

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
DEARBORN-N RAMP	CBox	751	8	1965	DEARBORN-N RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	1997	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Span (1.3)
Geotechnical Factors: Span (1.7); Curved (1.1); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class C-D
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections

Anticipated Retrofit Measures

Catcher block or Seat Widening ; Column Isolation ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	70	132
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
25.5	145.2	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	27	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
7	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	13.3	41.4
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Shafts ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Combination	NA

Additional Notes

Shafts at one abutment, spread footing support columns at the other abutment.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NBCD OVER DEARBORN ST	CBox	216	3	1965	I-5 NBCD
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Span (1.0)
Geotechnical Factors: Span (1.2); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class C-D
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Pushover ; Various superstructure sections

Anticipated Retrofit Measures

Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	60	96
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
2.2	5.1	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
3.94	27	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	2	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	28.5	32.2
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Spread footing supporting column	NA

Additional Notes

Integral Bents

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-W RAMP	CBox	449	6	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2007	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.5); Curved (1.1); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class C-D
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Internal Diaphragm Strengthening (Requires Access Hatches) ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	64.4	80
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
9.6	53.9	Continuous/Simple
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
11.2	28.5	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
5	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	19.8	44.4
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Single Shaft	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Spread	NA

Additional Notes

Bridge is skewed at one end. Integral Bents Abutment is on one side and adjacent structure is on the other.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
DEARBORN ST UNDER W-NBCD RAMP	CBox	864.5	10	1964	I-90 WCD RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	2007	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.9); Curved (1.1); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening) ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - FRP ; Column jacketing - Steel ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP ; Superstructure Strengthening - Other

Notes for WSDOT

1964 segments have steel jacket retrofit in 2007 but footings lack top reinforcement and in-hinge restrainers may not be adequate for current seismic demands. 1983 segment has larger columns and footings have top reinf. Strengthening of footings, columns, and restrainers may be needed.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	61.6	120
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
17.08	98.8	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
9	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	22.6	29.9
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Shafts ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Spread	NA

Additional Notes

Three segments of 1-lane reinf. concrete box girder ramp structure. 2 segments built in 1964 consist of 5 spans, 424', and 1 segment built in 1983 consists of 5 spans, 440.5'. Restrainers added at hinge joints in 1983. 1964 structure has 4' and 4.5' columns on either spread

footings (2) or drilled shafts (3). The 1983 structure has 6' dia columns on spread footings. The 1964 columns had steel jacket retrofits applied in 2007. 1964 footings have no top reinforcement; 1983 footings do have top reinforcement.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-E RAMP OVER I-5	CBox	947	9	1964	I-5 S-E RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	1997	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Skewed (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.8); Curved (1.1); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class C-D
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - FRP ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Existing steel jacketed columns may perform relatively well but spread footings w/o top reinforcement will likely need strengthening. 1983 segment w/ 7' dia. columns may need some strengthening (FRP) and seismic restrainers may be needed.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	60	140
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
16	105.3	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
52.3	20	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
8	1-2	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	23.7	46.6
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Shafts ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Spread	NA

Additional Notes

2 units, 7 spans built in 1964; 1 unit, 2 spans built in 1983. Skew only applies at Pier 6. Undersized shear keys at either end of 1983 unit. Single column piers except for Pier 6 (2-col.). Steel jacketed retrofit on 1964 columns. Piers 5-8 on shafts, 9-10 on spread footings w/o top reinf. 1983 Piers 3-4 on spread footings with top reinf.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 UNDER ST LEASED BRDG#4	SBox	1659	10	1987	SOUND TRANSIT RAIL
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.9); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - Steel ; Isolation bearings

Notes for WSDOT

Foundations appear to be well detailed and rectangular columns are fairly robust. A long continuous superstructure; will likely require column jacketing or potentially isolation bearings. Some adjacent retaining walls will need to be cut back at columns.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
Steel Box	89	198
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
7.8	65	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	72	One in Each Bay
No. Inter. Piers	Column Numbers / Bent	Column Shape
10	1	Rectangular
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Pinned	30.5	77.2
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Rocker	Piles ; Shafts ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Spread	NA

Additional Notes

Continuous steel box girder superstructure with direct fixation transit rail tracks on deck. Concrete section that curves into station is not included. Shear lugs in plans located between bearings may be undersized for seismic. Google Street-View images show some large external steel brackets at edges of columns but plans not included for these. Very large radius (1400'-1500') flat "S" curve; minor effect. Single column piers are 6', 7', or 8' x 12' rectangular columns. Bearings are steel pin rockers on ptfе sliding plates. Pile footings have good detailing; drilled shafts have pretty good detailing; spread footings have pretty good detailing but may be too thin. Capacities should be checked for these elements, but retrofits will be unlikely due to "Ordinary" classification.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 UNDER E-N RAMP	CBox	513	5	1964	E-N RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	2007	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Span (1.0)
Geotechnical Factors: Span (1.4); Curved (1.1); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class C-D
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Catcher block or Seat Widening ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	72	130.25
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
7	34	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	24	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
5	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	23.6	56
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller	Single Shaft	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles-Concrete	NA

Additional Notes

Superstructure is a two cell, variable depth box. First half of bridge is parallel and extremely close to the I-90 bridge. There are details showing long eq restrainers, but it is not clear if it applies to this bridge. Pier 9 column is covered in plants / vines growing on it on Google Maps. 5' dia single columns supported on 6' dia single shaft. Wingwalls supported by their own shafts

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-90 EB/WB over I-5	CBox	537	7	1964	I-90
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Crossbeam Bolster ; Seismic Restrainer	2008	Single Span	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Skewed (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); NLTH (2.5); Previously widened (1.2); Previously Retrofit (1.1); Multilevel bridge (2.0); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.6); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Nonlinear time history ; Extra Modelling complexity (i.e. Previous widening) ; Connection and Seat Width Checks ; Adjacent Structure Interaction ; Multi-Level Bridge

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Seismic Restrainer

Notes for WSDOT

Straight section of double decker bridge with a 2008 seismic retrofit including steel jackets on lower columns, seismic restrainers at ends and in-span hinge, crossbeam strengthening, and upper column steel jackets at Pier 14 (only). The existing seismic retrofits will need to be checked against current seismic requirements.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	56	97
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
30.3	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
6	2	Round ; Rectangular ; Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	18.5	31
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	NA	NA

Additional Notes

Unit 3 is 3-span double deck cip conc box structure; Unit 4 is a 4-span similar section. Seismic restrainers added at ends and in-span hinge in 2008. Original columns are 5' x 4.5', upper and lower. Round or elliptical steel jackets on lower level columns, rectangular steel jackets on upper columns at Pier 14 only. P-T crossbeam enlargement and strengthening of all upper and lower crossbeams. Column heights above are of lower columns sections; upper column sections are 17.5' plus lower crossbeam depth above lower columns. Drilled shafts are 7' dia except Pier 9 is 8' dia.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 UNDER W-S RAMP	CBox	1243	16	1964	I-90 W-S RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	1997	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.6)
Geotechnical Factors: Span (2.5); Curved (1.1); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening) ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column Isolation ; Seismic Restrainer

