

In recent years, 3D printing has been widely concerned by scholars at home and abroad. It developed rapidly in many fields, but started late in the field of construction engineering. Wire and Arc Additive Manufacturing (WAAM) is one of the 3D printing techniques largely employed in the field of steel construction, with the ability to produce large-scale structural members with high speed and low cost. Therefore, the research on material properties of WAAM stainless steel and finite element method of stub columns is carried out. The following sections are involved in this thesis:

(1) Uniaxial tensile tests were carried out on 216 WAAM stainless steel coupons, covering different welding process parameters, surface types and extraction directions. As-built and machined coupons were tested to investigate the influence of the geometrical properties that are inherent in WAAM process on mechanical properties, while the coupons extracted from three orientations were tested to explore the anisotropy of the material. It is found that WAAM 316L stainless steel exhibits anisotropic. The as-built coupons exhibit a decrease in Young's modulus, strength and ductility compared to the machined coupons due to the influence of geometrical undulation. The difference in the mechanical properties under different process parameters is not significant.

(2) A method to characterize rough contours of WAAM elements is proposed. Firstly, 3D models of WAAM 316L stainless steel plates were obtained by 3D laser scanning, and the coordinate information of contour lines was extracted by cutting three sections. The bending deformation of the plates was removed by moving average filtering method, and a method of sinusoidal half wave is proposed to characterize the undulating surface of WAAM elements.

(3) The finite element simulation method of WAAM stainless steel stub column is proposed. According to the WAAM stainless steel stub column tests in the existing references, the finite element simulation was carried out. The sinusoidal half wave characterization method was applied to finite element simulation. Four finite element modeling methods were used to simulate, moreover, the simulation results were compared with the experimental results. The most accurate and suitable finite element modeling method is proposed.