Executive Bridge Maintenance Management System: A Web Portal

By

Dr. David P. Hale
Aging Infrastructure Systems Center of Excellence
The University of Alabama
Tuscaloosa, Alabama

And

Dr. Shane Sharpe
Area of Management Information Systems
The University of Alabama
Tuscaloosa, Alabama

Prepared by

AISCE

Aging Infrastructure Systems Center of Excellence
The University of Alabama

And

UTCA

University Transportation Center for Alabama
The University of Alabama, The University of Alabama at Birmingham,
and The University of Alabama in Huntsville

Technical Report Documentation Page

1. Report No 930-612	2. Government Accession No.	3. Recipient Catalog No.
4. Title and Subtitle **Executive Bridge Maintenance Management System Phase I: A Web Portal**	**5. Report Date** July 18, 2007	
	6. Performing Organization Code	
7. Authors Drs. David Hale and Shane Sharpe	**8. Performing Organization Report No.** ALDOT Report 930-612 UTCA Report 05404 AISCE Report 07001	
9. Performing Organization Name & Address AISCE -106 Bevill 201 7th Avenue The University of Alabama Tuscaloosa, AL 35487-0208 205 348 5525; aisce@ua.edu	**10. Work Unit No.**	
	11. Contract or Grant No. ALDOT 930-612	
12. Sponsoring Agency Name and Address Alabama Department of Transportation 1409 Coliseum Blvd Montgomery Alabama 36110	**13. Type of Report and Period Covered** Final Report: October 15, 2003 – June 30, 2007	
	14. Sponsoring Agency Code	

15. Supplementary Notes

16. Abstract

This project conceptualized, designed, constructed and deployed a state-wide bridge reporting system for the Alabama Department of Transportation that extends the capabilities and user community for the existing Alabama Bridge Information Management System (ABIMS). The intranet-based application enables users to identify and retrieve selected bridge records in ABIMS and display the results in standard engineering terms rather than using screen numbers and a short mnemonic for values found in traditional IBM mainframe computer applications. Thus, users of this bridge information portal are able to readily interpret attributes, values and reports. This greatly enhances their ability to analyze bridge inspection and maintenance needs.

Usage requirements incorporated into this portal design and deployment came from state bridge engineers, maintenance engineers, division engineers, department leadership, county engineers and Federal Highway Administration (FHWA). To assist them with information retrieval, pre-defined, standard reports were developed along with functionality to create customized and on-demand reports to view bridge condition and structural information.

The value realized from this project includes:
- extending the use of centrally-located bridge information for occasional high-impact users by improving the ease of use,
- reducing misidentification of variables previously appearing in a coded format,
- reducing user training time,
- reducing the time required for central information systems personnel to develop custom reports, and
- enhancing the shared access of bridge data among bureaus, districts, divisions, FHWA staff and county bridge engineers.

This project also developed the IT architecture and standards for future ALDOT-wide web portals and integrated this application with a new web-enabled bridge mapping application to enhance the ease of information access for a broader range of users.

17. Key Words	18. Distribution Statement		
Asset management, BIM, BMS, Decision support, Web portal, Bridge code translation			
19. Security Class Unclassified	**20. Security Class**	**21. No of Pages** 48	**22. Price**

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Table of Contents

List of Figures

Executive Summary

This project conceptualized, designed, constructed and deployed a state-wide bridge reporting system for the Alabama Department of Transportation that extends the capabilities and user community for the existing Alabama Bridge Information Management System (ABIMS). The intranet-based application enables users to identify and retrieve selected bridge records in ABIMS and display the results in standard engineering terms rather than using screen numbers and a short mnemonic for values found in traditional IBM mainframe computer applications. Thus, users of this bridge information portal are able to readily interpret attributes, values and reports. This greatly enhances their ability to analyze bridge inspection and maintenance needs.

Usage requirements incorporated into this portal design and deployment came from state bridge engineers, maintenance engineers, division engineers, department leadership, county engineers and Federal Highway Administration (FHWA). To assist them with information retrieval, pre-defined, standard reports were developed along with functionality to create customized and on-demand reports to view bridge condition and structural information.

For the Alabama Department of Transportation, the delivery of the *Executive Bridge Web Portal* provides:

- Detailed goal-based workflows used for the bridge maintenance;
- Intuitive, civil and transportation engineering standard descriptions of translated ABIMS BI-6 codes;
- A new set of standard bridge maintenance reports;
- User-defined, on-demand reporting capabilities;
- Seamless access to the Bridge Card information system for members of the Bridge Design and Bridge Maintenance Bureaus;
- Integration with a new web-enabled mapping application; and
- Web portal architecture and standards to facilitate the building of a web portal for ABIMS.

The value realized from this project includes:

- extending the use of centrally-located bridge information for occasional high-impact users by improving the ease of use,
- reducing misidentification of variables previously appearing in a coded format,
- reducing user training time,
- reducing the time required for central information systems personnel to develop custom reports, and
- enhancing the shared access of bridge data among bureaus, districts, divisions, FHWA staff and county bridge engineers.

Introduction

The Alabama Department of Transportation (ALDOT) is charged with the effective management of the state's transportation assets. In addition, ALDOT must allocate funding in accordance with federal guidelines and increasingly formalized multi-criteria decision factors. Information about a bridge's eligibility for funding is currently contained in the BI-6 module of the Alabama Bridge Information Management System (ABIMS) in a manner that is not intuitive to ALDOT executives, Emergency Bridge Inspection Team (EBIT) members, Management/Transportation Planning personnel, Bridge and County Transportation Bureau personnel, and members of the Bridge Design Bureau.

Prior to this project, bridge sufficiency rating and funding eligibility information were only available through ABIMS in a mainframe green-screen format. In ABIMS, key variables are presented in a coded numeric and mnemonic format making these values difficult to interpret. The information is difficult to access and retrieval is time consuming. Although some standard reports were available, nonstandard reports required professional programmers to develop, process, and maintain custom-coded necessary output.

Bridge System Maintenance

The maintenance requirements on municipal, county, and state bridges continue to increase with road utilization throughout the state along with the average age of these bridges. Consequently, there is an increased emphasis on maintenance, management, and reconstruction of existing infrastructure while continuing to effectively manage user costs and the flow of traffic. Timely access to data about these bridge structures presented in an intuitive manner enhances the decision making capabilities of ALDOT user groups.

Funding Constraints

Federal and state budget pressures are placing constraints on the availability of funds, and an increasing emphasis on the accountability for the effective utilization of these funds. Consequently, ALDOT must now do more with less and require tools with the capability to articulate the trade-offs between alternative investment strategies and assist in the effective communication of alternatives to various stakeholders.

Integration of Data Resources

The combination of data from the bridge design, maintenance, and project management systems provides a more efficient and effective means of supporting transportation-planning decisions and influencing comprehensive funding decisions. Therefore, this proposal also intends to combine these disparate resources into one portal with integrated web architecture and standards which can be used in current and future projects. The

proposed web-enabled portal will provide necessary access to information for project stakeholders, thus making this an essential piece for enhanced future capabilities.

Project Deliverables

Executive Bridge Maintenance Management Web Portal Deliverables

The University of Alabama's Aging Infrastructure Systems Center of Excellence has delivered new bridge maintenance management capabilities, including:
- goal-based system definition specifications,
- bridge maintenance management application components, and a
- web-enabled management portal for bridge maintenance.

The system definition specifications served as necessary input for construction of both the bridge maintenance management application components and the web-enabled management portal. These deliverables are compliant with the GASB 34 directive and provide a means to achieve the longer-term goals of ALDOT's Asset Management Steering Committee. This is accomplished through the completion of the following deliverables:

1. *Detailed Requirements for Initial Bridge Executive Maintenance Management Module*
   - Defined the bridge maintenance decision-making process for primary and secondary stakeholders (users) (See Appendix A: Stakeholder Identification)
   - Detailed required decision data
   - Evaluated the availability and accessibility of needed data in ABIMS
   - Detailed system requirements (See Appendix B: Sample Requirements)
   - Gained ALDOT approval to proceed

2. *Translated ABIMS BI-6 Report Data Codes*
   - Determined the fields to be translated for each report that will be constructed
   - Delivered a copy of the code definitions to ALDOT for review
   - Evaluated definitions across key stakeholder groups to ensure that intuitive definitions are developed (See Appendix C: Sample BI-6 Translated Codes)

3. *Standard Bridge Maintenance Reports*
   - Identified a core set of standard reports and report contents based on essential work requirements by members of the Primary Stakeholder group
   - Created the structure and format of specific instances of the BI-6 Reports, Route Reports (HDRD) and Eligibility Reports (HBRRP) using the intuitive descriptions (See Appendix D: Sample Standard Reports)

4. *On-Demand Reporting Capabilities*
   - Identified bridge information components to include in reporting
   - Selected data filter conditions

- Defined ordering and sorting capabilities for report customization (See Appendix E: Sample On-Demand Reports; Appendix F: Executive Bridge Portal Custom Report User Documentation)

5. *Seamless Access to Bridge Card Information*
   - Integrated shared information related to bridge maintenance across the Bridge Design and Bridge Maintenance bureaus
   - Enhanced the maintainability and consistency of the bridge card information (See Appendix G: Bridge Card Component)

6. *Integration with Web-Enabled Mapping Application*
   - Enabled user to access details of a specific bridge via selection from a graphical, web-enabled external mapping application
   - Provides mapping application users with standard and on-demand reporting capabilities with translated BI-6 codes

7. *Web Portal Architecture, Standards, and Development*
   - Created web portal development, usage, and maintenance standards (See Appendix H: Web Portal Architecture, Standards, and Development; Appendix H.1: ALDOT Web Portal Group Architecture)
   - Verified standards through a walkthrough and the validation of standards through web portal construction

Project Value

In summary, this project has created value by completing the following objectives:

- Integrated data from bridge design, maintenance, and project management systems into one web portal;
- Created a web-based architecture and standards that can be used in current and future projects; and
- Enhanced reporting capabilities for executives and non-inspector personnel by creating standard reports and adding ad-hoc reporting capabilities.

Thus, the delivered system:

- Translates ABIMS BI-6 Report Data Codes for inspectors and engineers so that they may better comprehend the report fields;
- Standardizes bridge maintenance reports for primary stakeholders;
- Provides filtering capabilities for on-demand reporting;
- Provides seamless access to bridge card information for Design Bureau, cities and counties; and
- Provides access to necessary data in a uniform manner across maintenance management modules and facilitates uniform access for stakeholders through the web-enabled portal application and a web-enabled mapping application.

Thus, the value derived from this project is expressed as broadened use of automated bridge information, reduced training time, enhanced ease of use by casual users, reduced misidentification of variables, and enhanced the shared access of bridge data among bureaus, field divisions Federal Highway Administration staff and county bridge engineers.

