The Effectiveness of using Modern Construction Methods as a Solution to Assist the Social Housing Shortage in the United Kingdom

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Abstract

The shortage of social housing is on the rise and there is an urgent need for houses in recent days to fulfil UK's need. There are many complications regarding this issue and some of them being is to save time and money and build good quality units. Year in and year out the UK can't seem to achieve their target to fulfil the large demand. The British method of building homes is the traditional method which is brick, block and cavity, which can be expensive and a lengthy process.

This research is on MMC (Modern Method of Construction) and how these modern methods can solve this ongoing problem. These modern methods can be Volumetric, Panelized, Hybrid and Site based system, these methods can be used as individuals or as a team. The author has used the factual documentation to prove that modern method of construction can have a great input in solving this problem.

The methodology which the author has used is the mixed method where he obtained the valuable data from secondary research, primary research, interviews, survey questionnaires and case studies. The author started with the secondary source where he reviewed journals, articles, books, reports and case studies and one he gained enough knowledge he moved on to obtain primary data which he found the most important and valuable data by interviewing professional from Housing Development (Senior Project Manager and CEO of the company). On the other hand, he also handed out a minimum of 50 survey questionnaires to the professional of housing construction industry containing participants from senior to a junior level including labourers as well, where mixed views were received mostly in the favour of the modern method of construction as some participants were not aware or heard of MMC. The author also included a comparison of construction methods, such as comparing British traditional method to Modular and Breeam.
Lastly, the author came to a conclusion upon all the facts and statistics he obtained from throughout his research, he also added the recommendations and the scope of further studies, as this study would prove to provide great benefits to the future researcher in the field study of Modern Method of Construction.

Keywords

UK, Modern Construction Method, Shortage, Social Housing.

1. Introduction

There are many construction methods which are used all over the world and all the construction methods are good and effective in their own way as every method have advantages and disadvantages. It all depends on where in the world the method be implemented and how it is going to happen as there can be many complications implementing that method, for example, British traditional methods which consist of brick, block and cavity to keep houses warm, would not work in hot African country as in the UK it rains a lot and temperature drops below 0 degrees every year. On the other hand, construction methods which are used outside the UK might not work in the UK simply because of different weather, environment and regulations. (Essienyn 2012). The most common method which is used in the UK is the traditional method of construction which is Brick, Block and block to build a house. According to Weatherby, In some cases, traditional methods can take up a long time to build and can be costly times to times, especially when there is the shortage of houses in the UK, we need a construction method or methods combined as one to find the solution for that problem. By the look of the current construction situation, MMC can be the answer to the problem. (Weatherby 2017).

1.1. Types of Modern Method of Construction and Effects

1.1.1. Volumetric Construction

Which is commonly known as modular construction method and it involves the off-site production of units which that can be assembled on site, the units can be ranging from basic light to heavy steel structures. The unit is produced under the quality-controlled structure to maintain the high standards. Volumetric construction is more cost-effective than traditional built on-site construction, also this method is faster to build. However, the units in this method can't be too large due to transport issues, which means that they cannot be more than 60-75 feet long and 14-16 feet wide. (Lander 2017)

Figure 1: Part of the house built off – site and then transported to the site to assemble. (Brandt 2017)

1.1.2. Panelised

This includes closed and open panel systems, closed involves factory insulation and it can be from concrete panels, timber or steel frame. However open panel system doesn't include lining boards, vapour control and insulation and is applied to the frame system on site. Panelised construction method reduces onsite labour, best value for the client – cost saving and materials, greater quality control, faster and more reliable building program, and environmentally friendly. Again, the panels can't be too large otherwise delivering and transporting issues can occur (Western 2017).

1.1.3. Hybrid

Manufactured off-site, this method mainly combines both methods volumetric and panelised approaches. Enhances health and safety measures also programme monitoring from initiation of design and works great on - site giving certainly of project delivery, better construction quality due to offsite manufacturing. It works best in hotels and student accommodation. (PCE 2017).

1.1.4. Site Based System

This method doesn't include an off-site method and in this category, all the structural elements take places such as all the structural work, which only can be done on site under the proper supervision and quality control. (Gaurantee 2015).

1.2. The Future Technology and Training

The sector needs to meet the future skills challenges, also making certain that the courses are appealing and are satisfying to the potential students and the recruits, through mandating that the latest 3D printing technologies and augmented and virtual reality tools are instituted into the industry training programmes and into "construction clubs" in schools. At this time, the data in infrequent on what skills are needed for the future, however, there is a large-scale sector-wide research by the commissioning which is working with the government bodies, for example, the ONS and CITB. Due to this, the construction industry will be able to fortify that its skills profile is adapting and improving to meet the actual need. Technology and Digital design techniques are becoming more globally obtainable and are vital that such revolution is vitalised and expended in. Prompt proceeds in computational design, and the capacity to fully utilise data is able to produce sustainable time to revolutionise how the industry is functioned. Engineers are developing suites of advanced digital design tools to revolutionise the way we design, plan and build. Technology allows to model and examines numerous design options quickly and economically; therefore real engineering and construction challenges are resolved. (Kenny 2017).

1.3. Modular Demand and Popularity

UK government is trying to fix up the unstable and broken housing market sector by offsite manufacturing techniques and tools which could be a catalyst for the greater beneficial change. Plan to increase the number of house build by offsite construction methods within the next three years 59% are in the favour of off-site construction method and 16% had no plans to do this. By the year 2020, 51% of the respondents are expecting their establishment to be developing between 1-30% of their total houses using the offsite construction method, on the other hand, 10% are expecting to deliver between 31-100% of their total houses use offsite construction method. (Housing 2017).