Notes for WSDOT

Steel jacketed columns may perform relatively well but some shorter columns/shafts may need isolation. No plans for seismic restrainers so these details will be needed.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	46.5	85
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
10	74.7	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
15	1-2	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	9.4	43.3
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	NA	NA

Additional Notes

5 frames; 1 of 2-lane width and 4 of 1-lane width. No plans showing seismic restrainers. Piers 2-5 have 2-col's ea., 6-16 are single column piers; all steel jacketed in 1997. all columns on drilled shafts

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-W RAMP OVER I-5	PTCBox CBox	1284.2	13	1964	N-W RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	1997	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.6)
Geotechnical Factors: Span (2.2); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

1988 segment appears to have rather large footings (comb. ftg details not included); rectangular columns may need strengthening. 1964 segments have existing steel jackets on columns that may perform relatively well. Superstructure restraints at hinges will likely need strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
PT CBox	114.3	127.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
14	112.7	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
4	1	Rectangular
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	50.5	68.5
Bearing Type	Original Foundation Type	Widened Foundation Type
Multi-directional bearing	Piles - Concrete	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	NA	NA

Additional Notes

1988 4-span segment of PT Box girder, 499'. Curve data shown is for full ramp structure. 8'x6' rectangular columns. Piers12-14 appear to be combination footings but footing details not included. Concrete piles are concrete filled steel pipe piles.

▼ Add'l Bridge Info for 2nd Structure Type

.Girder Type CBox	.Shortest Span (ft) 50	.Longest span (ft) 140
.Max Degree of Curvature 14	.Sweep Angle btwn Abutments 112.7	.SS Continuity Continuous
.Deck Exp Joints? Yes	.Long. Exp Joints? No	.In-Span Hinge? Yes
.Skew Angle 0	.Seat Width (in) 18	.Girder Stop? No Girder Stops
.No. Inter. Piers 8	.Column Numbers / Bent 1	.Column Shape Round
.Column Fixity Fixed-Fixed	.Shortest Column Height (ft) 9.6	.Tallest Column Height (ft) 69.5
.Bearing Type Elastomeric pad	.Original Foundation Type Shafts	.Widened Foundation Type NA
.Battered? No	.Original Abutment Foundation Type Shafts	.Widening Abutment Foundation Type NA

.Additional Notes

1964 9-span, 3 segments of reinf conc box girder, 785.25'. Curvature info shown is for full ramp structure. 1964 segments have 5' and 5.5' columns on drilled shafts. Steel jacket retrofit added in 1997. Seat type abutment has wing on only one side.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-AIRPORT WAY BR	CBox	518	7	1966	S-W RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer ; Carbon Composite Encased Columns	1997	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.6); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Internal Diaphragm Strengthening (Requires Access Hatches) ; Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	50	92
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
16	13	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
6	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	22.3	28.37
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller ; NA	Piles - Concrete ; Single Shaft	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Combination	NA

Additional Notes

Transverse movement restrained at internal hinge / expansion by external "stops". Superstructure is a 3-cell box. Superstructure is integral. End bent at Pier 1 supported by 2 columns founded on pile caps / piles. End bent at Pier 8 is supported by 2 shafts. Both end bent columns or shafts have pinned rebar detail at bottom. Bent 1 has a pin near the top as well, at the bottom of the end wall. Intermediate bents are fixed - fixed. Expansion joint between Unit 1 and Unit 2 has steel cylinder rollers. Piers 2,3,4 are founded on concrete pile caps with 13" concrete piles, while piers 5,6,7 are founded on single shafts that are 6" larger than the columns they support. End pier 1 has end diaphragm supported by 2, short, rectangular columns founded on pile cap / piles. End pier 8 as end diaphragm supported by 2 shafts.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-AIRPT RAMP UNDER E-S RAMP	CBox	342	5	1964	I-90 E-S RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns	1997	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-pile deep foundations (1.25); Box girder superstructure sections (1.1); NLTH (2.5); Previously Retrofit (1.1); Multilevel bridge (2.0); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.0)
Geotechnical Factors: Span (1.4); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Nonlinear time history ; Connection and Seat Width Checks ; Adjacent Structure Interaction ; Multi-Level Bridge

Anticipated Retrofit Measures

Seismic Restrainer

Notes for WSDOT

Steel jacketed columns may perform fairly well but footings will likely have issues. Unclear if restrainers have been installed at ends to adjacent bridge units. They likely have but may need strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	48	87
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
13	44.5	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
4	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	45.8	59.4
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Piles - Concrete	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	NA	NA

Additional Notes

Only including Unit 6 as being the E-S ramp; Unit 1 includes spans for both E-S and W-S ramps but are applied to W-S ramp per original layout. Bridge connects to adjacent units at each end; unclear if restrainers were added. steel jackets applied in 1997 retrofit project. Concrete piles are concrete filled steel pipe piles. Footings lack top reinforcement. Various height pedestals between column and footing.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
SBCD VIADUCT STA 2133	CS	729	17	1967	I-5 SBCD
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer	1990	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.6)
Geotechnical Factors: Span (2.6); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - FRP ; Superstructure Strengthening - FRP

Notes for WSDOT

Jacketing columns will likely lead to inadequate capacity in the shafts. Potentially also the superstructure elements. Analysis may find poor seismic performance. Expect to see some torsion in the response due to cross slope
Expansion joints have a horizontal shear transfer device.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	34.7	45
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
2.25	19.5	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0		N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
16	Varies	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	11.55	46.32
Bearing Type	Original Foundation Type	Widened Foundation Type
Sliding bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	NA	NA

Additional Notes

4 units. Variable width as move north to gore area. Frames into bridge on each side with common expansion joints in span. Typical 3 (3' diam) columns splaying to ramp split w/ 3 at each side of split. 3'-6" diam shafts 140 - 145, 6' diam shafts 146 to 156some locations have a grade beam connecting the shaftss

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NBCD RAMP BR	CS	156	4	1965	I-5 NBCD RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Shaft deep foundations (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.0)
Geotechnical Factors: Span (1.3); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Column Isolation ; Column jacketing - Steel ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	35	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0.6	2.3	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	53.75	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
3	3	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	5.7	16.3
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA

Additional Notes

Integral Bents Abutment at one bridge end, adjacent structure at the other.

▼ Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 UNDER BEACON-HOLGATE	CBOX CS	771	9	1966	BEACON-HOLGATE
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2001	Multiple Spans			

▼ Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.8); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Internal Diaphragm Strengthening (Requires Access Hatches) ; Pier wall strengthening ; Superstructure Strengthening - FRP

Notes for WSDOT

The slab structure is only on the cellular approach.May perform reasonably well in a seismic event. Especially if cellular approach is tied to the longitudinal retaining walls.

