

HND: Quantity Surveying

Work Based Project

University of Wales Trinity Saint David



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Work Based Project: An investigation into how the construction methods of Zone 4 Old College Project can be implemented and achieved in comparison to the design.

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03/05/2023

Word Count: 5337

This study has been completed as part of the HND in Quantity Surveying at the University of Wales Trinity Saint David. This work is my own and where the work of others has been used or drawn upon to gain knowledge in this field of research it is referenced accordingly.

Abstract

It is well known within the construction industry that the design team often design sections of the building which can be very unrealistic/difficult for the Contractor to implement on-site. With this in mind there'll be an investigation carried out as to whether Zone 4 of the project is possible to build within the giving timeframe as detailed by the Principal Designer. The aim is to analyse the intended design, the advantages and disadvantages of different systems as well as the skilled labour available in the surrounding areas to carry out the work.

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List of Abbreviations

1. CIOB – Chartered Institute of Building
2. RIBA – Royal Institute of British Architects
3. RICS – Royal Institute of Chartered Surveyors
4. NBS – National Building Specification

Research Context

The Site in question is based on the promenade of Aberystwyth and the project is called 'New Life for Old College' which is being refurbished by a Contractor under guidance from CADW for the University of Aberystwyth for the value of thirty million pounds. As this site is a Grade 1 & 2 Listed Building the literature will also look to provide an understanding of what these are and how it can limit the construction techniques used on the project and what approval processes the Main Contractor and Design Team will need to comply with prior to carrying out these works.

The primary research will aim to gather an understanding from those working in the industry and further working on this project. The primary research also aims to analyse the particular trades where skilled labour resource is particularly difficult to acquire on the project.

Research Questions

Naoum (2019) suggests that it is important to breakdown my aim into sub aims and/or objectives, so it is possible to establish certain issues while achieving the overall aim. These objectives will then later provide subsequent questions to be researched during the primary research section of the dissertation.

Aim

The aim is to investigate how the construction process is implemented, constructed and achieved in comparison to the original intended design at RIBA Stage 4.

Objectives

The intended approach for researching these aims and objectives will largely be carried out via empirical research as research will be collected from construction individuals working on a listed building refurbishment project, thus, gaining valuable and direct experiences and knowledge. There will also be the use of doctrinal research methodology when discussing listed buildings, the consents surrounding this and the laws and regulations for such buildings.

Objective 1: Analyse & compare the intended design with the As-Built information post completion

The purpose of this objective is to analyse the intended design prior to the construction process, submit any relevant Technical Queries and/or Request for Information to query the design and potentially change the process. After that, we'll provide a summary of the intended design and further evaluate the process once we've received the As-Built information from the designers post

completion of the project. Furthermore, the analysis will confirm whether the changes in design increased the overall cost of the project.

Objective 2: Analyse and compare the available construction work methods

The purpose of this objective will be to discuss the methods of construction work available in comparison to what has been detailed on the intended design to see which approach is best suited to the scope of works.

Objective 3: Ease of acquiring skilled labour in the surrounding area to carry out specialist works

The purpose of this objective is to provide a study of how difficult it proved to find skilled labour to carry out such specialist works such as stonemasonry, timber window refurbishment and slate roofing to name a few. This will largely be down to the scale of the project as well as the complexity and location (Aberystwyth, Mid Wales). I'll provide statistical data of our findings and where these trades travelled from.

Research Methods

Whilst working on this project, primary knowledge will be gathered as well as aiming to interview numerous people who have various roles and responsibilities across the project. There'll also be monthly progress meetings as well as weekly internal meetings held with the project team to continually be discussing the works throughout the construction phase. The use of relevant conservation sources to help enhance knowledge on this topic and reference findings accordingly will be utilised throughout. The aim when interviewing members of the project will be to ask concise questions that will be useful to the research in this field, and also ask the same questions to the various different people that will be interviewed to ensure that the data can be analysed to produce a report.

