

Is Prefabrication The Future of Sustainable Housing?

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Figure 1.0: Annual percentage change in house prices.

Source: (Thisismoney, 2013)

Figure 2.0 Shows all three pillars of sustainable development

Source: (Sustainability, 2010)

Figure 3.0- Amount of waste created using prefabrication technique.

Source: (Wrap,2009)

Figure 4.0- Shows the cost difference between on-site and off-site techniques.

Source: (Wrap,2009)

Figure 5.0- Shows the amount of resources needed for each technique.

Source: (Wrap,2009)

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gives houses a letter which range from A to G, with A being the most efficient and G being the least efficient. Surprisingly, a large number of houses constructed are not given an A rating performance; is this because they are using the traditional method of construction?

1.4 Dissertation Aim

The aim of this dissertation is to present a comparative analysis of the traditional method and the prefabricated method, while keeping sustainability at the heart of the research. The study will look at whether the prefabricated method can be more sustainable than the traditional method. The social impacts and environmental implications of both the manufacturing and installation will be looked upon in regards to the prefabricated method.

This will provide a good investigation as to whether or not prefabricated houses are a worthy alternative to traditional housing. This will also show whether or not the prefabricated housing method can solve problems such as the high prices for first time house buyers.

1.5 Objectives

1. To provide a general overview on both prefabrication and sustainability, and why sustainability is currently an important issue.
2. To evaluate how and why prefabrication can help houses become more sustainable.
3. To assess whether prefabrication can produce lower cost houses.

1.6 Research Methodology:

The research method used was by gathering information through questionnaires which was given to many professionals within the construction industry. The data received from the questionnaires was analysed and compared against the findings of the literature review to help answer the dissertation aims and objectives.

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2.3 Sustainable Construction

The British Construction Industry Council set a large number of goals for the construction industry in 1992. The British Construction Industry Council decided to set these targets after a meeting was held; the Earth Summit in Brazil. One of the targets which were set was to reduce waste on site by up to 50%.

This target can be reached by using new methods of construction; prefabrication. Many studies show waste is significantly reduced by using off-site construction; Jailon *et al* (2008) conducted a study analysing construction in Hong Kong. The results of the study showed: *“The results revealed that construction waste reduction is one of the major benefits when using prefabrication compared with conventional construction. The average wastage reduction level was about 52%.”* Prefabrication is being adopted all over the world; prefabrication needs to be used more frequently in the UK to help meet all sustainability targets.

Sustainability has three fundamental pillars: social, environment and economy. It is argued that sustainability can only be fully achieved when demands are met by all three fundamental pillars. The three pillars of sustainability are shown in Figure 2.0

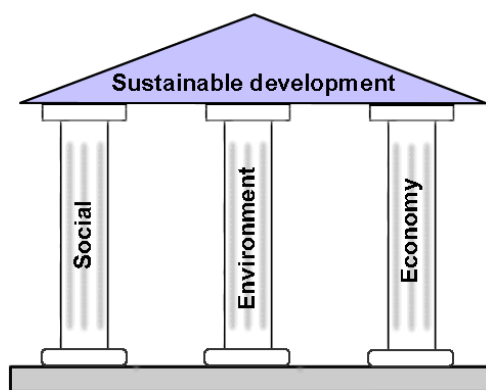


Figure 2.0 Shows all three pillars (elements) of sustainable development

Source: (Sustainability, 2010)

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make on-site construction more efficient. Hongping *et al* (2013), study in Hong Kong is promising, however, there is very little support in the UK that on-site construction is more efficient than off-site construction. On-site construction would most certainly be a better technique of constructing houses which are one of a kind, as most elements of the house will be custom made specifically for that house. However, this dissertation asks the question: 'Is Prefabrication The Future of Sustainable Housing', without straying from the title prefabrication is argued to be the more efficient option. Many studies show the speed of the project can be quicker with prefabrication as well as the major benefit of lowering the cost. This will in turn help first time buyers as they will be able to afford a home.

