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A Study on the effect of Change in Width to Depth Ratio of RCC Beam in Shear

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***Abstract*: This study of shear capacity in reinforced concrete member incorporate member incorporated a broad set of focus areas to satisfy the objectives outlined in section 1.2. Through a large analysis program and a review of other results available in the literature, and main discussion areas were established in Chapter 4. Shear in member with reinforcement were considered. The influence of width to depth ratio with simply supported in wider beam were evaluated.**

***Keywords*: Shear, Width/Depth Ratio.**

1. Introduction

The use of large, wide concrete Beam in structural systems has increased in recent years. This change responds to the need for economical solutions which minimize structural depth and construction complexities. For example, designers of modern high-rise structures are often tasked with transferring column loads from the tower portion over required column-free spaces in the podium or parking areas below. Wide beams can provide adequate cross-sectional areas to achieve the required capacity in a shallower depth than a system of narrower beams at a similar spacing in the plan. Where semi-irregular loads in the plan must be supported, a thick transfer slab may prove to be an economical solution that avoids formwork complexity.

IS 456:2000 design codes permit the use of analysis models for the flexural and shear response of reinforced concrete elements? That is, the flexural and shear demands are each evaluated against nominal capacities developed on the basis of the cross-sectional dimensions, and the reinforcement provided within the cross-section. Traditional BIS design provisions for shear capacity were developed on the basis of concrete and material test results for members usually narrower than about 350 mm.

The width-to-height aspect ratio of these specimens was usually well below 1.0. Comparatively less work addressed the performance characteristics of much wider members. Furthermore, early development work considered relatively shallow members. Thus, the application of design guidelines developed from small narrow specimens towards general use for all member widths and depths has not been adequately validated.

Extensive research over the last few decades has focused on the ability to accurately predict the shear performance of slender, narrow beams which do not contain web reinforcement. This research has identified significant parameters for estimating shear capacity. Several research groups have identified a so-called "size effect" in shear, where the average shear stress at failure decreases as the member depth increases and as the aggregate size decreases.

2. Problem Identification

A large proportion of the published research on shear in structural concrete has focused on small, narrow specimens. Additionally, many of the shear-critical specimens from the literature contain high levels of flexural capacity relative to the flexural demand at the force corresponding to shear failure. For example, in formulating the IS 456:2000 expression for shear capacity in members without and with web reinforcement described in Section 40.2, 40.3 and 40.4, A lack of "wide" members is evident. Thus, there was no direct test evidence to suggest that wide members behave in similar or different respects than narrow members. Furthermore, longitudinal reinforcement ratios in the data set were much higher than the reinforcement ratios consistent with flexure-critical designs.

Subsequent to development of the ACI 318-63 provisions, additional experimental programs have considered members with larger bw/d ratios (examples: Kani, 1967 [01]; Leonhardt and Walther, 1964 [3]; Regan, 1982; Serna-Ros et al., 2002). However, these studies typically included large flexural reinforcement ratios, or utilized very shallow member depths. The limited range of key test parameters in these research programs becomes problematic when these wide member results are used to assess the applicability of narrow member derived shear provisions for wide members in general. For example, if all wide member test data is from shallow wide members, it cannot be assessed whether size effect concepts from narrow members directly translate to their wide counterparts. The current research provides one of the few comprehensive investigations into the shear design of large, wide members having realistic levels of flexural and web reinforcement.

3. Methodology

An extensive analytically this program was developed to

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provide analyses the results for use in correlating the main shear performance parameters in the study. Consistent with the objectives of the research program, these included specimens that varied principally in width, specimens providing similar web reinforcement quantities but utilizing different transverse distribution strategies, and wide specimens with narrow and full-width load and simply support conditions. A range of member depths were evaluated, consistent with member dimensions used in practice. Specimens contained various flexural reinforcement ratios, including ratios approaching the levels needed to achieve flexure-critical conditions.

A total of fifty-four large-scale (b= 250mm, 300mm and 350mm with constant D=500, then change the section constant b=500mm with varying depth d= 250mm, 300mm and 350mm each cross section of clear span 6m, 8m, and 10m in M-20, M-25, and M-30 grade of concrete so total of fifty-four) specimen where nominal dimension.

