# Design of Reinforced Concrete Corbels

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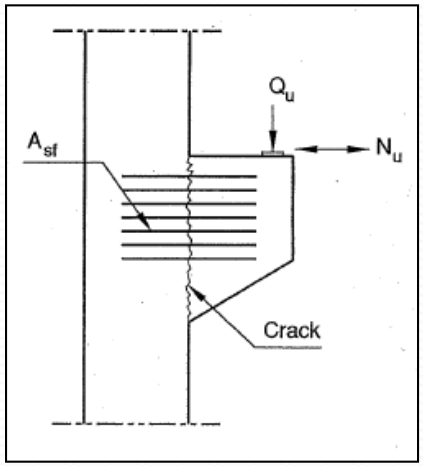
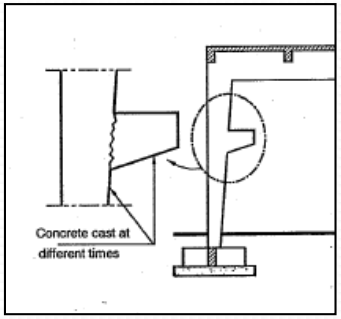
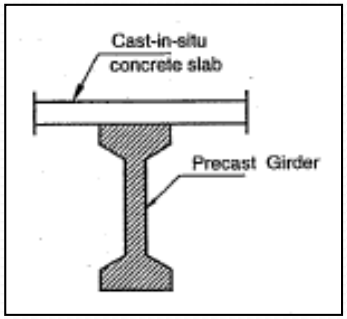
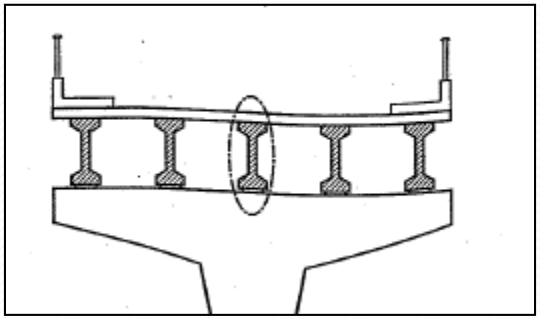
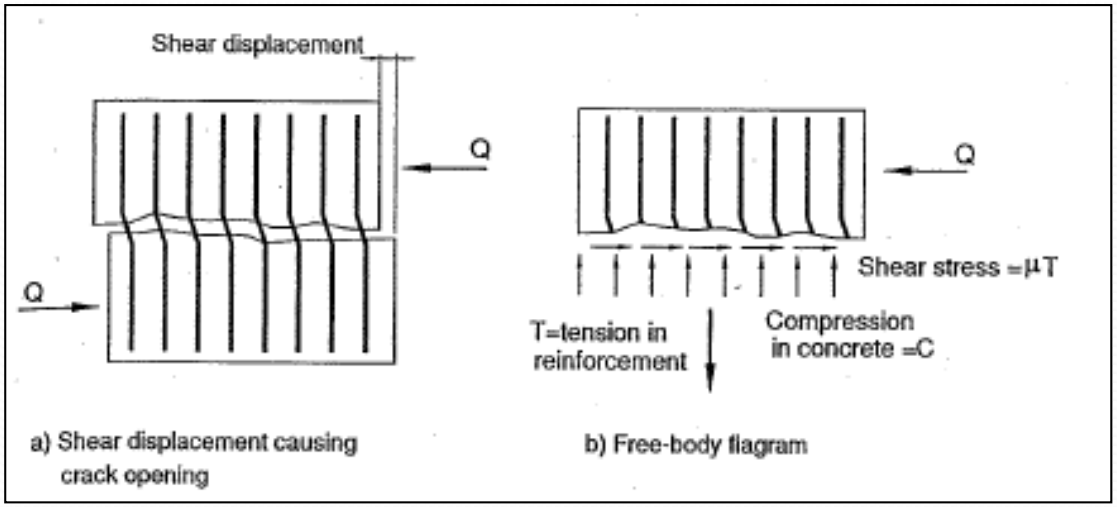
# Concept of shear transfer

