a. Determine the interface subsidence velocity v. The subsidence velocity is determined by computing the slope of the tangent drawn from the initial portion of the interface settling curve. The computed velocity represents the unhindered settling rate of the sludge.

$$v = \left(\frac{0.75\text{ m} - 0.3\text{ m}}{29.5\text{ m}}\right)\left(\frac{60\text{ min}}{\text{h}}\right) = 0.92\text{ m/h}$$

b. Determine the clarification rate. Because the clarification rate is proportional to the liquid volume above the critical sludge zone, it may be computed as follows:

$$Q = 3800\text{ m}^3\text{/d}\left(\frac{0.75\text{ m} - 0.188\text{ m}}{0.75\text{ m}}\right) = 2847\text{ m}^3\text{/d}$$

c. Determine the area required for clarification. The required area is obtained by dividing the clarification rate by the settling velocity.

$$A = \frac{Q_c}{v} = \frac{(2847\text{ m}^3\text{/d})}{(24\text{ h/d})(0.91\text{ m/h})} = 129\text{ m}^2$$

3. The controlling area is the thickening area (165 m^2) because it exceeds the area required for clarification (129 m^2).
4. Determine the solids loading. The solids loading is computed as follows:

$$\text{Solids, kg/d} = \frac{(3800\text{ m}^3\text{/d})(3000\text{ g/m}^3)}{(10^3\text{ g/kg})} = 11{,}400\text{ kg/d}$$

$$\text{Solids loading} = \frac{(11{,}400\text{ kg/d})}{165\text{ m}^2} = 69.1\text{ kg/m}^2\cdot\text{d}$$

5. Determine the hydraulic loading rate.

$$\text{Hydraulic loading rate} = \frac{(3800\text{ m}^3\text{/d})}{165\text{ m}^2} = 23.0\text{ m}^3\text{/m}^2\cdot\text{d}$$

Comment An alternative approach for sizing the secondary clarifiers using the initial settling velocity of the sludge is given in Sec. 8–8 in Chap. 8.

Area Requirements Based on Solids Flux Analysis. An alternative method of determining the area required for hindered settling is based on an analysis of the solids (mass) flux (Coe and Clevenger, 1916). In the solids flux method of analysis it is assumed that a settling basin is operating at steady state. Within the tank, the downward flux of solids is brought about by gravity (hindered) settling and by bulk transport due to the underflow that is being pumped out and recycled. The solids flux method of analysis is used to assess the performance of existing facilities and to obtain information for the design of new facilities to treat the same wastewater. Application of the solids flux