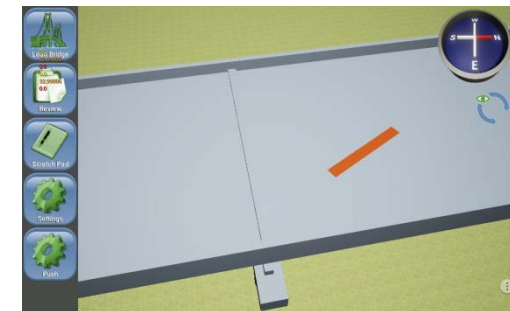


3D BRIDGE app overview: Enabling the Future of Bridge Inspection Data Collection

MDOT #2013-0067, Auth. No. 2

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The Problem

- Faced with an aging bridge inventory and increasing federal requirements for collecting element level data, MDOT wished to increase the efficiency and reliability of collected data.



The Problem

- Current bridge inspection practices at the Michigan Department of Transportation (MDOT) utilize paper forms followed by a manual data entry step to populate their database.



The Problem

- Additionally, photographs documenting bridge deterioration are collected and stored separately from inspection data.



The Problem

- MDOT inspectors also carry reference manuals and past inspection reports to help verify the accuracy of the data they are collecting.





The Problem

- The exact locations of bridge defects are not stored which creates an inconvenience as the data are difficult to visualize, to tabulates overall defect quantities, & to duplicate inspections.
- Federal rules require inspectors to collect AASHTO Element level data. Current processes don't enable the efficient collection of this data, especially for recording location-specific information.

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 2304	SAFETY INSPECTION REPORT - CORE ELEMENTS				B02-23092			
Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition					
M-99 NB	42.630728 / -84.622691	2312309200B020	Fair Condition(6)					
Feature	Length / Width	Owner						
GRAND RIVER	180 / 45.9	Region: University(6)						
Location	Built / Recon. / Paint / Ovly.	TSC	Operational Status					
0.5 MI S OF HOLT RD	1978 / / 2008 / 2008	Lansing(6A)	A Open, no restriction(A)					
Region / County	Material / Design	Last NBI Inspection	Scour Evaluation					
University(6) / Eaton(23)	3 Steel / 02 Stringer/Girder	05/07/2013 / BDYT	3 SC - Unstable					

NBI INSPECTION				BDYT				
Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date					
Janiene DeVinney	MDOT INSPECTOR	24	05/07/2013					

CORE ELEMENTS				(English Units)				
Element Number	Element Name	Total Quantity	Unit	State 1	State 2	State 3	State 4	State 5
Decks/Slabs								
18/ 3	Conc Dk Thn Epoxy Ov	8267	(SF)	8267 100%	0 0%	0 0%	0 0%	0 0%
Joints								
400/ 3	Strip Seal Exp Joint	92	(LF)	92 100%	0 0%	0 0%	xxxxx xxxxx	xxxxx xxxxx
401/ 3	Pourable Joint Seal	92	(LF)	0 0%	92 100%	0 0%	xxxxx xxxxx	xxxxx xxxxx
Superstructure								
107/ 3	Printed Stl Girder /Bm	1079	(LF)	1074 100%	5 0%	0 0%	0 0%	0 0%
161/ 3	Paint Stl Pin/Hanger	12	(EA)	12 100%	0 0%	0 0%	0 0%	0 0%
331/ 3	Concrete Bridge Rail	361	(LF)	269 75%	92 25%	0 0%	0 0%	xxxxx xxxxx
Bearings								
311/ 3	Movable Bearing	12	(EA)	12 100%	0 0%	0 0%	xxxxx xxxxx	xxxxx xxxxx
313/ 3	Fixed Bearing	12	(EA)	12 100%	0 0%	0 0%	xxxxx xxxxx	xxxxx xxxxx
Substructure								
205/ 3	Reinf Conc Column	6	(EA)	4 67%	2 33%	0 0%	0 0%	xxxxx xxxxx
215/ 3	Reinf Conc Abut	105	(LF)	80 76%	25 24%	0 0%	0 0%	xxxxx xxxxx
234/ 3	Reinf Conc Pier Cap	105	(LF)	92 88%	13 12%	0 0%	0 0%	xxxxx xxxxx
Other Elements								
321/ 3	Reinf Conc Appr Slab	2	(EA)	2 100%	0 0%	0 0%	0 0%	xxxxx xxxxx

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Objectives of MDOT Wireless Bridge Inspection Study

- The goal is to help MDOT take advantage of the advances in portable data entry technologies, reduce the time needed for field staff to collect bridge inspection data and thereby help have a safer bridge inspection program, and help provide a compatible path forward to a more efficient bridge inspection process that is available to all appropriate levels of MDOT.



Objectives of MDOT Wireless Study

- Develop a wireless web/tables based bridge inspection data collection system. This system would:
 - Use 3D models to help collect data.
 - Integrate with MDOT Michigan Bridge Reporting System and other current MDOT bridge inspection processes.



MDOT's requested solution



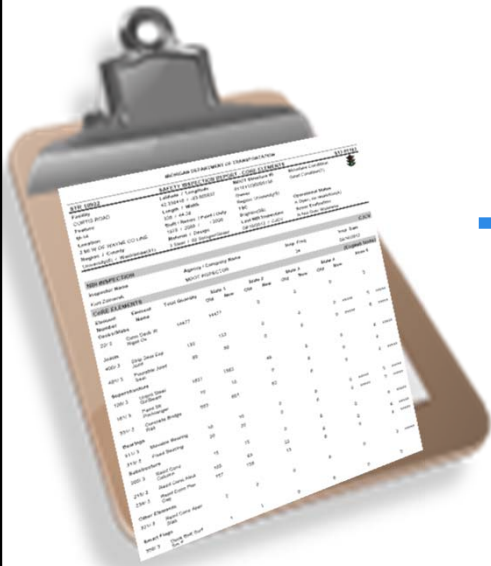
- A **tablet** application for MDOT Bridge Inspectors for the collection, display, and summarizing of bridge inspection data.

The 3D B^{BRIDGE}E app

- The 3D B^{BRIDGE}E app helps MDOT take advantage of the advances in portable data entry technologies, reduce the need for field staff time to collect bridge inspection, and facilitate the bridge inspection process



How will this tool work from the Bridge Inspector's point of view?



Defect	Condition State		Com
	Condition State 1	Condition State 2	
Spalls/ Delamination/ Patch Area (1.205)	None	Delaminated, Spall 1 in. or less deep or less than 6 in. diameter. Patched area is sound.	Spall greater than 1 in. deep or less than 6 in. diameter unpatched or also not warrant due
Exposed Rebar (1.205)	None	Present without section loss.	Present with section loss
Reference (1.205)	None	Surface white without buildup or staining	Recessed
Cracking - Randomized Concrete and Other (1.135)	Widths less than 0.012 in. or spacing greater than 3.0 ft.	Widths 0.012-0.05 in. or spacing of 1.0-3.0 ft.	Width greater than 0.05 in. or spacing of less than 1 ft.
ASR - Randomized Concrete and Other (1.135)	Widths less than 0.012 in. or spacing greater than 3.0 ft.	Widths 0.012-0.05 in. or spacing of 1.0-3.0 ft.	Width greater than 0.05 in. or spacing of less than 1 ft.
Distortion - Column (1.005)	None	Distortion not requiring mitigation or structural distress.	Distortion that requires mitigation but does not require structural review.
Settlement - Substructure (1.005)	None	Excess within tolerable limits or arrested with effective actions taken to mitigate.	Exceeds tolerable limits but does not warrant structural review.



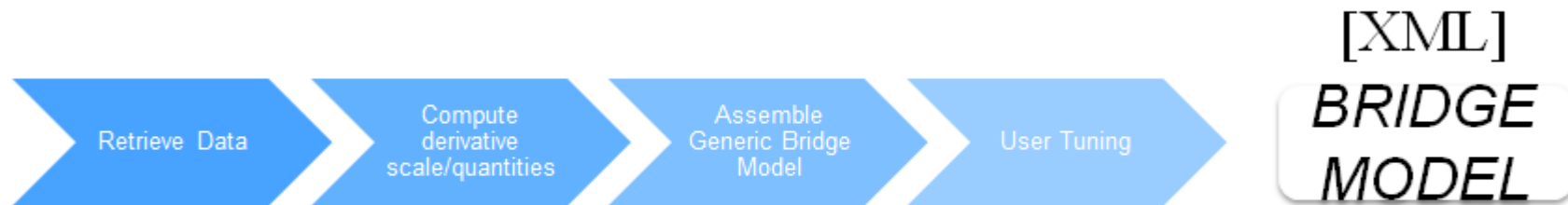
Overview videos available

Introduction to the 3D BRIDGE App
for bridge inspections

<https://www.youtube.com/watch?v=sCrxqZ57aol>

<http://www.mtri.org/3dbridge.html>

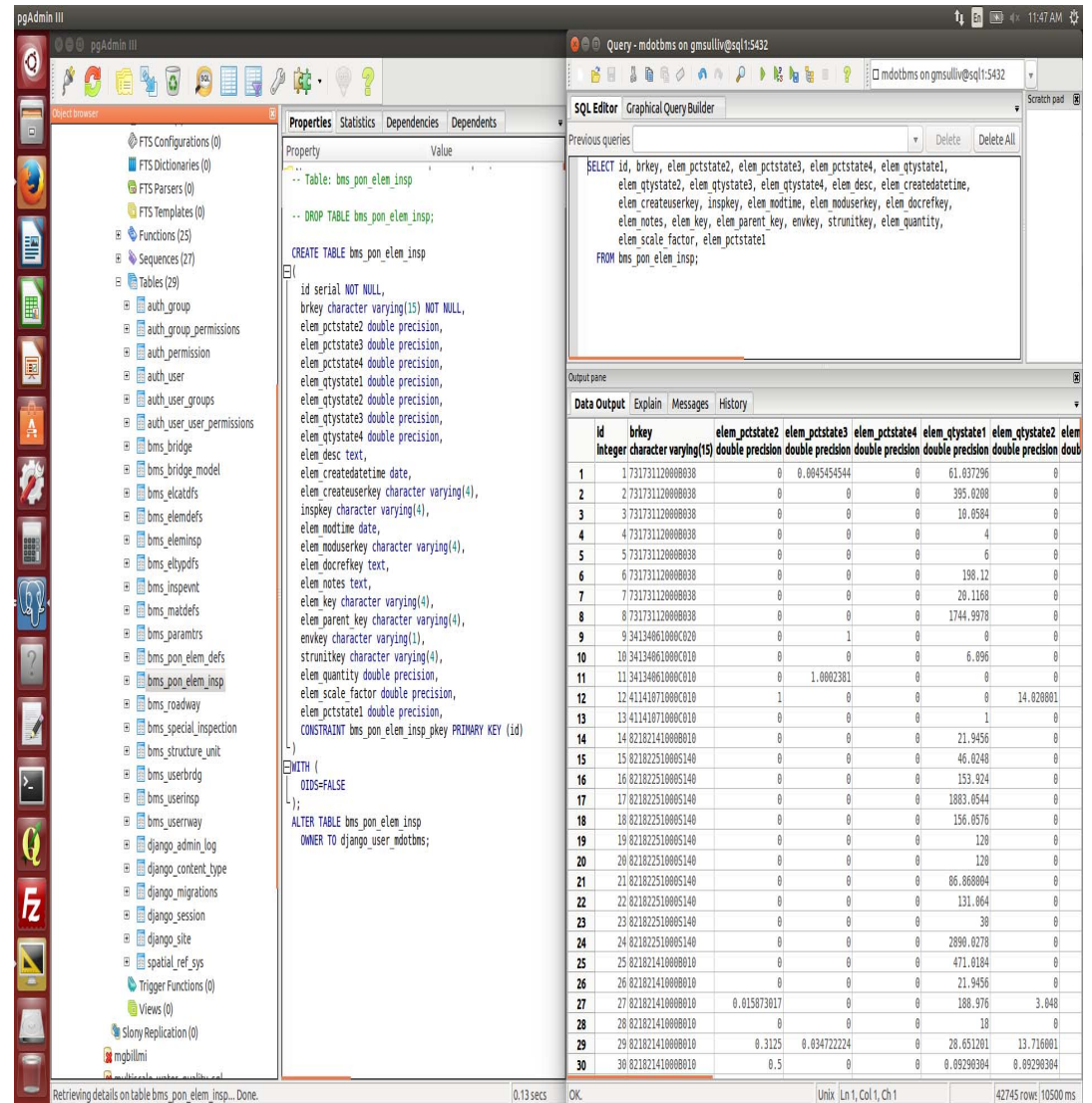
The 3D B^{RIDGE}E App Grabs Data from BMS Database



