Cast-In-Place Concrete Decks

Since 2013, we have been pouring castin-place concrete decks to cost-effectively rehabilitate aging structures and minimize leakage on both existing and new box beam structures and steel structures. This presentation will start by covering the construction process and end with an in-depth look at two recent projects.

Scott C. Coleman, P.E., P.S. Logan County Engineer





Pre-pour: Design and Procedure Pour deck

Post-pour: Surface finishing and wet curing



Pre-pour: Design







TRANSVERSE SECTION

Double mat and minimum 8" thick deck needed for structural capacity.



Edge Beam Detail



See AASHTO's "Standard Specifications for Highway Bridges" and ODOT's "Bridge Design Manual" for minimum cover and minimum deck thickness requirements.



Bar supports





Load Ratings

Bridge No:	LOG 86-2.87	PID Number:			
SFN:	4637968	Project No:			
Year Built:	1976 (major rehab in 2017)	Load Rated By:	MJK	Date:	12/1/2017
Bridge Type:	Simple Span Steel Beam w/ Non-	Chk'd By:	SCC	Date:	and the state
	Composite Concrete deck			-	

LRFR of Simple Span Steel Beam with Non-Composite Concrete Deck





Span Le	ength, L (ft)	59.9
d = dept	th of beam section (in)	33.000
$b_c = wid$	th of top flange (in)	11.500
$t_c = thich$	kness of top flange (in)	0.740
$t_w = thic$	kness of web (in)	0.550
t _t = thick	mess of bottom flange (in)	0.740
$b_t = wid$	th of bottom flange (in)	11.500
$x F_v = spe$	cified yield point of the steel (ksi)	36.0
$-E_{\rm B} = mod$	dulus of elasticity of steel beam (ksi)	29000
X Beam S	pacing, S (ft)	3.0
Cross-fr	rame Spacing (ft)	12.5
Total nu	umber of Beams, N_b	8
Rolled I	Beams(R) or Built-up Beams(B)	R
Concret	e Deck Thickness, t_s (in)	8.00
$f_c' = ultin$	mate compressive strength of concrete	4.5
$W_c = co$	ncrete density (lb/ft ³)	150.0
d.* (ft)		1.22
Exterior	Beam Overhang (ft)	1.50
"B" (in)		18.50
W _{DC-othe}	r(k/ft)	0.07
W _{DW} (k	/ft)	0.15
Total N	umber of Traffic Lanes, N_L	2
Ohio Le Operatio	egal Trucks & SHV & EV ng Load Factor γ_{LL}	1.40
f Load Ra	ate Interior (I) or Exterior (E) Beam	I
Structur	e Condition Factor, $\varphi_c =$	1.00
ht Structur	e System Factor. $\omega_{-} =$	1.00

 $d_{\rm e}$ * = distance from the exterior web of exterior beam to the interior edge of curb or traffic barrier

* see φ_c & φ_s tables on the right Structure System H

Calculate Beam Properties:

D = clear distance between bea	= 31.520			
$\bar{y}_{elastic} =$	16.50	in		
	A_i (in ²)			
A ₁	8.51	d _{i-e} (in)	$A_i d_{i-e}^2 (in^4)$	$I_i(in^4)$
A ₂	8.67	16.13	2214.11	0.39
A ₃	8.67	7.88	538.23	179.41

Page 1 of 8

Bridge No:	LOG 86-2.87	PID Number:			A L L L N
SFN:	4637968	Project No:			the second second
Year Built:	1976 (major rehab in 2017)	Load Rated By:	MJK	Date:	12/1/2017
Bridge Type:	Simple Span Steel Beam w/ Non-	Chk'd By:	SCC	Date:	and the second se
	Composite Concrete deck				

LRFR of Simple Span Steel Beam with Non-Composite Concrete Deck

φ _c	1.00
φs	1.00
$\varphi_c \varphi_s \ge 0.85 =$	1.00

Load Rating Summary - Ohio Legal Trucks											
I and in a Trans		Rating Fa	actor - RF	Legal							
Loading Type	GVW (Ions)	Inventory	Operating	(Tons)							
HL-93	· .	1.108	1.437								
Ohio Legal - 2F1	15	$>\!\!<$	3.531	15.00							
Ohio Legal - 3F1	23	\geq	2.377	23.00							
Ohio Legal - 4F1	27	\geq	2.108	27.00							
Ohio Legal - 5C1	40	> <	2.425	40.00							