The Modular and Portable Building Association (MPBA) claim the popularity of modular buildings are dynamically in evidence for numerous zones in the United Kingdom Temporary or permanent modular buildings are proven to be chosen the most by many classes of sector requirements which end users are approaching rapidly, therefore their problem which is related to increase demand in their business or organisation. Quickly, they are becoming to be a very popular solution for sectors such as health and education. They are seeking to get better of the increasing demand on them, with also the requirements for hotels, offices and the new hype term residential. The popularity displays no signs of declining due to the increasing numbers of companies and the end users finding their interest themselves, temporary or modular buildings are now dynamically in evidence in a lot of applications all around the United Kingdom. Condemnatory nature of requirements is given for the buildings, which are seen to be both modern, efficient, functional and smart. In addition to this, they have assurance rate of delivery, they also come face to face with cost, therefore, it suits the budget; meeting all needs. Due to the fact, structures are constructed offsite to very highest specifications, they are also able to be instituted in the absence of creating disruption within every day to basis routines on customer's locations. The
Modular and Portable Building Association's (MPBA) Chief Executive Jackie Maginnis vocalises that "customers greatly appreciate the possibility of sourcing these cuttingedge facilities both quickly and cost-effectively." (Wood 2017)

1.4. The Sustainable Journey of Modern Method of Construction

Developing method of construction is considered to have achieved a higher standard across the construction industry, therefore delivering upgraded building performance. Supplementary to the higher living standard, on the

other hand, that will be something that can be a challenging task to evaluate. In another factor the advance methods and strategies applied elsewhere, if employed in the construction industry, it's not guaranteed to come out to be environment friendly as it might believe to be. This has been applied as the fundamental discussion to appraise refurbishment building with newly built buildings with highlighting the reference to the environmental performance. In this investigation, there is an off-site method of construction which offers customization against its stabilised counterpart in a moderate environment. In the comparison, the result will be guaranteed to be most realistic and effective. (Peroozfar 2012).

1.4.1. The Housing Cycle

The better the understanding of the full LCA (life cycle assessment) impacts of the housing sector in the UK, by focusing on the most common types of houses and the existing stock. The existing bulk housing is stock is traditional built, which brick block and the cavity is fairly old and energy inefficient, in resulting the environmental impact can be moderately significant. The most common houses in the UK are the terrace, semi-detached and detached and together they alone represent, 72% of the stock housing 18 million households, which includes terraced and semi-detached houses and these account for 28% left with the rest which is detached houses which is 16% in the residential sector. However, since the years moved on the number of houses have likely to increase. (Franca 2012). In the recent years, the construction industry has been pushed forward to increase its development of offsite knowledge in order to discourse the poor quality of building methods. Despite having access benefits to such modern technologies still the acceptance within the construction industry has been rather slow. The questionnaire survey of top house builder in the UK and chain of interviews were examined to disclose the level to which such technologies are being operated and the factor which interrupt their recognition. The current finding suggests that the present offsite modern method of construction usage in large house builder is still short, however that level is expected to go up, as applying the pressure to improve health and safety, productivity, cost, time and quality. (Gibb 2007)

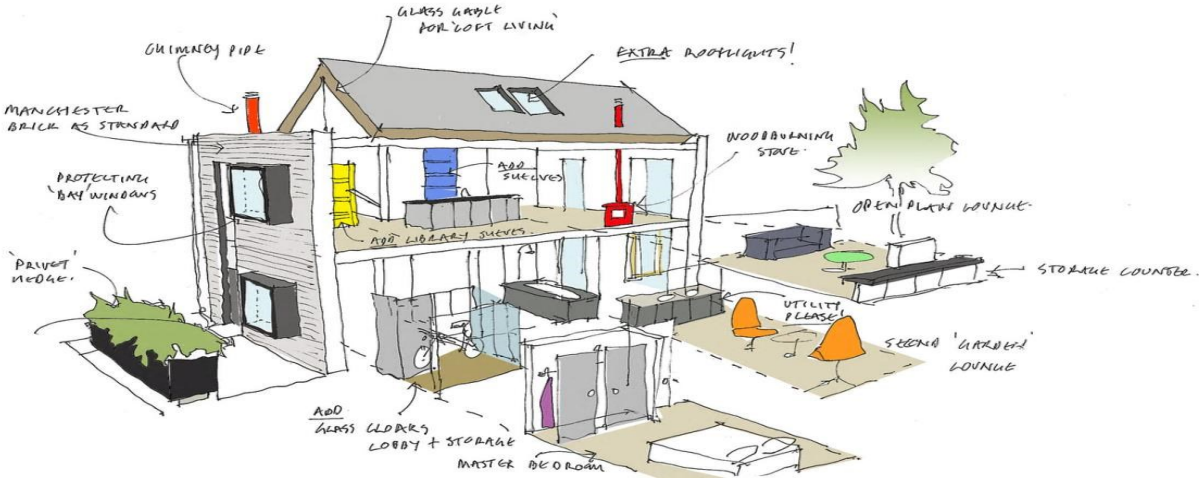

Figure 2 .Original theory drawing for factory build houses. (Gardiner 2017)

MMC has a lot of influence and its only aim of establishing a better perform environment whether it is the newly built, old built, refurbishment or demolishing. This will indicate and initiate the necessities performance, requirement and restrictions that are involved in making the final decision for a project. (Peroozfar 2012).There are numerous companies employing Modern Method of Construction willing to offer greener building options. Some of the firms will directly rely on sedum roofing or sustainable energy system, largely volumetric MMC. However, other firms will offer greater plus the range of sustainable materials in the fabric of the building itself.