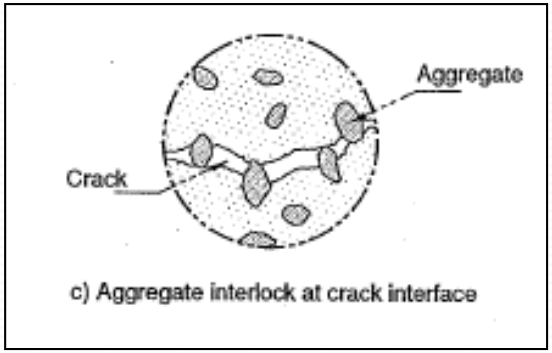


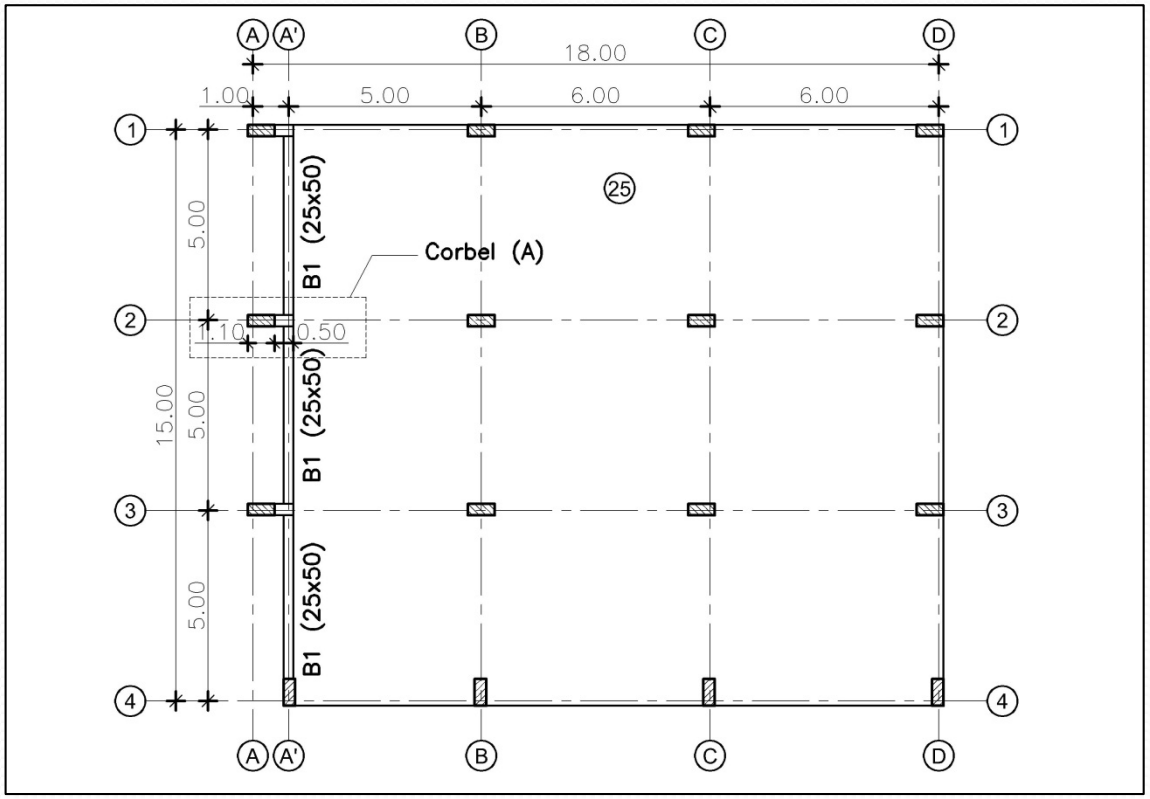



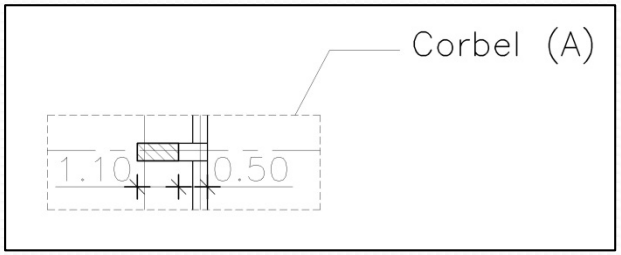


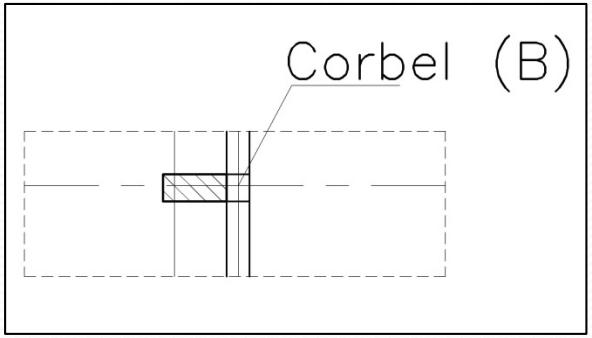



