

# **Engaging Structural Engineers**

## **- a Guide for Clients**

# Engaging Structural Engineers - a Guide for Clients

## Foreword

In the multidisciplinary world of construction, Structural Engineers need a framework for discussion with their clients to demonstrate how they can exceed their client's expectations and can best contribute to the successful and safe delivery of their client's objectives, and clients need an appreciation of the experience, skills and resources available from their Structural Engineers.

The following extracts highlight the contribution that Structural Engineers bring to the client team:

*"The capital cost of a building is typically only say 10-20% of the cost of owning and operating it over its expected life. Professional fees might be around 10-15% of the capital cost and therefore represent 1 or 2% of the life cycle cost. Therefore the relatively minor additional cost of procuring higher quality services, in particular design services which focus on optimising the balance between capital cost and maintenance costs, will be far outweighed by long-term savings."*

**Guide to the Appointment of Structural Engineers and Contractors, Property Advisors to the Civil Estate, UK.**

*"Structural Engineer selection is highly critical to the success of the entire project; to save a small percentage, perhaps 1% or less of project cost, is not worthwhile, considering the potential risks."*

**Rethinking Construction Toolkit, Institution of Structural Engineers**

Structural Engineers operate as small businesses or sole practitioners, as medium-sized practices or as large consultancies, operating in the UK and internationally.

They serve clients who may range from home-owners to government departments and multi-national giants of commerce.

Whatever the size of firm, it became very obvious to me when I met thousands of members during 2002/2003 as President of the Institution that many consider that the worth to clients of Structural Engineering has to be explained clearly. Greater resources are needed to attract the best into the profession, and to update skills continuously so as to deliver real end value to clients. A cut-price reduced-effort structural design service can potentially have two outcomes; the first is that it may sacrifice quality and real value for money, and the second is that it may compromise safety. Neither is welcome.

However, the ideal can be achieved:

*"...imagine your construction project on time, on budget and working well..."*

**Engineers – making a complex world simple, Association of Consultancy and Engineering**

This publication is intended to help clients meet these aspirations - I commend it to you.

**Bob McKittrick**

Institution of Structural Engineers – Past President

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## 1. INTRODUCTION

Professional advisors, such as Engineers, Architects and Surveyors, are key players in project teams and their selection should be seen as a major event in the evolution of a project.

Clients can look to Structural Engineers to add value to projects at every stage – concept, outline and detailed design, construction, operation and demolition – through their ability to provide appropriate solutions.

Chartered Structural Engineers have particular knowledge within the client's construction team of design and procurement processes. They are able to give strong leadership and input to the form, material, texture and excitement of the client's project, contributing to the achievement of the client's aspirations – "turning ideas into reality".

The Structural Engineer's formative process usually begins with an accredited university degree, typically four years of study. It continues with training and experience within design offices or on site for at least five years, and concludes with professional recognition through a formal examination, leading to Chartered status. After that, the best engineers continue to develop throughout their career and all are required to maintain up to date knowledge within their own field of work.

Chartered Structural Engineers (FIStructE or MIStructE) work alongside Incorporated Engineers (AMIStructE) and Technician Members (TIStructE) to develop fully-rounded solutions. They are professionally qualified to design, project manage, and oversee the construction of projects of all kinds.

Working with the project team they ensure safety and contribute to the elegance, value and overall performance of the structure during its lifetime.

Relationships within the team, between the Structural Engineers and client and other team members, must be built upon sound and open principles, delivering project success. The scope and level of service provided by the Structural Engineer is comparable to that of the Architect and other members of the "delivery team".

This document gives clients a better understanding of the expertise and value that Structural Engineers bring to clients' projects, how they deliver that value, how they should be chosen, and the costs of employing them.

## 2. VALUE

Each member of the professional team makes a unique contribution to the success of a project. Good, imaginative structural engineering will deliver a project that works well at all stages of its life; importantly, the final structure will do what it was intended to do.

Early involvement of the Structural Engineer enhances team integration, brings reality to performance on cost and programme and ensures the appropriate choice of structural form and materials.

Unlike the purchase of goods or commodities, engaging professional Structural Engineers requires an understanding of what is to be done, the client's expectations, and how much this will cost.

Commercial reality dictates that professional advisors cannot readily offer their own comprehensive services on projects where the client's financial resources are inadequate to meet the work required.

Experience shows that the appointment of experienced professionals, across a range of relevant disciplines, at the outset of a project will deliver long-term value.

It follows that the greatest value will be derived where clients commit adequate financial and professional resources at an early stage when the opportunity to explore the best available options exists.