2.Case study

The following figures explain the house building procedure, which is from excavations to fully finished. The purpose of this study is to compare this traditional method with the modern method to find out which method is most effective.

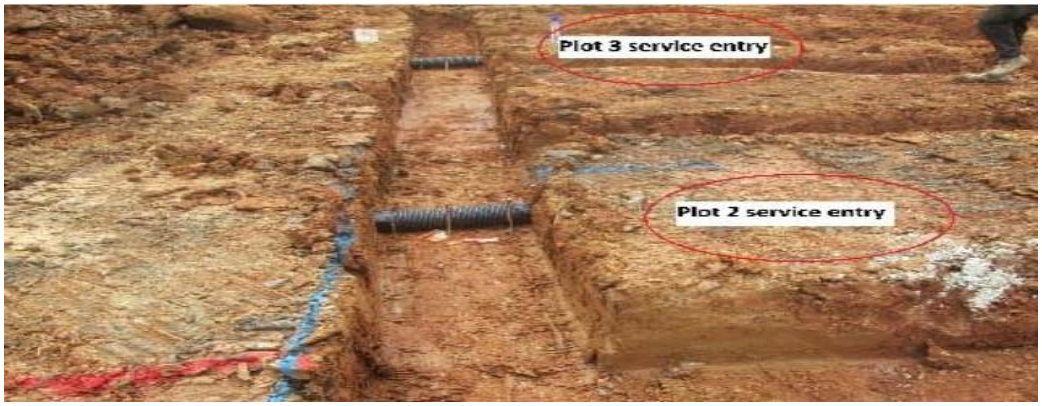

Figure 3. Foundations excavated to depth in clay, clean and dry ready for concreting. 150mm service entry ducts laid to front of property. Ducts pinned to prevent movement while concreting.

Figure 4. Cavities to fill before compaction of sub-base and sand blinding with membrane.

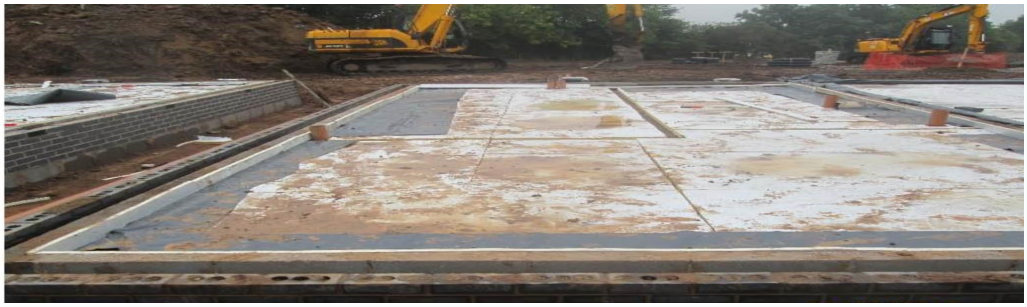

Figure 5. Engineering brick and block are in place, ready for the concrete block and beam to be placed on.

Figure 6. Concrete slab poured. DPM evident and lapping over internal block skin.

Figure 7. Brick and blockwork ongoing from ground to first floor level. Wall ties at reveals at each course and insulation appear satisfactory, maintain cavity
cleanliness.

Figure 8. Joists and boarding fixed. Boards appear glued adequately. Joists bearing on walls adequately.

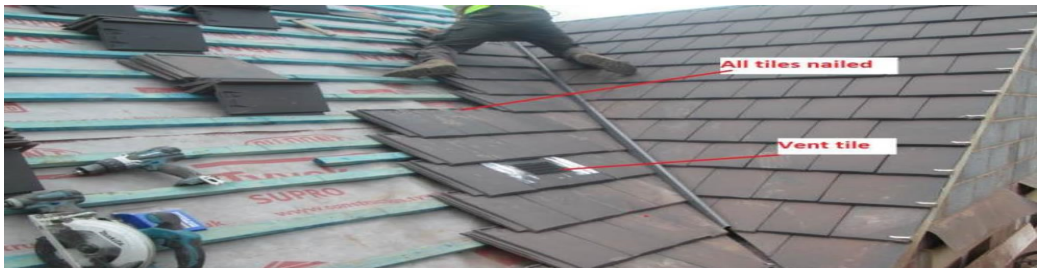

Figure 9. Roof tiling ongoing, noted all tiles being nailed, ridge vented, and VB lapped satisfactorily.

Figure 9. Insulation and wall plates straps are in place.

Eaves insulation and wall plate straps in place, acoustic insulation to be placed in bathroom area study room and insulation to be placed in SVP boxing in, and all window frames sealed from inside and fixing straps appear adequate.

Figure 10. The final stage as internal and external completed ready for snagging.
(The Surveyor)

All internals complete with final snagging and cleaning ongoing. Extract fans operating and with overrun, kitchen hood also checked and operating, all windows and doors fully sealed, kitchen flue however away from the wall and not sealed externally to be resolved. SVP's connected to the durgo valve within roof void and extract connected to air and ceiling void well insulated.

