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Potential of Dredged Material for CSEB in Building Structure

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Abstract : The research goal is to re-image a locally-sourced waste product as abuilding material. The author aims to contribute to the compressed stabilized earth block (CSEB) by investigating the promising role of dredged material as an alternative building ingredient in the production of bricks and tiles. Dredged material comes from the sediment deposited near the shore or downstream, where the water current velocity decreases. This sediment needs to be dredged to provide water transportation; thus, there are mounds of the dredged material stored at bay. It is the interest of this research to reduce the filtered un-organic soil in the production of CSEB and replace it with locally dredged material from the Atchafalaya River in Morgan City, Louisiana. Technology and mechanical innovations have evolved the traditional adobe production method, which mixes the soil and natural fiber into molded bricks, into chemically stabilized CSEB made by compressing the clay mixture and stabilizer in a compression chamber with particular loads. In the case of dredged material CSEB (DM-CSEB), cement plays an essential role as the bending agent contributing to the unit strength while sustaining the filtered un-organic soil. Each DM-CSEB unit is made in a compression chamber with 580 PSI (i.e., 4 MPa) force. The research studied the cement content from 5% to 10% along with the range of dredged material mixtures, which differed from 20% to 80%. The material mixture content affected the DM-CSEB's strength and workability during and after its compression. Results indicated two optimal workabilities of the mixture: 27% fine clay content and 63% dredged material with 10% cement, or 28% fine clay content, and 67% dredged material with 5% cement. The final product of DM-CSEB emitted between 10 to 13 times fewer carbon emissions compared to the conventional fired masonry structure. DM-CSEB satisfied the strength requirement given by the ASTM C62 and ASTM C34 standards for construction material. One of the final evaluations tested and validated the material performance by designing and constructing an architectural, conical tile-vault prototype that was 28" by 40" by 24." The vault utilized a computational form-finding approach to generate the form's geometry, which optimized the correlation between the vault geometry and structural load distribution. A series of scaffolding was deployed to create the framework for the tile-vault construction. The final tile-vault structure was made from 2 layers of DM-CSEB tiles jointed by mortar, and the construction of the structure used over 110 tiles. The tile-vault prototype was capable of carrying over 400 lbs of live loads, which further demonstrated the dredged material feasibility as a construction material. The presented case study of Dredged Material Compressed Stabilized Earth Block (DM-CSEB) provides the first impression of dredged material in the clayey mixture process, structural performance, and construction practice. Overall, the approach of integrating dredged material in building material can be feasible, regionally sourced, cost-effective, and environment-friendly.

Keywords : dredged material, compressed stabilized earth block, tile-vault, regionally sourced, environment-friendly
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