Significance of Research

The significance of the research into this topic will be important to the Main Contractor working on this project and the wider construction industry as it will demonstrate how much change is incorporated from the initial Architectural Design to how the main contractor will actually construct the build of the project. In addition, it'll be explored into whether this will incur additional costs over and above the original contract value due to design changes. However, on this particular contract it will not affect the contractor due to it being a Prime Cost Contract and so they'll be reimbursed for all costs incurred. This information will still be beneficial to us because it can demonstrate whether a contingency within the contract sum for design development should've been included, and if so, what value should be included in relation to the size and complexity of the project. Furthermore, the research will provide an opportunity to give a greater context into the Listed Building conditions and the work required to these complex buildings.

Literature Review

Intended Design & As built design

What is Intended Design?

When refurbishing listed buildings, the appointed conservation consultants often have clear visions of how they would like the building work to be constructed and they'll produce a design to up to RIBA Stage 5 to reflect this which refers to the manufacturing and construction due to it being a procurement route. This is where the contractor will then take the design forward to subcontractors to confirm the buildability on such a complex project. Typically, when the client has opted for a traditional procurement route in lieu of a design & build route it is to ensure they maintain control of the design changes. However, when working with listed buildings there can be many unpredicted aspects to the building that wouldn't have been discovered until the contractor uncovers them at the time.

What is As-built design?

The as-built design drawings are a reflection of what has been constructed on-site during RIBA Stage 5 which is carried out by the main contractor on-site. When working on a listed project there can be many design changes from the original construction drawings because of some of the unknown factors that lay within the building. Another factor is because of the ease of access to deliver materials to specific areas within a building as CADW or Historic England will not allow contractors just to take out a window or dismantle something should it be listed.

Literature review

As explained above there can be numerous changes between the intended design throughout the construction stage which can mean the as-built design looks very different. Literature will be reviewed to determine this.

According to the CIOB (2019), changes in construction projects can be determined by three categories: scope changes, design changes, and schedule changes. Scope changes relate to alterations in the project's objectives and goals, design changes refer to changes made to the project's plans and specifications, and schedule changes involve modifications in the project's timeline. In the UK, design changes account for a significant proportion of construction project costs, resulting in additional time and expenses. Moreover, throughout listed building projects, there are significant construction items such as timber wood floors, slate roof construction methods where there may be undetermined underlying issues such as asbestos used for insulation.

RICS (2018) also notes that design changes are a common occurrence in construction projects. The main reasons for design changes include changes in site conditions, client requirements, design errors, and changes in regulations. RICS further explains that design errors account for a substantial percentage of changes between the intended design and the as-built design. RICS recommends that design errors can be minimized through effective project management practices and the use of Building Information Modelling (BIM).

RIBA (2018) emphasises the importance of communication and collaboration among stakeholders in the construction process to minimize changes between the intended design and the as-built design. RIBA recommends that architects should engage with contractors, clients, and other stakeholders throughout the construction process to ensure that design changes are made with the appropriate knowledge and consent. RIBA also suggests that the use of BIM can enhance collaboration and coordination among stakeholders and improve the accuracy of the as-built design.

To summarise Changes between the intended design and the as-built design are common in the UK construction industry and can result in additional costs and delays. Design changes are a significant factor contributing to changes in the as-built design. CIOB, RICS, and RIBA highlight the importance

of effective project management practices, collaboration among stakeholders, and the use of BIM to minimize design errors and improve the accuracy of the as-built design. By implementing these recommendations, construction professionals can reduce the impact of design changes on construction projects.

Construction Work Methods

Listed buildings are a significant part of the UK's cultural heritage and require careful consideration during construction work. Various construction work methods can be used to carry out repairs, renovations, and maintenance on listed buildings. This literature review aims to evaluate the advantages and disadvantages of different construction work methods using UK information on listed buildings.

Traditional Building Techniques

Traditional building techniques are a popular choice for listed building repairs and renovations due to their historic authenticity. According to the Historic England (2016), traditional building techniques use natural materials such as lime and timber, which are compatible with the building's original construction materials. Traditional techniques also rely on skilled craftsmanship, resulting in high-quality workmanship. However, the use of traditional techniques can be time-consuming and costly, requiring skilled workers with specialised knowledge.