2.2. Research Strategy

This research strategy is a methodology that benefits the author to explore the research matters. (Saunders, 2003) narrates research strategy is a general proposal which benefited the researcher in providing the answers to questions which aren't clear in an organised way. This study contains clear aim and objectives, data collection, research/survey questionnaires, and various other limitations that can affect the research in various ways, for example, time restrictions, access limitations, money and location, ethical issues etc. an effective research strategy assisted the researcher to define that why the researcher engaging a specific research strategy to conduct the research studies in an operative style. The Research strategy is largely useful for the author to use a particular data collection procedure to support the argument. (Saunders 2003)

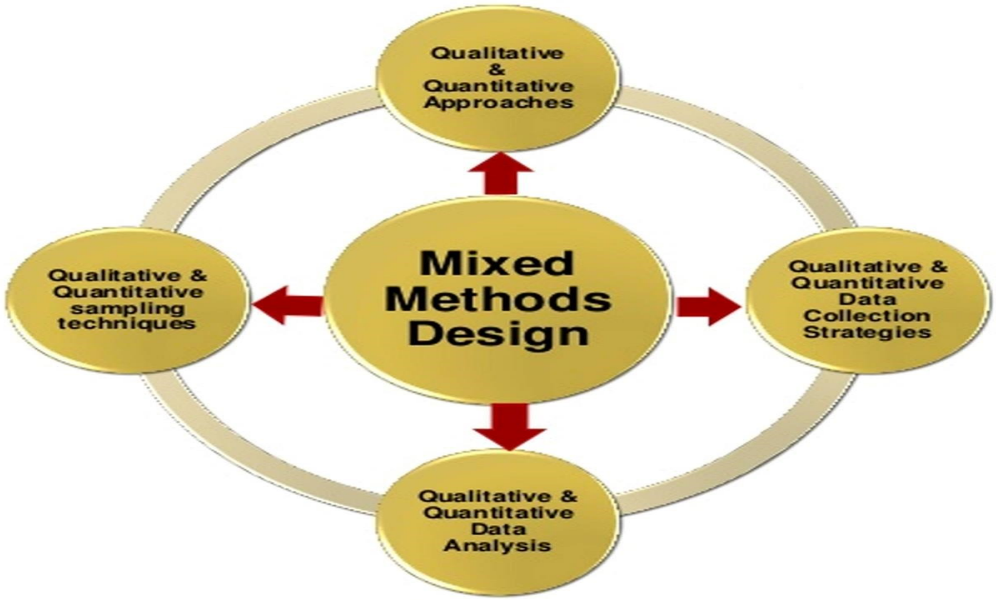

Figure 11. The researcher of this research has followed this mixed method design.(Adu 2015)

2.3. Secondary Data Collection

The secondary data is accumulated by a researcher. This comes from the theoretical aspects of MMC, on the various Modern Method of Construction books and journal articles for being able to understand the hypothetical tendency of MMC exercises in the development sectors. The UK sustainability practices culminate on how MMC is used in other countries, therefore a strong background of the study is found to evolve on. The methodological context is reviewed by the researcher, from the various research context, for example, books and documents. This is done to ensure the research is conducted in an appropriate manner, also to yield genuine rationality for the explanation of the use of methodologies for conducting the study. Effective information is found from many journal articles about the Modern Method of Construction for the houses to be built in an efficient and rapid manner, which is provided by the researcher. The representation of the journal articles data is seen to be crucial, due to the investigation to precariously evaluate MMC usage in the UK.

2.4. Primary Data Collection

When two types of techniques of survey strategy are used, for example, interview data collection techniques and questionnaire, the researcher assembles research based on primary data, therefore the complicated statement is supported. Interview questionnaire allows one to one contact with the participant, and the data technique is able to provide an abutment to receive to decisive information from senior project managers; the housing developer owners and surveyors. For the lack of housing shortage in the UK, quantitative techniques application is used due to the result of numerical data. Questionnaire data is collected by the researcher from diverse professionals which are related to the current construction industry, to discover about the housing shortage and ways in which a solution can be found to solve the issue.

Opinions are able to be analysed through interview surveys due to the one to one communication, on the senior engineers who work for many constructions within the UK. Opinions by experts through interview survey is very time-consuming for the researcher, which makes it an issue when conserving within the time limit of the study, however, the detection is very encouraging to put forward against the problem statement of the study. The positive affect if using primary data is that it is able to collect within the effective sampling procedure, therefore the targeted data outcome is maintained through the study.

3. Data Collection and Analysis

The interviews were conducted from senior project manager and the owner of the housing development company with the consent. Participants were asked directly about the influence of Modern Method of Construction as how such methods can have an impact on this current housing issue. The reason behind asking these questions to obtain the details from the participants as they huge amount of housing industry knowledge also they belong to a small successful housing development. The questions involved many parties such as, the people of UK themselves, the local authorities/government, the barriers/implications and the actual modern methods of construction. When the questions were asked the participants put forward a whole range of answers. The focal behind asking these questions is to understand the barriers stands between implementing MMC in the UK, also the participant were asked to address their views and vision on the solutions to these issues. Below are the interview comments:

Participant A (The Owner)

"The local authorities and governments should pass the new projects more quickly".

