DECISION-MAKING IN FAÇADE SELECTION FOR MULTI-STOREY BUILDINGS

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The design and construction of multi-storey buildings faces a multitude of demands such as aesthetics, cost, energy efficiency, and occupier comfort; with façades on both new and re-used buildings playing a key role in helping to meet these demands. The process of façade selection is aided by a plethora of decision-making tools, yet façade decisions are often largely guided by cost and aesthetics. Poorly specified façades can potentially expose developers, owners and occupiers of multi-storey buildings to risks such as poor thermal comfort, glare, and increased operational costs. The aim of this paper is to explore the current state of façade decision-making, with the objectives of discovering who is making the decisions and when, and what problems are perceived and what potential solutions might exist. Literature pertaining to façades, multi-storey buildings and façade decision-making is reviewed. Experience of façade decision-making in today's construction industry in the UK is collected via semi-structured interviews with construction professionals. The findings show architects as leading the initial façade decisions, with clients and planners making the final decisions. Very few decision-making tools were revealed as being used: namely whole life cost analysis, life cycle cost analysis and simulation. Further research is proposed to define the roles participating in façade decision-making for multi-storey buildings.

Keywords: building façade, decision-making, multi-storey building.

INTRODUCTION

This paper presents the initial findings of an exploratory study, conducted at the start of a larger research project that aims to provide decision support to the construction industry in the selection of façades for multi-storey buildings. The building façade is an outward facing component that has developed from being essentially protective, i.e. to shelter man from the elements, to playing also a key role in the architectural expression of buildings (Schittich 2006). In current building practice, façade selection appears to be largely driven by cost considerations and building aesthetics (Høseggen *et al.* 2008; Săparauskas *et al.* 2011). However, given the many demands on buildings, this approach can expose businesses and building occupants to risk. Buildings have to meet increasingly stringent requirements in terms of reducing carbon emissions, enabling high comfort and productivity of occupants, while also providing good return on investment; these requirements exist throughout the new and re-used life of a

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building. Meeting these requirements together is a complex task. People spend around 90% of their time indoors (BRE 2011) engaged in varying activities and in varying locales, meaning that buildings need to respond dynamically to changes in occupation and environmental load (Wigginton and Harris 2002). While façades exist on all buildings, this paper focuses only on multi-storey buildings, for which the term 'multi-storey' is used to denote any building containing two or more storeys above ground level. The focus on multi-storey buildings, as opposed to single storey buildings, is because of their increasing prominence due to the global trend towards urbanisation (Wang *et al.* 2012; Tang and Yiu 2010). Façade decision-making involves multiple participants, including: "client, design team, main contractor, specialist sub-contractors, and manufacturers" (Du and Ledbetter 2006: 1). Reaching a consensus in multidisciplinary teams can be very difficult (Šaparauskas *et al.* 2011), yet literature relating to façade decision-making appears to pertain more to building simulation (Høseggen *et al.* 2008; Stec *et al.* 2005) or multi-criteria analysis (Šaparauskas *et al.* 2011), as opposed to investigating the human element. Where it does focus on participants in decision-making in design and construction, much of its focus is on the architect (Emmitt and Heaton 2003; Luck and McDonnell 2005). This paper aims to help address this gap in the knowledge by providing an insight into façade decision-making in today's construction industry. The objectives of this paper are to:

1. Establish who makes façade decisions for multi-storey buildings, and when;
2. Identify the problems perceived with façade decision-making;
3. Explore the potential solutions to the problems in façade decision-making.

BUILDING FAÇADES

The façade is an outward facing building component that has developed from being essentially protective, i.e. to shelter man from the elements, to playing also a key role in the architectural expression of buildings (Schittich 2006). It is further defined by BS6100-1:2004 (BSI 2004: 33) as being the exterior surface of a wall enclosing a building, which is usually non-loadbearing, and which can include a curtain wall, cladding or some other exterior finish. Façades often have protective or insulating cladding attached to them, with the cladding sector accounting for a substantial proportion of UK external wall construction (Doran and Anderson 2011: 1).

