

STRUCTURES INSPECTION FIELD REPORT

FRACTURE CRITICAL INSPECTION

2-DIST
04

B.I.N.
2M4

BR. DEPT. NO.
L-15-088

CITY/TOWN LOWELL	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	11-Kilo. POINT 000.000	90-ROUTINE INSP. DATE Nov 16, 2022	93a - F.C. INSP. DATE Nov 16, 2022
07-FACILITY CARRIED HWY WOOD ST EXT	MEMORIAL NAME/LOCAL NAME ROURKE BRIDGE	27-YR BUILT 1983	106-YR REBUILT 0000	*YR REHAB'D (NON 106) 0000
06-FEATURES INTERSECTED COMB BMRR & MERRIMACK R	26-FUNCTIONAL CLASS Urban Arterial	DIST. BRIDGE INSPECTION ENGINEER J. Dideo		
43-STRUCTURE TYPE 310 : Steel Truss - Thru	22-OWNER State Highway Agency	21-MAINTAINER State Highway Agency	TEAM LEADER S. St Hilaire	PROJ MGR HNTB Corporation
107-DECK TYPE 5 : Steel plate	WEATHER Varied	TEMP. (air) 4°C	TEAM MEMBERS E. B. ROTKIEWICZ, T. GOETZ, T. E. MANNING	

WEIGHT POSTING	<i>Not Applicable</i>				Signs In Place (Y=Yes, N=No, NR=Not Required) Legibility/Visibility	At bridge		Advance		PLANS (Y/N): <input checked="" type="checkbox"/> Y	
	H	3	3S2	Single		N	S	N	S		(V.C.R.) (Y/N): <input type="checkbox"/> N
	Actual Posting	20	25	28		N	Y	Y	Y		
Recommended Posting	20	25	28	N	7	6	7	6			
Waived Date:	00/00/0000		EJDMT Date:	00/00/0000		TAPES#:					

RATING

Rating Report (Y/N): Y Date: **06/01/2003** Recommend for Rating or Rerating (Y/N): N If YES please give priority: HIGH () MEDIUM () LOW ()

Inspection data at time of existing rating
I 58: 7 I 59: 7 I 60: 5 I 62: Date : 10/11/2002

REASON:

FRACTURE CRITICAL MEMBER(S):

	MEMBER	CRACK (Y/N):	WELD'S CONDITION (0-9)	LOCATION OF CORROSION, SECTION LOSS (%), CRACKS, COLLISION DAMAGE, STRESS CONCENTRATION, ETC.	CONDITION		INV. RATING OF MEMBER FROM RATING ANALYSIS			Deficiencies
					PREVIOUS (0-9)	PRESENT (0-9)	H-20	3	3S2	
A	Item 59.2 - Floorbeams/Transoms	N	N	See remarks in comments section.	6	6	21	41	65	M-P
B										
C										
D										
E										

List of field tests performed:
Visual and Hands-on.

(Overall Previous Condition)	I-59	I-60
	<input type="text" value="6"/>	<input type="text" value="5"/>
(Overall Current Condition)	<input type="text" value="6"/>	<input type="text" value="5"/>

DEFICIENCY: A defect in a structure that requires corrective action.

CATEGORIES OF DEFICIENCIES:

M= Minor Deficiency Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor pot holes, Minor corrosion of steel, Minor scouring, Clogged drainage, etc.

S= Severe/Major Deficiency Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroded rebars, Considerable settlement, Considerable scouring or undermining, Moderate to extensive corrosion to structural steel with measurable loss of section, etc.

C-S= Critical Structural Deficiency A deficiency in a structural element of a bridge that poses an extreme unsafe condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.

C-H= Critical Hazard Deficiency A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to: Loose concrete hanging down over traffic or pedestrians, A hole in a sidewalk that may cause injuries to pedestrians, Missing section of bridge railing, etc.

URGENCY OF REPAIR:

I = Immediate- [Inspector(s) immediately contact District Bridge Inspection Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her].

A = ASAP- [Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) upon receipt of the Inspection Report].

P = Prioritize- [Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

X=UNKNOWN N=NOT APPLICABLE H=HIDDEN/INACCESSIBLE R=REMOVED

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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REMARKS

BRIDGE ORIENTATION

The Rourke Bridge, L-15-088 (2M4), is a nine span bridge carrying Wood Street Extension over the Merrimack River and CSX Railroad in the City of Lowell. The bridge is oriented from south to north. Refer to **sketch 1** for the general bridge location.

The spans are numbered from 1 through 9 from south to north. The span 1 transom members are numbered 0 through 8, and for spans 2 through 8 the transom members are numbered 0 through 29. The piers are numbered 1 through 8 from south to north, and abutments are designated as south and north.

