Currently, there is lack of understanding in the use of auxetic metamaterials in structural engineering applications. The definition of an auxetic material is that it laterally contracts under compressive loads, in other words having a negative Poisson's ratio. As a result, a concept is expanded where auxetically boosted confinement is actively confining reinforced concrete members. However, There are many structural elements that are subjected to different types of loading, like compression, bending, tension and shear. So, how do auxetics behave under these types of loading?

The aim of the research is set in terms of goals to contribute to the current academic knowledge and close the research gap when it comes to the use of auxetics for steel reinforcement of structural concrete elements. The research aims to contribute to a sustainable construction sector, by using less material on the structural design without compromising the structure's safety. Moreover, literature shows that an increase of 140% of the compressive strength and ductile post-peak behavior is obtained when compared with conventional rebar, which is desirable for structural applications.

Besides structural elements, such as columns, which are mainly under compression, several other structural elements are often used in civil engineering. Beams for example are subjected to several types of loading, such as: compression, tension, shear in multiple directions and bending. Besides auxetic architectures, non-auxetic architectures become interesting or even a combination of the architected material which may benefit the concrete element. So far, to the best knowledge of the author no combination of an architected material is used, which benefit as steel reinforcement for concrete structural elements. Combining different types of architected materials leads to issues regarding compatibility. Therefore, adjustments must be made in the geometry in order to ensure compatibility and with that a continuous structure. Besides, change in load is expected when elements are subjected to bending. A gradual transition is therefore needed of an architected material that can accommodate the change of loading on the structural element. The concept of active confinement becomes important to ensure confining pressure of the steel reinforcement throughout the concrete structural element. By obtaining the Poisson's ratio of a strut of the lattice a conclusion can be drawn on the pressure of the steel strut on the concrete. Active confinement is ensured when inward behavior is found throughout the whole lattice.

Furthermore, compared to several sectors such as: agriculture, manufacturing and wholesale and retail, productivity in the construction sector is currently limited. We therefore need state-of-the-art solutions in order to increase our productivity and be more efficient. The combination of multiple robots in construction offers significant advancements and possibilities. By having one robot holding an item while another robot performs tasks on the product, construction speed and precision can be greatly increased, showcasing substantial potential for further research. The research has demonstrated that robotics can effectively create spatial structures with desirable structural behavior, flexibility, and efficient fabrication using manual welding. Combining the concept of steel reinforcement lattices and state-of-the-art solution would be of great benefit to our society. With that, there is enormous potential in auxetics for civil engineering applications.