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16. Abstract  Development of accelerated bridge construction (ABC) technologies has been occurring across the country, many times in isolation. Although FHWA and others have worked to facilitate communication between these efforts, there was not a comprehensive resource to aid designers in selecting an appropriate technology for a particular project.  The work of this project expanded and enhanced the existing FHWA ABC project database resources. The main objective of the project was to compile information on existing ABC technologies and present the information in a manner useful to designers. The compilation includes all bridge types constructed of any material using ABC. Alternatives and objective information is provided, allowing the end user to make informed decisions regarding the suitability of particular technologies in particular circumstances.			
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# Compilation of Accelerated Bridge Construction (ABC) Bridges

Final Report

January 2016

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## **EXECUTIVE SUMMARY**

The use of accelerated bridge construction (ABC) is becoming more widespread with many different types of techniques and technologies being utilized in each project. As ABC is a relatively new form of bridge construction, bridge owners, designers, contractors, and fabricators involved in these projects learn valuable lessons during each project. A repository was needed to capture these valuable lessons for ready access by the bridge community.

The main objective of this project was to create a resource that allows any interested parties to have easy access information on completed bridge construction projects involving some aspect of ABC. An online database was created to host the ABC Project Database information and user interfaces were created to allow users to easily search, view, and submit completed ABC projects.

## **CHAPTER 1: INTRODUCTION**

### **1.1. Background**

About a quarter of the nation's bridges require repair, rehabilitation, or replacement. In the past, typically in order for work to be undertaken on a bridge that bridge had to be closed and traffic detoured, the road needed to be re-aligned, a temporary structure needed to be built to maintain traffic, and/or lane closures were required, all for a significant period of time. Accelerated bridge construction (ABC) involves the use of innovative planning, design, materials, and construction methods in order to reduce on-site construction times.<sup>[1]</sup> The use of ABC reduces the impact on traffic by reducing closure and detour times and can oftentimes produce longer lasting structures with the use of prefabricated elements.

As ABC is a relatively new concept in the bridge design and construction community, there are a large number of ABC-related projects that involve an innovative design concept or use of new technology or equipment. As with any new technology, many lessons are learned during its first uses and many refinements are possible.

While there are a large number of bridge projects that have been undertaken involving some aspect of ABC, there has not been an easy way for information to be exchanged amongst the bridge community. Technology and techniques used on a project and lessons learned by the various involved parties have not been readily available for others to access.

### **1.2. Research Scope, Objectives, and Tasks**

The main objective of this project was to create a resource that bridge owners and designers can use to exchange information related to projects involving ABC. The resource was to contain information valuable to bridge designers and owners and be organized in a manner such that the information could be easily searched and accessed.

The following tasks were completed to meet the objectives of the project:

1. Literature review
2. Data collection, synthesis, and analysis
3. Database development
4. Interface design
5. Final report

The outcome of these tasks was the final database (<http://utcdb.fiu.edu>) as documented in this report.

### **1.3. Overview of Report**

This report is intended to give readers an overview of the need for the database, development of the database, and use of the database. An overview of the project database and background on its development is presented in Chapter 2. Some keywords and definitions are then presented in Chapter 3; these keywords were used in the database to allow grouping of similar projects. A description of the features of the search functions (Chapter 4) and submit project functions (Chapter 5) are then presented; these sections also serve as a user manual for the database interface and give the reader a look behind the scenes as to how the systems function.

## **CHAPTER 2: BACKGROUND AND OVERVIEW OF ABC PROJECT DATABASE**

### **2.1. History of ABC Project Database**

From 2001 to 2004 the AASHTO Technology Implementation Group (TIG) Prefabricated Bridge Elements and Systems (PBES) Lead States Team conducted various activities to advance PBES implementation, including the development of a database of limited information on completed PBES projects in the US. The PBES Lead States Team posted this project information on the AASHTO TIG website. When the PBES Lead States Team was sunset in 2004, FHWA imported the AASHTO TIG project database to its website for continued technology transfer. Additional projects were added to the FHWA “Innovative Projects” database over the next few years. In 2009 FHWA’s Highways for LIFE Program funded work to update and expand the “Innovative Projects” database. In 2011 the database development project was further enhanced, and the database became known as the “National ABC Project Exchange.” The database contained 100 ABC projects from 39 different states, with a number of additional projects in various stages of completion. It was initially posted on the USDOT’s Research and Innovative Technology Administration (RITA) website and was transferred to the ABC-UTC in 2015 to allow more open access and enhancement through this research project.

### **2.2. Information Contained in Initial Database**

The initial database developed by AASHTO and the FHWA contained relevant project information, project photos, and relevant documents. The information gathered included:

- Bridge project name
- Description of location
- State where bridge is located
- Coordinates of bridge (latitude and longitude)
- Bridge owner
- Year ABC component of bridge was built
- ID number (both State and National Bridge Inventory)
- Point of contact (generally the bridge owner)
- Mobility impact time (construction time savings using ABC)
- Impact category (Tier 1 through 6 based on total time of impact)
- Benefits of ABC
- Bridge information (length, spans, construction materials, ADT, etc.)
- Existing bridge description
- Replacement bridge description
- Construction methods description
- High performance materials used
- ABC aspects related to:
  - Planning
  - Geotechnical solutions
  - Structural solutions
- Costs
- Funding

- Incentive programs

The resources gathered, which varied depending on the project, include:

- Photos
- Contract plans
- Specifications
- Bid tabs
- Schedule
- Other related information, including articles and other publications, URLs, etc.

This information was organized into project summary sheets (Microsoft Word files) and folders.

### 2.3. Project Tracking Sheet

The Project Tracking Sheet was developed by the FHWA to offer an easy, offline option for searching through the projects contained in the ABC project database. The Project Tracking Sheet is a Microsoft Excel spreadsheet that contains basic information on each of the projects and allows for the grouping of projects based on keyword filters. A sample of the spreadsheet is shown in Figure 2.1.

	B	C	D	M	Primary Driver(s)							Available Information					
					N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	State	Owner	Project Name	Impact Category	Traffic Impacts	Work-Zone Safety	Environment	On-site Construction Time	Site Constructability	Material Quality	Life Cycle Costs	Contract Plans	Specifications	Bid Tabs	Schedule	Photos	Additional Information
6	State	O'Malley	Tier 5		•			•	•	•	•	✓	✓	✓		✓	
8	State	Grayling Creek	Tier 5	•	•	•	•	•	•	•	•	✓	✓	✓		✓	

*Figure 2.1: Sample of headings in the EXCEL Project Tracking Sheet*

The Project Tracking Sheet allowed for the projects to be filtered based on pre-defined keywords (to be described in Chapter 3). The sheet also provided links to various documents.