Modern Construction Techniques

Modern construction techniques, such as pre-fabrication, can be used in listed building repairs and renovations to improve efficiency and reduce costs. Pre-fabrication involves the assembly of building components off-site before being transported to the construction site for installation. This method can reduce on-site construction time and minimize disruption to the listed building's surroundings. However, pre-fabrication may not be suitable for all listed building projects due to the need for careful consideration of the building's historic fabric and the use of modern materials, which may not be compatible with the original construction materials where the use of lime plastering/rendering is necessary etc.

Conservation-Based Approaches

Conservation based approaches involve the use of construction work methods that prioritize the preservation of the building's historic fabric. According to the Royal Institution of Chartered Surveyors (RICS, 2021), conservation-based approaches involve careful analysis of the building's significance, followed by the selection of appropriate repair and maintenance methods. This approach requires specialised knowledge of historic building materials and techniques and may involve more time and expense than other construction work methods.

Summary

Different construction work methods can be used in listed building repairs and renovations, each with their own advantages and disadvantages. Traditional building techniques provide historic authenticity and high-quality workmanship but can be time-consuming and costly. Modern construction techniques can improve efficiency and reduce costs but may not be suitable for all listed building projects. Conservation-based approaches prioritise the preservation of the building's historic fabric but require specialised knowledge and may involve more time and expense. By carefully evaluating the advantages and disadvantages of different construction work methods, construction professionals can select the most appropriate method for each listed building project.

Skilled Labour

There are many specific work packages that require skilled labour resources to be acquired for trades such as stonemasonry, slate, lead and asphalt roofing, timber refurbishment to name a few.

Currently, there are many concerns with the amount of skilled workers that are within the construction industry. This has been highlighted by the NBS (2017) that suggest it is the second biggest issue within the construction industry at this time. Furthermore, The NBS (2017) state that between 2013 & 2023 “19% of the UK Construction workforce is set to retire.” This means that beyond 2023 there is a major problem in finding UK workers to carry out skilled tasks meaning there could be a massive impact on the quality of workmanship within the industry. This causes greater concern for organisations such as CADW and Historic England because of such high standards that they usually expect when refurbishing listed buildings throughout Wales & England. The construction industry has been facing a persistent problem of labour shortages, which is having a detrimental impact on site progress and the regeneration of listed buildings. The shortage of skilled labour in the construction industry is a growing concern that is likely to persist in the coming years. This essay will discuss the causes and effects of the labour shortage in the construction industry and how it is affecting the regeneration of listed buildings.

This is further enforced by the Royal Institution of Chartered Surveyors (RICS), who suggest the lack of apprenticeships and training programs has led to a shortage of skilled workers in the industry (RICS, 2020). The aging workforce is also a contributing factor, as many skilled workers are reaching retirement age and leaving the industry. The COVID-19 pandemic has also played a role in the labour shortage, as many foreign workers have returned to their home countries due to travel restrictions and safety concerns. The shortage of labour in the construction industry has several effects, including the impact on site progress and the regeneration of listed buildings. The shortage of skilled workers can slow down the construction process, resulting in project delays and increased costs. This can have a significant impact on site progress, as delays can cause a knock-on effect on other projects, resulting in further delays and increased costs. The shortage of labour can also lead to health and safety risks, as inexperienced workers may be tasked with carrying out tasks that they are not qualified for, which can pose a risk to themselves and others. The regeneration of listed buildings is another area that is being affected by the labour shortage in the construction industry. Listed buildings are an important part of our cultural heritage and require skilled workers to carry out restoration work. The shortage of skilled labour in the construction industry can make it difficult to find skilled workers to carry out restoration work on listed buildings. This can result in delays to the restoration work and can lead to the deterioration of the building, which can be costly to repair.

To summarise, due to the labour shortages that are now being experienced in the construction industry this could cause great difficulties for all parties associated with the refurbishment of listed building projects. In addition, it is resulting in project delays/extensions & increased costs to find skilled workers to carry out restoration work on listed buildings. To address this, investment in training and apprenticeships is essential to ensure an increased supply of skilled workers in the future. It is to be determined whether this is further supported by the primary data gathered on the project.

