DEVELOPMENT OF A SENSOR SYSTEM TO INVESTIGATE THE ARCHING ACTION OF SOIL

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Names of the supervisors: Dr. L.I.N. De Silva

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ABSTRACT

This research focused on introducing a new mechanism to measure the effective earth pressure and total earth pressure in one degree of freedom sensor system. To identify the structural deformation with respect to the earth pressure (in other words sense the earth pressure) strain gauge based cross beam structure is introduced as the sensing structure. This study was focussed on measuring 150 kN/m^2 maximum earth pressure however, it is capable of customizing the system according to the measuring requirement. A novel mechanism is developed to measure the effective earth pressure directly by allowing infiltration of water into the sensor and there by cancelling the outside pore water pressure. Finite element analysis was carried out to identify and optimize the sensing cross-beam structure dimensions. Dimensions and the shape of the sensor were finalized after referring to the literature. Aluminium material was used to manufacture this sensor considering different geotechnical, mechanical and environmental factors. Precision marching methods were used to manufacture a high-quality sensor minimizing the manufacturing errors. For that CNC milling machine and CNC lathe machine in the Die and Mould laboratory were used. After that a complete data acquisition system was developed to collect, visualize and store the data. Cloud database based remote sensing mechanism was also introduced to monitor the earth pressure in real time via a web portal. Laboratory testing and validation were done using sand material. Sensitivity, zero load drift and thermal characteristic of the sensor was also identified. Finally using the developed sensor system, arching effect of sand was studied. Initially the active and passive arching effect behaviour of dry sand due to the settlement of clay soils was investigated. After that research was carried out to investigate the arching effect of dry sand and saturated sand with the known settlement. Special apparatus was developed to create a known settlement inside a sand fill .

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