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Title : CHEMICAL MODIFIED SAND SOIL USING POLYURETHANE (PU) FOR FOUNDATION IMPROVEMENT

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Roads are important assets to a country and need a maintenance programme to ensure that the longest life is achieved. Roads have to be cared for and without any maintenances they will lose their intrinsic value. Construction of road pavement generates instability to the naturally subsoil which encounters numerous engineering problems such as settlement, depression, sinkhole and faulting of subsoil. Conventional method of soil remediation work in subsoil such as crack sealing, patching potholes, overlays and grouting technique provide short term solutions to address those symptoms, but not underlying problem. This study permits a novel technique to solve the subsoil foundation problem precisely in sand that exists in the current pavement designs using Polyurethane (PU) grout. PU is a chemical substance that normally used in polymer industries for instance resilience foam seating, rigid foam insulation panels and microcellular foam seals. The study includes four main parts: the first part aims to optimize the composition of PU by varying the mixture of polyol and isocynate under Unconfined Compression Test (UCT). Two hundred fifty two (252) PU samples with different ratio of PU are tested using UCT and the ideal composition of polyurethane foam with 1:1 ratio is obtained. In addition, an empirical model is derived through the compressive strength of PU foam using numerical analysis (ABAQUS). Based on numerical analysis, the average difference between experimental and numerical results ranging between 3 to 5 % which is satisfactorily. The second part addresses the physical and mechanical properties of treated sand with different percentages of PU. The compressive strength of treated sands are determined by conducting the UCT in accordance with BS 1377: 1990: Methods of Test for Soils for Civil Engineering Purposes: Part 7–Shear Strength Test. The stress-strain relationship of the treated sand is presented. The third phase is to conduct a field evaluation on plate bearing test and mackintosh probe to evaluate the bearing pressure in treated soil. It is found that the performance of the bearing pressure in treated soil has improved almost twice as compared to natural soil. In addition, a great reduction in void ratio and swelling index are found in the treated soil as compared to the natural soil. The last part focuses on a laboratory sample sand model to determine and evaluate the performance of polyurethane in treated sand. Conclusively, this study has presented the reliable results and predictions on behavior of treated sand with PU. This study able to address as alternative remediation method whereby its shorten the time of implementation and eliminate the excavation works. In conclusion, this study is proven beneficial for a better environment and can be used as benchmark of ground improvement technique. This study can contribute to the improvement of pavement rehabilitation and ground modification works in Malaysia.