▼ Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	40	104
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
14	30.11	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	36.5	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
8	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	14.5	58.25
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller	Piles - Concrete ; Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Shafts	NA

Additional Notes

Concrete Box Girder. Columns vary. 4' diameter to 6' diameter. Some pile cap footings (Piers 2-6) on concrete piles (pier 2 battered), some columns on drilled shafts

▼ Add'I Bridge Info for 2nd Structure Type

.Girder Type Slab	.Shortest Span (ft) 16	.Longest span (ft) 20
.Max Degree of Curvature 0	.Sweep Angle btwn Abutments 0	.SS Continuity Continuous
.Deck Exp Joints? No	.Long. Exp Joints? No	.In-Span Hinge? No
.Skew Angle 0	.Seat Width (in) 18	.Girder Stop? External Only
.No. Inter. Piers 4	.Column Numbers / Bent 6	.Column Shape Round
.Column Fixity Fixed-Fixed	.Shortest Column Height (ft) 4.83	.Tallest Column Height (ft) 9.5
.Bearing Type Asbestos Packing	.Original Foundation Type Piles - Concrete	.Widened Foundation Type NA
.Battered? No	.Original Abutment Foundation Type Piles	.Widening Abutment Foundation Type NA

.Additional Notes

Cellular abutment (slab on piles) Slab supported on 6 concrete pile/columns (13" diameter) with an integral capbeam Cellular approach is 13" diameter piles/columns.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-W RAMP FOREST ST	CBOX CS	698	8	1967	I-5 RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer ; Catcher Block	2003	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.7); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; RSA

Anticipated Retrofit Measures

Curtain Wall Strengthening ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Primarily box girder spans. Has a cellular abutment and transitions to slab at SB I-5
Will likely perform well due to previous seismic retrofits, however the above ground capacity protected elements may need to be upgraded.
If retrofit of the substructure is desired, then it may be problematic for the drilled shaft foundations.
Seismic restrainers may only be designed to lower 500 year event.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
N/A	70	105
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
14	78.24	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	48	N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
7	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	17.5	41
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles-Concrete	NA

Additional Notes

Primarily a concrete box. The slab portion of structure is at the connection to the SB I-5. Combination of 5' diameter columns in 6' diameter shafts that reduce to 5' diameter ~68' along the length of shaft (measured from the top of shaft). Combination of drilled shafts and concrete piles with a concrete pile cap. Pier 2 has battered piles.

Add'l Bridge Info for 2nd Structure Type

.Girder Type	.Shortest Span (ft)	.Longest span (ft)
Slab	70	105
.Max Degree of Curvature	.Sweep Angle btwn Abutments	.SS Continuity
0	0	Continuous
.Deck Exp Joints?	.Long. Exp Joints?	.In-Span Hinge?
Yes	No	Yes
.Skew Angle	.Seat Width (in)	.Girder Stop?
0	6	External Only
.No. Inter. Piers	.Column Numbers / Bent	.Column Shape
7	5	Round
.Column Fixity	.Shortest Column Height (ft)	.Tallest Column Height (ft)
Fixed-Fixed	7.57	12.16
.Bearing Type	.Original Foundation Type	.Widened Foundation Type
Asbestos Packing	Piles - Concrete	NA
.Battered?	.Original Abutment Foundation Type	.Widening Abutment Foundation Type
No	Piles	NA
.Additional Notes		
Cellular abutment (slab on piles)		

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NB VIADUCT STA 2085	CS	5762	138	1966	I-5 NB
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (14.7); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Column Isolation ; Column jacketing - Steel ; Micropile or foundation enlargement

Notes for WSDOT

Jacketing columns will likely lead to inadequate capacity in the shafts. Potentially also the superstructure.
Very long bridge, but relatively easy to build model. Will have a lot of data due to the size.
Analysis may find bridge has poor seismic performance. Will be some torsion due to cross slope (also bridge makes a very shallow 'S' between abutments)
Expansion joints have a horizontal shear transfer device

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	30	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
2.5	2.06	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	9	N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
137	Varies	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	4.92	37.86
Bearing Type	Original Foundation Type	Widened Foundation Type
Sliding bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Shafts	NA

Additional Notes

34 units, typically 4 span units, sliding expansion joints @ 7' off columns. Widened 7" to 6' in width. Widening used a PTFE and fabric pad at expansion joint Typical 4 columns (3' diam), number varies at variable width locations (ramps), some locations have a wall connecting the columns. Widening thickened part of crossbeam Typically 3.5' diameter shafts, retaining wall built behind abutment columns/shafts, large cross slopes in some piers.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
SB VIADUCT STA 2075	CS	6584	157	1967	I-5 SB
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (16.6); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Column Isolation ; Column jacketing - Steel ; Micropile or foundation enlargement

Notes for WSDOT

Jacketing columns will likely lead to inadequate capacity in the shafts. Potentially also the superstructure.
Very long bridge, but relatively easy to build model. Will have a lot of data due to the length.
Analysis may find poor seismic performance. Will be some torsion due to cross slope (also bridge makes a very shallow 'S' between abutments). Extreme short at Bent 22
Expansion joints have a horizontal shear transfer device

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	35	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
2.5	2.06	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0		N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
156	Varies	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	2.5	63.77
Bearing Type	Original Foundation Type	Widened Foundation Type
Sliding bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Shafts	NA

Additional Notes

38 units, typically 4 span units, dowel expansion joints @ 7' off columns. Widened 7" to 6' in width. Widening used a PTFE and fabric pad at expansion joint Typical 4 columns (3' diam), number varies at variable width locations (ramps), some locations have a link beam connecting the shafts. Widening thickened part of crossbeam Typically 3.5' diameter shafts, small retaining wall built behind abutment shafts, large cross slopes in some piers.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-E RAMP OVER I-5	CBOX CS	1422	25	1967	I-5 SB OFF RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer ; Overpass	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (3.4); Curved (1.1); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Catcher block or Seat Widening ; Column jacketing - FRP ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP ; Superstructure Strengthening - Other

Notes for WSDOT

Note, fire damage noted in Span 23.

