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ANALTICAL INVESTIGATION OF THE INFLUNCE OF COLUMN SIZE ON THE FIRE LOAD BEHAVIOR OF STEEL BUILDING COLUMNS

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Research was performed to probe the supposition that small increases in steel column weight (which do not necessarily lead to large increases in associated construction costs) can lead to substantial increases in fire resistance of steel building columns. The supposition was probed by performing sequential nonlinear heat transfer and structural analyses of a series of columns to determine their capacities when exposed for varying times to the temperatures associated with ASTM E119 standard fire.

The research investigated three series of columns, a Light series (W360x134 to W360x162), a Medium series (W360x347 to W360x421), and a Heavy series (W360x744 to W360x900), representing columns that may be used at the upper, middle and lower stories of a high rise building, respectively. The behavior of these column series was determined at fire durations of 1, 2, 3 and 4 hours. Because an increase in column size results in a new design SFRM thickness for a given fire duration rating, increased column sizes were investigated with original (i.e. thicker) SFRM thickness, as well as with the reduced SFRM thicknesses required for the larger column size.

The major findings of the research were that: (1) for all columns considered, increasing the column weight 10% and providing design SFRM thickness on the new column did provide some benefit (approximately 5-20% increase in capacity depending on the column and fire duration considered); (2) the benefit of a 10% increase in weight was greatest for the Light and Medium column groups and least for the Heavy column group; (3) increasing the column weight 10% and maintaining SFRM thickness from the base column on the new column provided a substantial benefit in all cases (approximately 10-30% increase in capacity depending on the column and fire duration considered); (4) increasing the column weight 20% provided substantial benefit for all columns considered, regardless of SFRM thickness or fire duration (approximately 25-40% increase in capacity); and (5) for the columns with 20% weight increase, those with maintained SFRM outperformed those with design SFRM significantly due to the increased insulation provided.