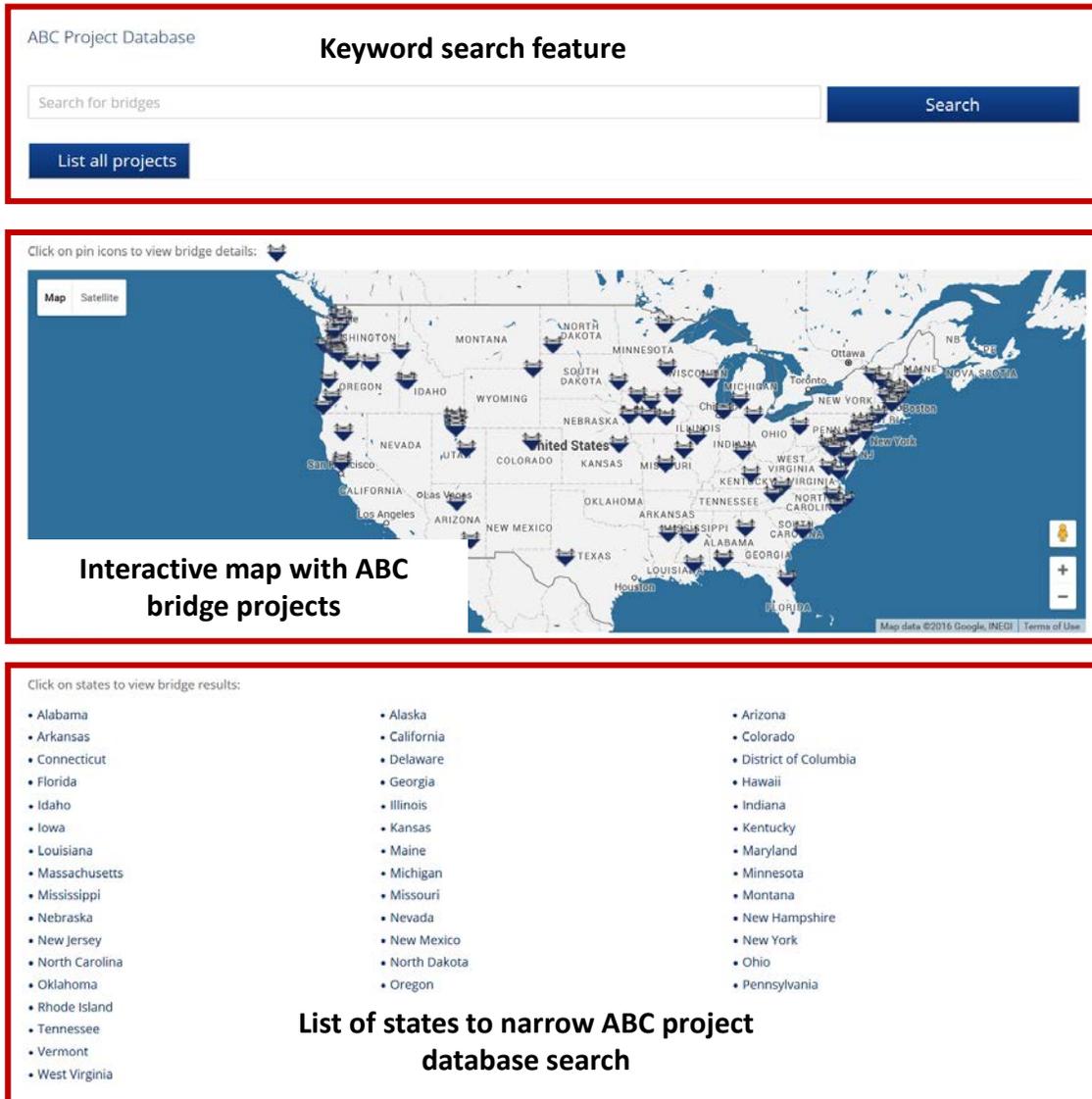
### 2.4. Creation of Online Database

The first objective of this project was to create an online database to host all of the information that was already contained in the FHWA Tracking Sheet and accompanying database. A separate server was obtained and a MySQL database was created to host and organize all of the data contained in the FHWA project database. Various data tables were set up to organize the data, link uploaded files to appropriate projects, and create keyword lists to be used in the faceted navigation tools.

The online database is backed up daily and is secured on servers that are housed at Florida International University (FIU).

## 2.5. Creation of Online Interface

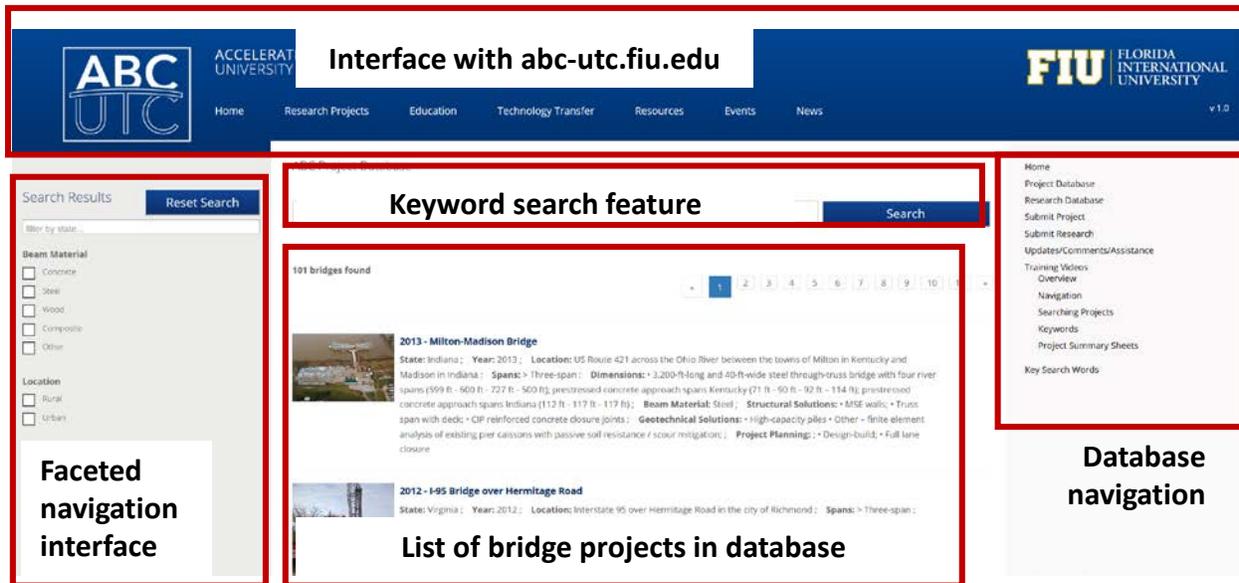
The next objective of this project was to create a user interface with the developed database so that any users are able to easily access and search the data. A webpage dedicated to the database was created for this purpose. The home page contains an interactive map displaying all of the projects contained in the ABC Project Database, as shown in Figure 2.2; the interactive map will be discussed in more detail in Chapter 4.



**Figure 2.2: Main features of the interactive map portion of the ABC project database**

A complete list of all of the projects contained in the ABC Project Database can be accessed in the “Project Database” page, shown in Figure 2.3. The complete database was designed to be searchable using faceted navigation and keyword search features; these search features will be described in more detail in Chapter 4.

The database website also allows for interface with the main Accelerated Bridge Construction University Transportation Center (ABC-UTC) website and a navigation panel on the right to more easily maneuver the database website, both shown in Figure 2.3.



**Figure 2.3: Main features of project database search interface**

The developed bridge summary sheets are accessed by selecting one of the projects from these two interfaces.

## 2.6. Bridge Summary Sheets

Bridge summary sheets were created to provide a clean and concise summary of all of the data for each bridge project contained in the database. A full version of the summary sheet is provided for each of the bridge projects, as shown in Figure 2.4. The summary sheets developed for the new interface contains fields for all of the information contained in the previous project summary sheets (previously discussed) and also fields for:

- Designer
- Fabricators
- Suppliers
- Contractors
- Subcontractors

## 2010 - I-15 / Pioneer Crossing Bridge

Year ABC Built: 2010

State: Utah

Owner: State

Location: Urban

Spans: One-span

Beam Material: Concrete

Max Span Length: 191.00

Total Bridge Length: 191.00

Construction Equipment: SPMTs

State ID #: S-R399(42) and S-R399(59)

NBI #: Eastbound: 2F 785; Westbound: 4F 785

Coordinates: Latitude: 40.376667, Longitude: -111.819725

### Bridge Description

**Project Location:** Pioneer Crossing over I-15 in American Fork, south of Salt Lake City

**Mobility Impact Time:** ABC: One or two of three I-15 lanes closed over 10-hr period during the night on two weekends, with one 30-minute full closure of I-15 per span; total 20 months; Conventional: Multiple long-term closures over 24 months

**Impact Category:** Tier 1 (within 1 day)

**Primary Drivers:** Reduced onsite construction time; reduced traffic impacts; improved work-zone safety; improved site constructability; improved material quality and product durability

**Dimensions:** 191-ft long and 69-ft wide single-span bridge roll-in; 2,300-ton self-weight (longest and heaviest multi-girder spans moved with SPMTs in the US to date)

**Average Daily Traffic:** 128475

**Traffic Management:** Traffic management alternative, if constructed conventionally: extended detour

### Existing Bridge Description:

The existing four-span 2-lane bridge was 353-ft-long and 42-ft-wide and constructed in 1963. The existing bridge was being removed due to existing deterioration and due to the need to increase the capacity of the interchange.