A. Beam Configuration

A large wide specimen, designated Beams, was designed and analyses according to the provisions of IS 456:2000. Once an effective width was selected as comparable to overall depth of the section analyzed beams and there after an overall depth has chosen as comparable to width of the section.

B. Beam analyses design procedures

The specimen was analyses and design by the two different methods:

1. By the manual analysis using code of practice IS 456: 2000
2. The beam design by the STADD. Pro

The specimen was loaded by uniformly distributed load of about 30 kN. This allowed proper seating of the load and support, and permitted an initial check of the analysis set-up.

4. Result

This study has examined significant parameters for predicting shear capacity in narrow and wide reinforcement concrete members. This included the influence on the shear stress at failure from member depth, longitudinal reinforcement ratio, and the longitudinal spacing of web reinforcement. For wide member, additional parameters were considered, including the member width the distribution of web reinforcement across the width, and the influence of load. The investigation focused on width and depth of the section, where sectional capacity model are traditionally used in design. This chapter summarizes the result of these findings, by providing the recommended sectional shear provision for use in the design and analysis of wide and narrow reinforced concrete member shows as in fig.

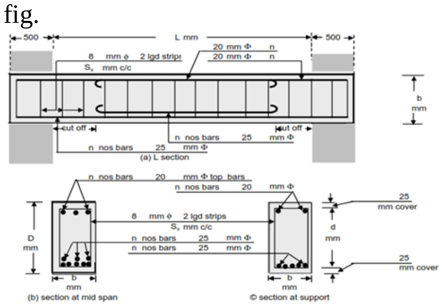

Fig. 1. Sectional view of member

A. Member with web Reinforcement

Parameter significant to predicting sectional two-way problem for shear capacity for member with web reinforcement. The methodology that is that is recommended from this study makes no distinction between shear capacities in narrow beam,

Table 1
Shear and strain in section in same overall depth

Concrete Grade	Length (m)	Width (m)	Depth (m)	f_{sc} (N/mm^2)	τ_v (N/mm^2)	τ_c (N/mm^2)
M-20	6 m	0.25	0.5	352	1.11	0.58
		0.3	0.5	352	0.94	0.54
		0.35	0.5	352	0.82	0.56
	8 m	0.25	0.5	352	1.54	0.75
		0.3	0.5	352	1.31	0.72
		0.35	0.5	352	1.07	0.64
	10 m	0.25	0.5	352	1.98	0.81
		0.3	0.5	352	1.68	0.79
		0.35	0.5	352	1.46	0.75
		0.3	0.5	352	1.68	0.8
		0.35	0.5	352	1.46	0.77

Table 2
Shear and strain in section in same width

Concrete Grade	Length (m)	Width (m)	Depth (m)	ε_{sc}	f_{sc} (N/mm^2)	τ_v (N/mm^2)	τ_c (N/mm^2)
M-20	6 m	0.5	0.25	0.002	325	1.34	0.81
		0.5	0.3	0.00229	325	1.08	0.72
		0.5	0.35	0.00248	343	0.9	0.6
	8 m	0.5	0.25	minimum reinforcement exceeds (> .04bD)			
		0.5	0.3	0.00229	325	1.47	0.82
		0.5	0.35	0.00248	343	1.24	0.75
	10 m	0.5	0.25	minimum reinforcement exceeds (> .04bD)			
		0.5	0.3	minimum reinforcement exceeds (> .04bD)			
		0.5	0.35	minimum reinforcement exceeds (> .04bD)			

and in wide beams. A common set of equation should apply to all three types.

The recommended design and analysis provision were adapted from the current IS 456:2000. These provisions were found to provide more consistent predictions of member capacity for a range of member capacity for a range of member geometries, including members of varying width to depth, than the IS 456:2000 provision. Further a restriction on the maximum spacing of web reinforcement across the member width was proposed. The notation in the model has been changed from its width to depth to reflect notation used in this thesis.

The shear capacity for model in member with web reinforcement was developed and the models is shear is tabulated in below as the section shown in fig.

B. Comparison the result of manual calculation and the STADD pro result

The comparison of the analysis by manual and Programming by STADD pro is tabulated below were the following members was similar and some member were dissimilarity are shown.