The superstructure of spans 1 to 8 consists of built-up steel Acrow trusses. Span 1 consists of galvanized steel Acrow panel type "triple single" truss panels (three wide x single height) at each fascia which support ten galvanized steel transoms labeled T0-T9. Spans 2 to 8 consist of galvanized steel Acrow panel type "triple double" truss panels (three wide x two high) at each fascia which support thirty galvanized steel transoms labeled T0-T29. The transoms support eleven steel deck panels with an epoxy aggregate wearing surface. The span 9 superstructure consists of a reinforced concrete deck slab which supports a bituminous concrete wearing surface.

The substructure consists of two reinforced concrete abutments labeled south and north, and eight piers labeled 1 to 8 from south to north. Piers 1 to 3, 5, and 6 consist of a pair of Acrow panel towers supported by concrete pedestals that are supported by steel pile bents with reinforced concrete pile caps. Pier 4 consists of a reinforced concrete pierwall supported by steel piles with a reinforced concrete pile cap. Pier 7 consists of a pair of reinforced concrete pedestals supported by steel piles with a reinforced concrete pile cap. Pier 8 consists of a pair of reinforced concrete stems.

GENERAL REMARKS

LOAD POSTINGS

The bridge is currently posted for 20, 25, and 28 tons for H20, Type 3, and 3S2 truck loadings, respectively. The southeast advance approach posting sign is partially obstructed by a "local attractions" sign. Refer to **sketch 1** for sign locations and **sketch 2** for the condition of posting signs.

WORK ACCESS NOTES

Spans 3 to 7 and portions of spans 2 and 8 were inspected utilizing a bucket boat lift. The underside of span 1, portions of the undersides of spans 2 and 8, and a portion of pier 1 were inspected utilizing an under-bridge inspection unit (UBIU). A portion of the underside of span 2 was inspected utilizing a hi-rail bucket truck, in conjunction with a CSX Railroad flagger. The underside of span 9 and a portion of the underside of span 8 were inspected on foot utilizing a six-foot ladder. The UBIU inspection efforts were performed in conjunction with a full bridge closure (9:00 pm to 5:00 am) and detour in-place with City of Lowell police details.

A railroad license agreement was obtained from CSX Railroad for inspection access. The entry permit is submitted electronically via the CSX property portal.

IDENTIFICATION OF FRACTURE CRITICAL MEMBERS

The following elements are considered "fracture critical":

- Floorbeams/Transoms

GENERAL DESCRIPTION OF FRACTURE CRITICAL INSPECTION

A hands-on fracture critical inspection was performed on all fracture critical members identified in the typical framing plan for transoms located in spans 1 through 8 (**see sketches 2 and 3**) and the framing plan for the end floorbeam located in span 9 (**see sketch 4**). Fatigue sensitive details along the transoms located in

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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REMARKS

spans 1 through 8 (**see sketch 5**) and the floorbeam located in span 9 were identified (**see sketch 6**). A fracture critical member inspection procedure has been included in this report (**see sketch 7**).

This fracture critical inspection was performed in conjunction with a routine inspection. Refer to the routine inspection report of the same date for findings of all other elements.

ITEM 59 - SUPERSTRUCTURE

Item 59.2 - Floorbeams/Transoms

The transoms typically have areas of galvanization loss with moderate to heavy surface rust at the lower portion of web, bottom flange, and around bracing and deck plate connections (**see photo 1**). There are isolated locations of heavy surface rust and up to 1/8" deep pitting at areas of failed galvanization (**see photos 2 and 3**). The webs and flanges have scattered rolling defects typically up to 1/16" deep.

The transom to Acrow truss connections have scattered locations with broken, loose, missing, or improperly installed fasteners (**see photo 4**). For spans containing these deficiencies, refer to **charts 1 through 4**.

The transoms have isolated areas of failed galvanization and section loss, specific deficiencies are as follows:

- Span 5, T26, North Face, Underside of Top Flange, Full Length: Failed galvanization and heavy surface rust with no measurable section loss.
- Span 6, T4, South Face, Underside of Top Flange and Web, 10'-0" from East Truss: Area of failed galvanization 1'-6" wide by 1'-6" high, and heavy surface rust with up to 1/32" section loss.
- Span 6, T12, South Face, Underside of Top Flange, 8'-0" from East Truss: Area of 100% section loss 1" long by 2" wide tapering to full flange section over 7-1/4" long (**see photo 5**).
- Span 6, T12, South Face, Top Flange, Below 10th Deck Panel from East: Four locations of 2-1/4" wide by 1/4" deep section loss in transom top flange resulting from mutual wear of four purlins, located above with transom top flange caused by loose deck panel (**see photo 6**).
- Span 6, T12, North Face, Web, Midspan: Area of 1'-8" wide by 1'-8" high by 1/32" deep section loss (**see photo 7**).
- Span 7, T14, Bottom Flange North Edge, 10'-0" from West Truss: 1/8" section loss at edge, tapering to zero loss at transom web (**see photo 8**).