Users who are not familiar with bridge inspection operational terminology or condition rating codes can use components developed as part of the Executive Bridge Portal to quickly access bridge information. This will provide value by allowing executive management find and compare bridges to determine funding eligibility and attributes concerning bridges during periods in which time is critical. Of particular interest to bridge portal executive users is the systematic translation of technical nomenclature to precise, standardized terms that are easily recognized.

ALDOT Deployment

During the spring of 2007, final deployment included movement of the Executive Bridge Management System from The University of Alabama labs to the Alabama Department of Transportation. The system was deployed and connections made to existing ALDOT systems. To aid in the deployment, The University of Alabama project team provide a series of training sessions for all 9 Alabama divisions, FHWA-Alabama Division staff and the maintenance bureau staff.

ALDOT Requested Out-of-Scope Changes & Additions

Upon completion of the delivered system, ALDOT made the following change and upgrade requests for the system which were determined to be outside the scope of this project. In many cases, the requested change has potential to increase the value of the delivered system to ALDOT, and for that reason these requests are documented for potential incorporation into a later phase of the Executive Bridge Maintenance Management System: A Web Portal.

- Integration of ALDOT's Bridge Photo Library into the Web Portal
- The ability to search for and return multiple BINs simultaneously
- Inclusion in the General BI-6 of the following Item Numbers in addition to Item 254F: Load Limit – School Bus:
    - Item 254A: Load Limit - M Vehicle
    - Item 254B: Load Limit - 2 Axle
    - Item 254C: Load Limit - 3 Axle
    - Item 254D: Load Limit - Concrete Truck
    - Item 254E: Load Limit - 18 Wheeler
    - Item 254G: Load Limit - 6 Axle
- Inclusion of an "Email to…" link for sending created reports to other ALDOT employees
- The ability to define a Custom Report by the following item numbers
    - Item 49: Structure Length
    - Item 52: Deck Width
- The ability to download both Standard and Custom Web Portal reports into Microsoft Excel
- The ability to save Custom Report queries for future reporting needs
- The inclusion of the following Item Number to the General BI-6 Report:
    - Item 58 – Deck Condition

Appendix A: Stakeholder Identification

To ensure a realization of value upon deployment of the Executive Bridge Maintenance Web Portal, users of the portal application within ALDOT and external to ALDOT were identified.

Primary stakeholders were categorized as those whose requirements were to be met if technologically and economically feasible.

Primary User Group(s) / Stakeholders and Assumed Role
- Senior ALDOT Management uses reports to categorize and prioritize the funding for the bridges that require work.
- Bridge Maintenance Engineers use reports to locate bridges in certain counties/divisions prioritize the list of bridges to be worked on and identify special equipment needs.
- Inspectors use reports to locate general information about a bridge by looking at previous inspector's entry as well as obtaining specific information about a certain bridge.

Secondary stakeholders provide context information, help set priorities when primary stakeholders are indifferent to order, and provide robustness to the portal by ensuring that functionality is as broad as is economically and technologically feasible.

Secondary User Group(s) / Stakeholders and Assumed Role
- Emergency Bridge Inspection Team (EBIT) members generate user-defined time-urgent reports to examine bridge characteristics.
- IT and Computer Services personnel use the portal to connect to bridge information along with other programs on the portal.
- Management/Transportation Planning personnel use the reports to look at planning of bridge work.
- Bridge and County Transportation Bureau personnel use the portal to look at bridge cards and bridge information for planning and maintenance purposes.

Appendix B: Sample Requirements

The initial systems analysis directly focused on required system outcomes necessary for Central Office bridge maintenance decision-making needs; the decision-making needs of Division Maintenance Engineers and County and Local Engineers were also evaluated for desired system capabilities.

The system definition focused on providing information search capabilities to:
- identify specific bridges or related sets of bridges
- code translations that allow for better explanation and understanding of bridge funding eligibility and bridge maintenance needs
- develop a prescribed set of standard reports and
- provide the capabilities for users to generate their own customized reports.

The two sample requirements noted below illustrate the detail required to properly specify the application system requirements to satisfy the data, workflow and decision algorithm needs of the primary and secondary stakeholders. The requirement steps provide additional detail related to the translation of user needs to application system requirements. The executive bridge maintenance management web portal application is comprised of several hundred detailed requirements.

Project Name:
ALDOT Exectutive Portal
Use Case Number:
UC001
Use Case Name:
BIN is Identified
Business Goal:
UC001 Bridge Identification Number is Identified
Description:
The goal of this use case is to identify the Bridge Identification Number. The use case is completed once the BIN number is indetified and delivered to the screen.
Pre-Condition
Use Case Begins When:
User enters portal
What Actors Play a Role in the Process:
User, Bridge Executive Management System
Post-Condition:
BIN or List of BINs are identified

Figure B.1: Sample executive bridge management requirement (identify BIN)

Step Number	BIN is Identified Use Case Steps	Responsible Participant	Information Algorithm	Information Required	Information Required Value
1	BIN is Identified				
1.1	User Enters Bridge Identification Number	User	User enters BIN	Bridge Identification Number is entered	Yes
1.2	Vaild BIN number is checked	System			
1.2.1	System checks for valid characters	System	System checks BIN number entered.	BIN Number	must be a numercial value
1.2.2	System checks for valid range of numbers	System	System checks BIN number entered.	BIN Number	must be greater than 0
1.3	Vaild BIN number is checked	System			
1.4	Retrieve Valid BIN Number	System	System retrieves valis BIN Number	BIN NUmber	must be a valid BIN
1.5	Identification Fields Are Retrieved	System	System retrieves values of report fields	• Beginning Milepoint (BI-6 Item 11) • **Table: HDBMPROD.BMS_ST_RDWAY** • **Attribute: SR-KP-LO** • Ending Milepoint (BI-6 Item 11+BI-6 Item 49) • **Table: HDBMPROD.BMS_ST_RDWAY; HDBMPROD.BMS_ST_INV** • **Attribute: SR-KP-LO+ST-LEN-MS** • Direction of Tr	Number: 7 digits (converted to miles) Number: 7 digits (Item 11+Item 49, converted to miles) Interpretation of BI-6 Item 102, Item 205, Item 5D 25 Character alpha-numeric description 6 digit identification number (unique to bridge) 1 digit
1.6	BIN is Verified				
	User accepts BIN returned	User	User accepts BIN number	BIN Number	valid BIN number
1.7	BIN is Identified				

Figure B.2: Sample executive bridge management requirement steps (identify BIN)

Project Name:	
ALDOT Executive Bridge Portal	
Use Case Number:	
UC007	
Use Case Name:	
Deliver AdHoc report to User	
Business Goal:	
Deliver custom Report to User	
Description:	
The goal of this use case is to deliver a user-defined custom report to meet the user's specific decision making needs. The use case is completed once the user has entered the search criteria, defined the constraints on the data to appear in the report,	
Pre-Condition	
User needs to search for bridges base on certain attributes and needs a unique set of information about these particular bridges.	
Use Case Begins When:	
The user moves to the choose geographic location Screen.	
What Actors Play a Role in the Process:	
User, Executive Bridge Portal	
Post-Condition:	
The report is displayed to the screen and/or the user prints the report on printer.	

Figure B.3: Sample executive bridge management requirement (create ad-hoc report)

Step Number	Deliver AdHoc report to User Use Case Steps	Responsible Participant	Information Algorithm	Information Required	Information Required Value
S001	Bridge Access Role Is Identified	System	System identifies user		
S002.010	Field Boundaries Are Retrieved	System	System defines fields - Congressional Districts, Alabama Senate District, Alabama House DistrictDivisions, Counties, BIN(s)	Division (Item 2) County (Item 204) Congressional District (Item 206) Alabama Senate District (Item 207) Alabama House District (Item 208) BIN	Number: Valid District (1 - 9) Number: Valid County (1 - 67) Number: Valid Congressional District (01 - 07) Number: Valid Alabama Senate District (01 - 35) Number:Valid Alabama House District (001 - 105) Number:Valid BIN (00002 - 19298)
S002.020	Geographic Filter Is Identified	User	User selects Division User selects County User selects Congressional District User selects Alabama Senate District User selects Alabama House District User selects BIN	Division (Item 2) County (Item 204) Congressional District (Item 206) Alabama Senate District (Item 207) Alabama House District (Item 208) BIN	
S002.030	Geographic Filter Is Defined	System	System defines filter		
S002.040	Geographic Filter Restrictions are applied	System	System filters		
S003.010	Attributes available to be included in Report are Displayed	System	System defines fields: BIN CPMS Reference # Structure Number Location Route City Division Alabama House District County Alabama Senate District Congressional District Beginning Milepoint/Ending Milepoint Structure Length Year Built Deck Width(	BIN CPMS Reference # (Item 210) Structure Number Location (Item 9) Route (Item 13) City (Item 4) Division (Item 2) Alabama House District (Item 208) County (Item 204) Alabama Senate District (Item 207) Congressional District (Item 206) B	
S003.020	Attributes to be included in Report are Identified	User	User selects attributes to include in report and to search by including: BIN CPMS Reference # Structure Number Location Route City Division Alabama House District County Alabama Senate District Congressional District Beginning Milepoint/Ending Mil	BIN CPMS Reference # (Item 210) Structure Number Location (Item 9) Route (Item 13) City (Item 4) Division (Item 2) Alabama House District (Item 208) County (Item 204) Alabama Senate District (Item 207) Congressional District (Item 206) B	
S003.030	Attributes to Search by and Included in Report are Defined	System	System defines filter		
S004.010	Limits are placed on attributes to search by	User	User limits values of attributes to search by	Attributes selected by the user to be included on the report and that can be searched by	BIN CPMS Reference # (0 - 622280096) Structure Number Location Route (AL0006 - US0431) City Division (01 - 09) Alabama House District (001 - 105) County (1 - 67) Alabama Senate District (01 - 35) Congressional District (01 - 07) Beginning Milepoint/

Figure B.4: Sample executive bridge management requirement steps (create ad-hoc report)

Appendix C: Sample BI-6 Translated Codes

As stated in the objectives of this project, a diverse set of stakeholders needs to be able to quickly understand existing bridge information. To enable this comprehension, existing codified information is translated into more easily understood descriptions that enable timely, informed decisions to be made about bridge maintenance and funding allocations. By eliminating the time it takes to determine what the code for a particular bridge attribute means, this application enhances the efficiency in identifying needed information about a bridge, increases the consistency in communicating the important attributes that lead to a bridge's rating, and reduces the time taken to interpret bridge details.

