Analysis of Geotechnical Parameters from Geophysical Information

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Content of Presentation

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- Conclusion

Introduction

- The high cost of geotechnical investigation is a major factor that discourages many building developers from carrying out site characterization.

- Especially, when there is no legislation that enforces it.

- One of the consequences of this is its significant contribution to the incessant building collapse experienced in many developing countries, including Nigeria of late.

Introduction Cont'd

- Geophysical investigations are usually less expensive and much easier to conduct (Anderson and Croxton, 2008; Mohd *et al*., 2012).
- This approach does not affect the natural state of the environment.
- One of such methods is the seismic refraction method (Tezcan *et al*., 2009; Atat *et al*., 2013).
- This involves the generation of seismic energy (seismic waves or elastic stress waves) that travels through the soil and interact with soil particles and interstitial fluids.

Introduction Cont'd……..

- The effect of soil texture and structure affect the responses of soil to seismic waves. These variations in responses are the interest of the geophysicist (Sayeed *et al*., 2007; Uyanik, 2010).

- Based on the above, seismic refraction method can be used to estimate and observe internal changes of soil properties,

- which can be used as a measure of seismic parameters that may be useful in subsurface characterization (Altindag, 2012; Bery and Saad, 2012).

Methodology

- Seismic refraction survey was conducted using a 24-Channel Terraloc MK 6 seismogram (ABEM Instrument, 1996).
- The length of the surveyed profiles ranges between 100 and 200 m, 2 m geophone spacing was used for proper coverage of the refractor layer (Mohd *et al*., 2012).
- A 15 kg sledge hammer was used as the energy source and data were acquired
- The data acquired were interpreted using seisImager software package (SeisImager, 2009).