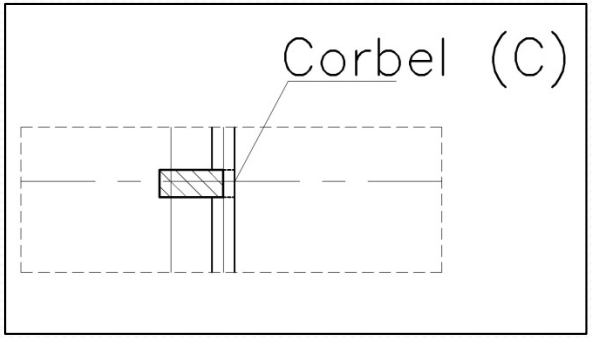
# Design of Corbels According to Egyptian Code of Practice (ECP 203-2007)

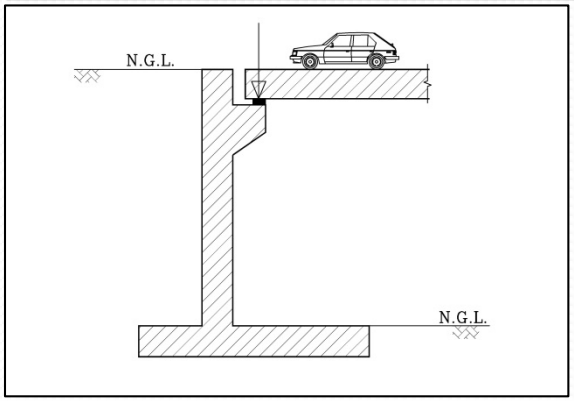
# Where to find corbels?

