



Pay Items as the Building Blocks of an LCA Tool

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April 13, 2017



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NATIONAL SECURITY



ENERGY & ENVIRONMENT



INFRASTRUCTURE



HEALTH SOLUTIONS

Tollway LCA Is Full Roadway Evaluation

Includes 5 different environmental impact categories:

- Drainage
- Landscaping
- Lighting
- Pavement
- Structures (6 sub-categories)

Intended to be used for projects over \$10M

Tollway LCA Is Full Roadway Evaluation

Each category has up to 4 phases:

- Materials & Construction
- Maintenance & Rehabilitation
- Use (only for DR, LI, and PA)
- End-of-Life

Environmental impact categories:

- Greenhouse gas emissions
- Energy consumption
- Single Point Score (several impacts combined into a single value)

Pay Items are the “language” of road design/construction

Able to measure impacts at different stages

- Initial design estimate
- Contractor bids
- Final Invoice (as-built)

LCA in Design is Simplified Using Pay Items

RECORD DRAWINGS

THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY

CONTRACT I - 07 - 5476

VETERANS MEMORIAL TOLLWAY (I-355)

WIDENING AND OVERLAY

<p>VOLUME 1 : ROADWAY, MOT, DRAINAGE</p> <p>VOLUME 2: ELECTRICAL, DETAILS, STRUCTURAL</p> <p>VOLUME 3: CROSS SECTIONS</p>	<table border="0"> <tr> <td>MILE POST</td> <td>15.9</td> <td>TO MILE POST</td> <td>19.4</td> </tr> <tr> <td>NB-STATION</td> <td>940+15.00</td> <td>TO STATION</td> <td>1067+60.00</td> </tr> <tr> <td>SB-STATION</td> <td>941+18.00</td> <td>TO STATION</td> <td>1125+37.00</td> </tr> </table>	MILE POST	15.9	TO MILE POST	19.4	NB-STATION	940+15.00	TO STATION	1067+60.00	SB-STATION	941+18.00	TO STATION	1125+37.00	<p>REVISIONS</p> <p>NO. 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LOCATION MAP

CONSTRUCTION AREA MAP

LCA in Design is Simplified Using Pay Items

INDEX OF DRAWINGS

VOLUME 1

BEGIN DRAWING NUMBER	END DRAWING NUMBER	SHEET NUMBERS	DESCRIPTION
1	1		TITLE SHEET
2	2	I-1	INDEX OF DRAWINGS
3	3	I-2	STANDARD DRAWINGS
4	4	GN-1	GENERAL NOTES
5	5	CS-1	SUGGESTED PROGRESS SCHEDULE
6	14	14SOQ-1 TO SOQ-9	SUMMARY OF QUANTITIES
15	23	AT-1 TO AT-9	ALIGNMENT AND TIES
24	31	TS-1 TO TS-8	TYPICAL SECTIONS MAINLINE

LCA in Design is Simplified Using Pay Items

S.P.	PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RECORD QUANTITY
	20100310	TREE REMOVAL, SPECIAL (6 TO 15 UNITS DIAMETER)	UNIT	1,300	444
	20100410	TREE REMOVAL, SPECIAL (OVER 15 UNITS DIAMETER)	UNIT	90	30
	20200100	EARTH EXCAVATION	CU YD	93,167	83,040.6
	20201200	REMOVAL AND DISPOSAL OF UNSUITABLE MATERIAL	CU YD	25,380	2,929
	20400800	FURNISHED EXCAVATION	CU YD	2,538	379
	20700220	POROUS GRANULAR EMBANKMENT	CU YD	25,723	3,907
	20800150	TRENCH BACKFILL	CU YD	41,715	32,880.8
	21101615	TOPSOIL FURNISH AND PLACE, 4"	SG YD	75,000	108,935