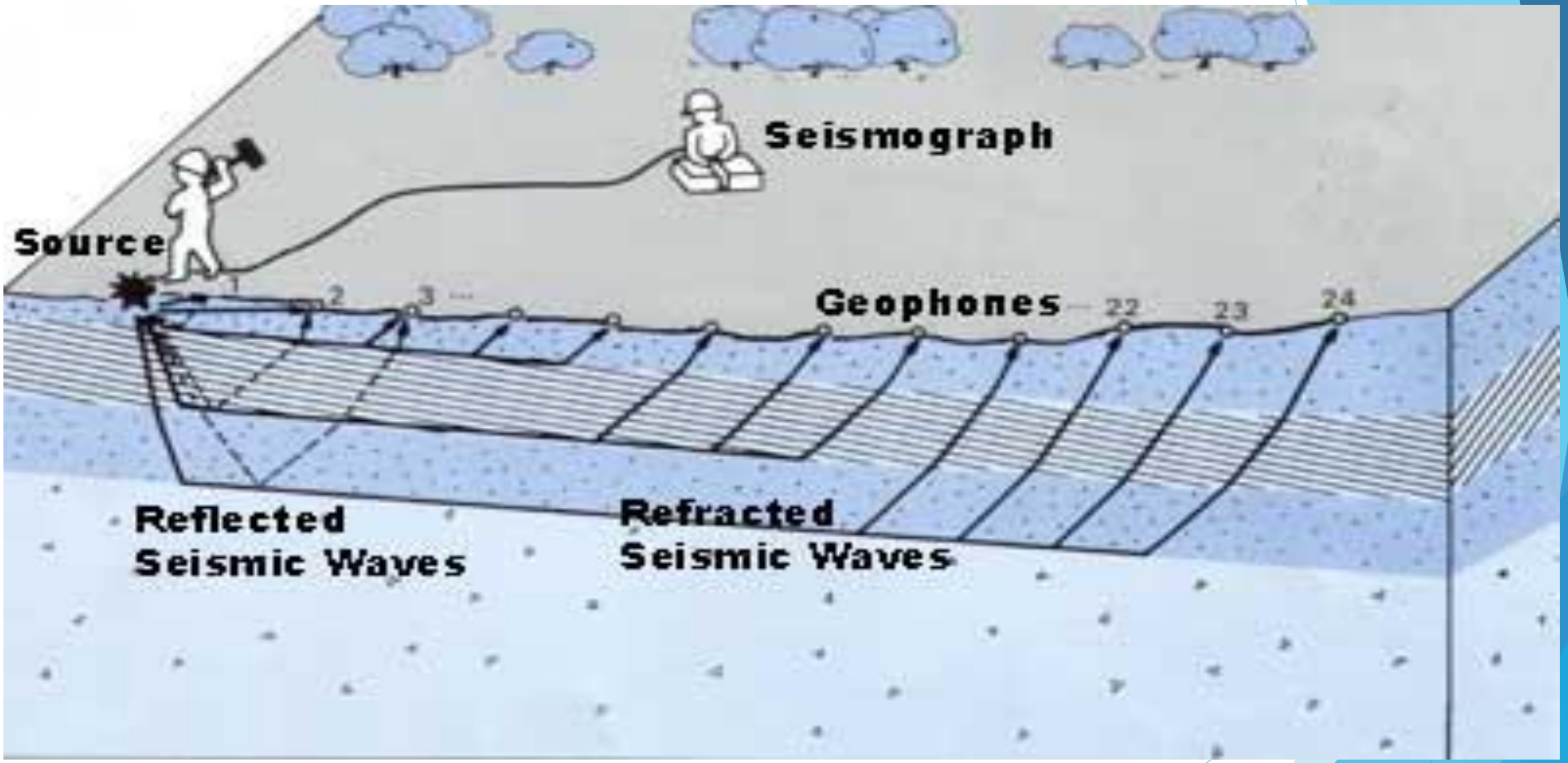

Fig 1: schematic diagram of seismic refraction method (Subsurface geotechnical, 2016).

Methodology Cont'd…….

- The results obtained from the software interpretation were subjected to some equations in theory in order to determine basic geotechnical parameters (Tezcan *et al*., 2009; Nastaran, 2012; Atat *et al*., 2013).

- Statistical analysis was applied to the raw data set.

- The analysis used in this study was based on the relationship between the primary wave velocity and other geotechnical parameters derived from the study (Altindag, 2012)

Methodology Cont'd…..

- The raw data set was subjected to least square regression analysis,
- Different curve fitting approximations were executed.
- The polynomial regression of order 2 was found to give the highest correlation coefficient in most cases.

Methodology Cont'd

- Empirical correlation equations were obtained that related both the p-wave velocities with basic geotechnical parameters.
- The graphs of the different geotechnical parameters were plotted against the primary wave velocity.
- The graphs obtained are as presented below