This Web Portal application allows the primary and secondary stakeholder groups to gain a greater understanding of bridge ratings by providing them with a translation of individual variables. The example below illustrates the codified information for a single item, which is currently displayed within ABIMS. The example also illustrates the corresponding translated item description displayed for users within the web portal application. The application provides translated descriptions for over 290 items (e.g. Item 26—Functional Classification) from the ALDOT Bridge Inspection Manual and the specific values for each item (e.g. Item 26 = 9).

Item 26 – Functional Classification			Description
Principal Arterials – Interstates, Freeways, or Expressways	**Other Principal & Minor Arterials, and Major Collectors**	**Minor Collectors, Locals**	
N	N	N	Bridge is not over a waterway
0	0	0	Bridge closed
2	2	2	Occasional or frequent overtopping of bridge deck and roadway approaches with severe traffic delays
2	2	3	Frequent overtopping of bridge deck & roadway approaches with significant traffic delays
2	3	4	Occasional overtopping of bridge deck and roadway approaches w/ significant traffic delays
3	4	5	Bridge deck above roadway approaches; occasional overtopping of roadway approaches with significant traffic delays
4	5	6	Bridge deck above roadway approaches; occasional overtopping of roadway approaches with insignificant traffic delays
6	6	7	Slight chance of overtopping bridge deck and roadway approaches
8	8	8	Bridge deck above roadway approaches; slight chance of overtopping roadway approaches
9	9	9	Bridge deck and roadway approaches above flood water elevations (high water); chance of overtopping is remote

Figure C.1: Example BI-6 translated codes

Appendix D: Sample Standard Reports

This project provides a set of standard reports constructed to meet the workflow needs of Primary Stakeholders, which includes a full BI-6 report, a general, condensed BI-6 report tailored to stakeholder decision-making needs, an inspection BI-6 report tailored to meet the needs of maintenance engineers and inspectors, route (HDRD) reports, and eligibility (HBRRP) reports. Where appropriate, the standard codes for reference items used in ABIMS are substituted with the translated descriptions to provide more interpretable reports.

The following are examples of the reports generated by the system:

General Bridge BI6 Report
BIN: 000262
This structure is currently in service.

Identification Information

Owner:	01	Location:	1.1 KM W JCT US 43
Facility Carried:	US 43	Division:	02
District:	01	County Code:	39 - Lauderdale County
Main Structure Type Code:	10 - Truss-Thru	Features Intersected:	SHOAL CREEK
Milepoint:	39.8060 - Miles	Local Identifier:	NNNN
Longitude:	087:34:13.70000 - D:M:S	Latitude:	34:51:03.80000 - D:M:S
U.S. Congressional District:	05	Alabama Senate District:	01
Alabama House District:	003	Structure Number:	O AL0002 39 39.8060-1

General Information

Year Built:	1925	Year Reconstructed:	0
Annual Average Daily Traffic (AADT):	14995 Vehicles	Structure Length:	803.10 Feet
Parallel Bridge Number:	006540	Parallel Bridge:	L - Left structure of parallel structures, carrying traffic in the opposite direction of the inventory route
Relative Position:	-1 - Parallel structure, left side - Parallel structure, left side	Inventory Route:	AL0002
Place Code:	00000	MPO Code:	00 - Not within any MPO jurisdiction

Condition Information

Sufficiency Rating:	18.50	Status:	1
HBRRP Eligibility Status:	1 - Eligible for replacement funding	Deficiency Points:	75 Points
Ranking:	2 locally	Posting Status:	D - Open, would be posted or closed except for temporary shoring
School Bus:	31.70	Reason Posted:	B0 - Superstructure
Operational Status:	O - Operational - structure record currently active		

Inspection Information

Maintenance Responsibility:	01 - State Highway Agency	Inspection Date:	10, 2004
Next Inspection Date:	10, 2006	Interim Inspection Date:	9, 1995
Next Interim Inspection Date:	9, 1997	Inspection Frequency:	24 Months

Report ran on: Tuesday, February 13, 2007 at 5:20:08 PM

Figure D.1: Sample general bridge BI-6 report

14

Inspection BI6 Report
BIN: 000262
This structure is currently in service.

Identification Information			
Division:	02	District:	01
County Code:	39 - Lauderdale County	Milepost:	39.8060 - Miles
Structure Number:	O AL0002 39 39.8060-1	Year Built:	1925
Main Structure Type Code:	10 - Truss-Thru	Inventory Route:	AL0002
Approach Structure Type Code:	00 - Other	Facility Carried:	US 43

Inspection Information			
Inspection Agency:	01 - State Highway Agency	Inspection Frequency:	24 Months
Last Routine Inspection Date:	10, 2004	Last Interim Inspection:	9, 1995
Special Equipment Used:	1,4,5,9 - Snooper - Aerial bucket - Any type of boat - Traffic control		
Critical Feature Inspection Frequency:	24 Months	Last Crtical Feature Inspection:	10, 2004
Under Water Inspection Frequency:	24 Months	Last Underwater Inspection Date:	9, 2005
Special Inspection Frequency:	0 Months	Last Special Inspection Date:	0, 0
Snooper Inspection Frequency:	24 Months	Last Snooper Inspection Date:	10, 2004
Scour Inspection Frequency:	24 - Months	Last Scour Inspection Date:	10, 2004

Condition Information			
Approach Roadway Condition:	6 - Satisfactory	Location:	1.1 KM W JCT US 43
Superstructure Condition:	4 - Poor condition	Substructure Condition:	7 - Good condition
Channel Condition:	7 - Bank protection is in need of minor repairs	Culverts Condition:	N - Not applicable
Overall Paint Condition:	4 - Poor-need for painting is urgent	Fracture Critical Bridge:	SEE BRIDGE FOLDER
Total Deficiency Points:	75 Points - Operational - structure record currently active		
Status:	1	Sufficiency Ratins:	18.50
Reason Posted:	B - Superstructure	Posting Status:	D - Open, would be posted or closed except for temporary shoring

Report ran on: Tuesday, February 13, 2007 at 5:12:28 PM

Figure D.2: Sample inspection BI-6 report

Search Criteria Selected:

Division: 01   **County:** 22 - Cullman County

City: [ALL]   **Route Type:** 1 - Interstate Highway

Route Number: IN0065   **Beginning Milepoint:**

Maintenance Responsibility: **Ending Milepoint:**

23 BINs were returned.

DIV.	CNTY.	BIN	BEG. MP	END. MP	MULT. RECS.	LOCATION	FACILITY	DIR. OF TRAFF.	LVL. OF SERVICE	FEAT. INT.	DESIGN LOAD	VERT. CLR.	LOCAL IDENT.	OP. STATUS
01	22	006475	291.85	291.88	2	JCT I65 & SR 91	I65	S	1	SR 91	5	99.99	NNNN	O
01	22	006476	291.85	291.88	2	JCT I65 & SR 91	I65	N	1	SR 91	5	99.99	NNNN	O
01	22	006096	294.07	294.07		2 MI N JCT SR 91	I65	NS	1	BRANCH	5	99.99	NNNN	O
01	22	006477	294.29	294.35	2	2 MI N JCT I65 & SR 91	CO RT 100		1	I65	4	99.99	NNNN	O
01	22	006097	295.52	295.54		4 MI N JCT SR 91	I65	NS	1	MARIOT CREEK	5	99.99	NNNN	O
01	22	006814	297.97	297.99		6 MI N JCT SR 91	I65	NS	1	MARIOT CREEK	5	99.99	NNNN	O
01	22	007084	299.45	299.51	2	S JCT I65 & SR 69	SR 69		1	SR 69	5	99.99	NNNN	O
01	22	015061	300.81	300.86	2	1.4MI N JCT SR69 S & I65	REST AREA RAMPS	NS	7	I-65	5	99.99	NNNN	O
01	22	006815	301.81	301.82		6 MI S JCT US 278	I65	NS	1	BAVERS CREEK	5	99.99	NNNN	O
01	22	006816	302.20	302.25	2	5 MI S JCT US 278 & I65	CO RT 18		1	CO RT 16	5	99.99	NNNN	O
01	22	007085	303.46	303.52	2	N JCT I65 & SR 69	SR 69		1	SR 69	5	99.99	NNNN	O
01	22	006817	303.72	303.72		3.7 MI S JCT US 278	I65	NS	1	BRANCH	5	99.99	NNNN	O
01	22	006818	304.66	304.71	2	3 MI S JCT US 278 & I65	CO RT 222		1	I65	4	99.99	NNNN	O
01	22	006478	304.88	304.89		3 MI S JCT US 278	I-65	NS	1	BRANCH	5	99.99	NNNN	O
01	22	006819	305.90	305.95	2	2 MI S JCT US 278 & I65	CO RT 36		1	I65	4	99.99	NNNN	O
01	22	007093	307.44	307.49	2	JCT I65 & US 278	US 278; SR 74		1	US 278 & SR 74	5	99.99	NNNN	O
01	22	007092	307.45	307.50	2	JCT I65 & US 278	US 278; SR 74		1	US 278 & SR 74	5	99.99	NNNN	O

Figure D.3: Sample HDRD report

HBRRP Eligibility Report

Tuesday, February 13, 2007 6:00:31 PM

This structure is currently in service.

BIN: 262 Structure Number: O AL0002 39 39.8060-1   Division: 02
          Beginning Milepost: 39.8060   County: 39 - Lauderdale County

HBRRP Eligibility Status	1 - Eligible for replacement funding
Special Consideration Flag	N - No special route consideration
Special Condition Deficiency Points	0

Load Deficiency Points	40 (Out of 40.0)
Width Deficiency Points	10 (Out of 10.0)
Vertical Clearance Deficiency Points	10 (Out of 10.0)
Physical Condition Deficiency Points	15 (Out of 40.0)
Total Deficiency Points	75 (Out of 100.0)

Local Bridge Ranking	2 of 361 bridges owned by the same owner
Statewide Bridge Ranking	13 of 6256 among bridges statewide

Sufficiency Rating	18.50 (Out of 100.0)
Sufficiency Status	1

Existing Length	803.10 feet
Existing Width	19 feet
Existing Area	15258.90 sq. feet
Proposed Length	802.80 feet
Proposed Width	19 feet
Proposed Area	15253.20 sq. feet

Type of Work	31-1 Replacement of bridge/other structure due to substandard load carrying capacity/substandard bridge roadway geometry - Work to be done by contract
Length of Structure Improvement	802.80 feet
Bridge Improvement Cost (in 1,000's)	$ 1846
Roadway Improvement Cost (in 1,000's)	$ 185
Calculated Incidental Cost (in 1,000's)	$ 738
Total Projected Cost (in 1,000's)	$ 2769
Year of Improvement Cost	2006

Replacement Cost Factors:

A) Bridge Cost per Square Foot of Deck Area	$55	C) Approach Cost Factor	10%
B) Culverts Cost per Square Foot of Top Slab	$45	D) Total Project Cost Factor	150%

CPMS Information

Associated BIN #	Project#	Scope	Status	Target Start Date	Federal Aid Project #	Estimated Cost
006540	100002446	CN	A	07/2002	ACBRF 0101 560	$0,000.00
006540	100002446	CN	A	07/2002	ACBRF 0101 560	$14,117,157.44
006540	100002447	RW	A	09/2001	BRF 0027 010	$7,750,000.00
006540	100002448	UT	A	07/2002	ACBRF 0101 560	$6,185,076.66
000262	100002449	PE	A	07/1998	BRF 0027 010	$760,000.00
000262	100042875	MC	A	11/2002	99-702-000-262-301	$125,000.00

Figure D.4: Sample HBRRP eligibility report

17

Appendix E: Sample On-Demand Reports

The ability to generate on-demand, user-defined reports stems from the need to locate multiple bridges or isolate specific bridges based on a user's defined set of criteria, such as location, sufficiency rating, or date of funding eligibility. The major system capability is a set of fields, field ranges and data selection operators that the primary stakeholder groups can use to develop a query in order to return specific sets of bridge information. Consequently, the on-demand, user-defined querying capability allows the user to reduce or filter the entire set of bridges to view a single bridge or group of related bridges based on a finite set of constraints in order to make a previously unspecified decision. The finite set of constraints used to develop a view of resulting bridges meeting these constraints forms the basis of the on-demand queries. The system also enables the user to select the specific attributes, the order of attributes and sorted order of records to appear on the user-generated report. The attributes are organized into identification, location, structural and inspection-related attribute categories.