### Replacement or New Bridge:

The replacement bridge is on the new six-mile urban arterial connecting Saratoga Springs to Lehi that is part of Utah's Corridor Expansion (CORE) initiative to restore and renovate I-15 in Utah County. The Pioneer Crossing interchange with I-15 is a diverging diamond interchange (DDI), only the third such interchange in the US, which replaces the existing diamond interchange. The DDI was proposed in an Alternative Technical Concept process included in the specifications to allow a design-build team to propose innovative concepts.

The Pioneer Crossing DDI includes twin two-span prestressed concrete beam bridges. Each of the four spans has a 53-degree skew and nine 94.5-inch-deep prestressed concrete Washington State bulb tee beams spaced at 7.75 ft with an 8.5-inch-thick cast-in-place concrete deck. The deck was designed with additional reinforcement to account for the temporary tensile stresses during the move. To help minimize temporary stresses and to accommodate live load continuity, the last 10 ft at each end of the deck and the concrete end diaphragms were cast after the spans were moved. UDOT's SPMT manual was followed for stress limits, twist tolerance, and other criteria.

### Construction Method:

The four spans were constructed on temporary falsework supported on large concrete spread footings in adjacent staging areas less than a quarter mile from the bridge site. The westbound spans were constructed in a staging area southwest of the bridge site, and the eastbound spans were constructed in a staging area northwest of the site.

The four spans were moved with SPMTs in four nights. Two lines of SPMTs supported the span at each end. Special tower stand jacks raised the span off the temporary supports and lowered it onto the new abutments. After the two spans were in their final positions, they were connected with a closure pour over the interior support.

The westbound bridge span over the I-15 northbound lanes was moved into place with SPMTs on a Friday night in October 2009. The westbound bridge span over the I-15 southbound lanes was moved into place two days later on Sunday night. The adjacent existing four-span bridge was then dismantled without reducing the three-lane capacity in each direction on I-15. [Note: The weekend timeline for the moves is described below for the eastbound bridge moves.]

Eight months later on a weekend in June 2010 SPMTs moved the eastbound bridge spans into place. The eight month period between span placements was utilized to accomplish multiple activities. The existing structure was removed and the proposed substructure was placed. The geotechnical site conditions required settlement time for the approach embankments leading up to the bridge. Concurrent with the final bridge location activities, the bridge staging area was moved and construction of the superstructure was completed.

Friday evening at 8 pm one lane of I-15 in each direction was closed. At 9 pm a second lane was closed in each direction. At 10 pm a rolling roadblock was begun by the Utah State Police to allow the SPMTs to move the span along I-15. Approximately 15 minutes later traffic in the one open lane on I-15 southbound was stopped and the SPMTs loaded with the span to go over southbound I-15 moved along southbound I-15 to the bridge site. After stopping traffic for half an hour, one lane in each direction of I-15 was reopened and detoured onto ramps around the bridge site. The bridge was



Stakeholder Feedback: (none)

High Performance Material: (none)

### Project Planning

Decision Making Tools: State process

Site Procurement: (none)

Project Delivery: Design-build

Contracting: Full lane closure; Incentive / disincentive clauses

### Geotechnical Solutions

Foundations & Walls: (none)

Rapid Embankment: Other; embankment surcharge

### Structural Solutions

Prefabricated Bridge Elements: MSE walls

Prefabricated Bridge Systems: Full width beam span with deck

Miscellaneous Prefabricated: CIP reinforced concrete closure pours

ABC Construction Equipment: SPMTs

### Cost & Funding

Costs:

\$172 million design-build project

Funding Source: State Only

Incentive Program: (none)

### Additional Information

Other Notes: (none)

### Downloadable Resources

Contract Plans:

View Contract Plans

Specifications:

View SP 032535 SPMT\_08-31-09

Bid Tabs:

Construction Schedule:

Bridge Description Summary Sheet:

View 120131 ABC\_New\_UT\_2010\_Pioneer Crossing.pdf

Other Related Information:

View 1-Aspire Winter - 2011 - Pioneer

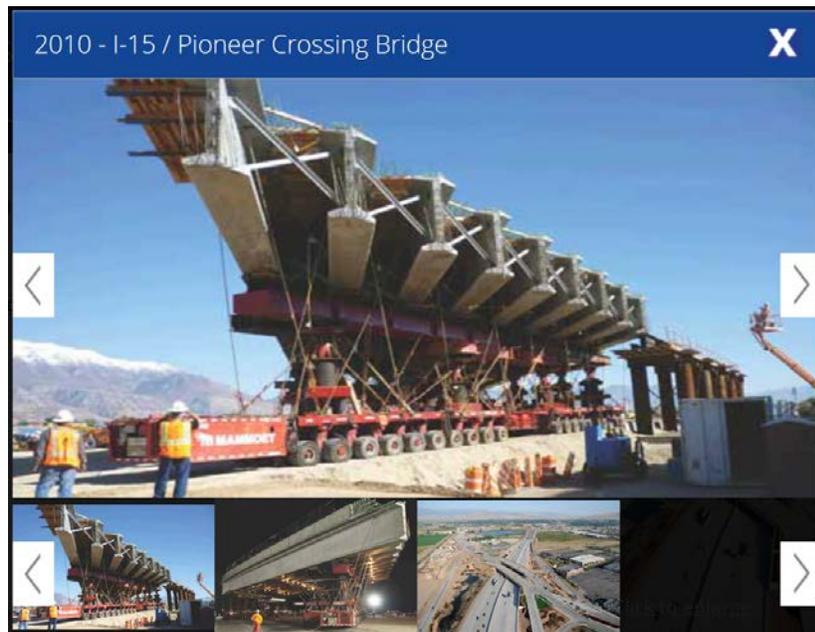
View 2-Roads & Bridges - Pioneer

View 3-02010 FHWA Conference - Pioneer

<http://www.udot.utah.gov>

**Figure 2.4: Example of information contained in Project Summary Sheets**

The bridge summary sheets also contain a gallery view feature for displaying all input images of the bridge project, as shown in Figure 2.5. The gallery view feature allows users to easily view all input photographs and images.



*Figure 2.5: Gallery view feature for displaying bridge images*

The bridge project descriptions all contain keywords in order to describe the ABC aspects of the project and allow for easy sorting. These keywords are listed and described in Chapter 3.

## CHAPTER 3: KEYWORDS AND DEFINITIONS

The FHWA and AASHTO T-4 Committee developed a list of keywords that have been used to classify and describe each ABC project. These keywords are presented in this chapter along with brief definitions where appropriate.

### 3.1. Funding Type

The funding type category describes the primary source of the funds for the bridge project. The types of funding are shown in Table 3.1.

*Table 3.1: Funding related keywords*

Funding
Federal only
State only
Federal and state
Local
Other

### 3.2. Incentive Programs

The incentive program category contains information on federal incentive programs that were utilized by the project. A list of the current incentive programs that have been used by ABC projects in the database to date is shown in Table 3.2.

