We are currently using a whole spectrum of available technologies, from a man with a jack and shovel to giant steel worms called TBM (tunnel boring machines). In the first case, we have a one-man band; in the other, a huge team of specialized workers feeding the beast. But these are extremes; usually techniques somewhere in between are used, such as a heavy mechanization and limited numbers of workers.

TBM machine

construction site

All techniques require at least two steps to advance. The first step is to excavate and transport material out of the tunnel or shafts. This can be done at the tunnel or shaft face, which leaves a slice of an underground structure boundary unsupported. So, the second step is to install support measures on the small portion before carrying out the next step of the excavation. This is necessary because of safety and the danger of collapse. There are, of course, deviations of this principle. TBM, for example, carries out both phases at the same time. Other concepts provide partial excavation and support, which allow work to be done at different places within underground structures. But all usual techniques provide an excavation of the underground structure in the advance direction only and require support of the boundaries because of stability or safety reasons. These are the main limiting factors to decreasing the costs of underground structures.

tunnel excavation

side cutter