

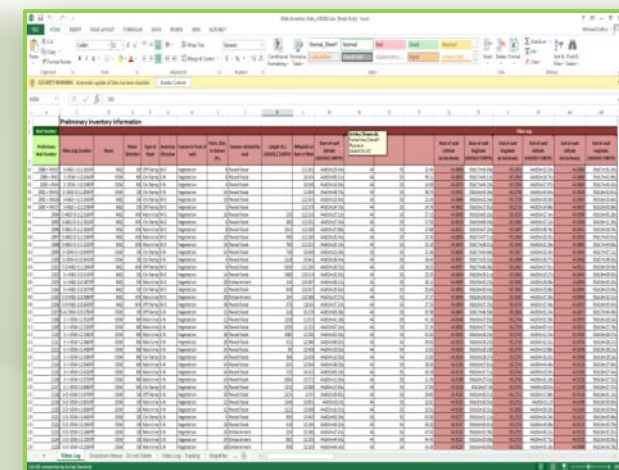
Wall Asset Management Implementation at Colorado Department of Transportation

Bryant Walters, Collins Engineers
Mark Vessely, Shannon & Wilson

Colorado DOT Wall Asset Management Program Development

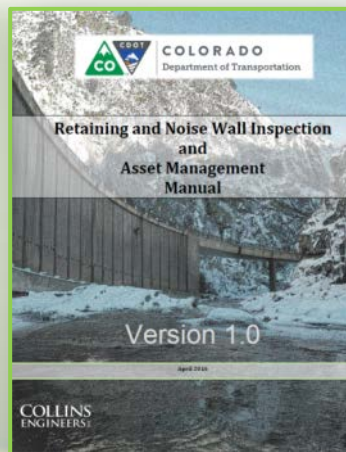
- Coding Guide
- Utilization of Mobile Data Collection Tools and Data Management
- Incorporation of Risk into Plan

Wall Asset Management Components



This screenshot shows a detailed spreadsheet titled 'Preliminary Risk-Based Inventory'. It contains multiple columns for item identification, location, and risk assessment. The data is organized in a grid format, with rows representing individual wall segments or structures.

Preliminary Risk-Based Inventory



Coding Guide

Reports

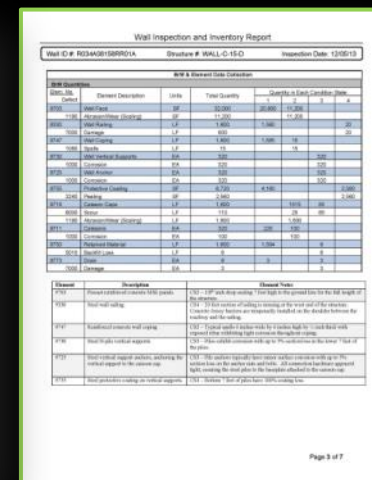


Photos



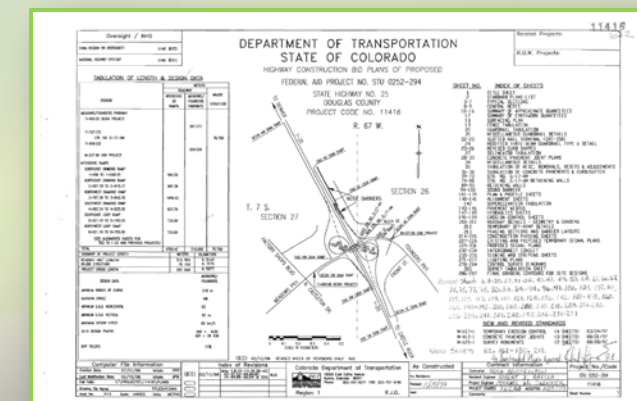
This screenshot shows a 'Wall Inspection and Inventory Report' (NBI Report). It contains a large table with columns for item ID, description, location, and inspection results. The report is titled 'Wall Inspection and Inventory Report' and 'Structure # 10411-C-150'.

