CHAPTER-1

INTRODUCTION

Generally there are two types of failure in flexural elements, flexural failure and shear failure. The flexural failures are notified with cracks prior to the failure whereas shear failure does not give any warning before failure. Hence, Shear failure in the concrete beams is more disastrous when compared with the other failures, as this failure is the sudden failure and causes the damage for life. Especially in the case of high strength concrete the chances of the early shrinkage and smoothness of crack surfaces causes the failure of beams in shear. The concrete beams which have been classified as deep beams, slender beams on the basis of their shear span depth ratio fail by forming a diagonal cracks from support to the point of application of load. Hence there is a need of study of behavior of shear behavior of high strength concrete beams.

1.1 Parameters influencing shear strength

The parameters influencing shear strength of the concrete beams are

- **Compressive Strength of Concrete:** Higher grade of concrete has higher characteristic strength which increases the aggregate inter lock capacity and also the concrete strength in compression zone. Hence, the shear strength increases with increase in the grade of concrete.
- **Percentage Tensile Reinforcement:** The increase in the percentage tensile reinforcement increases the shear strength of concrete. Higher grade of steel results in lesser shear resistance as the amount of steel required will be less when compared to lower grade of steel.
- **Shear Span-to-depth ratio:** The shear capacity of deep beams and short beams is more when compared to the slender beams. Hence the chances of shear failure will be more as the shear span to depth ratio increases.
- **Depth of beam**: As the depth of the beam increases the shear strength of concrete decreases as it is inversely proportional to shear strength.

1.2 Need for minimum shear reinforcement

In order to avoid shear failures, even though the beams are safe in shear design minimum amount of shear reinforcement is provided for the following reasons

i. To hold the main reinforcement in place at the time of pouring the concrete.
ii. To avoid brittle shear failure after the formation of diagonal shear cracks
iii. To provide reserve strength even after the diagonal shear crack formation.
iv. For redistribution of stresses in the region of shear span.
v. To guard against any sudden failure of a beam if concrete cover burst and bond to tension steel is lost.

1.2.1 Amount of minimum shear reinforcement in various codal provisions

The various codes of practice of different countries have their own equations for calculation of minimum amount of shear reinforcement.

i. IS $456-2000$ & BS $\quad A_{sv} = \frac{0.4 b s_v}{0.87 f_y}$

ii. $ACI\ 318-11$ $\quad A_{sv} = \frac{0.75 b s_v \sqrt{f_{ck}}}{f_y}$

iii. $CSA\ 23$ $\quad A_{sv} = \frac{0.06 b s_v \sqrt{f_{ck}}}{f_y}$

iv. $Euro\ Code\ 2$ $\quad A_{sv} = \frac{0.08 b s_v \sqrt{f_{ck}}}{f_y}$

v. $NZS\ 3101$ $\quad A_{sv} = \frac{b s_v \sqrt{f_{ck}}}{16 f_y}$

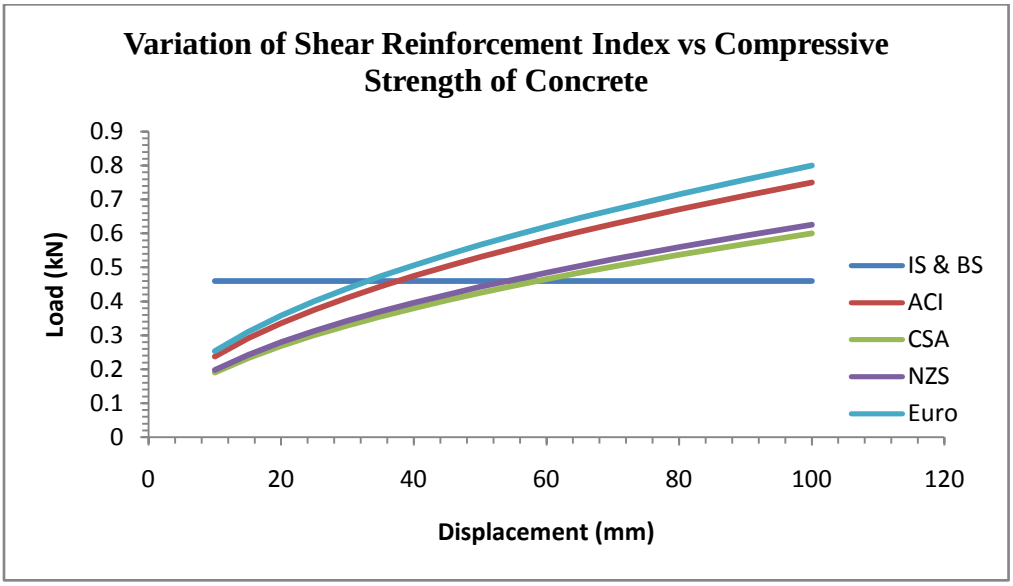

Fig. 1.1 Variation of Compressive Strength of concrete Vs Shear Reinforcement Index

Fig. 1.1 shows the variation of the shear reinforcement index versus the compressive strength of concrete. It may be observed that as per the Indian code of practice (IS 456-2000) the shear reinforcement index is independent of the compressive strength of concrete. However, as per other codes of practice (ACI, Euro codes, NZS and CSA) it can be observed that the variation of shear reinforcement index is in accordance with the compressive strength of the concrete. Also, in Indian code of practice the shear reinforcement index for the NSC is higher and uneconomical and for the HSC amount of shear reinforcement specified is inadequate for design when compared to the other code of practices. Hence, in our studies we have focused on relating the strength of concrete with the amount of shear reinforcement.