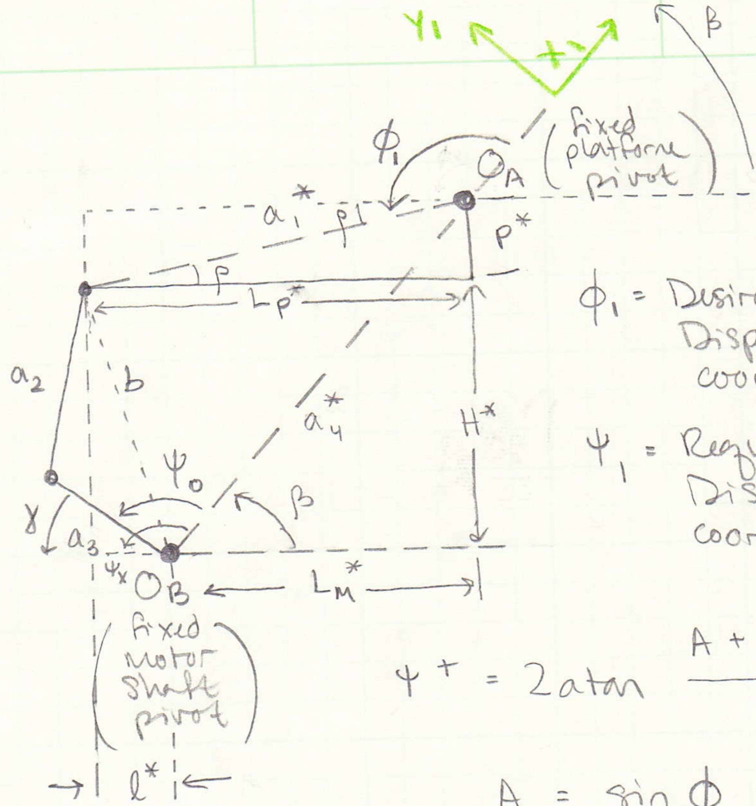
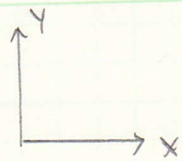




ϕ_1 = Desired Platform Displacement in X_1, Y_1 coordinates (Input)

ψ_1 = Required Motor Shaft Displacement in X_1, Y_1 coordinates (Output)

$$\psi^+ = 2\operatorname{atan} \frac{A + \sqrt{A^2 + B^2 - C^2}}{B + C}$$

$$A = \sin\phi$$

$$B = \frac{a_4}{a_1} + \cos\phi$$

$$C = \frac{a_4}{a_3}\cos\phi + \frac{a_1^2 - a_2^2 + a_3^2 + a_4^2}{2a_1 a_3}$$

$$\rho = \tan^{-1}\left(\frac{p^*}{L_p^*}\right)$$

$$\phi_1 = 180° - \beta + \rho$$

$$\beta = \tan^{-1}\left(\frac{H^* + p^*}{L_M^*}\right)$$

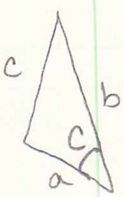
↳ transformation angle between X, Y & X_1, Y_1 reference

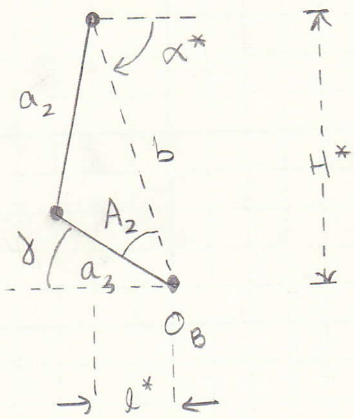
$$\psi_x = \phi_x = 180° - \beta$$

$$\psi_0 = \psi_x - \gamma$$

$$\gamma = \psi_x - \psi_0$$

Calculation of Ψ_0 (initial angle at motor shaft)





$$\alpha^* = \tan^{-1}\left(\frac{H^*}{l^*}\right)$$

$$b = \sqrt{l^{*2} + H^{*2}}$$

$$\alpha^* - A_2 = \gamma$$

$$\alpha^* - A_2 = \Psi_x - \Psi_0$$

$$\boxed{\Psi_0 = \Psi_x - \alpha^* + A_2}$$

Law of Cosines

$$c^2 = a^2 + b^2 - 2ab\cos(C)$$

$$a = a_3$$
$$b = b$$
$$c = a_2$$
$$C = A_2$$

$$a_2^2 = a_3^2 + b^2 - 2a_3 b\cos(A_2)$$

$$a_2^2 - a_3^2 - b^2 = -2a_3 b\cos(A_2)$$

$$\frac{(a_2^2 - a_3^2 - b^2)}{-2a_3 b} = \cos(A_2)$$

$$\frac{(-a_2^2 + a_3^2 + b^2)}{2a_3 b} = \cos(A_2)$$

$$\cos^{-1}\left(\frac{-a_2^2 + a_3^2 + b^2}{2a_3 b}\right) = A_2$$