Research Methodology

Scope of the chapter

This chapter will provide an explanation of the methodology behind the collection of data to address the aims and objectives within this study. At the same time, the benefits and limitations to the data collected will be highlighted and explained.

Primary Research

What is primary research? This is when a specific type of research approach such as an interview or questionnaire is completed by the researcher in the required field to gather qualitative and quantitative data. This is used to prove or disprove the hypothesis while also addressing the research question, aims and objectives (Naoum, 2019).

Secondary Research

To provide greater knowledge in the field of study and limit knowledge gaps, secondary research on existing data such as government documentation and information from reputable organisations such as CADW has been conducted. This allows for a descriptive, analytical and critical literature review.

Qualitative Data

Qualitative data is used as a way of understanding the individual's perception of the research area. This is supported by Naoum (2019) who suggests that qualitative data typically will draw upon a person's experience and is attitudinal and exploratory. Attitudinal research is when a person's view or opinion is evaluated whereas exploratory research involves the need for a defined statement.

Quantitative data

Whereas, Quantitative data is based on testing the hypothesis or opinion with numerical data and statistics that are in turn analysed with statistical procedures in order to prove or disprove the hypothesis (Creswell, 2018).

Research Strategy and method

This study will primarily contain primary research with a measured mix between quantitative and qualitative data dependant on the aim and objective that is being researched. It will assess the opinions of construction professionals working within the industry and the specific project of study in terms of the conservation of buildings. The primary research will be gathered using a questionnaire approach to gain accurate data without having to spend lengthy periods of time on other techniques such as one-to-one interviews. By opting for a questionnaire approach, it allows the professionals with time to analyse their answers prior to submitting and also privacy while doing so which should ensure that honest and accurate data is received.

Structured Interviews

Naoum (2019) implies that a structured interviewing format typically has a larger response rate than the other two types of interview formats being unstructured interviews and semi-structured interviews as it drifts more towards the quantitative research approach. It is also often thought that using the structured interview is the least flexible option as this does not allow further questions to gain a greater depth of information.

Closed Questions

“Closed questions often require a short response in the form of Yes or No, Agree or Disagree, Important or Not important, and so on. Closed-ended questions are easy to ask and quick to answer, they require no writing by either respondent or interviewer, and their analysis is straightforward (Naoum, 2019, p. 86)”

Open Questions

“Open questions seek to encourage the respondent to provide free responses (Naoum, 2019, p. 85)”. Naoum (2019) also suggests that an open question method gives the interviewee the opportunity to provide a more detailed opinion/answer to the question that has been asked by the interviewer. This can prove very beneficial, as it provided the interviewer with potentially more valuable information which they would never receive using a closed question method.

Unstructured Interviews

Naoum (2019) confirms that an unstructured interview will involve the open ended question method with the order of the questions being based upon the interviewee’s answer. While this could potentially be a beneficial way of collecting valuable information from experienced persons within their designated field, it proves difficult for the interviewer to analyse the information they’ve been given.

Semi-structured Interviews

The semi-structured interviewing process consists of numerous questions over several different issues relating to the topic in question with the availability to ask both open ended and closed questions throughout the process depending on the need to delve deeper into a specific area should it be deemed necessary. Naoum (2019) suggests that the semi-structured interviews allows for flexibility to ask for more detail should the original answer be unclear from the interviewee, demonstrating that there is freedom within the interview.

Chosen Interview Method

With reference to the above paragraphs, I have evaluated all of the methods available and the primary research will be conducted using a semi-structured approach as it provides the greatest opportunity to gather valuable information from experienced persons in the construction industry which will be vital to the success of the topic area.

Analysis & Results

Scope of the Chapter

Within this chapter, it will analyse and present the data collected as a result of the interviewing process that was described in the previous chapter. It will summarise the qualitative data gathered, highlighting patterns in answers and differences in responses should there be any.

Interviewees

All Interviewees were asked to identify their job titles prior to starting the semi-structured interviewing process along with the amount of experience they had within the industry. This resulted in all having between 20-30 year’s experience in the industry. This means that knowledgeable in-depth and accurate information could be obtained throughout the process.