S.P.	PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RECORD QUANTITY
	40603000	HOT-MIX ASPHALT BINDER COURSE, IL-19 0, N50	TON	4,995	5,388.3
	40603340	HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N70	TON	5,312	5,388.3
	42001300	PROTECTIVE COAT	SG YD	26,607	0
	42400100	PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH	SG FT	7,200	1,451
	44000100	PAVEMENT REMOVAL	SG YD	24,995	24,138.7
	44000156	HOT-MIX ASPHALT SURFACE REMOVAL, 1 3/4"	SG YD	1,825	595

S.P.	PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RECORD QUANTITY
	50401305	FURNISHING AND ERECTING PRECAST PRESTRESSED CONCRETE I BEAMS, 48 IN	FOOT	387	386.77
	50600205	REINFORCEMENT BARS, EPOXY COATED	POLAR	180,585	391,340
	51100100	SLOPE WALL 4 INCH	SG YD	579	489.79
	51201900	FURNISHING STEEL PILES HP12X53	FOOT	3,987	3,180

S.P.	PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RECORD QUANTITY
	40603080	HOT-MIX ASPHALT BINDER COURSE, IL-19 0, N50	TON	4,995	5,388.3
	40603340	HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N70	TON	5,312	5,388.3

40600100	BITUMINOUS MATERIALS (PRIME COAT)	GALLON	44,040	493
40600300	AGGREGATE (PRIME COAT)	TON	231	
40600982	HOT-MIX ASPHALT SURFACE REMOVAL - BUTT JOINT	SG YD	468	1,708
40600985	PORTLAND CEMENT CONCRETE SURFACE REMOVAL - BUTT JOINT	SG YD	1,680	5,492.4

50300225	CONCRETE STRUCTURES	CU YD	385	384
50300255	CONCRETE SUPERSTRUCTURE	CU YD	510	569,592
50400735	FURNISHING AND ERECTING PRECAST PRESTRESSED CONCRETE B&B T-BEAM 63"	FOOT	358	357.5
50400805	FURNISHING AND ERECTING PRECAST PRESTRESSED CONCRETE I-BEAM, 36 IN	FOOT	554	554.08

550A0140	STORM SEWERS, CLASS A, TYPE 1 30"	FOOT	50	32
550A0160	STORM SEWERS, CLASS A, TYPE 1 36"	FOOT	72	0
550A0210	STORM SEWERS, CLASS A, TYPE 1 60"	FOOT	11	2.1
550A0340	STORM SEWERS, CLASS A, TYPE 2 12"	FOOT	484	180.3
550A0360	STORM SEWERS, CLASS A, TYPE 2 18"	FOOT	6,349	6,603.1
550A0380	STORM SEWERS, CLASS A, TYPE 2 18"	FOOT	2,290	2,269.9

From Design We Move To Bidding Projects

Illinois State Toll Highway Authority - Bid Analysis -

Contract No: RR-12-4047
 Description: Roadway Resurfacing and Bridge Repair Project Veterans Memorial Tollway (I-355) MP 0.0 (I-80) to MP 29.8 (Army Trail Road) Station 100=00.00 to Station 1678+83.10
 Number of Bidders: 5
 Bid Opening Date: 2/5/2013
 Begin Date: 4/1/2013
 End Date: 11/22/2013

