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Design and Rehabilitation of a 1200 mm, 98 Year old brick sewer at depths of over 21m with CIPP (to protect it from a 6 m tunnel being constructed right under it)

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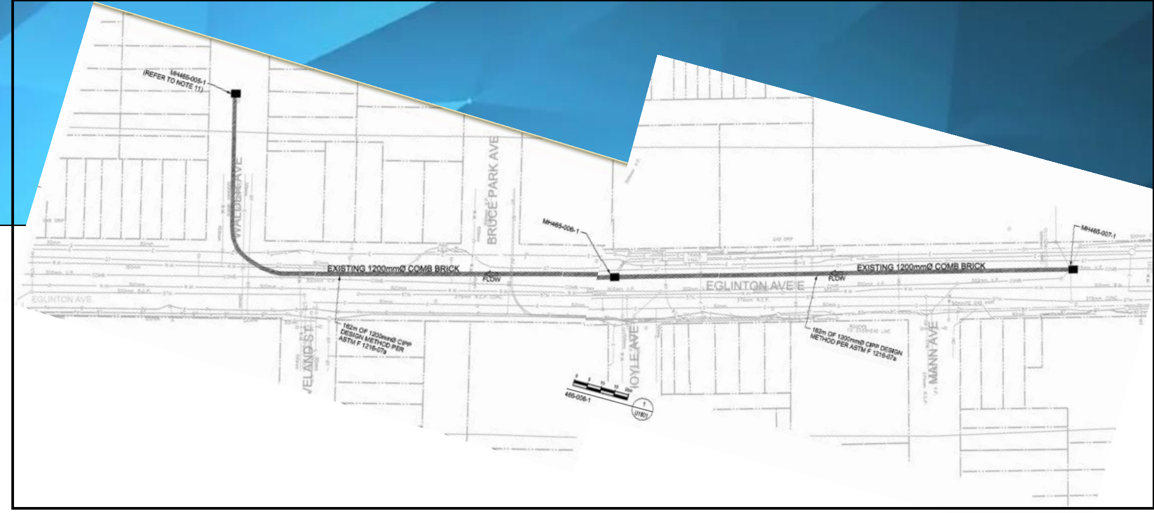
Condition Assessment and Rehabilitation

AECOM

Water New Zealand Conference & Expo 2018 Hamilton, NZ

water NEW ZEALAND CONFERENCE & EXPO 19–21 September 2018, Hamilton

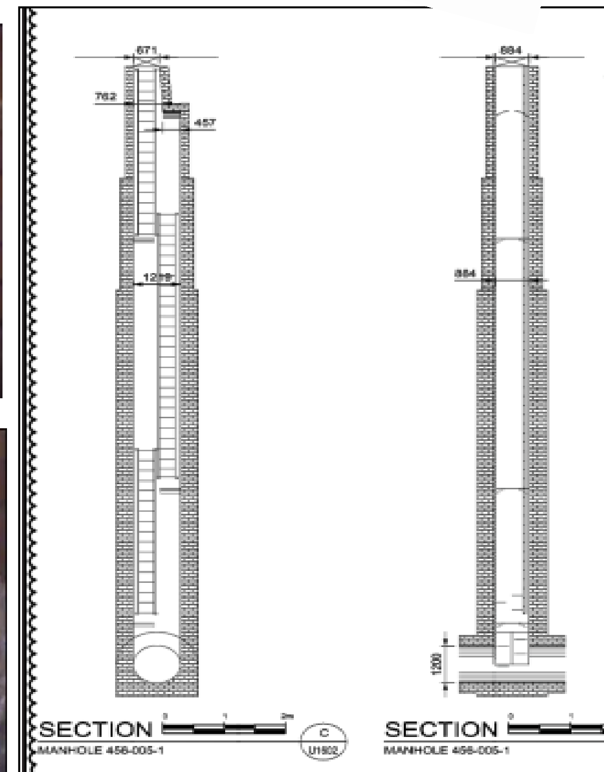
From the beginning this was no ordinary CIPP installation



Host pipe – Fairfield Sewer in Toronto, ON (Eglington Avenue)

- 1200 mm (48”) brick sewer host pipe
- ~ 90 year old tunnel
- Sewer depth ranges from 7.6 m (25’) to 21.5 m (70.5’)
- Set up at middle manhole 16.0 m (52.5’) deep
- Line through a 90º curve to the 21.5 m deep MH
- Eglington is a very busy street (major arterial designation)

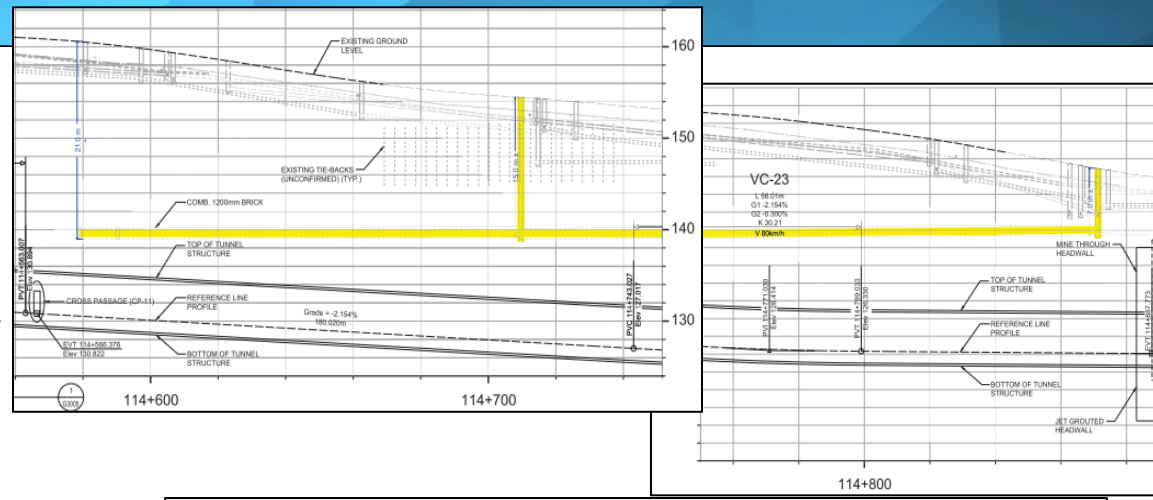
On the bright side, the brick sewer looked pretty good!