*Table 3.2: Incentive program related keywords*

Incentive Programs	
HfL	Highways for LIFE
IBRD	Innovative Bridge Research and Deployment Program
SHRP 2	Strategic Highway Research Program
ARRA	American Recovery and Reinvestment Act
Other	

The Highways for LIFE (HfL) program was created by the FHWA with the purpose “to advance Longer-lasting highway infrastructure using Innovations to accomplish the Fast construction of Efficient and safe highways and bridges” [2]. The Innovative Bridge Research and Deployment Program (IBRD) was created to provide funds for the promotion of innovative designs, materials, and construction methods in construction, repair, and rehabilitation of bridges and

other highway structures<sup>[3]</sup>. The Strategic Highway Research Program (SHRP2) provided funding for more than 100 research programs and led to development of a toolkit for use by bridge engineers<sup>[4]</sup>. The final incentive program that has been utilized by bridge engineers to date is the American Recovery and Reinvestment Act (ARRA). The ARRA was authored by President Obama in 2009 and led to \$26.6 billion being invested into more than 12,000 bridge projects across the country and 51 TIGER grants awarded to creative bridge projects representing the future of the diversity of our infrastructure<sup>[5]</sup>.

Additional incentive programs will be added to the keywords as they are created and utilized.

### 3.3. Impact Category

The impact categories describe the total amount of time traffic flow is negatively impacted due to the construction of a bridge. Impact category definitions were initially developed by FHWA. Definitions were recently updated by the AASHTO T-4 Committee. A list of the impact categories and updated list of definitions is included in Table 3.3.

*Table 3.3: Impact categories*

Impact Categories	
Tier 1	Traffic impacts within 1 day
Tier 2	Traffic impacts within 3 days
Tier 3	Traffic impacts within 2 weeks
Tier 4	Traffic impacts within 1 month
Tier 5	Traffic impacts within 3 months
Tier 6	Overall project schedule is significantly reduced by months to years

### 3.4. Project Planning

There are four different aspects of the project planning process that can be modified to accommodate or encourage ABC. These subcategories along with a list of ABC related project planning techniques or tools are shown in the below list.

- Decision-Making Tools
  - FHWA process
  - State process
  - TPF-5(221) (ABC decision making model developed by pooled fund study)
  - Benefit/cost methods
  - Other
- Site Procurement
  - Programmatic agreements
  - Right-of-way acquisition

- Relocation incentives
- Flexibility in utilities
- Early environmental clearance and permitting
- Electronic shop drawing submittal and approval process
- Fabrication drawings prior to bid
- Material procurement prior to contract award
- Other
- Project Delivery
  - Design-Bid-Build
  - Design-Build
  - Design-Build by in-house forces
  - CMGC (construction manager / general contractor)
  - Alternative technical concept
  - Alternative ton (foundation)
  - Other
- Contracting
  - A+B bidding
  - A+B+C bidding
  - Full lane closure
  - Warranties
  - Lane rental
  - I/D clauses (incentive/disincentive clauses)
  - No-excuse bonus
  - Lump sum bonus
  - Contractor option
  - Contractor revision
  - VE (value engineering)
  - VE with partnering
  - Formalized partnering
  - Best value award
  - Performance contracting
  - Emergency contract
  - Accelerated bid process
  - Other

### 3.5. Foundations and Walls

There are several types of foundation and wall systems that are currently considered an ABC technique or technology. These systems are shown in Table 3.4.

*Table 3.4: Foundation and wall element keywords*

<b>Foundation and Wall Elements</b>
Continuous flight auger piles
Micropiles
High-capacity piles
GRS integrated bridge system
CIP substr under traffic
Reused subst units
Pre-grouted voids
Other

### 3.6. Rapid Embankment Construction

There are several types of rapid embankment construction techniques that are currently utilized in ABC. These systems are shown in Table 3.5.

*Table 3.5: Rapid embankment construction*

<b>Rapid Embankment Construction</b>
EPS geoform
Self-compacting backfill
Smart compaction
Fully-contained flooded backfill
Embankment surcharge
Lightweight fill
Other

### 3.7. Prefabricated Bridge Elements and Systems

Numerous prefabricated bridge elements and systems are currently utilized in accelerated bridge construction. These elements and systems are grouped into categories related to the portion of the structure that is prefabricated, extent of prefabrication, type of prefabricated element, or type of connection detail used. A list of these keywords divided by sub-category is presented below:

- Deck Elements
  - Partial-depth precast deck panels
  - Full-depth precast deck w/PT
  - Full-depth precast deck w/o PT
  - FRP deck panels
  - Exodermic deck
  - Steel grid (open)
  - Steel grid (concrete filled)
  - Aluminum
  - Orthotropic deck
  - UHPC waffle deck
  - Other
- Deck Beam Elements
  - Adjacent deck bulb tee beams
  - Adjacent tee beams
  - Adjacent inverted tee beams
  - Adjacent box beams
  - Adjacent slab beams
  - Adjacent slab beams w/ backwalls
  - Modular Decked Beams (MDcBs) [concrete deck on steel beams]
  - Modular Decked Beams (MDcBc) [concrete deck on concrete beams]
  - PT concrete through-girder
  - Other decked beam
- Full-Width Beam Elements
  - Truss span without deck
  - Arch span without deck
  - Precast segmental
  - Steel segmental
  - Other full-width beam element w/o deck
- Pier Elements
  - Precast pile caps
  - Steel pile caps
  - Precast cap shells
  - Prefab caisson caps
  - Precast footings
  - Precast footing shells
  - Steel columns
  - Precast columns
  - Steel column caps
  - Precast column caps

- Steel caps and columns
- Precast caps and columns
- Other
- Abutment and Wall Elements
  - Precast abutment caps
  - Precast backwalls
  - Precast abt cap w/ backwall
  - Precast abutment stems
  - Precast wing walls
  - Precast cheek walls
  - Precast footings
  - Steel sheet piling
  - Precast sheet piling
  - Precast lagging panels
  - Precast full-height wall panels
  - Precast retaining walls
  - MSE walls
  - Modular block walls
  - GRS abutments
  - Proprietary walls
  - Precast 3-sided culvert
  - Other
- Closure Joints
  - CIP reinf closure joints
  - Grouted keys
  - Grouted blockouts w/shear connectors
  - Bars in splice couplers
  - PT ducts, grouted
  - PT ducts, not grouted
  - Match casting
  - Grouted ducts in precast substructure
  - CIP pockets in precast substructure
  - High-early-strength low-shrinkage concrete joints (HESt-LSH)
  - UHPC closure joints
  - Epoxy joints
  - Other
- Overlays
  - Standard concrete
  - HPC
  - High-density concrete
  - Asphalt w/ membrane
  - Asphalt w/o membrane
  - Latex-modified
  - Micro-silica
  - Thin-bonded epoxy
  - Polymer concrete

- Rapid set
- Asphalt chip seal, no membrane
- Other
- Other
  - Precast approach slab
  - Prefab parapets
  - Precast curbs
  - Steel diaphragms
  - Precast diaphragms
  - LWC deck
  - LWC beams
  - LWC substructure
  - Other
- Superstructure Systems
  - Full-width decked beam unit (FDcBs) [concrete deck on steel beams]
  - Full-width decked beam unit (FDcBc) [concrete deck on concrete beams]
  - Through-girder span w/deck
  - Truss span with deck
  - Arch span with deck
  - Steel orthotropic box girder span
  - PS multi-cell box girder span
  - Metal panel deck span
  - Reused decked beam span (RDcBs)
  - Reused decked beam span (RDcBc)
  - Other
- Superstructure / Pier Systems
  - Rigid frames w/deck & parapets
  - Other
- Total Bridge Systems
  - Rolled/launched/slid/lifted
  - Other

### 3.8. Construction

The final group of keywords used in the bridge project descriptions is related to the construction methods, techniques or technology used in the ABC project. These are broken down into the five different sub-categories shown below:

- Self-Propelled Modular Transporters (SPMTs) Moves
  - SPMTs
  - SPMTs with gantry system
  - SPMTs on barge
  - Other
- Longitudinal Launching
  - Longitudinal launch (Skids)
  - Longitudinal launch (Rollers)
- Lateral Slide (Slide-in Bridge Construction)

- Lateral Slide (Rollers)
  - Lateral Slide (Skids)
- High-Capacity Crane
  - High-capacity crane
  - High-capacity crane on barge
- Other
  - Strand jacks
  - Towed modular transporters
  - Float in
  - Gantry system
  - Multi-axle flatbed trailers

There are instances in which conventional construction equipment is used in accelerate bridge construction. Conventional construction equipment is commonly used with prefabricated elements to offer similar erection costs and convenience.