Koonen (2010) statement has supported all of the author's claims that prefabrication is the more sustainable option. It has been extremely difficult to find research which argues the traditional process is more environmentally efficient. The only solution for the traditional process is the process must be improved. The waste management systems used by the prefabricated process can be adopted by the traditional process to help make the process more efficient.

2. Traditional and Prefabricated House Building Method Socioeconomic Impact

So far the research has been focused on mainly the environmental pillar of sustainability. However, this section is going to examine the social and economic aspects in further detail.

Over time the reputation for prefabricated homes has been tarnished. Prefabricated homes are seen as quick, cheap and easy homes. As human nature, it is only natural to want the best and this is why traditional homes are preferred as they are seen as being 'superior' to prefabricated homes. This view is still present in the UK that prefabricated homes are cheap, this needs to be changed. Holzma (2008) agrees that prefabrication has a poor reputation. There is also a preconception that prefabricated houses are cold and do not have a long life span. Prefabricated homes are generally lower in

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Overall the case study shows:

- The off-site manufacturing method reduces overall waste as well as a providing a cheaper price.
- There were no reported injuries/incidents/delays while the products were manufactured off site.
- The off-site manufactured floor has a lower environmental impact than the alternative.
- The overall waste generated was reduced using off site manufacturing, the waste could also be more easily managed hence recycling is a more attractive option.

2.8 Case Study South Somerset Homes

The aim of this case study was to assess the use of prefabrication in construction against the traditional method in relation to: waste, site efficiency/productivity, cost and time.

The construction of 37 dwellings using the prefabricated technique was very closely monitored. The frame, along with various other elements was manufactured off-site, this showed numerous benefits: reduced site waste, reduced defects, both the thermal efficiency and air tightness had been improved.

By closely monitoring the project the results showed that on average 27% on time could be saved using the prefabrication technique. The construction of the project from foundation to handover took a mere 12 weeks in comparison to the 31 weeks which was needed for the traditional technique. Figure 5.0 shows a comparison between both techniques and compares the man hours needed. The biggest time saving is on superstructure and the prefabrication technique saved a significant amount of time; 270.33 hours/m².

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2.9 Literature Review Critical Analysis

Much of the literature focuses on constructing sustainable projects. The issue of improving existing buildings in the UK to become more sustainable has received very little attention. The literature review must be dissected to identify gaps where further research is needed. The respected scholars have left room for further investigation into how traditional construction methods can be improved. Further investigation is also needed to identify the reason why prefabrication is not being used more often, as prefabrication boasts a lower cost, shorter project time scale and may be more sustainable.

The literature does review some very good studies such as those of Hongping *et al* (2013). As Hongping *et al* takes a different approach and instead of encouraging a change, encourages the improvement of the existing traditional method. Hongping *et al* 's study was not conducted in the UK but this is still promising, as research does indicate the traditional approach does not have to be abandoned and can be improved.

The literature review has a limitation as many of the studies analysed were not from the UK, the literature on studies in the UK is very limited. The construction industry is always changing and this is why the literature used must be up to date. A majority of the literature used is up to two years old. A RICS (2006) reference has been used, this is simply stating that the climate change levy tax has not helped the current sustainability situation thus, this reference is not regarded as invalid as it is not out of date, a tax is being referred to which was introduced in 2001.

A considerable amount of the literature reviewed has been in favour of the prefabricated approach, it proved to be a very difficult task to find flaws in the prefabricated approach when comparing with the traditional approach. The available literature boasts the benefits that prefabrication can deliver.

There were no studies which discredited the claims prefabrication makes but authors Emmitt (2013) and Gorse (2013) have argued prefabrication is not for unique constructions. This information has been taken on board, although in

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Question 9

Why do you think the traditional method of construction is favoured over the prefabricated approach?	Nr
'Safer and Stronger', 'Not enough awareness', 'more of a reputable approach and is more commonly used', 'lack of knowledge', 'lack of adaptation', 'traditional building can easily be changed', 'lack of demand', 'people are comfortable with the existing method'.	