5. Conclusion

In this study also focused member with typically b/d ratio of

Table 3
Comparison the result of manual calculation and the STADD pro result (constant D)

Concrete Grade	Length (m)	Width (m)	Depth (m)	By Manual calculation	By STADD pro
M-20	6 m	0.5	0.25	Permissible for designing	Permissible for analysis
		0.5	0.3	Permissible for designing	Permissible for analysis
		0.5	0.35	Permissible for designing	Permissible for analysis
	8 m	0.5	0.25	Permissible for designing	Permissible for analysis
		0.5	0.3	Permissible for designing	Permissible for analysis
		0.5	0.35	Permissible for designing	Permissible for analysis
	10 m	0.5	0.25	Permissible for designing	fails while detailing
		0.5	0.3	Permissible for designing	Permissible for analysis
		0.5	0.35	Doubly not required	Permissible for analysis
		0.5	0.3	Permissible for designing	Permissible for analysis
		0.5	0.35	Permissible for designing	Permissible for analysis

Table 4
Comparison the result of manual calculation and the STADD pro result (constant b)

Concrete Grade	Length (m)	Width (m)	Depth (m)	By Manual calculation	By STADD pro
M-20	6 m	0.5	0.25	Permissible for designing	Permissible for analysis
		0.5	0.3	Permissible for designing	Permissible for analysis
		0.5	0.35	Permissible for designing	Permissible for analysis
	8 m	0.5	0.25	Min. reinforcement exceed (>0.04bD)	fails while detailing
		0.5	0.3	Permissible for designing	fails while detailing
		0.5	0.35	Permissible for designing	Permissible for analysis
	10 m	0.5	0.25	Min. reinforcement exceed (>0.04bD)	fails while detailing
		0.5	0.3	Min. reinforcement exceed (>0.04bD)	fails while detailing
		0.5	0.35	Min. reinforcement exceed (>0.04bD)	fails while detailing
		0.5	0.35	Min. reinforcement exceed (>0.04bD)	fails while detailing

Table 5
For M-20, Fe- 415, and Clear Span- 6m

S.No.	Section Width B (in m)	Section Depth D (in m)	Section (in m×m)	B/D ratio
1	0.49	0.5	0.49×0.5	Doubly not required ($M_{uD} < M_{u.lim}$)
2	0.48	0.5	0..48×0.5	0.96
3	0.09	0.5	0.09×0.5	0.18
4	0.08	0.5	0.08×0.6	minimum reinforcement exceeds (> 0.04bD)

Table 6
For M-20, Fe- 415, and Clear Span- 8m

S. No.	Section Width B (in m)	Section Depth D(in m)	Section (in m×m)	B/D ratio
1	0.99	0.5	0.99×0.5	Doubly not required ($M_{uD} < M_{u.lim}$)
2	0.98	0.5	0.98×0.5	1.96
3	0.15	0.5	0.15×0.5	0.3
4	0.14	0.5	0.14×0.5	minimum reinforcement exceeds (> 0.04bD)

Table 7
For M-20, Fe- 415, and Clear Span- 10m

S. No.	Section Width B(in m)	Section Depth D(in m)	Section (in m×m)	B/D ratio
1	1.92	0.5	1.92×0.5	Doubly not required ($M_{uD} < M_{u.lim}$)
2	1.91	0.5	1.91×0.5	3.82
3	0.24	0.5	0.24×0.5	0.48
4	0.23	0.5	0.23×0.6	minimum reinforcement exceeds (> 0.04bD)

members once a parameter of depth constant and another parameter is width constant. Additional consideration should be given to member having b/d ratio of about its analyzing and designing resistivity, which are also representative of wide beams used in industry. Each of these geometric relationships should be considered in the context of member with web reinforcement. The details are tabulated below:

B/D ratio (for same over all depth, D)

The section has been consider as in above tabulation are failed in section 0.49×0.5 and above by doubly not required (M_{uD}<$M_{u.lim}$) and 0.08×0.6 and below by minimum reinforcement exceeds (> 0.04bD) as consider by IS 456:2000.

The section has been consider as in above tabulation are failed in section 0.99×0.5 and above by doubly not required (M_{uD}<$M_{u.lim}$) and 0.14×0.5 and below by minimum reinforcement exceeds (> 0.04bD) as consider by IS 456:2000.

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