Figure 1. I-35 Southbound over Rollercoaster Road and Pine. Logan Co., OK. The photograph highlights spans 2 and 3 which were made with AASHTO Type IV girders. Span 2 spans 103.43 ft. with girder spacings at 8.20 ft. The bridge was built in 1998 with straight strand patterns that replaced draped strand designs. Strand patterns included fully tensioned "top strands" to mitigate the number and length of debonded strands. This bridge was the first of 700 bridges built in Oklahoma that incorporate designs with straight strand patterns and fully tensioned top strands, and limited debonding where required to control end zone stresses. The practice continues through today. Photo taken by Bruce W. Russell, 2014.

Figure 1. Alternate to Fig. 1 above. Same caption. Pick one.

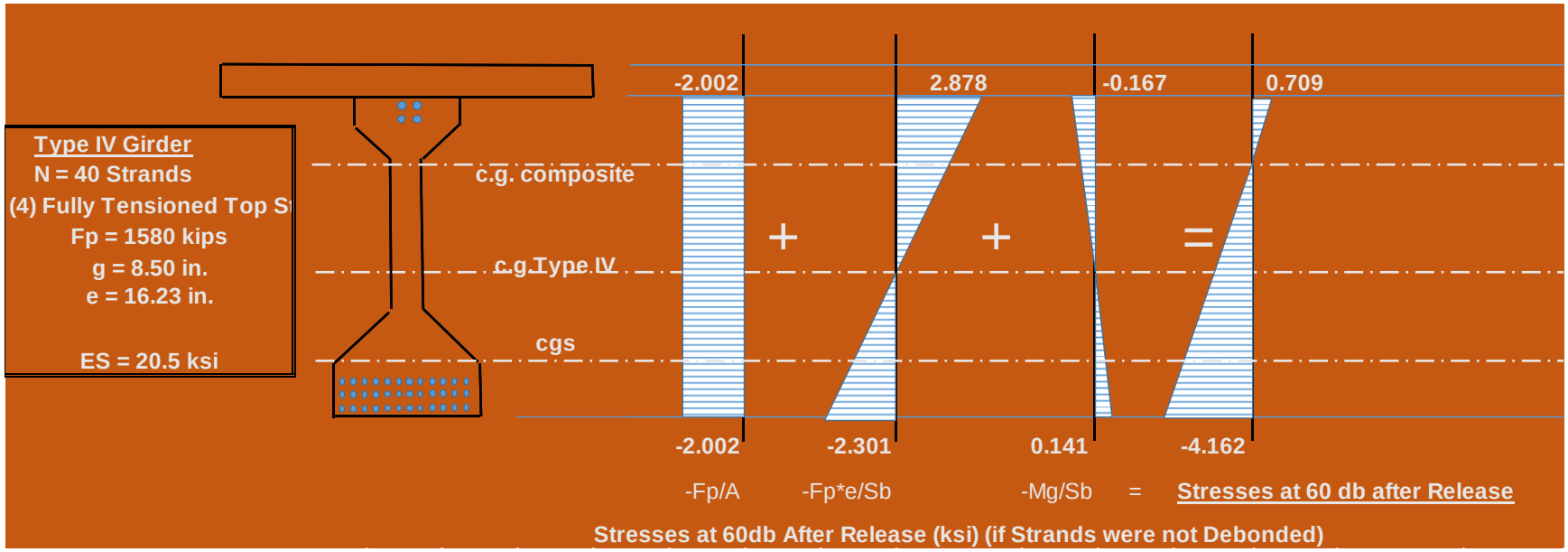

Figure 2. Straight Strand Pattern for Type IV Bridge Beams used in the I-35 Bridge over Rollercoaster and Pine Roads, Logan Co., Oklahoma – but WITHOUT DEBONDING. Span length = 133'-5". A total of 40, 0.6 in. diameter, Gr. 270 strands were used in each girder. Four Fully Tensioned Top Strands help control stresses in end regions, reduce the top fiber tension by approximately one half even without debonding, and substantially reduce the risk of cracking in end regions. When the bridge was built, the allowable compressive stress at release was 0.6 f'ci, and the concrete stress exceeded the allowable limit. Therefore, the design required eight strands to be debonded, as shown in Fig. 3.