With open dialogue this objective, of maximising value, can be achieved readily.

### 3. COMPETENT COSTS AND FEES

There is a basic level of costs within a practice which have to be recovered within the fee arrangement, otherwise it is no longer possible to provide a service in the interests of the client nor to protect the public safety; this is defined as the “competent cost” level. Clients should be aware that, when procuring professional engineering services, this competent cost level, with its additional margin, has to be recovered in the agreed fee.

Experience shows that cheap engineering input can lead to expensive outcomes; professional services cannot be procured on a sustainable basis where insufficient resource is provided by the client.

The competent costs to be recovered by Structural Engineers should include the costs of running the business; these include the following:

- Technical staff costs, including salaries, holidays, pension schemes, national insurance, sickness, paternity/maternity leave;
- Training staff, including in house seminars, courses, conferences;
- Operating, maintaining and replacing office equipment;
- Purchasing, updating software and software licensing;
- Maintaining & updating library information, including codes of practice;
- Support staff including secretaries, librarians, accountants, IT managers, administrators;
- External professional services such as accountants, auditors, lawyers;
- Insurances including professional indemnity, public liability, etc;
- Property costs;
- Business development;
- Warranties.

The fee charged to the client embraces these costs and the margin appropriate to the profession, the practice and the practice’s continued well-being.

## 4. CHOOSING STRUCTURAL ENGINEERS

### 4.1 What do Structural Engineers do?

The chosen Structural Engineer for any project is the one who has the experience and the ability to interact quickly with other professionals to conceive the optimum structure that is robust, cost effective, buildable, that can be easily maintained and, eventually, readily dismantled. They will also be able to contribute to the wider aspirations of the project. The Structural Engineer can advise the client and the team on appropriate methods of procurement and to offer advice on the quality of construction to be achieved.

Structural Engineers work on a wide range of projects, including residential and commercial buildings, theatres, sports stadia, hospitals, bridges, transport terminals, oil rigs, factories, shopping centres, maritime facilities and surrounding infrastructure. They also advise on the repair of damaged structures, the extension of existing structures, and the restoration and renovation of historic buildings.

In addition, their responsibility includes the critical issues of robustness, safety, serviceability, buildability and economy; these relate not only to the concept design but also to the design and detailing of each individual structural element. The contractor must also be furnished with the necessary data to construct the structure safely. To achieve this, the Structural Engineer is able to offer a range of services to meet the client's needs, as defined in Appendix A1 "Structural Engineering Services".

### 4.2 Responsibilities of the client

The client should select a Structural Engineer on the basis of professional competence and experience (particularly in relation to the proposed works), managerial ability, availability of resources, professional independence, value, fee structure, professional integrity, and quality management systems.

The client should establish that the agreed fee is adequate for the full spectrum of services that is required. An important issue here is to secure the right mix of professional staff with levels of experience appropriate to the complexity of the project; this is discussed further in section 5.

A client seeking to secure the services of a Structural Engineer for a given commission has the following responsibilities:

- To fulfil his own responsibilities under all relevant legislation.
- To prepare a brief for the scope of services that are required (see Appendix A1).
- To appoint a Structural Engineer who has demonstrated in the submission that he has allowed for all the work disciplines envisaged by the brief (see Appendix A2).
- To establish a total limit of liability or other risk control arrangement (such as net contribution), so that all parties can understand the boundaries of the agreement.
- To appoint a Structural Engineer who is committed to Continuing Professional Development, demonstrating that commitment in training and maintaining current knowledge.

The client should satisfy himself that the services to be provided by the Structural Engineer will interface adequately with other professional services, so as to deliver an easy to construct, holistic, cost-effective solution during design and construction.

The client will recognise that, if services are "cherry-picked", there is a danger that this objective will not be achieved, which could be severely detrimental in terms of cost, quality and out-turn of the project.

### 4.3 Responsibilities of the Structural Engineer

The main responsibilities for the Structural Engineer are:

- To study the Client Brief and to ascertain what the client wishes to achieve from the project.



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- To advise the client if there are omissions from the scope of services defined by the brief that could adversely influence the quality of the end product.
- To assess the work defined by the client's brief
- To make proper allowance in the fee for executing it with reasonable skill and care
- To state clearly the cost of the services to be provided based on a schedule of deliverables (see Appendix A3, section B.3)
- To highlight any qualifications that would influence the proposals.
- To keep client information confidential.
- To advise the client, if appropriate, on the appointment of other professionals to assist with the project.
- To provide the client with information and updates on the progress of the project.
- Not to make material alteration to the scope of services without advising the client, particularly if additional services are required.
- To act within the IStructE's Regulations and Code of Conduct.