This question is the only question which requires a qualitative answer. It provides a deeper answer which helps gain a better understanding as to why the traditional method of construction is favoured over the prefabricated approach.

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prefabricated approach can also be constructed to a cheaper price; this can in turn help the problem first time buyers are facing. The Ropemaker case study shows that a cost saving can be made with the flooring prefabricated approach; a cost saving of £37 per m² can be made.

The first objective of the dissertation is. "To provide a general overview on both prefabrication and sustainability, and why sustainability is currently an important issue." This objective has been met throughout the dissertation, as prefabrication has been assessed from many different perspectives as well as sustainability. Chapter 2.2 analysed sustainability and showed why sustainability must be used throughout construction.

The second objective is: "To evaluate how and why prefabrication can help houses become more sustainable." This objective has been met to a high standard as the dissertation has showed prefabrication produces less waste/pollution and can economically be more sustainable due to lower costs.

The final objective is: "To assess whether prefabrication can produce lower cost houses". This objective has not been met on the same high level as the other objectives, as there was not much relevant literature available on the cost of both methods, however, Chapter 2.1 shows that prefabricated houses are on average cheaper than the traditional approach, this information was provided by the BBC. Although, the first case study analysed; Ropemaker, showed that prefabrication techniques were actually more expensive. This was regarded as an unfair statement when the off-site and on site method were compared they were both of different standards and hence why this was disregarded as this was not fair. The Somerset case study showed that the price for both techniques was relatively similar. There is not much evidence in the UK that prefabrication is cheaper however this may be because of the demand being low which does not let the method take advantage of economies of scale.

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Appendices:

Appendix A:

Sustainable Housing Questionnaire

Dear Sir/Madam,

I am a student at the University of Greenwich and currently researching if prefabrication is the future of sustainable housing. Could you please spare the time to assist in my research by completing this questionnaire. This will enable me to gather vital information which would allow me to complete my dissertation report. A definition is given of prefabrication by The Oxford Dictionary: "manufacture sections of (a building or piece of furniture) to enable quick assembly on site"

Question 1:

Which is your job role ?

Please tick the appropriate box.

Client ☐ Contractor ☐ Sub-Contractor ☐ Surveyor ☐ Labourer ☐ Project Manager ☐ Other.....

Question 2:

How long have you been working in the construction industry?

Please tick the appropriate box.

0-4years ☐ 5-10years ☐ 11-20years ☐ 21-30years ☐ 31+years ☐

Question 3:

Have you used prefabrication before?

Please tick the appropriate box.

Yes ☐ No ☐ If Yes Please state which type (eg Kitchens, Structural Frame).....

Question 4:

Which barrier is limiting the demand for prefabrication in the UK with the biggest impact?

Please tick the appropriate boxes.

Cost ☐ Design and Appearance ☐

Negative Public View ☐ Quality ☐

Previous Experience ☐ Other.....

Question 5:

Which method offers a more sustainable approach considering all factors: economic, social and environmental?

Please tick the appropriate box.

Traditional Method (Off-Site) ☐ Prefabrication Method ☐

Question 6:

What do you consider to be the main benefits and drawbacks of prefabrication? Please tick the appropriate boxes.

	Benefits	Drawbacks		Benefits	Drawbacks
Sustainability	☐	☐	Cost	☐	☐
Time	☐	☐	Demand	☐	☐
Design Flexibility	☐	☐	Poor reputation of prefabrication	☐	☐
Quality	☐	☐			

Question 7:

Do you agree with the following statements: Please tick the appropriate box.

Prefabrication is the future of sustainable housing.

Strongly Agree ☐ Agree ☐ Neither Agree/Disagree ☐ Disagree ☐ Strongly Disagree ☐

Do you agree with the following statement: Over the past 10 years the UK construction industry has failed to meet its housing demand.

Strongly Agree ☐ Agree ☐ Neither Agree/Disagree ☐ Disagree ☐ Strongly Disagree ☐

Prefabrication is an excellent replacement for the traditional (on-site) building method?