

PROTOTYPE OF A THIN, VAULTED CONCRETE FLOOR USING A KNITTED STAY-IN-PLACE FORMWORK

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1. INTRODUCTION

Using structural principles and force flow as a driver for design enables the optimisation of concrete structures, significantly reducing material use. This has been demonstrated with a lightweight, “unreinforced” floor relying the structural principle of arching action for compression and being stiffened by ribs, significantly lighter than comparable systems [1].

While these systems are more material efficient, the construction of their intricate geometries is challenging, especially as bespoke concrete elements built with traditional methods require single use double-sided moulds. Even if integration of functionality (e.g. insulation) is conceivable with parts of mould material, the process remains labour intensive and wasteful. Methods more recently developed and embracing additive manufacturing such as binder jetting are used for moulds [2] or the structure itself [3], but are generally slow, materials are generally weak and environmental impact of binders can be high [4]. Stay-in-place lightweight formwork systems providing the same large design space can offer an alternative.

2. APPROACH AND PHYSICAL PROTOTYPE

The use of fabric as formwork has gained attention in recent years by proving to be a waste reducing and efficient strategy. Moreover, the use of knit textiles offers the advantage of lowering the cost of labour and manufacturing for complex parts as they allow for the minimisation of seams, integration of features such as channels, openings, ribs and tailored surface textures in a single CNC process [5].

This paper investigates the feasibility of using a knit stay-in-place formwork for building bespoke rib-stiffened slab. A rib-stiffened funicular slab prototype will be presented using a knitted stay-in-place formwork. The formwork is knit as a single layered textile featuring ribs with integrated channels.

A simple frame allows for the hanging of the textile to take the desired compression form. Subsequently, it is rigidified using a cement-paste coating and used as formwork for subsequently pouring the concrete.

The prototype is used to assess the feasibility of the building process, the accuracy of the novel moulding approach, the possibility to create variable thicknesses and surface features otherwise difficult to manufacture, and the overall quality of the moulding process.



Figure 1. Process steps of previous prototype - Left: tensioned knit textile; Mid: cement paste coated textile; Right: finalized concrete structure.

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