The span 9 south end of deck support floorbeam typically has heavy surface rust throughout the south face of the member. At the east half of member, the bottom of bottom flange exhibits heavy surface rust, and the south face of the web has up to 1/16" deep section loss/pitting by up to full height of web (**see photo 9**).

Sketch / Chart / Photo Log

- Sketch 1 : Location map and posting sign layout.
- Sketch 2 : Posting sign conditions.
- Sketch 3 : Identification of fracture critical members (FCMs) - Framing plan of span 1 Acrow span, with transoms.
- Sketch 4 : Identification of fracture critical members (FCMs) - Framing plan of span 2 Acrow span, with transoms (span 2 shown, spans 3 through 8 similar).
- Sketch 5 : Identification of fracture critical members (FCMs) - Framing plan of span 9 reinforced concrete deck slab, with steel end floorbeam.
- Sketch 6 : Fatigue sensitive details - Transoms in spans 1 through 8 Acrow spans.
- Sketch 7 : Fatigue sensitive details - End floorbeam below span 9 reinforced concrete deck slab at pier 8.
- Sketch 8 : Fracture critical inspection procedure.
- Chart 1 : Span 3 - transom fastener connections.
- Chart 2 : Span 4 - transom fastener connections.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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REMARKS

- Chart 3 : Span 5 - transom fastener connections.
- Chart 4 : Span 6 - transom fastener connections.
- Photo 1 : Span 7, Transoms in Northern Third of Span, Looking South - Areas of galvanization loss, and light to moderate surface rust at bottom of web.
- Photo 2 : Span 2, Transom T27, Bottom Flange, Looking Northeast - Loss of galvanization and pitting section loss.
- Photo 3 : Span 3, Transom T0, Web, North Face, Looking South - Localized pitting section loss at area of failed galvanization.
- Photo 4 : Span 3, Transom T16 at West Truss Bearing Area, Looking West - One bolt missing in southeast corner of transom bearing area. Note galvanization loss and surface rust on bolts.
- Photo 5 : Span 6, Transom T12, 8'-0" from East Truss, Top Flange, South Face, Looking North - Hole at edge of top flange, surrounded by area of section loss.
- Photo 6 : Span 6, Transom T12 Top Flange below 10th Roadway Deck Panel from East Curb, South Face of T12, Looking North - Four purlins have mutual wear with transom top flange, caused by loose panel above.
- Photo 7 : Span 6, Transom T12, at Midspan, Web, North Face, Looking Southeast - Up to 1/32" section loss on web around floor system bracing connection.
- Photo 8 : Span 7, Transom T14, 10'-0" from West Truss, Bottom Flange, North Face, Looking South - Up to 1/8" section loss at north edge of bottom flange.
- Photo 9 : Span 9, at Pier 9, South Support Floorbeam, South Face, Looking Northwest - Section loss and pitting along full height.