Vulnerability analysis will need to assess adequacy of existing restrainers and coolumn jackets.
Potential for interaction with NB & SB I-5. (notably Pier 4, see PDF Page66/85)
Column jackets only added to Box Girder portion of structure.
No additional capacity protection provided.
May be difficult to get capacity protection from concrete slab superstructure. Will likely require thickened crossbeam for capacity protection.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	64	134.1
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
20	91.32	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	17	N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
7	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	24	78
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Shafts	NA

Additional Notes

Concrete box to south, concrete slab begins in span 8 5' diam column Piers 2-4, 6' diam column Piers 5-8 Stepped abutment supported on drilled shafts. 6' diam drilled shaft at Piers 2-3, 7' diam drilled shaft at Piers 4-8

▼ Add'l Bridge Info for 2nd Structure Type

.Girder Type	.Shortest Span (ft)	.Longest span (ft)
Slab	64	134.1
.Max Degree of Curvature	.Sweep Angle btwn Abutments	.SS Continuity
1	3.34	Continuous
.Deck Exp Joints?	.Long. Exp Joints?	.In-Span Hinge?
Yes	No	No
.Skew Angle	.Seat Width (in)	.Girder Stop?
0		No Girder Stops
.No. Inter. Piers	.Column Numbers / Bent	.Column Shape
17	2	Round
.Column Fixity	.Shortest Column Height (ft)	.Tallest Column Height (ft)
Fixed-Fixed	12.9	84.33
.Bearing Type	.Original Foundation Type	.Widened Foundation Type
NA	Shafts	NA
.Battered?	.Original Abutment Foundation Type	.Widening Abutment Foundation Type
No	NA	NA

.Additional Notes

Concrete slab begins at in-span hinge North of Pier 8. Expansion joints have a slip joint between reinforcing and concrete. No Column jackets. Piers 9 - 13, 5' diameter columns with strut connecting 2 columns, Pier 14, 4' diameter columns with strut connecting 2 columns, Piers 15-26 3' diam columns. No Abutment either side. Piers 9 - 13, 6' diam shafts , Pier 14, 6' diam shafts, Piers 15-26 3.5' diam shafts

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NB VIADUCT STA 2075	CS	872	21	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer	1990	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Previously Retrofit (1.1); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (3); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - Steel ; Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

Large degree of variability in the column heights.
Will require column jackets, however, this will lead to issues meeting capacity protection in the superstructure and substructure elements.
Widening has single diameter column/shafts at most piers. Will potentially have significant issues meeting the capacity protection requirements.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	29	45
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	7.75	N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
20	3	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	10.13	70.46
Bearing Type	Original Foundation Type	Widened Foundation Type
Sliding bearing	Shafts	Shafts ; Spread
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Shafts	Shaft

Additional Notes

Sliding Bearing Detail at in-span expansion joints. 3' diameter columns into 3.5' diameter shafts, 3.5' & 4' dia. columns into 5' diameter shafts. 10 long wingwalls cantilever off of the abutment stem. 1 side of abutment only.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-W RAMP WB VIADUCT	CBox	2885	33	1967	SPOKANE ST WB LANE
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2012	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (4.2); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Extra Modelling complexity (i.e. Previous widening) ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - Steel ; Micropile or foundation enlargement ; Seismic Restrainer

Notes for WSDOT

Very long bridge with sweeping "S" curve alignment and 9 frames, width varies from 1 to 3 lanes with multiple ramp stubs. Numerous tension and compression models will be needed. Existing restrainers at hinge joints (1992) and steel jackets on single-column piers (2003) may perform fairly well, though restrainers and superstructure may need additional strengthening. Remaining columns may need jacketing and pile footings may need strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	15	119.6
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
10	55.4	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
33	1-3	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	7	58
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Piles - Concrete ; Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA

Additional Notes

9 frames varying from 1 to 3 lanes wide, sweeping left then right, with 5 ramp stubs. Seismic restrainers added at hinge joints in 1992. 1, 2, and 3 column piers on drilled shafts or pile footings. 2003 retrofit installed steel jackets on single column piers only. concrete piles are concrete filled pipe piles; piles lack embedment and footings lack top reinforcement.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
W-6TH RAMP BR	CS	411	10	1967	I-5 RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Catcher Block ; Seat Extension	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Multiple superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.9); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - Steel ; Curtain Wall Strengthening ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP ; Web Wall Strengthening

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	16.25	44.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
6.2	16.8	Continuous/Simple
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	3	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
16	Varies (2 or 8 or 5)	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	8.5	24.5
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Piles - Concrete	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles	NA

Additional Notes

Integral Bents with web walls and curtain walls. 1.08' columns are plain concrete piles.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-W RAMP BR	CBox	1029	12	1967	I-5 S-W RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None	2007	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.6)
Geotechnical Factors: Span (2.1); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column Isolation ; Micropile or foundation enlargement ; Seismic Restrainer

Notes for WSDOT

Expect that steel jacketed columns may perform OK; hinge joint restrainers will likely need strengthening, pile footing w/o top reinforcement will likely need strengthening, superstructure may need strengthening, and top of shafts may need strengthening. Two very short columns may need some isolation to soften them.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	15	94
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
11	69.6	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
11	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	8.9	80.5
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Single Shaft	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles	NA

Additional Notes

3 frames of cip conc box; 1-lane ramp structure; seismic restrainers added in 1992. all single column piers, 5'-dia.; steel jackets added in 2007 Pier 1 on conc-pile footing; rest on single shafts. No abutment; ramp frames between two other bridges.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
6TH-S RAMP BR	CBOX CS	424	4	1967	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer ; Seat Extension	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.0)
Geotechnical Factors: Span (1.3); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Seismic Restrainer

Notes for WSDOT

Bridge has a cellular abutment at one end. Intermediate piers are single diameter piles/columns. Retrofit should consider connecting the superstructure to the curtain walls to significantly reduce the displacement demands.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	75	90
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	48	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
3	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	12.8	19.81
Bearing Type	Original Foundation Type	Widened Foundation Type
Asbestos Packing ; Roller bearing	Piles - Concrete ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles-Concrete	NA

Additional Notes

5'-0" deep double cell Cbox with 7" top and 6.5" bottom slabs. Rollers at Pier 4 (abutment) Pier 4 is an abutment with 27.33'/x7.25'x2.75' spread footing on 12 (2-rows of 6) 13" concrete piles.

▼ Add'l Bridge Info for 2nd Structure Type

.Girder Type	.Shortest Span (ft)	.Longest span (ft)
Slab	16.25	20
.Max Degree of Curvature	.Sweep Angle btwn Abutments	.SS Continuity
0	0	Continuous
.Deck Exp Joints?	.Long. Exp Joints?	.In-Span Hinge?
No	No	No
.Skew Angle	.Seat Width (in)	.Girder Stop?
0	16.5	No Girder Stops
.No. Inter. Piers	.Column Numbers / Bent	.Column Shape
4	5	Round
.Column Fixity	.Shortest Column Height (ft)	.Tallest Column Height (ft)
Fixed-Fixed	5.53	8.74
.Bearing Type	.Original Foundation Type	.Widened Foundation Type
Sliding bearing	Piles - Concrete	NA
.Battered?	.Original Abutment Foundation Type	.Widening Abutment Foundation Type
No	Piles	NA
.Additional Notes		
Cellular Abutment Cellular Abutment Cellular Abutment		

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
E-S RAMP BR	CBox	1206	15	1967	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2008	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.6)
Geotechnical Factors: Span (2.4); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening) ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - FRP ; Micropile or foundation enlargement ; Seismic Restrainer