## CHAPTER 4: ABC PROJECT DATABASE – SEARCH FUNCTIONS

One of the objectives of this project was to create a user-friendly interface so that all the information contained in the database could be easily accessed by any interested parties. The database interface borrows from several types of user interfaces that are commonly employed by other successful sites with search functions:

1. Interactive map search
2. Faceted navigation
3. Keyword search

Each of these searching techniques will be described briefly in the following sections.

### 4.1. Interactive Map

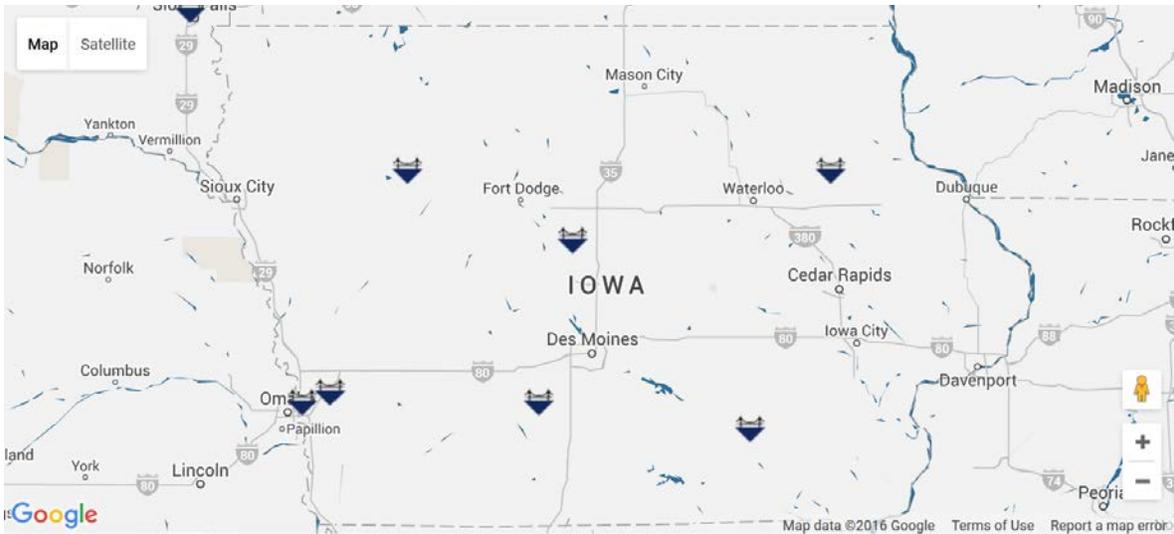
An interactive map was developed to present the location of all the ABC projects contained in the database, as shown in Figure 4.1. This interactive map allows for users to observe where in the United States ABC projects are being utilized.



*Figure 4.1: Interactive map displaying all ABC-related bridge projects contained in the database*

One of the goals of the interactive map is to connect users to local projects. A designer who may be working in Iowa (for example) can investigate ABC projects that have been completed nearby, as shown in Figure 4.2.

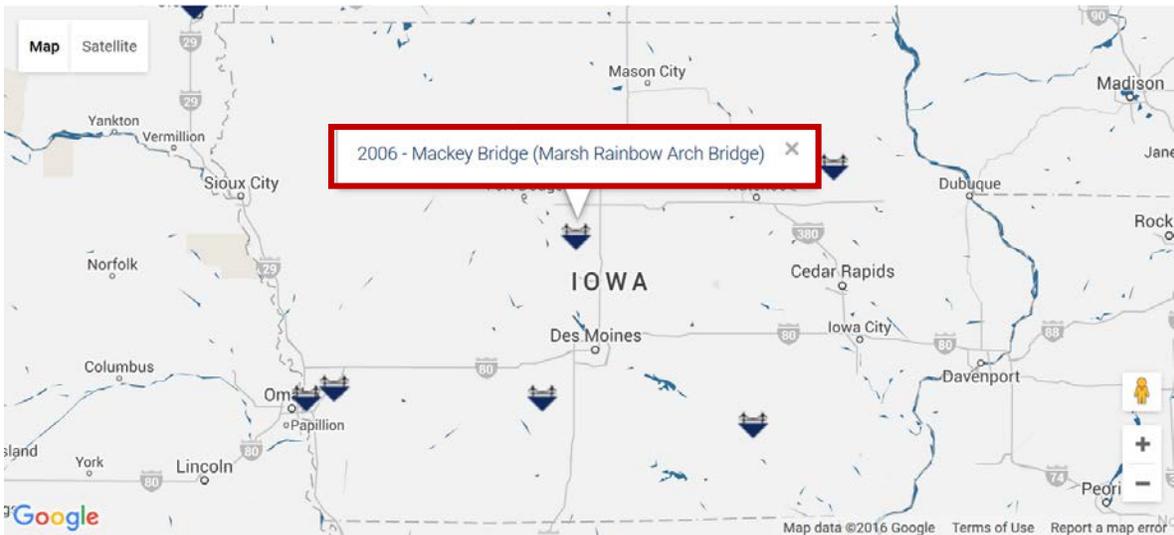
The interactive map will also hopefully encourage the additional submission of bridge projects. For example, an Iowa engineer or owner can quickly determine if their local projects are included in the database; if not, they are encouraged to submit the project.



***Figure 4.2: Example of cluster of ABC bridge projects located in Iowa***

Finally, the interactive map feature can encourage a state that has not yet begun to utilize ABC by showing the extent that ABC is being used throughout the country. For example, a state without ABC projects (such as North Dakota at the time this report was published) may be encouraged to begin utilizing ABC after seeing the extent that neighboring states are making use of it.

The project summary pages can be accessed directly from the interactive map by clicking on any of the bridge markers and then link, as shown in Figure 4.3. Clicking on this link will take the user to the project summary pages described in Chapter 2.



