



**LAUZON PARKWAY TMP PLANNING AND
PRELIMINARY DESIGN**

Highway 401 Lauzon Parkway Underpass

Site No. XXX

PRELIMINARY STRUCTURAL DESIGN REPORT

FINAL



A member of  **MMM GROUP**

MCCORMICK RANKIN

March 2013

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1.0 INTRODUCTION

McCormick Rankin (MRC), on behalf of the Ministry of Transportation (MTO), the City of Windsor, and the County of Essex, is undertaking a Class Environmental Assessment Study which includes widening the Lauzon Parkway from EC Row Expressway to County Road 42, and extending it across Highway 401 and to Highway 3, a length of approximately 9 km.

The proposed alignment of Lauzon Parkway includes three existing bridges, one existing structural culvert, a new Highway 401 interchange, and a pedestrian bridge over Highway 401. This Preliminary Structural Design Report (PSDR) focuses on the new underpass at the Highway 401 Interchange.

This report discusses the proposed interim and future interchange configuration, the options considered for a new underpass, and the considerations for design. An associated general arrangement plan and a cost estimate are also provided in the appendices.

2.0 PROJECT LOCATION

It is proposed that the underpass structure will span Highway 401 between the existing County Road 17 (10th Concession Road) Underpass and the existing 9th Concession Road Underpass at the boundary of the City of Windsor and the County of Essex.

3.0 EXISTING CONDITIONS

The proposed interchange site surrounding the existing 6-lane Highway 401 cross-section is primarily made up of agricultural lands. The Little River Drain flows along the west side of the proposed interchange through an existing culvert under Highway 401. No geotechnical information was available for review at this time, however based on the foundation design of the surrounding underpasses at 9th Concession Road and at County Road 17 (10th Concession Road), with piles at the abutments and spread footings at the piers, difficulties with foundations are not anticipated.

4.0 DESIGN CRITERIA

Lauzon Parkway is an urban arterial divided roadway with a design speed of 90 km/h (UAD 90). The estimated AADT on Lauzon Parkway projected for 2031 is 38,000 vehicles north of Highway 401 and 28,000 vehicles south of Highway 401. Ten percent of these vehicles can be assumed to be commercial vehicles.

4.1 ALIGNMENTS AND CROSS-SECTIONS

Lauzon Parkway Cross-Section:

The interim cross-section of Lauzon Parkway Underpass at Highway 401 consists of the following:

West

- 0.5 m PL2 barrier wall
- 1.5 m shoulder
- 2 - 3.75 m driving lanes
- 2.0 m raised median
- 2 - 3.75 m driving lanes
- 1.5 m shoulder
- 0.5 m PL2 barrier wall

East

The ultimate cross-section including future widening adds an extra 3.75 m driving lane in each direction.

Minimum Side Clearance:

According to Table D7-1 of the MTO Geometric Design Standards, a bridge carrying a road with classification UAD with design speed of 90km/h has minimum right side clearances of 2.5m. For bridges longer than 50m, consideration can be given to further reducing the 2.5m clearance to 1.5m. As the length of the bridge exceeds 50m, the reduction to 1.5m was adopted to minimize the width of the bridge and therefore the costs.

Bridge Alignment:

Based on the proposed preferred alignment, the bridge will be constructed on a tangent horizontal alignment and will intersect Highway 401 perpendicularly.

Highway 401 Cross-Section, Alignment and Clear Zone:

Underneath the Lauzon Parkway Underpass, Highway 401 currently consists of a 6-lane cross-section with a 6.8m median, a 3.5m driving lane adjacent to the median and two 3.75m driving lanes in each direction. A future widening scheme includes an extra 3.75m driving lane as well as varying width ramp lanes for the proposed interchange.

According to the MTO Structural Manual Section 2.7.2, clear zone requirements are 7m from the edge of the ramp lane to the face of the abutments. By choosing a consistent girder length for both spans to meet this requirement rounded up to the nearest whole number, clear zone requirements have been met at both the north and south sides.