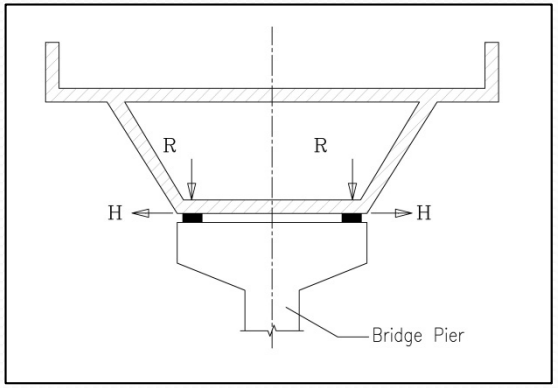


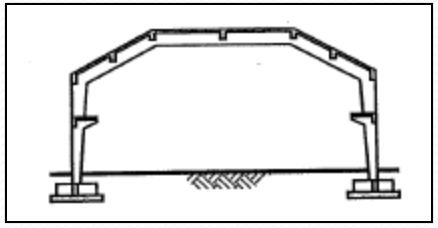



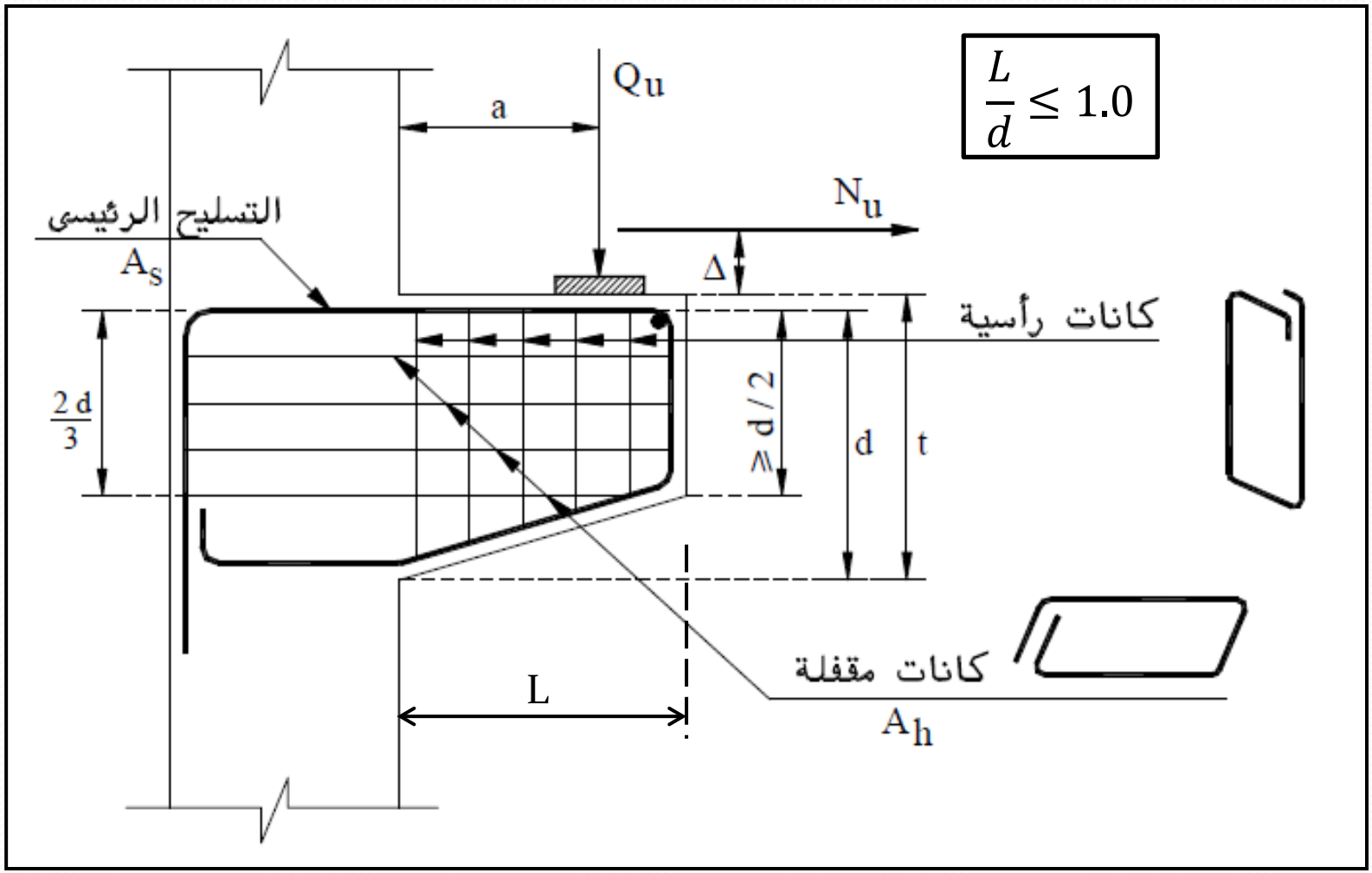



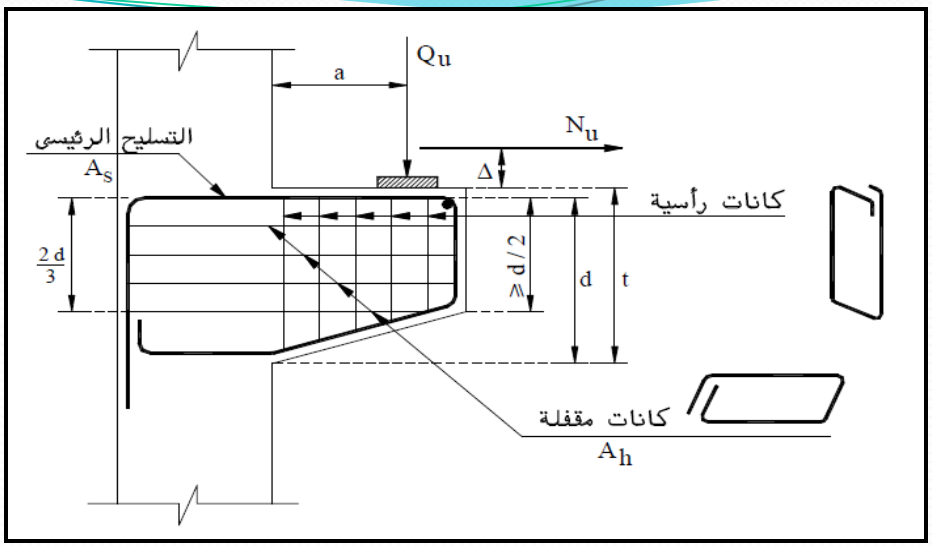



# Design Strategy



$$A_n = \frac{N_u}{\left(\frac{f_y}{\gamma_s}\right)}$$

$$A_{sf} = \frac{Q_u}{\mu\left(\frac{f_y}{\gamma_s}\right)} + \frac{N_u}{\left(\frac{f_y}{\gamma_s}\right)}$$




| | Crack Interface Condition | $\mu$ |
|---|---|---|
| 1 | Concrete cast monolithically | 1.20 |
| 2 | Concrete cast against hardened concrete with surface intentionally roughened | 0.80 |
| 3 | Concrete cast against hardened concrete not intentionally roughened or concrete anchored to structural steel by headed studs or bars. | 0.50 |

$A_f$ = مساحة صلب التسليح الأساسى لمقطع الكابولى عند وجـــه الركيـــزة والتـــى تقاوم عزم انحناء قيمته تساوى :

