Collapse Temperature analysis of Multilayered Steel Frames Considering Variability of Steel Strength at Elevated Temperatures

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Keywords**: Collapse temperature, Variability of steel strength, Tensile test at elevated temperature**

In this study, the author created stress strain relation considering variability of steel strength at elevated temperatures that conducting tensile tests at elevated temperature and accumulating the data which can announce. And the collapse temperature analysis of the multilayered steel frames was carried out using created stress strain relations. The examination contents are comparisons between multilayered steel frames considering variability of steel strength at Elevated Temperatures and the multilayered steel frames which they do not consider. As a result, the author considered how variability had an influence on the Multilayered Steel Frames.

Tensile test at elevated temperature based on JIS G 0567 of「Method of elevated temperature tensile test for steels and heat-resisting alloys」. The temperature rose by an electric furnace. The temperature is four hundred, five hundred, six hundred, and seven hundred degrees Celsius. After having done heating to setting temperature in a thermocouple, tensile test was conducted while maintaining more than fifteen minutes. Test pieces used steel class SS400 and SNR400. As a result of having measured one percent yield strength and tensile strength, strength decreased so that both became the elevated temperature and was an approximately linear decline tendency.

Stress strain relation was created to use for analysis in reference to an experiment and documents.to satisfy the conditions. The creation set it based on the expression of stress strain relations of the recommendation for fire resistant design of steel structures (AIJ recommendation) to satisfy the following targeted value.

① Coefficient of variation $V_{\sigma 01}$ of one percent yield strength at room temperatures σ_{01} is satisfied with More than six percent and seven percent or less.

② Twenty percent strength at room temperatures σ_{20} is less than or equal to one percent which the probability that becomes less than four hundred N/mm^2 or more than 510 N/mm^2.

In the parameters of the stress strain formula, let σ_0 and E_t vary according to normal distribution by Monte Carlo simulation. As a result of Created the histogram (number of the samples three thousand) of one percent yield strength and Twenty percent strength at each temperature, it almost satisfied the conditions.

This analysis is all material SS400 and the pure ramen frames of fifteen stories of two spans. The fire room set a single compartment (two cases of right and left) and all compartments with first floor, eighth floor, fifteenth floor, nine cases in total. Analysis results brought the following knowledge.

- The variability of steel strength affects the collapse temperature of the frames, but it of the collapse temperature is smaller than the coefficient of variation of steel strength at elevated temperatures.
- The collapse temperature decreases so that the axial force ratio becomes big, and the coefficient of variation grows big. On the contrary, the coefficient of variation grows becomes small if collapse temperature rises.