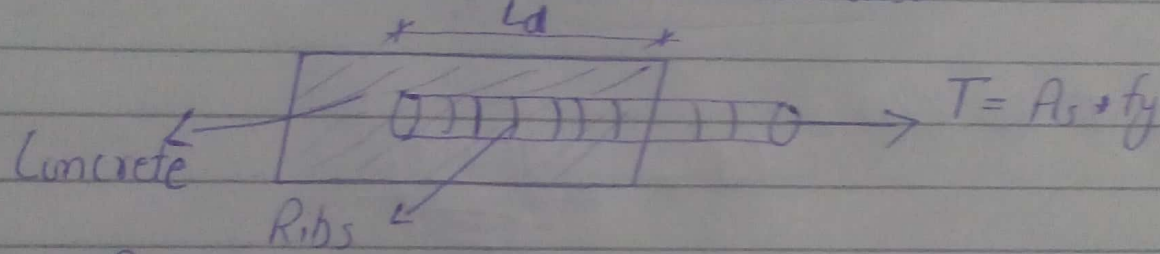
Bond: The pulling out of steel bar from concrete is resisted by gripping action of concrete is known as Bond and the resulting stress is called Bond Stress. Resistance offered to slipping of bars is due to three reasons;

1- Chemical adhesion b/w two materials.
2- Friction due to natural roughness of bars.
3- Due to closely spaced rib-shaped deformations made on the bar surfaces.



Bond can also be increased by Providing;

1- Sufficient Cover
2- Rich mix Concrete
3- Deformed Bars

Development length of Deformed Bars:

"The necessary length b/w the point of maximum stress in a bar and the end of bar."

For #11 or, smaller bars the development length must not be less than the value obtained from the following three equations;

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Development length required for tension bars:

1- $l_d = \frac{0.04 * A_b * f_y}{\sqrt{f'_c}}$ 2- $l_d = 0.0004 * d_b * f_y$

3- $l_d = 12''$.

Select the minimum value.

For # 14 Bar; $l_d = \frac{0.085 * f_y}{\sqrt{f'_c}}$

For # 18 Bar; $l_d = \frac{0.11 * f_y}{\sqrt{f'_c}}$

where; l_d = Development length required
A_b = Cross-sectional Area of bar
d_b = Diameter of bar
f_y = Yield Strength of steel
f'_c = Concrete compression strength.

Development length for Compression Bars:

$$l_{dc} = \frac{0.02 * d_b * f_y}{f'_c} \geq 0.0003 * d_b * f_y$$

Note: Development length required for compression bars will be less than that required for tensile steel because

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No tensile cracks are present to encourage slipping.

Hooks: They may be used to anchor tension bars mostly when sufficient space/length is not available to run them straight for full development.

Hooks are not quite as effective as equivalent length of straight bars but they are very useful where space is limited.

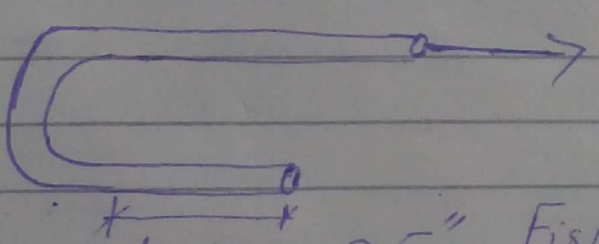

Figure-01

Fig-01 represent 180° hook having an extension of 4* dia of bar at free end.

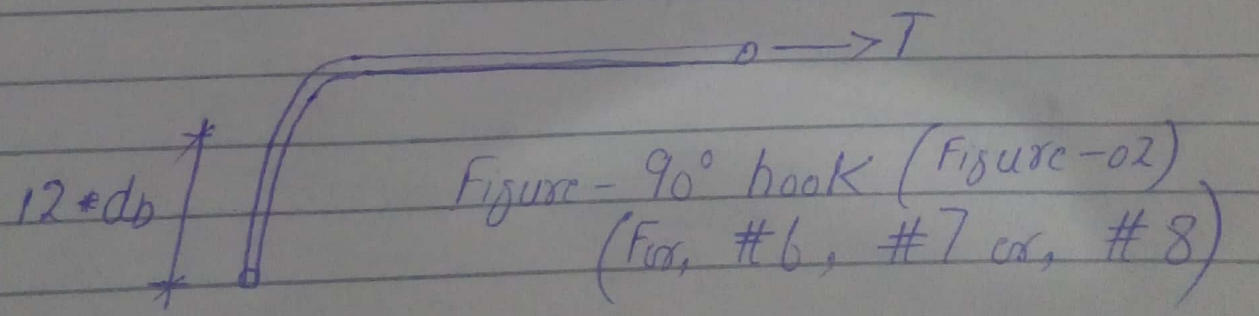

Figure - 90° hook (Figure-02)
(For, #6, #7 or, #8)

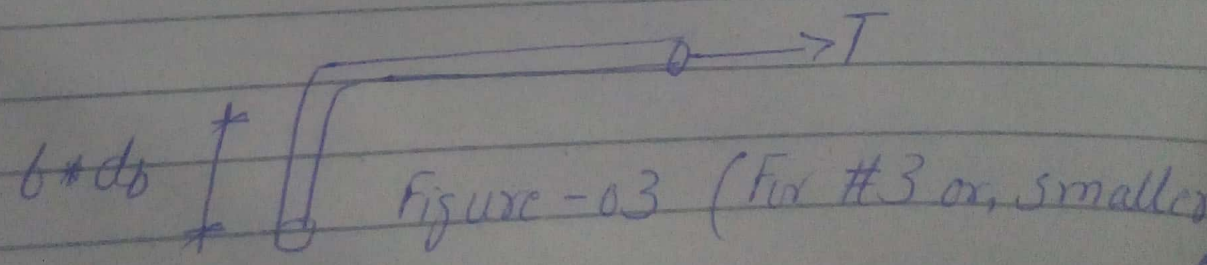

Figure-03 (For #3 or, smaller)

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Page-04 (08/04/2020)

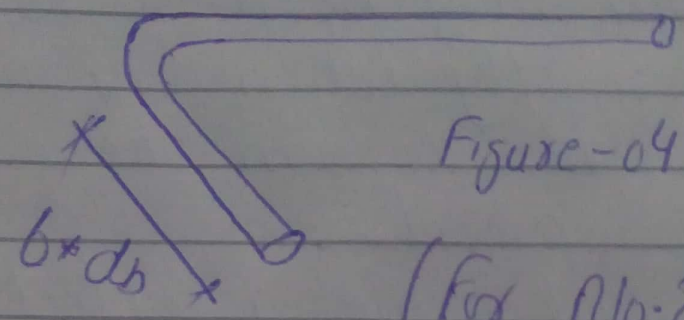

Figure-04 (135° hook)

(For No.8 bar or, smaller)

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