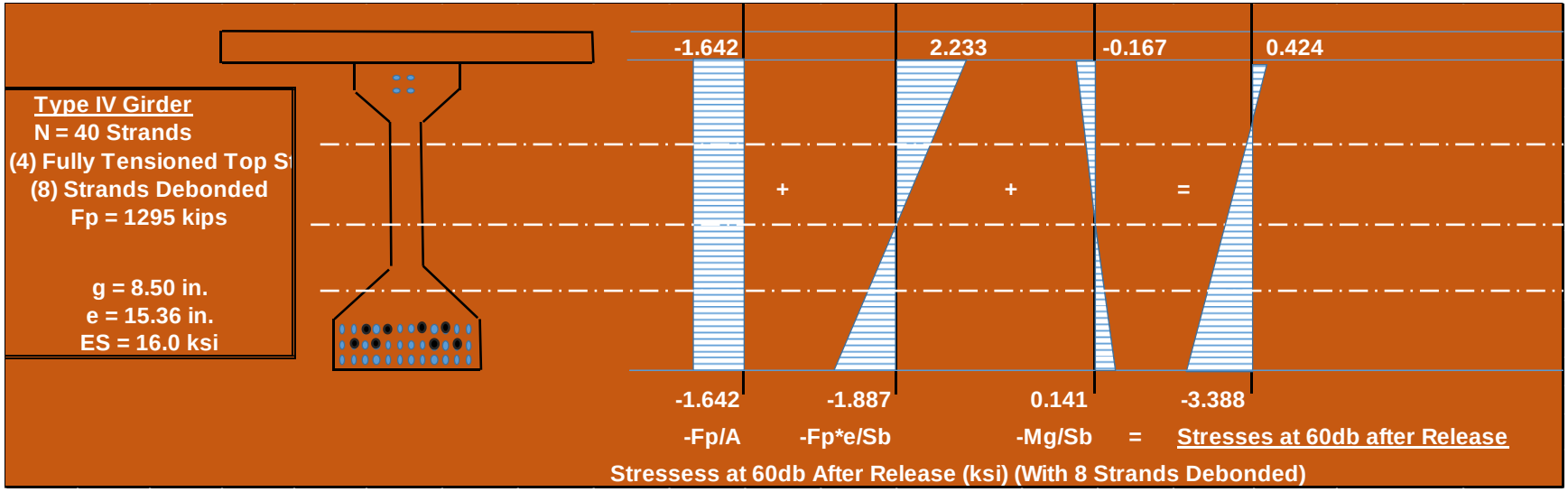

Figure 3. Straight Strand Pattern with Four Fully Tensioned Top Strands and Eight Debonded Strands for Type IV Bridge Beams used in the I-35 Bridge over Rollercoaster and Pine Roads, Logan Co., Oklahoma. Span length = 133'-5". A total of 40, 0.6 in. diameter, Gr. 270 strands were used in each girder. Debonded strands are shown by the black strand symbols in the figure. Debonding strands reduced the Effective Prestress Force to 1295 kips from 1580 kips (an 18 percent reduction) and decreased the CGS eccentricity to 15.36 in. from 16.23 in. Debonding strands in combination with fully tensioned top strands reduced the top fiber tension from 709 psi to 424 psi. Debonding plus fully tensioned top strands reduced the bottom fiber compression from 4,160 psi to 3,390 psi.

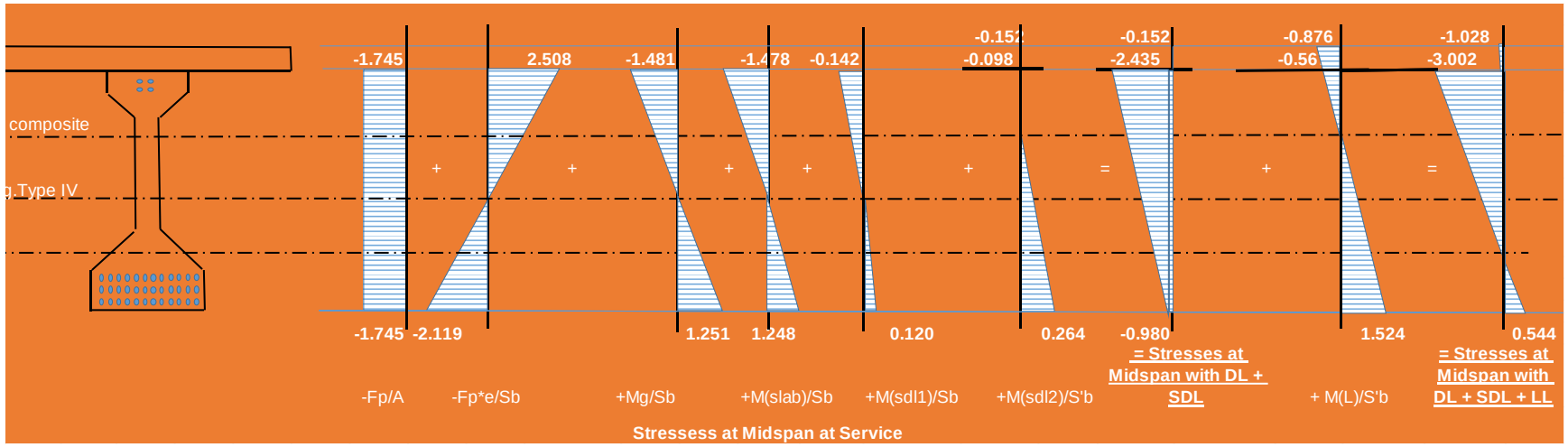

Figure 5. Service Level Stresses at midspan. The stresses are computed using current loss equations in the LRFD, plus using a 1.0 load factor on the service live loads. The key calculation is shown where the bottom fiber stress at service loads is computed as 544 psi. This compares to an allowable stress of 700 psi. The figure shows the computation of concrete stress at each stage of loading.


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