**Additional Exercises**

**Chapter 14**

**Exercise 14.2**

Using the concept of effective normal stress, which represents the difference between total normal stress and total fluid pressure, and the definitions for hydrostatic pressure, non-equilibrium pressure, total fluid pressure, and total normal stress derived in Exercise 14.1 (Chapter 14), sketch a sequence of diagrams showing profiles of fluid pressure, total normal stress, and effective stress at times *t* = 0 (fully liquefied state), *t* = Δ*t* (intermediate state), and *t* = ∞ (when *p\** = 0).

**Exercise 14.3**

(a) Measurements during large-scale experimental debris flows have shown that total bed normal stress varies directly with flow depth. If the measured total bed normal stress of a decelerating sandy debris flow is 2.5 kPa, and the flow depth is 0.12 m, what is the estimated average total bulk density of the flow? Is this a reasonable value for total bulk density?

* 1. Assuming a grain density of 2650 kg m-3, estimate the porosity of the debris flow. Is this a reasonable estimate of porosity of sandy debris?
  2. If this was a dry granular flow, estimate its total bulk density.
  3. Measurements of dry bulk density of the experimental debris flow deposits ranged from 1870 to 1930 kg m-3. How do these values compare with that estimated above? What do the estimates of bulk density of flowing debris and that measured in deposits indicate?