

Stress-Strain Behavior of Banana Fiber Reinforced and Biochar Amended Compressed Stabilized Earth Blocks

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Abstract : Though earth construction is an ancient technology, researchers are working on increasing its strength by adding different types of stabilizers. Ordinary Portland cement for sandy soil and lime for clayey soil is very popular practice as well as recommended by various authorities for making stabilized blocks for satisfactory performance. The addition of these additives improves compressive strength but fails to improve ductility. The addition of both synthetic and natural fibers increases both compressive strength and ductility. Studies are conducted to make earth blocks more cost-effective, energy-efficient and sustainable. In this experiment, an agricultural waste banana fiber and biochar is used to study the compressive stress-strain behavior of earth blocks made with four types of soil low plastic clay, sandy low plastic clay, very fine sand and medium to fine sand. Biochar is a charcoal-like carbon usually produced from organic or agricultural waste in high temperatures through a controlled condition called pyrolysis. In this experimental study, biochar was collected from BBI (Bangladesh Biochar Initiative) produced from wood flakes around 400 deg. Celsius. Locally available PPC (Portland Pozzolana Cement) is used. 5 cm × 5 cm × 5 cm earth blocks were made with eight different combinations such as bare soil, soil with 6% cement, soil with 6% cement and 5% biochar, soil with 6% cement, 5% biochar and 1% fiber, soil with 1% fiber, soil with 5% biochar and 1% fiber and soil with 6% cement and 1% fiber. All samples were prepared with 10-12% water content. Uniaxial compressive strength tests were conducted on 21 days old earth blocks. Stress-strain diagram shows that the addition of banana fiber improved compressive strength drastically, but the combined effect of fiber and biochar is different based on different soil types. For clayey soil, 6% cement and 1% fiber give maximum compressive strength of 991 kPa, and for very fine sand, a combination of 5% biochar, 6% cement and 1% fiber gives maximum compressive strength of 522 kPa as well as ductility. For medium-to-fine sand, 6% cement and 1% fiber give the best result, 1530 kPa, among other combinations. The addition of fiber increases not only ductility but also compressive strength as well. The effect of biochar with fiber varies with the soil type.

Keywords : banana fiber, biochar, cement, compressed stabilized earth blocks, compressive strength

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