CITY/TOWN
LOWELL

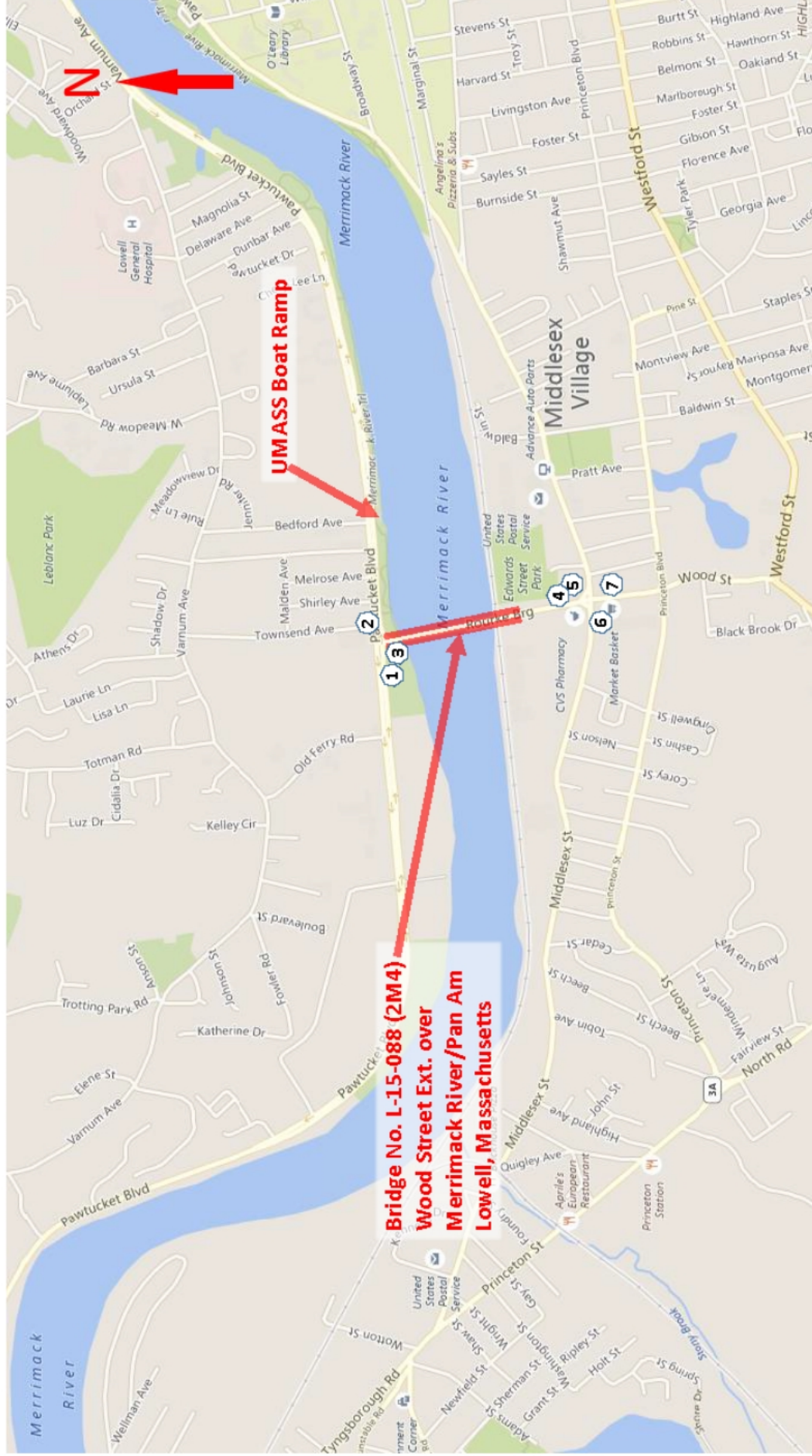
B.I.N.
2M4

BR. DEPT. NO.
L-15-088

8-STRUCTURE NO.
L15088-2M4-DOT-NBI

INSPECTION DATE
NOV 16, 2022

SKETCHES



LEGEND

WEIGHT POSTING SIGN - SEE SKETCH 2 FOR DESCRIPTIONS

Sketch 1: Location map and posting sign layout.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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SKETCHES

POSTING SIGN CONDITIONS:



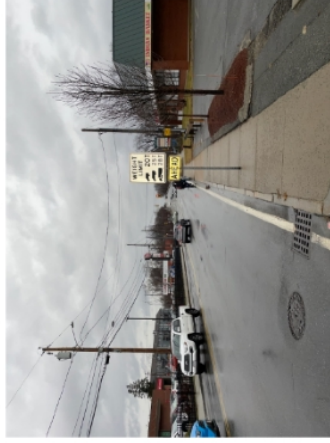
① Advance weight posting sign that reads: "20, 25, and 28 tons."



③ At bridge weight posting sign that reads: "20, 25, and 28 tons."



⑤ Advance weight posting sign that reads: "20, 25, and 28 tons," partially obscured by another traffic sign.



⑦ Advance weight posting sign that reads: "20, 25, and 28 tons ahead."



② Advance weight posting sign that reads: "20, 25, and 28 tons."



④ At bridge weight posting sign that reads: "20, 25, and 28 tons."

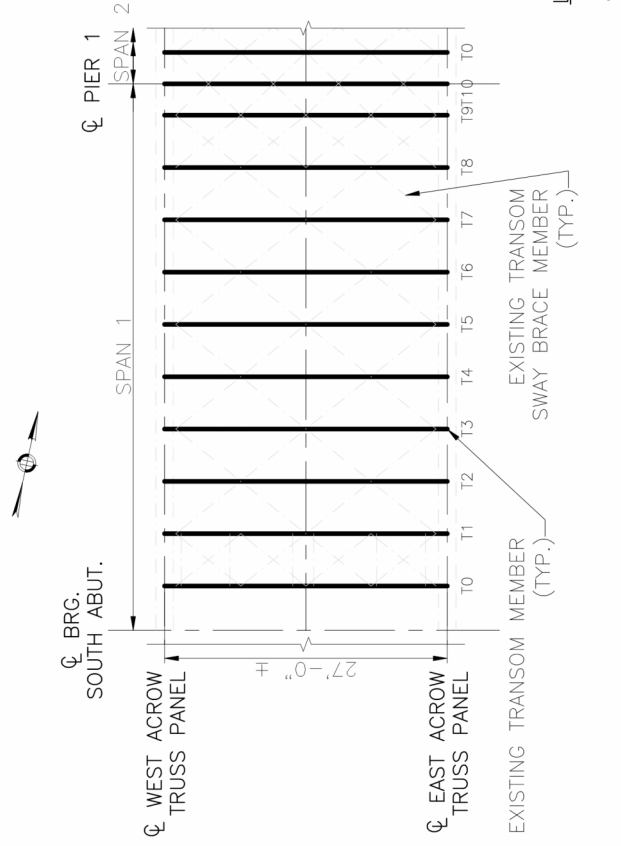


⑥ Advance weight posting sign that reads: "20, 25, and 28 tons."

