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ABCs of ABC Virtual Symposium

AASHTO LRFD Guide Specifications for Accelerated Bridge Construction

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NCHRP 12-102: Project Overview



- Guide Specification Development
 - · Significant synthesis project
 - · No new research involved
 - Technology readiness evaluation done for each technology
- Approach:
 - Not a stand-alone document
 - Supplement to:
 - AASHTO LRFD Bridge Design Specifications
 - AASHTO Bridge Construction Specifications
 - Separate Design and Construction Parts
- Project Status: Complete

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NCHRP 12-102: Project Overview

- Sources of provisions
 - Significant technology synthesis
 - Dozens of past research projects
 on ABC
 - NCHRP Research
 - State DOT Research
 - International Research
 - FHWA research
 - Questionnaire to Each State DOT
 - What are they using?
 - · What is working? What is not?



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Source: FHWA UHPC Research

Technology Readiness

- Evaluation
 - Level of testing and research
 - Existing Specifications
 - Implementation
 - Durability
- Parameters and weight factors worked out with project panel

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Technology	Description	Article 3.6.4.	4 Type 2 M	lechanical Con	nectors in H	flastic Hinge H	Regions for SD	Us C and
Technology	Description.	D (Seismic Z	ones 5 and	14)	and sound			
resung and Research 4			2	One Research Project Completed				
			2	The Research	ch Project C	ompieted		
			3	Two Researd	ch Project C	Completed		
			4	Innee Resea	inch Project	Completed	and the second	
Commente	Decembra	I bei serite af	5 Marada Dar	More than th	2042 Tee	on Projects C	ompleted	
Comments	San Diego (Philipi & Hegin	mer, 2013),	and the Univer	sity of Utah	(Pantelides e	et al. 2014).	iversity t
Existing Sp	ecifications	2	1	Not sufficient data to develop provisions				
Design and/or construction			2	Data available, but provisions not developed				
-			3	Provisions available in other countries				
			4	Provisions a	vailable in o	ther US codes	5	
			5	Design provisions fully developed				
Comments	Design reco	mmendations	included in	cited research	n. ACI 318-	14 allows the	use of these co	onnector
	in plastic hi	nge regions fo	r buildings.					
Implementation 5			1	Never used on a bridge, minor lab testing				
			2	Never used	on a bridge,	signficant lab	testing	
			3	Used on one	sucessful	bridge project		
			4	Used on two	sucessful l	oridge projects	3	
5				Commonly used				
Comments	These conn	ectors are incl	uded in Uta	ah DOT standa	rd precast s	ubstructure d	etails.	
Durability		5	1	No information on performance				
·····,			2	Used once with limited exposure (newer bridges)				
			3	Used a few t	imes with li	mited exposu	re (newer bridg	es)
			4	Used a man	y times with	limited expos	sure (newer bri	dges)
			5	Used many	times with s	ignificant exp	osure	
	Durability or	cpected to be	the come a	1 0/0	design when	adequate cor	and the second shared	
Comments	Durability e.		ule sallie a	is regular R/C i	acoign mich		ver is provided.	
Comments Technology	Readiness	Rating	cile salite a	Weight	Adjusted	Maximum	Adjusted	
Comments Technology	Readiness	Rating	Score	Weight Factor	Adjusted Score	Maximum Score	Adjusted Score	
Comments Technology	Readiness	Rating Research	Score 4	Weight Factor 25	Adjusted Score 100	Maximum Score 5	Adjusted Score 125	
Comments Technology	Readiness Testing and Existing Sp	Rating Research ecifications	Score 4 2	Weight Factor 25 15	Adjusted Score 100 30	Maximum Score 5 5	Adjusted Score 125 75	
Comments Technology	r Readiness Testing and Existing Sp Implementa	Rating Research ecifications tion	Score 4 2 5	Weight Factor 25 15 30	Adjusted Score 100 30 150	Maximum Score 5 5 5	Adjusted Score 125 75 150	
Comments Technology	Readiness Testing and Existing Sp Implementa Durability	Rating Research ecifications tion	Score 4 2 5 5	Weight Factor 25 15 30 30	Adjusted Score 100 30 150 150	Maximum Score 5 5 5 5 5	Adjusted Score 125 75 150 150	
Comments Technology	Readiness Testing and Existing Sp Implementa Durability	Rating Research ecifications tion	Score 4 2 5 5	Weight Factor 25 15 30 30 Total Score	Adjusted Score 100 30 150 150 430	Maximum Score 5 5 5 5 5 Max. Score	Adjusted Score 125 75 150 150 500	
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Comments Technology	Readiness Readiness Testing and Existing Sp Implementa Durability Tech	Rating Research ecifications tion nology Read	Score 4 2 5 5	Weight Factor 25 15 30 Total Score e 86	Adjusted Score 100 30 150 150 430	Maximum Score 5 5 5 5 Max. Score Technology 75-100	Adjusted Score 125 75 150 150 500 Readiness S Include	cale