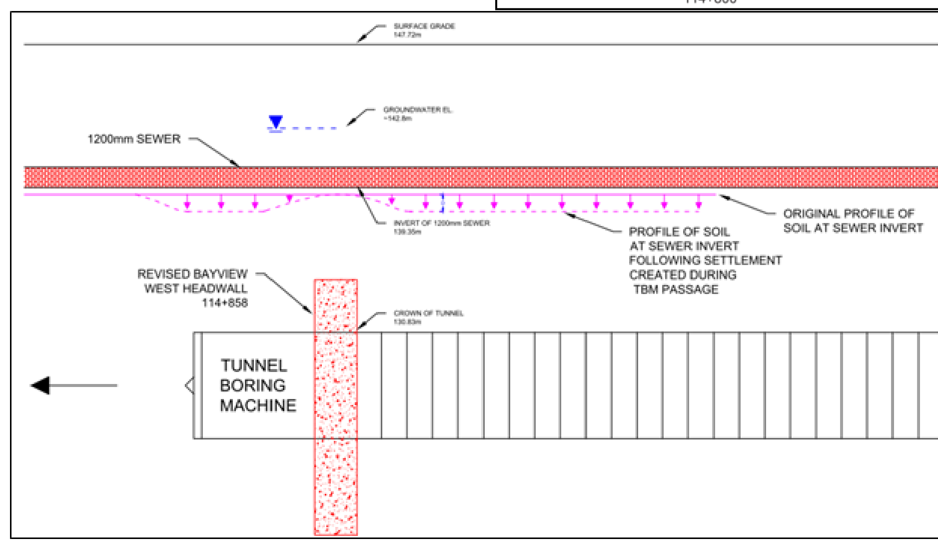


And if a challenging CIPP installation wasn't enough?

There was another tunnel coming (a big one)

- Eglington-Scarborough Crosstown (ESC) Twin Tunnels Project
- Twin 6 m (20 foot) diameter tunnels
- Closed face tunnel boring machines (TBM) with earth pressure balance (EPB) technology.
- The tunnel ran directly under the brick sewer and within 2 m (~6 feet) of it at its closest proximity
  - ***Where the brick sewer was the deepest…***

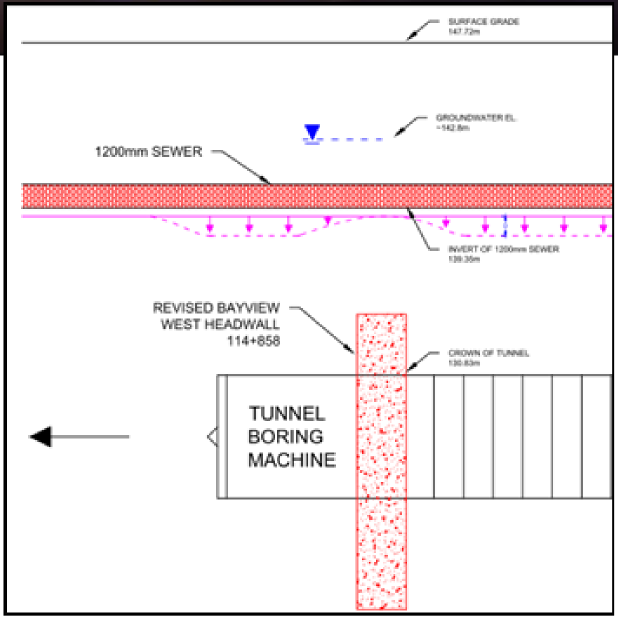




Brick Sewers are temperamental!

Concerns…

- Brick sewers rely entirely on radial soil stress around the pipe to hold the bricks in place
- Even with an TBM with advanced EPB, some loss of ground would be anticipated
- A headwall feature in the tunnel would induce even greater differential movement
- Relatively small losses of ground around the brick would likely induce a total collapse
    - *Its depth, location, and service area means that the direct and indirect cost of failure would be very high*



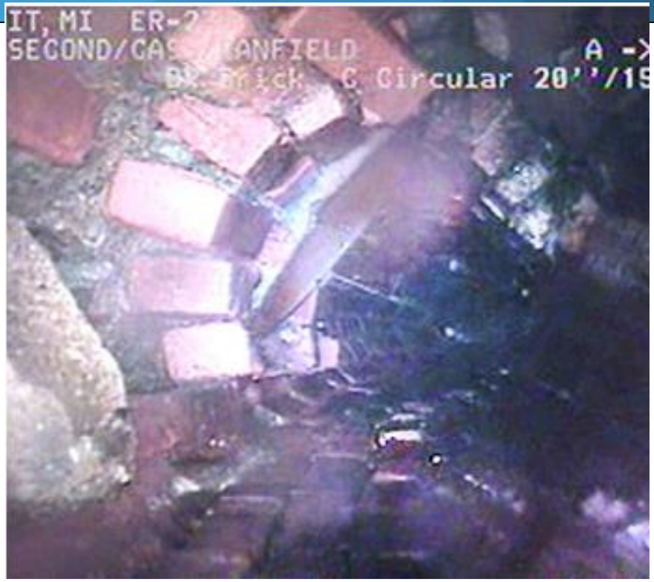
While not removing all of the risk, CIPP had some attractive advantages