5.0 PROFILE DATA

Lauzon Parkway Profile:

Lauzon Parkway's profile at the structure is a vertical crest curve as follows:

PVI Sta. 16+492.23 Elevation 196.38
LVC = 280m
K = 70
G1 = 2.00% (rising to south)
G2 = -2.00%

Minimum Vertical Clearance:

According to the MTO Geometric Design Standards Section C4.4.3.1, new bridges shall have a minimum vertical clearance of 5.0m. Based on the preferred Lauzon Parkway profile, and the available Highway 401 elevation information, the minimum vertical clearance provided is approximately 5.09m. Further survey information of Highway 401 should be provided to confirm elevations and cross-falls on the highway. The minimum vertical clearance has been assumed to be at the crown of the westbound lanes of Highway 401, and the outer girder of the Lauzon Parkway underpass.

6.0 FOUNDATIONS

No geotechnical information was available at this time for review, however, general arrangement drawings of the two adjacent underpasses at 9th Concession Road and County Road 17 (10th Concession Road) were reviewed with respect to the foundation styles used at these nearby sites. At both adjacent underpasses, piles were used at the abutments (which were perched above the existing ground elevation), and spread footings were used at each of the three piers.

In the proposed structural design, a single central pier is proposed with longer spans to each integral abutment. The proposed span length is more than 50% longer than the spans of either of the adjacent bridges, therefore the pier foundations will sustain more load. Conservatively, piles are shown at the pier on the preliminary general arrangement drawing, however this should be confirmed once geotechnical investigation has been completed.

7.0 STRUCTURAL DESIGN

7.1 GENERAL

The proposed structural design has been configured such that it will accommodate not only interim conditions, but can also be modified easily to accommodate future widening. The preliminary general arrangement shows spans that will accommodate the future widening of Highway 401 and a Parclo-A interchange. The interim structure will carry four lanes of traffic based on a roundabout

interchange, and will accommodate future widening on both sides to incorporate ramp lanes on the bridge for the future Parclo-A design.

7.2 STRUCTURAL ALTERNATIVES

Various structural types were considered and investigated including concrete rigid frame, precast concrete girders, steel girders, and post-tensioned slab.

Of the four options, all would be appropriate for the span length of 33m, except for the rigid frame, which is typically appropriate for spans up to approximately 18m.

Post-tensioned slab bridges are more practical over new highways. Because of the formwork required for this option, the vertical clearance would need to be greater than ultimately required which would result in taller abutments, a taller pier, longer approach slopes, and longer retaining walls.

Both precast prestressed concrete girders and steel girders are considered to be appropriate at this site with this span configuration. Preference is given to the concrete girders due both to their improved durability and cost effectiveness as compared to steel girders in today's market, especially as the price of steel fluctuates considerably depending on supply and demand.

Both CPCI girders and NU girders can be considered for this span, although CPCI girders have been shown on the general arrangement drawing as the current preferred alternative. CPCI girders are currently readily available and being used on many of the Ministry's highway bridges, while NU girders are not yet readily available in Ontario (currently only a single fabricator owns forms for these girders). It is understood that it is the Ministry's intention in the future to replace CPCI girders with NU girders in new bridges, however this has not yet become policy and typical girder sizes have not yet been decided upon. NU girders are considered to have a superior cross-section that enables similarly sized girders to be spaced further apart (thus potentially eliminating one or more rows of girders from a cross-section). If more information is available during detailed design, consideration should be given to using similar sized NU girders in place of the CPCI girders to minimize costs.

Both integral and semi-integral abutments were considered to eliminate the need for expansion joints and their associated maintenance.

In addition to eliminating expansion joints, fully integral abutments also eliminate the need for bearings and where appropriate provide a more durable, and cost-effective option.

The Preliminary General Arrangement for the recommended structure is given in Appendix B.

7.3 RECOMMENDED STRUCTURAL CONFIGURATION

The recommended new structure consists of a two-span bridge with integral abutments. The span lengths (33.0m each) were determined to accommodate the future 8-lane Highway 401 cross-section incorporating a Parclo-A interchange with ramps under the bridge. Since the required wingwall lengths are more than 7 m and the propose bridge is Integral Abutment type, Retaining Soil system (RSS Walls) shall be proposed at all four quadrants.