Figure E.1: On-demand filtering options

Figure E.2: On-demand report attribute options

Ad Hoc Report

293 rows were returned

BIN	Division	County	Route Number	Route Type	MilePoint	Date Last Inspected	Next Inspection Date	Special Equipment Used
4568	01	22 -- Cullman County	00014	4 -- County Highway	.00621	04/1995	04/1995	9 :: 9 -- Traffic control
1430	01	22 -- Cullman County	00014	4 -- County Highway	.00621	02/1997	02/1997	9 :: 9 -- Traffic control
10974	01	22 -- Cullman County	00047	4 -- County Highway	.00621	02/1997	02/1997	39 :: 3 -- Special ladder, 9 -- Traffic control
16883	01	22 -- Cullman County	00000	5 -- City Street	.00621	02/1997	02/1997	36 :: 3 -- Special ladder, 6 -- Camera
8000	01	22 -- Cullman County	00047	4 -- County Highway	.00621	02/1997	02/1997	9 :: 9 -- Traffic control
2725	01	22 -- Cullman County	00091	3 -- State Highway	8.70913	10/1997	10/1997	0 :: 0 -- No special equipment is needed
2726	01	22 -- Cullman County	00091	3 -- State Highway	9.10495	10/1997	10/1997	0 :: 0 -- No special equipment is needed
5400	01	22 -- Cullman County	00000	4 -- County Highway	.006	02/1999	02/1999	9 :: 9 -- Traffic control
3384	01	22 -- Cullman County	00000	4 -- County Highway	.00621	03/1999	03/1999	9 :: 9 -- Traffic control

Figure E.3: Sample on-demand report

Appendix F: Custom Report User Documentation

The Executive Bridge Maintenance Web Portal provides users with the ability to generate customized, non-standard reports without requiring professional programmers to develop, process, and maintain custom-coded reports and output for a multitude of users. This section outlines the steps for generating a user-defined, custom report.

There are five pages on the Custom Report Generation piece of the application that guide the users through the generation of Custom Reports.

1. The first step is the Search page where the user can search for an individual bridge or a set of bridges based on any number of geographic constraints.

There are four types of searches that can be conducted on the Custom Report Generation Search page:
*   One is to enter in the BIN number for information on the bridge corresponding to that BIN.
*   The second type of search is to select a county and enter in the local identifier for information on the bridge corresponding to the local identifier.
*   The third type of search is to query on all bridges in the state by selecting all divisions, selecting an individual division, selecting an individual county or even selecting an individual city. If a search is conducted on all bridges in the state the number of items displayed will be limited to 20 or less per page.
*   The fourth and final type of search is to select a United States Congressional district, Alabama Senate district, or Alabama Congressional district.

2. Once the user has identified a bridge or set of bridges, the next page is the Select page. The user may further restrict the selection of bridges by using the Define check box to identify items (bridge attributes) that will have a specific value or value range set on the Define page. For example, a user may have previously selected all bridges in Jefferson County and may now select the Inspection Date Define check box. On the following Define page, the user will enter an Inspection Date range such as a last inspection date prior to two years ago this month, thus returning all bridges that need to be inspected in Jefferson County.

The second set of check boxes on the Select page is the Display check boxes, which allows the user to identify items to Display on the Custom Report from the 51 available items. Continuing with the example, the user may want to Display on the Custom Report the special equipment needed for an inspection of the Jefferson County bridges that are due for an inspection this month.

Once the user has Defined the items to further restrict the bridge set and identified the items to be Displayed on the Custom Report, the user should click the Submit button to continue to the Define page.

Note: if the initial geographic Search resulted in an individual bridge or the desired subset of bridges, there is no reason to select any items using the Define option. In this case, the user would select the items to be displayed on the Custom Report for the individual bridge or subset of bridges.

3. On the Define page the user can define the constraints for each item chosen. The user can also enter a name he/she would like to title the report. Click the Submit button to continue to the Order page.

4. On the Order page the user can select up to five items, from the list of items selected to Display or Define search constraints, to order the results on the report in ascending or descending order. For instance, if the user has selected to display the last inspection date for all bridges in Jefferson County, he/she can order the results on the report by the last inspection date in ascending or descending order. Click the Submit button to generate the report.

5. The final page is the Custom Report. On this page all bridges that fit the constraints the user has placed on the search are returned. The BIN for each bridge is displayed along with each item selected to Display on the report. Note: the BIN is a link to a menu of the static pre-defined reports of the application. Click on any one of the static pre-defined reports (Full BI-6, General BI-6, Inspection BI-6, HDRD and HBRRP) available to see that report for the BIN you have selected. From the static report view, the user may click the Back button to return to the Custom Report view to select another BIN.

Appendix G: Bridge Card Component

To integrate shared information related to bridge maintenance across the Bridge Design and Bridge Maintenance bureaus, the information on bridge cards currently available in hard copy form through the Design bureau was made available online as *portable document format* (PDF) files. The bridge cards contain graphic (plots, maps and pictures) and text material for all ALDOT-maintained bridges. The integration of this information enhances the maintainability and consistency of the bridge card information.

The Bridge Card portion of the Executive Bridge Portal depends on the availability of files external to the system. The Bridge Portal provides a means of accessing the Bridge Cards once this server is in place. The following information provides background and instructions on how to set up the folder structure on the server hosting the Bridge Cards, as well as how to configure the Web Portal to interface with this server.

The application reads the location of the Bridge Cards from a Microsoft Access Database. The structure of the database consists of nine (9) columns of information that allow Bridge Cards to be matched to the appropriate BIN number. The columns are: ID, DOCSERVER_LOC, BRIDGE_PROFILE_PATH, BRIDGE_COMPONENTS_PATH, BIN_NBR, STATUS, FEDERALROUTE, COUNTY, and PROJECTNBR.

Of interest in rebuilding the structure of the server hosting these cards are the columns DOCSERVER_LOC and BRIDGE_PROFILE_PATH. The DOCSERVER_LOC column contains the name of the machine on which the documents will be hosted, as well as the first level folder in which they reside. In the Access Database delivered to ALDOT, all the rows of the DOCSERVER_LOC column contain the following: "\\CSNTS003\TEMPDOCS", where CSNTS003 is the computer name and TEMPDOCS is the top-level shared folder. The next column, BRIDGE_PROFILE_PATH contains subsequent folders to be navigated through. In the Access Database delivered to ALDOT, each of the rows of the BRIDGE_PROFILE_PATH contains the following: "\BRIDGE\DOCSFUSI\".

These two portions of the file path combine to provide the path to the folder containing all of the Bridge Cards. Each bridge card is formatted in PDF. The individual filename for the card is contained in the BRIDGE_COMPONENTS_PATH column. It is assumed that these filenames will be the same when the server for the Bridge Cards is made available.

In order to configure the Access Database to work on a new server, the DOCSERVER_LOC and BRIDGE_PROFILE_PATH columns will have to be modified to reflect the new path to the folder containing the Bridge Cards. An example of a possible change would be if the server hosting the cards' name were to change from CSNTS003 to CSNTS009. In the original case of CSNTS003, if BIN 6375 were selected in the application then the file path the application would attempt to access would be //csnts003/TEMPDOCS/BRIDGE/DOCSFUSI/16T701!.PDF. If the name were to change

to CSNTS009, then the application would need to access the location file://csnts009/TEMPDOCS/BRIDGE/DOCSFUSI/16T701!.PDF. To facilitate this change, simply update all the rows of the DOCSERVER_LOC column in the Access Database to read \\CSNTS009\TEMPDOCS. This will allow the application to navigate to the correct location of the Bridge Cards. Permissions for this folder will have to be configured to allow the application read access.

Abbreviated Instructions:
1.) On the new server, create a shared folder named "TEMPDOCS"
2.) Under this folder, create another folder named "BRIDGE"
3.) Under the BRIDGE folder, create a folder named "DOCSFUSI"
4.) Place the Bridge Card files in the DOCSFUSI folder (these files are assumed to have the same filenames corresponding to an individual BIN as those in the Access Database)
5.) Ensure the application has proper permissions to access these folders
6.) In the Access Database file, update the server name "CSNTS003" to the name of the new server

ALIGNMENT: TANGENT TOTAL LENGTH: 90'.0" GRADE: SEE VERT CURVE DATA

BEGIN BRIDGE
STA. 17+51.079
P. G. 203.028

END BRIDGE
STA. 16+61.079
P. G. 203.509

90.0'

GENERAL: ELEVATION OF STRUCTURE SCALE: H- N.T.S. V- N.T.S.