Results and discussion

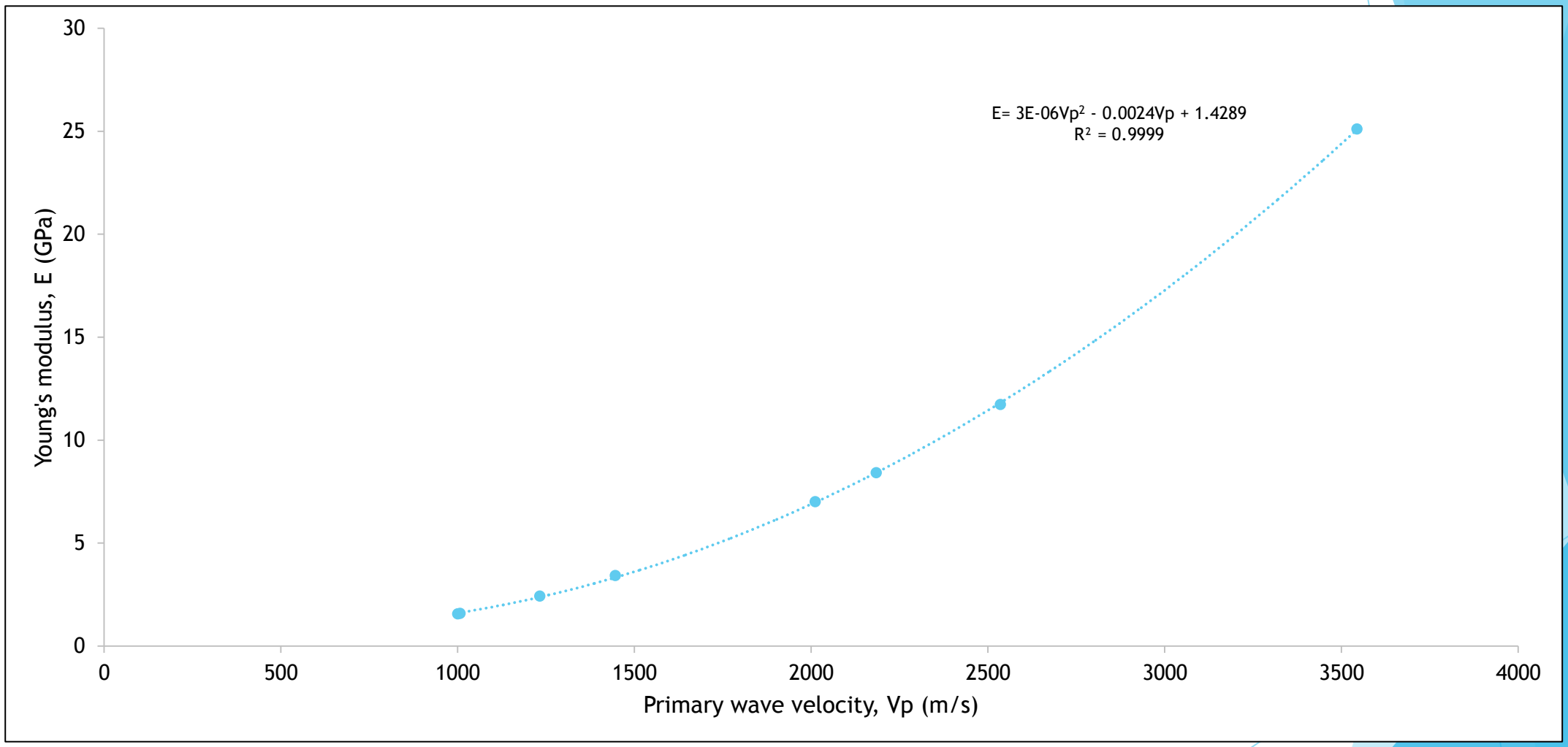

Fig 2: The graph of Young's modulus (GPa) against the primary wave velocity (m/s)

Results and discussion Cont'd.....