- With few 3D models of the bridges available, a model needed to be created from scratch
 - Wanted to be able to use a 3D model for a bridge needing inspection, regardless of whether one already existed
- Large amounts of descriptive information within MDOT's Bridge Management Database
 - Sufficient information to auto-generate a sufficiently representative model of most bridges needing inspection

The 3D BRIDGE App Grabs Data from BMS Database

- Queries all of the data from a static copy of MDOT's database.
- The MDOT bridge management database is composed of 16 tables.
- The 3D BRIDGE App queries from almost all of them.



The screenshot shows the pgAdmin III interface. The left pane displays a tree view of the database schema, including tables like 'bms_pon_elem_insp'. The central pane shows the SQL Editor with a query to create and populate the 'bms_pon_elem_insp' table. The right pane shows the 'Data Output' window displaying the results of the query as a table.

```

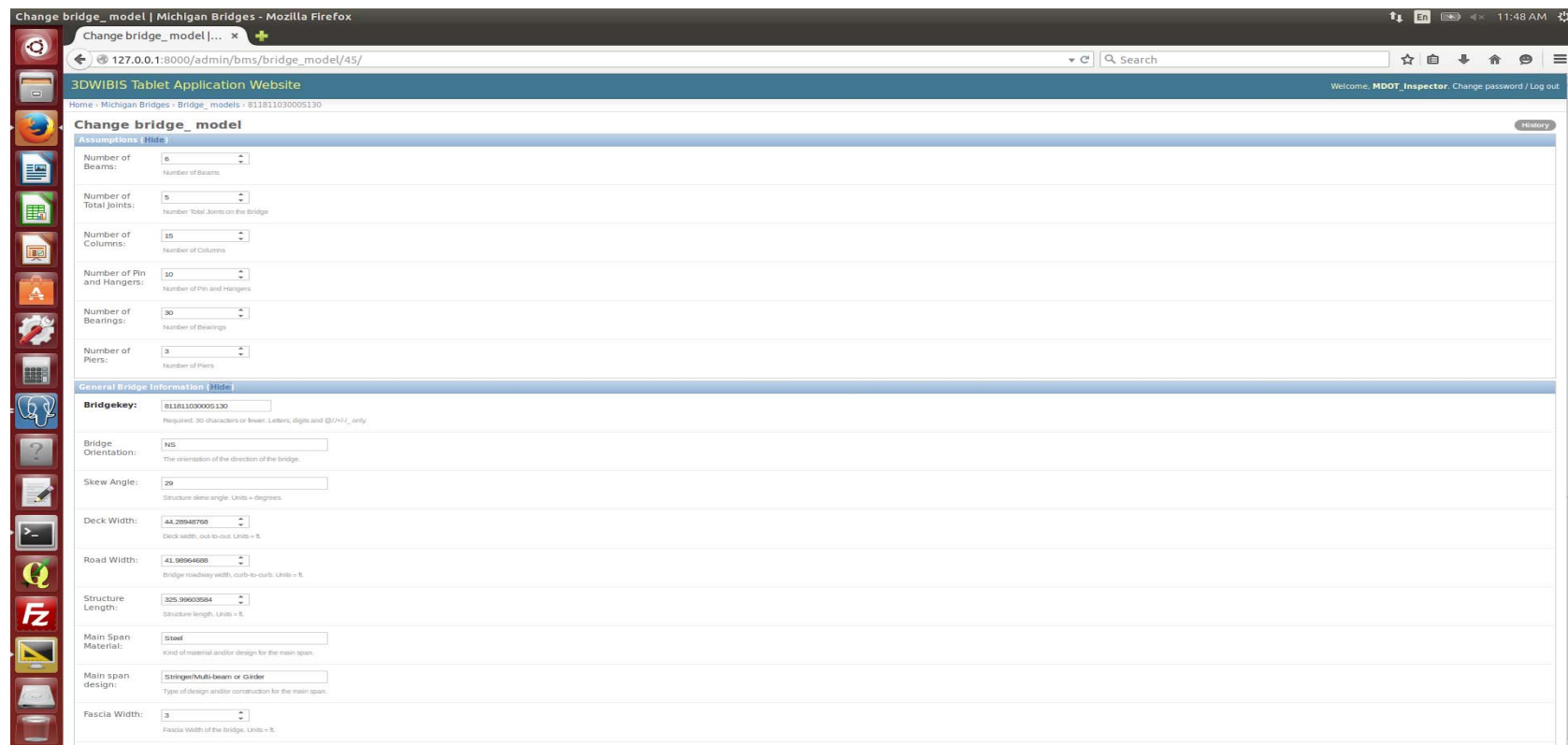
CREATE TABLE bms_pon_elem_insp
(
  id serial NOT NULL,
  brkey character varying(15) NOT NULL,
  elem_pctstate2 double precision,
  elem_pctstate3 double precision,
  elem_pctstate4 double precision,
  elem_qtystate1 double precision,
  elem_qtystate2 double precision,
  elem_qtystate3 double precision,
  elem_qtystate4 double precision,
  elem_desc text,
  elem_createdatetime date,
  elem_createuserkey character varying(4),
  elem_inspkey character varying(4),
  elem_modtime date,
  elem_moduserkey character varying(4),
  elem_dockrefkey text,
  elem_notes text,
  elem_key character varying(4),
  elem_parent_key character varying(4),
  elem_envkey character varying(1),
  elem_strunitkey character varying(4),
  elem_quantity double precision,
  elem_scale_factor double precision,
  elem_pctstate1 double precision,
  CONSTRAINT bms_pon_elem_insp_pkey PRIMARY KEY (id)
)
WITH (
  OIDS=FALSE
);
ALTER TABLE bms_pon_elem_insp
OWNER TO django_user_mdotbms;

```

id	brkey	elem_pctstate2	elem_pctstate3	elem_pctstate4	elem_qtystate1	elem_qtystate2	elem_qtystate3	elem_qtystate4
1	1731731120000038	0	0.0045454544	0	61.037296	0	0	0
2	2731731120000038	0	0	0	395.0208	0	0	0
3	3731731120000038	0	0	0	10.0584	0	0	0
4	4731731120000038	0	0	0	4	0	0	0
5	5731731120000038	0	0	0	6	0	0	0
6	6731731120000038	0	0	0	198.12	0	0	0
7	7731731120000038	0	0	0	20.1168	0	0	0
8	8731731120000038	0	0	0	1744.9978	0	0	0
9	9341340610000020	0	1	0	0	0	0	0
10	10341340610000020	0	0	0	6.096	0	0	0
11	11341340610000020	0	1.0002301	0	0	0	0	0
12	1241418710000010	1	0	0	0	14.020801	0	0
13	1341418710000010	0	0	0	1	0	0	0
14	14021821410000010	0	0	0	21.9456	0	0	0
15	15021822510005140	0	0	0	46.0248	0	0	0
16	16021822510005140	0	0	0	153.924	0	0	0
17	17021822510005140	0	0	0	1883.0544	0	0	0
18	18021822510005140	0	0	0	156.0576	0	0	0
19	19021822510005140	0	0	0	128	0	0	0
20	20021822510005140	0	0	0	128	0	0	0
21	21021822510005140	0	0	0	86.068004	0	0	0
22	22021822510005140	0	0	0	131.064	0	0	0
23	23021822510005140	0	0	0	38	0	0	0
24	24021822510005140	0	0	0	2890.0278	0	0	0
25	25021821410000010	0	0	0	471.0104	0	0	0
26	26021821410000010	0	0	0	21.9456	0	0	0
27	27021821410000010	0.015873017	0	0	188.976	3.048	0	0
28	28021821410000010	0	0	0	18	0	0	0
29	29021821410000010	0.3125	0.034722224	0	28.651201	13.716001	0	0
30	30021821410000010	0.5	0	0	0.09290304	0.09290304	0	0

User Tuning

- Created a web-based user interface for fine tuning the 3D bridge model
- Missing data are filled in with generic assumptions.
 - Ex: locations of pin & hanger assemblies
- User can alter data to fix any assumptions that were not correct



The screenshot displays a web browser window titled 'Change bridge_model | Michigan Bridges - Mozilla Firefox'. The address bar shows the URL '127.0.0.1:8000/admin/bms/bridge_model/45/'. The page content is organized into two main sections: 'Assumptions' and 'General Bridge Information'.