Buildings have to meet increasingly stringent requirements in terms of reducing carbon emissions, enabling high comfort and productivity of occupants, while also providing a good return on investment. Du and Ledbetter (2006: 1) succinctly describe the part that façades can play in helping to meet these requirements, showing clearly the multi-factorial contribution that just one element must make in helping to meet the overall demands placed on a building (Figure 1). These demands differ according to world view of an observer. From an occupiers view point, warmth and air quality are highly important (Humphreys 2005), as is user control (Stevens 2001). When architects, designers and builders consider the needs of building users at an early stage, it can lead to improved comfort, energy efficiency, and health and safety in buildings (Săparauskas *et al.* 2011). However, certain aspects of building performance can sometimes be reprioritised in the face of other drivers. The building client wants a good return on investment; therefore, as the façade can account for up to 25% (Layzell and Ledbetter 1998: 351) and sometimes even up to 40% of a total building’s cost (Hall, 1997, in Wigginton and Harris 2002: 5), façade selection can often result in being cost-driven (Høseggen *et al.* 2008; Rosenfeld and Shohet 1999).

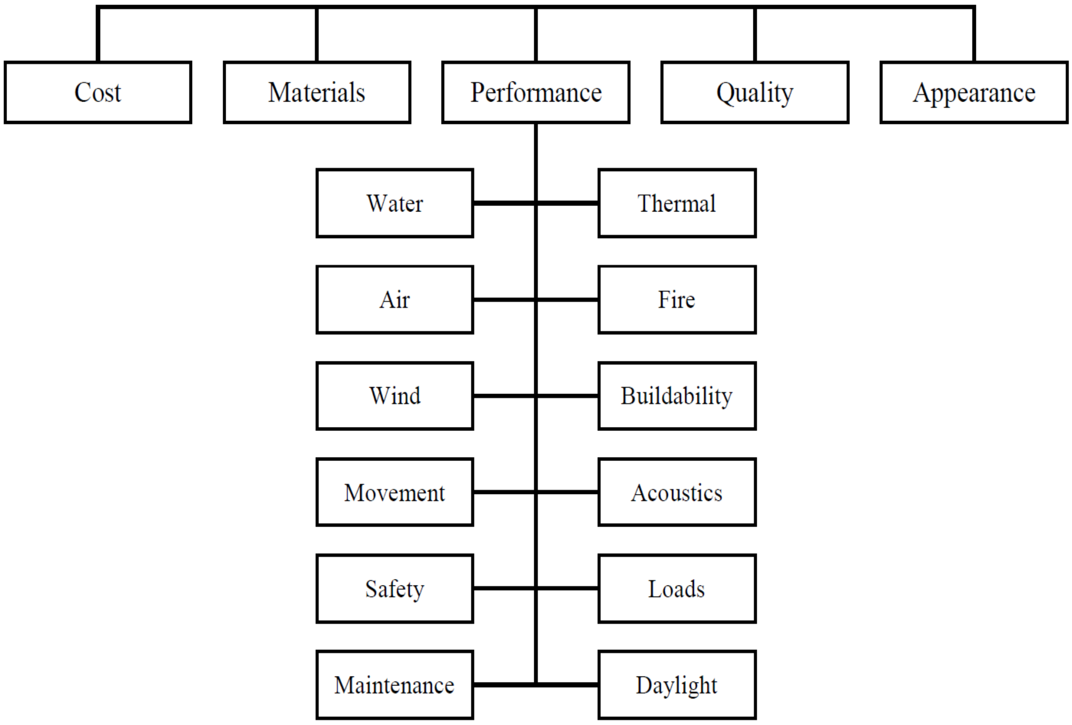

Figure 1: The ingredients of cladding design (reproduced from Du and Ledbetter 2006: 1)

FAÇADES ON MULTI-STOREY BUILDINGS

Multi-storey buildings are required to meet certain statutory drivers, such as building regulations, of which many also apply to single-storey buildings. However, due to the potential height of multi-storey buildings, these statutory drivers often contain stricter elements solely for use on multi-storey buildings. For example, a proposed new dwelling building that is over 18m in height and located in England and Wales, may need to supplement the fire safety requirements of 'Approved Document (AD) B - Volume 1 - Dwellinghouses', with some of the guidance contained in 'AD B - Volume 2 - Buildings other than dwellinghouses'. Volume 2 states that "in a building with a storey 18m or more above ground level any insulation product, filler material (not including gaskets, sealants and similar) etc. used in the external wall construction should be of limited combustibility" (HM Government 2006: 94). The use of limited combustibility material is required "because of the increased risks associated with external flame spread on buildings of this size" and thus cladding must pass the testing criteria in British Standard 8414 in order to demonstrate compliance with AD B (Baker 2012). This requirement applies to façades on both new and re-used buildings, the latter of which is felt to be an under researched area, despite being a significant proportion of the European building stock (Zavadskas *et al.* 2008). Multi-storey buildings comprise thirteen per cent, and over one-third, of the existing building stock, in the old EU member states, and in the new Central and Eastern European member states, respectively; the majority of which has poor structural and thermal quality (Zavadskas *et al.* 2008). Furthermore, as “it is estimated that by 2050 two thirds of the UK’s housing stock will be made up of dwellings built before 2006” (Business Link 2011), the refurbishment of existing high-rise (EST 2006) residential buildings is seen as a necessary part of improving the energy efficiency of the UK housing stock.