Item	Description	Unit	Qty	Engineer's Estimate		Low Bidder		Max
				Price	Item Total	Price	Item Total	
				TOTAL	\$19,216,705.00	TOTAL	\$17,181,090.80	
20100110	TREE REMOV 6-15	UNIT	225	\$51.00	\$11,475.000	\$18.000	\$4,050.000	\$30.000
20100210	TREE REMOV OVER 15	UNIT	58	\$76.00	\$4,408.000	\$21.000	\$1,218.000	\$70.000
20200100	EARTH EXCAVATION	CU YD	150	\$25.00	\$3,750.000	\$78.000	\$11,700.000	\$80.000
20201200	REM & DISP UNS MATL	CU YD	20	\$75.00	\$1,500.000	\$133.000	\$2,660.000	\$133.000
20400800	FURNISHED EXCAV	CU YD	2400	\$25.00	\$60,000.000	\$10.000	\$24,000.000	\$94.000
20700220	POROUS GRAN EMBANK	CU YD	50	\$45.00	\$2,250.000	\$135.000	\$6,750.000	\$135.000
20800150	TRENCH BACKFILL	CU YD	1184	\$35.00	\$41,440.000	\$38.200	\$45,228.800	\$38.200
21101625	TOPSOIL F & P 6	SQ YD	7151	\$4.00	\$28,604.000	\$6.000	\$42,906.000	\$6.000
25000210	SEEDING CL 2A	ACRE	2	\$1,500.00	\$3,000.000	\$3,500.000	\$7,000.000	\$5,712.000
25000400	NITROGEN FERT NUTR	POUND	180	\$3.00	\$540.000	\$2.000	\$360.000	\$3.000
25000500	PHOSPHORUS FERT NUTR	POUND	180	\$3.00	\$540.000	\$2.000	\$360.000	\$3.000

At completion of construction you know actuals

Final Pay Estimate

Date of Notice To Proceed 4/7/2008
 Date of Final Completion 11/21/2008
 Amount of Contract Award \$29,458,925.40
 Adjusted Contract Amount \$28,336,892.41

Contract No: I-08-5542
 Current Est No. 27
 Period Beginning 5/21/2009
 Period Ending 6/5/2009

Contractor Rockford Blacktop Construction Co./Rock Road Companies JV
 5290 Nimitz Road
 Loves Park, IL 61111

% Work Completed 100.00%
 Contract Balance \$0.00

Description Roadway & Bridge Reconstruction - EB Jane Addams Memorial Tollway (I-90) - From Plaza 1 (So. Beloit) to IL Route 173 - M.P. 74.9 to M.P. 69.9 - Station 168+80.37 to Station 432+88.60.

Item #	Proposal Qty	Approved	Approved Adjusted Quantity	Unit of Measure	Description	Unit Price	Qty this Period	Earned this Period	Qty. to Date	Earned to Date
X0324388	2		2	EACH	REM OH SN STR END SUP	\$33,500.32			2.00	\$67,000.64
X0325569	2		2	EACH	TEMP BR TR SIGNALS RA	\$1,988.02			2.00	\$3,976.04
X4400198	115	1	112.9	FOOT	CONC BARRIER REM SPL	\$110.00			112.90	\$12,419.00
X602000X	3		3	EACH	DRAINAGE STRUCTS, TY 4 SPL W/2 TY 2	\$10,515.66			3.00	\$31,546.98
XB110125	420	1	313.4	FOOT	CON ATS 4 GALVS PVC	\$125.63			313.40	\$39,372.44
Z0030150	5	1	0	EACH	IMPACT ATTEN NRD TL3	\$3,800.04			0.00	\$0.00
Z0030250	1	1	5	EACH	IMP ATTN TEMP NRD TL3	\$4,000.04			5.00	\$20,000.20
Z0030260	1		1	EACH	IMP ATTN TEMP FRN TL3	\$11,500.11			1.00	\$11,500.11
Z0030330	1	1	0	EACH	IMP ATTN REL FRD TL3	\$4,350.04			0.00	\$0.00
Z0030350	15	1	3	EACH	IMP ATTN REL NRD TL3	\$600.01			3.00	\$1,800.03
J1A20001	64		64	EACH	TREE, ACER MIYABEI MORTON (STATE S	\$374.40			64.00	\$23,961.60
J1A20005	64		64	EACH	TREE, ACER PLATANOIDES(JADE GLEN N	\$302.00			64.00	\$19,328.00
J1A20011	64		64	EACH	TREE, GLEDITSIA TRIACANTHOS INERMI	\$302.00			64.00	\$19,328.00
J1A20020	63	1	0	EACH	TREE, QUERCUS MACROCARPA(BUR OAK)	\$302.00			0.00	\$0.00
J1209020	16234	3	18759.48	CU YD	POROUS GRANULAR EMBANKMENT, SUBG	\$17.91			18,759.48	\$335,982.29
J1213001	300	1	0	FOOT	EXPLORATION TRENCH, UTILITIES	\$16.54			0.00	\$0.00
J1406030	767	1	809.68	TON	GTR MODIFIED HOT-MIX ASPHALT SURF	\$126.56			809.68	\$102,473.10
J1420040	2019	1	2075.09	SQ YD	BRIDGE APPROACH SLAB	\$278.26			2,075.09	\$577,414.54
J1442204	6	1	0	SQ YD	CLASS D1 PATCHES, TYPE II, 6 INCHES	\$332.89			0.00	\$0.00
J1481070	1657	3	1116.63	TON	AGGREGATE SHOULDERS SPECIAL, TYPE	\$20.33			1,116.63	\$22,701.09
J1481110	1057	2	1865.3	TON	AGGREGATE SHOULDERS WITH FILTER F	\$18.40			1,865.30	\$34,321.52
J1482004	43	1	0	SQ YD	HOT-MIX ASPHALT SHOULDERS (6 IN.)	\$37.93			0.00	\$0.00
J1482020	50407	3	51452.32	SQ YD	HOT-MIX ASPHALT SHOULDERS (9 IN.)	\$26.00			51,452.32	\$1,337,760.32