By agreeing to an appointment both client and Structural Engineer accept that reasonable skill and care will be exercised in carrying out the services, and the Structural Engineer further accepts that the scope of the contract is within their available expertise, and that adequate time and resources will be made available to fulfil the requirements of the brief.

Indicative details of a Plan of Work for both the client and the Structural Engineer are given in Appendix A3.

## 4.4 Professional Indemnity and Other Insurances

IStructE recommends that clients check that their Structural Engineer carries Professional Indemnity and other insurance cover, appropriate to the scope of their commission.

Such insurances are part of the engineer's background overhead costs and must be recovered within fee arrangements with clients.

## 4.5 Process for Choosing Structural Engineers

There are many situations where clients, quite correctly, wish to engage Structural Engineers with whom they already have (or have had) a successful working relationship, without using other selection methods.

Alternatively, where appropriate and based on the client's initial brief and, possibly, the location of the project, two or three Structural Engineers should be selected, either from personal knowledge, by recommendation from other clients or by inquiring at the Institution of Structural Engineers' website. These Engineers should be interviewed and, if the project is large enough, should be asked to give a presentation describing their approach; references from previous clients should then be taken up (see Appendix A2 – Checklist for Choosing a Structural Engineer). The Structural Engineer should be invited to demonstrate how he would achieve value, as set down in Section 2 of this document.

Finally, it is recommended that a set of Terms and Conditions of Engagement be agreed (see 6.5)

## 5. DEFINING THE RESOURCE

Of equal importance to establishing appropriate cost rates and fee recovery (see sections 3 and 6), it is essential to define the complexity of the project and its effect on:

- The total resource input by members or classes of staff, and
- The 'mix' of staff required to carry out the appointment.

### 5.1 Estimating Hours ('Quantum')

It is of obvious and underlying importance that the number of hours required to enable the appointment to be discharged adequately and to the client's satisfaction must be estimated accurately. The balance of risk here, between the client and the Structural Engineer, depends on the arrangement under which the fee is to be negotiated and agreed (see section 6).

It is also important that, whatever the fee arrangement, the estimate of hours be used in the subsequent management of the project to:

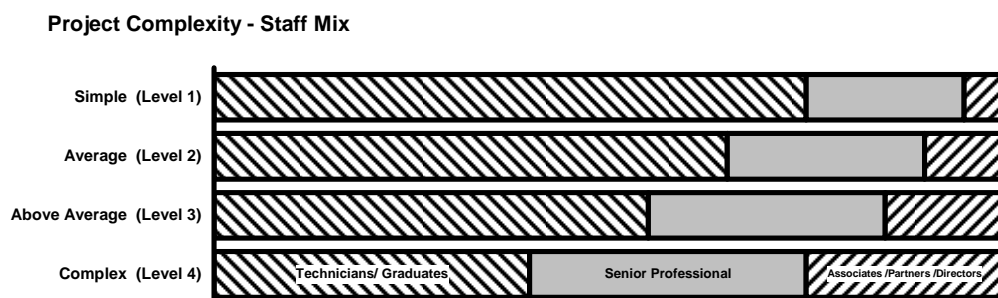
- Monitor actual progress and costs against those tendered
- Identify specific services included within the fee tendered
- Provide an indicator of 'performance' for similar future projects.

### 5.2 Estimating Complexity (Staff/Experience 'Mix')

Before any negotiation with the client or, indeed, before the Structural Engineer's project costs can be estimated, the complexity of the project must be considered, since it will influence the 'mix' of staff (and their seniority and experience) to be employed on that project.

The more complex the project (or part thereof) is, the greater the involvement and time input of more senior experienced staff. It should be recognised by the client that this delivers the necessary experience to the project, provides a more efficient solution and, in the project overall, economy and value. It is essential that the project's complexity is recognised, and that its effect on staff 'mix' is allowed for from the outset.

The following figure illustrates this issue, showing the effect of 'complexity level' on the total mix of staff required.



The table on the following pages identifies these idealised 'complexity levels' from the figure above, and suggests examples of structures falling within these levels.

