40, 60MPa 압축강도 콘크리트에서 철근 압축이음 길이

Compression Splice Length in Concrete of 40 and 60 MPa Compressive Strengths

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ABSTRACT

Current design codes regarding compression lap splice dose not utilize merits of the improved strength of ultra-high strength concrete. Especially, a compression lap splice can be calculated longer than a tension lap splice according to the codes because they do not consider effects of strength of concrete and transverse reinforcement. Design equation is proposed for compression lap splice in 40 to 70 MPa of compressive strength of concrete. The proposed equation is based on 51 specimens. Through two-variable non-linear regression analysis of measured splice strengths, a splice strength equation is derived, which is converted into a splice length equation.

요　약

초고강도 콘크리트의 개발에 따라 철근 압축이음에 대한 연구 필요성이 높아지고 있다. 현행 설계기준에서 콘크리트강도와 횡보강근의 영향을 고려하지 않기 때문에 압축이음길이가 인장이음길이보다 길어지는 기현상(奇現象)이 발생한다. 본 연구에서는 51개 실험체의 결과를 바탕으로 40MPa부터 70MPa까지 콘크리트에 대한 압축이음길이 설계식을 제안하였다. 본 연구에서 제안된 압축이음길이 설계식을 이용하여 고강도 콘크리트에서 압축이음길이가 인장이음길이보다 길어지는 이상 현상을 해소할 수 있다. 더불어 제안된 압축이음길이 설계식은 통계적 기법에 기반을 두어 재료강도와 동일한 수준의 신뢰성을 확보할 수 있다.

1. Introduction

The compression lap splice criteria in KCI were based on just 11 column tests[1)] conducted over 40 years ago using a maximum concrete strength of 29 MPa. Due to end bearing, the splice length in compression is shorter than the length in tension to develop the specified yield strength of reinforcing bars. However, a design compression lap splice could be longer than a design tension lap splice according to KCI, as concrete strength becomes higher, as shown in Fig. 2. This anomaly arises because the provisions for compression splices do not properly consider the effects of the compressive strength of the concrete and end bearing. To enhance the efficiency of high strength concrete, new criteria for compression lap splices are required.

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2. Proposed Mdoel for Compression Splices

The splice strength in compression was found to be evaluated with the $\sqrt{f_{ck}}$ and $\sqrt{l_s}$. Because of the short length and the existence of the end bearing, the splice strength was more sensitive to concrete strength compared with tension splices. The spacing between bars had little effect on the splice strength in compression. The axial stress decreased the tensile strength of the concrete surrounding the spliced bars and, therefore, the total tensile capacity of the concrete hardly increased with an increase in the clear spacing from $1.5d_b$ to $3.5d_b$. A regression analysis is carried out based on the model composed of $\sqrt{f_{ck}}$ and $\sqrt{l_s}$ and provides an equation for predicting the mean strengths of compression splices $f_{sc,p}$. as shown Eq. (1).

The splice strengths predicted by Eq. (1) were compared to the test values for 51 specimens. Figure 1 shows that the splice strengths were predicted without bias on four specimen-series. The coefficient of variation (COV) of the ratios of tests to predictions was 9.1% .

Splices should have a strength equivalent to the reinforcing bars, which means the nominal strength of a splice must not be less than the specified design yield strength of the reinforcing bars with the same reliability as the bars. The mean strength of a compression splice ($f_{sc,p}$) should be reduced to the design strength ($f_{sc,d}$) using a 5% fractile coefficient $n_{5\%}$ of 0.82. For design purposes, it is desirable to determine the splice length rather than the splice strength and Eq. (2) is developed to calculate a splice length of compression splice.

$$f_{sc} = \left[(11.1 + 58.5\kappa_{tr}) \sqrt{\frac{l_s}{d_b}} + 16.4 + 1.9\delta \right] \sqrt{f_{ck}} \quad (1)$$

$$\frac{l_s}{d_b} = \left[\frac{\frac{f_y}{0.82\sqrt{f_{ck}}} - 16.4 - 1.9\delta}{11.1 + 58.5\kappa_{tr}} \right]^2 \quad (2)$$

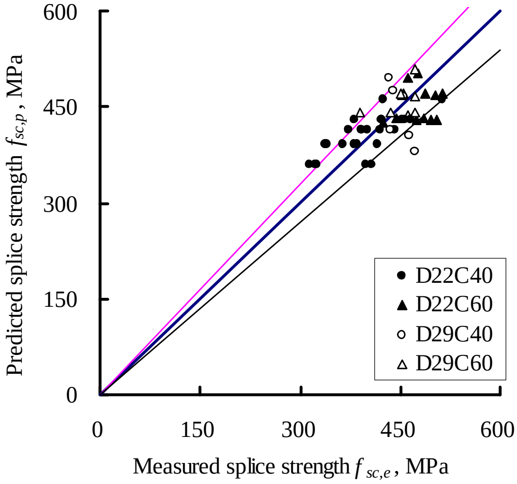

Fig. 1 Comparison of test results and predictions

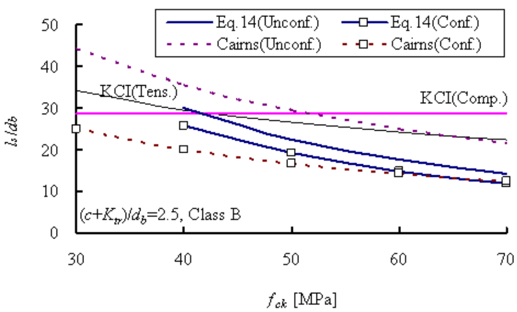

Fig. 2 Comparison of splice lengths by KCI with those by the proposed equation

3. Conclusion

A design equation for a splice length in compression was developed through regression analysis of the results of 51 compression tests.

Acknowledgement

The work presented in this paper was funded by Center for Concrete Corea (05-CCT-D11), supported by Korea Institute of Construction and Transportation Technology Evaluation and Planning (KICTTEP) under the Ministry of Construction and Transportation (MOCT).

참고문헌

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