Assumptions Section:

- Number of Beams: 6
- Number of Total Joints: 5
- Number of Columns: 15
- Number of Pin and Hangers: 30
- Number of Bearings: 30
- Number of Piers: 3

General Bridge Information Section:

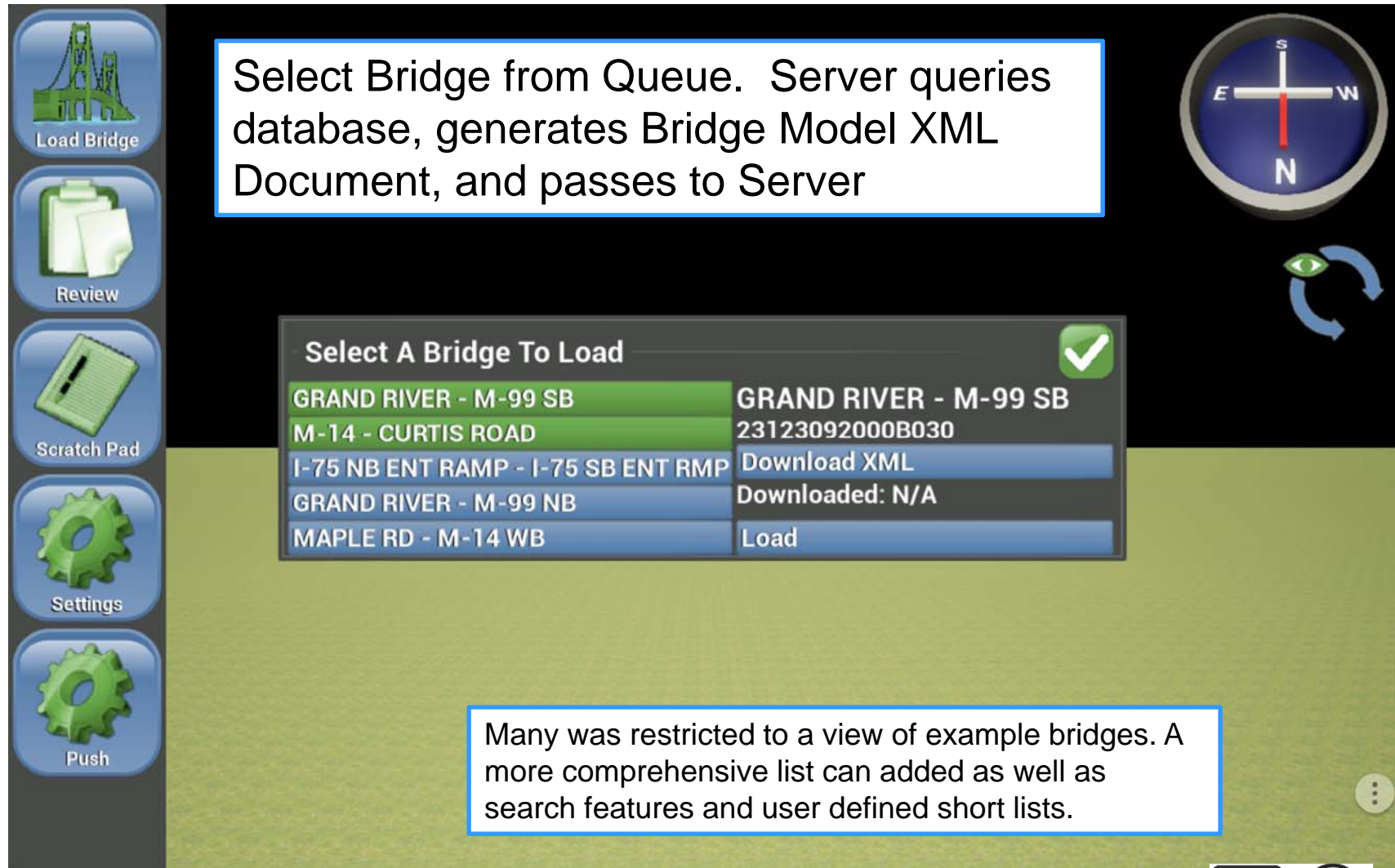
- Bridgekey: 811811000005130
- Bridge Orientation: NS
- Skew Angle: 29
- Deck Width: 44.28948768
- Road Width: 41.90964008
- Structure Length: 325.99603584
- Main Span Material: Steel
- Main span design: Stringer/Sub-beam or Girder
- Fascia Width: 3

Backend Outputs XML to Frontend

- Outputs bridge XML to create model.
 - Small file transmitted to tablet to create 3D model on the fly

```
- <Member>  
  <role>Deck</role>  
  <type>Concrete Deck - Coated Bars</type>  
  <name>2S</name>  
  <length>1451.98234368</length>  
  <width>491.47385216</width>  
  <height>15.0</height>  
  <AASHTO_Element_803>803</AASHTO_Element_803>  
  <x>1229.9850432</x>  
  <y>265.73692608</y>  
  <z>270.5133888</z>
```


Select bridge by Region / StructureID



Select Bridge from Queue. Server queries database, generates Bridge Model XML Document, and passes to Server

Select A Bridge To Load	
GRAND RIVER - M-99 SB	GRAND RIVER - M-99 SB
M-14 - CURTIS ROAD	23123092000B030
I-75 NB ENT RAMP - I-75 SB ENT RMP	Download XML
GRAND RIVER - M-99 NB	Downloaded: N/A
MAPLE RD - M-14 WB	Load

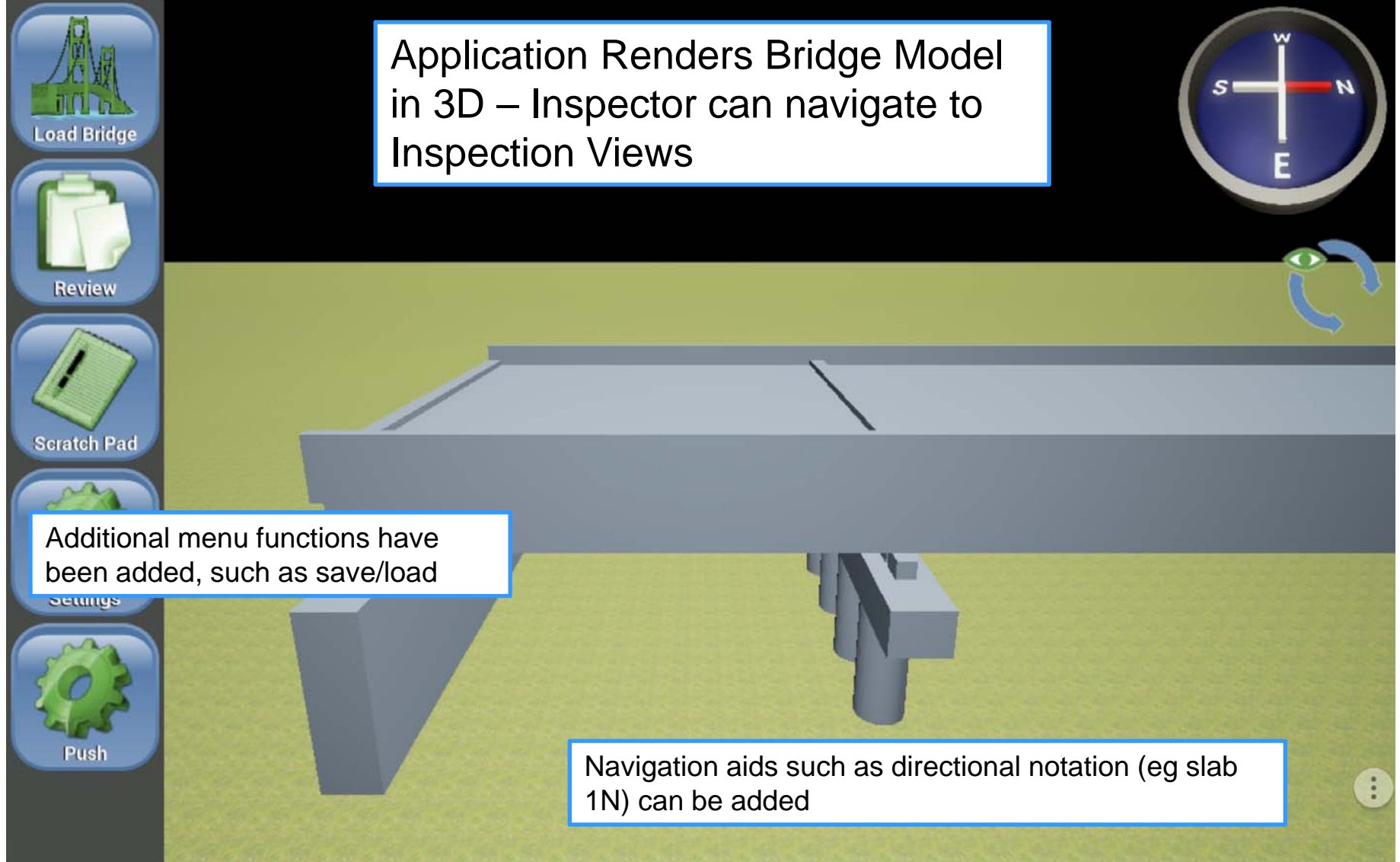
Many was restricted to a view of example bridges. A more comprehensive list can added as well as search features and user defined short lists.

3D model is auto-generated using Epic Games' Unreal Engine, also provides user interface

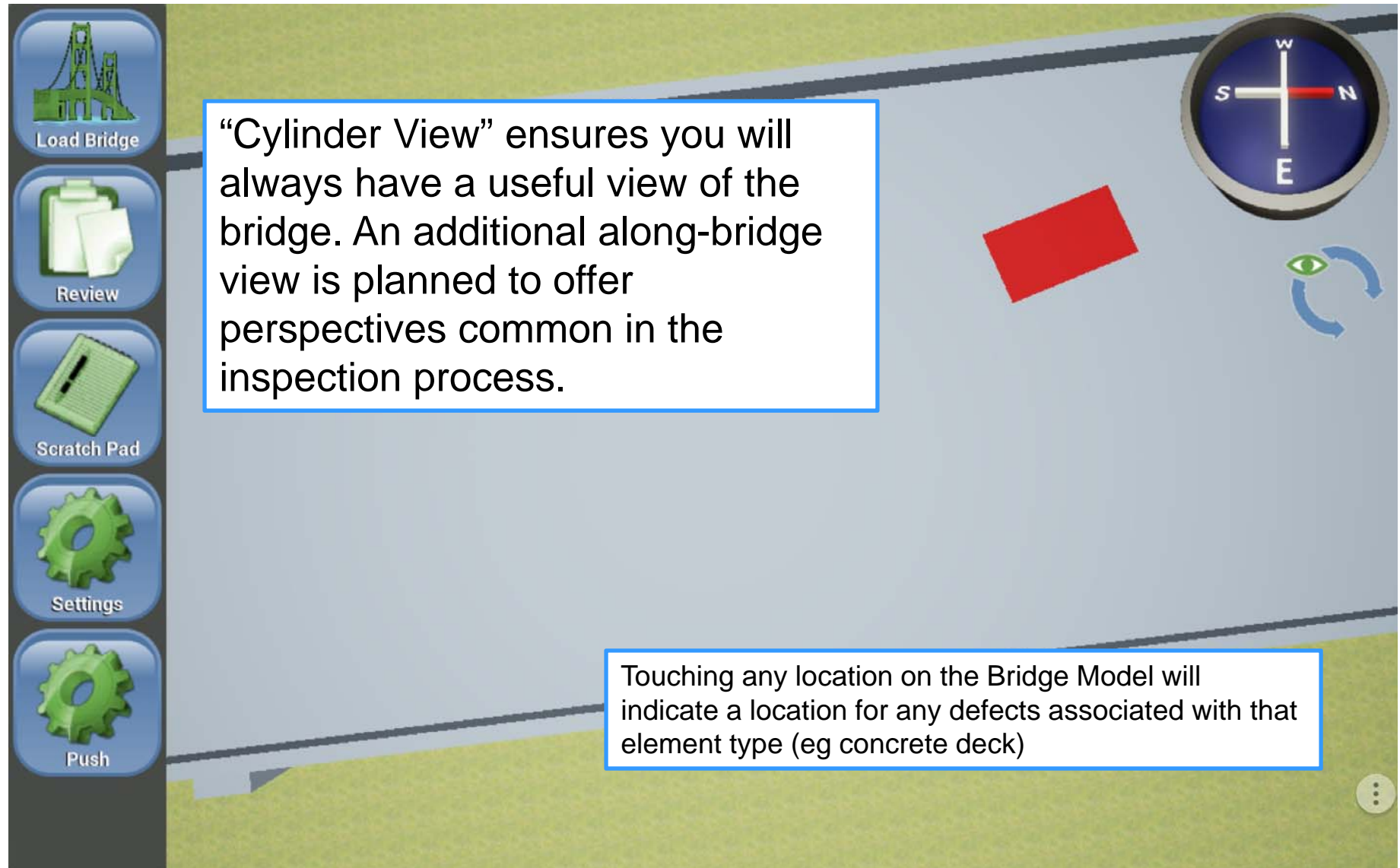


Desired bridge loads and is rendered

3D model is auto-generated using Epic Games' Unreal Engine, also provides user interface