NAME OF BRIDGE	RAIL DESIGN RATING: HS20.44	FOR:
OVER STREAM, R.R. OR HIGHWAY: NORFOLK SOUTHERN RR	OPERATING RATING: 48	INVENTORY RATING: 36
WHEN BUILT: 2003 BY: STATE	APPROACH PVM'T. TYPE: BITUMINOUS CONCRETE	
MAINT. BY: STATE OVERALL LGTH. FLOOR: 90'.0"	PAVEMENT WIDTH: 24'.0"	SHOULDER WIDTH: 9' EACH SIDE
NO. AND LENGTH OF SPANS: 1 @ 90.0'	SIGHT DIST: VERTICAL:	HORIZ:
	GRDE. DIST:	

REMARKS: 13°10'00" SKEW

PHOTOGRAPH

TO DEMOPOLIS →

END BRIDGE
STA. 16+61.079

FUTURE TRACK

G.R. 13

BEGIN BRIDGE
STA. 17+51.079

VERTICAL CURVE DATA

500' VC
+3.414%, -5.222%

PVC=14+75

PVT=19+75

WATERWAY DATA:

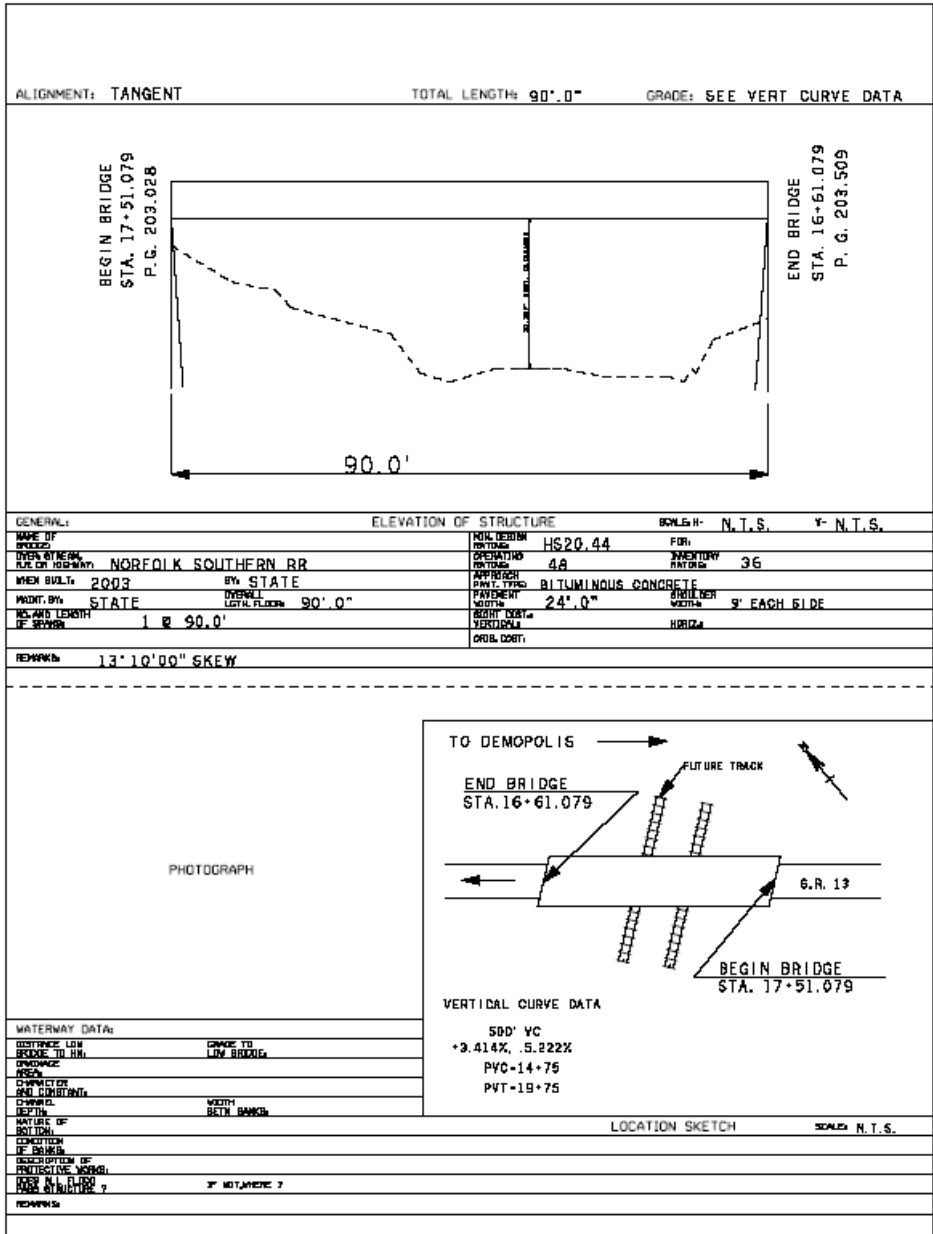|		
DISTANCE LOW BRIDGE TO H.W.:	GRADE TO LOW BRIDGE:	
DRAINAGE AREA:		
CHARACTER AND CONSTANTS:		
CHANNEL DEPTH:	WIDTH BETN BANKS:	
NATURE OF BOTTOM:		
CONDITION OF BANKS:		
DESCRIPTION OF PROTECTIVE WORKS:		
DOES H. W. FLOOD CROSS STRUCTURE ?	IF NOT, WHERE ?	
REMARKS:		

LOCATION SKETCH SCALE: N.T.S.

Figure G.1: Sample bridge card

25

Appendix H: Architecture, Standards, and Development

The ALDOT Executive Bridge Portal required that multiple users be able to access a common system of applications and data from varied locations over various network connection methods (ranging from high-speed DSL connections and local intranet connections, and to home dial-up connections). It was also required that the ALDOT Executive Bridge Portal is centrally maintainable and administrated. The data used by the ALDOT Executive Bridge Portal systems was to be centrally stored in a reporting database. To meet these requirements, it was determined that a new system architecture, a three-tier architecture, be implemented at ALDOT for these systems.

A three-tier architecture consists of three tiers, or layers; a client-side layer (including calculations and processing done by the system user's personal workstation), a business-logic layer (including calculations and processing relating to the enforcement of business rules, procedures, and processes), and a data layer (including calculations and processing done to access, store, and manipulate data). A three-tier architecture provides segregation of responsibilities and tasks within a system; this facilitates the centralization of maintenance and administration for each of the main functional tasks within a major system.

One of the main drivers behind the implementation of a three-tier architecture at ALDOT is the desire for the multiple users (with varying network connection methods, connection speeds, and workstation configurations) to be able to access and interact with the same systems (same system version, same data, same ability to generate output, etc.) concurrently in real time. Previous system architectures at ALDOT required that the maintenance and administration of the business-logic and data functions be performed (at least to some extent) on the system user's personal workstation. When systems were used by a multiple users, this created unnecessary maintenance and administration complexity; several different versions of a system with various administrative settings would be deployed and supported at the same time. The three-tier architecture implemented at ALDOT as part of the Executive Bridge Portal eliminated these problems by centralizing the client-side, business-logic, and data functions.

A three-tier architecture means that if ALDOT needs to implement a change in the business-logic of a system within the Executive Bridge Portal, ALDOT would have to update only the business rule in one location (the business-logic layer), and the update would be mitigated to all the system users the next time they used the system. The same concept holds true for updates in the data of a system. Since all data is centrally stored within the data layer, an update to the data will immediately be seen by all system users the next time they access the system.

The three-tier architecture, as deployed at ALDOT for the Executive Bridge Portal, can be fully explored in Appendix H.1.

Appendix H.1: ALDOT Web Portal Group Architecture

Introduction

The purpose of this document is to provide architecture standards for Executive Web Portal. A three-tier architecture defines the division of any web based application that will be located in the portal into three layers. This three-tier model will consist of user interface (UI), business services/rules, and data. The UI will be written in HTML and ASP.NET. Data will be pulled from an Oracle 9i database that is replicated with a DB2 database. Data is entered in the DB2 database from ABIMS (Alabama Bridge Information Management System) which is currently used to enter in all bridge information. The Web Portal in no way will save data back to the Database but only retrieve information for viewing or client-side manipulation purposes. The Web Portal will be located in the demilitarized zone (DMZ) of the firewall and will go through port 8080.

The end-users of the Web Portal will be connecting at different speeds. Fifty percent or more of the users will connect at the speed of digital subscriber line (DSL) at 1 mbps and above. The other portion of the users will be using a dial-up connection at 56 kbps. The dial-up users will be mostly in the county offices and ALDOT employees dial in when out of town. All data and applications available by the portal are open to all Intranet users as "read only". Everyone that logs on to the Intranet will have equal access, because no data will be saved back on the database. All security measures will take place outside the Web Portal with the Intranet login.

The main benefit of having a three-tier architecture is easy management of the contents of the application. Each major piece of functionality is isolated from the others. The UI is independent of the business services, which is in turn isolated from the data piece. This architecture will reduce maintenance costs and greatly increase flexibility over the life of the system.

System Requirements (Client-Side)

The following minimum client specifications are required to connect to the Web Portal:

Client System Requirements	
Min Operating System	Windows 98 or Windows NT 4.0
Internet Explorer	Version 5.5
Screen Resolution	800x600
Internet Connection	Any available (dial-up, broadband, etc.)

All users will have to connect to the ALDOT intranet to connect to the Web Portal; therefore a username and password is required from the ALDOT intranet account designee.

Server Requirements

The Web Portal will be coded and tested under the operating conditions provided in the tables below. These specifications were gathered from ALDOT and its GIS group and then replicated in the University of Alabama AIME lab. The web server and the database server are physically two separate servers.

Web Server Requirements

The following specifications are to which the Web Portal is coded:

Web Server Requirements	
Standard Operating System	Windows 2003 Server
IIS	Version 6.0 (comes with Windows 2003 server)

Database Server Requirements

The following specifications are to which the Web Portal is coded:

Database Server Requirements	
DB Application	Oracle 9i
Block Size	8192

Three-tier Architecture

A three-tier architecture is used for all applications located in the Web Portal. The model below shows the flow of how the different pieces (UI, Business Services, Data) fit together. It is important to follow this model to keep the logic of the application in blocks for readability and maintainability. The model below illustrates how the Web Portal will work in a three-tier architecture environment.
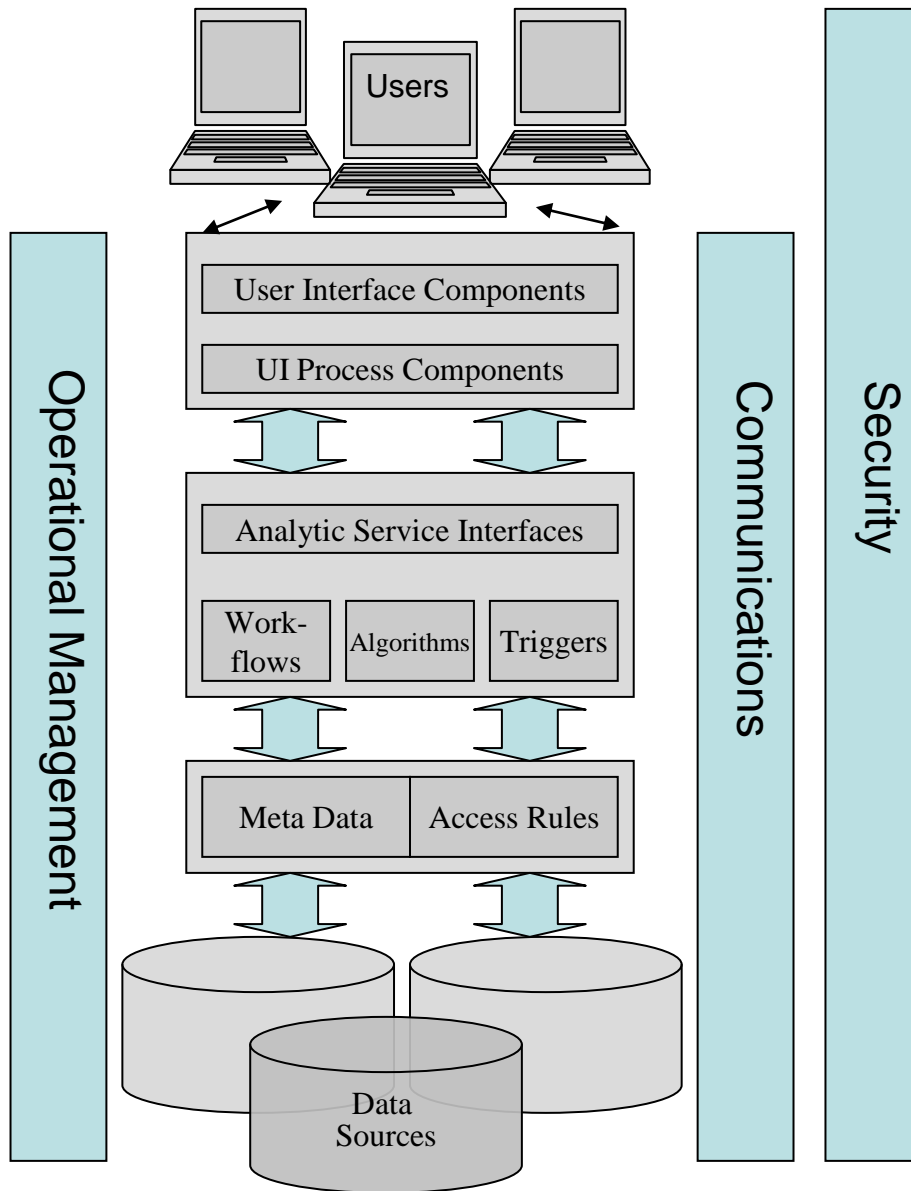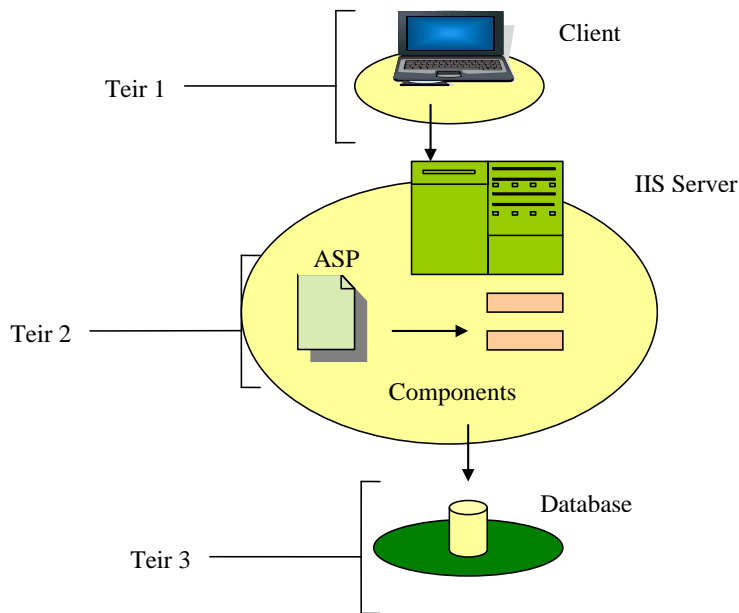

Figure H.1.1: Three-tier architecture

Figure H.1.2: Three-tier architecture

User Interface

The User Interface provides a way for users to interact with the application. User interfaces consists of Windows Forms, Microsoft ASP.NET pages, buttons controls, or any other technology used to render and format data for users' view. Users will be able to select searching criteria and save files will reside in this layer of the architecture. The Internet Explorer 5.5 web browser will be used on each client machine to perform rendering for the display of the UI pieces. Style Sheet validation will also be performed.

Business Services

The business services layer will contain all of the calculations after data is pulled from the database. Data will be passed though business services from the data layer to the user interface. This layer contains all business tasks (queried reports for decision making: Does the bridge need painted?; Does the bridge need to be in the budget for next year?; Will be bridge be federally inspected?) needed to be preformed by the user. ASP.NET code will be used in this layer to perform business logic.

Data

This layer will contain all code that accesses the database. Data retrievals will be found in this layer of the architecture. We will not have any updates because information retrieved via the Web Portal will be read-only. All data will be pulled from two external database systems. The first external system is an Oracle Reporting database which will pull information from the ABIMS DB2 production database and the second is CPMS which is stored in a separate Oracle database. Source: http://msdn.microsoft.com/architecture/application/default.aspx?pull=/library/en-us/dnbda/html/AppArchCh2.asp

30

GIS Architecture Recommendations

Geographic Information Systems (GIS) provided the following architecture specifications and diagram to go by for the Web Portal and the production all future projects. Our architecture for the Web Portal is inline with the recommendations set by the GIS group.

- Data tier
  - The database is being stored in Oracle 9i.
  - Spatial data is being stored in Open Spatial Format (oracle spatial)
  - Data can be accessed via a standard ole db client with ANSI SQL
  - Spatial data may also be accessed via ESRI Arc SDE API.
- Middleware
  - Consists of a mix of products and technologies, including Arc IMS, Arc Objects, and functionality implemented via .Net code objects, callable via web services (soap/xml requests)
- Application tier
  - Web Server
  - Arc Map
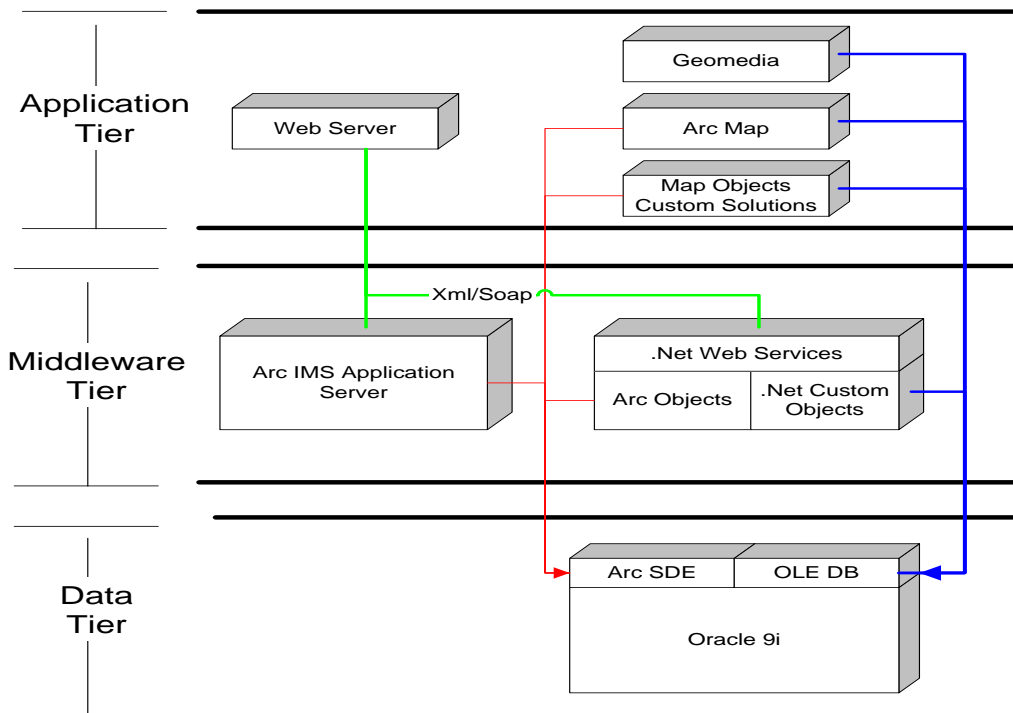 - Map Objects/ Custom Product
  - Geomedia

Figure H.1.3: Recommended GIS architecture
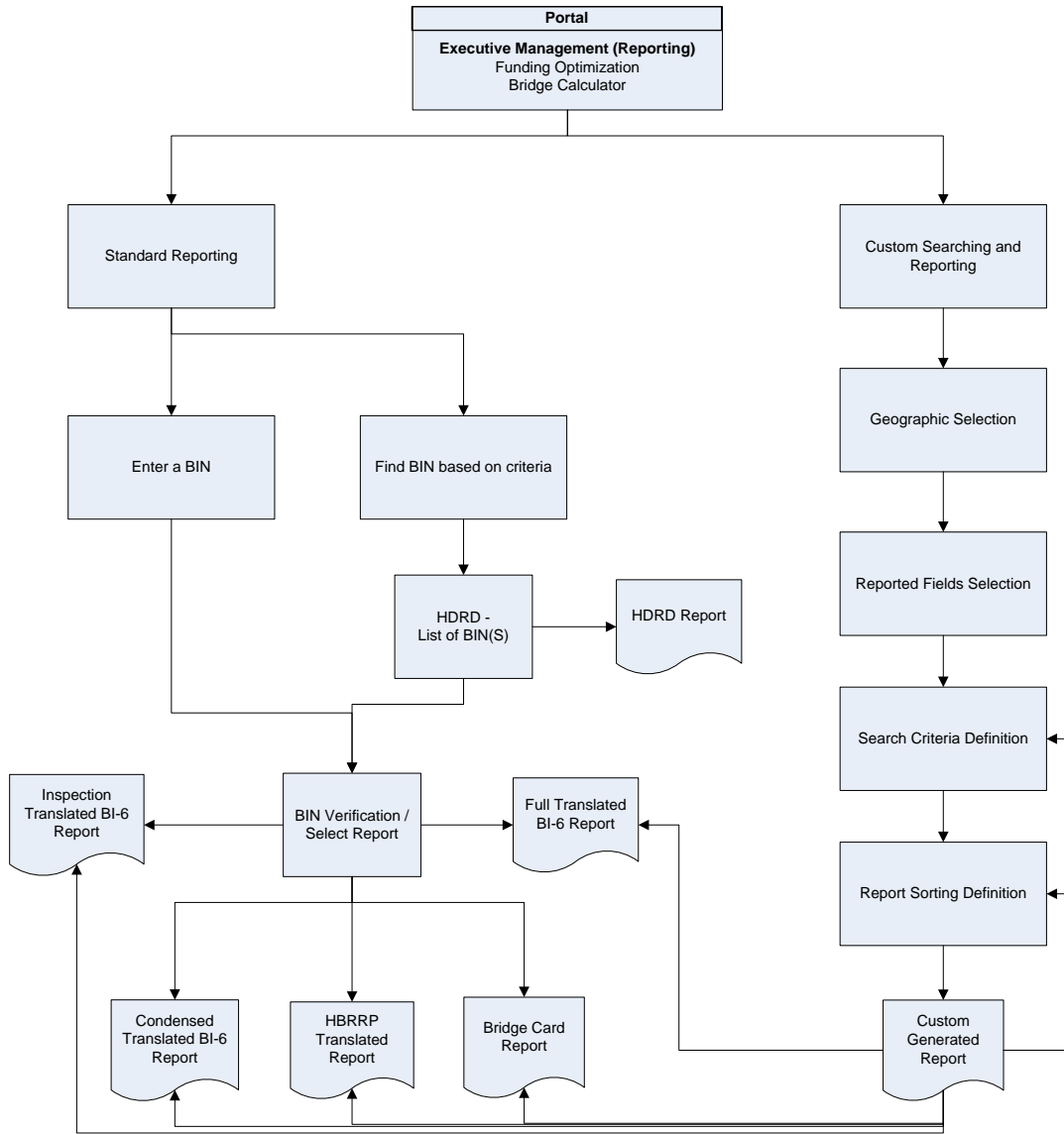
Appendix I: System Workflow