Interviewee 1 – Senior Project Manager

Interviewee 2 – Senior Quantity Surveyor

Interviewee 3 – Senior Associate (RIBA)

All of the above interviewees listed are currently working on the project in question at Old College, Aberystwyth and have been chosen from various sides of the project including the Principal Designer, Main Contractors Commercial Department & Main Contractors Operations Department.

Intended Design & As-built design comparison

The first question that was asked to the interviewee's was which area of scope they expected the greatest number of changes to occur from. The responses can be found in the table below:

Interviewee:	Response:
Interviewee 1	I would expect that on this particular project due to its complex nature and it being a grade 1/2 listed building the majority of the changes will be due to unforeseen items and thus will sit between scope changes and design changes.
Interviewee 2	Yes, I'd certainly expect there to be hundreds if not thousands of design & scope changes throughout the duration of the project as we've seen already throughout the enabling works that there are many items of work that are not picked up within the Bill of Quantities.
Interviewee 3	From my perspective, we surveyed the building over two years ago and there's been ongoing deterioration to the building since and throughout the design & tendering process meaning there'll be many design and scope changes that will need to be detailed for the first time or re-detailed after the main contractor has carried out the exploratory works.

As you can see from the above responses, all parties believe that there will be numerous design & scope changes throughout the re-development of the listed building due to the ongoing deterioration of the building as the contractor has progressed through the procurement process. These responses reinforce the literature explained by numerous sources in the previous sections of the project which explain that a large percentage of extensions of time/delays to projects and additional costs occur due to changes in the scope of works.

The next question that was tabled to the interviewee's was whether they thought the intended design would change throughout the construction phase resulting in potentially unrecognisable as-built designs post completion. The responses are detailed below:

Interviewee:	Response:
Interviewee 1	Yes, I agree with this statement and similar to the previous response the complexity of the project will play a major part in the changes that need to be made.

Interviewee 2	I agree, certainly as we currently have not received listed building consent conditions for 95% of the project works and there could be numerous comments from CADW that will result in design changes.
Interviewee 3	On a typical design & build project you wouldn't expect to see many changes between the intended & as-built, only client requests but as with the nature of this project we have an allowance to be detailing right the way through the construction stage as the contractor completes and arrives at different sections of work. We'll also rely on numerous specialists such as King Post Piling subcontractors and under pinners to provide technical designs.

Again, the above responses truly reinforce the expectation that the as built designs would've changed drastically post-completion in comparison to the intended designs.

Construction Work Methods

The first question that was asked in relation to the aforementioned subject was whether the interviewees thought the construction work methods described within the intended design would change now the Main Contractor has been appointed, the responses are included within the below table:

Interviewee:	Response:
Interviewee 1	Having reviewed the construction drawings there are many items of work that we need to carry out throughout the duration of the project which have been detailed by the design team but no thought has gone into how we are going to construct/refurbish what has been detailed. As a result, I would expect us to request to alter certain materials in order for us to be able to access/egress te areas with the required materials. There are certain steels 'I' Beams which are 6-8 metres in length and are meant to be going into the centre of the listed building. I'd expect that we are going to request to splice these beams to get them into the required area as CADW will not allow us to take out windows/doors and increase opening sizes that aren't being touched in the first instance.
Interviewee 2	After already having meetings/discussions with our operations team and various

	subcontractors we are looking to appoint to carry out packages of work there's lots of detailed work that is part of the contractor's design portion (CDP) which will look very different to the intended designs once the subcontractor has completed their as-built information.
Interviewee 3	I wouldn't expect the construction work methods to change to what has already been designed as this is a traditional contractual approach. Therefore, if any changes are to be made to what has been detailed the main contractor will need to request this.

As you can see from the above responses there are differing opinions between the interviewee from the design team as opposed to the interviewees from the Main Contractors side. It is clear to see that the experience that interviewees 1 & 2 have on different types of construction work methods is showing through and can understand that certain scopes that have been detailed aren't possible due to the complexity of the project. Furthermore, they can understand that more respect and consideration need to be treated to the project and the design team need to detail certain sections catered closely to a conservation-based approach or even a traditional approach in comparison to a more modern work methodology.