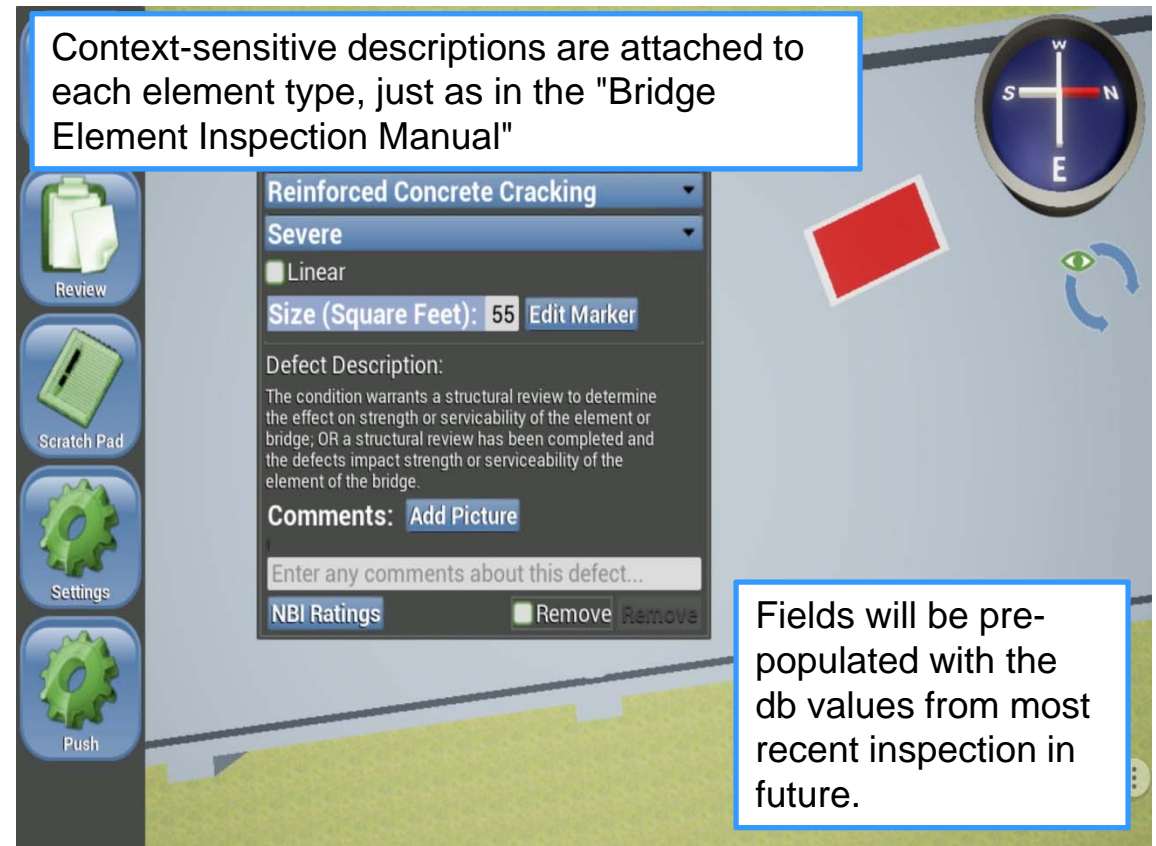


Navigation is constrained to an orbit around the bridge



3D B^{RIDGE}E App Usage

- The 3D B^{RIDGE}E App enables bridge inspectors to collect and record all of the necessary data for the bridge inspection process in one tool.
- Each individual defect can be annotated with a description, photos, and quantity.
- Inspectors no longer have to carry the Bridge Element Inspection Manual

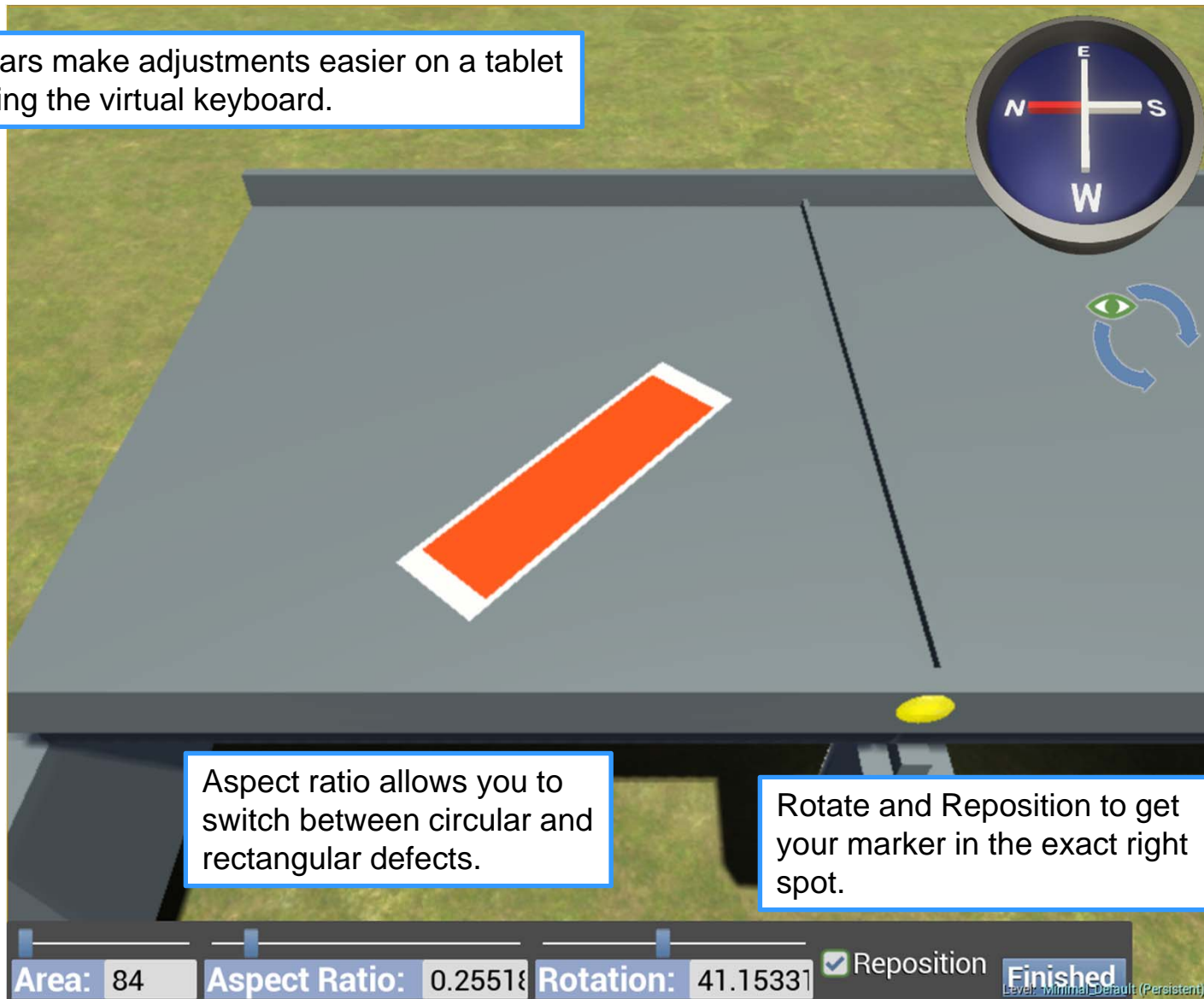


View Photos of the Desired Defect

Defects can be tagged with photos. Clicking on a photo thumbnail brings up a fullscreen view.