Load Rating Summary - Specialized Hauling Vehicles (SHV)

Londing Type	CVIV (Terre)	Rating Factor - RF	Legal
Loading Type	GVW (10hs)	Operating	(Tons)
SU4	27	2.092	27.00
SU5	31	1.905	31.00
SU6	34.75	1.714	34.75
SU7	38.75	1.579	38.75

Load Rating Summary - EMERGENCY VEHICLES (EV)										
Loading Type	GVW (Tons)	Rating Factor - RF	Legal							
Bouding Type	GVW (Ions)	Operating	(Tons)							
EV2	28.75	2.048	28.75							
EV3	43	1.349	43.00							



Revised by ODOT 2/2017

Page 9 of 8

LOGAN COUNTY ENGINEER'S OFFICE

Revised by ODOT 2/2017

Pre-pour: Procedure

Temporary walkway

➢Clean steel beams

Install forms (temporary wooden forms & permanent SIP metal forms)

Deck preparations: Grout & install HDG rebar reinforcement

Screed

Concrete supplier

Pump Truck or conveyor



Temporary Walkway













Total cost in 2013 via Dayton Superior: **\$5,452.53**

Included brackets, 2x4 rail receptacles, plate assemblies, coil bolts, and shipping for 52 units.













Clean Steel Beams



ENGINEER'S OFFICE

Install forms



LOGAN COUNTY ENGINEER'S OFFICE



"Permanent Corrugated Steel Bridge Deck is a heavy-duty system for forming bridge deck slabs quickly and permanently. It is fabricated from structural quality high strength, galvanized steel conforming to ASTM A 653/A 653M. A uniform zinc coating, conforming to ASTM A 924/A 924M, latest edition, coating class G-165 or G-235, protects all exposed parts of the form and adds an extra measure of durability." -LB Foster



LBFoster

Construction Products

To: All Bidding Contractors

Mailing Address:

L. B. Foster Company 415 Holiday Dr. Pittsburgh, PA 15220

 Phone:
 (412) 928-3520

 Mobile:
 (304) 281-8874

 Fax:
 (412) 928-3477

 Date:
 08/25/2016

Re: Bridge 12- 6.51 Logan Co, OH

Shipping Location: , OH

Price / UOM \$3,490.0000/ LS

We are pleased to quote as follows:

Description Gross Area: 750 Sq. Ft.

Scope: We propose to furnish the stay in place forms,screws,closures, related accessory items. Design is based on an slab thickness of 8 inches with concrete in the deck valleys.

Placement drawings for Approval with calculations & PE Stamps.

Freight is included to the job site.

Material list: 70 sheets 2 x 8 1/2 - 20 gage G- 235 Bridge Deck - 43.00 inches long. Bridge Deck Form to sit on top flange of beams with 1 5/8 bearing on each end. Bridge Deck Forms are to be puddle welded to the top flange or other approved attachment. 250 Tek Screws for sidelap attachment of the sheets. 5 pcs 3 x 3 - 14 gage flashing - 90 degrees. 5 pcs 2 inch Channel Closure.

Material:

Bridge Deck Forms and accessories will have a galvanized G235 coating. Material to be structural quality steel conforming to ASTM A-653. Galvanized coating to conform to ASTM A-924. Accessories will be furnished in ten foot lengths.



Deck preparations

Fill the gaps between the beams with jute rope & grout.

Lay hot-dipped galvanized reinforcing.

The deck surface should be kept clean while grouting and placing concrete.

Spray wooden forms with a form-release agent before the deck pour.







After setting the box beams, a flowable, 7,000 psi high-strength grout is placed between the beams.



Screed

BEEM Construction has provided the concrete screed on each project.



ENGINEER'S OFFICE







For longer projects, the anchor must be quickly moved from the starting position to the end of the bridge mid-pour. Anchor used to pull screed by being attached to a winch on the screed.



ENGINEER'S OFFICE







As concrete is placed, a spud vibrator and vibrating screed are used to consolidate the concrete while concrete is evenly spread across the rebar mat.