BUILDING FAÇADE DECISION-MAKING

Numerous methods exist that can aid façade decision-making. These include multi-criteria analysis (Šaparauskas *et al.* 2011); building simulation (Høseggen *et al.* 2008; Stec *et al.* 2005); life cycle analysis (Radhi 2010); and bespoke façade selection software (Chartered Institution of Building Services Engineers (CIBSE) Façade Selector (CIBSE 2004); Environmental façade design tool (Robinson-Gayle and Tanno 2004)). Despite using such tools, decisions are shown in the literature as sometimes being 'disadvantageously' over-turned by human intervention in the final stage. This is demonstrated in Høseggen *et al.* (2008) where the most environmental façade option (derived using building energy simulation ESR-r) was not selected on grounds of cost; and in Rosenfeld and Shohet (1999: 510) when after conducting a building refurbishment exercise (using semi-automated selection), it was declared that "if the budget is really tight, the decision-makers may decide consciously to choose alternative #2, which requires the lowest initial investment despite its short life (5 years), poor service, high equivalent annual cost, and high uncertainty". Reaching a consensus in a multidisciplinary team is known to be very difficult (Šaparauskas *et al.* 2011). Where the literature focuses on the participants involved in decision-making in design and construction (as opposed to the decision-making aids) much of the research appears to focus on the architect, e.g. Emmitt and Heaton (2003) conducted an observational review of specifiers in the face of a new edition of Part L; while Luck and McDonnell (2005) investigated architect and user interactions. Research into the interaction that occurs between all participants involved in façade selection appears to be minimal, with perhaps the exception of Du and Ledbetter's (2006) research into decision-making in the cladding supply chain.

METHODOLOGY

In order to produce robust results that are of benefit to the construction industry, this exploratory study is being used to discover the state of façade decision-making in today's construction industry in the UK (Davis 2006). The exploratory study uses semi-structured interviews, containing ten questions in two parts; the first part (questions 1-4) asks about the interviewees' role in construction, while the second part (questions 5-10) asks about the interviewees' experiences in façade decision-making. To determine when façade decisions are being made, one question asks at what stage of The Royal Institute of British Architects (RIBA) Outline Plan of Work the interviewees generally observed decisions as being made. The Outline Plan of Work is comprised of the following stages: A - Appraisal; B - Design Brief; C - Concept; D - Design Development; E - Technical Design; F - Product Information; G - Tender Documentation; H - Tender Action; J - Mobilisation; K - Construction to Practical Completion; and L - Post Practical Completion (RIBA 2009). Despite the varied construction roles being interviewed, the RIBA Outline Plan of Work was used, as it is "the most widely used model of building design" (Austin *et al.* 1999: 281).

Semi-structured interviews were adopted for the exploratory study, as it was deemed important to know the interviewees' opinions, as they could reveal aspects of the decision-making process that might benefit from further study (Bryman 2012). A semi-structured approach, also allowed the necessary "latitude to ask further questions in response to what are seen as significant replies" (Bryman 2012: 212). The interviews were mainly conducted face-to-face, but were also carried out as telephone interviews when this was more convenient for the interviewee. The interviews were recorded when permitted by the interviewee, or extensive notes taken, if recording was not permitted. All of the interview recordings were transcribed. The interview sample group was created with the purpose of capturing the opinions of construction professionals, who were deemed commonly involved in construction and thus, highly likely to be exposed to the intricacies of façade selection. The term 'construction professional' was used to denote that the interviewee was in receipt of some form of membership with one or more construction professional body, e.g. Chartered Institute of Building, Royal Institution of Chartered Surveyors. The construction professionals were categorised to ensure that all expected key areas concerning façade decision-making were captured. BS6100-1:2004 (BSI 2004: 74-75), which describes the persons involved in construction projects (user, operative, client, contractor, manufacturer, supplier, specifier, and consultant) was used to guide the interviewee categorization for this study. Further guidance was taken from Du and Ledbetter (2006: 1) who describe the participants in the cladding supply chain: "client, design team, main contractor, specialist sub-contractors, and manufacturers". The interviewees for this exploratory study are therefore grouped into six categories: client; design team; consultant; contractor; building control; and façade specialist and supplier. The method used to obtain the interviewees reflects purposive sampling (Robson 2011), as specific individuals were contacted and invited to participate in the study. The method also reflects an element of convenience, as some interviewees were already available to the researcher, while some further interviewees were proposed by interviewees taking part in the study. Convenience sampling is however, an acceptable method of sampling, when "getting a feeling for the issues involved" is the chief aim of the exploratory study (Robson 2011: 275), and this study's learnings should be of a suitable nature to guide the main study methodology for the larger study in question.