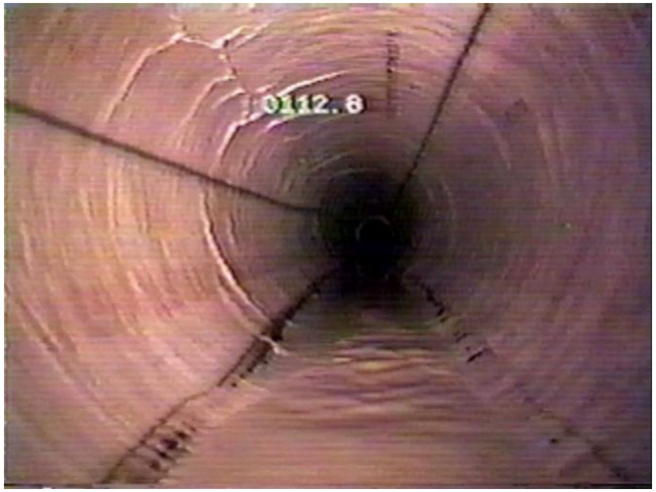
– If the settlement trough were allowed to occur without lining the host brick pipe, there was a very high probability that the brick sewer would catastrophically collapse.

– While relining the host pipe wouldn't eliminate all possibility of a failure, it would radically change the mode of failure

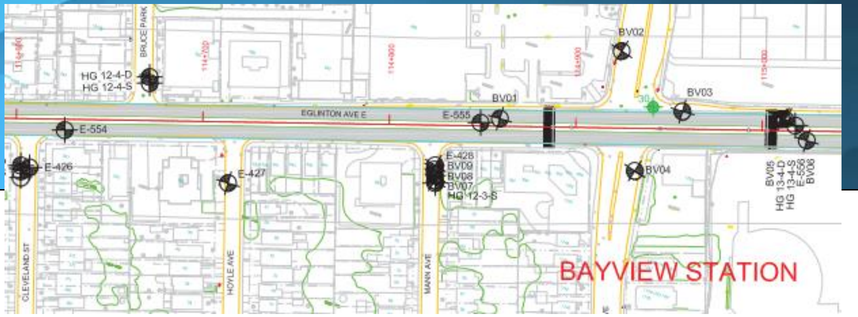
– CIPP's ability to yield and stabilize the overall pipe-soil system would greatly minimize the possibility of loss of the overall structure

- ***A more localized failure in the lining itself was still possible***
- ***Worst case considered a localized shear failure***
- ***Could be repaired internally in a trenchless point repair***

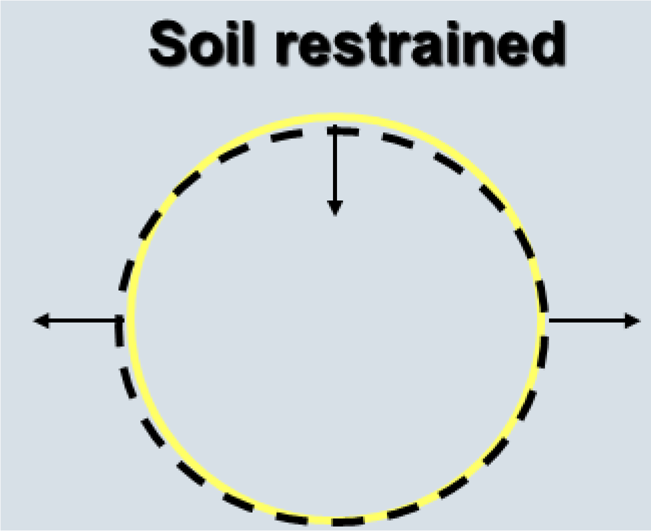




What to design the CIPP for?



- Intuitively, the Owner of the sewer and the tunnel wanted the CIPP as robust as possible
- Even without the logistical challenges present, there are limits how robust a liner is practical to install
  - *Agreed to limit section to maximum single lift thicknesses of 50 mm (2") and a minimum DR of 30*
- Even a robust liner section, was flexible enough to yield in response to minor loss of ground
  - *Yielding would mobilize soil support for the section*
  - *Close review of the geotechnical considerations were required to estimate realistic values for groundwater loads and modulus of soil reaction*



Prevailing Geotechnical Conditions

Geotechnical Considerations (HMH)

- Groundwater load was lower at deeper heights of cover (lots of gradient on surface, not a lot gradient on the groundwater surface)
  - 4 m below ground surface for the area from MH465-005-01 to MH465-006-01
  - 2 m below ground surface for the area from MH465-007-01 to MH465-007-01
- Native soils at pipe depth were dense to very dense material
  - SPT values >50
  - Modulus of soil reaction ~10 MPa (1500 psi) would still be very conservative for design
  - Much higher than traditional CIPP design but validated with increased knowledge of insitu conditions

In-situ Soils				
Granular		Cohesive		E'_{native}
SPT (Blows/0.3 m)	Description	Unconfined Compressive Strength q_u(kPa)	Description	kPa (psi)
>0-1	very, very loose	>0-12	very, very soft	345 (50)
1-2	very loose	12-24	very soft	1380 (200)
2-4		24-48	soft	4825 (700)
4-8	loose	48-96	medium	10,340 (1,500)
8-15	slightly loose	96-192	stiff	20,680 (3,000)
15-30	compact	192-383	very stiff	34,470 (5,000)
30-50	dense	383-575	hard	68,940 (10,000)
>50	very dense	>575	very hard	137,880 (20,000)

AWWA M45
Modulus of Soil Reaction vs Unconfined Compressive Strength

Condition of the host pipe needed to be seriously understood

Existing Host Pipe Condition

- MH 006 to 007; Structural and Service Grades of 3.
  - From a stability perspective short term collapse was unlikely but further deterioration likely
- MH 006 to 005; Structural Grade of 3 and Service Grade of 5 due to the infiltration gusher present.
  - Short term collapse was still unlikely and deterioration was much more active where the gusher was present.
- Detailed man-entry survey employed to define ovality
  - (I know, why didn't we use LIDAR/laser)

