T5 Strength IV, 2015 Ballot Item 1
Background

April 21, 2015
Dip in target reliability where $\frac{LL}{(DL+LL)}$ ratio is approx. 0.13 (when LL is approx. 20% of total load)
Proposed alternatives

Horizontal axis: $\frac{LL}{DL+LL}$
2010 proposed revision to Strength IV:
\[ \Sigma \gamma_i Q_i = 1.4DC + 1.5DW + 1.40(LL+IM) \]

- From T5 May 2010 Annual Meeting Minutes:
  - NC--force effects on some short-span steel bridges control
  - Caltrans--Strength IV sometimes controls over Strength I for concrete boxes; ASBI similarly concerned
  - Continuous thought (of some)—is the resultant change to the target reliability, \( \beta \), worth it?
  - Pulled--T5 agreed to look at a larger sample of bridges
Dataset:
- Steel I-Girders (6); 3-span, 100-600-ft center span
- Concrete Spliced I-Girder, CIP multi-cell, precast segmental boxes (2); up to 508-ft spans
- Steel Trusses: 6 total; 250-822-ft spans

Load combinations after more rigorous study
A. \[ \sum \gamma_i Q_i = 1.4 DC + 1.5 DW + 1.45(LL+IM) \]
B. \[ \sum \gamma_i Q_i = 1.4(DC + DW) + 1.0(LL+IM) \]
C. \[ \sum \gamma_i Q_i = 1.5(DC + DW) \] (no change)

2014 Ballot Item 40: \[ \sum \gamma_i Q_i = 1.4 DC + 1.5 DW + 1.45(LL+IM) \], also pulled
Steel I-girders (Precast concrete, similar)

- Strength I currently controls all span lengths (▲ above ●); values for $\beta$ between 3 and 4
- New Strength IV ■ sometimes controls by typically a small margin; small improvement in $\beta$
Concrete Boxes

- Strength IV currently controls some of the time over Strength I; values for $\beta$ between 2.5 and 3.5
- New Strength IV would control more frequently over Strength I; small improvement in $\beta$
Steel Trusses

Green triangle = Strength I
Blue diamond = existing Strength IV
Red square = proposed Strength IV

• Strength I currently controls in all cases (△ above ⬛); β approx. 2.5
• New Strength IV controls; achieves β of approx. 3.0
Conclusion

- Beam-slab bridges and concrete boxes, not much benefit.
- However, how perfect is the process to enforce $\beta = 3.5$ for ONE member in ALL structures?
  - Load path redundancy and system behavior not accounted for
  - The LRFD load distribution factors used in calibration provided refinement only for beam-slab bridges; boxes and trusses never benefitted
  - Strength IV tries to rectify design loads for long-span bridges, but conservatively use the full HL93
- Withdraw ballot item in 2014
- Ballot Item in 2015 to explain in Commentary