Notes for WSDOT

Expect column jackets may perform OK; connections to superstructure and shafts may be inadequate and pile footings with no top reinforcement and shallow pile embedment will likely have poor performance. Columns in multi-column piers may need FRP jacketing for additional confinement. Superstructure restrainers may need strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	15	92.3
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
15.2	93.5	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
14	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	18.5	30
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Piles - Concrete ; Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Combination	NA

Additional Notes

4 frames of cip conc box ramp structure; splits to two adjacent legs on west end. Fairly uniform column heights, from 18.5'-30'; bottom hinge zone details have short splices. Concrete piles are filled steel pipe piles. about half of col's on shafts; west half on pile footings.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
W-S RAMP OVER MAINLINE & RAMPS	CBox	1664	19	1967	W-S RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2003	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (2.8); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - FRP ; Seismic Restrainer

Notes for WSDOT

Existing steel jackets and drilled shaft foundations may perform well. May need strengthening of existing superstructure, restrainers and possibly FRP jacketing of upper column section of oblong columns.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	60	103
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
12	58.5	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
18	1	Round ; Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	22.2	97.8
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA

Additional Notes

5 frames of cip conc box; uniform width throughout. round and oblong columns w/ steel jackets; oblong column jackets only in hinge/splice zone all drilled shafts; various sizes

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-E RAMP BR	CS	872	21	1967	I-5 RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Shaft deep foundations (1.1); Previously Retrofit (1.1); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (3); Curved (1.1); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - FRP ; Superstructure Strengthening - FRP

Notes for WSDOT

Column jackets are only 1/4" thick and will need to be checked for seismic loading.
The shafts and the superstructure are likely incapable of resisting the seismic overstrength demands.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	35	49
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
17	29.49	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	6	N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
20	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	12.47	48.25
Bearing Type	Original Foundation Type	Widened Foundation Type
Sliding bearing	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Shafts	NA

Additional Notes

Sliding Bearing Detail at in-span expansion joints. Single 4'-0" dia. column into 5'-0 dia. shafts typical. 10 long wingwalls cantilever off of the abutment stem. 1 side of abutment only.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
6TH-N RAMP BR	CS	154	8	1967	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Catcher Block	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.7); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - Steel ; Curtain Wall Strengthening ; Pier wall strengthening

Notes for WSDOT

Cellular abutment. Intermediate piers are single diameter pile/columns. Retrofit should consider connecting the superstructure to the curtain walls to significantly reduce the displacement demands.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
N/A	16.1	86.2
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	16.5	N/A
No. Inter. Piers	Column Numbers / Bent	Column Shape
7	0	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	7.29	15.65
Bearing Type	Original Foundation Type	Widened Foundation Type
Sliding bearing ; Steel Roller	Piles - Concrete	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Unknown	NA

Additional Notes

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
E-N RAMP OVER I-5	CBox	284	3	1966	E-N RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Catcher Block	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-pile deep foundations (1.25); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.0)
Geotechnical Factors: Span (1.2); Curved (1.1); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Girder Stops ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	62.1	111.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
12.3	20.1	Continuous/Simple
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
12	40.5	Unknown
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	22.1	30.2
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Piles - Concrete	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Unknown	Unknown	NA

Additional Notes

Abutment detail is missing, seat width is measured in Sheet 54 of 73. Bridge is skewed at expansion joint pier. Integral Bents Abutment is on one side and adjacent structure is on the other.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-6TH RAMP BRIDGE	CBox	720	8	1967	I-5 N - 6TH RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer ; Catcher Block	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.7); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column Isolation ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	75	104
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
9.1	63	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	51	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
7	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	28.5	72.2
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller	Piles - Concrete ; Single Shaft	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles-Concrete	NA
Additional Notes		

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
E-N RAMP BR	CS	406	10	1967	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2007	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Previously Retrofit (1.1); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.9); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks

Anticipated Retrofit Measures

Capbeam Strengthening ; Catcher block or Seat Widening ; Column Isolation ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
1'-6" Reinf. Slab	35	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	60	N/A since no girders
No. Inter. Piers	Column Numbers / Bent	Column Shape
9	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	12.7	31.21
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA

Additional Notes

In-span Exp. Joint 7'-0" away from Pier 6 (Box Hinge Restrainer), Longit. and Transv. Restrainer at Pier 1 Hammerhead Int. Bents with 1'-6" deep cap, 4'-0" round column on 5'-0" shaft. Piers 1 and 11, two columns on shafts. Piers 2-10, single column on single 5'-0" shaft.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
W-N RAMP BR	CS	406	10	1967	W-N RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Previously Retrofit (1.1); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.9); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Connection and Seat Width Checks

Anticipated Retrofit Measures

Column Isolation ; Column jacketing - Steel ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

abutments have reinforcement connecing the substructure to the deck/end diaphragm, therefore not an expansion joint at the end of bridge. In span hinge 7' after pier 6 - seat width measured at inspan hinge. Will need to check restrainer, tie rods, superstructure, shafts and jackets (only 1/4" thick)

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	35	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
9	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	7.9	15.8
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Shafts	NA
Additional Notes		

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
EB LANES OVER I-5	CBox	1793	20	1966	SPOKANE ST EB LANE
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (2.9); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening) ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - Steel ; Seismic Restrainer

Notes for WSDOT

1, 2, and 3-column piers, 2-legged ramp at one end. Expect existing steel jackets (only single column piers) to perform fairly well. Expect that other columns may need strengthening, as will pile footings. Existing superstructure restrainers and end diaphragms may need strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	15	117
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
11	71.4	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
22	1-3	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	16.5	50
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Piles - Concrete ; Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA

Additional Notes

6 frames cip conc box, plus an adjacent 7th frame at split leg end. 1, 2 and 3 column piers; appears that only single column piers were jacketed in 2003. concrete piles are concrete filled steel pipe piles. pile footings lack top reinf. and pile embedment.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-W RAMP OVER I-5 MAINLINE	CBox	1708	17	1967	NB I5 OFF RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Seismic Restrainer ; Catcher Block	2003	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Higher LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Shaft deep foundations (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (1.6)
Geotechnical Factors: Span (2.6); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Ordinary SEE Significant No Service	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Micropile or foundation enlargement ; Seismic Restrainer

Notes for WSDOT

Existing column retrofits may perform OK. Superstructure restrainers may need to be strengthened, pile footings may need strengthening/enlargement and internal end diaphragms may need strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	73	141
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
13	99.6	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	24	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
16	1	Round ; Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
	21.2	78.3
Bearing Type	Original Foundation Type	Widened Foundation Type
Roller bearing	Piles - Concrete ; Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA

Additional Notes

CIP box structure with roller bearings at in-span hinges; existing restrainers may not hold up to new loads. 5 frames, eccentric columns in 2 frames, steel jackets pile footings lack embedment and top reinforcement