Not Every Pay Item is Included

Assign each pay item to the appropriate module

Sort pay items within each module by cost

Top 95 percent for each module included in LCA evaluation

- (plus any individual pay items > 0.5% of total cost)

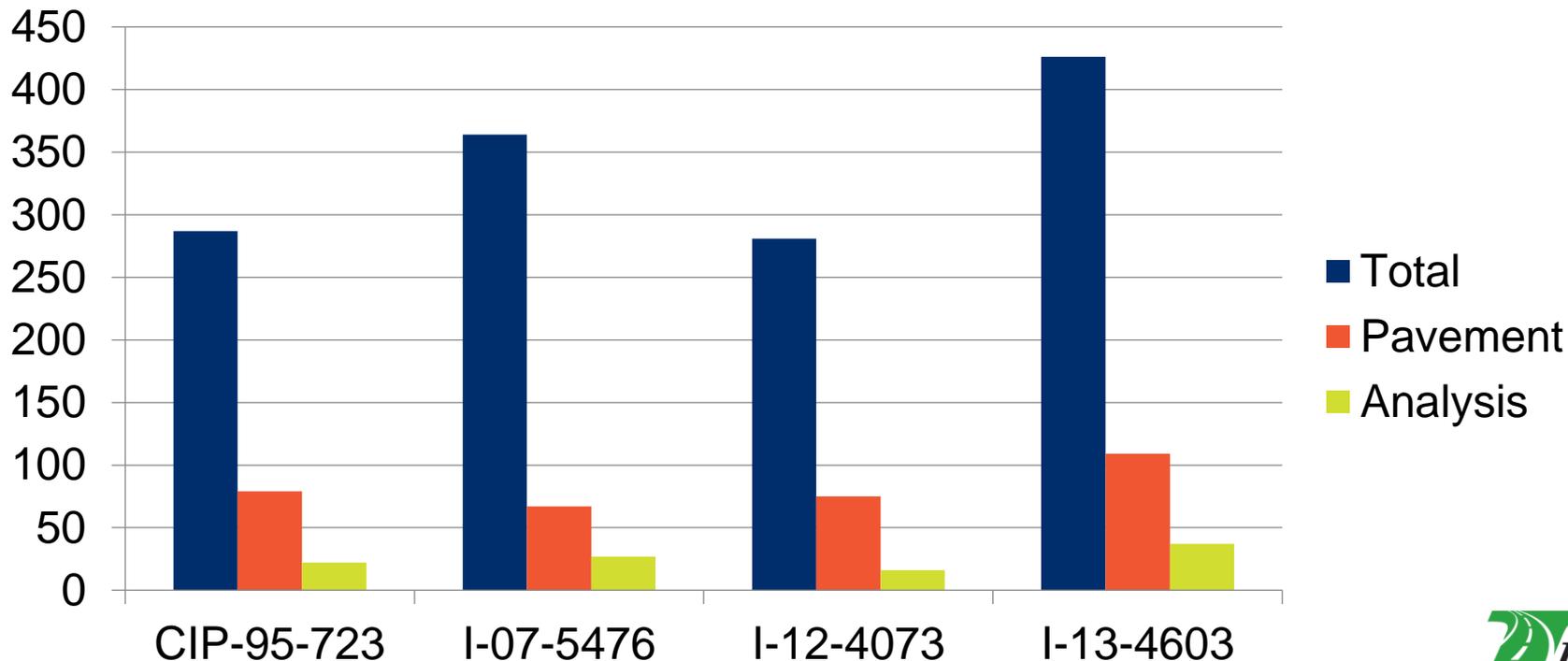
Eliminated may be included if environmentally relevant