NBI Report

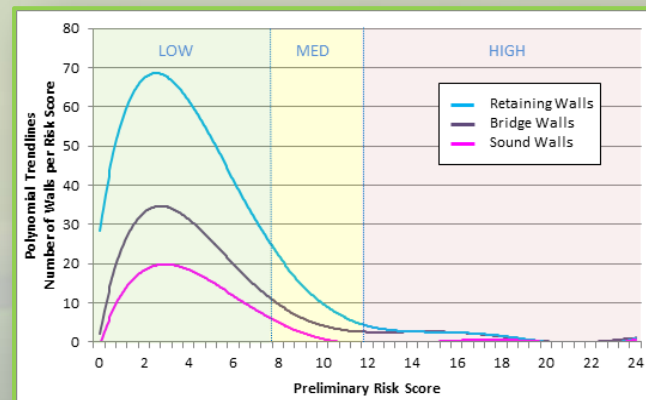


This screenshot shows an 'Element Report' which includes a table of element data and maintenance recommendations. The table has columns for element ID, description, location, and recommended actions. The report is titled 'Wall Inspection and Inventory Report' and 'Structure # 10411-C-150'.

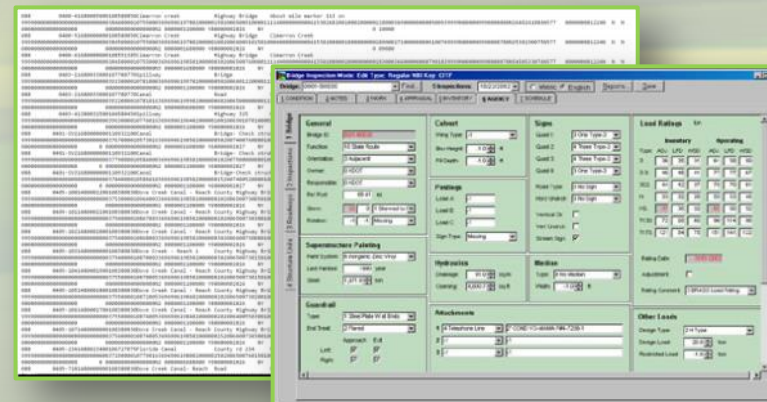
Element Report Including Maintenance Recommendations