"The reason for the housing shortage in the UK is that we don't build enough houses in the UK as we should be building. The modular method of construction can be used as a solution to this housing crisis as this method is the quicker way to build, which saves time and money. However, as well as the UK construction industry is driving themselves forward to achieve their own set targets to reduce the number of housing shortage, the needs to play their role too, as they need to need to pass housing projects quicker through the local government, he also added there is too much red tape and more infrastructure funding should be allowed".

According to this interviewer, 150k units can solve this problem in the UK and if we do achieve this number the houses should be a good standard to live and affordable. At this moment in our construction industry the level of a modern method of construction in the UK is zero and which is not benefiting the problem it is only increasing this issue. The barrier and implication which lay behind implementing MMC in the UK housing construction industry is the local government as they have to pass the housing projects quicker and NIMBY which stands for Not In My

Back Yard. The people in the UK don't want to change the look of their houses because they are too traditional and don't like the change, as people are happy with the look of the current houses". (The Owner of the Housing Development 2017) .

Participant B (The Senior Project Manager)
"The actual modern construction methods that can benefit the social housing issue is having to be the carbon footprint".

"The main reasons behind the shortage of social housing in the UK are we have not built enough houses over the last 10 years especially affordable which has had an impact especially with the population growing on an annual basis. The actual modern construction methods that can benefit the social housing issue is having to be the carbon footprint, construction time and costs of, these methods would certainly benefit the social housing benefit. There is currently a shortage of 100,000 units a year in the UK so if this build could contribute to at least 20% this would help the numbers especially if more attention was given to social housing. Then we can achieve the number of units built using the modular method of construction, then we expect them to be high standard houses especially the interior of the house".

"The barrier and implication which lay behind implementing MMC in the UK housing construction industry is the way these houses are constructed has not been advertised very well so there is a lack of knowledge from most housing developers at the moment who predominately build of traditional masonry construction. The main reason why people don't want to change the look of their houses is simply that, we believe most people in the UK like houses to be built of a traditional construction method, so any form of change always raises concerns". (The Senior Project Manager 2017)

Cross Case Analysis

After carefully revising the participant's views and vising and comments. First of all it is very difficult to change the mind of people of UK on the building method and the appearance of the houses, as they have lived in traditional houses all their live, also the shape of the houses is symbol of heritage of Britain, and UK don't build enough houses on the first place. Even though MMC methods are economical, sustainable and faster method to building but still UK would not be able to achieve their set target, however the modular method can have some effluence on this issue. But the local Authorities and the government have to pass the housing project quickly and lastly more infrastructure money should be allowed.

Table 1. Peculiarity on housing issue and common terms.

Peculiarity	**Common Terms**
People Don't want the change	Mind set
Local Authorities and Government	Pass the housing projects quickly
Modular method	Economical and quicker
UK don't build enough	The funding

Survey Questionnaire

The survey questionnaire added a lot of first-hand knowledge into this research, as 50 professional took part in this incredible survey. The professional involved in this survey were from labourers to construction / project managers and once again the researcher only introduced 8 well-written questionnaires in this survey.

The survey questionnaire is a multiple choice with the options of Agree, Strongly Agree, Neutral, Disagree, Strongly Disagree and an option for comment if the participant feels like to add extra information to the research.

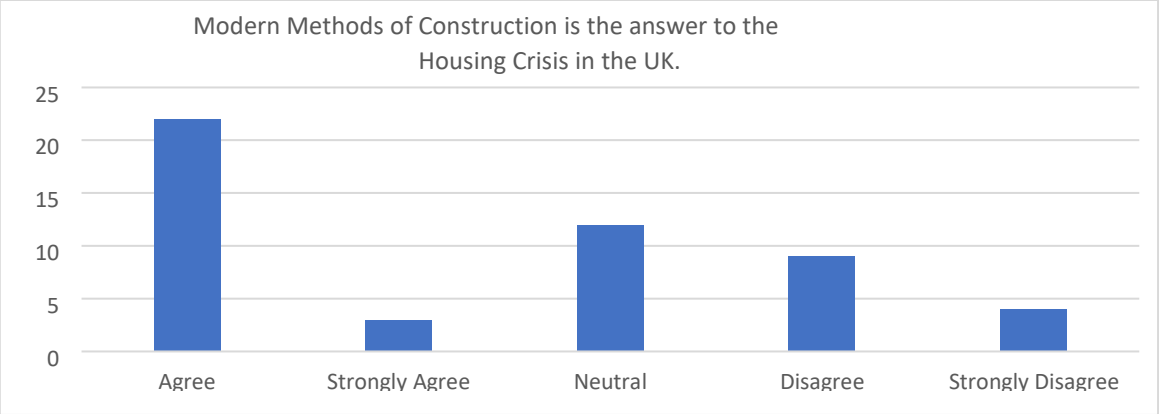

Figure 12. MMC is the answer to the housing crisis in the UK.

Comments: Modern method of Construction is more flexible compare to the other traditional methods and several audiences does believe that MMC is the right answer to this horizon issue.

Table 2. MMC is the answer to the housing crisis in the UK.

