MATERIALS LABORATORY
FACTUAL REPORT 13-069

Bridge Collapse
Mount Vernon, WA; 05/23/2013

HWY13MH012

(11 pages)

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

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MATERIALS LABORATORY FACTUAL REPORT Report No. 13-069

A. ACCIDENT INFORMATION

Place	:	Mount Vernon, Washington
Date	:	May 23, 2013
Vehicle	:	I-5 Bridge across the Skagit River
NTSB No.	:	HWY13MH012
Investigator	:	Robert Accetta, IIC HS-20

B. COMPONENTS EXAMINED

I-5 Bridge NBI No 4794A, Span 8

C. DETAILS OF THE EXAMINATION

Introduction

Frames of a security camera video were analyzed to aid in establishing the collapse sequence of the I-5 bridge over the Skagit River. The camera was located at Foothills Toyota dealership looking generally to the south southeast. Most of the camera's view was of the front (east) display lot of the dealership. However, the I-5 bridge over the Skagit River was also visible in the upper portion of the camera's view. The western trusses of span 8 and span 7 were visible throughout the video. The north portal and the northern end of the east truss of span 8 were also visible. Spans 4 and 5 of the truss were partially hidden by a tree.

The video contained 1059 frames with an indicated recording rate of 25 frames per second. The camera only recorded the initial portion of the collapse of the bridge and ended prior to the bridge span contacting the water. The video reportedly ended when power to the camera was interrupted.

Methodology

Analysis was conducted on still images (24 bit RGB color, 720 by 480 pixels) taken from the individual frames of the video. Frames were numbered beginning with 0000 and ending with 1058. From the full frame image, a 474 by 138 pixel portion of the image containing the visible bridge was cropped and saved separately, as shown in figure 1. The resulting image had relatively low pixel resolution but remained sufficient to identify significantly large features and objects. At this resolution, many of the truss members were only a few pixels wide. However, contrast between the lighter appearing members and a darker background allowed identification. No enhancements or modifications were made to the images.

On spans 7 and 8, individual members of the west truss were identified along with the lower chord of the north portal and the identifiable portions of the east truss of span 8. The members were overlaid by thin lines (yellow for span 8 and green for span 7) in the approximate middle of the identified member. The western concrete traffic barrier of the southbound lanes was also identified and delineated. This was performed on frames well before the collapse and the member locations checked on several frames. An example of the cropped and lined image is displayed as figure 2.

The examination concentrated on the collapse sequence and associated features in the later portion of the video and early non-collapse images were given only cursory inspections.

Results

Detailed analysis began at frame 0980 when a large rectilinear object approached the north portal of the truss section of the bridge. The object was identified as an oversize load consisting of an oil field well casing shed. The casing shed (more fully described elsewhere) had two open sides with the interior painted white. Further a white trailer was on the east side of the casing shed making it easily visible on the video. From frame 0980 onward, changes in the locations and shapes of west truss members and deck were tracked to the end of the video. Thirteen frames were then selected from frame 0980 to the end of the video to illustrate the initiation and progression of the collapse.

The selected frames are list below with the significant feature noted and shown as figures 3 through 14. Cumulative time is also listed in seconds with frame 0980 set to zero and assuming 25 frames per second.

Frame	Seconds	Feature
0980	0.00	Oversize load approaches the north portal of the truss spans.
0998	0.72	Load through the north portal.
1018	1.52	Front of load at Span 8 node 4 west.
1020	1.60	First deflection noted in upper chord at U4W.
1022	1.68	First noted deflection of vertical member at Node 4W.
1024	1.76	More deflection of upper chord at U4W.
1030	2.00	Load passes span 8 node 4W.
1036	2.24	Deck and lower chord begin deflecting. Node 4 sway brace visible.
1042	2.48	Continued downward movement of west truss. Tractor nears span 7.
1048	2.72	Continuing truss deformation. Camper trailer approaches north portal.
1053	2.92	Load is off of span 8.
1058	3.13	First movement of east side of portal. Load approaches Span 7 U4W. End of video.

Joe Epperson
Senior Metallurgist

Figure 1. Upper view displays a typical video from with the red box denoting the area of the bridge cropped from each image for analysis. Lower view shows the cropped portion. View looking approximately south southeast.

Figure 2. The cropped image from figure 1 with the visible members of span 8 trusses denoted in yellow. The red line indicates the north portal. Identified members of span 7 are highlighted in green. Red box indicates the additional cropping used for display in this report (see below).