Historic Data Association

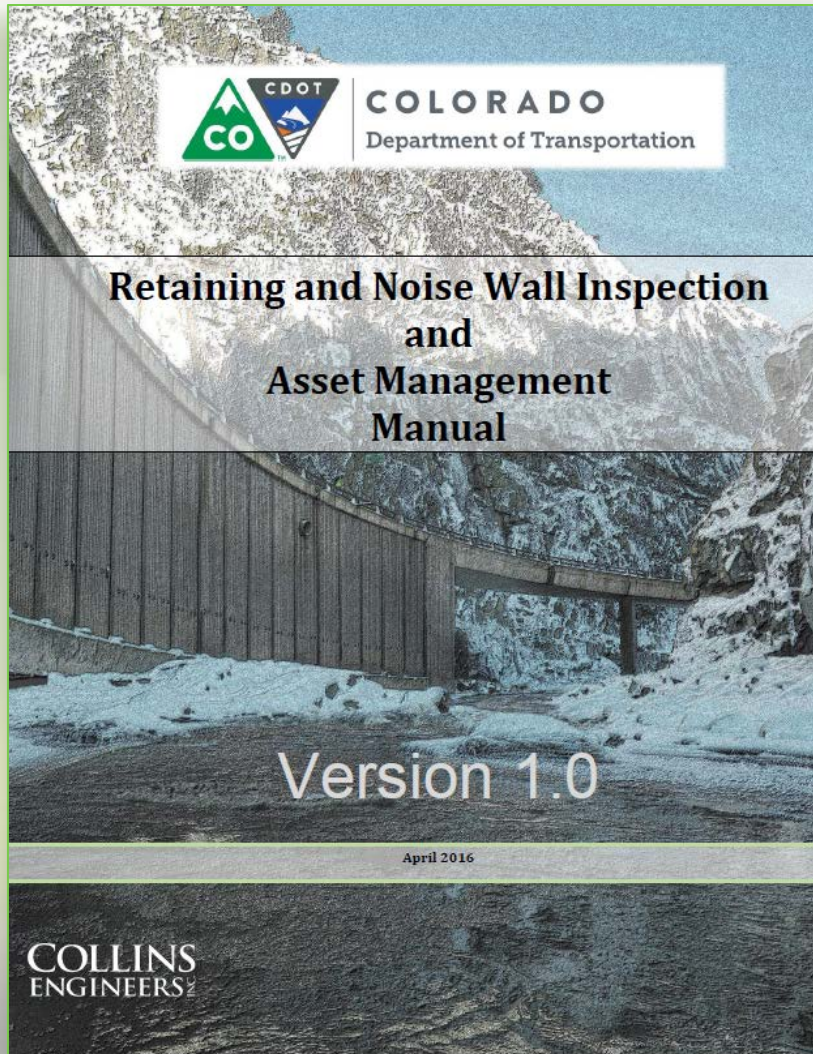


Risk-Based Asset Management



Data Exports/Imports

Coding Guide



- Based on bridge inspection program making it easy for current inspectors to use and maintain reporting consistency.
- Contains NBI based inspection data for locating and identifying asset inventory and appraisal information following FHWA (bridge) standards.
- Includes elements based inspection in line with FHWA BrM (bridge) standards. Includes identifying defects and association of condition ratings.
- Maintenance recommendations and priority can be assigned to element defects, providing cost takeoffs.
- Includes description of the program, definitions and examples.

NBI Items

Wall Assets Program

Collected in Field (30 items)

- Structure Type, Wall Facing
- Structure Material, Wall Facing
- Structure Length
- Average wall Height
- Maximum wall Height
- Minimum wall Height
- Curb or Sidewalk Width, Carried Route
- Curb or Sidewalk Width, Route In Front
- Vertical Supports Structure Type
- Slope Angle, Carried and In Front
- Safety Features On Top
- Height of Rail On Top
- Safety Features In Front
- Height of Rail In Front
- Vertical Batter
- Protective Coating Type
- Main Structure Condition Code
- Foundation Condition Code
- Channel and Channel Protection Condition
- Waterway Adequacy
- Adjacent Roadway Alignment
- Horizontal Clearance, Carried/Behind
- Horizontal Clearance, In Front
- Width, Curb-to-Curb, Carried Route
- Width, Curb-to-Curb, Route In Front
- Min., Max., and Avg. Dist. from Route Carried
- Min., Max., and Avg. Distance from Route in Front

Auto-Populated by Shapefile or App (29 items)

- State/Region
- District
- County
- Place Code
- Latitude – Start of wall
- Latitude – End of wall
- Elevation – Start of wall
- Longitude – Start of wall
- Longitude – End of wall
- Elevation – End of wall
- Range
- Township
- Section
- Routine Inspection Date
- Inspector Name
- Route Type (Route Signing Prefix)
- Route Number
- Base Highway Network
- Mile Point
- LRS Inventory Route and Sub-route Number
- Functional Classification
- Average Daily Traffic
- ADT Year
- STRAHNET Highway Designation
- National Highway System
- Federal Lands Highways
- Heavy Commercial Average Daily Traffic Percentage
- Future Average Daily Traffic
- Future Average Daily Traffic Year

NBI Items

Wall Assets Program

Collected in-Office (41 items)

- Record Type
- Designated Level of Service
- Structure Identification Number
- Wall System
- Features in Front
- Features Carried
- Wall Number
- Location
- Bypass, Detour Length
- Toll
- Maintenance Responsibility
- Owner
- Original Construction Project Number
- Subaccount Number
- Project Indicator
- Year Built
- Historic Significance
- Inventory Route Median
- Border State Region
- Border State Percentage
- Border wall Structure Number
- Year Reconstructed
- Direction of Traffic
- Temporary Structure Designation
- Lanes On and In Front of the Structure
- Type of Service, Carried
- Type of Service, In Front
- Routine Inspection Frequency
- Underwater Inspection
- Special Feature Inspection
- Designated National Network
- Scour Critical Wall
- Type of Railing on Top
- Type of Railing in Front
- Special Inspection Equipment
- Mileage Log Section Letter
- Speed Limit, Route Carried
- Speed Limit, Route In Front
- Associated Bridge
- Lanes On the wall
- Lanes In Front of the wall

Geo-Referenced Data

Wall Assets Program

Photos



- Photos can be embedded with metadata such as lat/long
- Photos can be provided in a folder alongside a database extraction
- Photos can be associated with a database extraction
- Photos are labeled according to CDOT's file naming convention

Mobile Inspection Application



Handheld Demonstration



Overview



UPLOAD



DOWNLOAD

Inspection #
5009

Structure Type
Retaining

Route
040A

Mile Point
244.292

Inspection Type



Start



TAKE
PHOTO



Overview



Structure Map



SI&A



ELEMENTS



PHOTOS



HIST. DATA



Online

Offline



5009



Name R040A244292LRA
Summary WALL-E-13-B
Structure Type Retaining
Route 040A
Milepoint 244.292
Latitude 39.78690449008
Longitude -105.789467407
Elements 11
Defects 0
Photos 41

