Wall-Bounded Shear Flows - Introduction:

Most turbulent flows are bounded (at least in part) by one or more solid surfaces, including:

1. Internal flows: Flow through pipes or ducts.
2. External flows: Flow around aircraft, ships, or automobiles.
3. Atmospheric flows: Flow in the atmospheric boundary layer or rivers.

Wall-bounded shear flows are more complicated than free shear flows due to the interaction of turbulence with the wall. One consequence of the presence of the wall is that a new length scale is imposed on the turbulence, the so-called viscous length-scale. In particular, unlike free shear flows in which the large turbulence length scale was just the layer thickness, near the wall in a wall-bounded shear flow, the turbulent eddies must be of order the distance to the wall in size. Moreover, near the wall, viscous effects dominate turbulent effects, in contrast with free shear flows. Due to the above, wall-bounded shear flows are more complicated than free shear flows, and simple similarity analysis may not be used to study them.

Here, we will study two simple wall-bounded flows, the turbulent channel and the turbulent boundary layer. The central issue is the form of the mean velocity profile for these two flows.