Condition confirmed the need to reline before tunneling; ***host pipe was waiting for a reason to fall down***

MH465-006-1 to MH465-007-1

Distance (m)	Vertical (inches)	Horizontal (inches)	Δ	Ovality 1	Ovality 2			
0	47	46.75	0.25	2.1%	2.6%			
5	48.75	46.5	2.25	1.6%	3.1%			
10	46.5	47	-0.5	2.1%	3.1%			
15	48.75	47	1.75	1.6%	2.1%			
20	48.25	46	2.25	0.5%	4.2%			
25	48	47	1	0.0%	2.1%			
30	47.75	47.5	0.25	0.5%	1.0%			
35	48	47	1	0.0%	2.1%			
40	48	47	1	0.0%	2.1%			
45	48.25	47	1.25	0.5%	2.1%			
50	48	48	0	0.0%	0.0%			
55	48.5	46.75	1.75	1.0%	2.6%			
60	48.25	48	0.25	0.5%	0.0%			
65	48.25	48	0.25	0.5%	0.0%			
70	48.25	46.5	1.75	0.5%	3.1%			
75	48.25	47	1.25	0.5%	2.1%			
80	48.75	48	0.75	1.6%	0.0%			
85	48	47	1	0.0%	2.1%			
90	48.5	46.75	1.75	1.0%	2.6%			
95	48.5	46	2.5	1.0%	4.2%			
100	48.75	47.75	1	1.6%	0.5%			
105	48.25	48	0.25	0.5%	0.0%			
110	48.5	47.25	1.25	1.0%	1.6%			
115	48.5	46.75	1.75	1.0%	2.6%			
120	48.25	48	0.25	0.5%	0.0%			
125	48.75	48	0.75	1.6%	0.0%			
130	48.5	47.5	1	1.0%	1.0%			
135	48.75	47	1.75	1.6%	2.1%			
140	48.75	48.25	0.5	1.6%	0.5%			
145	48.25	48	0.25	0.5%	0.0%			
150	49	47.5	1.5	2.1%	1.0%			
155	48	48.25	-0.25	0.5%	0.0%		Max	Avg
160	48.5	47	1.5	1.0%	2.1%		4.2%	1.3%
				2.5	-0.5			
Average	48.28	47.27						

Final CIPP Design

- Even though original construction of host pipe confirmed to be tunnel loading, full overburden loads used in design
  - Owner mandated use of ASTM F1216-07a
  - Increased conservative nature of design
- Developed three load cases to check for F1216 design checks
  - Deeper cover with lower groundwater loads governed
  - Iteratively balanced maximum safety factor attainable with practical installation risk limits on CIPP wall thickness
  - Final SF for ASTM F1216 design checks = 2.5
- Carried out additional limit state checks in longitudinal bending to assist in assessing significance of loss of ground from tunneling operations
  - Solved for maximum deflection values at various settlement trough lengths

ASTM F 1216 Load Cases

Load Case 1: Reach: MH465-005 to -006

- Max depth of 21.5 m, and
- Prevailing GW in 005 to 006 section – 4 m below ground surface
- Modulus of soil reaction = 10.34 MPa

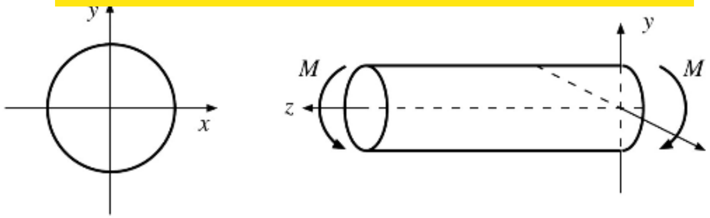
Load Case 2: Reach: MH465-006 to -007 – deepest cover @ Tunnel station 114+710

- Depth of 16.0
- Shallowest GW in deeper cover areas – 4 m below ground surface
- Modulus of soil reaction = 10.34 MPa

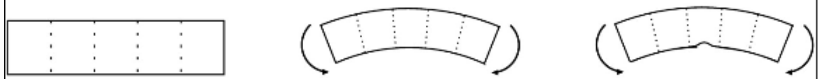
Load Case 3: Reach: MH465-006 to -007 – deepest cover with shallower GW @ +850

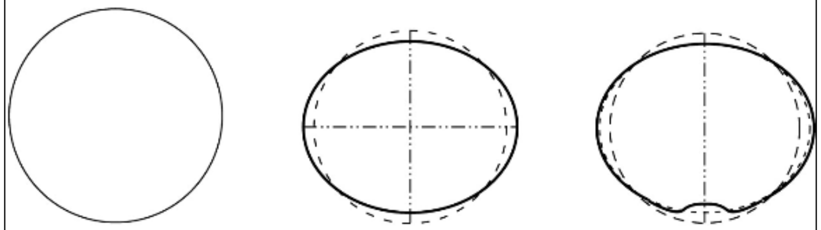
- Depth of 8.9 m
- GW of 2 m below ground surface
- Modulus of soil reaction = 10.34 MPa

Reissner Effect Load Cases



(a) orientation of the undeformed tube and axes


(b) zero load (c) small curvature (d) larger curvature


(e) original cross-section (f) ovalization (g) localization

Final CIPP Design – Calculated and Proposed Wall Thicknesses

– Contractor selected to work with
  - Standard neat isophthalic polyester resin (AOC L-704-NET-11)
  - Reinforced Applied Felts tube (AquaCure RP with a glass fiber reinforcing scheme)

– Aside from design considerations
  - Previous field results with the reinforced CIPP system proposed for use were in the 6000-7000 MPa (870,000 to 1,000,000 psi) for initial flexural modulus
  - Based on the challenges of this installation and likelihood of very thick wall sections; lowered objectives for design to 3169 MPa (460,000 psi)
  - As resulting flexural stress levels were still very low in response to the governing load cases, left initial flexural strength design values at 31 MPa (4500 psi)