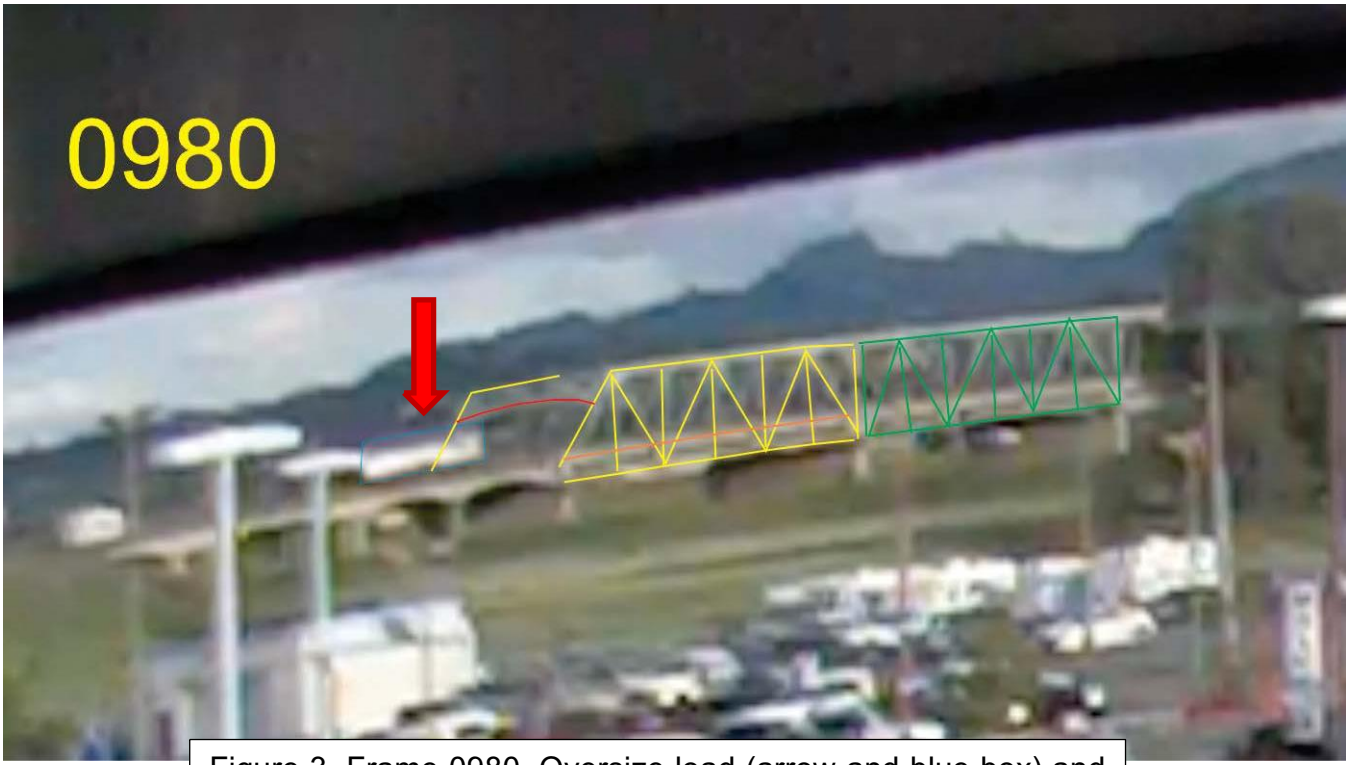

Figure 3. Frame 0980. Oversize load (arrow and blue box) and white trailer approach the north portal of the truss spans.