Launch

Legend

- Not Started
- In Progress
- Completed



+ NEW INSPECTION

Inspection # 5009	Structure Type Retaining	Route 040A	Mile Point 244.292	Inspection Type <div><input checked="" type="checkbox"/> Complete</div> <div> TAKE PHOTO</div>
----------------------	-----------------------------	---------------	-----------------------	---

- Overview
- Structure Map**
- SI&A
- ELEMENTS
- PHOTOS
- HIST. DATA

5009

Name

R040A244292LRA

Summary

WALL-E-13-B

Summary

Retaining

Route

040A

Milepoint

244.292

Latitude

39.78690449008

Longitude

-105.789467407

Elements

11

Defects

0

Photos

41

Filter Disabled

Wall Marker

Visible

Defect

Visible

Element Photo

Hidden

Defect Photo

Hidden

General Photo

Hidden

Online Offline

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Elements: R040A245226LRA



Inspection # 5012	Structure Type Retaining	Route 40A	Mile Point 245.226	Inspection Type	<input checked="" type="checkbox"/> Complete
----------------------	-----------------------------	--------------	-----------------------	-----------------	--

- Overview
- Structure Map
- SI&A
- ELEMENTS
- PHOTOS
- HIST. DATA

+ Add Element

Create New Element

Category	Wall Facing	Type	Metal Wall	Qty	Units		
Element	Wall Facing	Longitude				DESCRIPTION	PROCEDURE
	Foundation						
	Vertical Supports						
Defect	Anchors	Condition State		Qty		Notes	Photo
	Railings						
	Horizontal Coping						
	Vertical Coping						
	Retained Material						
	Protective Coatings and Systems						