LOGAN COUNTY ENGINEER'S OFFICE

ENGINEER'S OFFICE

Concrete Test Results

QC II, 4500 with superplastizer and Ipanex

CTL Engineering, Inc.

102 Commerce Drive, PO Box 44, Wapakoneta, OH, 45895

Phone : 419-738-1447 Fax : 419-738-7670

Email : ctlwapak@ctleng.com

AN EMPLOYEE OWNED COMPANY

Consulting Engineers - Testing - Inspection Services - Analytical Laboratories

Established 1927

TICKET NO.	TIME BATCH	TIME PLACE	LOAD SIZE (cy)	1	AIR (% 2) 3	1	SLUM 2	IP (in) 3	4	DENSITY (pcf)	BATCH WT. (Ibs)	YIELD (cf/cy)	TEMP (F)	WATER ADDED (gal)	SET NO.	LOCATION OF TEST SAMPLE
1st load	09:00			6.0			4.50							71		1	Northeast deck pour
AIR:1 - At Discharge / 2 - At Placement / 3 - Air Loss SLUMP:1-Initial Slump / 2 - After Water / 3 - After HRWR / 4 - After Pump							mp		IN IN	IITIAL C	URING URING	METHOI TEMP (F	D : Not) HIGH	Defined : LOW:			

REMARKS :

LAB DATA - ASTM C 39, C 1231													
SAMPLE NUMBER	DATE TESTED	AGE (days)	WEIGHT (Ibs)	DIAM. (in)	AREA (in ²)	LOAD (Ibs)	COMPRESSIVE STRENGTH (psi)	TYPE OF BREAK	AVERAGE STRENGTH				
1 - A	11/06/2017	5	8.41	4.00	12.56	52330	4160	Type 2-PO					
1 - B	11/08/2017	7	8.43	4.01	12.62	59600	4730	Type 1-PO					
1 - C	11/29/2017	28	8.44	4.03	12.75	86650	6810	Type 2-PF					
1 - D	11/29/2017	28	8.47	4.02	12.69	88460	6990	Type 2-PF	6900				



QC II, 5500 with superplastizer and Ipanex.

Higher strength because it was used in structural capacity.

CTL Enginee	ring, Inc.							· · · · · ·	
102 Commerce	ce Drive, PO Bo	ox 44, Wapal	koneta, OH, 458		//				
Phone : 419-7	738-1447 Fax :	419-738 - 767	0					ENGINEE	NAS STREET
Email : ctlwap	ak@ctleng.com	ו		AN EMPI		ED COMPAN	IY	19 B La , 2007 ()	
Consulting Er	ngineers - Testir	ng - Inspectio	on Services - Ar	alytical Labo	ratories	-		Establish	ed 1927
				CONC	RETE TESTIN	IG REPORT			
AIR : SLUM	1 - At Discharge IP : 1-Initial Slur	e / 2 - At Plac mp / 2 - After	cement / 3 - Air Water / 3 - Afte	Loss er HRWR / 4 -	- After Pump		INITIAL CURING	G METHOD : Not Defi G TEMP (F) HIGH :	ned LOW :
REMARKS :									
-				LAB D/	ATA - ASTM	C 39, C 1231	~ ~ ~		
SAMPLE NUMBER	DATE TESTED	AGE (days)	WEIGHT (lbs)	DIAM. (in)	AREA (in ²)	LOAD (Ibs)	COMPRESSIVE STRENGTH (psi)	TYPE OF BREAK	AVERAGE STRENGTH
1 - A	03/02/2018	3	8.50	4.01	12.62	44190	3510	Type 2-PO	
1 - B	03/05/2018	6	8.78	4.01	12.62	50270	3990	Type 2-PO	
1 - C	03/27/2018	28	8.51	4.02	12.69	98300	7760	Type 3-PF	
1 - D	03/27/2018	28	8.58	4.01	12.62	92290	7310	Type 3-PF	7540



Post-pour: Surface finishing



LOGAN COUNTY ENGINEER'S OFFICE

ENGINEER'S OFFICE

Using the tine for a finished texture along with the cross slope helps prevent water & ice accumulation.





