AS Unit 1: Our Built Environment

2.1.6: SUBSTRUCTURES (3 of 3)

DESIGN PRINCIPLES

Substructure design involves matching the total calculated dead and imposed loads arising from a superstructure with a foundation type and depth to suit the bearing capacity and other subsoil parameters established by site investigations.

The condition of the ground may need to be improved in situations where the subsoil characteristics are not suitable to support the loads required, without unacceptable settlements.

IMPROVING THE CONDITION OF SUBSOIL

There are several ground improvement methods that can be used to stabilise or improve the condition of an area of ground before construction work takes place. These methods include:

Vibro-compaction. Deep level mechanical vibration of the subsoil can be used to strengthen the ground by compacting the soil particles by reducing voids. Works well in non-cohesive soils, such as sands, and can be a cost-effective alternative to piling.

Vibro-replacement. Construction of stone columns through weak subsoils, by drilling and vibrating into position.

Soil mixing. Mechanically mixing wet subsoils with a dry cementitious binder to create soilcrete, with improved bearing capacity and decreased settlement.

Dynamic soil compaction. Increases density and decreases air volume. Existing soil can be compacted, or layers of new soil can be compacted, to raise a site to the required level.

Grouting in this context refers to the injection of pumpable cementitious grout into a sub soil formation to change its physical characteristics, improve stability and control ground water during construction.

Geotextiles and geomembranes of synthetic fibres such as polypropylene or polyester can be used to:

- separate layers of different subsoils
- stabilise and drain subsoils
- retain particles whilst allowing water through
- reinforce and strengthen layers of subsoil (due to their high tensile strength)
- protect – earth embankments etc. – from erosion.

Chemical stabilisation. The addition of a chemical binder to subsoil to reduce moisture and improve stability.

Drainage. Control of ground water by the protection and improvement of existing land drains, diversion of water courses and pumping of excavations during construction.

RETAINING WALLS

Used to prevent soil erosion and create usable level terraced areas from sloping ground. Types of retaining wall include:

Gravity retaining walls, usually in stone, concrete and brickwork, rely on their mass to retain the material behind.

Sheet piling walls formed by placing piles, usually concrete or steel, directly adjacent to one another.

Cantilever retaining walls, made of reinforced concrete, connected to a slab (to form an inverted 'T' or 'L') which allows horizontal pressures from behind the wall to be converted to vertical pressures on the ground below.

Gabions. Cages of wire, filled with crushed rock form free-draining retaining structures, used where water will be present, such as flood defences.

BASEMENTS

Basements become more expensive as the depth increases. However, in prime 'city centre' locations, the cost of land may justify multi storey 'iceberg' basements and below-ground parking garages.

Excavations. Vary in complexity according to site conditions, depth, proximity of existing structures and treatment of any party walls if an existing building.

Temporary work will range from simple hoardings to sheet piled retaining walls and underpinning of existing structures. Keeping ground water out of the excavation will require drainage trenches and possibly pumping.

Types of basement construction include blockwork walls on concrete floor slab; reinforced insitu concrete and precast concrete panels.

Waterproofing. Usually, a bituminous 'stick-on' plastic sheet applied to the basement structure, or a spray painted external membrane and / or use of water-resistant concrete in combination and / or drainage to collect and remove water entering the basement using a sump and pump and / or a perimeter drain just below foundation, removing external water.

Insulation, such as built-in rigid insulation boards, will retain heat inside the basement and, together with controlled ventilation, will prevent condensation.

Building services will supply the basement from above, and drainage is likely to require pumping.

DAMP PROOF COURSES (DPC)

A damp proof course may be polyethylene, slate or other material that will prevent the passage of moisture. Approved document C requires that a damp proof course should be continuous with any damp proof membrane in the floor and be at least 150 mm above the level of the adjoining ground. A DPC may also be required below copings and in joints between walls and frames.