Response	Participant	Percentage
Agree	22	44%
Strongly Agree	3	6%
Neutral	12	24%
Disagree	9	18%
Strongly Disagree	4	8%

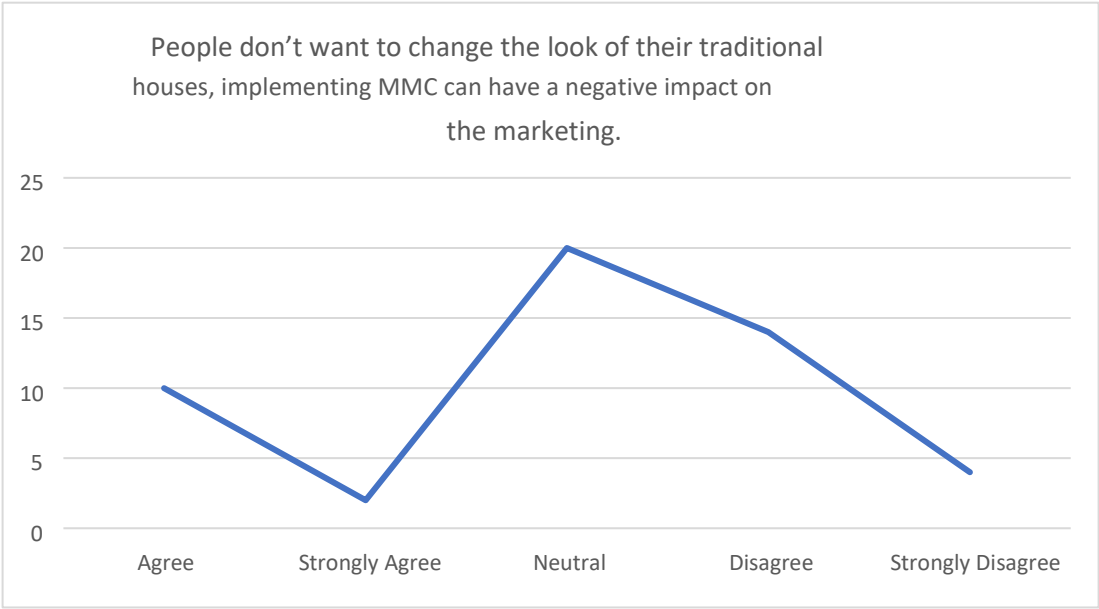

Figure 13. Implementing MMC can have a negative impact on the marketing.

Comments: People of United Kingdom have been living in the tradition build houses all their lives they are happy with the look of their houses. However, people do have to move with the time and have a faith in the new methods which will benefit them.

Table 3. Implementing MMC can have a negative impact on the marketing.

Response	Participant	Percentage
Agree	10	20%
Strongly Agree	2	4%
Neutral	20	40%
Disagree	14	28%
Strongly Disagree	4	8%

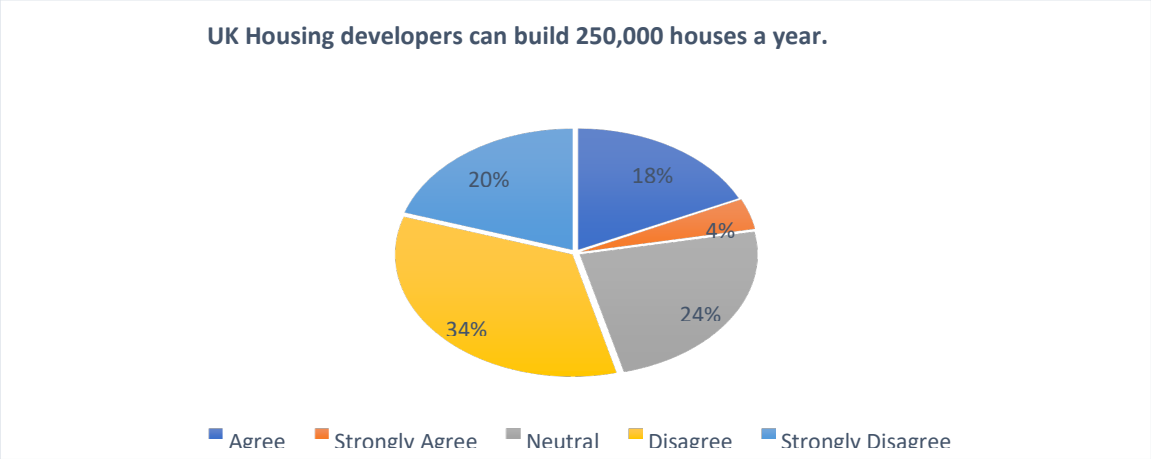

Figure 14. UK developers can build 250,000 houses a year.

Comments: The numbers units are too high to be achieved, although an extra input and effort must be put in to achieve this target.

Table 4. UK developers can build 250,000 houses a year.

Response	Participants	Percentage
Agree	9	18%
Strongly Agree	2	4%
Neutral	12	24%
Disagree	17	34%
Strongly Disagree	10	20%

UK Government and Local Authorities should invest in Modern Methods of Construction imported from outside UK to achieve their targets.
UK should import MMC methods from outside of the country.
Comments: The UK government and local authorities should invest in mother method of construction imported from outside, such as a Chinese MMC as one of their construction firms erected a 57- storey building in just 19 days in central China. (Guardian 2015).

Table 5. UK should import MMC methods from outside of the country.