Figure I.1: Work flow diagram

Appendix J: Web Portal Item Number References

Each screen and report in the Executive Bridge Maintenance Management Web Portal references specific item numbers from the Bridge Inspection Manual provided by the Maintenance Bureau. The following section outlines the item numbers used in the Executive Bridge Maintenance Management Web Portal application. The application is essentially divided into a "Search for a Bridge or Set of Bridges" section and a "Report Selection/Generation" section. The section below details the items referenced in the Search section and items referenced in the Reporting section for a Full BI-6 report. The items and their corresponding ABIMS screens (1A-13) are illustrated in the following section. In addition, the definitions of each of the items are detailed for screen 1A as an example of the detailed information required to fully define each attribute appearing in the various static and user-defined reports.

Section: Search and Pre-Defined Reports
Item numbers related to search screen (report item numbers are in last section)

http://*hostname/*executive_bridge_portal/BinSearch.aspx:
BIN:
County: Item 204
> The County in which the bridge resides is entered in this field, right justified with blanks filled with zeros.

Local Identifier: Item 201
> This is a 4-digit field available to local government agencies to develop their own structure numbering/identification schemes.

Division: Item 2
> This item is two digits in length. It is coded by entering the number corresponding to one of the nine field divisions of the Alabama Department of Transportation. Valid codes for this item are 01 through 09. When the bridge falls at the boundary between divisions, it is identified as being in (and assigned to) the county or division to the west or south of the boundary. As a general rule, even numbered routes are understood to run from west to east and odd numbered routes are understood to run from south to north.

City: Item 4
> FIPS Place Code. This number is placed by the city name in this program. Cities, towns, townships, villages, and other census-designated places are identified by entering their Federal Information Processing Standards (FIPS) code. The number is right justified in this five-digit field with blanks filled with zeros.

Route Type: Item 13A, Sub Item 5B - ALXXXX

Route Number: Item 13A, Sub Item 5D – XX0059

Beginning Milepost: Item 11

Ending Milepost: Item 11

Maintenance Responsibility: Item 21
> This 2-digit field represents the type of agency that has primary responsibility for maintaining the structure.

Eligible for Replacement (Item 281 = 1)

Eligible for Rehabilitation (Item 281 = 2)

Section Custom Search and Report
Item numbers related to search page only (Report item numbers are in last section)
http://*hostname*/executive_bridge_portal/AdHoc_Geo.aspx
Division: Item 2
> This item is two digits in length. It is coded by entering the number corresponding to one of the nine field divisions of the Alabama Department of Transportation. Valid codes for this item are 01 through 09. When the bridge falls at the boundary between divisions, it is identified as being in (and assigned to) the county or division to the west or south of the boundary. As a general rule, even numbered routes are understood to run from west to east and odd numbered routes are understood to run from south to north.

County Code: Item 204 Indicates County where structure resides
> The County in which the bridge resides is entered in this field, right justified with blanks filled with zeros.

City ID: Item 4
> FIPS Place Code. This number is placed by the city name in this program. Cities, towns, townships, villages, and other census-designated places are identified by entering their Federal Information Processing Standards (FIPS) code. The number is right justified in this five-digit field with blanks filled with zeros.

U.S. Congressional District: Item 206
> Enter the 2-digit number (right justified) to indicate the U.S. Congressional District in which the bridge is located. If the bridge crosses a boundary between two congressional districts, record the number of the district to the south or to the west of the bridge.

Alabama Senate District: Item 207
> Enter the 2-digit number (right justified) to indicate the Alabama Senate District in which the bridge is located. If the bridge crosses a boundary between two

districts, record the number of the district to the south or to the west of the structure. Valid codes for this item are 01 through 35.

Alabama House District: Item 208

Enter the 3-digit number (right justified) to indicate the Alabama House of Representatives District in which the bridge is located. If the bridge crosses a boundary between two districts, record the number of the district to the south or to the west of the structure. Valid codes for this item are 001 through 105.

Local Identifier: Item 201

This is a 4-digit field available to local government agencies to develop their own structure numbering/identification schemes.

Full Item Listing from BI-6 report:
Screen 1A

Item 200: Operational Statue
1-digit code describing the operational status of the structure. Valid codes are:
      P – Structure not yet in service   I – Structure not in service
      O – Structure currently in service

Item 201: Local Identifier
4-digit field available to local government agencies to develop their own structure numbering/identification schemes.

Item 5A: Record Type
There are two distinct types of records in the SI&A file. The first of these is for "on" records, and the second is for "under" records. The first subfield in the inventory route is a single digit reserved to distinguish between "on" and "under" records.

Code	Description
1	Route carried "on" the structure
2	Single route goes "under" the structure
A-Z	Multiple routes go "under" the structure

    A signifies the first of multiple routes "under" the structure
    B signifies the second of multiple routes "under" the structure
    Z signifies the twenty sixth of multiple routes "under" the structure

Item 5B: Route Prefix

Code	Description
1	Interstate highway
2	U.S. numbered highway
3	State highway
4	County highway
5	City street
6	Federal lands road
7	State lands road
8	Other (toll roads not otherwise indicated/identified above)
9	

Item 5C: Level of Service

Code	Description
0	None of the below
1	Mainline
2	Alternate
3	Bypass
4	Spur
6	Business
7	Ramp, Connector, etc.
8	Service and/or unclassified frontage road

Full Item Listing from BI-6 report Screen 1A (continued):

Item 5D: FHWA Route ID
> Code the inventory route number in the next 5 positions, right justified in the field with leading zeros filled in. The route number in this subfield must agree with the route signing prefix coded in subfield 5B.

Item 5E: FHWA Direction Code
> 1 digit field for the directional suffix of the inventory route number, when it is part of the route number.
> | Code | Description |
> |---|---|
> | 0 | Not applicable |
> | 1 | North |
> | 2 | East |
> | 3 | South |
> | 4 | West |
> | 5 | |

Item 2: ALDOT Division
> 2 digit field corresponding to one of the nine ALDOT field divisions. Valid codes for this item are 01 through 09. If a bridge is located at the boundary between divisions, it is identified as being in (and assigned to) the county or division to the west or south of the boundary. As a general rule, even numbered routes are understood to run from west to east and odd numbered routes are understood to run from south to north.

Item 202: ALDOT District
> 2-digit field indicating the district in which the bridge is located.

Item 203: MPO Code
> 2-digit field indicating if a bridge is located in a MPO (Metropolitan Planning Organization) jurisdiction. Valid codes are 00 through 12.
> | Code | Area |
> |---|---|
> | 00 | Not within any MPO jurisdiction |
> | 01 | Auburn-Opelika Area |
> | 02 | Birmingham Area |
> | 03 | Calhoun Area |
> | 04 | Columbus-Phoenix City Area |
> | 05 | Decatur Area |
> | 06 | Dothan Area |
> | 07 | Etowah Area |
> | 08 | Huntsville Area |
> | 09 | Mobile Area |
> | 10 | Montgomery Area |
> | 11 | Shoals Area |
> | 12 | Tuscaloosa Area |

Full Item Listing from BI-6 report Screen 1A (continued):

Item 204: Numeric County Code
    The county in which the bridge resides is entered in this 2-digit field, right justified with blanks filled with zeros.

Item 4: City Place Code
    FIPS Place Code. This number is placed by the city name in this program. Cities, towns, townships, villages, and other census-designated places are identified by entering their Federal Information Processing Standards (FIPS) code. The number is right justified in this five-digit field with blanks filled with zeros.

Item 6A: Features Intersected
    24 digit number

Item 6B: Critical Facility Indicator
    1 digit number

Item 7: Facility Carried
    The facility being carried by the structure is recorded and coded. In all situations, this item describes the use "on" the structure, even when item 5A indicates an "under" record.

Item 9: Location
    25-digit descriptive narrative indicating where the bridge is located.

Item 205: Relative Position Indicator
    2-digit used to indicate a structure's relative position to other structures which may overlap any particular kilometer point on the inventory route.

Item 11: Kilometer Point

Item 13: LRS Inventory Route
    12-digit field used to record the LSR inventory route number and the sub-route number.

Item 16: Latitude
    For bridges on STRAHNET and STRAHNET connect highways and on the NHS, record and code the latitude of each bridge in degrees, minutes, and seconds to the nearest hundred thousandth of a second.

