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RE: **Moody Property Bridge Assessment – Technical Memorandum**

Dear Malik,

This technical memorandum summarizes findings that have been generated by a limited structural assessment of the existing Moody Bridge located in Bonsall, California. The scope of this memorandum includes a visual condition assessment of the bridge, verification of its conformance with the as-built drawings provided to us, and our opinion of its ability to accommodate:

- the maximum design loading specified on the as-built drawings (HS20-44), and
- a proposed 128,000-pound truck loading.

Peterson Structural Engineers (PSE) visually inspected the bridge on 8/25/2023. As shown in the figure below, it provides a creek crossing on a site that is just north of Camino del Rey. The bridge is located approximately three-quarters of a mile west of Interstate 15.

Figure 1 *– Aerial image of the bridge taken from Google Earth (November 2022) and annotated by PSE*

Figure 2 *– Enlarged view of the bridge taken by drone during the PSE inspection*

Inspection Photographs

The photographs included in this memorandum are representative and not intended to include all observed conditions that may have existed during PSE's inspection.

Photograph 1 *– Ground-level view of drivable surface*

Photograph 2 *– Underside of the bridge*

Photograph 3 *– Minor stains and discoloration*

Photograph 4 *– Surface corrosion of secondary stringers*

Photograph 5 *– Structural members intact and undeflected*

Observations and Analysis

The bridge consists of two parallel, fabricated railcar assemblies that are interconnected. The as built drawings do not specify the size of each part of the assemblies; however, the drawings do specify the size and material (ASTM A-36) of the C-shape members that connect the two assemblies at approximate ten-foot intervals. As shown in Photograph 2 above, these channels (C6x10.5) are visible along the underside of the bridge. By inspection and measurement of the depth, width, and flange thicknesses, PSE confirms that these C-shapes conform with the size and material listed on the as-built drawings.

Based on visual observations, bridge framing did not appear deflected at the time of the site visit. As noted in the photographs, stains, surface corrosion of secondary stringers, and instances of discoloration were present at various locations along the length of this 20+ year-old bridge. These types of minor deteriorations are normal for a bridge of this age located over a creek. Furthermore, the main load carrying structural members of the bridge structure were intact, and no indications of section loss were present. Therefore, it is PSE's opinion that the overall structural integrity of the bridge is good and serviceability is intact.

As described above, PSE found the visible portions of the structure to be in good to fair condition and in general conformance with the provided as-built drawings. For this reason, PSE believes the current capacity of the bridge is comparable to the original capacity of the bridge and is adequate to support the original HS20-44 design loading.

Construction Loading Approach

PSE understands that the District is considering transport of a premanufactured pump station over the bridge, which requires the pump station to be transported by truck, crane, or some combination thereof, over the bridge. PSE has specifically been requested to evaluate a proposed 128,000-pound truck loading in connection to the pump station transport. To evaluate the proposed loads imposed by transport of the pump station, PSE compared the shear and flexural demands associated with the design HS20-44 loading with demands generated by the proposed 128,000-pound truck and loaded transport trailer. The table below summarizes the load configurations for both analyzed scenarios (see also Figure 7 below).

Table 1 *– Analyzed Load Configurations*

	Axle #1	Axle #2	Axle #3	Axle #4	Axle #5	Axle #6	Axle #7
	HS20-44 Loading						
Load	8 kip	32 kip	32 kip				
Distance	14.00'	14.00'	-				
	128,000-Pound Proposed Loading						
Load	8 kip	20 kip	20 kip	20 kip	20 kip	20 kip	20 kip
Distance	13.92'	4.83'	4.58'	60.00'	4.50'	4.67'	-

Notes:

1. Axle #1 occurs at the front of the vehicle.
2. Distances above represent spacings to the next axle.
3. The spacing between axles #2 and #3 for HS20-44 is conservatively taken as 14 feet.

PSE used RISA 3D software to determine the worst-case shear and moment demand load envelopes for the two configurations described above. Figures 3 through 6 below illustrate the outcome of this software analysis; Table 2 provides a direct comparison of the demands associated with each of the two configurations.