***Figure 4.3: Project summary pages can be accessed directly from interactive map page***

## 4.2. Faceted Navigation

A faceted navigation search option, shown in Figure 4.4, was created to allow users to narrow down the ABC Project Database to show only projects of interest to them. Faceted navigation functions by allowing users to narrow down their search through selection of desired search filters in various categories. The categories that have been included in the faceted navigation feature of this site are shown in Figure 4.4 and include:

- State
- Beam Material
- Location (rural or urban)
- Spans (number of spans)
- Construction Equipment
- Traffic Impact Category
- Max Span Length
- Total Bridge Length
- Year ABC Built
- Average Daily Traffic
- Structural Solutions
- Geotechnical Solutions
- Project Planning
- Funding Source

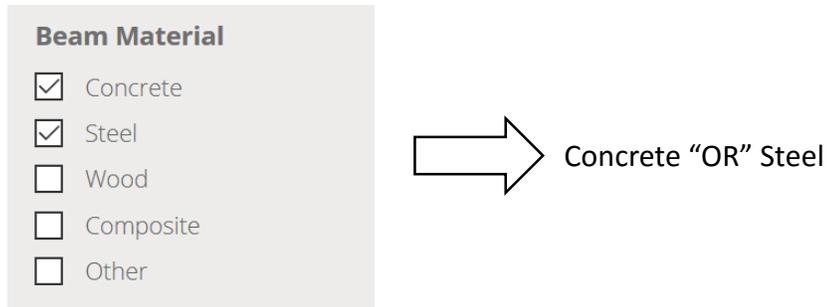
The screenshot displays a search results page with a 'Reset Search' button and a search filter input field labeled 'filter by state...'. The filters are organized into several categories:

- Beam Material:** Concrete, Steel, Wood, Composite, Other.
- Location:** Rural, Urban.
- Spans:** One-span, Two-span, Three-span, > Three-span.
- Construction Equipment:** SPMTs, Longitudinal Launching, Lateral Sliding or Skidding, High-Capacity Crane, Conventional, Other.
- Traffic Impact Category:** Tier 1 (within 1 day), Tier 2 (within 3 days), Tier 3 (within 2 weeks), Tier 4 (within 1 month), Tier 5 (within 3 months), Tier 6 (longer but reduced by months/years).
- Max Span Length:** Range slider from 0 to 2389.
- Total Bridge Length:** Range slider from 0 to 14784.
- Year ABC Built:** Range slider from 1900 to 2015.
- Average Daily Traffic:** Range slider from 0 to 500000.
- Structural Solutions:** Prefabricated Elements, Prefabricated Systems, Miscellaneous Elements.
- Geotechnical Solutions:** Foundations and Walls, Rapid Embankment.
- Project Planning:** Decision Making Tools, Site Procurement, Project Delivery, Contracting.
- Funding Source:** Federal Only, State Only, Federal and State, Other.

A 'Search' button is located at the bottom right of the filter area.

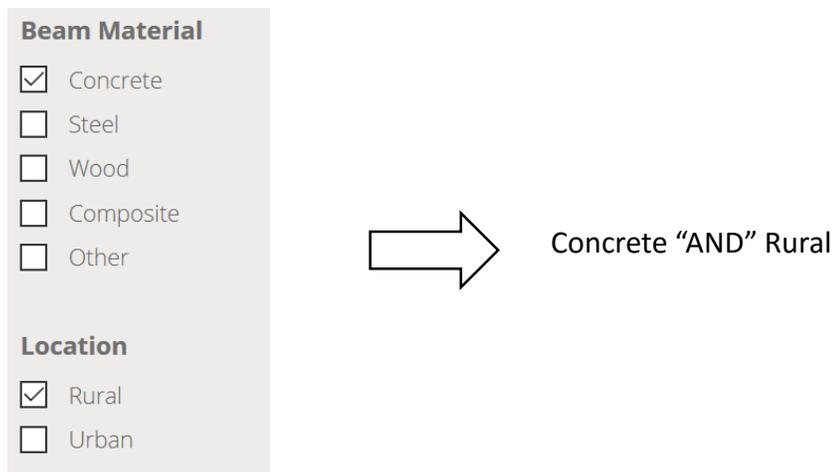
*Figure 4.4: Overview of faceted navigation options*

The search functions as an “OR” criteria within categories and “AND” criteria between categories. For example, if within “Beam Materials” both “Concrete” and “Steel” are selected, as shown in Figure 4.5, bridges will be included that have either concrete or steel beam materials.



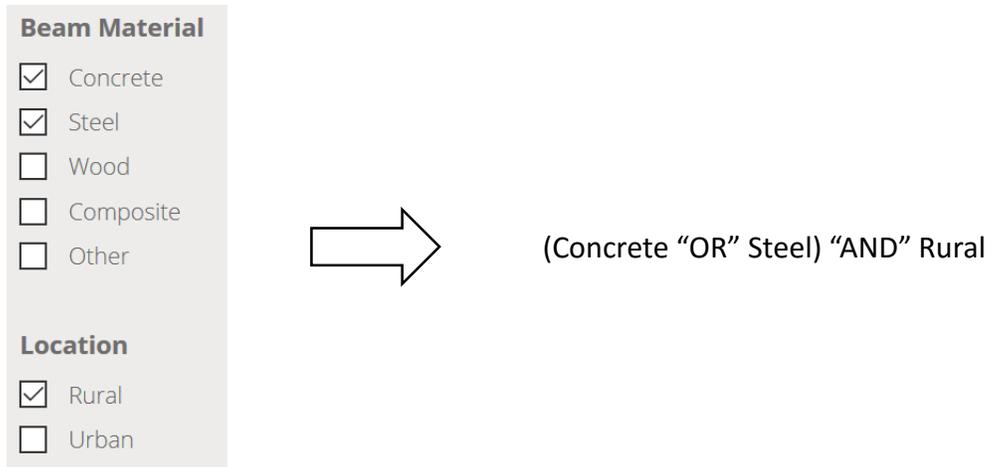
**Figure 4.5: Example of "OR" criteria within categories**

When multiple categories are selected, the search will filter using an "AND" search criteria. For example, if "Concrete" Beam Material and "Rural" Location are selected, then only bridges with concrete beam materials and in a rural location will remain after filtering, as shown in Figure 4.6.



**Figure 4.6: Example of "AND" criteria when multiple categories are selected**

When multiple options are selected within a single category and multiple categories are selected, the filter criteria will be a combination of the "AND" and "OR" gates. For example, if "Concrete" and "Steel" are both selected in Beam Materials and "Rural" is selected in Location, then bridges will be displayed that contain either concrete or steel beam material and are located in a rural location, as shown in Figure 4.7.



**Figure 4.7: Example of “OR” criteria within category combined with “AND” criteria between categories**

An example of a completed search using the faceted navigation is shown in Figure 4.8. If the user wanted to find a bridge with the criteria shown:

- Concrete beams
- One-span
- Use SPMTs for construction

Then the appropriate options could be selected. In this case (at the time of report publication), only two bridges in the ABC Project Database have concrete beams, are single spans, and used SPMTs in construction. The user can then view additional details on these bridges by clicking on the bridge names.

**Search Results** [Reset Search](#)

filter by state...

**Beam Material**

- Concrete
- Steel
- Wood
- Composite
- Other

**Spans**

- One-span
- Two-span
- Three-span
- > Three-span

**Construction Equipment**

- SPMTs
- Longitudinal Launching
- Lateral Sliding or Skidding
- High-Capacity Crane
- Conventional
- Other

**2 bridges found**

**2010 - I-15 / Pioneer Crossing Bridge**

**State:** Utah ; **Year:** 2010 ; **Location:** Pioneer Crossing over I-15 in American Fork, south of Salt Lake City ; **Spans:** One-span ; **Dimensions:** 191-ft long and 69-ft wide single-span bridge roll-in; 2,300-ton self-weight (longest and heaviest multi-girder spans moved with SPMTs in the US to date) ; **Beam Material:** Concrete ; **Structural Solutions:** • MSE walls ; • Full-width beam span with deck ; • CIP reinforced concrete closure pours ; **Geotechnical Solutions:** ; • Other - embankment surcharge ; **Project Planning:** • State process ; • Design-build ; • Full lane closure ; • Incentive / disincentive clauses

**2007 - I-215 / 4500 South Bridge**

**State:** Utah ; **Year:** 2007 ; **Location:** 4500 South (SR-266) over I-215 in Salt Lake City ; **Spans:** One-span ; **Dimensions:** 172-ft long and 82-ft wide single-span bridge roll-in; 1,600-ton self-weight ; **Beam Material:** Concrete ; **Structural Solutions:** ; • Full-width beam span with deck ; • Precast approach slab ; • Lightweight concrete deck ; **Geotechnical Solutions:** ; • CIP abutment under traffic ; • Self-compacting backfill ; **Project Planning:** • State process ; • CMGC ; • Full lane closure

**Figure 4.8: Example of faceted navigation search**

The faceted navigation can be combined with the keyword search described below to conduct more detailed searches.