The semi-structured interviews, which were used to aid discovery in this exploratory study, resulted in a qualitative data set (Davis 2006), which was analysed by coding to a thematic framework. These findings were combined with the literature review to produce a rich picture of façade decision-making. The data set size is a limitation of this study. While theoretical saturation is stated in research methodology literature as being difficult to define (Bryman 2012; Robson 2011) it is however, unlikely that this sample group (itself split into six separate smaller groups) has reached saturation. Further exploratory work is proposed, ideally to the point that no new information is being added to the data set (Robson 2011), though as each building project is likely to be unique, the difficulty of this goal is recognised. A second limitation relates to the observations as to when façade decision-making occurs within the RIBA Outline Plan of Work. These observations are based on the interviewees' general building experience (so are not for specific buildings) and, therefore, while they can be considered as indicative, they cannot be used to draw definite conclusions as to the points at which decision-making might occur in a project. Future work could involve recording façade decisions for specific buildings throughout the project life. Despite its limitations, this study's findings are valid in their own right as they provide an insight into façade decision-making in today's construction industry, and thus, will aid in the generation of theory for the larger study in question (Davis 2006).

RESULTS AND DISCUSSION

Interviewee sample group information

Thirteen semi-structured interviews were conducted with personnel involved in façade selection, which were categorised by the following roles: client (2), design team (2), consultant (4), building control (1), contractor (2), and façade specialist and supplier

(2). Ten interviews were conducted face-to-face, while three were conducted by telephone. Eleven interviewees met this paper's definition of a 'construction professional'. The two interviewees within the 'façade specialist and supplier' category, which did not possess membership to a construction professional body, were however retained in this study's main data set, due to their clear role in the cladding supply chain (Du and Ledbetter 2006). The interviewees' experience related to buildings in the UK. The interviewees' general experience according to building type, height in metres (m) and number (no.) of storeys, is shown in Table 1.

Table 1: Interview sample group experience: building type, height and number of storeys

Role	Position	Building type	Height (m)	Storeys (no.)
Client	Head of Estates Operations	C	≤ 30	4-8
Client	Energy and Environmental Manager	C	≤ 30	4-8
Design team	Chartered Architect	R	5-8	2-3
Design team	Senior Architectural Technologist	R&C	≤ 100	≤ 23
Consultant	Learning and Development Manager / Project Manager	C	≥ 28	≥ 8
Consultant	Chairman - Europe, Middle East and Africa	C	75-100	≤ 26
Consultant	Project Manager	R	≤ 48	2-20
Consultant	Regional Director	R&C	9-12	3-4
Building control	Principal Building Control Surveyor	R&C	≤ 18	2-4
Contractor	Director	R	12	4
Contractor	Senior Project Manager	R&C	≤ 72	3-24
Façade specialist and supplier	Senior Sales Executive	R&C	4.8	2
Façade specialist and supplier	Director of Business Development	R&C	7-70	3-18

Building type: R = residential; C = commercial (e.g. denoting one or more of the following: education, office, retail, health, stadia, hotels); R&C = residential and commercial.