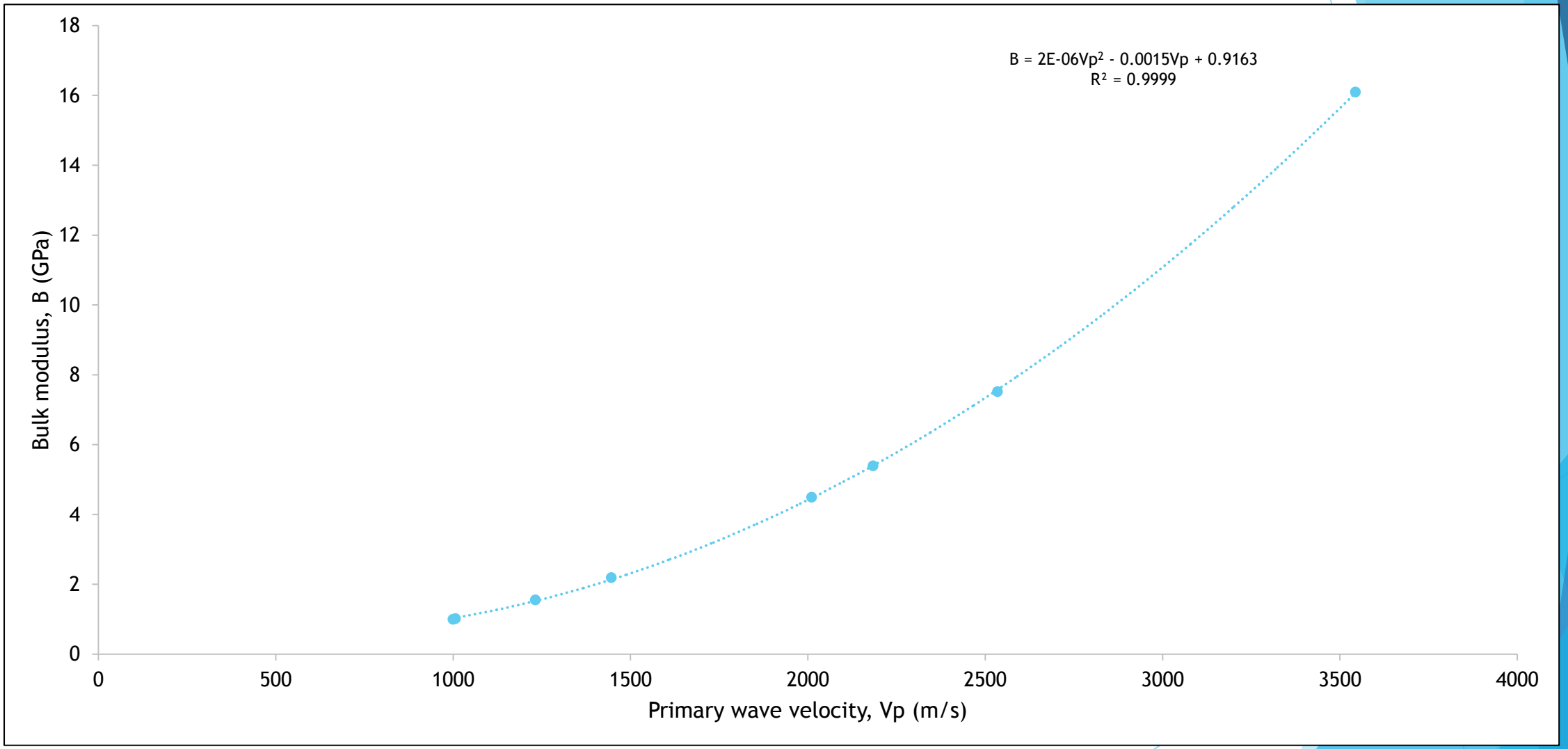

Fig 3: The graph of Bulk modulus (GPa) against the primary wave velocity (m/s)

Results and discussion Cont'd…….