The cross-section of the proposed structure consists of a slab-on-girder system initially utilizing 9 - 1600mm deep concrete CPCI girders made composite with a 225 mm concrete deck. For future widening of the bridge, 4 extra girders are shown to accommodate the 3.75m of extra width on each side.

As the timing is not known for the future bridge widening and incorporation of a Parclo-A interchange, nor is it known if it will ever become necessary, it is not proposed at this time to extend the footings, piers, or abutments to the future bridge width. If at the time of detailed design, the future Parclo-A interchange seems to be more imminent, consideration can be given to extending the substructure to accommodate the widening.

The design proposes to utilize conventional 30 MPa concrete for all components except for the precast girders (50 MPa). Stainless steel reinforcing would be used in all structure components within the splash zone in accordance with the Structural Manual.

The estimated construction cost for this structure is \$5,500,000 and the estimated construction cost for the widening is \$2,900,000. A breakdown of the cost estimates are given in Appendix C.

7.4 CONSTRUCTION CONSIDERATIONS

It is anticipated that one construction season would be sufficient to complete the construction of the new structure.

8.0 MISCELLANEOUS

8.1 DESIGN CODES

The detailed design of this structure shall be carried out in accordance with the latest edition of the Canadian Highway Bridge Design Code (CHBDC) at the time of design. Design details will be in accordance with the MTO Structural Manual.

8.2 ACCESS TO SITE

The site is accessible from Highway 401.

8.3 UTILITIES

No utilities are known to exist in the vicinity of the proposed underpass.

8.4 ENTRANCES AND INTERCHANGES

The new bridge is proposed between two underpasses: 9th Concession Road and County Road 17 (10th Concession Road). The nearest interchange to the west is approximately 3.0 km away at Essex Road 46 and the nearest interchange to the east is Manning Road, approximately 4.0 km away.

8.5 ENVIRONMENTAL CONSIDERATIONS

Little River Drain is immediately to the west of the proposed bridge location.

8.6 DECK DRAINAGE

According to the MTO Structural Manual, structures less than 120 m long with not more than two lanes draining to each side, built with normal crossfall to a more or less symmetrical vertical curve normally do not require deck drainage. This underpass meets all of these requirements, and deck drainage will most likely not be required. This should be investigated further during detailed design, and during the future widening of the deck.

8.7 EXPANSION JOINTS

Expansion joints are not required as an integral abutment bridge type is proposed.

8.8 BARRIERS

PL-2 concrete barrier walls without railing (conforming to Structural Standard Drawing SS110-80) are proposed for both sides of the bridge

8.9 APPROACH SLABS

Approach slabs will be detailed in accordance with Structural Standard Drawing SS116-1.

8.10 SLOPE PROTECTION

It is proposed that slope protection under the bridge will consist of concrete slope paving in accordance with Structural Standard Drawing SS116-10.

MTO has requested to provide a future abutment inspection access by proposing a 0.5 m wide slope paving on each side of the abutments.

