V-9 EFFECT OF SHEAR SPAN-TO-DEPTH RATIO ON SHEAR STRENGTH OF REINFORCED CONCRETE SHORT BEAMS AND DEEP BEAMS

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1. INTRODUCTION

Reinforced concrete deep beam find useful applications in tall building construction, offshore structure and complex foundation system. According to ACI-ASCE Committee 426, a beam with shear-span-to-depth ratio *a/d* less than 1.0 is classified as a deep beam and a beam with *a/d* exceeding 2.5 as an ordinary shallow beam. Any beam in between these two limits is categorized as a short beam. It was studied by many researches that the shear strength V_c for RC deep beam is greatly affected by shear span-to-depth ratio. Recently high strength concrete material was utilized in many RC structures. This paper aim to study the effect of *a/d* ratio with using high strength concrete material. The published data were collected and the comparison of current design equation is presented.

2. SHEAR STRENGTH EQUATION WITHOUT WEB REINFORCEMENT

The concrete shear strength equation for RC beam with small a/d ratio was proposed in 1987 by Ishibashi[1].

$$V_C = 3.58 fc`^{1/3}\left(\frac{a}{d}\right)^{-1.66}(100 p_W)^{1/3}\left(\frac{100}{d}\right)^{1/4} bd \qquad , 1.0 \le \frac{a}{d} \le 2.5 \qquad (1)$$

where $p_W = \frac{As}{bd}$, V_C:concrete shear strength (kg), fc`: concrete compressive strength (kg/cm^2), a: shear span (cm), d: effective depth (cm), b: width (cm).

3. DATA COLLECTION AND DESING EQUATION COMPARISON

The 152 published data were collected[3)~17)]. It is in the range of a/d 0.5~5.0, fc` 18.1~104.2N/mm^2, tension steel ratio 0.74~3.77%, web reinforcement ratio 0~0.19%, width 80~375, and effective depth 125~1,559mm. A regression line is drawn with the relationship of order −1.166, which is extracted from Eq. (1). The analytical results show a good tendency with normalized shear strength (V/bdfc`), which scope the high strength concrete material. The variety of data can be observed especially in the range of a/d ratio less than 1.0 probably because of experimental set-up, which is different in steel bearing plate.

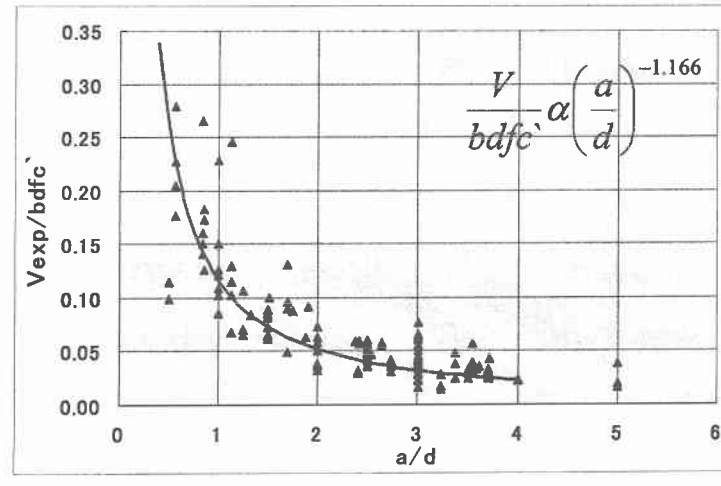

Fig. 1 The effect of a/d ratio

The design equation (1) was used to calculate and compare with the experimental results as shown in Fig. 2~3. The calculated results show conservative safe side for design purpose. In the range of a/d ratio 1.0~2.5, only 5 specimens from 66 were show slightly higher calculated shear strength than experimental one.

4. CONCLUSIONS

1) The shear span-to-effective depth ratio had relationship with normalized shear strength (V/bdfc`) with the order of −1.166 as proposed by Ishibashi et all.
2) The high strength concrete material was applicable to Ishibashi's equation. It shown conservative results for design purpose.

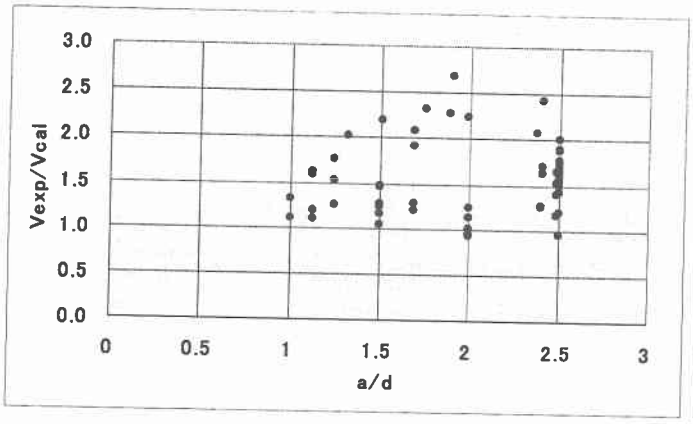

Fig. 2 The design equation is in the range of a/d 1.0~2.5

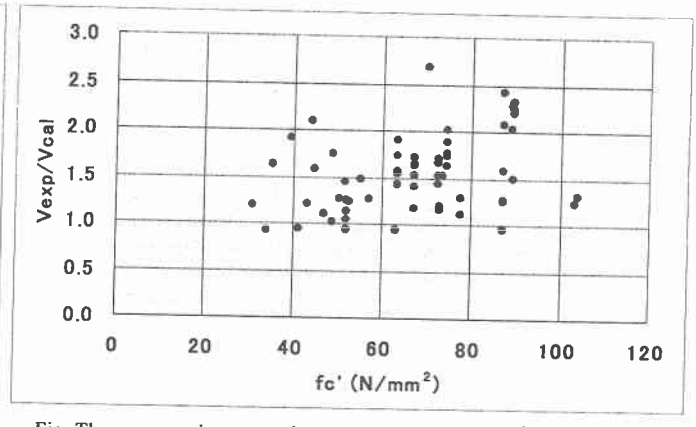

Fig. The compressive strength extend up to 100 N/mm²

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