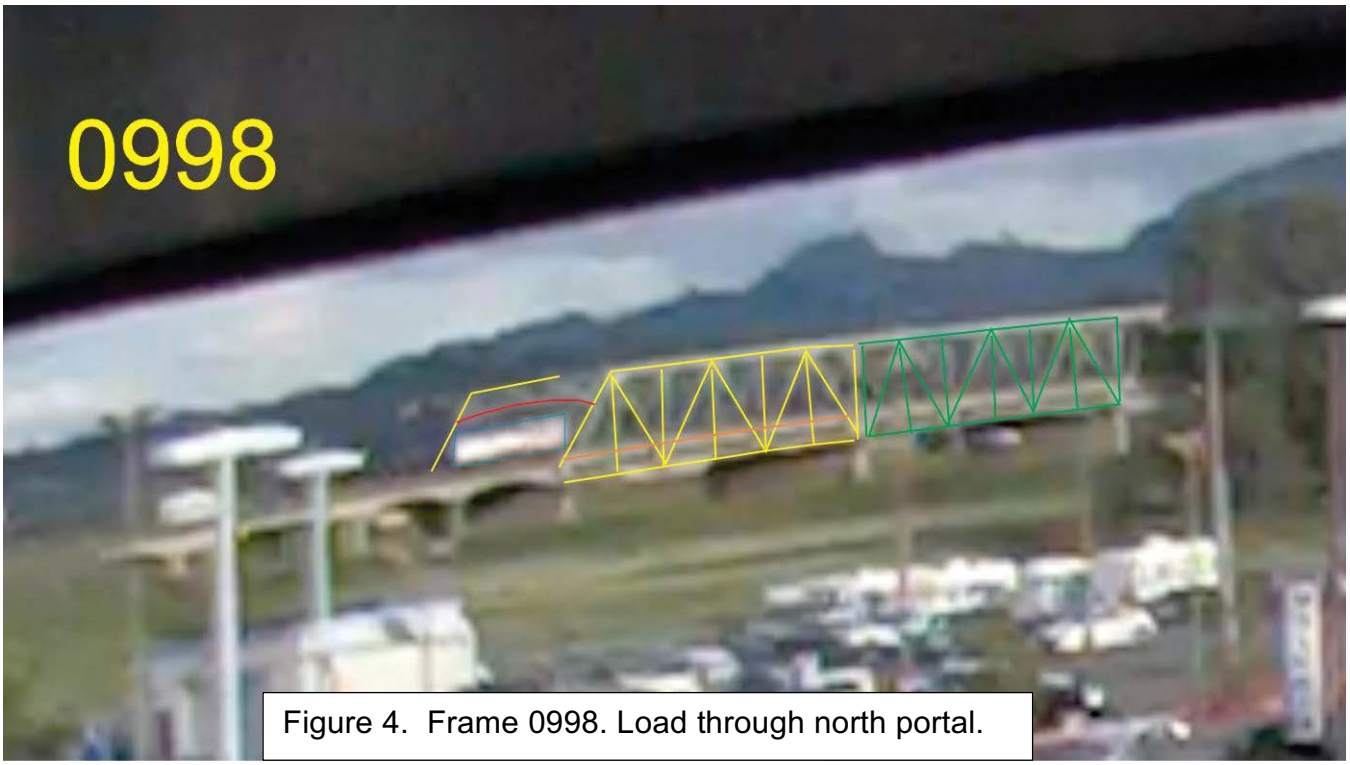

Figure 4. Frame 0998. Load through north portal.

Figure 5. Frame 1018. Front of load at span 8 node 4 west.

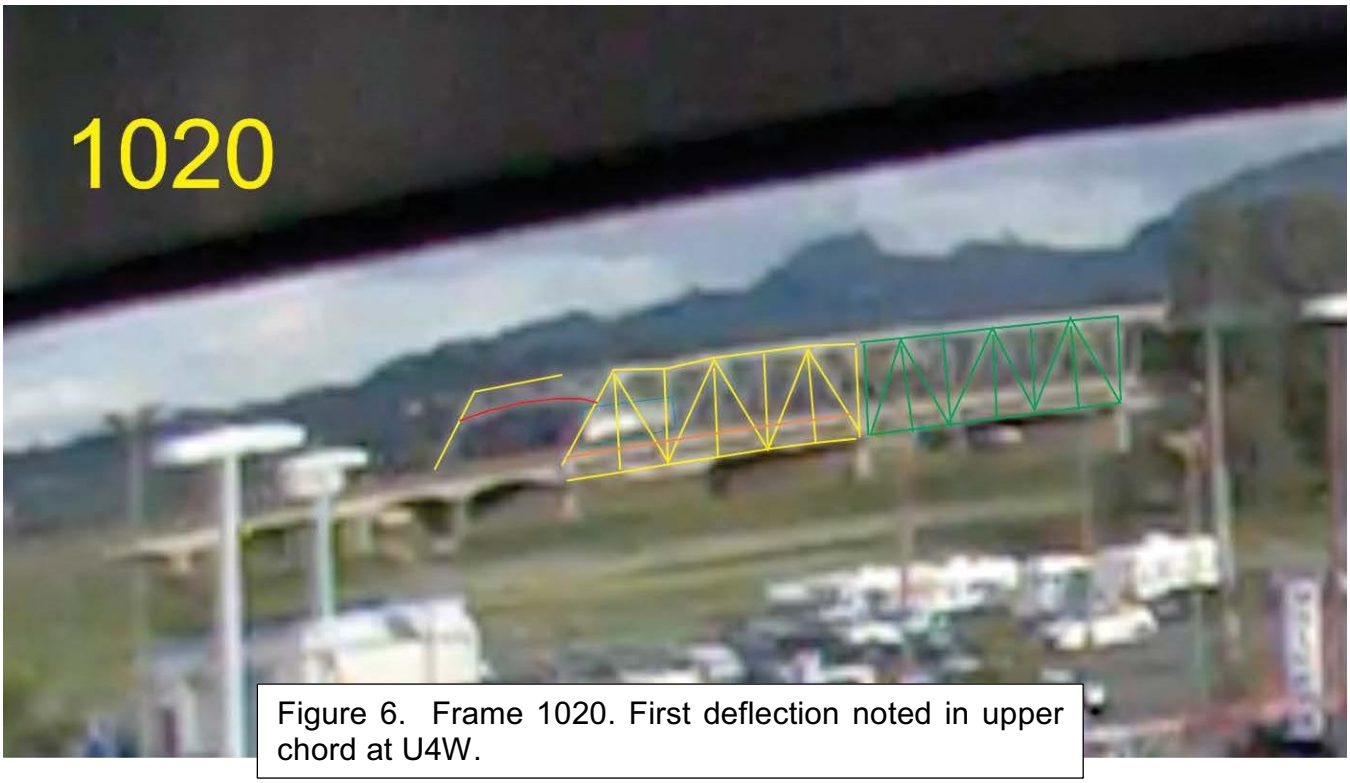

Figure 6. Frame 1020. First deflection noted in upper chord at U4W.

