The 2025 World Congress on
Advances in Structural Engineering and Mechanics (ASEM25)
BEXCO, Busan, Korea, August 11-14, 2025

Interpolation and Moment-Curvature Relation based P-I Diagram Prediction of RC Beams

*Hyunseung Chung[1] and Hyo-Gyoung Kwak[2]

[1), 2)] *Department of Civil Engineering, KAIST, Daejeon 34141, Korea*
[1)] *hyunseungchung@kaist.ac.kr* [2)] *kwakhg@kaist.ac.kr*

ABSTRACT

Blast analysis of reinforced concrete (RC) structures based on the moment-curvature relationship (M-ϕ) has demonstrated numerical efficiency while maintaining accuracy compared to solid element-based approaches in previous studies. The P-I diagram enables the estimation of the damage of a structure or structural member upon applied blast loading and can be constructed for multiple failure modes. However, the numerical approach to constructing a P-I diagram requires multiple analyses, necessitating simple approach to predict the diagram.

To enhance the benefits of the P-I diagram and section analysis-based approach, this study constructed a P-I diagram database of representative RC beams with typical section dimensions, reinforcement ratios, and loading intensities. However, the database cannot encompass every possible structural member and loading condition. Therefore, if an RC section falls within the database boundaries, an approximation procedure with section properties is provided to predict a P-I diagram, which is subsequently verified with a numerical analysis-based P-I diagram.

As a result, an RC beam was analyzed and the resulting approximated P-I diagram for flexural and direct shear failure modes exhibited an R2 score of 0.9984 and 0.9998, with each data point exhibiting less than a 10% error. Furthermore, the approximated P-I diagram from the pre-analyzed database can estimate a P-I diagram of a given structure without conducting a numerical analysis. This simple approach can be utilized during the design process of protective structures, providing information on whether the structural member possesses sufficient blast-resisting capacity against various blast attack scenarios.

ACKNOWLEDGEMENT

This work was supported by the Korea Government as the National Research Foundation of Korea (NRF) grant (No RS-2023-NR077074) and the Korea Ministry of Land, Infrastructure and Transport (MOLIT) as an “Innovative Talent Education Program for Smart City”.

[1)] Graduate Student
[2)] Professor