B.1.8 Polysilicon Depletion Effect

$$V_{poly} = \frac{1}{2} X_{poly} E_{poly} = \frac{q N_{gate} X_{poly}^2}{2\varepsilon_{si}}$$

$$\varepsilon_{ox} E_{ox} = \varepsilon_{si} E_{poly} = \sqrt{2q\varepsilon_{si} N_{gate} V_{poly}}$$

$$V_{gs} - V_{FB} - \Phi_s = V_{poly} + V_{ox}$$

$$a\left(V_{gs} - V_{FB} - \Phi_s - V_{poly}\right)^2 - V_{poly} = 0$$

$$a = \frac{\varepsilon_{ox}^2}{2q\varepsilon_{si} N_{gate} T_{ox}^2}$$

$$V_{gs\_eff} = V_{FB} + \Phi_s + \frac{q\varepsilon_{si} N_{gate} T_{ox}^2}{\varepsilon_{ox}^2}\left(\sqrt{1 + \frac{2\varepsilon_{ox}^2 \left(V_{gs} - V_{FB} - \Phi_s\right)}{q\varepsilon_{si} N_{gate} T_{ox}^2}} - 1\right)$$

B.1.9 Effective Channel Length and Width

$$L_{eff} = L_{drawn} - 2dL$$

$$W_{eff} = W_{drawn} - 2dW$$