The Number of Pay Items is Reasonable

Individual above 0.5% Total at least 95%

Contract_Number	Item_Number	Unit_Of_Measure	Description	Unit_Price	Quantity_To	Total_Cost	Category		
I-12-4073	JT420079	SY	COMP PRTLND CEM CONC PVMT 11.25" (\$ 38.20	199,449	\$ 7,618,951.80	Pavement	39.9	
I-12-4073	20200100	CY	EARTH EXCAVATION	\$ 8.75	239,425	\$ 2,094,968.75	Pavement	11.0	50.9
I-12-4073	J1312022	SY	STABZD SBBSE, WMA, 3"	\$ 8.75	218,042	\$ 1,907,867.50	Pavement	10.0	60.9
I-12-4073	J1482112	SY	WARM MIX ASPHALT SHLRS (9 IN)	\$ 30.30	58,248	\$ 1,764,914.40	Pavement	9.3	70.2
I-12-4073	JT313010	CY	SUBGRD AGGR, SPCL, 9"	\$ 20.25	78,237	\$ 1,584,299.25	Pavement	8.3	78.5
I-12-4073	44000100	SY	PAVEMENT REM	\$ 6.30	132,760	\$ 836,388.00	Pavement	4.4	82.8
I-12-4073	60109520	FT	P UNDER FAB LINE TR 6	\$ 9.45	54,805	\$ 517,907.25	Pavement	2.7	85.6
I-12-4073	44004250	SY	PAVED SHLD REMOVAL	\$ 3.85	102,075	\$ 392,988.75	Pavement	2.1	87.6
I-12-4073	78005110	FT	EPOXY PVT MK LINE 4	\$ 0.65	517,369	\$ 336,289.85	Pavement	1.8	89.4
I-12-4073	J13355114	SY	WARM-MIX ASPHALT BSE CSE, 7-1/4"	\$ 26.00	10,786	\$ 280,436.00	Pavement	1.5	90.9
I-12-4073	JT314010	SY	SUBGRD GRNLR EMBNKMNT, SPCL, 6"	\$ 0.85	279,806	\$ 237,835.10	Pavement	1.2	92.1
I-12-4073	J1420005	SY	PORTLAND CEMENT CONCRETE PAVEME	\$ 47.50	2,989	\$ 141,977.50	Pavement	0.7	92.8
I-12-4073	J1481130	SY	AGGREGATE SHOULDERS WITH FILTER F	\$ 7.50	18,372	\$ 137,790.00	Pavement	0.7	93.6
I-12-4073	Z0026400	CY	FURNISHING AND PLACING SAND FILL	\$ 25.00	3,941	\$ 98,525.00	Pavement	0.5	94.1
I-12-4073	J1406510	TON	WARM-MIX ASPHALT SURF CSE, MIX D, N	\$ 92.00	1,057	\$ 97,244.00	Pavement	0.5	94.6
I-12-4073	JT990100	FT	REMOVE HIGH TENSION CABLE MEDIAN B	\$ 2.70	31,810	\$ 85,887.00	Pavement	0.5	95.0
I-12-4073	J1635010	EA	ROADWAY DELINEATORS	\$ 90.90	906	\$ 82,355.40	Pavement	0.4	95.5
I-12-4073	JT154001	UNIT	PAVEMENT PATCHING AND TRAFFIC CON	\$ 1.00	75,000	\$ 75,000.00	Pavement	0.4	95.9
I-12-4073	J1482104	SY	WARM MIX ASPHALT SHLRS (6 IN)	\$ 36.70	1,682	\$ 61,729.40	Pavement	0.3	96.2
I-12-4073	JT301010	CY	GRNLR SUBBSE, SPCL 6"	\$ 33.90	1,798	\$ 60,952.20	Pavement	0.3	96.5
I-12-4073	JT900510	SY	SUBGRADE SOIL MOD TY I	\$ 15.40	3,900	\$ 60,060.00	Pavement	0.3	96.8
I-12-4073	JT154005	UNIT	EMERGENCY PAVEMENT AND SHOULDER	\$ 1.00	60,000	\$ 60,000.00	Pavement	0.3	97.1
I-12-4073	JT154161	UNIT	ALLOW F/BIT MATLS COSTS ADJ	\$ 1.00	50,000	\$ 50,000.00	Pavement	0.3	97.4
I-12-4073	JT302017	TON	FLY ASH	\$ 28.05	1,500	\$ 42,075.00	Pavement	0.2	97.6
I-12-4073	JT783001	SF	PAVEMENT MARKING REMOVAL	\$ 0.30	121,652	\$ 36,495.60	Pavement	0.2	97.8
I-12-4073	J1420028	EA	CONSTRG COMPST CONC TST STRP	\$ 15,000.00	2	\$ 30,000.00	Pavement	0.2	98.0