Specification Overview

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Guide Specification Contents

Part 1: ABC Design Guide Specifications

- 1. Introduction
- 2. General Design Provisions
- 3. Design of Prefabricated Elements
- 4. Detailing Requirements
- 5. Durability of ABC Technologies

Part 2: ABC Construction Guide Specifications

- 6. Introduction
- 7. Temporary Works
- 8. Fabrication and Assembly Planning
- 9. Layout and Tolerances
- 10. Concrete Structures
- 11. Steel Structures
- 12. Geosynthetic Reinforced Soil / Integrated Bridge System



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Guide Specification Grammar

- · This document is a guide specification
- Not mandatory
- The document primarily makes use of the terms "should", "may", and "recommended".
 - The term "should" indicates a strong preference for a given criterion.
 - The term "may" indicates a criterion that is usable, but other local and suitably documented, verified, and approved criterion may also be used in a manner consistent with the LRFD approach to bridge design.
 - The term "recommended" is used to give guidance based on past experiences.



Other References

NCHRP Project 12-98

- 2018 Guidelines on Prefab Tolerances
- 2018 Guidelines on Dynamics
- Including SPMTs and Lateral Sliding
- Want to know more?
 - FIU ABC Webinar Archives recordings Free
 - Download
 - Search NCHRP Project 12-98
 - Free Download



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Design Specification Overview

Section 1: Introduction

- Definitions
- Design Responsibilities

Section 2: General Design Provisions

- Shipping and Handling Provisions
- Load Combinations
 - Including SPMT and Lateral Slide





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Design Specification Overview

Section 3: Design of Prefabricated Elements

- · Majority of specs are based on emulation
- Significant seismic provisions
- Major provisions that are not in the AASHTO LRFD BDS
 - · Lapped hooked and headed bars
 - UHPC connections
 - Type 2 Mechanical Connectors
 - Corrugated Metal Pipe Sockets and corrugated precast sockets
 - Link slabs
 - GRS-IBS



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Figure C3.5.1.5-1—Precast Integral Abutment Stem with Grouted Key Joints

Design Specification Overview

Section 4: Detailing Requirements

- Tolerances and layout of precast elements
 - Reference to NCHRP Project 12-98
 guidelines
- GRS-IBS Detailing

Section 5: Durability of ABC Technologies

 Detailing recommendations for durability



Figure C5.4.2-2—Semi-Integral Abutment with Wra (design sketch on left, actual construction on right)

Construction Specification Overview¹¹

8.5.1—ASSEMBLY SEQUENCE AND CONSTRUCTION METHODS

The following minimum information with regard to sequence of assembly shall be included in the Assembly Plan:

- Step-by-step assembly sequence detailing the overall construction process.
- Details of any formwork for closure joints including methods for attachment to the adjacent prefabricated elements.
- Details of all materials to be used for the construction.
- Methods and materials to be used for casting and curing concrete closure joints.
- Estimated timeframe of strength gain for concrete closure joints.
- A statement of compliance with all requirements of applicable environmental permits.
- Any weather limitations for the assembly work.

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Section 6: Introduction Section 7: Temporary Works

- · Roles and responsibilities
 - PBES & Systems

Section 8: Fabrication and Assembly Planning

- Improved Fabrication Specs (QC)
- Shipping and Handling of PBEs
- · Assembly of elements
- Post-tensioning procedures

Construction Specification Overview¹²

Section 9: Layout and Tolerances

• Follow NCHRP 12-98 Guidelines Section 10: Concrete Structures

- Grouts
- High Early Strength Concrete
- UHPC

Section 11: Steel Structures Section 12: Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS)



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Definitions

- Definitions are included in Section 1 of the Design Section
- Based on FHWA and AASHTO T-4 Committee



Key Definitions

Prefabricated Bridge Elements and Systems (PBES) Structural components of a bridge that are built offsite or near the site that include features that reduce the on-site construction time that occurs with conventional bridge construction.



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Key Definitions

Prefabricated Bridge

Elements (PBE) A category of PBES which comprise a single structural

component of a bridge. Prefabricated Bridge Elements can be made of any approved structural material.



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Key Definitions

Prefabricated System

An entire superstructure, an entire superstructure and substructure, or a total bridge that is procured in a modular manner such that traffic operations can be allowed to resume after placement. A Prefabricated system is rolled, launched, slid, lifted, or otherwise transported into place, having the deck and preferably the railing in place such that no separate construction phase is required after placement.





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Key Definitions

Self-Propelled Modular Transporters (SPMTs)

A high capacity transport device that can lift and move prefabricated elements and systems with a high degree of precision and maneuverability in all three directional axes without the aid of a tractor for propulsion.