### 4.3. Keyword Search

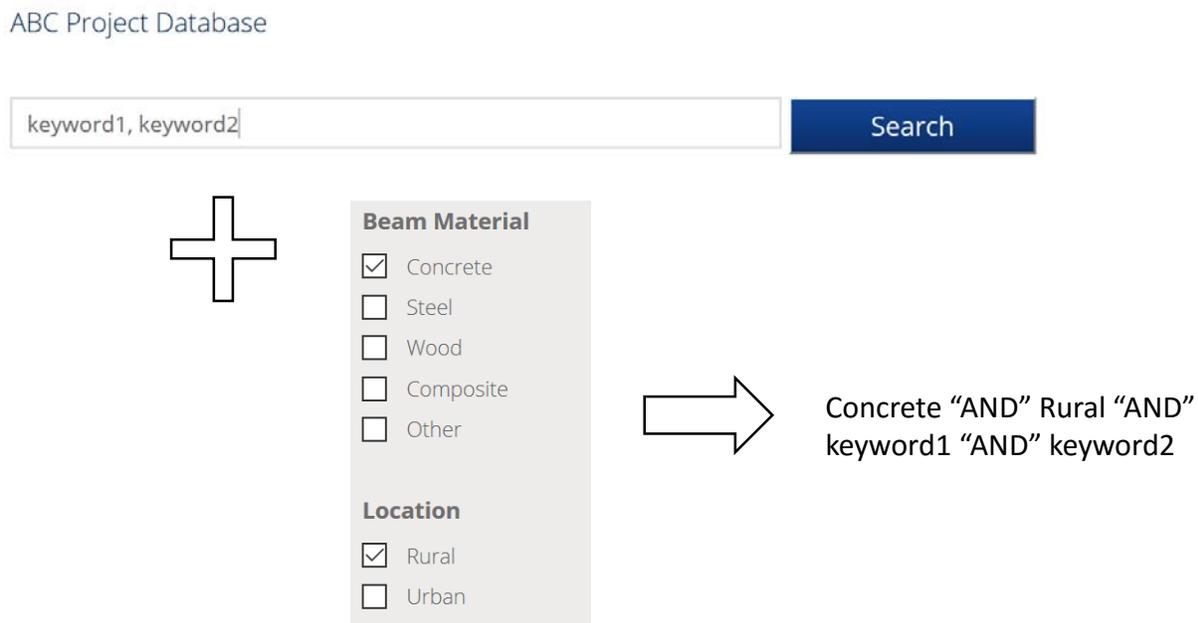
The keyword search feature, shown in Figure 4.9, was developed to provide a supplement to the faceted navigation feature and provide added search flexibility for the user. The keyword search functions similarly to the way additional categories function as described in the faceted navigation section.

Users can enter into the keyword search any words that may help them to narrow their search (e.g. lightweight concrete, UHPC, etc.). However, a user who may not be as familiar with ABC may go to the keywords page (described in Chapter 3) and use these predefined keywords in their search. Multiple keywords can be separated by commas in the search bar.



**Figure 4.9: Keyword search bar**

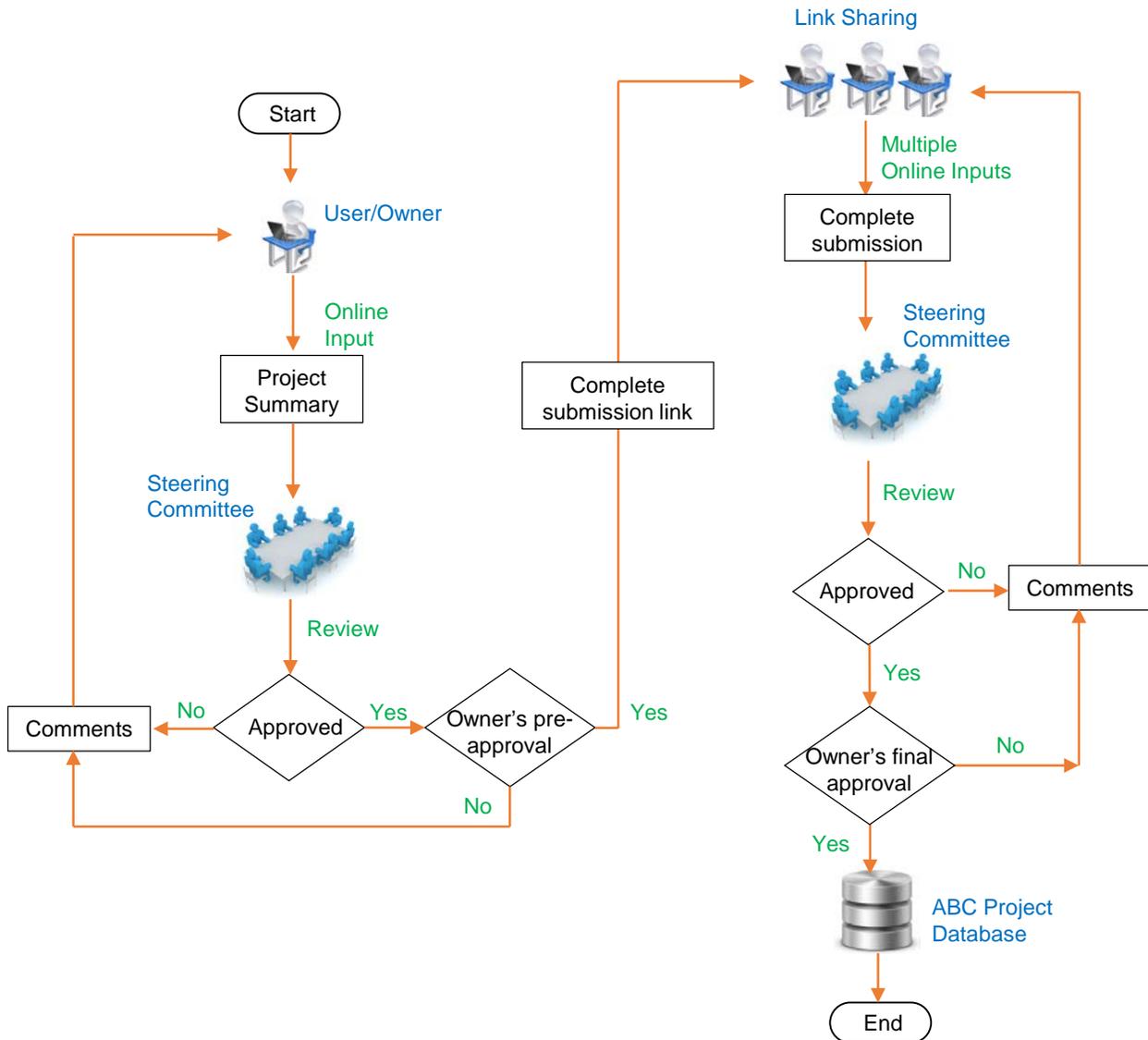
When a keyword (or keywords) is entered into the search bar in combination with some of the faceted navigation categories selected, the keywords search will act as an additional category with an “AND” criteria. For example, if two keywords are entered in addition to the search conducted in Figure 4.6, then only bridges in which keyword1 and keyword2 are found somewhere on the bridge summary sheet and with concrete beam materials in rural locations will remain, as shown in Figure 4.10.