Response	Participant	Percentage
Agree	14	28%
Strongly Agree	5	10%
Neutral	13	26%
Disagree	13	26%
Strongly Disagree	5	10%

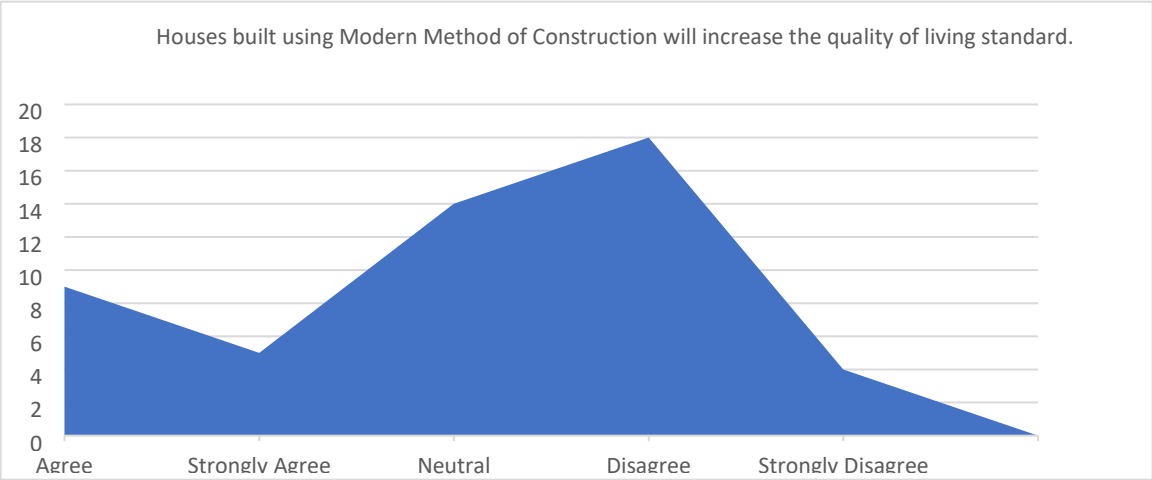

Figure 15. Houses build using MMC can increase quality and living standards.

Comments: It would not directly change the living standard, however, the money that was in the building process with using MMC can be spent on other consumer's needs.

Table 6. Houses build using MMC can increase quality and living standards.

Response	Participant	Percentage
Agree	9	18%
Strongly Agree	5	10%
Neutral	14	28%
Disagree	18	36%
Strongly Disagree	4	8%

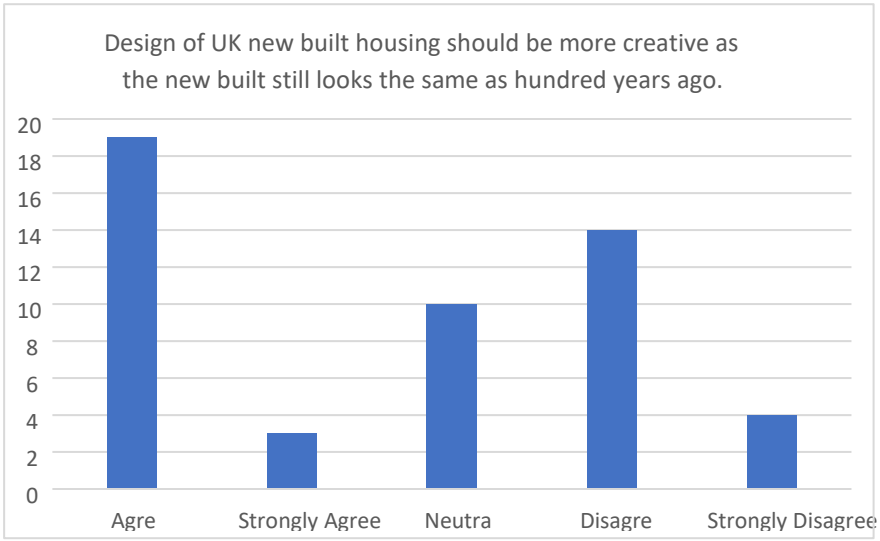

Figure 16. Designs of UK new built houses should be more creative.

Comments: Some People are in the favour of yes, they would like to see the change in the Design, on the other hand, people like the way their houses look, especially the terrace houses, simple because of the British Culture. 22 people out of 50 which is 44% agree with the houses should be more creative, however, 16 people out of 50 with is 36% disagree, because they are in the favour of the great British Heritage, and the remaining 20% answered neutrally.

Table 7. Designs of UK new built houses should be more creative.

Response	Participant	Percentage
Agree	19	38%
Strongly Agree	3	6%
Neutral	10	20%
Disagree	14	28%
Strongly Disagree	4	8%

