7) A 0.75 mm LLDPE geomembrane has an allowable stress of 2,400 kN/m² and an ultimate stress of 4,800 kN/m². It is on a 3 (horizontal) to 1(vertical) side slope and is covered with a 0.3 m depth of soil that has a weight of 15.7 kN/m³, and the same type of soil is beneath the geomembrane. The soil has a friction angle of 20° with the geomembrane. What length of geomembrane is required for the geomembrane to be held in place under these conditions? Since there is only 0.3 m of soil on top of the geomembrane, this soil would also likely move with the geomembrane should the geomembrane move. (4 marks)

$$T \cos\beta = F_{\mu\sigma} + F_{L\sigma} + F_{LT} \qquad \text{neglect } F_{\mu\sigma}$$

so
$$T \cos\beta = F_{L\sigma} + F_{LT}$$

$$T \cos\beta = \sigma_n \tan\delta_L (x) + T\sin\beta \tan\delta_L \qquad = t\sigma_{allow} \cos\beta$$

$$= t\sigma_{allow} \cos\beta$$

$$\underset{0.00075\,m}{\left(\underset{0.75\,mm}{} \times 2400\,\frac{kN}{m^2}\right)\left(\cos 18.43°\right)}$$

$$= \left(15.7\,\frac{kN}{m^3}\right)\left(0.3\,m\right)\tan 20° \,(x) + \underset{0.00075}{\left(0.75mm\right)}\left(2400\,\frac{kN}{m^2}\right) x$$

$$\left(\tan 18.43°\right)\left(\tan 20°\right)$$

$$\frac{kN}{m.}\; 1.708 = 1.714\,(x)\,\frac{kN}{m} + 0.2183\,\frac{kN}{m}$$

$$x = 0.869\,m$$

$$\tan\beta = \frac{1}{3}\;;\; \beta = 18.43°$$