The final question that was asked on this subject was which construction method each interviewee consider is the best approach for this project moving forward. The responses are found in the table below:

Interviewee:	Response:
Interviewee 1	I believe that the best approach would be to combine a conservation-based with traditional work methods where necessary but provide a modern look to the building in office areas etc by using glazed screen partitions and the like whilst also 'showing off' the characteristics of the existing building. Balance is key!
Interviewee 2	In my experience of being on these types of projects we must promote the conservation-based approach wherever possible.
Interviewee 3	Following discussions with the local council and CADW we must adopt the conservation approach due to the conditions on the building but I am trying to encourage modern methods as much as possible.

From the responses that have been received, it provides valuable insight into how each person on the same project thinks and believes we can carry out the different methods of work. As the project

progresses, you'd expect people to adopt a similar opinion and method of working once other obstacles are discovered and discussions can be had.

Skilled Labour

The first question that was tabled to the interviewee's regarding skilled labour was if they believe there is a shortage of skilled labour in the construction industry. The responses can be found in the table below:

Interviewee:	Response:
Interviewee 1	Yes, I believe there is a massive shortage of skilled workers in the industry and witness this first hand when trying to source labour to carry out works on the projects I am managing. I believe we'll have increased difficulty in sourcing labour for this project too.
Interviewee 2	Of course, we have a massive issue in construction as we have ageing workforces, me included! There are many people in the industry who have valuable experience and we need to encourage the future generations to join the industry to gain this knowledge of their elders/mentors.
Interviewee 3	Whilst I don't experience this directly, every project I design has some form of labour shortage for skilled workers.

These responses all reinforce the literature reviewed by the NBS, RICS etc that there is a massive skilled labour shortage throughout the United Kingdom. It is expected that it will be difficult to source labour in Aberystwyth due to its remote location as explained by interviewee 1. As explained by interviewee 2 we must encourage younger persons to gain the industry through funding schemes and any further investment to bridge the gap for this shortage.

Conclusion of objectives

Objective 1: Analyse & compare the intended design with the As-Built information post completion

This objective hasn't been fully executed due to the project still ongoing and the as-built information is yet to be produced. However, the literature that has been reviewed all suggests that the intended design information would've changed considerably when the as-built information is complete. This is further supported by the interviewee's responses who all believe this will be the case too.

Objective 2: Analyse and compare the available construction work methods

This objective has been fully executed and I have reviewed literature which has discussed the 3 different types of work methods to help understand whether the methods detailed will change once the Main Contractor is onboard due to the complexity of the project. It has been confirmed in the interviewing process that both interviewees from the main contractor believe that there are materials/methods that haven't been considered and will need to change following discussions with all parties.

Objective 3: Ease of acquiring skilled labour in the surrounding area to carry out specialist works

This objective has not been executed fully due to the limitation of the project not starting yet. Therefore, I have not been able to obtain statistical data to support where the labour on the project has been traveling from and whether we are sourcing labour locally. However, the literature reviewed supports the fact that there is a skilled labour shortage throughout the United Kingdom and the interviewees believe that due to the remote location of this project, it will be difficult to source labour. This could result in delays to the project works and extensions of time being submitted.

Reflective journal

Personally, this exercise/project has taught me numerous skills which I will take with me in the future, such as conducting interviews on the topic to discuss their views on the matter and this has developed my personable skills greater while talking in a professional manner with very experienced members of the construction industry. In addition, this process has taught me how to have an idea, develop this idea and execute it to the best of my ability.

Through my research for this project, I have managed to analyse data and generate answers to my original aims and objectives. Although, my research has been created through minimal interviewees although very experienced professionals within the construction industry from various backgrounds. Therefore, some people may feel that due to the small-scale results it produces less accurate research when compared with structured interviews with closed questions that would provide a much greater amount of results for analysis. This could result in a limitation to my research and the data provided. It is important to take this into account when reviewing my results. The further limitation on this project has been due to the Old College, Aberystwyth scheme not starting as of yet due to various different issues, however, this was unforeseen at the time I chose this topic. Carrying out this study has strengthened by ambition and I'm looking forward to starting the project in June 2023 and provided greater knowledge and understanding to the aims and objectives detailed.

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