Customize the Defect's Size and Shape

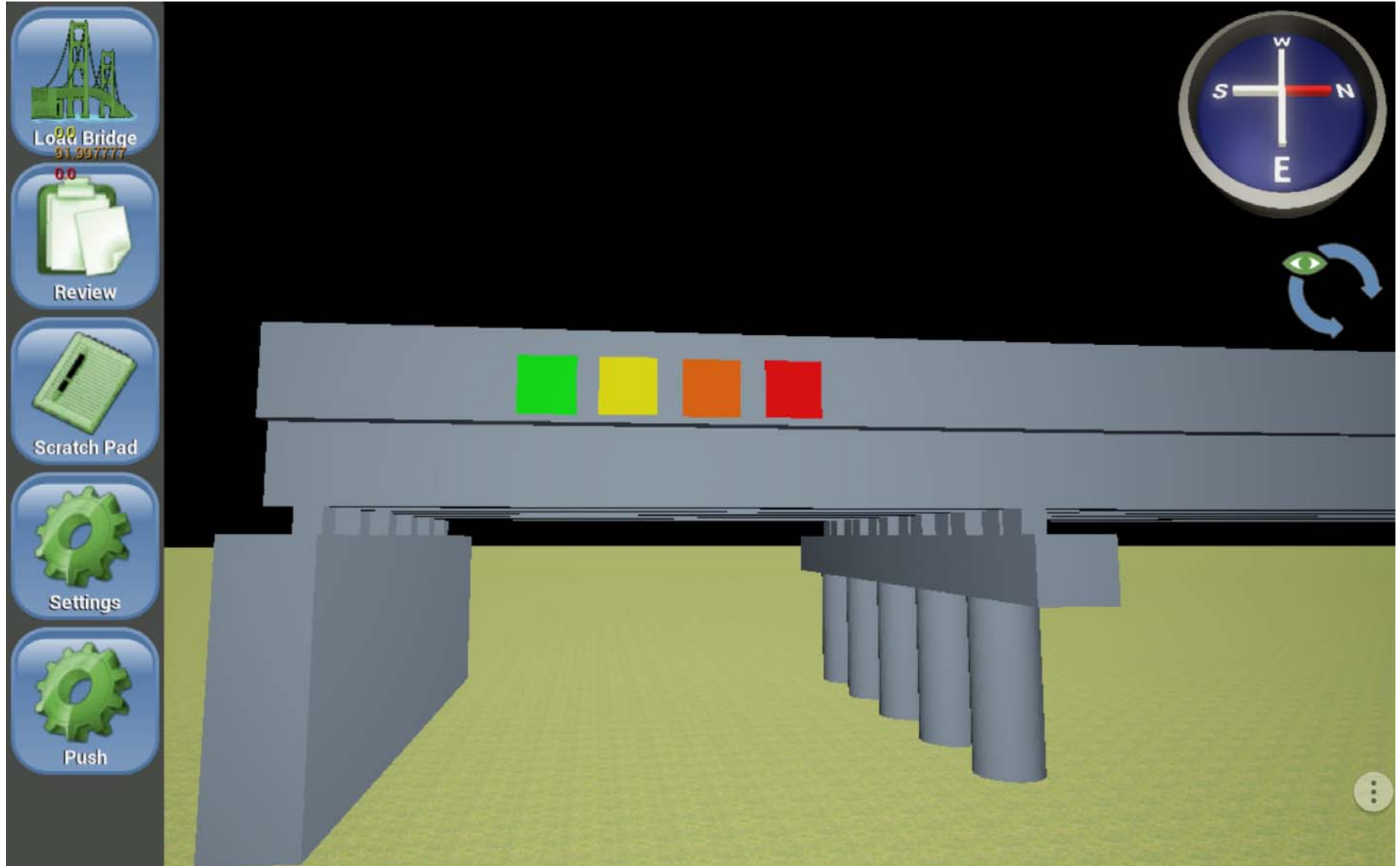
Slider bars make adjustments easier on a tablet than using the virtual keyboard.



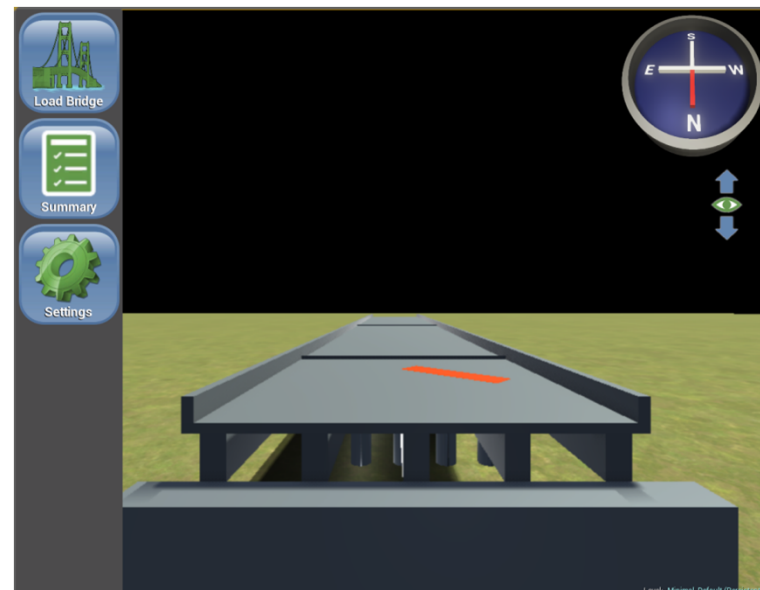
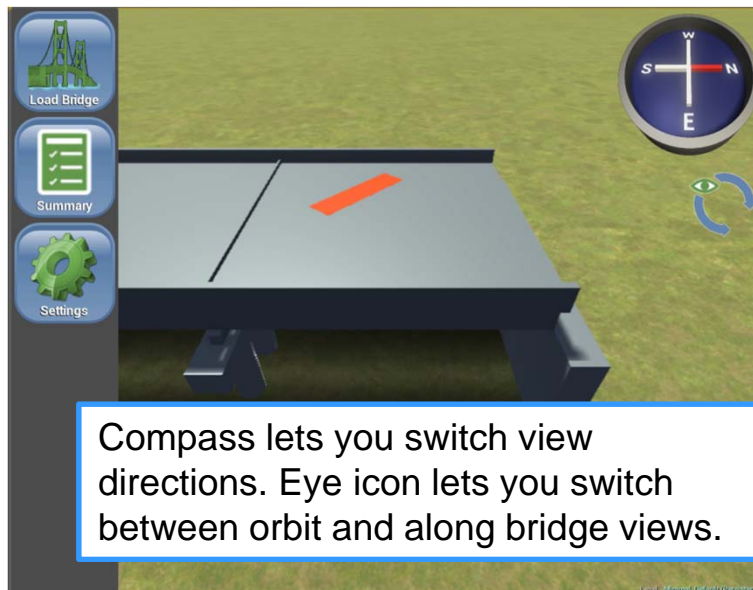
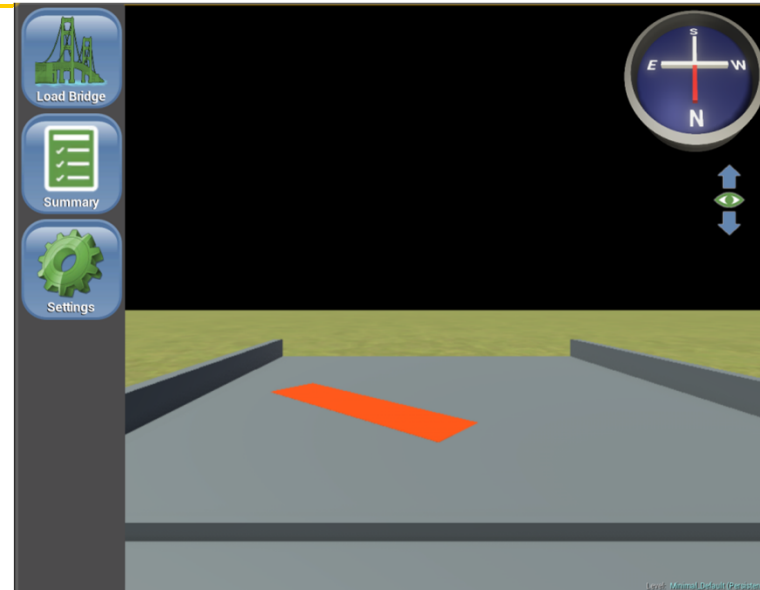
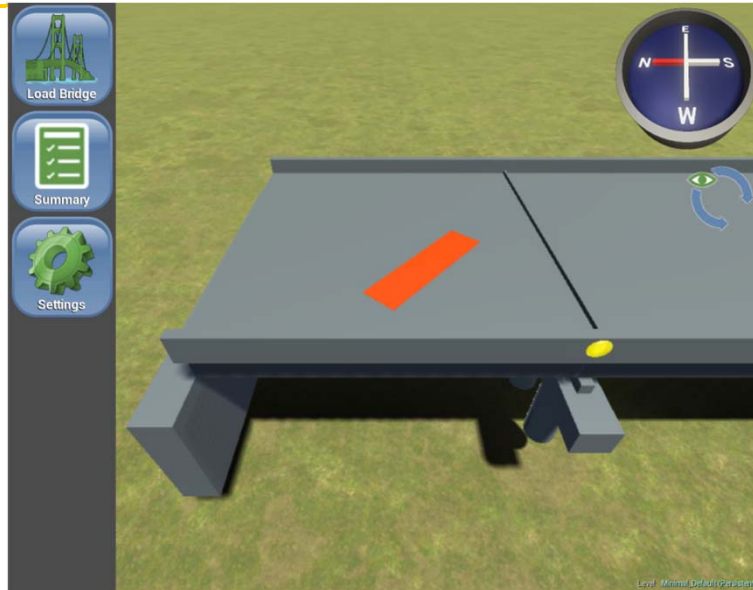
Aspect ratio allows you to switch between circular and rectangular defects.

Rotate and Reposition to get your marker in the exact right spot.

Colors indicate condition states, and relative sizes are proportional to "quantity"



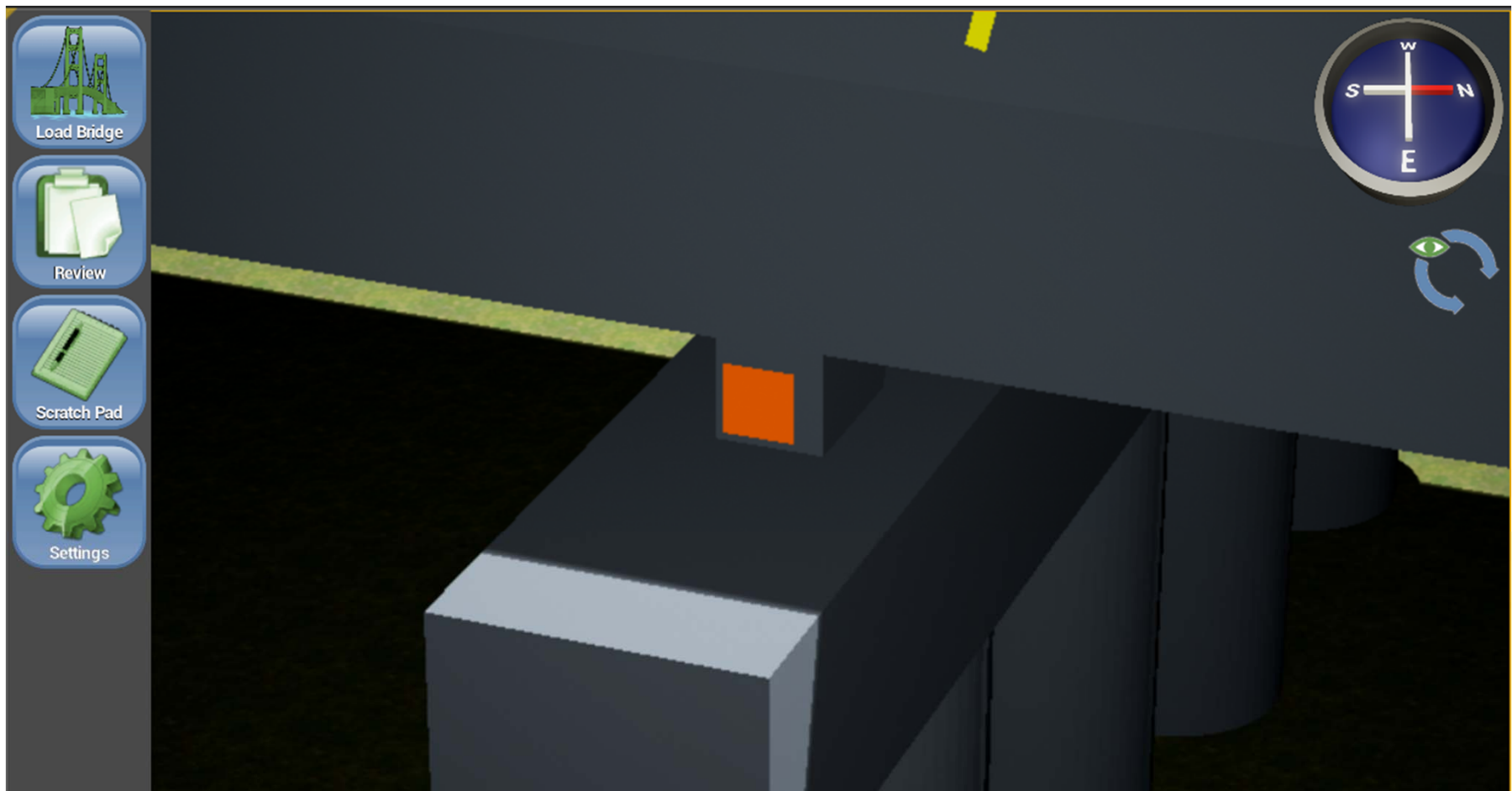
Saves the Defect's 3D Position For Future Inspections



Compass lets you switch view directions. Eye icon lets you switch between orbit and along bridge views.

