Boundary Conditions

Rheological equations like those given above, also require the stipulation of appropriate boundary conditions and it transpires this is a more difficult issue than in conventional fluid mechanics. Many granular flows change quite drastically with changes in the boundary conditions. For example, the shear cell experiments of Hanes and Inman (1985) yielded stresses about three times those of Savage and Sayed (1984) in a very similar apparatus; the modest differences in the boundary roughnesses employed seem to be responsible for this discrepancy. Moreover, computer simulations in which various particle-wall interaction models have been examined (for example, Campbell and Brennen, 1985a,b) exhibit similar sensitivities. Though the normal velocity at a solid wall must necessarily be zero, the tangential velocities may be non-zero due to wall slip. Perhaps a Coulomb friction condition on the stresses is appropriate. But one must also stipulate a wall boundary condition on the granular temperature and this is particularly complicated for wall slip will imply that work is being done by the wall on the granular material so that the wall is a source of granular heat. At the same time, the particle-wall collisions dissipate energy; so the wall could be either a granular heat source or sink. The reader is referred to the work of Hui *et al.* (1984), Jenkins and Richman (1986), Richman (1988) and Campbell (1993) for further discussion of the boundary conditions.