Number is Reduced By Module and Cost



Pay Item Definitions

Each significant pay items is “defined”

Definitions include:

- Mix designs (where appropriate)
- Materials
- Equipment
- Operations

Objective is to account for all impacts associated with providing a unit of a pay item, in-place, accepted by the Tollway

The item is defined in the LCA tool

CATCH BASIN TY M-4

PayItem Number 610C13
Module Drainage
Description CATCH BASIN TY M-4
PayItem Unit EACH
Productivity per hour 0.4375
Cost per Unit 11100
Baseline project? Baseline
No. of Mix Design 1
Notes Originally for baseline project I-05-7713. Mass of concrete and reinforcing steel calculated from IDOT 602006-04 for Type G-2:

List of Materials used in the Pay Item

Material Name	Unit	Quantity per payitem unit	Transportation Mode	Distance to Supplier (mi)
Reinforced steel	TON	0.105	Hauling Truck	10
Cast iron	TON	0.05	Hauling Truck	10

List of Equipments used in the Pay Item

Equipment Name	Distance to site (mi)
Diesel Excavator, Crawler 300 Average	10
Diesel Roller, Tandem Smooth Drum Vibratory 16 Average	10

Other Pay Items Are Part of the LCA

Maintenance and Rehabilitation

- Based on LCCA scenarios
- Specific to maintenance/rehab activity

End-of-Life (EOL)

- Scenarios include Recycle, Re-use (onsite/offsite), Landfill

Defined in the same way as the Materials and Construction pay items (described above)

Pay Items Result

LCA Tool is designed to allow results for individual pay item impacts to be presented

Impacts can be sorted, or “top 10” pay item impacts can be displayed

Allows for “gut check” on results

Questions?





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