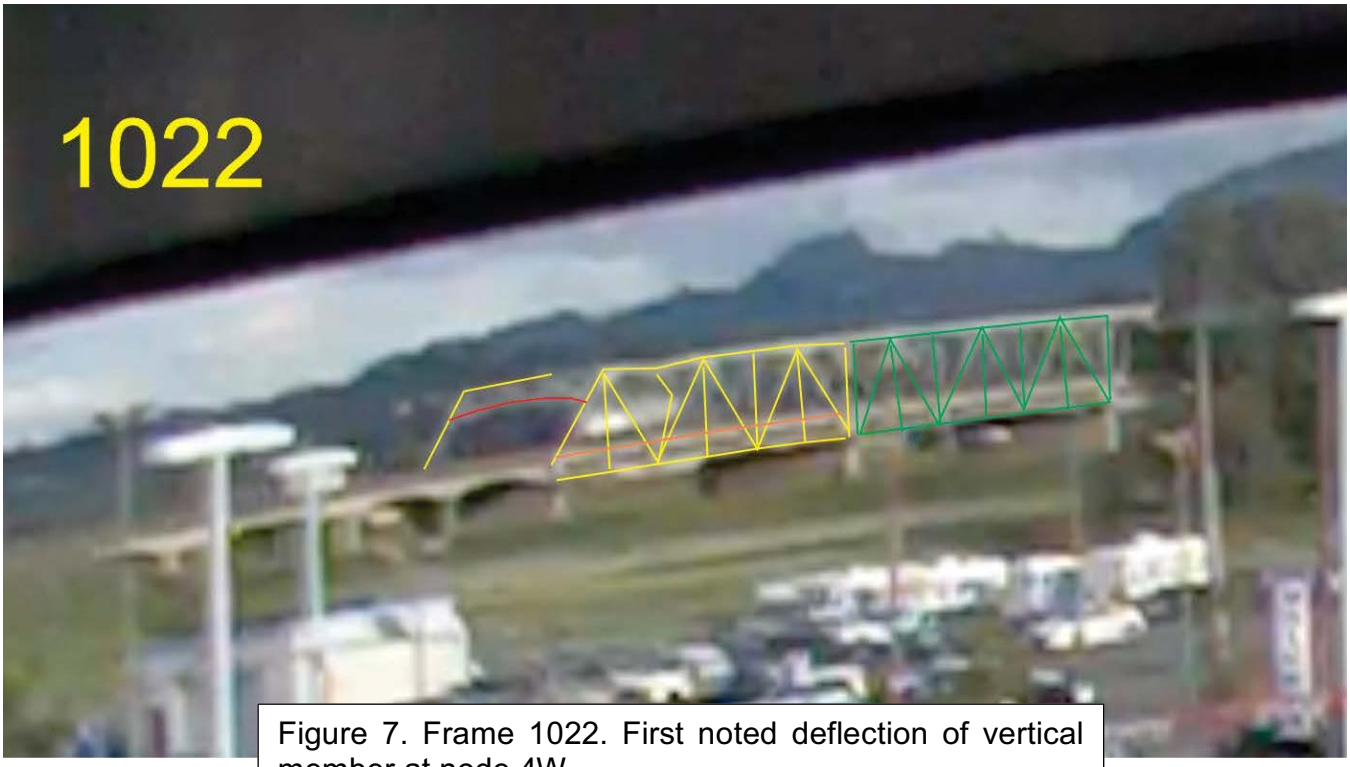

Figure 7. Frame 1022. First noted deflection of vertical member at node 4W.

Figure 8. Frame 1024. More deflection of upper chord at U4W.