Photos: R040A244292LRA



UPLOAD



DOWNLOAD

Inspection #
5009

Structure Type
Retaining

Route
040A

Mile Point
244.292

Inspection Type



Overview



Structure Map



SI&A



ELEMENTS



PHOTOS



HIST. DATA

Filter: All

Sort: Select



Defect-Reinforced Concrete Wall Railing-



Element-Reinforced Concrete Wall Railing



Inventory



Element-Expansion Joint



Defect-Reinforced Concrete Wall Railing-



Element-Adjacent Roadway



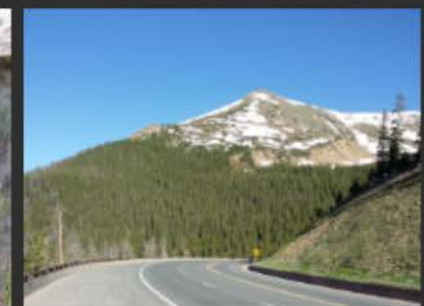
Element-Area Drain



General-



Element-Masonry Wall




Inventory



Web-based Data Management

COLLINS ENGINEERS

 **COLORADO**
Department of Transportation

Search Walls

▼ Wall Inventory

▼ Inspection Stages

▼ In Field

Preliminary

Prepped

Assigned

In Field

Field Report

All

▼ In Office

Initial Report

Engineer Report

Submitted

Accepted

All

► Type

► Risk

CDOT Provided Data

Comments

► Base Map


► Bridge Inventory

► Sign & Signal Inventory


► Minors Inventory

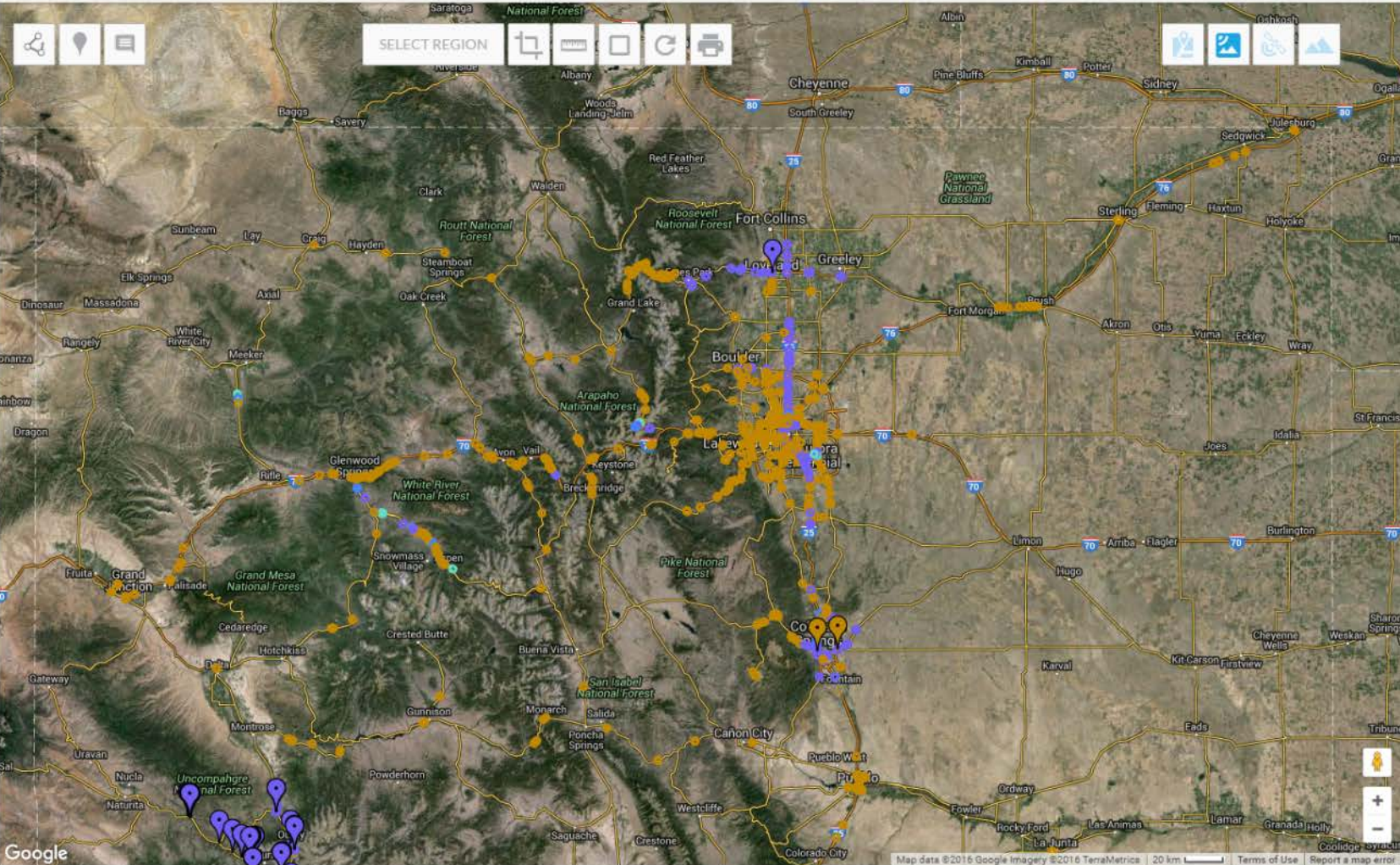
► Tunnels Inventory


Zoom Level: 8



SELECT REGION






































Map data ©2016 Google Imagery ©2016 TerraMetrics 20 km Terms of Use Report a map error

Add Element

Elements												
Element	Description	Quantity	Unit	Env.	Qt. CS1	Qt. CS2	Qt. CS3	Qt. CS4	Photos	Notes	Delete	Add
9750	Retained Material	1272	LF	1	1272	0	0	0			✕	<div>Coating</div> <div>Defect</div>
9770	Weep Holes/Slots	1	EA	1	1	0	0	0			✕	<div>Coating</div> <div>Defect</div>
9342	Sign Attachment to Wall	4	EA	1	4	0	0	0	   		✕	<div>Coating</div> <div>Defect</div>
9771	Area Drain	1	EA	1	1	0	0	0			✕	<div>Coating</div> <div>Defect</div>
9762	Expansion Joint	15	EA	2	0	8	6	1	        		✕	<div>Coating</div> <div>Defect</div>
2310	Leakage				0	8	6	1			✕	
9747	Reinforced Concrete Horizontal Coping	1272	LF	2	1017	255	0	0			✕	<div>Coating</div> <div>Defect</div>
1130	Cracking (RC and Other)				0	255	0	0			✕	
9705	Masonry Wall	20352	SF	1	16246	4070	26	10			✕	<div>Coating</div> <div>Defect</div>
									     			

New

Old

User

The concrete coping is integral with the concrete railing and is located in the splash zone.