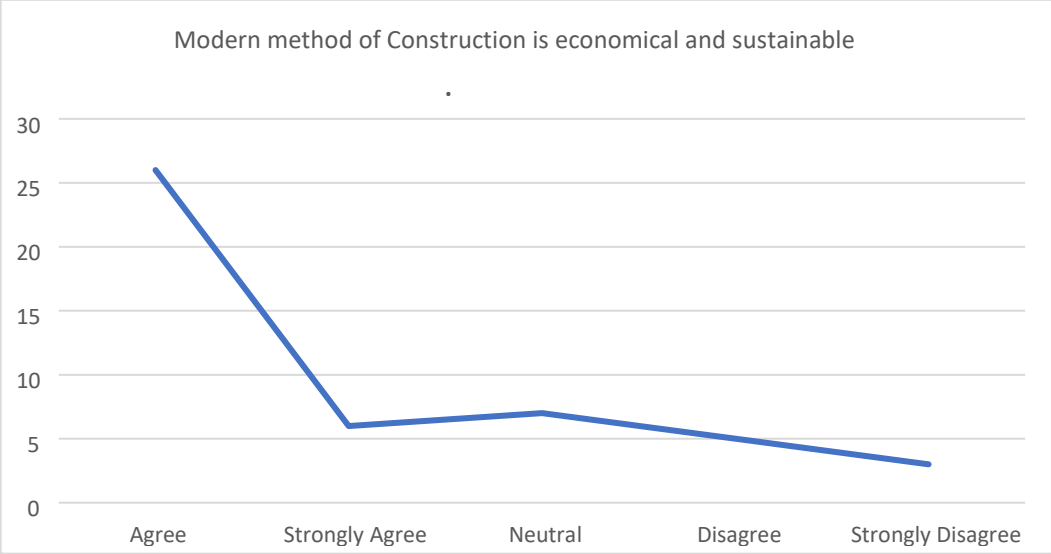

Figure 17. MMC is economical and sustainable

Table 8. MMC is economical and sustainable

Response	Participant	Percentage
Agree	26	52%
Strongly Agree	9	18%
Neutral	7	14%
Disagree	5	10%
Strongly Disagree	3	6%

MMC can be used as a solution to build houses more quickly and efficiently.
Comments: There is huge possibility MMC is the solution to the housing shortage and all the statistic are in the favour of the modern method of construction too.

Table 9. MMC can be used as a solution to build houses more quickly and efficiently

Response	Participant	Percentage
Agree	26	52%
Strongly Agree	9	18%
Neutral	5	10%
Disagree	8	16%
Strongly Disagree	2	4%

Reliability of Quantitative Data

a.Case Processing Summary

Table 10. Case Processing Summary

Cases		N	%
	Valid	50	100.0
	Excluded	0	.0
	Total	50	100.0

Listwise deletion based on all variables in the procedure.

b. Reliability Statistics

Table 11. Reliability Statistic

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.960	.960	8

c. Item Statistics

Table 12. Item Statistics

	Mean	Std. Deviation	N
VAR00001	3.0000	1.32480	50
VAR00004	2.4000	1.30931	50
VAR00005	2.3800	1.24360	50
VAR00006	2.8600	1.35541	50
VAR00007	2.7400	1.32187	50
VAR00008	3.0200	1.23701	50
VAR00009	3.5400	1.26507	50
VAR00010	3.6400	1.13856	50

d. Inter-Item Correlation Matrix

Table 13. Inter-Item Correlation Matrix

	VAR00001	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010
VAR00001	1.000	.824	.805	.875	.851	.884	.731	.676
VAR00004	.824	1.000	.933	.826	.887	.789	.446	.400
VAR00005	.805	.933	1.000	.843	.893	.817	.503	.459
VAR00006	.875	.826	.843	1.000	.856	.866	.664	.615
VAR00007	.851	.887	.893	.856	1.000	.839	.659	.615
VAR00008	.884	.789	.817	.866	.839	1.000	.762	.701
VAR00009	.731	.446	.503	.664	.659	.762	1.000	.974
VAR00010	.676	.400	.459	.615	.615	.701	.974	1.000

e. Item-Total Statistics

Table 14. Item-Total Statistics

Scale Mean if Item Deleted		Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
VAR00001	20.5800	60.820	.920	.871	.950
VAR00004	21.1800	62.763	.825	.918	.956
VAR00005	21.2000	63.184	.853	.903	.955
VAR00006	20.7200	60.696	.903	.838	.952
VAR00007	20.8400	60.994	.913	.887	.951
VAR00008	20.5600	62.088	.922	.872	.951
VAR00009	20.0400	64.815	.745	.966	.961
VAR00010	19.9400	67.241	.699	.953	.963

f. Scale Statistics

Table 15. Scale Statistics

Mean	Variance	Std. Deviation	N of Items
23.5800	81.596	9.03302	8

4. Conclusions

Modern Method of Constructions is still fairly a new method and this method only started getting used only a few years ago to minimize cost and time and to help the environment. The researcher will highlight all the important aspects in this chapter, also run through a recap to freshen up the reader's memory again. This chapter has a lot of importance whole as it plays the backbone of this research, as this is the moment of truth and waits to see how accurate were the hypothesis, discuss all the noteworthy topics and recommendations and further research and further work. The project title is on MMC (Modern method of construction), which involves new construction methods that can save a vast amount of time and speeds up the process. (Hiremath 2017) This research will highlight how MMC can play its part to get the UK out of the social housing crisis. MMC can be in a form of a volumetric, panelised, hybrid or site-based construction. One of the issues which Britain has been facing for many years until this present day, which is the shortage of social housing in the UK. From past number of years this problem has not been solved, as the target set for every year has not seemed to be attainable. In the UK the usage of MMC is very little compare to the other countries, such as China where 57-storey building can be constructed in just little as 19 days (Guardion 2015). But the question is by obtaining this method can the UK solve this problem.

Reintroduction to the Methodology

In this research, the researcher is in favour of the mixed method as he includes qualitative and quantitative research methods. Within this mixed method, it also includes experiments, survey research, participant observation, and secondary data. Quantitative methods aim to classify features, by counting them and creating a statistical model to test hypotheses and to explain observations from gathering all the information. One the hand, qualitative methods are seen to be the opposite as the aim is for a complete, detailed description of observations and interviews, for example, the context of events and circumstances within the research method.

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