Full Item Listing from BI-6 report Screen 1A (continued):

Item 17: Longitude
  For bridges on STRAHNET and STRAHNET connector highways and on
  the NHS, record and code the longitude of each structure in degrees,
  minutes, and seconds

Item 27: Year Built
  4 digits of the year (ex 1999)

Item 106: Year Reconstructed
  4 digit of the year (ex 1999)

Item 294A: Bridge Name

Item 294B: Bridge Name Assigned By

Full Item Listing from BI-6 report (continued):

Screen 1B

Item 206: Congressional District
Item 207: Senate District
Item 208: House District
Item 209A: Contract Drawings Available
Item 209B: Contract Drawings Location
Item 210: CPMS Reference Number
Item 292: Old Project Number
Item 211A: Microfilm Plans Available
Item 211B: Microfilm Plans Location
Item 212A: Shop Drawings Available
Item 212B: Shop Drawings Location
Item 213A: CAD Files Available
Item 213B: CAD Files Location
Item 214: Adjacent Mainline Bin
Item 215: Previous Structure Bin
Item 98A: Border State Code
Item 98B: Border State Perc. Resp.
Item 99: Border State Str. Num.
Item 216: General Narrative Info Ind

Screen 2

Item 112: NBIS Bridge Length
Item 104: National Highway System
Item 12: Base Highway Network Indicator
Item 105: Federal Lands Highways
Item 26: Functional Classification Code
Item 100: Strahnet Highway Designation
Item 101: Parallel Str. Designation
Item 102: Direction of Traffic
Item 103: Temporary Structure Designation
Item 110: National Truck Network
Item 20: Toll Status
Item 21: Maintenance Responsibility
Item 293: Inspection Responsibility Code
Item 22: Owner
Item 37: Historical Significance

Full Item Listing from BI-6 report (continued):
Screen 3

       Item 42A: Type of Service On Structure
       Item 42B: Type of Service Under Structure
       Item 28A: Lanes On Structure
       Item 28B: Lanes Under Structure
       Item 29: Average Annual Daily Traffic
       Item 109: Average Daily Truck Traffic
       Item 30: Year of AADT
       Item 19: Detour Length
       Item 38: Navigation Control
       Item 111: Pier Protection
       Item 39: Navigation Vertical Clear.
       Item 116: Vertical Lift Bridge Vertical. Clear
       Item 40: Navigation Horizontal Clear

Screen 4
       Item 90: Routine Inspection Date
       Item 217: Interim Inspection Date
       Item 91: Inspection Frequency
       Item 92A: Critical Feature Insp. Required/Rate
       Item 92B: Under Water Insp. Required/Rate
       Item 92C: Special Inspection Required/Rate
       Item 93A: Critical Feature Insp. Date
       Item 93B: Under Water Inspection Date
       Item 93C: Special Inspection Date
       Item 218: Under Water Inspection Hours
       Item 219A: Snooper Inspection Required
       Item 219B: Snooper Inspection Frequency
       Item 220: Snooper Inspection Date
       Item 221: Snooper Inspection Hours
       Item 222: Special Equipment Used
       Item 223: Last Inspection Hours
       Item 224A: Scour Monitoring Required
       Item 224B: Scour Monitoring Frequency
       Item 224C: Scour Monitoring Indicator
       Item 224D: Scour Monitoring Freq. Date
       Item 225A: Counter Measures Required
       Item 225B: Counter Measures Date
       Item 225C: Counter Measures Completed Date

Full Item Listing from BI-6 report (continued):
Screen 5A

        Item 49: Structure Length
        Item 48: Maximum Span Length
        Item 226A: Superstructure Steel Length
        Item 226B: Superstructure Concrete Length
        Item 226C: Superstructure Timber Length
        Item 50A: Left Curb/Sidewalk Width
        Item 50B: Right Curb/Sidewalk Width
        Item 32: Approach Roadway Width
        Item 227: Approach Travel Way Width
        Item 51: Bridge Roadway Width
        Item 52: Deck Width
        Item 228: Deck Thickness
        Item 229: Overlay Thickness
        Item 33: Bridge Median
        Item 34: Skew

Screen 5B

        Item 35: Structure Flared
        Item 10: Minimum Vertical Clearance
        Item 47: Horizontal Clearance
        Item 53: Minimum Vertical Clearance
        Item 54A: Vertical Under Clearance Ref.
        Item 54B: Vertical Under Clearance
        Item 230: Vertical Clearance Signing
        Item 231: Vertical Clearance Sign Legend
        Item 55A: Lateral Under Clearance Ref.
        Item 55B: Right Lateral Under Clearance
        Item 56: Left Lateral Under Clearance
        Item 232: Horizontal/Vertical Curve
        Item 233A: Number of Barrels
        Item 233B: Barrel Length
        Item 233C: Barrel Span
        Item 233D: Barrel Height
        Item 233E: Depth of Fill

Full Item Listing from BI-6 report (continued):

Screen 6A

        Item 43A: Main Span Kind
        Item 43B: Main Span Type
        Item 45: Number of Main Spans
        Item 44A: Approach Span Kind
        Item 44B: Approach Span Type
        Item 46: Number of Approach Spans
        Item 234: Approach Road/Slab Type
        Item 107: Deck Structure Type
        Item 108A: Wearing Surface Type
        Item 108B: Membrane Type
        Item 108C: Deck Protection
        Item 235A: Expansion Joint Type
        Item 235B: Expansion Joint Filler/Seal
        Item 235C: Expansion Joint Movement
        Item 236: Bearing Types
        Item 237: Culvert Type

Screen 6B

        Item 238: Field Splice Type
        Item 239A: Bridge Rail Type
        Item 239B: Transition Rail Type
        Item 239C: Approach Rail Type
        Item 239D: End Treatment Rail Type
        Item 240A: Fracture Critical Group Type
        Item 240B: Fracture Critical Support
        Item 241A: Fracture Critical Span Type
        Item 241B: Fracture Critical Span Number
        Item 242: Fracture Critical Member
        Item 243: Fracture Critical Detail

Full Item Listing from BI-6 report (continued):

Screen 7

      Item 244A: Beg. Abut Type
      Item 244B: Beg. Abut Cap Material Type
      Item 244C: Beg. Abut Cap Structure Type
      Item 244D: Beg. Abut Foundation Type
      Item 245A: End Abut Type
      Item 245B: End Abut Cap Material Type
      Item 245C: End Abut Cap Structure Type
      Item 245D: End Abut Foundation Type
      Item 246A: Main Pier Material Primary/Secondary
      Item 246B: Main Pier Type Primary/Secondary
      Item 246C: Main Pier Cap Material Primary/Secondary
      Item 246D: Main Pier Cap Structure Primary/Secondary
      Item 246E: Main Pier Foundation Primary/Secondary
      Item 247A: Appr Pier Material Primary/Secondary
      Item 247B: Appr Pier Type Primary/Secondary
      Item 247C: Appr Pier Cap Material Primary/Secondary
      Item 247D: Appr Pier Cap Structure Primary/Secondary
      Item 247E: Appr Pier Foundation Primary/Secondary

Screen 8A

      Item 248: Special Information Indicator
      Item 64: Operating Rating
      Item 66: Inventory Rating
      Item 63: Operating Rating Method
      Item 65: Inventory Rating Method
      Item 249: Rating Specification Used
      Item 250A: Major Rating Analysis Done
      Item 250B: Minor Rating Analysis Done
      Item 251: Rating Agency
      Item 252: Rating Date
      Item 253A: Rating Published
      Item 253B: Primary Rating Status
      Item 253C: Secondary Rating Status
      Item 254A: Load Limit - M Vehicle
      Item 254B: Load Limit - 2 Axle
      Item 254C: Load Limit - 3 Axle
      Item 254D: Load Limit - Concrete Truck
      Item 254E: Load Limit - 18 Wheeler
      Item 254F: Load Limit - School Bus
      Item 254G: Load Limit - 6 Axle
      Item 31: Design Load
      Item 255: Design Method
      Item 256: Year of AASHTO Specifications

Full Item Listing from BI-6 report (continued):
Screen 8B

Item 41: Posting Status
Item 70: Posting Level
Item 257A: Members Controlling Posting
Item 257B: Damage Members
Item 258A: Last Posting Change Reason
Item 258B: Last Posting Change Date
Item 259: Posting Chart Indicator
Item 260A: Posting Signs Present
Item 260B: Posting Signs Visible
Item 260C: Posting Signs Legible
Item 261: Temporary Strengthening Date
Item 262A: Temporary Strengthened Element
Item 262B: Type of Temporary Strengthening
Item 263A: Controlling Member Type
Item 263B: Controlling Member Fatigue Rel
Item 264A: EBIT Recommendation Member Type
Item 264B: EBIT Recommended Action
Item 265A: Main Span Standard Draw Name
Item 265B: Main Span Rating Screen Flag
Item 266A: Appr Span Standard Draw Name
Item 266B: Appr Span Rating Screen Flag

Screen 9

Item 267: Last Date Painted
Item 268: Paintable Surface Area
Item 269: Paint Color
Item 270: Type Cleaning
Item 271A: Paint Primer Coat
Item 271B: Paint Intermediate Coat
Item 271C: Paint Finish Coat
Item 271D: Paint Undercoat
Item 272A: Primer Coat Thickness
Item 272B: Intermediate Coat Thickness
Item 272C: Finish Coat Thickness
Item 272D: Undercoat Thickness
Item 273: Paint Extent
Item 274: Undercoat Thickness

Full Item Listing from BI-6 report (continued):

Screen 10

       Item 58: Deck Condition
       Item 59: Superstructure Condition
       Item 60: Substructure Condition
       Item 61: Channel Condition
       Item 62: Culvert Condition
       Item 275: Approach Roadway Condition
       Item 276: Total Paint Condition
       Item 277: Air Temperature
       Item 278: Expansion Joint Opening
       Item 279: Horizontal Misalignment at Joint
       Item 280: Vertical Misalignment at Joint

Screen 11

       Item 67: Structural Evaluation
       Item 68: Deck Evaluation
       Item 69: Under Clearance Evaluation
       Item 71: Waterway Evaluation
       Item 72: Approach Roadway Evaluation
       Item 36A: Bridge Rail Indicator
       Item 36B: Transitions Indicator
       Item 36C: Approach Rail Indicator
       Item 36D: Approach Rail End Indicator
       Item 113A: Scour Critical Evaluation
       Item 113B: Scour Calculation Code

Screen 12

       Item 281: HBRRP Eligibility Status
       Item 282: Special Consideration Flag
       Item 283: Special Condition Deficiency Points
       Item 284: Load Deficiency Points
       Item 285: Width Deficiency Points
       Item 286: Vertical Clearance Deficiency Points
       Item 287: Condition Deficiency Points
       Item 288: Total Deficiency Points
       Item 289A: Local Deficiency Rank
       Item 289B: Statewide Deficiency Rank
       Item N/A: Sufficiency Rating
       Item N/A: Functional Status

Full Item Listing from BI-6 report (continued):

Screen 13
> Item 75A: Type of Work Proposed
> Item 75B: Work Done By
> Item 76: Improvement Length
> Item 94: Improvement Cost
> Item 95: Roadway Improvement Cost
> Item 290: Incidental Cost
> Item 96: Total Improvement Cost
> Item 97: Year of Improvement Cost
> Item 114: Future AADT
> Item 115: Year of Future AADT
> Item 291A: State and Non-State Cost/S.Q.M. of Deck Area
> Item 291B: Culvert Cost/S.Q.M. of Top Slab
> Item 291C: Approach Cost Factor Percent
> Item 291D: Total Project Cost Factor Percent

Acknowledgements