(CS 2) - Cracking (RC and Other): The coping exhibits typical vertical 1/16 in. wide x full height cracks with associated efflorescence spaced approximately every 5 ft. throughout.

Change

User

Comment

General Comment:

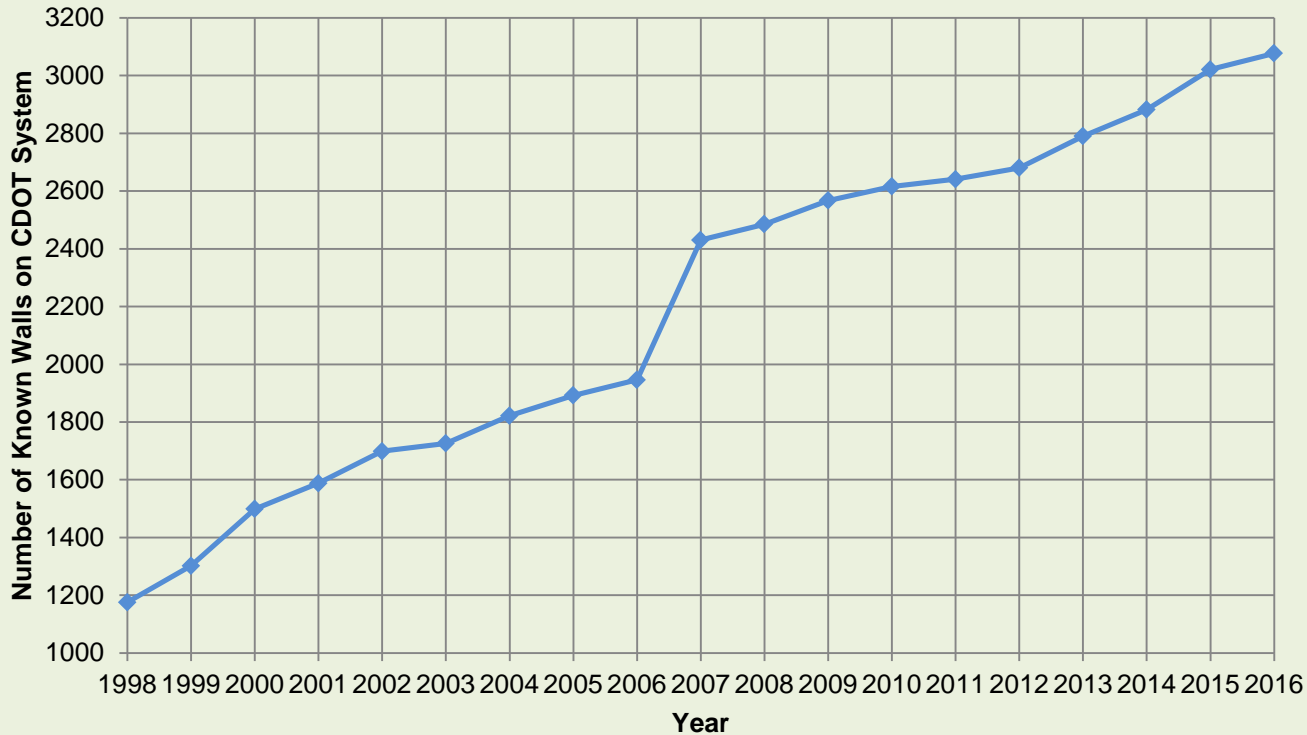
New Comment

Comment

Risk Based Asset Management

Wall Assets Program

Risk Based Asset Management



- Rapidly growing and relatively young asset group.

Risk Based Asset Management

Wall Assets Program

Risk Based Asset Management

Risk to what?

- Selection of risk areas based on TAM performance goals.
- Identifying inventory parameters that support risk analysis

<u>Performance Area</u>	<u>Factor</u>	<u>Parameter</u>
Maintenance		
	Consequence	Element Category (primary or secondary)
		Element Type
		Quantity of Elements
		~Unit Costs
	Likelihood	Condition State
Mobility		
	Consequence	Avg. Wall Height
		Avg. Distance from Road in Front
		Avg. Distance from Road Carried
		AADT
		^Delay Time, 2 hours
		*User Value, \$30.50
		*Occupancy Rate, 1.67
		*ADT Delay, 33% of Actual ADT
	Likelihood	Main Structure Condition
		Foundation Condition
		Scour Critical

Risk Based Asset Management

Wall Assets Program

Risk Based Asset Management

Risk to what?