Summary of Calculated Liner Thicknesses Required

MH to MH Section	Flexural Modulus (MPa)	Flexural Strength (MPa)	Design Load Case	Required Thickness (mm)	Proposed thickness (mm)
MH465-005 to -006	**3169**	**31**	**Long Term**	**49.1**	**51**
MH465-006 to -007	**3169**	**31**	**Long Term**	**40.5**	**42**

Even though we were not the designer of record; technical approach for CIPP Quality Assurance were followed

– Type testing by the product manufacturer
  - Confirm the short and long term mechanical properties
  - Confirm chemical resistance of the liner
– Protocol Submissions and Records
– Acceptance Testing
  - Visual
  - Confirmation of meeting design intent
    - Mechanical properties
      - Flexure
      - Strength
      - Thickness

Design basis

Wet out and Inversion Logs

Curing Logs

Sampling Approach

How to build very thick CIPP sections?

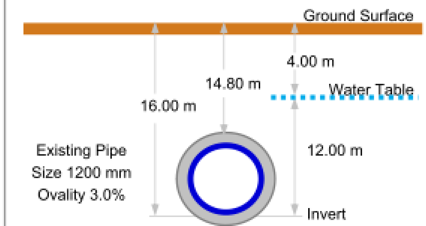
- Load Case 2
  - 40.5 mm leads to a DR = 29.6
- Load Case 1
  - 49.1 mm leads to a DR = 24.4
  - ***Too much!***
- Try multiple lifts
  - 2~25.5 mm thick tubes for MH465-005 to -006, and
  - 2~21 mm thick tubes for MH465-006 to -007
- As design is premised on close fit, no bond or shear transfer is necessary to build-up composite wall thickness
  - Sizing the liner correctly is always a big deal
  - Now it was an even bigger deal

PROJECT INFORMATION

2-Dec-15

Aecon
Crosstown - Eglinton
Mh 465-007 to Mh 465-006
1200mm diameter combined sewer
Load case 2 - max cover at MH-007

162 meters in length



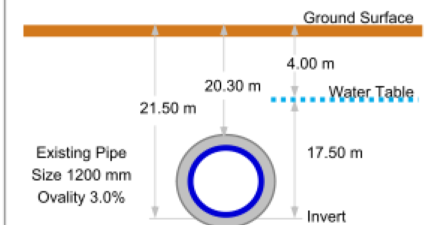
Fully Deteriorated Design
Required Liner Thickness: 40.5 mm

PROJECT INFORMATION

2-Dec-15

Aecon
Crosstown - Eglinton
Mh 465-005 to Mh 465-006
1200mm diameter combined sewer
Load Case 1 - 21.5 m deep

182 meters in length



Fully Deteriorated Design
Required Liner Thickness: 49.1 mm

BY ASTM F1216 VERSION	F1216-07a	CIPP liner design by Appendix X1 method of ASTM F1216-07a		
EXISTING PIPE PARAMETERS	ENTERED	**FACTOR SUMMARY - FULLY DETERIORATED**		
Design Condition	Fully Det.	Flexural Modulus Design	1,584.5 MPa	50% of Short-term
Inside Dia. of Existing Pipe	1200 mm	Flexural Strength Design	15.50 MPa	50% of Short-term
Depth to Invert	21.5 m	Minimum Dia for host pipe	1164 mm	For 3% ovality
Water Table Below Surface	4 m	Maximum Dia for host pipe	1236 mm	For 3% ovality
Ovality, Δ	3%	Ovality Reduction Factor, C	0.764	
Soil Density	18.85 KN/m3	Water Buoyancy Factor, Rw	0.735	
Soil Modulus	10.34 MPa	Coeff of Elastic Support, B'	0.9497	
Live Load	2. HS-20	Water Pressure, Invert	0.1717 MPa	17.50 m Head
Other Load	0 kPa	Vacuum Pressure, Invert	0.0000 MPa	
Vacuum Condition	0 kPa	Total Design Pressure, Invert	0.1717 MPa	For X1.1 & X1.2
CIPP LINER PARAMETERS	ENTERED	Water Pressure, Overt	0.1599 MPa	16.30 m Head
Flexural Modulus short-term	3169 MPa	Soil Pressure, Overt	0.2813 MPa	20.30 m Cover
Flexural Strength short-term	31 MPa	Live Load Pressure, Overt	0.0000 MPa	Note 1
Long-term Retention	50%	Other Load Pressure, Overt	0.0000 MPa	
Enhancement Factor	7	Total Design Pressure, Overt	0.4412 MPa	For X1.3
Poisson's Ratio	0.3	Note 1: AASHTO HS-20. Refer AWWA M11, M23, M55.		
Safety Factor	2.5			

FULLY DETERIORATED DESIGN REQUIRES SATISFYING F1216-X1 EQUATIONS X1.1, X1.2, X1.3 & X1.4

Equations X1.1, X1.2, X1.3 & X1.4 solved for liner thickness t	t mm	t in	DR
X1.1: $P = [2KE_L/(1-v^2)] \times [1/(DR-1)^3] \times [C/N]$ For load due to groundwater at invert	33.3 mm	1.31 in	36.0
X1.2: $(1.5\Delta/100)(1+\Delta/100)DR^2-0.5(1+\Delta/100)DR=\sigma_L/(PN)$ For minimum thickness for ovality	35.3 mm	1.39 in	34.0
X1.3: qt=[C/N]x[32xRwxB'xE'sx(ELxI/D^3)]^(1/2) Governs For hydraulic, soil & live loads at overt	49.1 mm	1.93 in	24.4
X1.4: EI/D^3 = E/[12(DR^3)] ≥ 0.00064 For minimum thickness fully deteriorated	16.2 mm	0.64 in	74.1
Required Liner Thickness - Fully Deteriorated	**49.1 mm**	**1.93 in**	**24.4**

t mm is rounded-up to 1 decimal place; t in = t mm/25.4; DR = (Inside Diameter mm)/(t mm) NA - Not Available/Applicable