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Category	Structure	Examples of Structures
Complexity Level 1	<u>Simple structures:</u> <ul style="list-style-type: none"> <li>Structures of conventional design,</li> <li>Masonry structures with load bearing walls,</li> <li>Simple foundations.</li> </ul>	<ul style="list-style-type: none"> <li>Houses up to two storeys with simple foundations</li> <li>Small span industrial units with simple foundations</li> <li>Single storey school building with simple foundations</li> </ul>
Complexity Level 2	<u>Structures with an average degree of difficulty:</u> <ul style="list-style-type: none"> <li>Simple frames,</li> <li>Simple composite construction,</li> <li>Normal piled foundations.</li> </ul>	<ul style="list-style-type: none"> <li>Housing above two storeys</li> <li>Large span industrial buildings</li> <li>Office buildings and similar, up to four storeys</li> </ul>
Complexity Level 3	<u>Structures with an above-average degree of difficulty:</u> <ul style="list-style-type: none"> <li>Complex design for conventional structures</li> <li>Three dimensional trusses</li> <li>Simple cable tensioned structures</li> <li>Difficult frame structures</li> <li>Composite structures</li> <li>Structures with dynamic design requirements</li> <li>Difficult foundations</li> </ul>	<ul style="list-style-type: none"> <li>Complex roofs</li> <li>Housing, commercial buildings and similar, over four storeys</li> <li>Basements</li> <li>Large cantilevers</li> <li>Transition/transfer structures</li> <li>Complex refurbishment</li> <li>Silos &amp; bulk storage structures</li> <li>Heavy industrial structures</li> <li>Mill footings</li> </ul>
Complexity Level 4	<u>Very complex structures:</u> <ul style="list-style-type: none"> <li>Three-dimensional girder work</li> <li>Cable tensioned structures</li> </ul>	<ul style="list-style-type: none"> <li>Complex bridges</li> <li>Deep basements</li> <li>Stability of large adjacent buildings</li> <li>Masts &amp; Towers</li> <li>Unusual and novel architectural features</li> <li>Chimneys</li> <li>Shell Structures</li> </ul>
	<ul style="list-style-type: none"> <li><u>Structures designed for a complex regulatory environment or requiring a formal safety case</u></li> </ul>	<ul style="list-style-type: none"> <li>Nuclear structures</li> <li>Oil and gas platforms</li> <li>Others??</li> </ul>

## 6. DEFINING THE FEE

This section describes different forms of fee arrangement between client and Structural Engineer. It is imperative that this is read in conjunction with section 5, which gives guidance on agreeing appropriate and adequate project resource, and which illustrates the effect of project complexity on resource allocation.

### 6.1 Negotiation of Fee

After a preferred Structural Engineer has been chosen, the fee should then be established by negotiation, taking into account any special features of the project. Allowance in the final fee should be made for special features, such as where:

- the engineer is required to give less than the full service described in Appendix A1 of this guide;
- the project is likely to be carried out to an unusually slow or fast programme;
- detailed survey/investigation of existing structures is necessary;
- the project is highly repetitive, requiring less engineering time;
- the project is unusually complex, requiring a greater than usual involvement from experienced staff;
- work on existing or historic structures is involved, where more emphasis on investigation and assessment is inevitable;
- façade retention is involved;
- the form of procurement has a major impact on the agreement and the services required of the Structural Engineer.

There is an element of risk in estimating a professional fee; this risk may be carried by the client or by the Structural Engineer, or shared between them. The various ways of defining a professional fee described below differ principally in how this risk is to be shared.

The principal methods of setting professional fees are:

- as a percentage of overall project cost,
- as a lump sum,
- on time basis,
- by combinations of these.

Whatever method is chosen, there must be a clear understanding between client and Structural Engineer as to the level of services to be provided.

### 6.2 Fee Arrangements

#### a) Percentage of overall project cost

The fee can be calculated as a proportion of overall construction costs, and is influenced by the complexity of the design and the proportion of structural-to-total construction costs.

This type of fee arrangement is unlikely to be appropriate for projects of an unquantifiable nature such as existing and historic structures; such projects have an inherent high degree of uncertainty and require specialist skills.

Similarly, it is inadvisable to use a percentage fee arrangement where normal percentages do not reflect the level of service required (e.g. on smaller projects or on projects with a greater degree of complexity); in these circumstances fees should be charged on a time basis.

#### b) Lump sum

A lump sum can only be successful when the full extent of the project, and of the services

required, is defined fully at the outset, such that detailed resource estimates for all categories of staff can be assessed and costed. The client's risk is that the lump sum may be too high, and the Structural Engineer's risk is that it may be too low.

If the volume of work increases due to unforeseen or changed circumstances, there needs to be an agreed mechanism for recouping additional costs (6.3).