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- Identifying inventory parameters that support risk analysis

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		Avg. Distance from Road Carried
		AADT
		^Delay Time, 2 hours
		*User Value, \$30.50
		*Occupancy Rate, 1.67
		*ADT Delay, 33% of Actual ADT
	Likelihood	Main Structure Condition
		Foundation Condition
		Scour Critical

Risk Based Asset Management

Wall Assets Program

Monetizing Risk

Maintenance Risk

<u>Likelihood of Incurring Maintenance Cost</u>		
Condition State	Primary Elements	Secondary Elements
CS1	0%	0%
CS2	11%	7%
CS3	59%	37%
CS4	98%	66%



Expected Element
Replacement/Rehab
Cost

Mobility Risk

<u>Condition</u>	<u>Likelihood</u>
9	2%
8	
7	
6	5%
5	
4	26%
3	
2	78%
1	
0	



Relationship between:
Wall Proximity, Height,
and User Delay

Risk Based Asset Management

Wall Assets Program

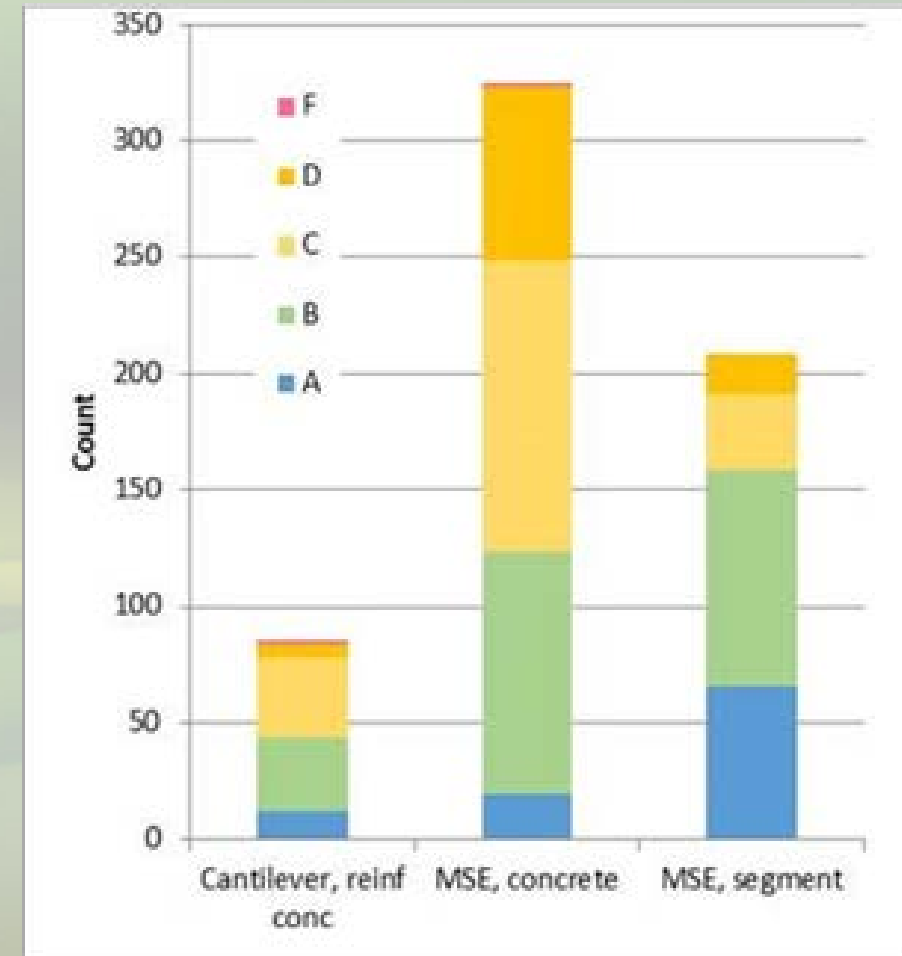
