

Enhancing Productivity in Reinforced Concrete Frame Buildings: A Study of Modern Construction Methods and Off-Site Manufacturing



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This dissertation investigates how modern methods of construction (MMC), specifically off-site manufacturing (OSM), influence labour productivity in reinforced concrete frame buildings. The issue highlighted is the ongoing productivity gap within the construction industry compared to other sectors, such as manufacturing, where productivity has consistently risen. Conversely, construction has experienced an 8% global decline in productivity from 2020 to 2022. This gap is critical because improving construction productivity is essential for meeting future infrastructure demands, achieving economic growth, and enhancing sustainability.

This research is important because it can show measurable productivity gains through adopting OSM, especially in labour-intensive tasks like reinforcement installation. Despite the recognised benefits of OSM, including reduced time, improved safety, and higher quality, its implementation in the UK construction sector remains limited due to design complexity, lack of standardisation, and cultural resistance to change.

To answer the research problem, a quantitative methodology was employed, using case study analysis of two projects: Project A (a large infrastructure construction site) and Project B (an off-site manufacturing facility). Data collection involved both primary and secondary sources, such as design documentation, non-conformance reports (NCRs), and direct tracking of the productivity of prefabricated reinforcement cages. Metrics like hours per tonne, number of loose bars, and complexity levels were analysed to examine correlations and productivity results.

The research concludes that off-site manufacturing significantly enhances labour productivity, particularly when product standardisation is high and complexity is minimised. For example, the prefabrication of reinforcement cages led to improved efficiency and reduced on-site labour hours. However, high cage complexity and variability in design led to significant productivity inefficiencies, with complexity Level 4 cages requiring up to 17 more hours than Level 1 equivalents. The study also found a direct correlation between design standardisation and quality outcomes, with more complex designs resulting in a higher number of NCRs.

Ultimately, the dissertation confirms the hypothesis that implementing off-site manufacturing improves productivity in reinforced concrete construction. However, this benefit is most noticeable in cases involving simpler reinforcement arrangements with fewer loose bars. Where cage complexity increases, the advantages of OSM are significantly reduced due to rising labour demands and coordination challenges. The research identifies key barriers, such as a lack of design standardisation and resistance to automation, that must be addressed to fully realise the benefits of OSM. The findings offer a data-driven foundation for advocating broader adoption of off-site methods in construction to bridge the sector's longstanding productivity gap.