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Department of Civil Engineering

The Use of Binding Jetting Additive Manufacturing in Creating Corrugated Web Beams and Truss Beams for Lightweight Steel framing Systems

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COMMITTEE DECISION

This thesis (The Use of Binding Jetting Additive Manufacturing for Creating Corrugated Web Beams and Truss Beams for Lightweight steel framing systems) was successfully defended and approved on (18-5-2020)

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AUTHORIZATION FORM

I, Ghaith Atef Abureden, authorize Isra University to supply copies of my thesis to libraries or establishments or individuals on request, in accordance to the university regulations.

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CONTENTS

Dedications

To my father who was there on every step of the way giving me the support I needed, and to my mother who poured her heart out trying to make me a better man, every step I ever take and every success I ever achieve are yours to be proud of

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ABSTRACT

This research is dedicated to explore the benefits of the additive manufacturing in the field of structural engineering. For that purpose, two structural systems were chosen for investigation. The corrugated web beam, and the truss beam. Various 3D models were created of these two systems, finite element analysis was conducted on these models, and then these prototypes were manufactured. Four prototypes of one normal web beam and three corrugated web beams were created using traditional methods of welding, three prototypes of similar corrugated web beams were created using additive manufacturing, and two prototypes of truss beams were created using the additive technology.

Experimental tests were conducted on these prototypes. Both the finite element analysis and the experimental tests showed that the higher the level of corrugation, the higher the value of load carrying capacity. However, in the traditionally manufactured beams, the effect of the corrugation is reduced significantly due to the effect of the heat of welding. This problem does not exist in the additively manufactured prototypes that showed close performances to the finite element analysis models. This is because no welding existed.

The finite element analysis of the truss beam models showed very close performances of models TR1 and TR2 and a higher load carrying capacity of model TR3. However, prototype TR2 had a higher load capacity than its finite element analysis model, while prototype TR1 had a less load capacity than its finite element analysis model due to the higher level of load redistribution of model TR2.