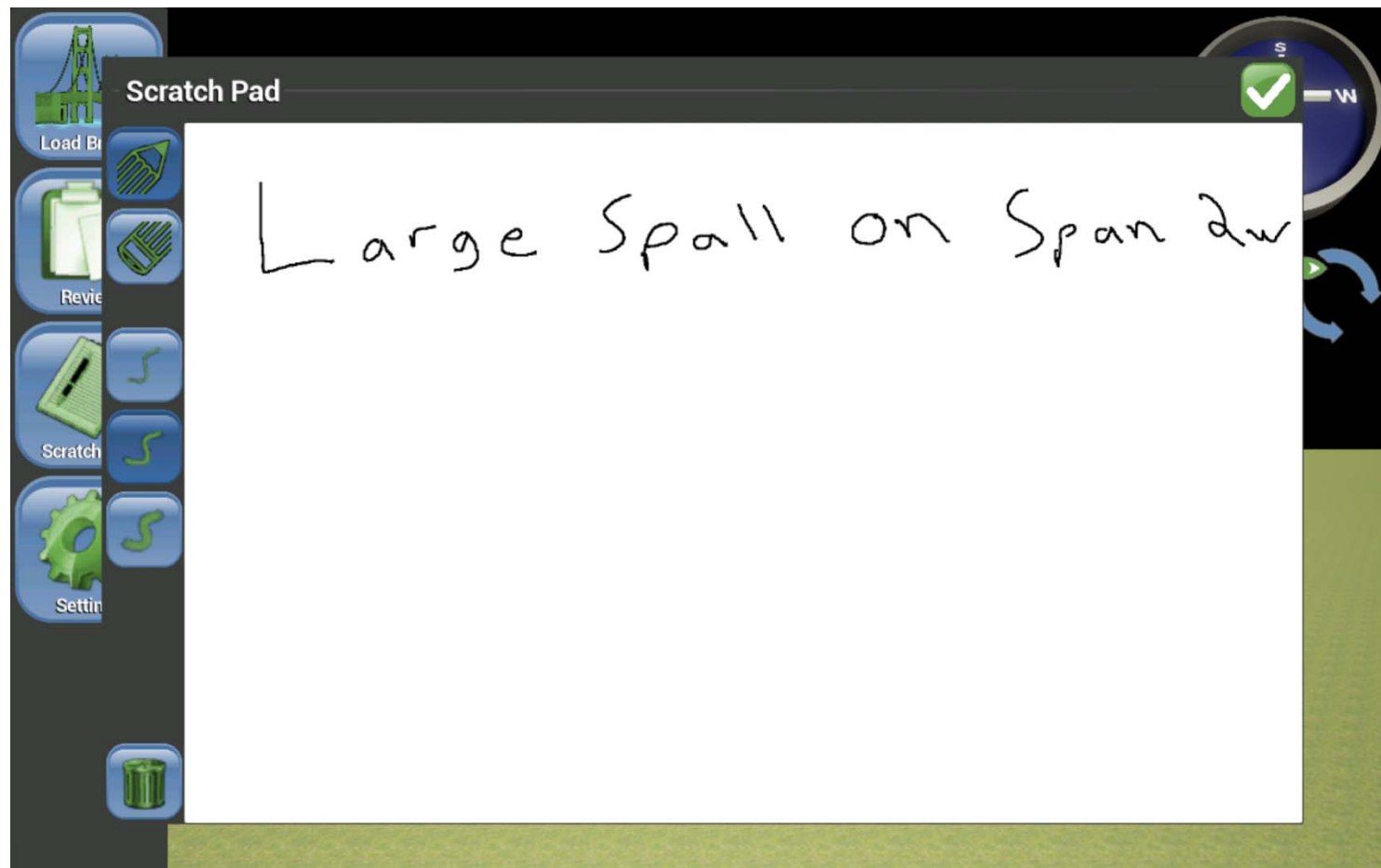
Pinch to Zoom

- Pinch to zoom in on a part of the bridge, or a defect.



Scratch Pad

- Write on the scratch pad to add any additional comments or drawings



Collect and Display NBI Information

Bridge Review ✓

Element Review
Defect Summary
NBI Report

STR 10922	BRIDGE SAFETY INSPECTION REPORT		S13-81103
Facility CURTIS ROAD	Latitude / Longitude 42.338417 / -83.605835	MDOT Structure ID 81181103000S130	Structure Condition Good Condition(7)
Feature M-14	Length / Width 325.996033 / 44.289486	Owner 1	
Location 3 MI W OF WAYNE CO LINE	Built / Recon. / Paint / Ovly. 1975 / 2006 / 0 / 2006	TSC Brighton(6B)	Operational Status Open, no restriction(A)
Region / County 6- University, Jackson / Washtenaw(81)	Material / Design 3 Steel / 02 Stringer/Girder	Last NBI Inspection 9/4/2014 / EJD7	Scour Evaluation Bridge not over waterway

NBI INSPECTION			EJD7
Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
	MDOT Inspector	24	

GENERAL NOTES

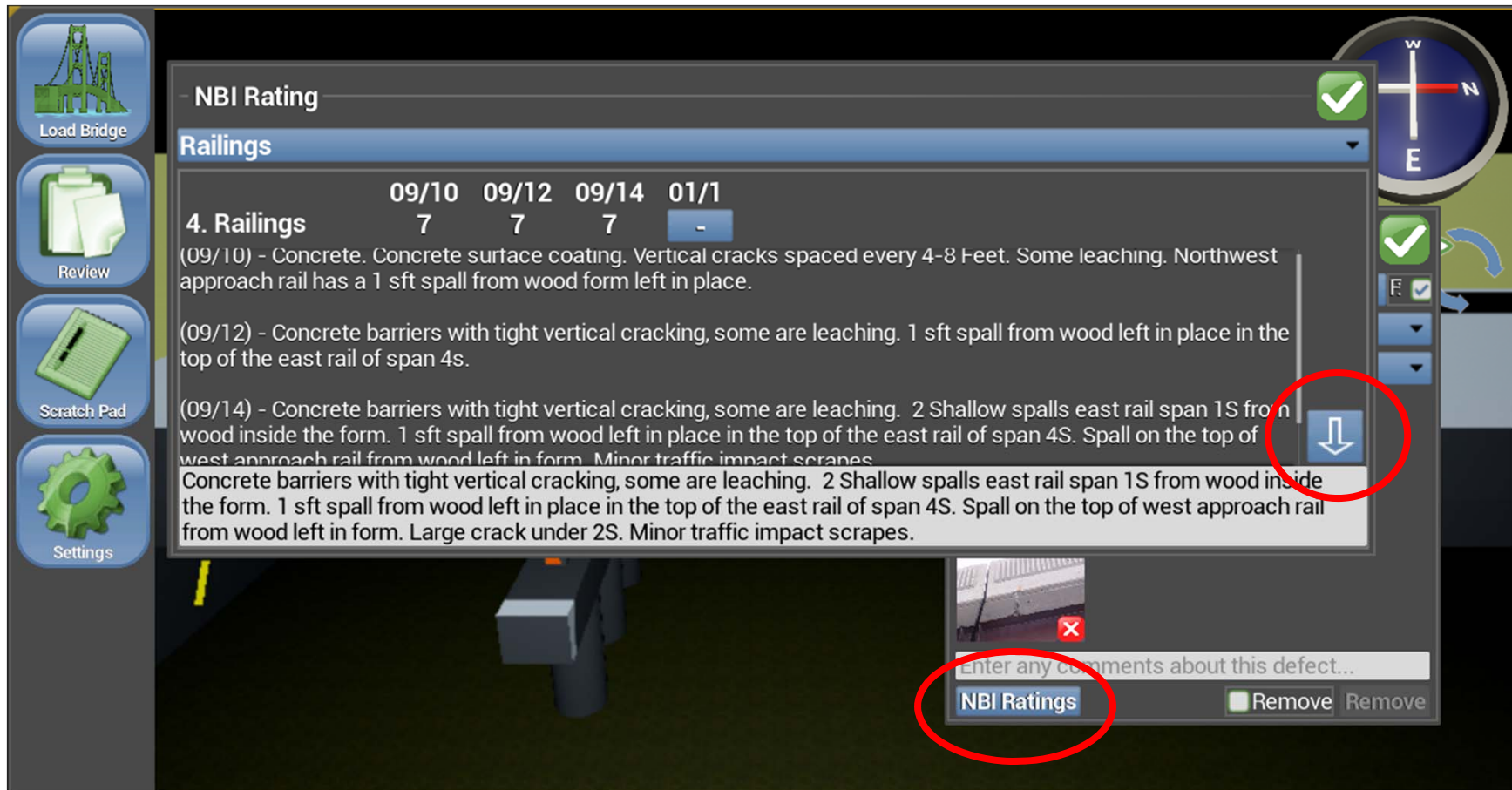
Long term testing of old concrete columns under span 1w.

- ▷ DECK
- ▷ SUPERSTRUCTURE
- ▷ SUBSTRUCTURE
- ▷ APPROACH

- Review NBI Report Information in the “NBI Report” Summary Tab, and expand the report according to the category.

Collect and Display NBI Information

- Enter in NBI Information by clicking the “NBI Ratings” button. Use previous comments from past NBI Reports using the “Download” arrow button



The screenshot displays the NBI Rating software interface. On the left, there is a vertical toolbar with icons for 'Load Bridge', 'Review', 'Scratch Pad', and 'Settings'. The main window shows a table of NBI ratings for 'Railings'.