Sketch 2: Posting sign conditions.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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SKETCHES

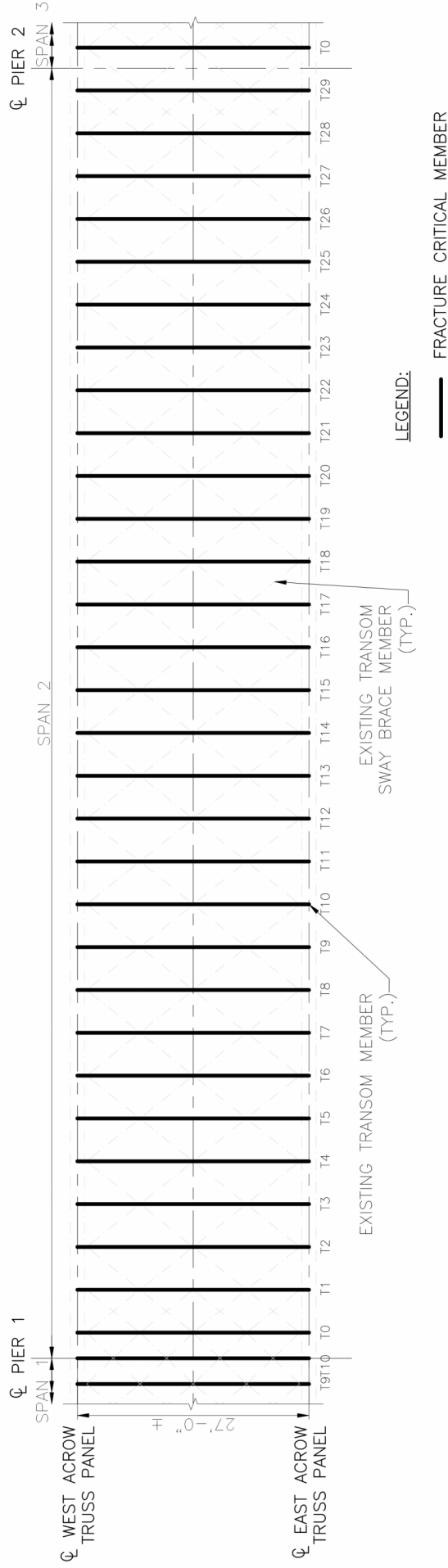


IDENTIFICATION OF FRACTURE CRITICAL MEMBERS (FCMs):
 FRAMING PLAN OF SPAN 1 ACROW SPAN, WITH TRANSOMS

Sketch 3: Identification of fracture critical members (FCMs) - Framing plan of span 1 Acrow span, with transoms.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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SKETCHES

