UNDERPINNING AND SEISMIC UPGRADE OF BUILDINGS USING COMPOSITE TUBULAR GROUTED MICROPILES

The seismic upgrade of buildings is in Italy a very current task. Underpinning is often the most important part of this kind of projects. The use of composite tubular grouted micropiles allows simply and effective solutions also in very confined sites. Using this technology, the TITAN micropiles, developed by Ernst Friedrich Ischebeck in Germany more than 30 years ago, the hollow bar simultaneously acts as the drilling rod, injection tube and reinforcement for the micropile and can be used in any type of soil. This is a composite micropile: steel with a continuous thread and cement grout body just like reinforced concretes. The use of a fine-grain structural steel is necessary. The dynamic pressure grouting of the TITAN micropile produces a grout body that interlocks with the surrounding subsoil with an excellent shear bond between the tendon and grout body. Controlled crack widths of less than 0.1 mm within the grout, guarantees the permanent corrosion protection for the system according with the DIBt Approval for permanent applications as tension or compression pile, also under cycling loading; they are the only tubular grouted micropiles that can be used for permanent applications with a design life exceeding 100 years. Thanks to the very high skin friction between grout body and the ground this is a low settlement system which has an excellent behavior under seismic forces transferring a big percentage of the inertial forces to the ground. The compression load tests carried out on the micropiles used for the underpinning in the two presented projects in the city of Monflacone in Italy have showed the extremely low settlements of the TITAN micropiles under load. By using hollow steel tendons of several dimensions and designing the pile to transfer the forces to the ground, it is possible to install micropiles with many design loads, even for 2.000 kN and more.