Biomimetic Design of Long Bones from Human Skeleton for Structural Systems

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ABSTRACT

The concept of green construction enables a revolutionary change in construction sector in terms of design, production, and management. One such method is introducing the concept of biomimicry. Biomimicry is utilized in the field of design to solve problems. This paper mainly discusses about the mimicking of human skeleton for structural design. The idea is mimicking humerus bone as a tension member and femur bone as a compression member. The optimized members of compression and tension (strut and tie) were put together to form the mimicked king post truss analytically with the conventional cross section truss. Three cases were considered analytically with average diameter, maximum diameter, and equivalent self-weight to the members of mimicked truss. And experimentally testing with non-destructive test and point load test. The result shows that the ultimate load carrying capacity of critical compression member and tension member was 846.16 kN and 1952 kN respectively. Whereas, the achieved load was 780.30 kN and 1729 kN. Also, the ratio of analytical stiffness to self-weight is 21.83 mm^{-1} and the ratio of experimental stiffness to self-weight was 19.15 mm^{-1}. Therefore, from the results it was observed that the equivalent results for mimic truss can be achieved in a truss which is modeled of equivalent self-weight. Hence the development and use of structural elements using biomimicry is feasible and that will lead to economic, green and energy efficient structures.

Keywords: Biomimicry, Structural element, Femur Bone, Humerus bone, Tie member, Strut Member, King Post Truss, Stress analysis, Carbon Footprint