DISCUSSION

Updating Standard Shape Material Properties Database for Design and Reliability

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Discussion by RICHARD M. BENNETT

The authors are to be commended on their thorough and well-presented statistical analysis of the mechanical properties of ASTM A992 steel. The authors perform a preliminary reliability analysis and conclude that A992 steel gives slightly higher reliability indices than those adopted in the original calibration for the AISC *Load and Resistance Factor Design Specification for Structural Steel Buildings* (AISC, 2000). However, the new statistical values are felt to be insufficient in themselves to permit increasing the resistance factor from 0.90 to 0.95.

Resistance factors have typically had only one to one and one-half significant digits, for example, 0.80, 0.85, 0.90. However, this discusser is aware of no reason why resistance factors could not have two significant digits. The original calibration of the LRFD specification was $\beta = 2.52$ at $L/D = 3$. Using the new resistance parameters, $\beta = 2.61$ for $\phi = 0.90$ and $\beta = 2.37$ for $\phi = 0.95$ at $L/D = 3$. Using linear interpolation results in a value of $\phi = 0.92$ for $\beta = 2.52$. It is proposed that the resistance factor for braced compact beams in flexure and tension members at yield be increased from 0.90 to 0.92.

Due to the discretization mentioned in the paper, slightly increasing the resistance factor will not change the required size of many beams, and it is impossible to say exactly what the savings would be by increasing the resistance factor. If it is assumed that the factored design moment is uniformly distributed between 50 kip-ft and 1000 kip-ft (beams between a W12×14 and W27×84) and only the most efficient shapes are considered, increasing the resistance factor from 0.90 to 0.92 would result in a lighter required beam 14 percent of the time. There would be an overall average savings of 0.78 lb/ft of steel. For heavier loads where the factored design moment is assumed to be uniformly distributed between 1000 kip-ft and 3000 kip-ft (beams between a W30×90 and W40×183) increasing the resistance factor would result in a lighter required beam 26 percent of the time, and an average savings of 2.4 lb/ft of steel. If only a constant depth is considered, such as W16 beams, a lighter beam would be required 14 percent of the time and the average savings would be 1.15 lb/ft of steel for an assumed uniform distribution of factored moments between 100 and 700 kip-ft.

One of the main advantages of LRFD design is that it allows uncertainties to be treated in a rational fashion. It is proposed that full advantage be taken of the thorough statistical analysis of mechanical properties reported in the paper and the LRFD method to increase the resistance factor for braced compact beams in flexure and tension members at yield from 0.90 to 0.92. This will result in a lighter required beam section approximately 15 percent of the time and an average savings of approximately 1 lb/ft of steel.

REFERENCES

AISC (2000), *Load and Resistance Factor Design Specification for Structural Steel Buildings*, December 27, 1999, American Institute of Steel Construction, Inc., Chicago, IL.

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