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NB VIADUCT STA 2064	CS	746	18	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer ; Widened	1990	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (2.7); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Bridge Tie ; Capbeam Strengthening ; Column jacketing - Steel ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	37	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0.2	3.7	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	33	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
17	Varies (3 or 4)	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	11.6	20.5
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Shafts	Single Shaft
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	Single Shaft
Additional Notes		

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
SB VIADUCT STA 2064	CS	746	18	1967	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer	1990	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Shaft deep foundations (1.1); Multiple superstructure sections (1.1); Previously Retrofit (1.1); Adjacent structure interaction (1.2); Landslide hazard (1.2); Span (2.0)
Geotechnical Factors: Span (2.7); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Bridge Tie ; Capbeam Strengthening ; Column jacketing - Steel ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	37	42
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0.2	3.7	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	Yes	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	33	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
17	Varies (4 or 3)	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	14.9	28.2
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Shafts	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Shafts	NA
Additional Notes		
Integral Bents		

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
SB VIADUCT STA 2032	PCG	601.6	6	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer ; Widened ; Girder Stops	1994	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Previously widened (1.2); Previously Retrofit (1.1); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.5); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Recovery SEE Moderate Limited	Site Class D-E
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Capbeam Strengthening ; Catcher block or Seat Widening ; Column Isolation ; Column jacketing - Steel ; Micropile or foundation enlargement

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
Series 100	99.8	101.1
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
1.5	10.5	Simple Span
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0.74	21	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
5	6	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	29.5	105.7
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller ; Steel Plate	Hollow-Core Piles ; Spread	Single Shaft
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Combination	Single Shaft

Additional Notes

Seismic restrainers exist at intermediate piers where the bridge hinges are located. Columns of original structures at Piers 6 and 7 are hollow core p/s core piles filled with conc., RC columns at the rest of piers. Columns of widened structure are drilled shaft. Original abutments have spread footing supporting columns at one end and hollow core p/s conc. piles at the other end.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NB VIADUCT STA 2032	PCG	901	9	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer ; Widened ; Girder Stops	1993	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Previously widened (1.2); Previously Retrofit (1.1); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.8); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Recovery SEE Moderate Limited	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Capbeam Strengthening ; Catcher block or Seat Widening ; Column Isolation ; Column jacketing - FRP ; Micropile or foundation enlargement

Notes for WSDOT

Bridge columns and shafts were constructed using hollow-core piles. There is a note on the drawings that these were to be filled with concrete.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
Series 100	99.8	101
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
1.8	15.8	Simple Span
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0.88	24	One in Each Bay
No. Inter. Piers	Column Numbers / Bent	Column Shape
8	6	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	40.3	106.1
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel cylinder roller ; Steel Plate	Hollow-Core Piles	Single Shaft
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Combination	Single Shaft

Additional Notes

Seismic restrainers exist at intermediate piers where the bridge hinges are located. Superstructure is supported directly by hollow core p/s conc. piles. Spread footings supporting columns at one abutment, and hollow core p/s conc. piles group at the other abutment.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 OVER LUCILE ST	CS	190	3	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None ; Widened	1994	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Previously widened (1.2); Span (1.0)
Geotechnical Factors: Span (1.2); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class B
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Column jacketing - Steel ; Girder Stops ; Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

Similar and adjacent to 0007734B; 5/534E.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	56	69.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
22.33	27	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	5	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	28.6	31.7
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Plate	Spread	Single Shaft
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	Shafts

Additional Notes

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 OVER LUCILE ST	CS	172	3	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Span (1.0)
Geotechnical Factors: Span (1.2); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class B
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover

Anticipated Retrofit Measures

Column jacketing - Steel ; Girder Stops ; Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

1990 plan set shows addition of HOV but no seismic retrofit. Similar and adjacent to 0007734C; 5/534W.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CSlab	41	69.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
22.33	27	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	5	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	30.5	34.6
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Plate	Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	NA

Additional Notes

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 SB OVER N-W RAMP	CBox	469	6	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer ; Widened	1994	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Skewed (1.1); Multi-frame (1.25); Box girder superstructure sections (1.1); Previously widened (1.2); Previously Retrofit (1.1); Span (1.3)
Geotechnical Factors: Span (1.5); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class D-E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Pushover ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Capbeam Strengthening ; Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP ; Web Wall Strengthening

Notes for WSDOT

1 of 2 frames skewed. Seismic restrainers have been retrofited but might need to be strengthened in the future retrofit. Connection between split column and cap at Pier 4 may require strengthening and could be challenging.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	56.17	106.78
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
3	14	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
54.45	12	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
5	3	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	20.1	59.26
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Rocker ; Fabric Pad	Spread	Shafts
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Spread	Shaft

Additional Notes

seismic restrainer across pier 4. min seat width reported from pier 1 Pier 4 columns oblong split column, remainder round. Up to 30' column length variation within same pier 3 Widened portion uses shafts, remainder spread

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
E-N RAMP OVER RR, AIRPORT WAY	CBox	938.5	11	1966	RAMP TO I-5 NB/SB
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Catcher Block ; External Girder Stops	2007	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Span (1.3)
Geotechnical Factors: Span (2); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class D-E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Atypical detail – Split column

Anticipated Retrofit Measures

Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Micropile or foundation enlargement ; Seismic Restrainer ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	69.9	111
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
14.1	14.1	Continuous/Simple
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
23.61	18	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
10	Varies (2 or 1)	Round ; Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	13.8	46.2
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Piles - Steel ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Combination	NA

Additional Notes

Number of girder lines varies. Elliptical columns are split in the higher part of the columns. Integral Bents. Only some of the columns were jacketed. Steel pile group at one abutment and spread footing at the other abutment.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
E-N RAMP OVER I-5	CBox	339	4	1966	E-N RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Overpass ; Catcher Block ; External Girder Stops	2007	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Lower LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-pile deep foundations (1.25); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Span (1.0)
Geotechnical Factors: Span (1.3); Curved (1.1); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class B
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover

Anticipated Retrofit Measures

Girder Stops ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	60	106.3
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
20	66.83	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	36	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
3	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	20.5	28.7
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Rocker	Piles - Concrete ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Spread	NA

Additional Notes

Wing walls for pier 5, not pier 1. Piles/battered piles at pier 1 only, remainder are spread

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-W RAMP OVER LUCILE ST	CBox	550	7	1967	S-W RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Catcher Block ; External Girder Stops	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.6); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D-E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Atypical detail – Split column ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Original Plan sheet 116 of 117 not included in set. Can be found with 5/534A

Common Pier (at beginning of bridge, Pier 9) where bridge splits from a single alignment to two alignments (each ramp has a different bridge number)

Existing column retrofits may perform OK. However, capacity protected elements may require strengthening.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
N/A	63.5	98.7
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
16.5	76.5	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	36	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
6	Varies	Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	34.6	63.5
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Rocker	Piles - Steel ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Spread	NA

