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Simplified *P-M* Interaction Curve Model for a Reinforced Concrete Column Exposed to Standard Fire

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ABSTRACT

A fire-resisting performance evaluation model of a reinforced concrete (RC) column was proposed in authors' previous study, based on the *P-M* interaction approach, which can consider the secondary moment effect of the column due to the larger slenderness ratio caused by the fire damage of materials. Although the proposed *P-M* interaction model provided a good accuracy, it has limitations for practical use due to its complex and iterative calculation process. Thus, in this study, the process of deriving the *P-M* interaction curve has been sharply simplified by its linearization, introducing the balanced point obtained from regression analysis on the key influencing parameters. The simplified *P-M* interaction model was then verified with test results collected from other studies. The results showed that the simplified *P-M* interaction model proposed in this study can reasonably estimate the fire-resisting performances of the RC columns under elevated temperatures.

1. INTRODUCTION

In the authors' previous study, an axial force-flexural moment (*P-M*) interaction curve model was proposed to evaluate the fire-resisting performances of reinforced concrete (RC) columns, and Fig. 1 shows the concept of the proposed *P-M* interaction curve model. In the authors' previous study, it was also verified that the proposed method can properly consider the material strength degradation phenomenon due to the fire damage and the secondary moment effects in slender RC columns. However,

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this *P-M* interaction curve model is quite complex to be used in practical design. Thus, this study was aimed at developing a simplified *P-M* interaction curve model of RC columns exposed to fire.

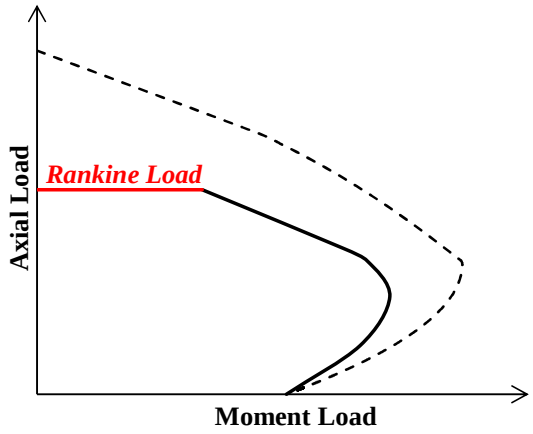

Fig. 1 Main concept of proposed *P-M* interaction curve model of a RC column

2. SIMPLIFIED P-M INTERACTION CURVE

Fig. 2 shows the normalized *P-M* interaction curves, in which the balanced failure point was idealized by using coefficients α_2 and β_2. The normalized *P-M* interaction curve when $P_R > P_b(=\beta P_0)$ can be expressed, as follows:

$$\frac{P_u}{P_R}+\frac{1-\beta_2}{\alpha_2}\frac{M_u}{M_0}=1 \quad \text{for} \quad \frac{P_u}{P_R}\geq\beta_2 \tag{3a}$$

$$\frac{1-\alpha_2}{\beta_2}\frac{P_u}{P_R}+\frac{M_u}{M_0}=1 \quad \text{for} \quad \frac{P_u}{P_R}<\beta_2 \tag{3b}$$

and the normalized *P-M* interaction curve when $P_R \leq P_b(=\beta P_0)$ can also be expressed, as follows:

$$\frac{1}{\alpha_2}\frac{M_u}{M_0}=1 \quad \text{for} \quad \frac{P_u}{P_R}=1 \tag{4a}$$

$$\frac{1-\alpha_2}{\beta_2}\frac{P_u}{P_R}+\frac{M_u}{M_0}=1 \quad \text{for} \quad \frac{P_u}{P_R}<1 \tag{4b}$$