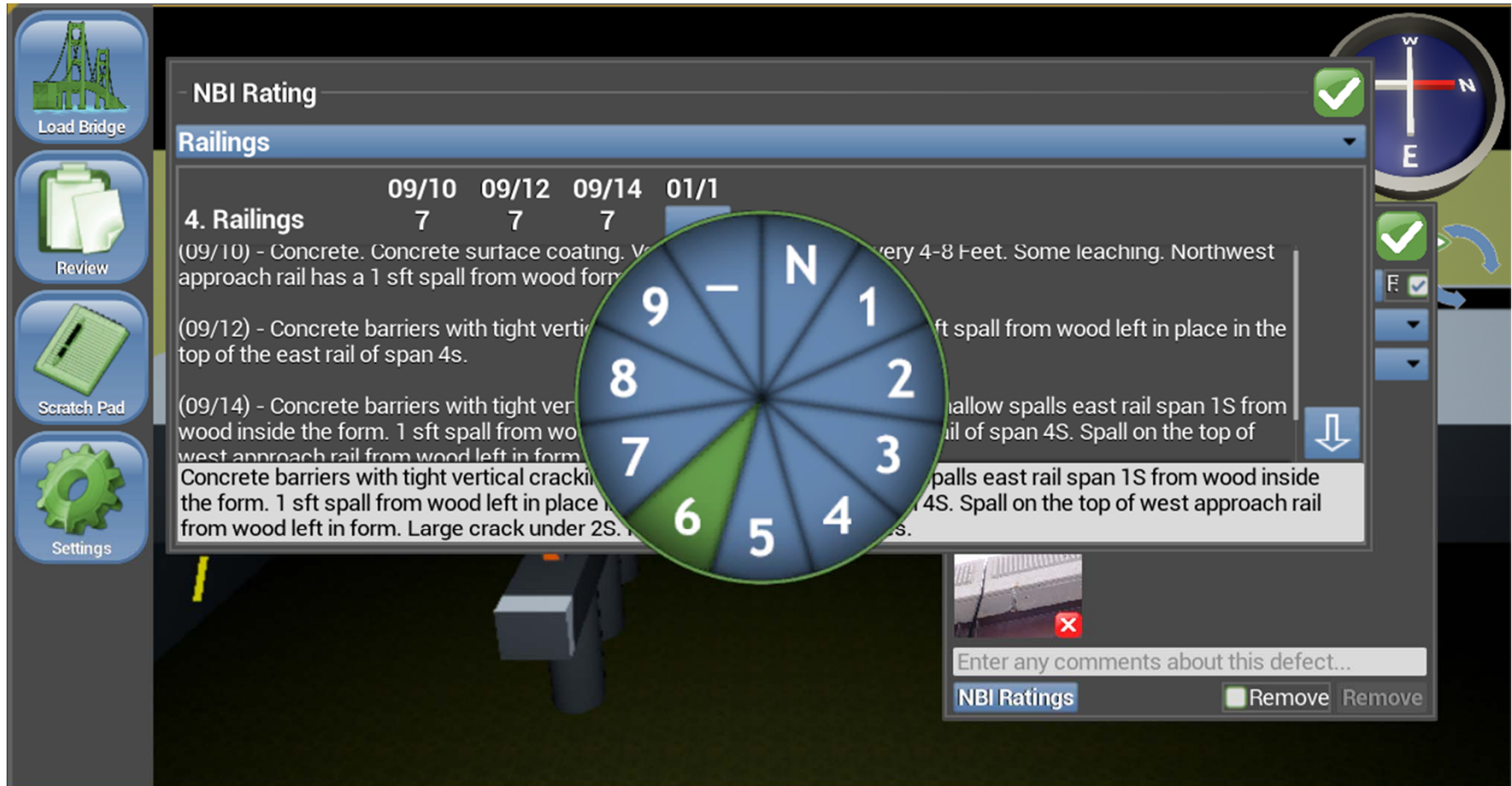
	09/10	09/12	09/14	01/1
4. Railings	7	7	7	-

Below the table, there are three detailed entries for the date 09/14:

- (09/10) - Concrete. Concrete surface coating. Vertical cracks spaced every 4-8 Feet. Some leaching. Northwest approach rail has a 1 sft spall from wood form left in place.
- (09/12) - Concrete barriers with tight vertical cracking, some are leaching. 1 sft spall from wood left in place in the top of the east rail of span 4s.
- (09/14) - Concrete barriers with tight vertical cracking, some are leaching. 2 Shallow spalls east rail span 1S from wood inside the form. 1 sft spall from wood left in place in the top of the east rail of span 4S. Spall on the top of west approach rail from wood left in form. Minor traffic impact scrapes.

At the bottom of the interface, there is a text input field with the placeholder text "Enter any comments about this defect...". Below this field are two buttons: "NBI Ratings" and "Remove". A red circle highlights the "NBI Ratings" button. Another red circle highlights a "Download" arrow button in the top right corner of the main window.

Collect and Display NBI Information



The screenshot displays the NBI Rating software interface. On the left, there is a vertical toolbar with icons for 'Load Bridge', 'Review', 'Scratch Pad', and 'Settings'. The main window is titled 'NBI Rating' and contains a table of ratings for 'Railings' across different dates: 09/10, 09/12, 09/14, and 01/1. The table shows a rating of 7 for each date. Below the table, there are three entries for defects, each with a description and a date. A large, semi-transparent NBI Rating wheel is overlaid on the interface, showing a scale from 1 to 9, with 'N' at the top and '6' highlighted in green. To the right of the wheel, there is a compass rose and a 'Load Bridge' button. At the bottom right, there is a text input field for comments and buttons for 'NBI Ratings', 'Remove', and 'Remove'.

	09/10	09/12	09/14	01/1
4. Railings	7	7	7	


(09/10) - Concrete. Concrete surface coating. V...
approach rail has a 1 sft spill from wood form

(09/12) - Concrete barriers with tight verti...
top of the east rail of span 4s.


(09/14) - Concrete barriers with tight ver...
wood inside the form. 1 sft spill from wo...
west approach rail from wood left in form...
Concrete barriers with tight vertical cracki...
the form. 1 sft spill from wood left in place...
from wood left in form. Large crack under 2S...

- Enter in the NBI Rating for a category by using user-friendly NBI Rating wheel

Collect and Display NBI Information

Bridge Review


Element Review
Defect Summary
NBI Report

	09/10	09/12	09/14	01/1
4. Railings	7	7	7	6
<p>(09/10) - Concrete. Concrete surface coating. Vertical cracks spaced every 4-8 Feet. Some leaching. Northwest approach rail has a 1 sft spall from wood form left in place.</p> <p>(09/12) - Concrete barriers with tight vertical cracking, some are leaching. 1 sft spall from wood left in place in the top of the east rail of span 4s.</p> <p>(09/14) - Concrete barriers with tight vertical cracking, some are leaching. 2 Shallow spalls east rail span 1S from wood inside the form. 1 sft spall from wood left in place in the top of the east rail of span 4S. Spall on the top of west approach rail from wood left in form. Minor traffic impact scrapes.</p>				
				
<p>Concrete barriers with tight vertical cracking, some are leaching. 2 Shallow spalls east rail span 1S from wood inside the form. 1 sft spall from wood left in place in the top of the east rail of span 4S. Spall on the top of west approach rail from wood left in form. Large crack under 2S. Minor traffic impact scrapes.</p>				
	09/10	09/12	09/14	01/1
5. Sidewalks Or Curbs	N	N	N	N
<p>(09/10) -</p> <p>(09/12) -</p>				

- Scroll through the entire report, and review NBI ratings of past and current reports

View Different Summaries of the Recorded Data

- Display and summarize the bridge inspection data with different views.

Bridge Review

AASHTO
Element Level
Data View

Bridge Review ✓		
Summary Review	Element Report	NBI Report
Good	0 ft ²	
▼ Fair	4 ft ²	
▼ Railing	4 ft ²	
▼ Reinforced Concrete Bridge Railing	4 ft ²	
▼ Damage	4 ft ²	
Railing - 2w	4 ft ²	
▼ Poor	8 ft ²	
▼ Deck	8 ft ²	
▼ Reinforced Concrete Coated Bars	8 ft ²	
▼ Exposed Rebar	8 ft ²	
Deck - 1s	8 ft ²	
Severe	0 ft ²	

Bridge Review ✓							
Summary Review		Element Report		NBI Report			
Element Number	Element Name	Unit	Total Quantity	State 1	State 2	State 3	State 4
▼ Decks/Slabs	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4
▼ 803	Reinforced Concrete Coated Bars	Units	1344.957275	1336.95727	0.0	8.0	0.0
AASHTO Num	Exposed Rebar	Poor	8	\$1	\$2	\$3	\$4
Superstructure	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4
Substructure	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4
Bearings	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4
Joints	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4
▼ Other Elemen	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4
▼ 331	Reinforced Concrete Bridge Railing	Units	199.034409	195.034409	4.0	0.0	0.0
AASHTO Num	Damage	Fair	4	\$1	\$2	\$3	\$4
Culvert	AASHTO name	Units	Total Quantity	\$1	\$2	\$3	\$4

Transparency Setting (new)

Partial Transparency allows inspectors to see what they have placed on either side of a component

Full Transparency hides defects too, letting inspectors zero in on locations that may otherwise be hidden by other components.



Settings

General Transparency

Deck:	1	<input type="range"/>
Railing:	2	<input type="range"/>
Joint:	2	<input type="range"/>
Beam:	2	<input type="range"/>
Bearing:	2	<input type="range"/>
Abutment:	2	<input type="range"/>
Pier:	2	<input type="range"/>

Linear Defect Calculator: abutments example (new)

For components such as this abutment, only the linear projection of the defects counts, the application performs this calculation automatically.



When the defects overlap, only the most serious counts.

Area Defect Calculator

Components with area quantities still have to deal with overlap, such as defects on the top and bottom of the bridge deck. The application also handles this computation automatically.