How the façade decisions are being made and the influential roles

When asked about how the decision-making was carried out, the interviewees made little mention of decision-making tools. Two interviewees: client (1), and façade specialist and supplier (1), mentioned whole life cost analysis, while one consultant mentioned life-cycle cost analysis in relation to the decisions made by owner-occupiers. Another consultant mentioned simulation software in relation to assessing façade designs with the purpose of trying to influence the client to increase the level of insulation. A few of the interviewees felt that the construction industry is changing and that the days when the architect was at the top are long gone. For some, the change was perceived to be a good thing, while for others, the reduction in project structure and in the quality of materials is considered to be a non-beneficial result of new methods of procurement, i.e. design and build. Despite comments about the changing industry, the interviewees still generally considered that architects were responsible for the initial façade decisions (reflecting the tendency for design and construction research to focus on the architect). Some interviewees (consultants, and façade specialists and suppliers) felt that they had no direct involvement in the façade decision-making, but tried to influence decisions where possible. The contractors try to make façade decisions at a later stage (post-tender), if possible, for the purpose of achieving cost and time reductions in the overall build. The client and the planning officer are seen as having the most say in façade decision-making, with the planning officer appearing to play a very 'commanding role', in which the interviewees opinion differed. Most of the interviewees expressed frustration at the time scales involved in the planning process, while two interviewees' responses were clearly divergent. One interviewee perceived that planners lack experience and knowledge in key areas such as material longevity, yet have inordinate power to block façade proposals made by experienced architects. Conversely, the other interviewee felt that planners should not act any differently to how they already do, as it was perceived to be correct that they work to preserve the integrity of a geographical area. The number of different roles participating in façade decision-making, in just this small sample alone, suggests that the 'traditional' project roles described in BS6100-1:2004 (BSI 2004: 74-75) should be amended to enable it to better reflect the complexity of today's construction industry.

When the façade decisions are being made

To investigate when façade decisions are generally being made, the interview sample group were asked to state, at which stages in the RIBA Outline Plan of Work, they had observed façade decisions taking place. These observations reflect the interviewees' general building experience and therefore, are only indicative in nature. Eleven interviewees responded with a total of 29 observations (Figure 2).

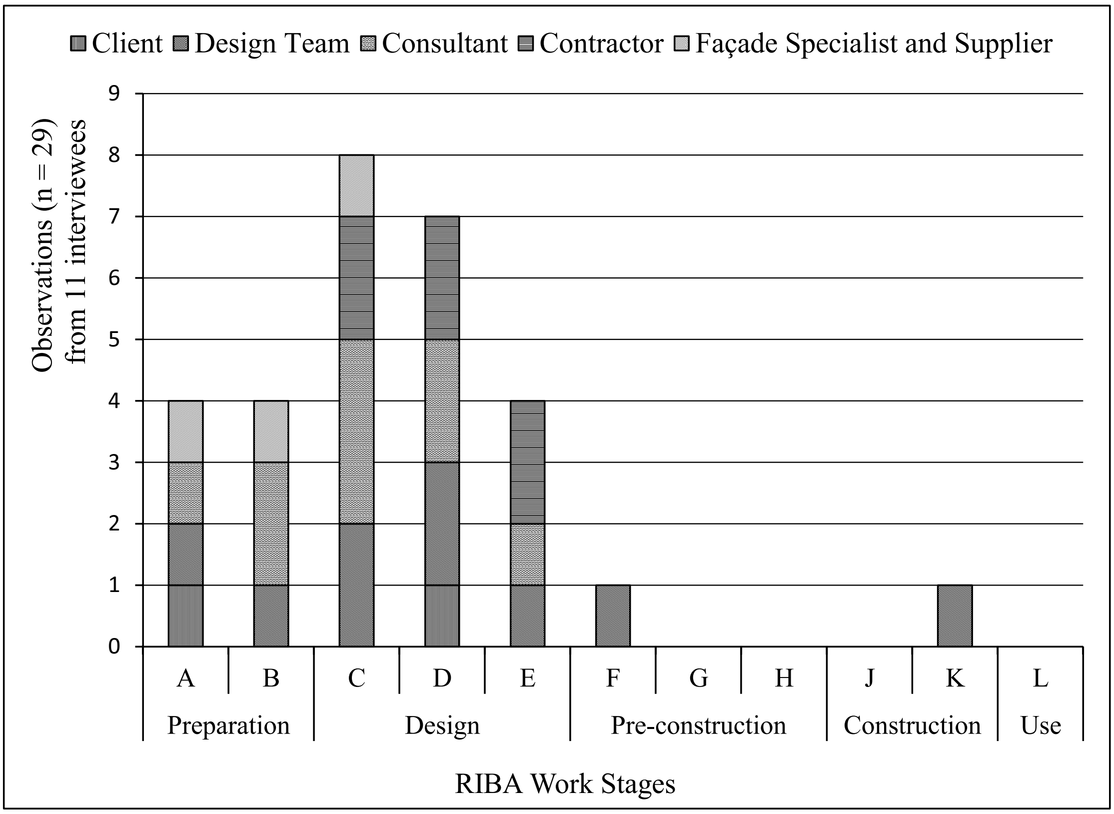

Figure 2: RIBA Work Stages in which façade decisions were observed

Two interviewees: building control (1), and façade specialist and supplier (1), were in roles that did not result in observing the RIBA Outline Plan of Work, and the fact that only 2 interviewees do not have exposure could be said to reinforce that it is "the most widely used model of building design" (Austin *et al.* 1999: 281). The results show that the majority of the observed façade decision-making occurs during the Preparation