FLOW COMPARISON PARAMETERS		FLOW COMPARISON FOR: ENTERED LINER THICKNESS		
Liner Thickness - Entered	51.0 mm	Inside Diameter before Lining	1200 mm	
Before Lining Manning n	0.0130	Inside Diameter after Lining	1098 mm	51.0 mm liner
After Lining Manning n	0.0100	Flow Capacity after Lining	103%	Of before Lining

COMMENTS Soil Density: KN/m3 is unit in ASTM F1216 Appendix X1. KN/m3 x 101.97 = kg/m3

Proposed: 2 ~ 25.5 mm tubes for a composite thickness of 51 mm

Construction

– Site setup for the installation was very tight due to the high traffic volumes on Eglington

– Construction footprint was limited to the two middle lanes

– Liner was cured using conventional hot water cure methods

– Inversion set up was at MH 006, where the depth of the MH (16m/52 feet)

– Hydraulic submersible pumps were used to circulate water within the liner.

– Twin submersibles were originally contemplated for use, each capable of 56 l/s (900 gallons per minute)

Construction

- Wet outs were carried off site in a controlled wet out facility in late December 2015 and early January 2016
- Multiple inversion approach made the liners light enough to be wet out in a controlled environment
  - Over-the-hole wet out wouldn't work given the available construction footprint
- Inversions were all carried out from MH006 in 4 separate installations
- Suitably, given the nature of the challenging installation to be undertaken, the first inversion was successfully executed on New Year's Eve 2015.
- Subsequent inversions were successfully carried out on January 6th, 11th, and 14th; 2016.

Wet out, installation and curing records

Wet out

- Over 64,000 kgs (141,000 lbs) of resin wet out into 4 separate tubes
- All wet outs with excess resin versus

Cure

- Clear exotherm in all installations
- Curing heads maintained throughout and curing monitored for entire liner via a VeriCure continuous monitoring

WET OUT DATA
Crosstown - Eglinton Avenue
Mh 006 to 007
Installation No. 1

LINER & RESIN INPUT-INFO

Diameter 48 inches
Thickness 25.5 mm
(to nearest 0.5mm) (4.5 to 58mm)
Length 595 feet
No. of Layers 5
(approximate)
Spec. Gravity 1.1
Amount of Fall 1.0 feet *
(if any)
Amount of Rise 0.0 feet *

dry liner weight 12.0 lbs./ft.
(approximate)
resin rate 68.5 lbs./ft.
total resin expect. 40,735 lbs

INSTALLATION PRESSURE

(Normal)
IdealHead= 13.9 feet = 6 psi
MinHead = 10.6 feet = 5 psi
MaxCold = 21.3 feet = 9 psi
MaxHot = 18.6 feet = 8 psi

******* ******* ******* *******
******* ******* ******* *******
(See graph on Sheet2)
******* ******* ******* *******
******* ******* ******* *******
****

41,275 # used

												Thickness	
From	To							Length		Weight		Finished	Design (min)
MH006	MH005	Wet Out Date	Install Date	Boiler on	Exotherm	End cook	Heat to cool down	m	ft	kg	lbs	mm	
Install 1		22-Dec-15	31-Dec-15	2:30	9:30	15:00	12:30	181	595	18,761	41,275	26.2	
Install 2		31-Dec-15	6-Jan-16	17:30	22:30	4:30	13:00	181	595	17,933	39,452	26.4	
										36,694	***80,727***	***52.6***	***49.1***
MH006	MH007												
Install 3		3-Jan-16	11-Jan-16	0:00	6:00	11:00	11:00	162	531	14,069	30,951	21.6	
Install 4		6-Jan-16	14-Jan-16	22:30	5:30	10:00	12:30	162	531	13,489	29,675	21.2	
										27,557	***60,626***	***42.8***	***40.5***

Manhole Restoration

– Subsequent to relining, all brick MH's were rehabilitated with a VOC free spray-on epoxy system to provide a new design life for the MH's

Visual Classification of Installation Pre- and Post Tunnel Crossing

Visual classification at install

–No lifts, delamination

–Good evidence of close-fit (to host pipe and between lifts)

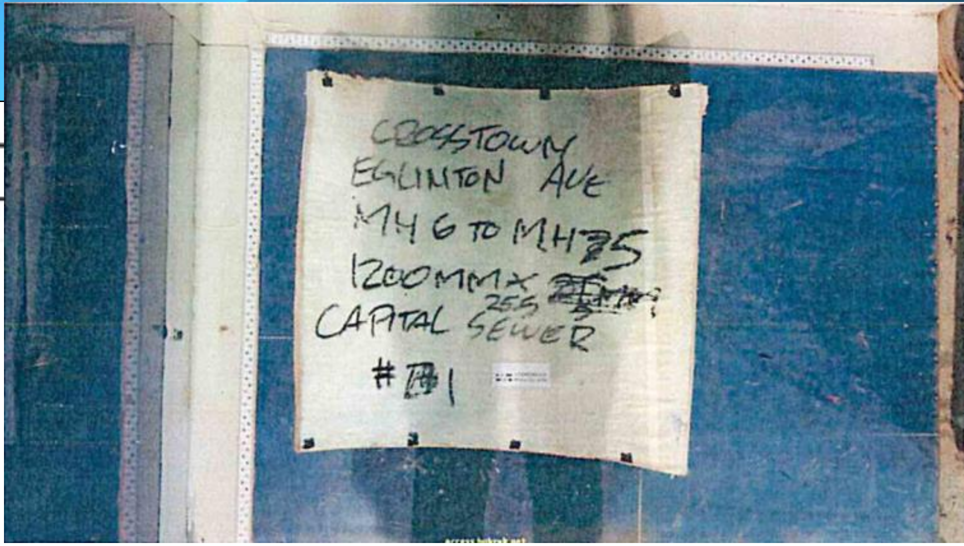
–Minor wrinkling; even around the 90º curve