Linear/Area Defect Calculator

Bridge Review



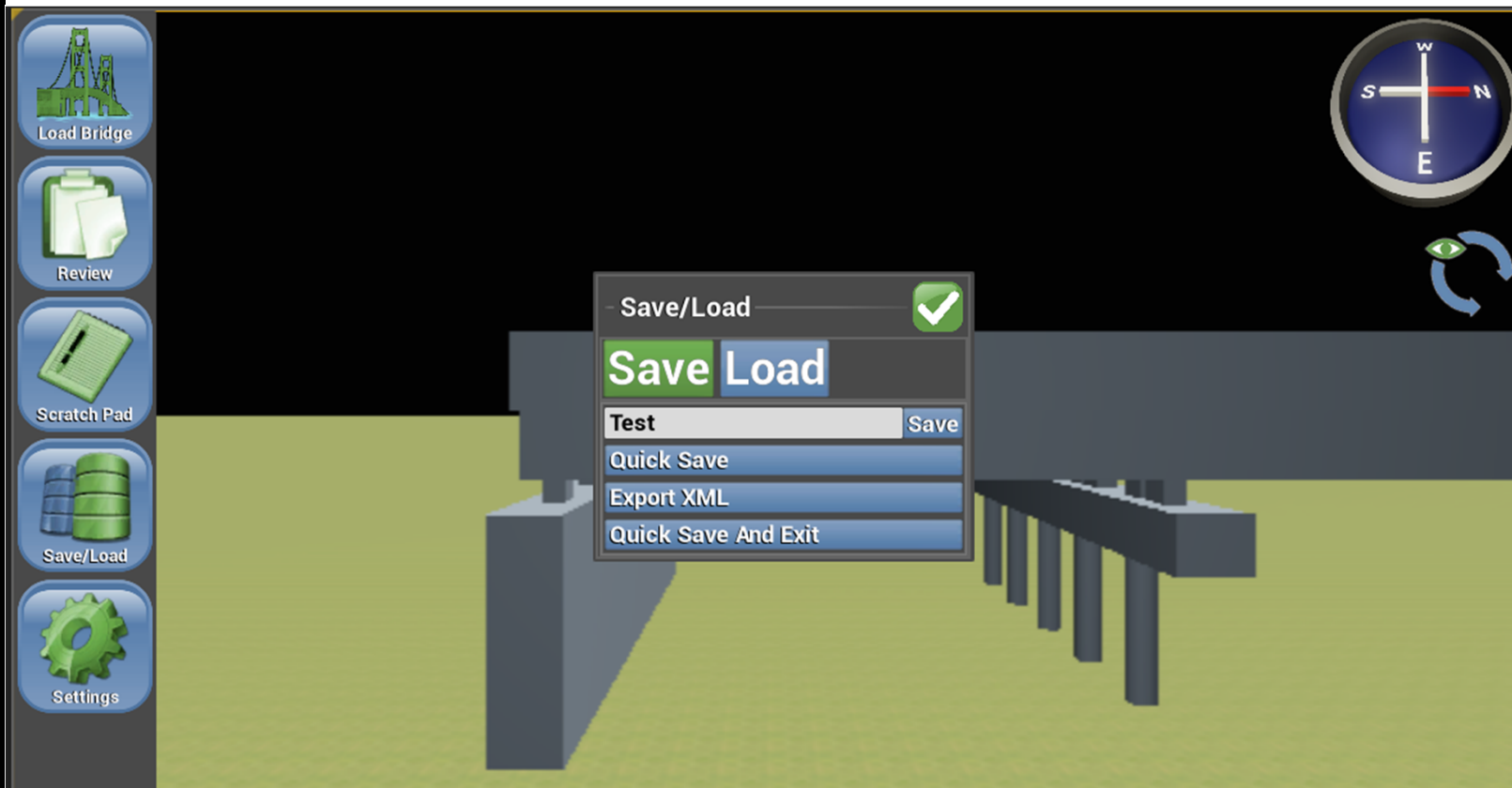
Element Review Defect Summary NBI Report

Element Number	Element Name	Unit	Quantity	Good	Fair	Poor	Severe	
	Decks/Slabs	-	Units	Total Quantity	CS1	CS2	CS3	CS4
	Superstructure	-	Units	Total Quantity	CS1	CS2	CS3	CS4
▽	Substructure	-	Units	Total Quantity	CS1	CS2	CS3	CS4
▽	215	Reinforced Concrete Abutment	feet	112	96 86%	5 4%	10 9%	0 0%
	215	Delamination/Spall/Patched Area	feet	10	-	0	10	0
	215	Exposed Rebar	feet	10	-	10	0	0
	Bearings	-	Units	Total Quantity	CS1	CS2	CS3	CS4
	Joints	-						
	Other Elements	-						
	Culvert	-						

These calculations are reflected in the summary report. Here the fair defect partially overlapped the poor defect, both defects are reported but only half the fair defect counts towards the total quantity for the abutment.

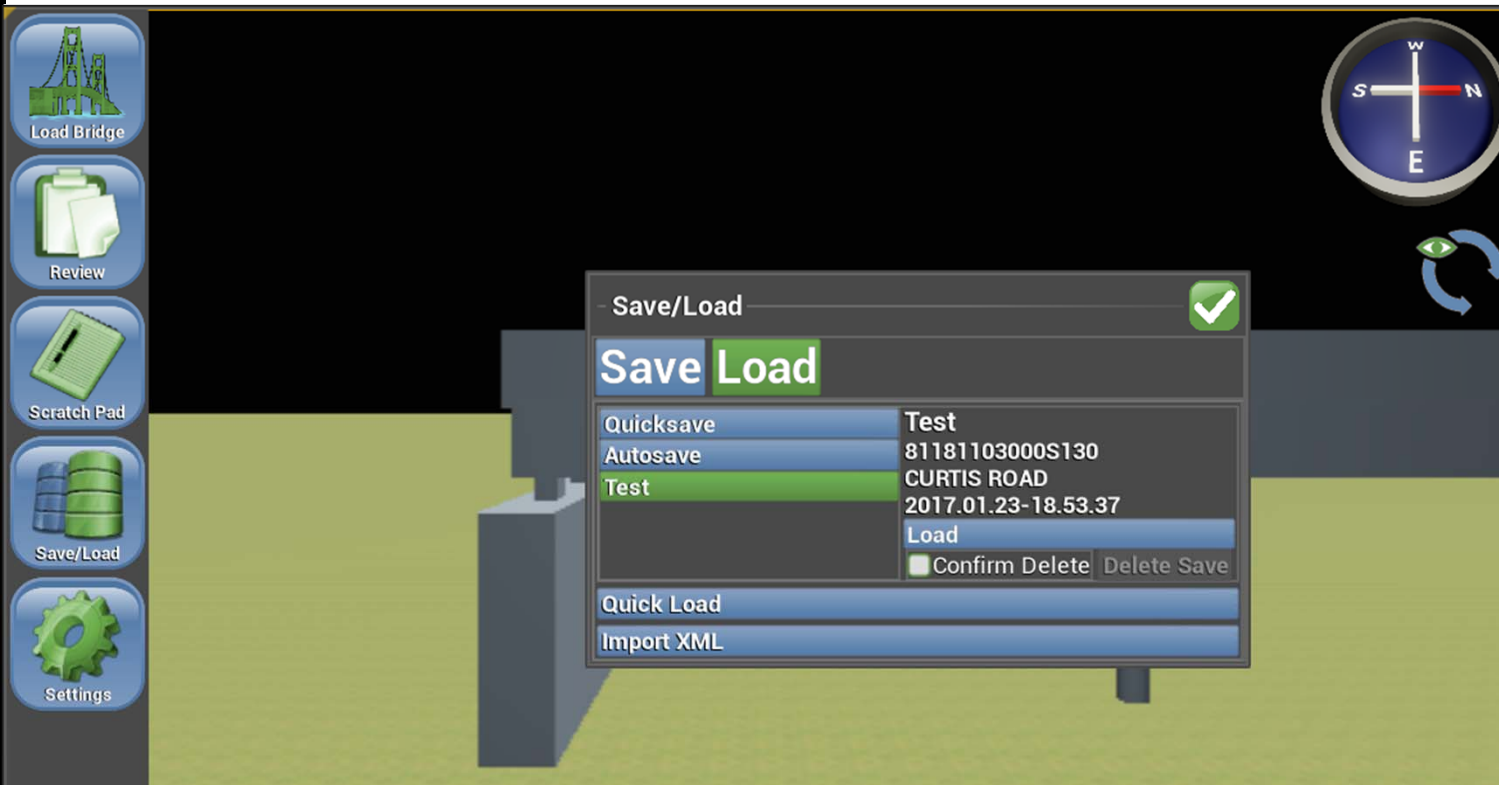
Save/Load (new)

- Users can save the progress of their inspection on their mobile device using named save files.
- Application also autosaves their progress every time they make an update, so they can restore should their work be interrupted unexpectedly.



Save/Load

- Load menu gives a list of all save slots, selecting a save slot will list the bridge id, location, and date the save was created.
 - Can also delete unneeded/old saves



XML Import/Export

- It was necessary to develop a system to import/export data from the MDOT Bridge Management Database.
 - Would like to replace this with direct write to BrM 5.2.3 as its implemented by MDOT, with appropriate review
- All relevant data can be saved in an XML file for later upload to the database management system
 - While not as convenient as a direct uplink, it is also independent from MDOT's database (could be readily adapted to work with other database systems, as the bridge app does not need to change)

XML cont'd

```

    <aashto_number>331</aashto_number>
    <parent_key>0</parent_key>
    <total_quantity>652.992092328</total_quantity>
    <role>Other Elements</role>
    <unit>feet</unit>
  </aashto_element>
- <aashto_element>
  <aashto_number>321</aashto_number>
  <parent_key>0</parent_key>
  <total_quantity>2969.92778296</total_quantity>
  <role>Other Elements</role>
  <unit>sq feet</unit>
</aashto_element>
</aashto_elements>
- <defects>
  - <defect>
    <size>1</size>
    <aspect>1.0</aspect>
    <rotation>0.0</rotation>
    <severity>2</severity>
    <comment>narg</comment>
    <element>331</element>
    <type>1130</type>
    <linear>0</linear>
    <role>1</role>
    <location X="431.179199" Y="1349.943604" Z="747.372864"/>
    <orientation Yaw="-90.0" Pitch="-90.0" Roll="179.999985"/>
    <parent_location X="4968.179688" Y="1332.418823" Z="744.254028"/>
  </defect>
</defects>
</bridge>

```

- XML contains the data needed to build the bridge model, previous NBI data, and current NBI ratings and bridge defects.
 - Does not currently contain photos, but all other defect information is stored
 - Photos are still on the tablet device and could be uploaded with whatever method is currently in place to deal with inspection photos.
- Exported XML files can be imported back into the app on any device.
 - Behaves like a save file, restoring the inspection to the state it was at when exported.

The Application is Cross-Platform

- The 3D BRIDGE App is compatible with Windows and Android, and iOS.
 - Unreal Engine platform is cross-platform compatible



Windows

Benefits

- Benefits of using a location-specific 3D interface extend beyond inspection, but also a tool for future asset management
 - 3D BRIDGE App enables this future
- Enables transportation agency users (MDOT, etc.) to tie condition and deterioration of one component to related components
- Improves forecasting of condition, bridge needs
 - Leads to better, more efficient asset management

The Future of Bridge Inspections

- 3D BRIDGE app is a key component towards the future goal of utilizing 3D models to monitor and review a bridge throughout its lifetime.



- Next steps:
 - MDOT: full implementation after BrM 5.2.3 deployment & integration, expand to more bridge types, user enhancements
 - integrate other distress data (from NDT / remote sensing / UAV platforms / other sources)
 - Other states: Interest in version for other states
 - National: could be a national tool; interested in AASHTOWare BrM integration; complex / big bridge application

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<http://www.mtri.org/3dbridge.html>