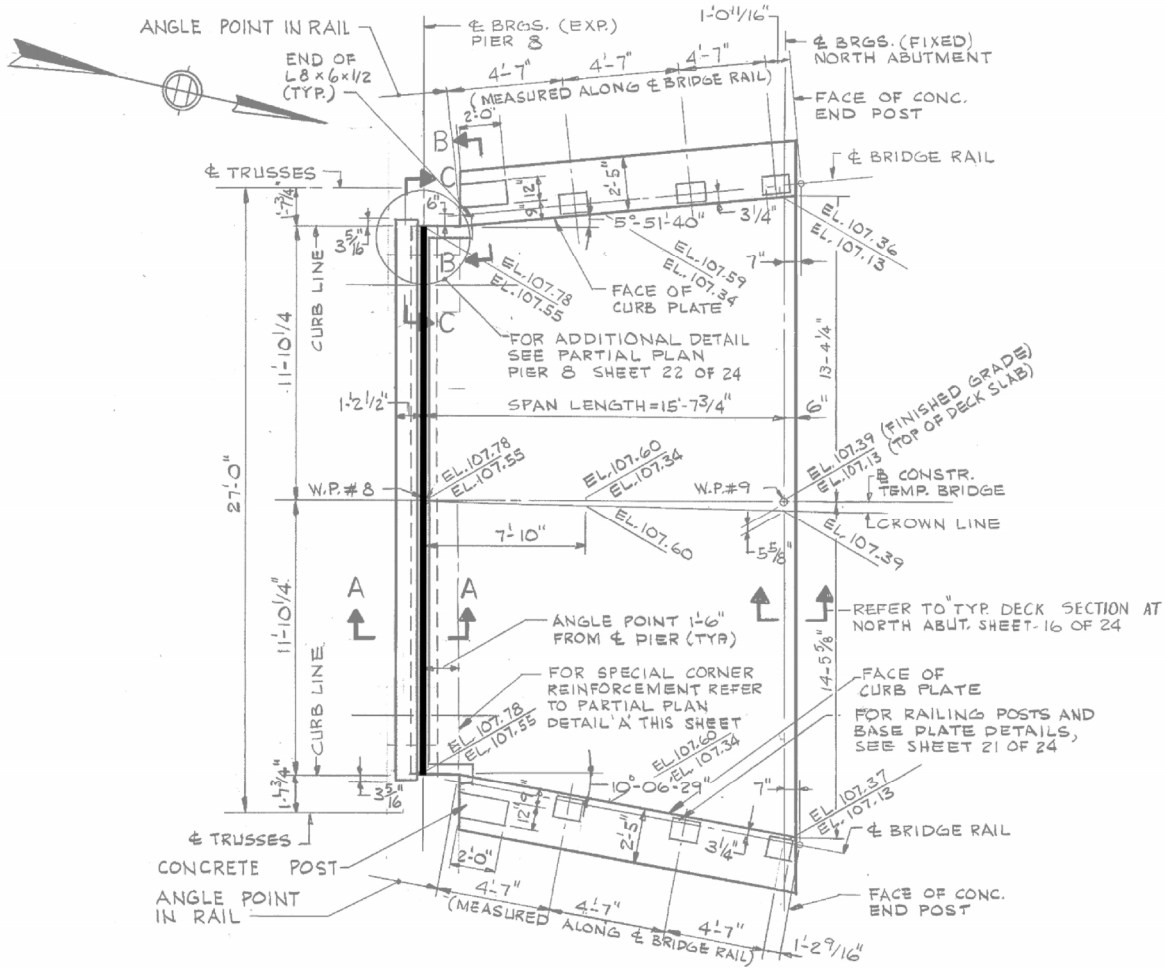


IDENTIFICATION OF FRACTURE CRITICAL MEMBERS (FCMs):
 FRAMING PLAN OF SPAN 2 ACROW SPAN, WITH TRANSOMS
 (SPAN 2 SHOWN, SPANS 3 THROUGH 8 SIMILAR)

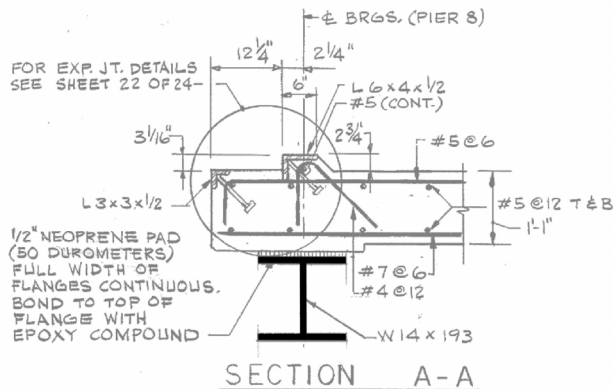
Sketch 4: Identification of fracture critical members (FCMs) - Framing plan of span 2 Acrow span, with transoms (span 2 shown, spans 3 through 8 similar).

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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SKETCHES



PLAN - SPAN 9



LEGEND:
 FRACTURE CRITICAL MEMBER

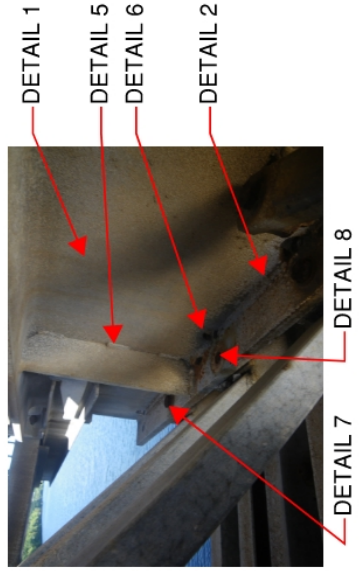
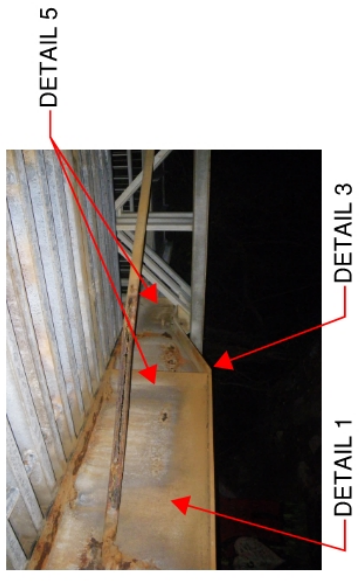
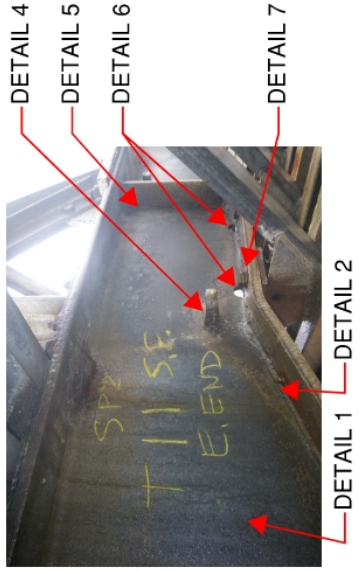
**IDENTIFICATION OF FRACTURE CRITICAL MEMBERS (FCM'S):
 FRAMING PLAN OF REINFORCED CONCRETE DECK SLAB (SPAN 9)**