8.11 PROPERTY REQUIREMENTS

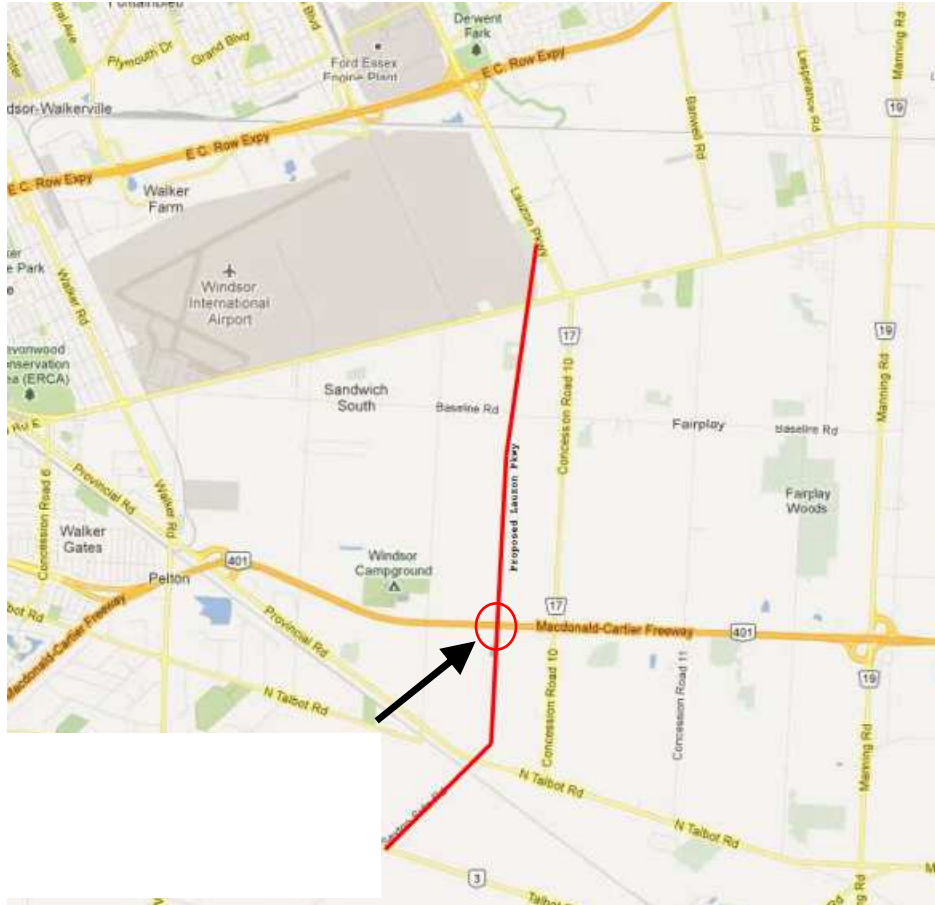
The acquisition of property is required for the new Lauzon Parkway and the bridge crossing.

9.0 SUMMARY AND RECOMMENDATIONS

The investigation has concluded that the construction of the new underpass with a two-span concrete CPCI girder bridge represents the preferred scheme. The estimated construction cost is \$5,500,000 and the estimated construction cost for the widening is \$2,900,000.

A Preliminary General Arrangement Drawing for the new structure is included in Appendix B.

APPENDIX A
KEY PLAN



Highway 401 Lauzon Parkway Underpass
Boundary of City of Windsor and County of Essex, Ontario

KEY PLAN
N.T.S.

**APPENDIX B
PRELIMINARY GENERAL
ARRANGEMENT DRAWING**

DISTRICT
 CONT. No.
 GWP No. 3017-09-00

LAUZON PARKWAY
 HIGHWAY 401 UNDERPASS

PRELIMINARY GENERAL ARRANGEMENT

MRC
McCORMICK RANKIN
 A member of **WSPAR GROUP**

METRIC

50 MPa
 30 MPa

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.

STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.

- LIST OF ABBREVIATIONS**
- ABUT - DENOTES ABUTMENT
 - EL - DENOTES ELEVATION
 - H.O.T. - DENOTES HUB ON TANGENT
 - HWY - DENOTES HIGHWAY
 - N. - DENOTES NORTH
 - S. - DENOTES SOUTH
 - STA. - DENOTES STATION
 - TYP. - DENOTES TYPICAL
 - WP - DENOTES WORKING POINT