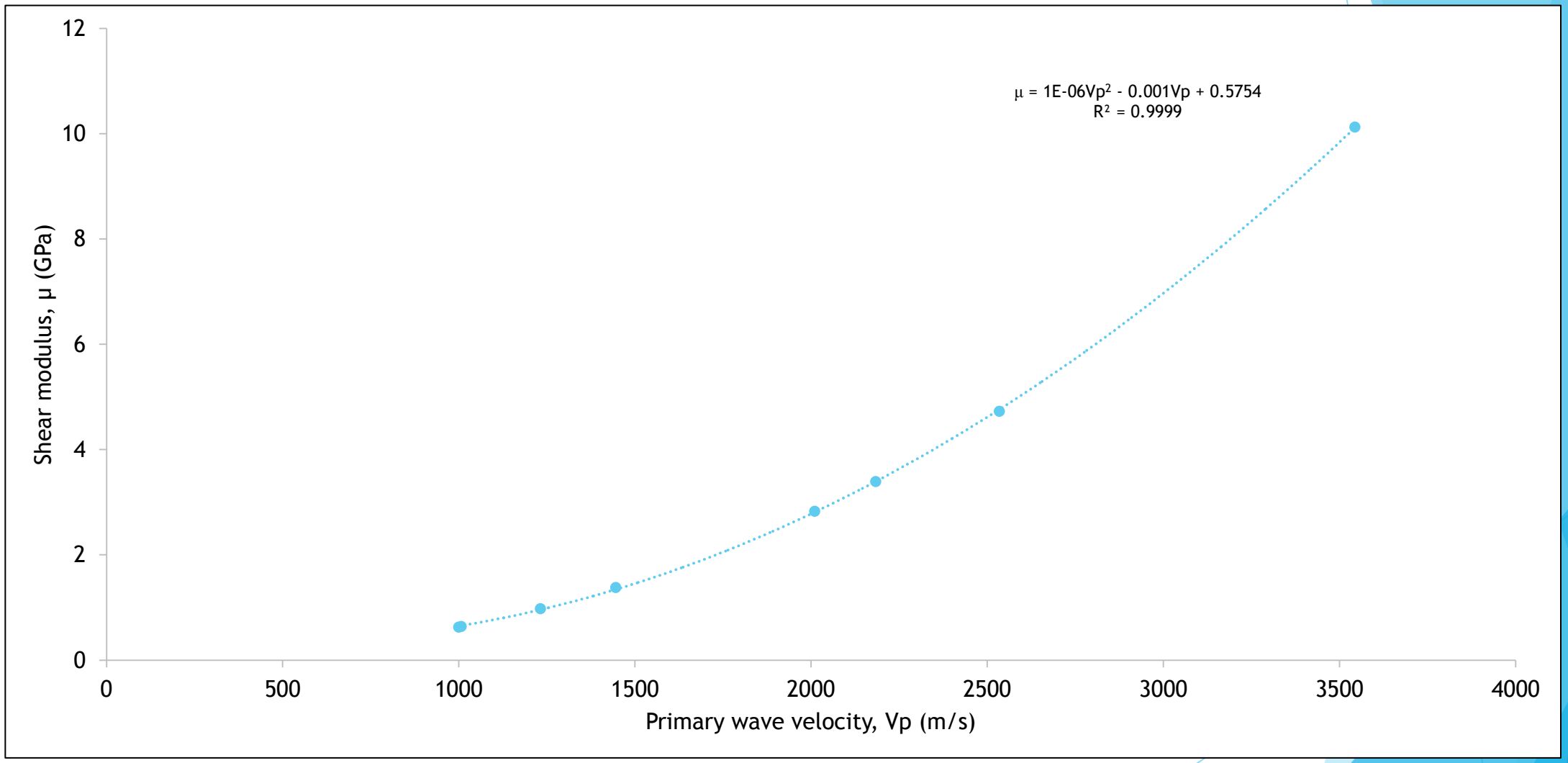

Fig 4: The graph of shear modulus (GPa) against primary wave velocity (m/s)