Figure 3 *– Envelope shear diagram –* ***HS20-44*** *loading*

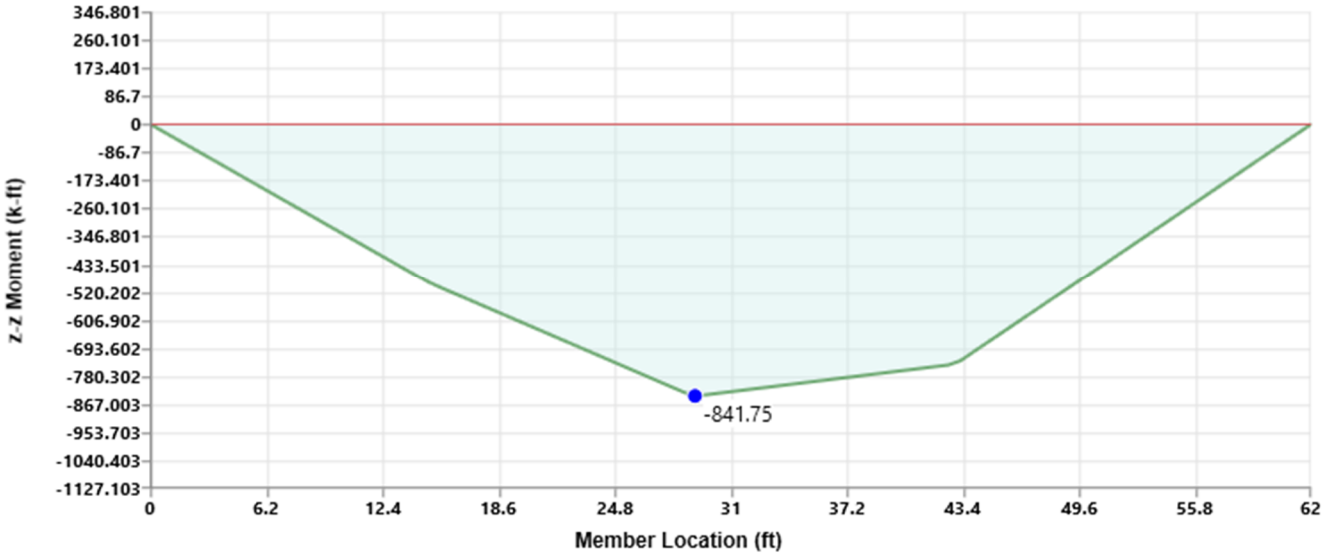

Figure 4 *– Envelope moment diagram –* ***HS20-44*** *loading*

Figure 5 *– Envelope shear diagram –* ***Proposed*** *loading*

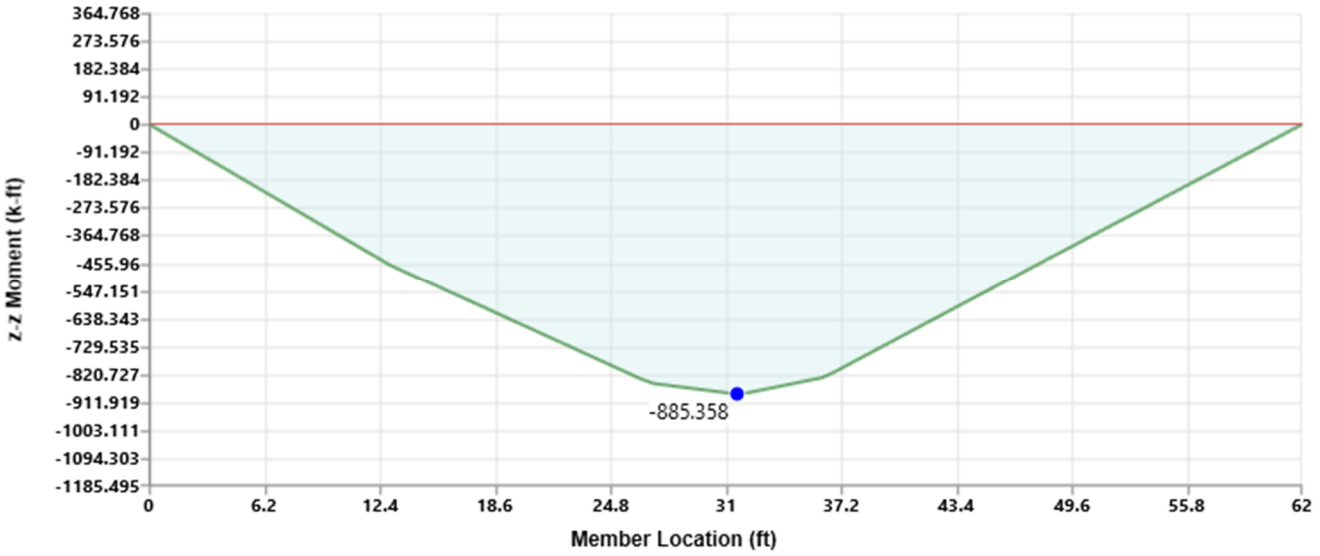

Figure 6 *– Envelope moment diagram –* ***Proposed*** *loading*

Table 2 *– Comparative Demand Analysis*

	HS20-44	Proposed Loading	%Δ
Shear	39.10	35.68	-8.7%
Moment	841.75	885.36	5.2%

Notes:

1. The shears values listed above are the absolute maximum of the values shown on the diagrams; units are kips.
2. Moments are expressed in kip-feet.