Additional Notes

split columns, odd shape. Columns on steel piles and Piers 13-15 on spread footings. Joint pier is a multi-column bent (2 columns) and remainder of piers are a single column.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-W RAMP OVER AIRPORT WAY	CBox	636	8	1967	I-5 S-W, N-W RAMPS
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Catcher Block ; External Girder Stops	2007	Multiple Spans			

Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multi-pile deep foundations (1.25); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.3)
Geotechnical Factors: Span (1.7); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D-E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Atypical detail – Split column ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Column jacketing - Steel ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Abutment on 1 end, adjacent structure on the other end.
Most columns have not received column jackets, likely needed.
Pier 9 column has been jacketed as part of the 5/534S-W bridge retrofit.
Catcher block may perform OK. However, column jacketing may require significant upgrades to capacity protected elements.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
N/A	58	95
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
13.3	43.6	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	36.75	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
7		Round ; Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	18.14	45.61
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Rocker	Piles - Steel	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	NA

Additional Notes

Deck integral with diaphragms and diaphragms integral with all non-expansion piers. Similar at expansion piers (integral on each side of expansion). Typically round columns. Eliptical columns with a split at expansion joints (P5 & P9) Battered Piles present at abutments.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
S-ALBRO RAMP BR	CS	173	3	1966	S-ALBRO RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Shear Block	2007	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Lower LOE

Factors Increasing LOE

Structure Factors: Multi-pile deep foundations (1.25); Previously Retrofit (1.1); Liquefiable soils (1.4); Span (1.0)
Geotechnical Factors: Span (1.2); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class B
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover

Anticipated Retrofit Measures

Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
2'-6" Slab	50.8	67
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0		No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	1	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	18.8	32.75
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Piles - Concrete ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	NA

Additional Notes

2.5' thick slab Single Jacketed 4' round column per Int. Bent. Abutment / Pier 1 is on two rows of piles with one of them being battered, with 2'-6" min Bent Cap (varies). Pier two 9'x15'x3.5' footing on 14 round 13" concrete piles. Pier three on 9'x10'x2.5' footing no piles. Pier 4 no piles.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-W RAMP OVER RR	CBox	289	3	1967	N-W RAMP
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Catcher Block ; External Girder Stops	2007	Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-pile deep foundations (1.25); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Previously Retrofit (1.1); Liquefiable soils (1.4); Adjacent structure interaction (1.2); Span (1.0)
Geotechnical Factors: Span (1.2); Curved (1.1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class D-E
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections ; Atypical detail – Split column ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Internal Diaphragm Strengthening (Requires Access Hatches) ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	83.1	114.7
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
24.9	33.8	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	43.5	External Only
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	1	Elliptical
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	44.8	49.9
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Piles - Steel ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Spread footing supporting column	NA

Additional Notes

Split column supporting this bridge and adjacent structure. Integral Bents. Column is 6.3'x5' in Pier 9. Retrofitting may increase the column sections. Abutment is on one side and adjacent structure is on the other. Column in one pier is supported on a pedestal.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 UNDER ALBRO ST	CBox	283	4	1966	ALBRO ST
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Lower LOE

Factors Increasing LOE

Structure Factors: Box girder superstructure sections (1.1); Adjacent structure interaction (1.2); Span (1.0)
Geotechnical Factors: Span (1.3); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class C
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Pushover ; Adjacent Structure Interaction

Anticipated Retrofit Measures

Catcher block or Seat Widening ; Girder Stops ; Internal Diaphragm Strengthening (Requires Access Hatches) ; Pier wall strengthening ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	60	81.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
14.34	19.25	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
3	1	Wall
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	23.3	30.1
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Combination	NA

Additional Notes

Integral Bents Abutment Foundation Type at Pier 1 is "Spread", at Pier 5 is "Group Piles-Steel Pipe Filled with Concrete".

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
N-SWIFT RAMP	CBox	391	8	1969	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	No		

Assessment Summary

Seismic Vulnerability Assessment LOE

●●○ Medium LOE

Factors Increasing LOE

Structure Factors: Curved (1.1); Multi-frame (1.25); Multiple superstructure sections (1.1); Box girder superstructure sections (1.1); Landslide hazard (1.2); Span (1.3)
Geotechnical Factors: Span (1.7); Curved (1.1); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Ordinary SEE Significant No Service	Site Class B
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover ; Various superstructure sections

Anticipated Retrofit Measures

Capbeam Strengthening ; Column Isolation ; Column jacketing - Steel ; Girder Stops ; Seismic Restrainer

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
CBox	48.8	48.8
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
68.2	90	Simple Span
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	18	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
7	2	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Pinned	9.7	21.86
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles	NA

Additional Notes

3' deep box girder with 6.5" top and bottom slab. Pier 1 has 2.25' deep cap beam with two 2' round columns; Piers 2 - 9 have 2.5' deep cap beam with two 3' round columns. Spread Footing size: Pier 1 - 10'x13'x2.33', Piers 2, 3, 4 - 9.5'x12', Pier 5, 6 - 11.5'x13.5', Piers 7, 8 - 13'x15, Pier 9 - (7) 2.5' drilled shafts

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
SB VIADUCT STA 1918	SG	529	4	1967	I-5 SOUTHBOUND
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Seismic Restrainer ; Widened ; External Girder Stops	1992	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Grillage/shell models required (1.75); Multi-pile deep foundations (1.25); Previously widened (1.2); Previously Retrofit (1.1); Landslide hazard (1.2); Span (1.0)
Geotechnical Factors: Span (1.3); Hazard analysis flag (1)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Complex	Recovery SEE Moderate Limited	Site Class D
Peat	Cyclic Softening	Landslide Hazard
No	No	Level 1
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; ii. Grillage model ; Deep foundations/Fdn spring iteration ; Pushover ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Capbeam Strengthening ; Column Isolation ; Column jacketing - FRP ; Girder Stops ; Isolation bearings ; Superstructure Strengthening - Other

Notes for WSDOT

Significant cross slope of soil which leads to highly variable column heights within a pier; may need some confinement reinforcement on hollow core piles/columns and/or column isolation, capbeam strengthening, steel cross frame strengthening, and additional bearing restraint/strengthening. Grillage model assumed to evaluate steel cross frames. May need to consider isolation bearings.