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Key Definitions

Lateral Slide

A method of moving a bridge system built adjacent to the final bridge location using hydraulic jacks or cable winches while supported on sliding materials or rollers. The bridge is typically built parallel to its final alignment, facilitating the installation.





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Key Definitions

Assembly Plan

A package of plans, specifications and calculations developed by the contractor that describes the process for the assembly of prefabricated elements. The assembly plan may include handling and erection plans, materials specifications, details and calculations for bridge temporary works, and construction scheduling.



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Key Definitions

Closure Joint

A gap between two elements or systems that is filled with materials to form a connection. The joint may or may not include reinforcing. The width of the closure joint can vary based on the type of material used to fill the joint and the reinforcing within the joint. This feature is also referred to as a "closure pour" by some agencies.







Key Definitions

Link Slab

Links slabs are a transverse deck level connection at piers between the decks of two adjacent spans, providing a jointless bridge without continuity. The deck is made continuous across the pier, but the supporting beams or girders are not connected.





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Socket Connection

A connection between two prefabricated elements thru the projection of a single portion of one element into a single void of the receiving element. The gap between the two elements is then filled with either concrete, grout, or other suitable material.



Pocket Connection

A connection between two prefabricated elements thru the projection of multiple bars or connectors of one element into a single void that is cast internal to the receiving element. The void is then filled with either concrete, grout, or other suitable material.



Guide Specification Format

Standard AASHTO Format

- Specifications on Left
- Commentary on Right
 - There is significant commentary
- Includes Notation definitions
- Includes references
- This is not an ABC Manual
 - Limited to Design and Construction "Specifications"
- Not a cookbook
 - You need to use engineering knowledge and

3.6.2.4.1—Development of Deformed Reinforcing Bars in Tension in UHPC	C3.6.2.4.1		
The basic development length for straight or hooked deformed bars cast into UHPC, $l_{\rm dos}$ shall satisfy:	These provisi reinforcement an noted in the AASH		
For reinforcing bars with:	in development ler The values fo		
$f_j \le 75 \ ksi$	for hooked bars ba UHPC.		
$l_{dm} \ge 8d_b$ (3.6.2.4.1-1)			
where:			
d_b = nominal diameter of bar (in.) f_y = specified yield stress of reinforcing bars (ksi)			
For reinforcing bars with:			
75 ksi ≤ f _y <u>≤</u> 100 ksi			
$l_{dm} \ge 10d_b$ (3.6.2.4.1-2)			
 where all of the following criteria are met: Field cast UHPC shall coatain a minimum of 2 percent (by volume) steel fiber reinforcement The minimum compressive strength of the UHPC shall be greater or equal to 14 ksi; Bar size shall not exceed No. 8; Clear cover for the sharshall not be less than 3ds; 	The compress use of UHPC in application of co connections is ac compressive streng		
The basic development length, $l_{\rm dres}$ shall be increased by $2d_b$ if:	The limitation data on larger bars		
$2d_b \leq \textit{minimum clear cover} \leq 3d_b$	the bar and thus a length.		

These provisions are applicable for all types of stee reinforcement and for epoxy coated bars. Adjustment noted in the AJSTO IAPD Bridge Dering Specification are not applicable to these provisions including increase in development length for epoxy coated bars. The values for straight bars are conservatively use for hooked bars based on limited testing on hooked bars i UHPC.

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The compressive stress of 14 ksi is set to facilitate the use of UHPC in accelerated construction when early application of construction loads to newly completed connections is advantageous. The specified minimum compressive strength at 28 days should still be specified.

The limitation on bar size is based on limited testing data on larger bars. A decrease in the cover results in reduced confinement of the bar and thus an increase in the required development lenoth.

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Guide Specification Format

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Available ABC Publications

Free Publications

- PCI: State of the Art Report on Full-Depth Bridge Decks Panels
- PCI Northeast: Full Depth Deck Panel Guidelines (recently updated)
- PCI Northeast: Guidelines for Resolution of Non-Conformances in Precast Concrete Bridge Elements
- PCI Northeast: Suggested Guide Details for Precast Substructures
- PCI Northeast: Northeast Extreme Tee (NEXT) Beam Details
- PCI Northeast: Guidelines for Camber and Profile Management in Adjacent Beams
- NCHRP Project 12-98: Guidelines for Dynamic Effects for Bridge Systems
 FIU Monthly Webinar
- NCHRP Project 12-98: Guidelines for PBES
 - FIU Monthly Webinar



Available ABC Publications

- For Purchase Publications
 - AASHTO LRFD Guide Specifications for ABC
 - Available at the AASHTO Bookstore
 - \$270 non-member price





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Summary

- The AASHTO LRFD ABC Guide Specs cover all aspects of typical ABC Design and Construction
- There are separate parts for:
 - Design Provisions
 - Construction Specifications
- You have all the tools required to design an ABC project
- Let's go build something FAST



Questions?