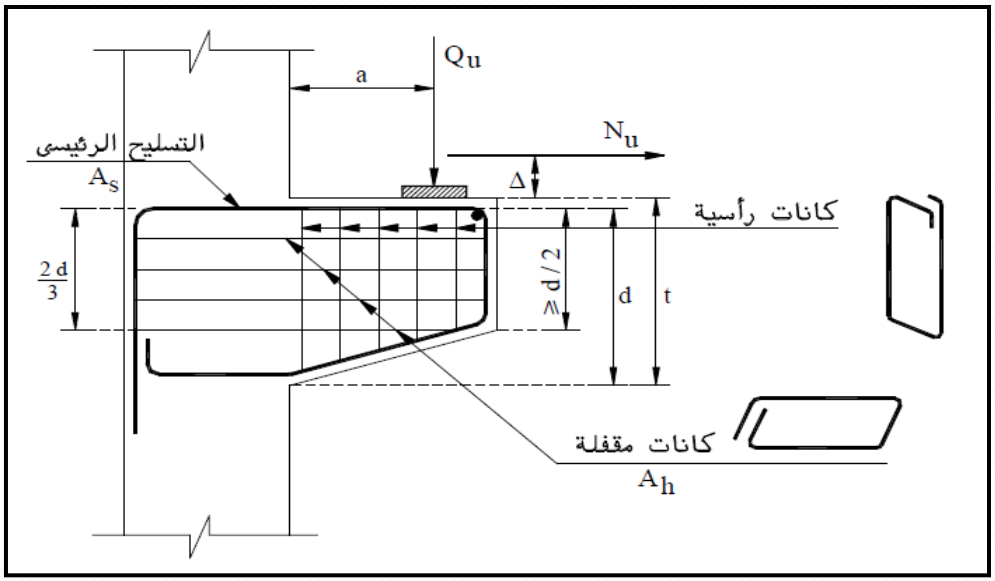
$$M_u = Q_u \cdot a + N_u \left(t + \Delta - d\right)$$

The total main top steel $A_s$ is the greater of the following:

1. $A_s = A_n + A_f$ .....
2. $A_s = A_n + 2/3A_{sf}$ .....
3. $A_{s\,min} = 0.03\frac{f_{cu}}{f_y} b\ d$ .....

where $b$ is the width of the corbel.

$$A_h = 0.5\ (A_s - A_n)$$




Corbels should also be provided with vertical stirrups that satisfies the minimum requirements of the ECP-203.

$$A_v = \frac{0.4}{f_y} b\ s$$

where $s$ is the spacing of the vertical stirrups.

# Check of Shear Stresses

بالإضافة لما سبق ، يجب ألا يتجاوز إجهاد القص بالاحتكاك $\frac{Q_u}{A_c}$ على القطاع القيمة

$0.225 \frac{f_{cu}}{\gamma_c}$ حيث $A_c$ هى مساحة مقطع الخرسانة المقاوم للقص وبحد أقصى 5 ن/م$^2$.

- يجب ألا تؤخذ قيمة $f_y$ أكبر من 400 ن/مم$^2$.