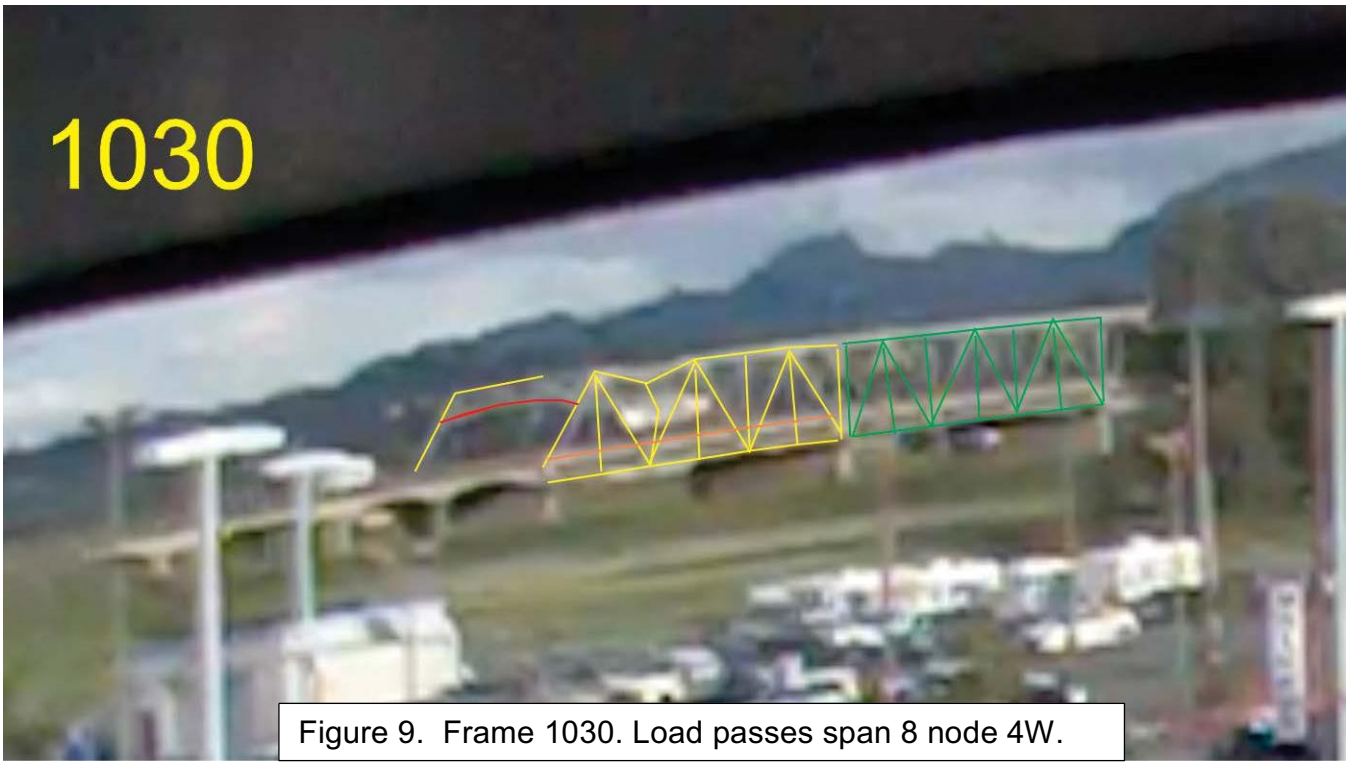

Figure 9. Frame 1030. Load passes span 8 node 4W.