Visual classification after tunnel crossing

–Same as at completion; no defects, no loss of ground response

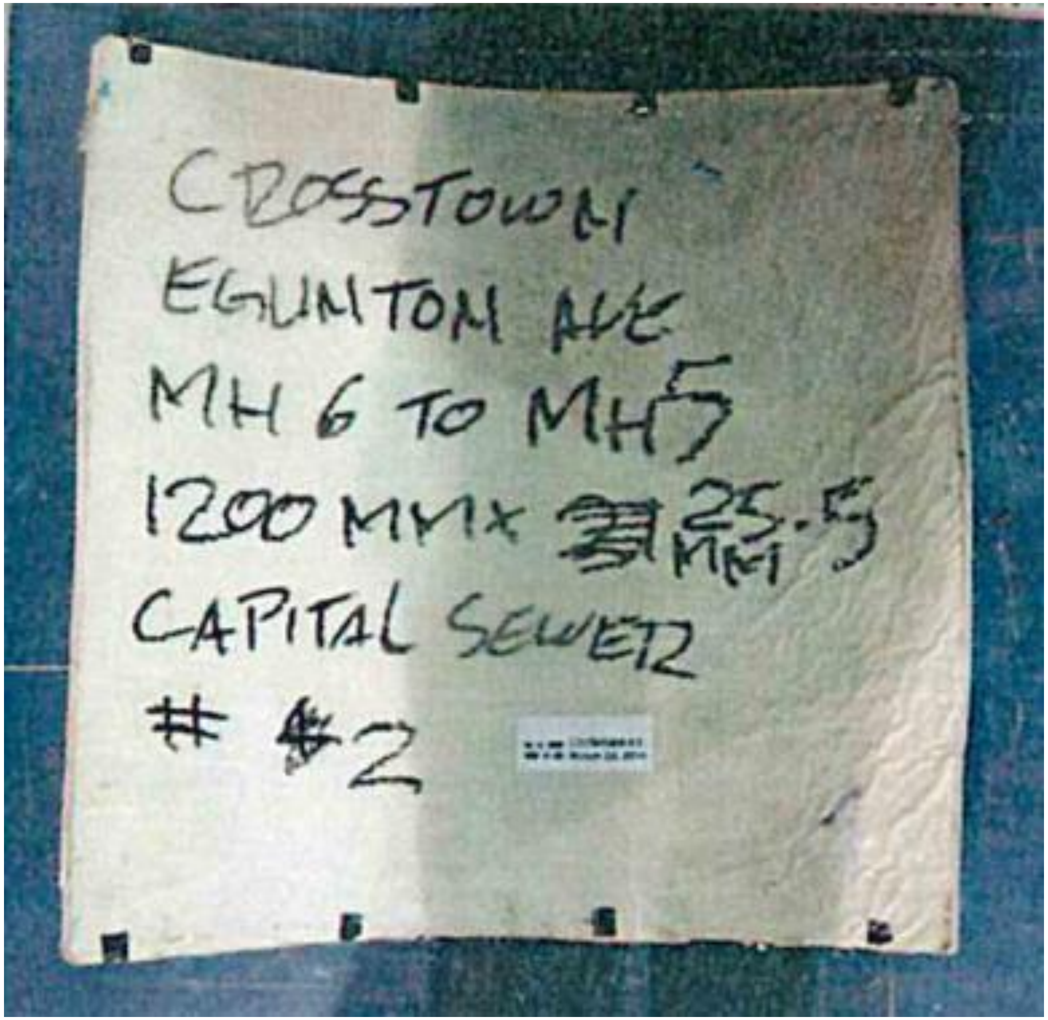
Sampling and Design Reconciliation

Test Performed	Test Results		
1. Tangent Modulus of Elasticity & Flexural Strength	**Test Specimen**	**Tangent Modulus of Elasticity (MPa)**	**Flexural Strength (MPa)**
ASTM Method/Procedure/Load Cell D790 / Method A / 2000lb	**1.**	2,840	39.9
- Nominal crosshead speed: 6.49 mm/min	**2.**	2,350	34.5
	3.	2,590	39.0
- Nominal specimen dimensions: Depth: 16.8 mm x Width: 45.2 mm	**4.**	2,920	47.7
	5.	2,300	35.5
- Nominal support span: 269.5 mm - L/D = 16 W/D = 2.7 - Date tested: March 31, 2016	**Average**	**2,600**	**39.3**
Minimum amount of material from both the exterior and interior surfaces were machined to obtain rectangular specimens.			
2. Wall Thickness	**Reading**	**Thickness (mm)**	
- Measured at four (4) equally spaced locations in the hoop direction on both sides of the liner using a vernier caliper in general accordance with ASTM D5813.	**1.**	27.4	
	2.	28.0	
	3.	23.8	
	4.	24.5	
- Any non-structural plastic coating on the inner diameter of the liner was deducted from the wall thickness measurements.	**5.**	26.5	
	6.	24.5	
	7.	29.6	
	8.	25.0	
	Average	**26.2**	



Sampling and Design Reconciliation

- Sampling and testing was carried out on in-place samples
- Axial direction was tested
  - Bi-directional fabric, tested in weaker of two directions
- Installed thicknesses were all in excess of minimum
- Flexural strength values were all in excess (ASTM min used for design not based on anticipated values)
- Flexural modulus values were lower than design objective
- Design reconciliation required



