3D SCANNING IMPERFECTION MEASUREMENTS FOR FEM ANALYSIS OF STEEL LINKS

SUMMARY

Along with the rapid development of 3D scanning technologies, and the implementation of relatively new processes such as digital twinning and reverse engineering in the construction industry, an appropriate application of these in FEM simulations for example, can greatly facilitate analysis of real geometries when is needed. In this study, a new approach to construct 3D finite element models using advanced techniques in the field of 3D scanning is introduced. In the finite element method (FEM), constructing three-dimensional (3D) models with real geometric imperfections of structures or structural elements can be technically difficult and time inefficient. To date, there is no robust automated approach to translate this data directly into a valid model for FE analysis. In this thesis it was studied how to provide a simple and practical procedure that can convert point clouds to FE models. Another objective of this thesis is to provide an overview of 3D scanning methodologies and technologies proposed in the existing scientific and industrial literature. Throughout the thesis, various types of the related techniques are reviewed, which consist, mainly, of close-range, aerial, terrestrial photogrammetry, and mobile, terrestrial and airborne laser scanning, as well as time-of-flight, structured-light and phase-shift methods. Also, the work includes a case study that addresses the issue of processing three-dimensional point clouds that are generated from 3D scans. Five distinct 3D scanning technologies were selected for the measurement of replaceable stainless steel links used for eccentrically braced frames for the purpose of evaluating real geometric imperfections as well as for direct use in finite element simulations of measured imperfections.