Wet curing

Immediately after tining, pre-wetted burlap is placed over the entire deck and overhangs the deck by one foot. Soaker hoses, which are connected to one of the county's 1600 gallon portable water tanks, are then placed on top of the burlap to keep the deck surface from drying out. These hoses were placed longitudinally, starting 6" from the crown and placed ~2' apart Clear plastic tarps were placed over the soaker hoses and rebar was used to keep these tarps down.





ENGINEER'S OFFICE



Our wet cure burlap system kept is saturated for a minimum of 3 days. LOGAN COUNTY ENGINEER'S OFFICE



In-Depth: County installs metal SIP for the first time

LOGAN COUNTY

Bridge size: 37'6" x 24'-0" LOGAN COUNTY ENGINEER'S OFFICE





Beams were cleaned by needling but we have recently transitioned to a much better cleaning process by sand blasting steel beams.

LOGAN COUNTY ENGINEER'S OFFICE



















In-Depth: No posting after rehab



Deck size: 59'11" x 24'-0"

Load-restricted bridge with a timber deck with asphalt surface was replaced with non-composite concrete deck.



LOGAN COUNTY ENGINEER'S OFFICE























BR 86-2.87

ENGINEER'S OFFICE









		OHIO DEPA	RTMENT C	F TRANSPO	ORTATION	1		
SFN		BRIDGE NUMBER			DISTRICT			
4637968		LOG 86-2.87			7			
ORIGINAL CONSTRUCTION YEAR		REHABILITATION YEAR	OVERALL STRUCTURE FEATURE INTERSECTED			ED		
1976		2017	59'-11"				and the second second	
SPECIAL ASSUMP COMMENT	PTIONS & TS	These load ratings reflec deck onto rehabbed stee	t the major rehat I beams.	o done in 2017 tha	it consisted of p	ouring a non-com	posite 8" concrete	
	200	PLEASE SELECT O	ON RIGHT, WHER	E APPROPRIATE,	BY USING THE D	DROP DOWN ARR	OW BUTTON	
LOAD RATING PURPOSE:		2 - Rehabilitation						
LOAD RATING SOFTWARE:		3 - AASHTO BrR (VIRTIS)						
RATING SOURCE:		1 - Plan information available for load rating analysis (Default)						
RATING METHOD:		8 - Load & Resistance Factor Rating (LRFR) reported by rating factor (RF)						
ORIGINAL DESIGN L	OADING:			A - HLS	93			
			STRUCTURE RAT	NG SUMMARY				
OHIO LEGAL VEHICLES				DESIGN VEHICLE				
Loading Type	GVW (Tons)	Operating Rating RF	Legal Weight (Tons)	Loading Type HL93 Loading Overall Legal Posting Rating		#N Operating	Inventory	
2F1	15	3.531	15.00			1.437	1.108	
3F1	23	2.377	23.00					
4F1	27	2.108	27.00			150%		
5C1	40	2.425	40.00	(Does not include EV's)				
SPECIALIZED H		AULING VEHICLES (SHV)	BRIDGE POSTING		No Load Posting is Recommended		
SU4	27	2.092	27.00	RECOMMENDED BY RATING				
505	34.75	1.905	34.75					
SU7	38.75	1.579	38.75					
EMERGEN	CY VEHICL	ES (EV) - Check box to include EV		Sign Posting				
EV2 28.75		0.631	.631 18.14		indation:			
EV3	43	0.410	17.63					
AGENCY/FIRM/OFFICE		LOGAN COUNTY ENGINEER'S		OFFICE	REPORT DATE: 12/1/2017		12/1/2017	
RATED BY		PE NUMBER	PHONE NUMBER		EMAIL			
МЈК		N/A	937-592-2791		mkerns@lceo.us			
REVIEWED BY		PE NUMBER	PHONE NUMBER			EMAIL		
SCC		63397	937-592-2791		_scoleman@lceo.us			

_





ODOT Structures page for load rating spreadsheets and BR 100 forms: <u>ftp://ftp.dot.state.oh.us/pub/structures/bms/We</u> b_download_files/

LB Foster Bridge Forms: http://lbfosterfabricatedproducts.com/Bridge_Forms.asp

Dayton Superior Bridge Deck Handbook: http://www.daytonsuperior.com/docs/defaultsource/handbooks/bridge-deck-handbook.pdf

This presentation can be found online at: www.lceo.us

LOGAN COUNTY