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
Steel Plate Girder	80	150
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
2.5	13.24	Continuous/Simple
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	Yes
Skew Angle	Seat Width (in)	Girder Stop?
0	28	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
3	3-5	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	0	18.9
Bearing Type	Original Foundation Type	Widened Foundation Type
Steel Plate	Hollow-Core Piles ; Piles - Steel	Shafts
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	Shaft

Additional Notes

steel transverse bearing restraints; mostly single spans; one in-span hinge; large radius curve (2291.8'). low profile rocker brgs; retrofitted for transv. restraint hollow core p/s conc piles with steel I-shaped cores and conc.; drilled shafts/columns for widening; steel piles at abut's, front row battered; ground appears to have a fair side slope so variable stiffness each bent.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 OVER MILITARY RD	CS	161	3	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Widened ; Expension Joint	2013	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

 Lower LOE

Factors Increasing LOE

Structure Factors: Skewed (1.1); Multi-pile deep foundations (1.25); Previously Retrofit (1.1); Span (1.0)
Geotechnical Factors: Span (1.2); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class C
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover

Anticipated Retrofit Measures

Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
2'-4" thick slab	47	62
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
77	36	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	5	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	22.1	29
Bearing Type	Original Foundation Type	Widened Foundation Type
NA	Piles - Steel	Piles - Steel
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	Piles

Additional Notes

2'-4" Slab Depth. Slightly curved (R is not specified) but could be ignored. Exp. joints at piers 1 and 4. Four 1966 jacketed columns and one 1990 widened column per Bent 2 and Bent 3. 1966 Piers 2 and 3 have a 9'x12'x4.167' spread footing with twelve 12BP53 steel piles. Widening portion of Piers 2 and 3 have a 9.5'x9.5'x4.5'spread footing with 8 HP 12x53 piles. Original abutments 1 and 4 have two rows of 12BP53 steel piles with first battered row.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 OVER MILITARY RD	CS	149	3	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
Jacketed Columns ; Widened ; Expension Joint	2013	Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Previously widened (1.2); Previously Retrofit (1.1); Span (1.0)
Geotechnical Factors: Span (1.2); Hazard analysis flag (0)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class C
Peat	Cyclic Softening	Landslide Hazard
No	No	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	No	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; c. Compression model only ; i. Spine model ; Pushover ; Extra Modelling complexity (i.e. Previous widening)

Anticipated Retrofit Measures

Catcher block or Seat Widening ; Micropile or foundation enlargement ; Superstructure Strengthening - FRP

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
2'-4" thick slab	45.5	57.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Continuous
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
0	36	No Girder Stops
No. Inter. Piers	Column Numbers / Bent	Column Shape
2	5	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	22.3	30.7
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Spread	Shafts
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
N/A	Spread	Shaft

Additional Notes

2'-4" Slab Depth Four 1964 jacketed columns, one 1994 widened column 1964 Piers 2 and 3 have spread footing (no piles) of 8'x8'x2.5', Widened portion has a drilled shaft

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NORFOLK ST SEWER	PCG	74	1	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None ; Widened	1994	Single Span	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Lower LOE

Factors Increasing LOE

Structure Factors: Skewed (1.1); Multi-pile deep foundations (1.25); Previously widened (1.2); Liquefiable soils (1.4); Span (1.0)
Geotechnical Factors: Span (1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Simple Span	Recovery SEE Moderate Limited	Site Class E-F
Peat	Cyclic Softening	Landslide Hazard
Yes	Yes	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

Extra Modelling complexity (i.e. Previous widening) ; Connection and Seat Width Checks ; Foundation Stability Check

Anticipated Retrofit Measures

Catcher block or Seat Widening ; Girder Stops

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
VARIES	74.5	74.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Simple Span
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	No	No
Skew Angle	Seat Width (in)	Girder Stop?
61.4		Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
0		
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Piles - Concrete	Piles - Concrete
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	Piles

Additional Notes

13'-0" Widening. Original 3'-6" W-Girders, Widened 4'-2" W50G Girders No Intern Piers. Original 13" Precast Conc. Piles. Widenined 2'-6" deep cap supported on 2 rows of H-Piles.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
NORFOLK ST SEWER	PCG	64	1	1966	I-5
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None ; Widened	1995	Single Span	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE



Factors Increasing LOE

Structure Factors: Skewed (1.1); Multi-pile deep foundations (1.25); Previously widened (1.2); Liquefiable soils (1.4); Span (1.0)
Geotechnical Factors: Span (1); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Simple Span	Recovery SEE Moderate Limited	Site Class E-F
Peat	Cyclic Softening	Landslide Hazard
Yes	Yes	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
Yes	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

Extra Modelling complexity (i.e. Previous widening) ; Connection and Seat Width Checks ; Foundation Stability Check

Anticipated Retrofit Measures

Catcher block or Seat Widening ; Girder Stops

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
Series 60	64.5	64.5
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
	0	Simple Span
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
No	No	No
Skew Angle	Seat Width (in)	Girder Stop?
61.4	3	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
0		
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Piles - Concrete	Piles - Concrete
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
Yes	Piles	Piles

Additional Notes

3'-6" W-Girders No Inter. Piers Two rows of concrete piles on each abutment.

Bridge Basic Information

Bridge Name	Span Type	Br. Len. (ft)	No. of Spans	Year Built	Facilities Carried
I-5 UNDER BOEING ACCESS RD	PCG	337.5	5	1966	S BOEING ACCESS RD
Previous Seismic Retrofit	Last Retrofit Yr	Multiple/Single Span	Boring Log		
None		Multiple Spans	Yes		

Assessment Summary

Seismic Vulnerability Assessment LOE

Medium LOE

Factors Increasing LOE

Structure Factors: Multi-frame (1.25); Multi-pile deep foundations (1.25); Liquefiable soils (1.4); Span (1.0)
Geotechnical Factors: Span (1.4); Hazard analysis flag (0.5)

Retrofit Category	Expected Seismic Performance	Seismic Site Class
Typical	Recovery SEE Moderate Limited	Site Class E-F
Peat	Cyclic Softening	Landslide Hazard
Yes	Yes	NA
Abutment Passive Resistance?	Liquefiable	Ground Motion Level
No	Yes	Upper Level (1000 years)

Anticipated Analysis Measures

a. RSA Analysis ; b. Tension and Compression models ; i. Spine model ; Deep foundations/Fdn spring iteration ; Pushover

Anticipated Retrofit Measures

Bridge Tie ; Capbeam Strengthening ; Catcher block or Seat Widening ; Column jacketing - Steel ; Girder Stops ; Micropile or foundation enlargement

Notes for WSDOT

Additional Bridge Information

Girder Type	Shortest Span (ft)	Longest span (ft)
Series 80	50	81
Max Degree of Curvature	Sweep Angle btwn Abutments	SS Continuity
0	0	Simple Span
Deck Exp Joints?	Long. Exp Joints?	In-Span Hinge?
Yes	Yes	No
Skew Angle	Seat Width (in)	Girder Stop?
22.08	24	Some present
No. Inter. Piers	Column Numbers / Bent	Column Shape
4	5	Round
Column Fixity	Shortest Column Height (ft)	Tallest Column Height (ft)
Fixed-Fixed	19.7	26.2
Bearing Type	Original Foundation Type	Widened Foundation Type
Elastomeric pad	Piles - Steel ; Spread	NA
Battered?	Original Abutment Foundation Type	Widening Abutment Foundation Type
No	Piles-Concrete	NA

Additional Notes