As shown above, shear demand is less for the proposed configuration than for the original HS20-44 design. The moment demand is greater but only by approximately 5%. It is PSE's opinion that the loads imposed by the proposed transport vehicle (see Figure 7 below) are within a reasonable margin of the original design loading. Therefore, the proposed live load of 128,000 pounds appears to be structurally acceptable. The proposed transport vehicle should cross the bridge slowly to limit dynamic loading to the bridge and the 128,000-pound vehicle loading should not be exceeded.

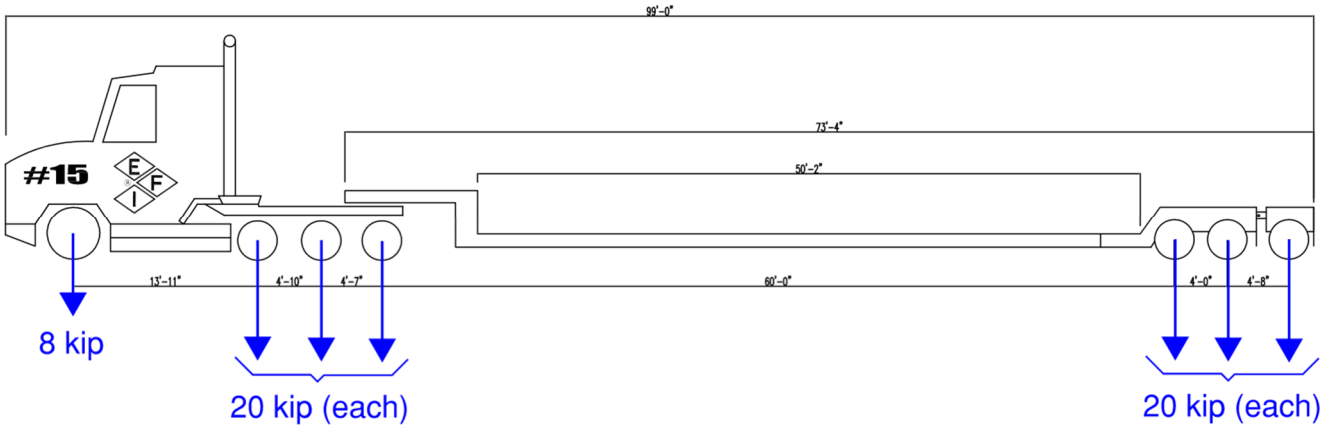

Figure 7 *– Proposed Truck Loading*

Conclusions

In summary, PSE is providing the following conclusions:

1. The overall structural integrity and serviceability of the bridge appears to be acceptable. PSE believes that observed minor stains, discoloration, and corrosion of secondary stringers does not significantly affect the ability of the bridge to carry loads.
2. It is PSE's professional opinion that the current capacity of the bridge is sufficient to handle the HS20-44 design loading as specified in the as-built drawings.
3. The demands imposed by the proposed 128,000-pound transport vehicle are within +/- 5% of the demands imposed by the design vehicle, therefore the bridge appears to have sufficient capacity to support the design vehicle. The design vehicle should cross the bridge slowly as to not impart dynamic forces and the 128,000-pound vehicle loading should not be exceeded.

4. PSE recommends that the bridge be visually inspected every two to four years by a California licensed civil professional engineer (PE) or structural engineer (SE) for continued use and to maintain the recommended load limit.

The observations summarized above represent the observed condition on the date of the site visit. Please note that the condition of the bridge may change over time. The recommendations above represent the opinion of licensed Professional Engineers in the State of California. No formal load rating of the bridge has been completed as part of this study. Furthermore, this document provides a limited evaluation of the above noted loading criteria; it is not intended to be a comprehensive structural assessment of the bridge.

Please do not hesitate to contact our office with any questions or concerns about information contained within this memorandum.

Sincerely,

Galit Ryan, PE
Senior Vice President
Peterson Structural Engineers, Inc.

EXPIRES 12/31/24

Andrew Wiese, PE
Associate Project Manager
Peterson Structural Engineers, Inc.

EXPIRES 09/30/25