Design Reconciliation – Load Case 1

FULLY DETERIORATED DESIGN REQUIRES SATISFYING F1216-X1 EQUATIONS X1.1, X1.2, X1.3 & X1.4

Equations X1.1, X1.2, X1.3 & X1.4 solved for liner thickness t	**t mm**	**t in**	**DR**
X1.1: $P = [2KE_L/(1-v^2)] \times [1/(DR-1)^3] \times [C/N]$ For load due to groundwater at invert	35.7 mm	1.41 in	33.6
X1.2: $(1.5\Delta/100)(1+\Delta/100)DR^2-0.5(1+\Delta/100)DR=\sigma_L/(PN)$ For minimum thickness for ovality	33.7 mm	1.33 in	35.6
X1.3: qt=[C/N]x[32xRwxB'xE'sx(ELxI/D^3)]^(1/2) Governs For hydraulic, soil & live loads at overt	52.8 mm	2.08 in	22.7
X1.4: EI/D^3 = E/[12(DR^3)] ≥ 0.00064 For minimum thickness fully deteriorated	17.4 mm	0.69 in	69.0
Required Liner Thickness - Fully Deteriorated	**52.8 mm**	**2.08 in**	**22.7**

t mm is rounded-up to 1 decimal place; t in = t mm/25.4; DR = (Inside Diameter mm)/(t mm) NA - Not Available/Applicable

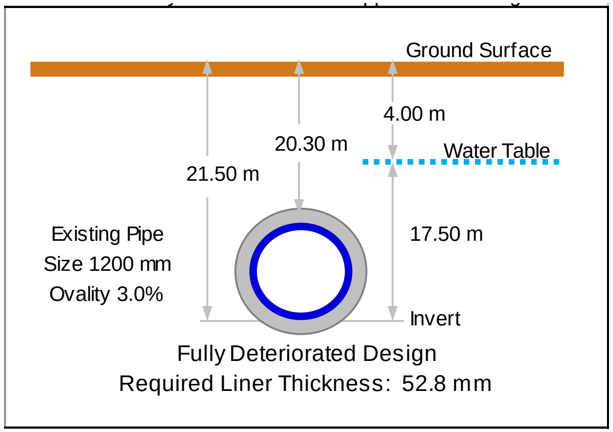
FLOW COMPARISON PARAMETERS		**FLOW COMPARISON FOR: ENTERED LINER THICKNESS**		
Liner Thickness - Entered	54.6 mm	Inside Diameter before Lining	1200 mm	
Before Lining Manning n	0.0130	Inside Diameter after Lining	1091 mm	54.6 mm liner
After Lining Manning n	0.0100	Flow Capacity after Lining	101%	Of before Lining

COMMENTS

Soil Density: KN/m3 is unit in ASTM F1216 Appendix X1. KN/m3 x 101.97 = kg/m3

Actual installed thickness 26.2 + 26.4 = 54.6 mm

Meets design intent



Design Reconciliation – Load Case 2

FULLY DETERIORATED DESIGN REQUIRES SATISFYING F1216-X1 EQUATIONS X1.1, X1.2, X1.3 & X1.4				
Equations X1.1, X1.2, X1.3 & X1.4 solved for liner thickness t		**t mm**	**t in**	**DR**
X1.1: $P = [2KE_L/(1-v^2)] \times [1/(DR-1)^3] \times [C/N]$ For load due to groundwater at invert		31.2 mm	1.23 in	38.5
X1.2: $(1.5\Delta/100)(1+\Delta/100)DR^2-0.5(1+\Delta/100)DR=\sigma_L/(PN)$ For minimum thickness for ovality		28.0 mm	1.10 in	42.9
X1.3: qt=[C/N]x[32xRwxB'xE'sx(ELxI/D^3)]^(1/2) For hydraulic, soil & live loads at overt	Governs	42.7 mm	1.68 in	28.1
X1.4: EI/D^3 = E/[12(DR^3)] ≥ 0.00064 For minimum thickness fully deteriorated		17.3 mm	0.68 in	69.4
Required Liner Thickness - Fully Deteriorated		**42.7 mm**	**1.68 in**	**28.1**

t mm is rounded-up to 1 decimal place; t in = t mm/25.4; DR = (Inside Diameter mm)/(t mm) NA - Not Available/Applicable

FLOW COMPARISON PARAMETERS		**FLOW COMPARISON FOR: ENTERED LINER THICKNESS**		
Liner Thickness - Entered	42.8 mm	Inside Diameter before Lining	1200 mm	
Before Lining Manning n	0.0130	Inside Diameter after Lining	1114 mm	42.8 mm liner
After Lining Manning n	0.0100	Flow Capacity after Lining	107%	Of before Lining

COMMENTS

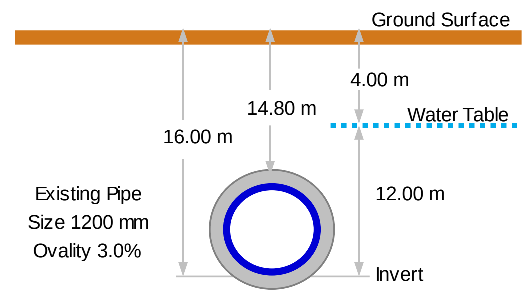
Soil Density: KN/m3 is unit in ASTM F1216 Appendix X1. KN/m3 x 101.97 = kg/m3

Actual installed thickness = 21.6 + 21.2 = 42.8 mm

Matches Design Objective at FOS 2.46

CIPP-DESIGN

CIPP Liner Thickness for Non-Pressure Pipes
By ASTM F1216-07a Appendix X1 Design Method



Fully Deteriorated Design
Required Liner Thickness: 42.7 mm

Closure

– Fairfield Sewer was successfully planned to be rehabilitated with CIPP in 2015

– A very challenging design and installation that would push the outer envelope of CIPP installations was completed in early 2016

– The Eglington-Scarborough Crosstown (ESC) Twin Tunnels Project constructed the 6 m (20 foot) diameter tunnel directly under the 90 year old brick sewer (with its new CIPP lease on life) in February of 2016 without incident.

– In 2017 and 2018, inspections were carried out and confirmed the quality of the CIPP liner in Fairfield Sewer
  - No further remedial works were required