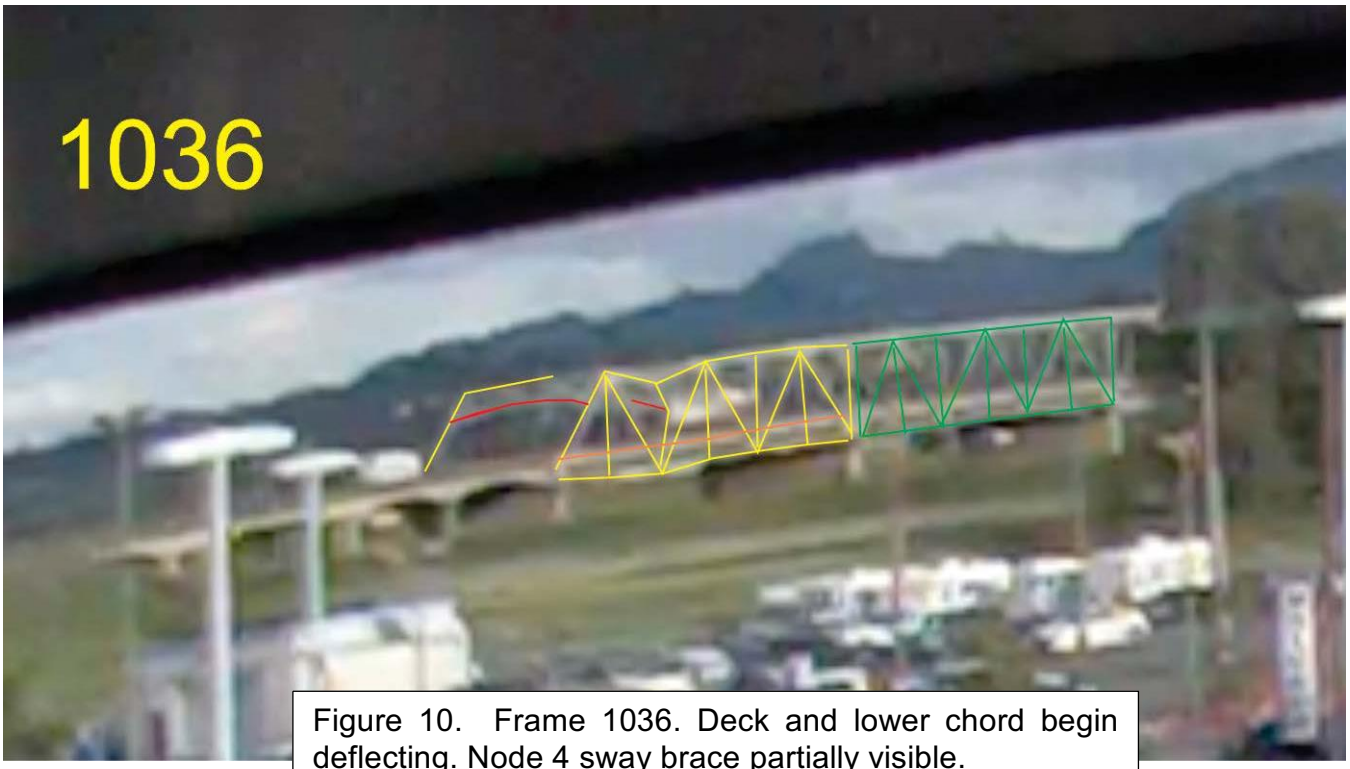

Figure 10. Frame 1036. Deck and lower chord begin deflecting. Node 4 sway brace partially visible.

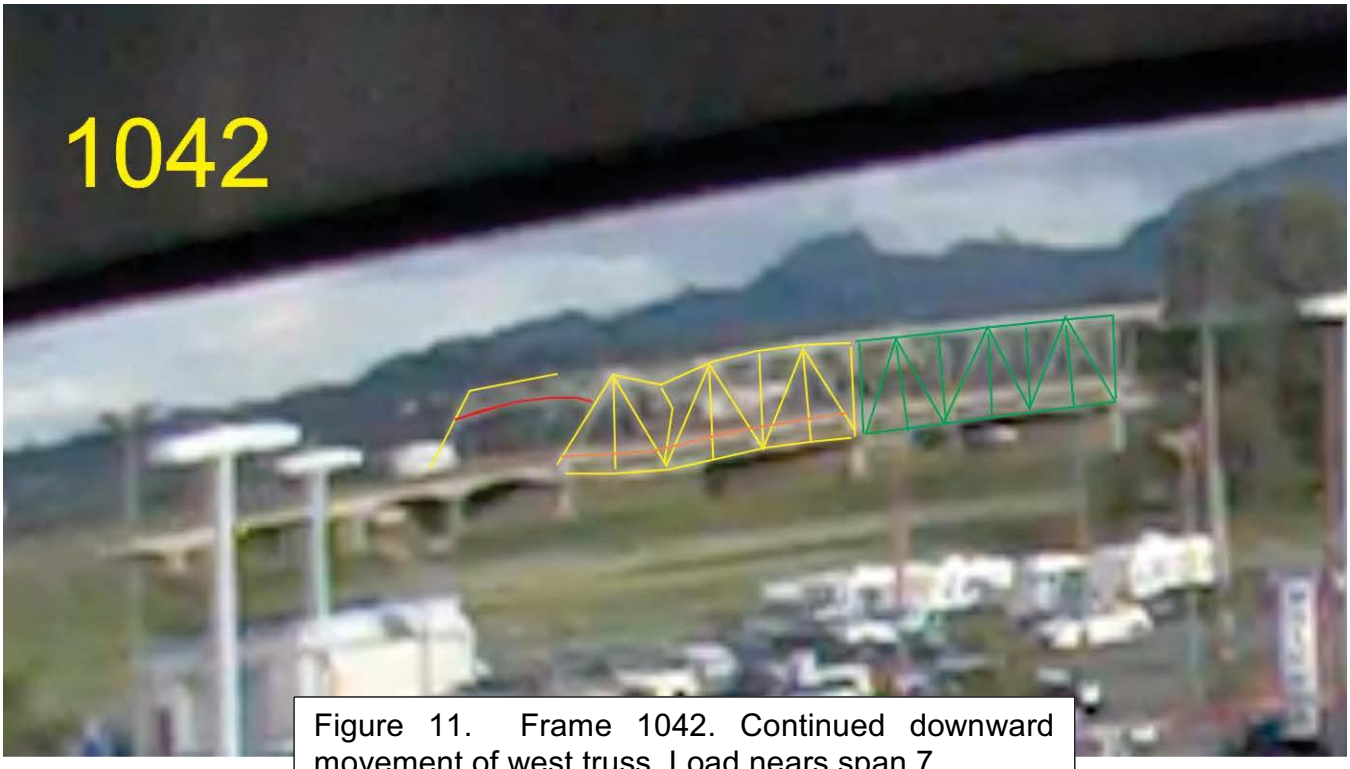

Figure 11. Frame 1042. Continued downward movement of west truss. Load nears span 7.