**Figure 4.10: Example of keyword search bar in combination with faceted navigation tools**

## CHAPTER 5: ABC PROJECT DATABASE – USER INPUT

Another main objective of the project was to create a way in which any user can submit a completed accelerated bridge construction (ABC) project into the database. A two-stage submission and review process was designed to ensure that any user can submit a project, but only projects consistent with the current definition of ABC make it into the final database; this process is shown in Figure 5.1. This submittal and review process will be described in more detail below.



**Figure 5.1: Flowchart for user input review process for ABC Project Database**

There are two submittal and review stages for submitted projects. The first submission stage can be accessed by anyone (i.e., any user of the website can submit the first stage of the project submission). Stage 1 submission, shown partially in Figure 5.2, can be accessed from the sidebar navigation menu. This first stage submission can be quickly and easily completed as it only

requires information on the submitter, project owner, and basic information on the project (including why it should be considered to be included in the database).

**Figure 5.2: Stage 1 submission page – partial view (1 page in length)**

Upon completion of the project the user is shown confirmation of the submission, shown in Figure 5.3, and an email is sent to the ABC Project Database Committee chair. The chair then reviews the Stage 1 submission and discusses it with the ABC Project Database Committee as needed. If the project is deemed appropriate by the committee and the owner gives approval for the project to be included in the ABC Project Database, then a Stage 2 Project Submission link is sent to the point of contact. If it is decided that the project is not an ABC project or the owner does not give approval, then the submitter is contacted and no further submittal steps are taken.

**Figure 5.3: Confirmation that Stage 1 of the submittal process is complete**

The second stage of the submission process is more detailed and involves four steps (four pages to be completed). A sample of some of the data required for one of the steps is shown in Figure

5.4. The goal of Stage 2 is to collect all of the remaining data required for the project summary page and any relevant documents. The data required for Stage 2 includes:

- General Project Information
  - Spans
  - Dimensions
  - Traffic management alternative, if constructed conventionally
  - Existing bridge description
  - Replacement or new bridge description
  - Construction methods
  - Lessons learned or stakeholder feedback
- ABC Benefits
  - Mobility impact time (ABC versus conventional construction)
  - Impact category
  - Primary drivers (ABC benefits)
- General Bridge Information
  - Bridge length
  - Max span length
  - Primary beam material
  - Location type
  - Average daily traffic count
  - High performance materials
- Project Planning
  - Decision-making tools
  - Site procurement
  - Project delivery
  - Contracting
- Geotechnical Solutions
  - Foundations and walls
  - Rapid embankment
- Structural Solutions
  - Prefabricated bridge elements
  - Prefabricated bridge systems
  - Miscellaneous prefabricated
  - Construction equipment description
- Cost and Funding Information
  - Cost description
  - Funding source
  - Incentive programs
- Contact Information
  - Primary designer
  - Primary contractor
  - Sub-contractors
  - Fabricators
  - Suppliers

There are several resources that are also collected during the Stage 2 submittal process, to the extent they are available and approved for posting by the owner. These include:

- Contract Plans
- Specifications
- Bid Tabs
- Construction Schedule
- Photos
- Other Related Documents
- Other Related URLs

The Stage 2 submission process is accessed via a URL link that is only connected to one project. This unique link will allow multiple users to work on the submission by link sharing. Information on each page can be saved in a temporary database by clicking the “Next” button at the bottom of the page, shown in Figure 5.4. Saved data will reappear when the page is reopened. The project submission will only complete once the “Submit” button is pressed on the page of the final step.

Recommend a Project

## Stage 2 Submission

Complete the Following Steps: 1 2 3 4 5

### ABC Benefits:

Hitting the "Next" button will save the information stored on the current page. If the submitter would like to go to the previous page after hitting next, please use the back button on your browser.

Thank you for your submission! Please send any further questions to David Garber at dgarber@ffu.edu.

### Project Information

Spans:

One-span

Dimensions:

Describe in detail the dimensions of the bridge. e.g. 'Two adjacent four-span modular-beam-with-deck bridges, each 207-ft long and 54.33-ft wide (34 ft - 66 ft - 66 ft - 41 ft); 46° skew'

Replacement or New Bridge Description:

Describe in detail the replacement (or new) bridge (with an emphasis on the ABC related components of the project).

Construction Methods:

Describe the construction methods used on the project (with an emphasis on ABC related construction methods).

Lessons Learned and Stakeholder Feedback:

Describe any lessons learned on the project that may be useful for future engineers.

Other Notes:

Use this section to add any additional notes or comments on the project.

Mobility Impact Time

Compare the time for construction using ABC methods versus what the expected time using conventional construction methods

Impact Category:

Tier 1 (within 1 day)

Primary Drivers and ABC Benefits

List the Primary Drivers or the main reasons for ABC being selected for this project

### Bridge Length and Other Information:

Bridge Length (ft.)

2222.98

Max Span Length (ft.)

230.55

Beam Material Type:

Concrete

Location Types:

Rural

Average Daily Traffic Count

1233

High Performance Materials

List of high performance materials utilized for project

Next

**Figure 5.4: Sample of some information required for Stage 2 project submission**

When Stage 2 of the project is submitted, users will be directed to a confirmation page, shown in Figure 5.5, and an email will be sent to the ABC Project Database Committee chair. Similar to Stage 1, the chair will then review the final submission and discuss with the committee its appropriateness for being included in the ABC Project Database. Any minor edits will be made by the committee and major edits will be completed by the submitter. Both the subcommittee and the bridge owner need to agree on the final version of the submitted project information.

## Recommend a Project

Complete the Following Steps: 1

### Final Project Submission Complete

Thank you for submitting final report for your project. If your project is approved, it will be uploaded into the ABC-UTC database and will be viewable from the site. The submitter will be contacted if any additional information is needed.

Please send any additional questions to Mary Lou Ralls Newman at [ralls-newman@sbcglobal.net](mailto:ralls-newman@sbcglobal.net)

Thank you!

### ***Figure 5.5: Confirmation that Stage 2 of the submittal process is complete***

When all of the Stage 2 data has been reviewed and the owner has given final approval, the project is then included into the ABC Project Database. The process described above was designed to ensure that only ABC projects with owner approval and well-written project summaries are included into the ABC Project Database. This process will allow for the expansion of the database while ensuring its integrity is maintained.

## CHAPTER 6: SUMMARY

Accelerated bridge construction (ABC) is becoming more widespread with new techniques and technologies being utilized to accelerate or ease construction, reduce cost, and improve behavior of bridges. Each ABC project that is undertaken is accompanied by unique challenges and oftentimes innovative solutions. There have been some resources and opportunities for other bridge engineers to learn from a selection of these projects (through journal publications, monthly webinars, and in-depth workshops), but before this project there was no publicly available resource providing everyone with access to a significant number of ABC projects.

The goal of this project was to create a resource that would provide every bridge engineer the ability to access information on completed ABC projects and submit information on their own projects. This goal was accomplished through the development of an online database to house the ABC Project Database and user interfaces to allow the database to be easily searched and viewed and to allow users to submit their own projects.

The search interface is accomplished through:

- *Interactive Map*: showing the locations of ABC projects on a map
- *Faceted Navigation*: borrowing from popular shopping sites to allow for easy filtering of the full database using predefined categories and options
- *Keyword Search*: allowing for users to have additional flexibility in their search of the database

A detailed submission process was developed to ensure that (a) any user can submit a project to be considered for the database and (b) only projects consistent with the current definition of ABC are included in the ABC Project Database.

The hope is that the developed database will become the place for bridge engineers to exchange information about ABC, helping them to both learn from other projects and share knowledge and lessons learned from their own projects.

## REFERENCES

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