Chapter III - Bond and Development Length

Bond

It refers to the adhesion b/w con. & steel which resist the slipping of steel bar from concrete. And it transfer stress from steel to concrete.

Bond between Steel & con. can be achieved by the following methods

(i) Chemical adhesion: Cement is used as a binder in concrete, which sets & hardened independently & can bind other materials such as aggregates & steel together

ii) Frictional resistance: It is due to friction between Steel and concrete.

(iii) Mechanical interlock: Twisted or deformed bars can be used to increase the bond.

Bond Stress: Stress developed at the interface of steel bar & surrounding is Bond stress.

Types

i) Flexural Bond stress
It develops along the length of a bar in order to keep the concrete & steel act together.

(ii) Anchorage bond
It is a Flexural bond develops at ends of a beam.

Design Bond stress Tbd given in clause no 26.2.1.1

Factors affecting bond strength

① larger bars give less bond than smaller one

② inadequate cover thickness

③ "   development length

④ Reinforcement without L & U hook)
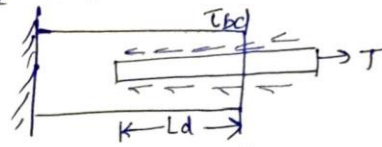
⑤ lesser grades of concrete.

Development length: (Ld)

The reinforcement bar must extend in the anchorage zone concrete sufficiently, to develop the required stress. The extended length of bar inside the face of the support is called Ld.

As per, IS456, 26.2.1

$$Ld = \frac{\phi \, \sigma_s}{4 \, \tau_{bd}} \quad \leq \text{less} \qquad \sigma_s = 0.87 \, fy$$
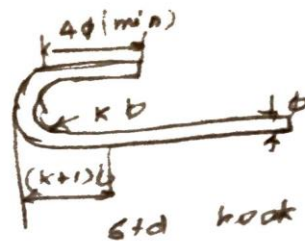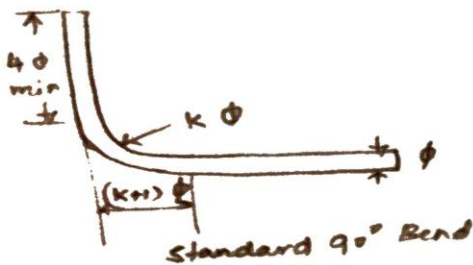
Ref.

Anchorage length: (Cl 26.2.2 of IS 456)

It is provided to slippage of the bar from the ends of concrete portion. The length of the bar available for anchorage is insufficient, the reinforcement can be bent or a hook may be formed to provide required anchorage.

Anchoring bars in Tension, compression & Anchoring shear reinforcement ref. cl. 26.2.2 of IS 456.

⑤

standard 90° Bend

6td hook

K → For Mild steel = 2
      Cold worked = 4

Bends : The anchorage value of bend = 4ϕ for 45° bend

Hooks = As 11 " " " = 16ϕ of bars.

Curtailment of Reinforcement → Ref cl. 26.2.2 of IS456
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