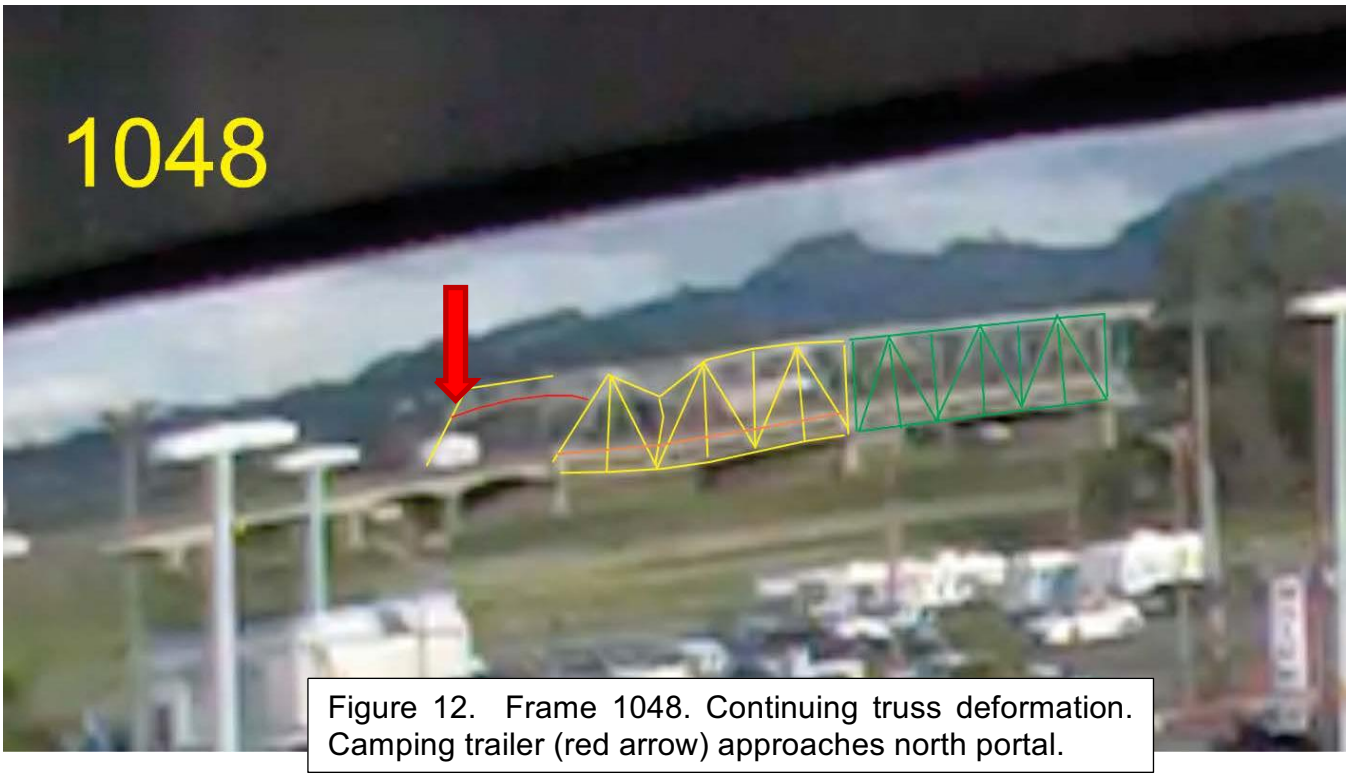

Figure 12. Frame 1048. Continuing truss deformation. Camping trailer (red arrow) approaches north portal.