GENERAL NOTES

CLASS OF CONCRETE

REINFORCING STEEL

LIST OF ABBREVIATIONS

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GENERAL NOTES

CLASS OF CONCRETE

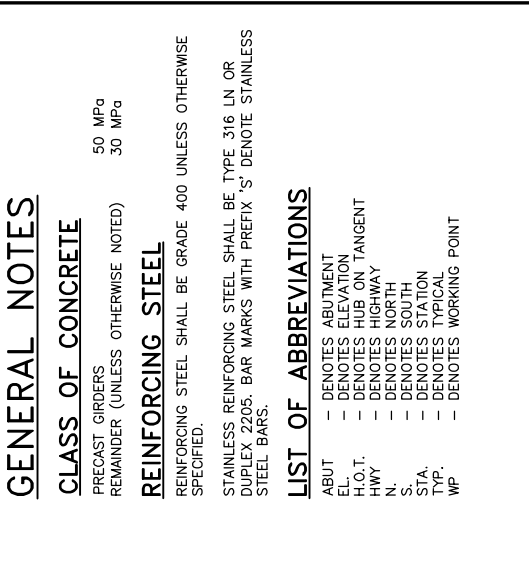
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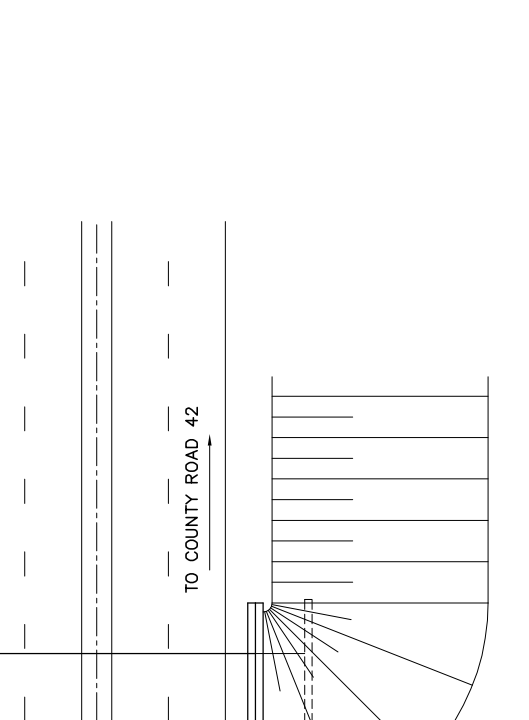
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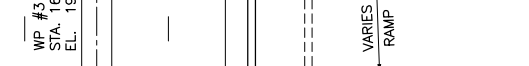


PLAN
 1 : 250



ELEVATION
 1 : 250

*EXISTING 6-LANES CONFIGURATION SHOWN



PROFILE OF LAUZON PARKWAY
 N.T.S.

DRAWING NOT TO BE SCALED
 100mm ON ORIGINAL DRAWING

NO.	DATE	BY	CHK	DESCRIPTION

DESIGN: KS | CHK: KA | CODE: CHBDC-10 | LOAD CL-625-ONT | DATE: MAR/13

DRAWN: AZ | CHK: KS | SITE: | STRUCT: | SCHEME: | DWG: PT

DATE PLOTTED: 3/1/2013 11:25:56 AM BY: MICHAEL YANG

MODIFIED: 3/1/2013 11:23:18 AM BY: YANGMI

CAD FILE LOCATION AND NAME: S:\2011\32\321012\301-Lauzon Parkway\S321012-301-001GA.dwg

8 SPACES @ 2300 c/c

1300 (TYP.)

18400

ASPHALT AND WATERPROOFING SYSTEM (90mm TOTAL) 2%

LAUZON PARKWAY 2% 2%

PROFILE CONTROL

225mm CONCRETE DECK 2%

PL2 CONCRETE BARRIER (TYP.)

1500 SIDE CLEARANCE

3750 LANE

21000

3750 FUTURE WIDENING

1500 SIDE CLEARANCE

500

CPCI 1600 PRESTRESSED GIRDERS (TYP.)

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APPENDIX C
ESTIMATED CONSTRUCTION
COST