Sketch 5: Identification of fracture critical members (FCMs) - Framing plan of span 9 reinforced concrete deck slab, with steel end floorbeam.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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SKETCHES

**FATIGUE SENSITIVE DETAILS:
TRANSOMS**



- DETAIL 1** BASE METAL OF TRANSOM, ALONG LENGTH OF TRANSOM MEMBER BETWEEN TRUSSES (CATEGORY A, AASHTO FSD #1.1)
- DETAIL 2** WELDED TRANSOM BOTTOM FLANGE, AT END OF TRANSOM MEMBER AT TRUSS (CATEGORY B, AASHTO FSD #3.1)
- DETAIL 3** WELDED TRANSOM BOTTOM FLANGE, AT END OF TRANSOM MEMBER (CATEGORY B, AASHTO FSD #5.1)
- DETAIL 4** WELDED LATERAL CONNECTION PLATE TO TRANSOM WEB (CATEGORY C, AASHTO FSD #7.1)
- DETAIL 5** WELDED STIFFENER CONNECTIONS TO TRANSOM WEB (CATEGORY C, AASHTO FSD #4.1)
- DETAIL 6** WELD ACCESS HOLES (CATEGORY D, AASHTO FSD #3.3)
- DETAIL 7** BOLTED JOINTS AT TRANSOM BOTTOM FLANGE CONNECTION TO SEAT (CATEGORY D, AASHTO FSD #2.3)
- DETAIL 8** OPEN HOLE (CATEGORY D, AASHTO FSD #1.5)

Sketch 6: Fatigue sensitive details - Transoms in spans 1 through 8 Acrow spans.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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SKETCHES

**FATIGUE SENSITIVE DETAILS:
END FLOORBEAM**



DETAIL 1 BASE METAL OF FLOORBEAM (CATEGORY A, AASHTO FSD #1.1)

DETAIL 2 RE-ENTRANT CORNER AT GEOMETRIC DISCONTINUITY (CATEGORY C, AASHTO FSD #1.3)

DETAIL 3 BOLTED JOINTS (CATEGORY D, AASHTO FSD #2.3)

Sketch 7: Fatigue sensitive details - End floorbeam below span 9 reinforced concrete deck slab at pier 8.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
----------------------------	----------------------	----------------------------------	---	--

SKETCHES

FRACTURE CRITICAL INSPECTION PROCEDURE – FLOORBEAMS/TRANSOMS: BOLTED CONNECTIONS

1. **Check all rivets and bolts to determine that they are tight and that individual components are operating as one. Check for cracked or missing bolts, rivets, and rivet heads.**

In various spans, there are missing, broken, or loose bolts which connect the transom bottom flange to the beam seats at beam ends.

2. **Check the members for misplaced holes or repaired holes that have been filled with weld metal. These are possible sources of fatigue cracking.**

There are no misplaced or repaired holes that have been filled with weld metal.

3. **Check the entire length of the tension flange and web for cracking in the web due to out-of-plane bending.**

There is no cracking due to out-of-plane bending.

4. **Check the entire length of the flanges and web for cracking which may have originated from corrosion, pitting, or section loss, or defect in fabrication (e.g. nicks and gouges in the steel).**

The transoms have scattered areas of light rust staining and isolated areas of section loss. No cracking or fabrication defects were observed. Refer to Item 59.2 – Floorbeams/Transoms.

5. **Check entire length for temporary erection welds, tack welds, or welded connections not shown on the design drawings.**

The transoms have welded web stiffeners and welded plates for the connection of the floor system sway brace members to the transom members. These weld details have been shown on the design drawings. There were no cracked welds and no evidence of fatigue found.

Notes:

1. Refer to previous sheets for sketches of locations of FCMs and Fatigue Sensitive Details.
2. Portions of the Inspection Procedure taken from Federal Highway Administration Report No. FHWA-IP-86-26 "Inspection of Fracture Critical Bridge Members," dated September 1986.