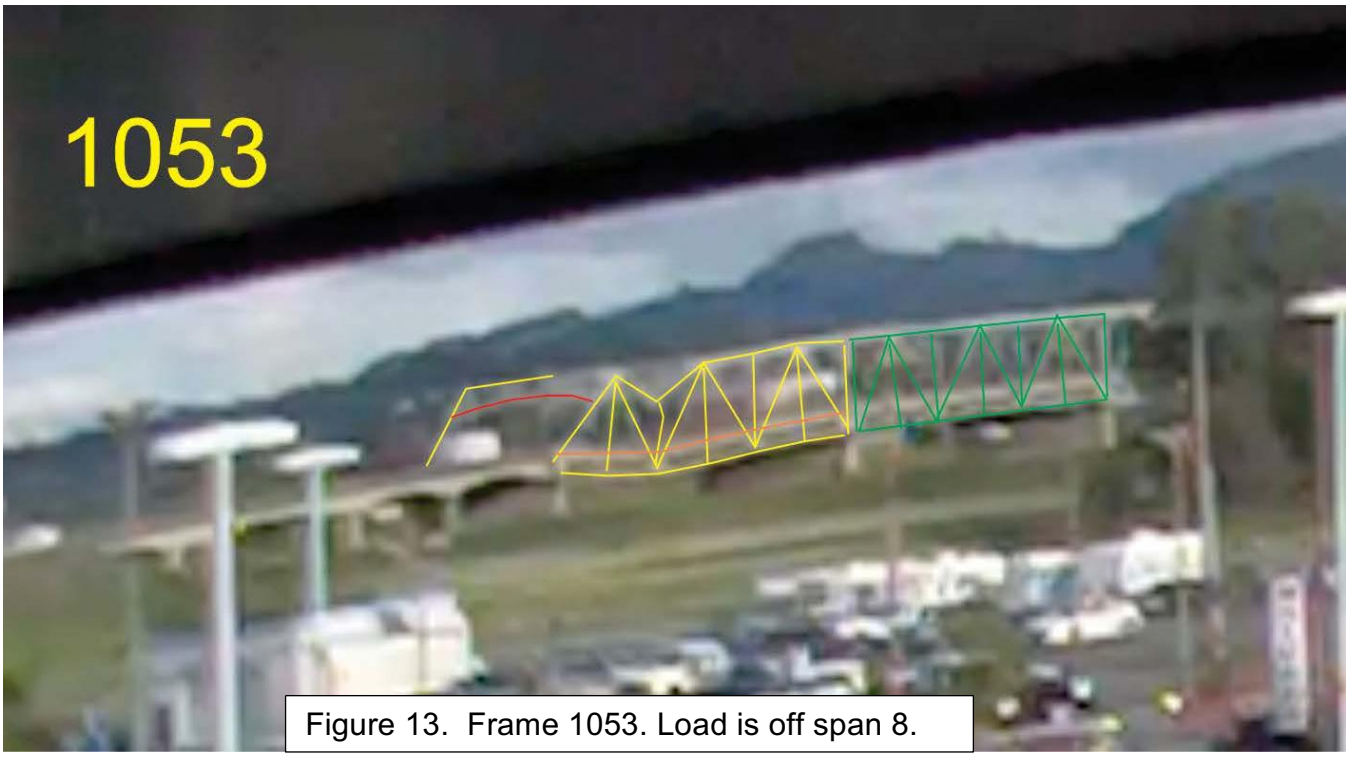

Figure 13. Frame 1053. Load is off span 8.

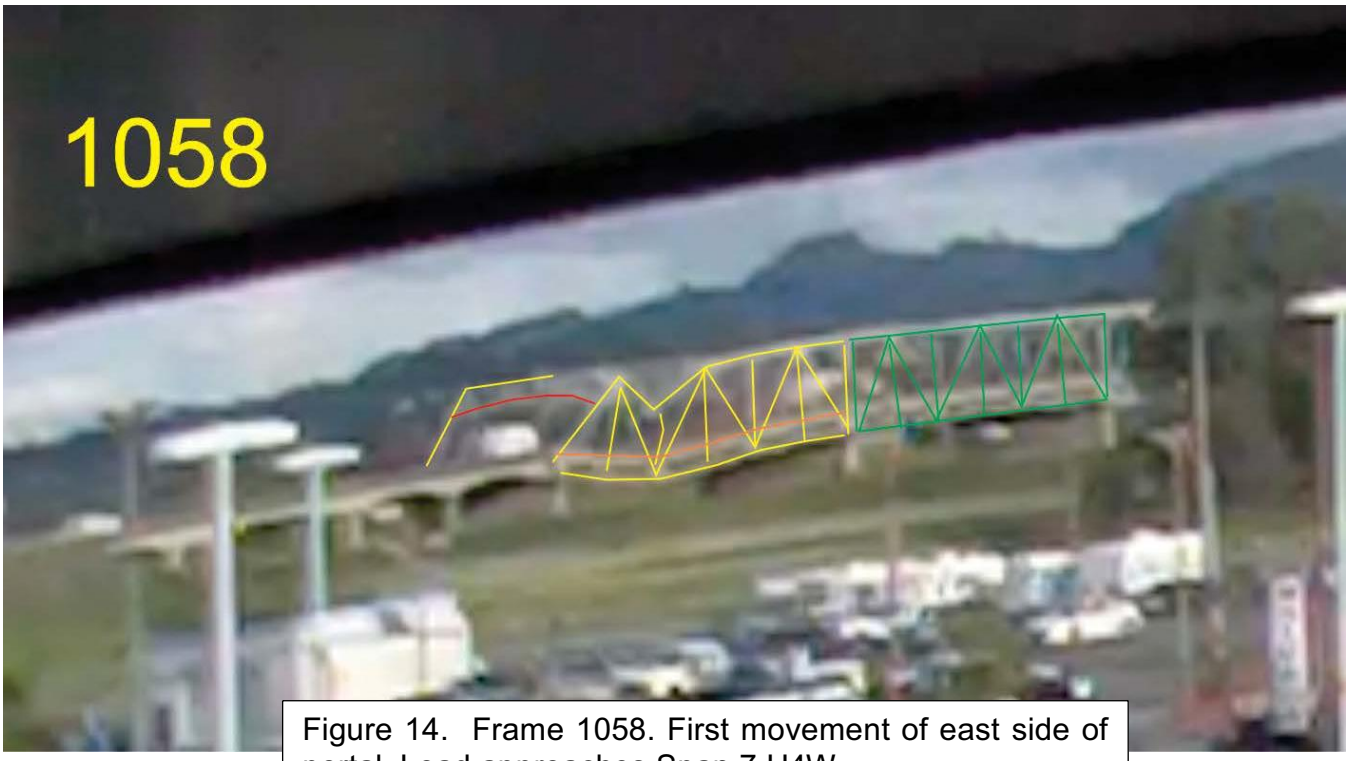

Figure 14. Frame 1058. First movement of east side of portal. Load approaches Span 7 U4W.