Results and discussion Cont'd……

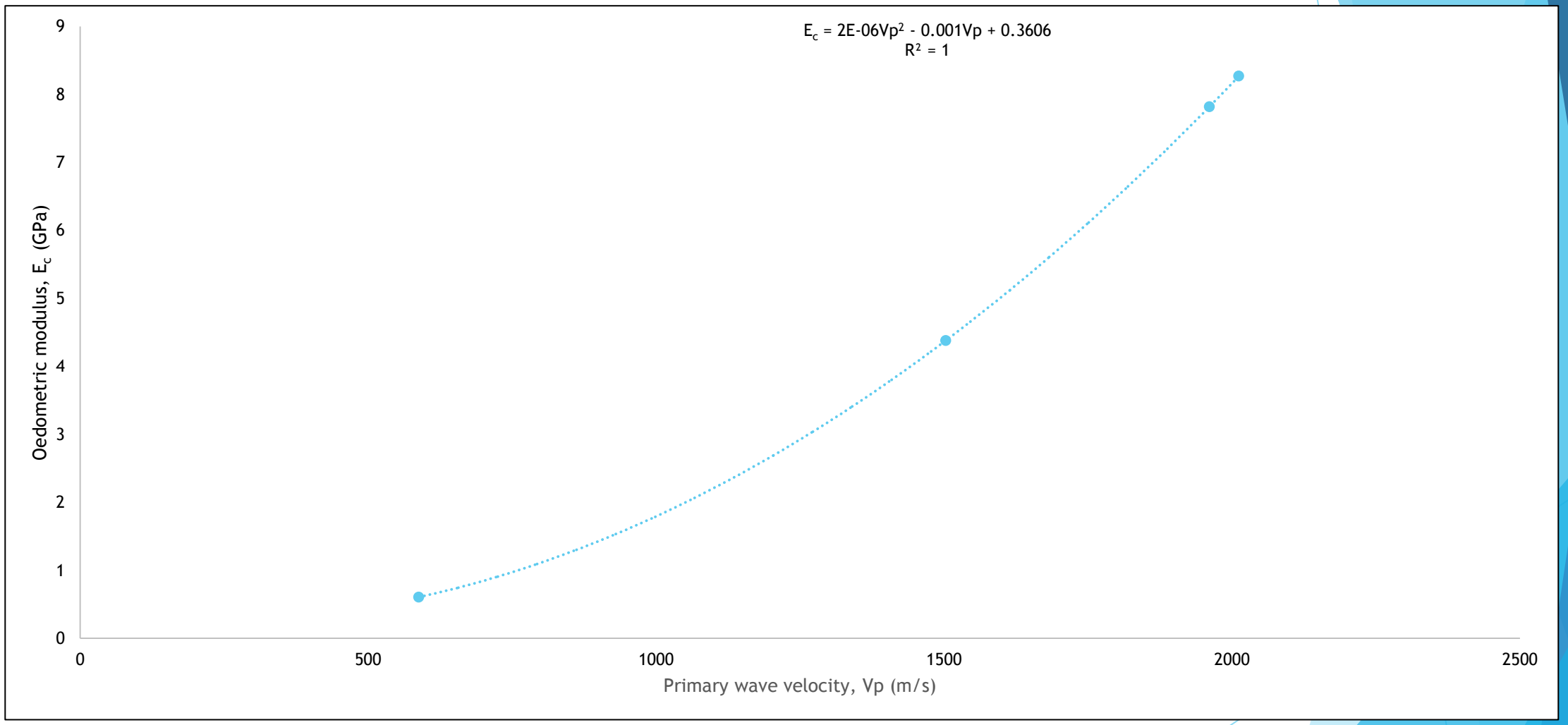

Fig 5: The graph of Oedometric modulus (GPa) against primary wave velocity (m/s)