(Stages A-B) and Design (Stages C-E) stages of a project. The design team and consultants observed decision-making at multiple stages, while the clients made unconnected observations, with one observing them in Stage A and one in Stage D. The façade specialist and supplier observed decision-making in the early project stage, reflecting their admission that they aim to influence decisions at an early stage to aid project success. The contractor observations slightly overlap the façade specialist and supplier, while their subsequent decisions hint at post-tender value engineering.

Problems perceived in the façade decision-making and suggested solutions

The problems that the interviewees perceived as occurring in façade decision-making are shown together with their suggested solutions, in Table 2 (listed alphabetically in order of 'Problem Theme'). Cost is a key factor in making good decisions, but not simply the total cost of procuring the façade. Other important cost factors include: paying adequate fees at an early stage in the design process to ensure that the right decision is made by the right people; and analysing the expected payback in terms of energy saving, but accepting that it might not 'win' the business case, in the face of less tangible gains, e.g. occupier satisfaction, maintaining the company brand. Collaborative working appears to be another way in which the perceived problems in façade decision-making can be improved. This collaboration can be among many roles and in varying combinations: architect and planner; lead architect with colleagues from the design team; client and consultant; or indeed, a whole project team of construction professionals collaborating at a project workshop dedicated to the façade.

Table 2: Problems perceived in the façade decision-making and suggested solutions

Problem Theme	Perceived Problems	Suggested Solutions
Business case	Justifying the re-cladding of buildings; short-term view when making façade decisions	The driver is not always cost; benefits can come from other areas, such as managing the company brand, attracting customers and retaining staff; use whole life cost analysis
Energy Efficiency	The client needs the building as energy efficient as possible; increasingly stringent standards	A business case for refurbishment may see aesthetics as secondary to performance (though some architects may not think this way); evolution - embrace the changes
Fees	Making the wrong decision; having to value engineer at a later stage to reduce costs	Paying fees up-front so that the client gets the right advice and the right decision; paying for a full consultant team at the start, so that a quantity surveyor is involved from the outset
Planners	Façade material rejected for not being local enough; planning approval delayed due to other complications; planners lacking knowledge in material durability; planners lacking an understanding of the architects' design intent	Get the planner on-board early in the design stage; produce options; produce a mock-up of the façade for the planner to review; increase the number of project design workshops purely devoted to façades; create a project checklist of façade design issues; take time to consider the options; no one system will fit all projects; better training
Quality	Façade system must be well built; design and build procurement allows flexibility for the contractor to cut corners; material faults; led by aesthetics rather than function; installation standards; buildability; maintenance in-use	25-year guarantee; collaboration to make a proper informed decision; pay for a full design team up-front so that full details are already produced when the job goes to tender; increase the number of project design workshops purely devoted to façades; Clerk of Works' role important to installation quality; craftsmanship - need to go back to grassroots
Specialist advice	Lack of choice in the façade specialists available	The specialists mentioned were all deemed of excellent quality, but where a job is small, may only provide off-the-shelf options

CONCLUSION

This paper has sought the opinions of different participants in the façade selection process, to explore and discover the current state of façade decision-making in today's construction industry in the UK. It has focused on façades on multi-storey buildings, due to the increasing prominence of multi-storey buildings as a result of the global trend towards urbanisation. The decision-making observations against the RIBA Outline Plan of Work indicate that certain participants might tend towards decision-making at different times in the project process. Architects are shown as leading the initial façade decisions; with consultants, and façade specialists and suppliers influencing these decisions where possible. Contractors are shown as attempting to make decisions at a later stage, post-tender, to potentially achieve cost and time reductions. The final façade decisions are made by the client, with planners giving ultimate approval. Very few decision-making tools were revealed as being used: namely whole life cost analysis, life cycle cost analysis and simulation. Further exploratory work is proposed to further define the roles participating in façade decision-making; and to investigate specific projects, with the aim of producing higher resolution as to what decisions are being made, and when.

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