INTERIM BRIDGE FOR ROUNDABOUT CONFIGURATION

Item	Description	Unit	Quantity	Unit Cost	Cost	item	notes
1	Earth Excavation	m ³	225	\$25	\$5,625	6	assume excavation for pier pilecap - 4.5 x 2
2	Backfill	m ³	4,100	\$50	\$205,000	7	assumed ex. ground at same elevation as 401, bridge import to end of RSS wall
3	Supply Equipment for Driving Piles	LS	1	\$100,000	\$100,000		
4	Steel H Piles - HP 310 x 110	m	1,760	\$600	\$1,056,000	9	assume 2m spacing and 40m depth for all piles
5	Driving Shoes	ea	44	\$200	\$8,800		
6	Concrete in Footings	m ³	88	\$600	\$52,920	11	assume 3.5m x 1.2m for pier footing
7	Concrete in Substructure	m ³	347	\$1,200	\$416,170	12	assume 4 x 1500mm dia columns & 2 x 1.5 piercap, 1.2m thk abutments
8	Concrete in Deck	m ³	312	\$1,400	\$436,590		
9	Concrete in Barrier Walls	m ³	37	\$1,800	\$66,528		
10	Concrete in Approach Slabs	m ³	63	\$800	\$50,400		
11	Concrete in Slope Paving	m ³	21	\$1,500	\$31,500	17	assumed 0.3t/m ³ for pilecap, 0.15 for substructure, 0.1 for black bar in deck & approach,
12	Reinforcing Steel Bar	t	118	\$3,000	\$354,199		0.1 for slope paving
13	Stainless Reinforcing Steel Bar	t	45	\$15,000	\$673,155	18	assumed 0.1 for stainless in deck & approach, 0.2 for barrier wall
14	CPCI 1600 Girder Fabrication	m	594	\$1,200	\$712,800		
15	CPCI 1600 Girder Delivery	m	594	\$200	\$118,800		
16	CPCI 1600 Girder Erection	m	594	\$350	\$207,900		
17	Bridge Deck Waterproofing	m ²	1,470	\$60	\$88,200		
18	Bearings	ea	36	\$1,500	\$54,000		
19	RSS Walls with Barrier	m ²	240	\$1,500	\$360,000		
					\$4,998,587		
				Contingency (10%)	\$499,859		
				Estimated Total	\$5,500,000		
				Deck area	1,386		
				Cost/m ²	\$4,000.00		

WIDEN BRIDGE FOR ULTIMATE PARCLO-A

Item	Description	Unit	Quantity	Unit Cost	Cost	item	notes
20	Earth Excavation	m ³	752	\$25	\$18,788	30	assume excavation for pier pilecap 4.5 x 2, and RSS & abutment to flat grade for equipment
21	Backfill	m ³	726	\$50	\$36,300		
22	Remove ex. Barrier Walls	m ³	37	\$1,000	\$36,960		
23	Remove ex. Deck Cantilever	m ³	33	\$1,500	\$49,500	33	assume 1m strip of deck removal on each side
24	Removal of RSS Wall	m ²	240	\$500	\$120,000		
25	Supply Equipment for Driving Piles	LS	1	\$100,000	\$100,000		
26	Steel H Piles - HP 310 x 110	m	640	\$500	\$320,000	36	assume 2 extra piles per side, per row at 40m deep
27	Driving Shoes	ea	16	\$200	\$3,200		
28	Concrete in Footings	m ³	32	\$600	\$18,900		
29	Concrete in Substructure	m ³	128	\$1,200	\$154,085	39	assume 1 more column on each side
30	Concrete in Deck	m ³	141	\$1,400	\$197,505		
31	Concrete in Barrier Walls	m ³	37	\$1,800	\$66,528		
32	Concrete in Approach Slabs	m ³	23	\$800	\$18,000		
33	Concrete in Slope Paving	m ³	8	\$1,500	\$11,250		
34	Reinforcing Steel Bar	t	50	\$3,000	\$150,174	44	same ratio as above
35	Stainless Reinforcing Steel Bar	t	19	\$15,000	\$285,405	45	same ratio as above
36	Dowels into Concrete	ea	1,040	\$25	\$26,000	46	assume deck & approach slab bars at 300mm spacing (top & bottom)
37	CPCI 1600 Girder Fabrication	m	264	\$1,200	\$316,800	47	2 extra girders each side
38	CPCI 1600 Girder Delivery	m	264	\$200	\$52,800		
39	CPCI 1600 Girder Erection	m	264	\$350	\$92,400		
40	Bridge Deck Waterproofing	m ²	1,881	\$50	\$94,050	51	assume whole deck waterproofing
41	Bearings	ea	16	\$1,500	\$24,000		
42	RSS Walls with Barrier	m ²	240	\$1,500	\$360,000		
					\$2,552,645		
				Contingency (10%)	\$255,265		
					\$2,807,910		
				Estimated Total	\$2,900,000		
				Deck area	495		
				Cost/m ²	\$5,700.00		