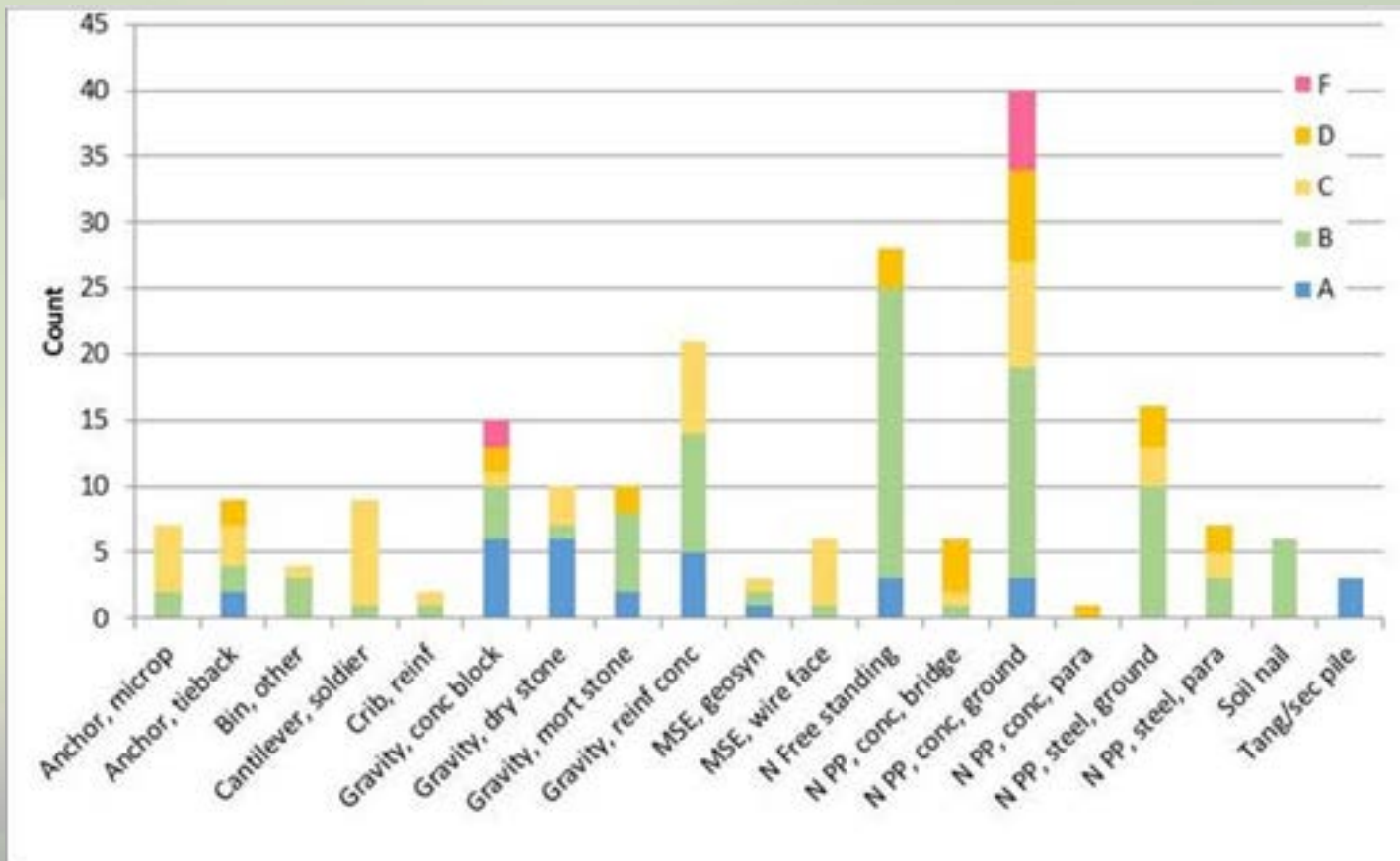
Grading Risk

Grade (Total Risk Cost)	Maintenance Indicators	Mobility Indicators
A (<\$1,000)	90% driven by maintenance risk costs (avg cost = \$180)	10% driven by mobility risk costs (avg cost = \$700)
B (\$1,000-\$5,000)	49% driven by maintenance risk costs (avg cost = \$2,525)	51% driven by mobility risk costs (avg cost = \$2,475)
C (\$5,000-\$50,000)	45% driven by maintenance risk costs (avg cost = \$16,000)	55% driven by mobility risk costs (avg cost = \$9,500)
D (\$50,000-\$100,000)	100% driven by maintenance risk costs (avg cost = \$62,915)	0% driven by mobility risk costs
F (>\$100,000)	100% driven by maintenance risk costs (avg cost = \$305,000)	0% driven by mobility risk costs

Risk Based Asset Management

Wall Assets Program

Data Analysis Example: Risk Grades by Wall Types



Risk Based Asset Management

Wall Assets Program

Financial Planning