Sketch 8: Fracture critical inspection procedure.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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CHARTS

Span 3		
Transom	East Truss Transom Bolts	West Truss Transom Bolts
T0		
T1		
T2		
T3		
T4		
T5		
T6		
T7		
T8		
T9		
T10		
T11		
T12		
T13		
T14		
T15		
T16		2 bolts, M.
T17		
T18		
T19		
T20		
T21		
T22		
T23		
T24		
T25		
T26		
T27		
T28		
T29		

L = Loose; **Br** = Broken; **M** = Missing;
E = East; **C** = Center; **W** = West
HE = Enlarged Pin Hole;
AD = Abrasion Dust (signs of movement);
R = Replaced; **NF** = Not Found
 Items in **BOLD RED LETTERS** have been updated
 from the last inspection.

Chart 1: Span 3 - transom fastener connections.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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CHARTS

Span 4		
Transom	East Truss Transom Bolts	West Truss Transom Bolts
T0		
T1		
T2		
T3		
T4		
T5		
T6		
T7		
T8		2 bolts, M.
T9		
T10		
T11		
T12		
T13		
T14		
T15		
T16		
T17		
T18		
T19		
T20		
T21		
T22		
T23		
T24		
T25		
T26		
T27		
T28		
T29	1 bolt¹, L.	

¹Up to 1/8" gap between Transom W Bottom flange & seat plate @ middle bolt

L = Loose; **Br** = Broken; **M** = Missing;
E = East; **C** = Center; **W** = West
HE = Enlarged Pin Hole;
AD = Abrasion Dust (signs of movement);
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 Items in **BOLD RED LETTERS** have been updated
 from the last inspection.

Chart 2: Span 4 - transom fastener connections.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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CHARTS

Span 5		
Transom	East Truss Transom Bolts	West Truss Transom Bolts
T0		
T1		
T2		
T3		
T4	1 bolt, Br.	
T5		
T6		
T7		
T8		
T9		
T10		
T11		
T12		
T13		
T14	2 bolts, L (NF).	
T15		
T16		
T17		
T18		
T19		
T20		
T21		
T22	1 bolt, Br w/ 1/8" gap at W Truss.	
T23		
T24		
T25		
T26		
T27		
T28		
T29		

L = Loose; **Br** = Broken; **M** = Missing;
E = East; **C** = Center; **W** = West
HE = Enlarged Pin Hole;
AD = Abrasion Dust (signs of movement);
R = Replaced; **NF** = Not Found
 Items in **BOLD RED LETTERS** have been updated
 from the last inspection.

Chart 3: Span 5 - transom fastener connections.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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CHARTS

Span 6		
Transom	East Truss Transom Bolts	West Truss Transom Bolts
T0		
T1		
T2		
T3		
T4		
T5	1 washer, Br.	
T6	2 bolts, Br.	
T7	2 bolts, L (NF) .	
T8		
T9		
T10		
T11		
T12		
T13		
T14		
T15		
T16		
T17		
T18		
T19		
T20		
T21		
T22		
T23		
T24		
T25		
T26		
T27		
T28		
T29		

L = Loose; **Br** = Broken; **M** = Missing;
E = East; **C** = Center; **W** = West
HE = Enlarged Pin Hole;
AD = Abrasion Dust (signs of movement);
R = Replaced; **NF** = Not Found
 Items in **BOLD RED LETTERS** have been updated
 from the last inspection.

Chart 4: Span 6 - transom fastener connections.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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PHOTOS



Photo 1: Span 7, Transoms in Northern Third of Span, Looking South - Areas of galvanization loss, and light to moderate surface rust at bottom of web.



Photo 2: Span 2, Transom T27, Bottom Flange, Looking Northeast - Loss of galvanization and pitting section loss.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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PHOTOS



Photo 3: Span 3, Transom T0, Web, North Face, Looking South - Localized pitting section loss at area of failed galvanization.



Photo 4: Span 3, Transom T16 at West Truss Bearing Area, Looking West - One bolt missing in southeast corner of transom bearing area. Note galvanization loss and surface rust on bolts.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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PHOTOS



Photo 5: Span 6, Transom T12, 8'-0" from East Truss, Top Flange, South Face, Looking North - Hole at edge of top flange, surrounded by area of section loss.



Photo 6: Span 6, Transom T12 Top Flange below 10th Roadway Deck Panel from East Curb, South Face of T12, Looking North - Four purlins have mutual wear with transom top flange, caused by loose panel above.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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PHOTOS



Photo 7: Span 6, Transom T12, at Midspan, Web, North Face, Looking Southeast - Up to 1/32" section loss on web around floor system bracing connection.



Photo 8: Span 7, Transom T14, 10'-0" from West Truss, Bottom Flange, North Face, Looking South - Up to 1/8" section loss at north edge of bottom flange.

CITY/TOWN LOWELL	B.I.N. 2M4	BR. DEPT. NO. L-15-088	8.-STRUCTURE NO. L15088-2M4-DOT-NBI	INSPECTION DATE NOV 16, 2022
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PHOTOS

Photo 9: Span 9, at Pier 9, South Support Floorbeam, South Face, Looking Northwest - Section loss and pitting along full height.