Executive Summary: Measuring Installation Productivity on Panelised Timber Construction (PNA329-1314)

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Panelised prefabricated timber construction offers a fast and productive site installation process. Cranage provides the lead resource as it dictates the speed of installation – optimising crane time is central to optimising productivity.

This study used time lapse photography on 5 active case study construction sites to measure installation productivity. Net crane time was used as the basis for measuring productivity, being the time dedicated purely to crane cycles involved directly in installing prefabricated timber panels (521 cycles were measured relating to the installation of 5,592m^2 of panels). Other contributors to Gross crane time and general down time must be added to these productivity figures to estimate overall program time. For instance, Gross crane time can include issues that are only peripherally related to the timber installation aspect of the project such as unexpected stoppages, miscellaneous handling of other materials, and crane operation attributes (setup time, take down time, and scheduled breaks). Down time is where the crane is sits unused. Such criteria often go beyond the pure needs of prefabricated timber installation and relate to project-wide scheduling issues. In general, the findings indicate the following guidelines:

- Larger panels take slightly longer to place than smaller panels but this minor extra time is more than offset by the increased area installed per hour.
- On the 2 and 3 level buildings studied, no statistically significant difference existed in terms of the time for crane cycles for each separate floor level. This situation may change on taller buildings especially where wind will likely slow upper floors.
- The greater the synchronisation between the crane and installation crew, the better the overall productivity. Here, the crane crew is often supplied as a fixed part of the overall crane package and so the installation crew is the main labour variable of interest because it can be more readily up-scaled or down-scaled according to perceived need. Only small crews were required on the sites studied: the crew for pre-clad wall panels project ranged from 2-3 workers, crews for cassette projects ranged from 3-4 workers, and the crew for the CLT project still only involved a relatively small 5 workers. This may not need to change much for larger projects.
- Variances in productivity within each panel type (refer Table 1) is a function of the size of the project, the appropriateness and inherent efficiency of the chosen prefabrication system, delivery logistics, and the prevailing on-site work environment

(including work flow, wind, site access, rain, and safety requirements). The efficiency and appropriateness of crane selection is particularly important.

- Care in pre-construction and offsite production planning are important including early pre-fabricator involvement, panelising the architectural design with a view to creating economies of scale, designing-in structural efficiency, providing accurate dimensional tolerances and installation friendly delivery logistics.

- Floor panel installation productivity tends to be somewhat faster than the general panel average. Contributing factors include less exposure to wind and greater assistance by gravity when placing floor panels compared to wall panels. Wall panels are also slower due to the greater time and accuracy required in aligning and positioning walls, dealing with floor flatness tolerances and greater need for temporary bracing and cramping (especially CLT wall panels).

Average crane productivity rates for panels (including overall plus individual panel types) are provided in Table1. Of note, pre-clad walls and CLT rates are based on relatively small samples (a single case study each). The CLT project was also a large house and tight site, and so it is felt that productivity rates would likely be better where applied to larger, repetitive projects. Consequently, the stated figures must be taken in terms of the context of the projects studied. Verification from ongoing research will provide greater confidence in generalising findings to other projects.

Table 1: installation productivity rates

Panel type	**Average Installation productivity (based on net crane hours)**	
	Typical rate (crane hours/m2)	**Outliers removed (crane hours/m2)**
All panels (include below)	67.4m^2/crane hour	79.8m^2/crane hour
Floor/roof cassettes only	83.1m^2/crane hour	100.1m^2/crane hour
Pre-clad wall frame panels*	66.65m^2/crane hour	77.47m^2/crane hours
CLT floor panels*	80.03m^2/crane hour	84.88m^2/crane hour
CLT wall panels**	26.59m^2/crane hour	32.85m^2/crane hour

"*" Denotes small sample and for CLT wall panels denotes odd shaped walls in sample

Ongoing research work aims to focus more on holistic productivity issues surrounding the delivery of entire structure/envelope solutions which and the interface with other trades, which goes beyond the installation of individual panel assemblies (as analysed in this study).