | Deflection (mm) | Axial Strain (%) | Corrected Area ($m^2$) | Axial Load (N) | Compressive Stress, $q_u$ (kPa) | Shear Stress, $S_u$ (kPa) |
|---|---|---|---|---|---|---|---|
| 240 | 134 | 6.0960 | 4.0578 | 0.004196 | 444.2 | 105.87 | 52.93 |
| 250 | 135 | 6.3500 | 4.23 | 0.004203 | 447.6 | 106.49 | 53.24 |
| 260 | 135 | 6.6040 | 4.40 | 0.004211 | 447.6 | 106.30 | 53.15 |
| 270 | 135 | 6.8580 | 4.57 | 0.004218 | 447.6 | 106.11 | 53.05 |
| 280 | 135 | 7.1120 | 4.73 | 0.004226 | 447.6 | 105.92 | 52.96 |
| 290 | 134 | 7.3660 | 4.90 | 0.004233 | 444.2 | 104.93 | 52.47 |
| 300 | 132 | 7.6200 | 5.07 | 0.004241 | 437.5 | 103.16 | 51.58 |
| 310 | 131 | 7.8740 | 5.24 | 0.004248 | 434.1 | 102.18 | 51.09 |
| 320 | 128 | 8.1280 | 5.41 | 0.004256 | 424.0 | 99.63 | 49.81 |
| 330 | 126 | 8.3820 | 5.58 | 0.004263 | 417.2 | 97.87 | 48.93 |
| 340 | 122 | 8.6360 | 5.75 | 0.004271 | 403.8 | 94.55 | 47.27 |
| 350 | 119 | 8.8900 | 5.92 | 0.004279 | 393.7 | 92.01 | 46.00 |
| 360 | 118 | 9.1440 | 6.09 | 0.004286 | 390.3 | 91.06 | 45.53 |
| 370 | 115 | 9.3980 | 6.26 | 0.004294 | 380.2 | 88.55 | 44.27 |
| 380 | 113 | 9.6520 | 6.42 | 0.004302 | 373.5 | 86.81 | 43.41 |
| 390 | 111 | 9.9060 | 6.59 | 0.004310 | 366.8 | 85.10 | 42.55 |
| 400 | 107 | 10.1600 | 6.76 | 0.004318 | 353.3 | 81.82 | 40.91 |
| 410 | 104 | 10.4140 | 6.93 | 0.004325 | 343.2 | 79.34 | 39.67 |