Results and discussion Cont'd……

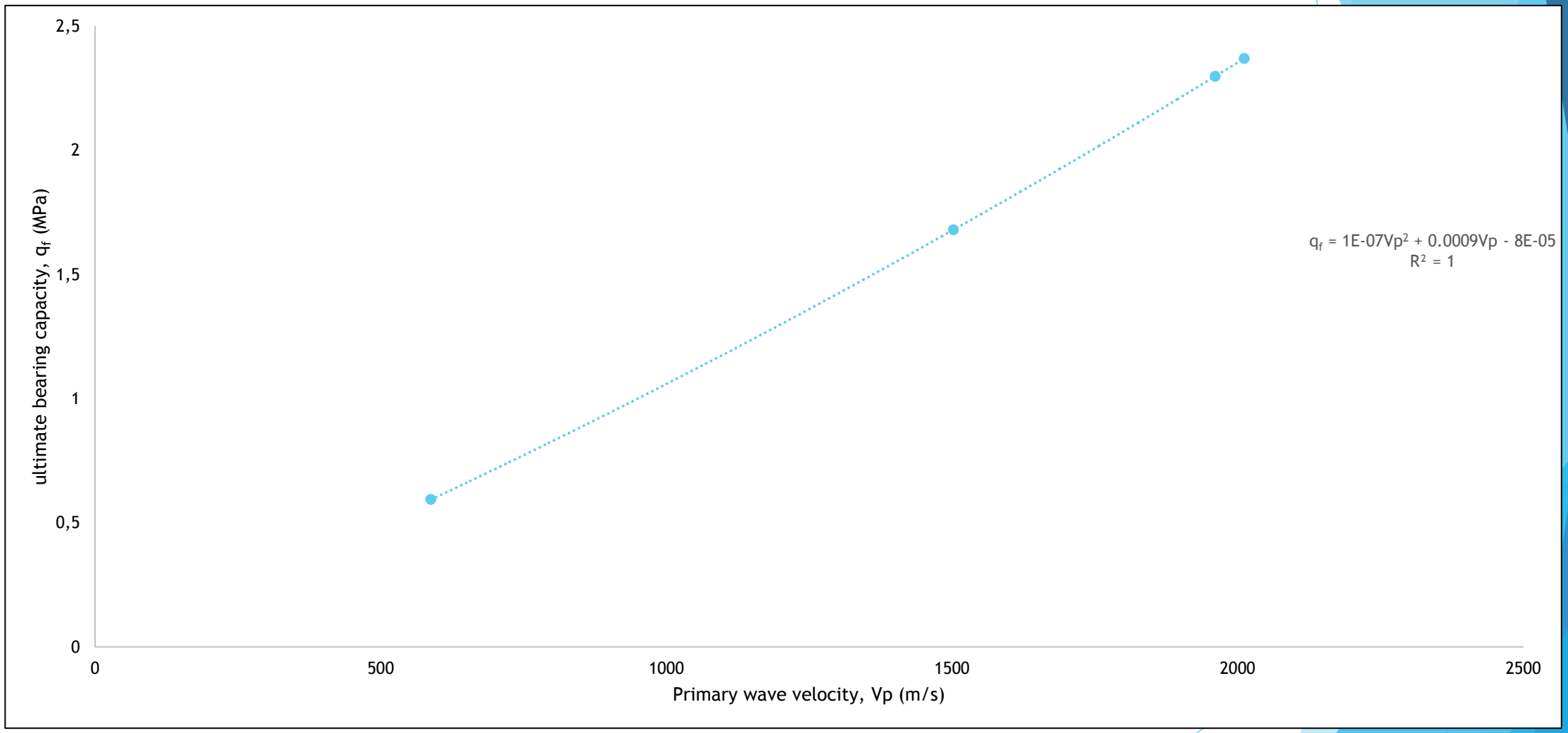

Fig 6: The graph of ultimate bearing capacity (MPa) against the primary wave velocity

Results and discussion Cont'd…….

- The empirical correlation equations were obtained

$$E = 3\times10^{-6}V_p{}^2 - 0.0024V_p + 1.4289$$

$$B = 2\times10^{-6}V_p{}^2 - 0.0015V_p + 0.9163$$

$$\mu = 1\times10^{-6}V_p{}^2 - 0.001V_p + 0.5754$$

Results and discussion Cont'd…….

$$E_c = 2\times10^{-6}V_p{}^2 - 0.001V_p + 0.3606$$

$$q_f = 1\times10^{-7}V_p{}^2 + 0.0009V_p - 8\times10^{-5}$$

Results and discussion Cont'd….

- The coefficient of determination for the various parameters ranged between 0.99 and 1.00.

- This indicates a high degree of correlation.

- Thus, from these equations the geotechnical parameters of interest can be determined by obtaining information on either the compressional wave velocity of the different layers of the subsurface.

Results and discussion Cont'd…..

- It is important to state at this point that the results obtained in this study correlated with the results of Altindag (2012) and Bery and Saad (2012).

- The correlation coefficient in Altindag (2012) differed from the present study by 0.22 while in Bery and Saad (2012) the correlation coefficient varied from the present study by a factor of 0.06.

- This variation in results could be as a result of the different curve fitting approximation used or the variation in the geological formation of the areas of study.

Results and discussion cont'd…….

- For instance, in Altindag (2012), power curve fitting approximation was found to give the highest correlation coefficient and the geomaterials studied were of sedimentary geological composition.

- In Bery and Saad (2012) linear curve fitting approximation was used for the study and the geologic formation is microcline granite, which is quite different from the present study.

Conclusion

- In conclusion, this study revealed that geotechnical parameters can be determined from the p-wave velocity, which can be used to easily characterize the subsurface condition of a site.

- Also, the empirical equations obtained can be used to evaluate and predict the geotechnical parameters of a site.

Conclusion Cont'd…….

- Finally, this study has the potential to reduce the cost and the difficulty of conducting geotechnical investigations before embarking on building development.

Acknowledgements

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