## c) Time basis fees

Usually charge-out rates are banded for various categories of staff depending upon qualifications and experience.

Although time basis fees may appear to be open-ended, the Structural Engineer should tell the client regularly what has been spent and what progress has been made. Budget ceilings, beyond which further client authorisation is required, should be agreed. This also allows the client to make due allowance for the costs within his overall project budget at an early stage, and the Structural Engineer to monitor progress against estimated completion costs. The arrangement is particularly well suited to investigation and reporting work.

Hourly rates should be set so that a competent level of service can be provided, based on delivering an adequate and appropriate margin on the competent costs highlighted in section 3.

It is imperative that practices calculate multipliers to include all their costs and the margin; failure to do so means that every hour spent on the project by each staff member is, potentially, costing the practice dearly, leading to under-recovery of costs and erosion of service and skills.

It should be recognised that rates for Expert Witness work are usually higher to account for the specialist nature of the advice being sought, the requirement for specific availability and the fact that key staff, often very senior, are taken out of circulation at short notice and as demanded by the Courts.

## d) Combination of Fee Types

There are many circumstances in which the client, Structural Engineer and project benefit from different fee arrangements at different stages of the project.

The most likely combination is for initial investigations or reports, or initial conceptual development and comparison, to be undertaken on a time basis arrangement, with subsequent stages being on a percentage or lump sum basis.

## 6.3 Additional fees

If there are changes to the project at a late stage, for example where a client wants to alter the structure because of new commercial opportunity, there will, generally, be a case for additional fees. These can be an extension of the proportions already agreed or can be on a time basis. It is important that the contract/agreement includes the facility to recognise these changes and to recompense appropriately.

Special care is needed by Structural Engineers where other members of the design team make changes when the structural design is well advanced. The Architect for example may consider the matter to be a 'design development', but to the Structural Engineer it may mean scrapping a great deal of analytical/design development work. A claim for additional fees is justifiable in these circumstances.

## 6.4 Stages

Stage payments should be agreed for all but the smallest jobs. A typical example for a new build project would be for payments to be made when the stages in the following table are reached. Ideally

these need to be aligned with the appointment of the lead consultant – normally the Architect or Construction Manager. This will aid team reporting through a formal process of agreed deliverables stage by stage, which all parties in the team sign up to.

The percentage of the total fee for a stage payment will depend upon negotiation, and will reflect the periods of largest expenditure. For work to existing structures the stages may differ but the principles remain.

A convenient way of scheduling payments is for the Structural Engineer to render monthly invoices with reconciliations at key stages. Timely payment of fees is essential for both client and Structural Engineer as it helps relationships that are important for the success of the venture.

## **6.5 Terms and Conditions of Engagement**

Once the Structural Engineer has been chosen, the brief has been agreed, the method of fee calculation has been settled and stage payments agreed, Terms and Conditions of Engagement between the client and the Structural Engineer are required. For many clients an exchange of letters is sufficient, particularly if they have worked with the Structural Engineer before, but better protection is given to both sides by a formal document/agreement.

There are many different published versions of Terms and Conditions of Engagement - for example, those published by the Association for Consultancy and Engineering. In addition, some companies have their own established terms of business, or Terms and Conditions of Engagement.

## APPENDIX A1 – Structural Engineering Services

### A1.1 The Brief

The brief for a project must be agreed between the client and the Structural Engineer; alternatively, the Structural Engineer can help to draft the brief, based on discussions with the client and others.

Once a reasonably clear Brief has been formulated, the principal services to be provided will be agreed between the client and the Structural Engineer. Time scales are also important and the client and the Structural Engineer must agree what is to be achieved by the client's key dates. With a team encompassing several disciplines the interaction between them is crucial as each will depend upon others for information to keep the design running. A programme with the critical links between design activities clearly defined will prove to be of immense benefit later. It should be noted that there are several different ways in which to procure work; these options should be discussed and agreed with the Structural Engineer.

A plan of work will normally follow the brief - see Appendix A3.

Of course there are huge differences in scale between projects, and a simple low cost project will only need a short brief, whereas a complex high value job will demand substantial briefs for each team member together with detailed and compatible programmes. The most important aspect is to be sure that everyone understands what is wanted and agrees that it can be achieved. Responsibilities must be assigned by the client and accepted by the Structural Engineers and other team members so as to minimise the effects of interfaces between different members.

### A1.2 Services Offered

The range of services that can be provided is wide and different members of the design team describe them in different ways.

The activities of the Structural Engineer may include some or all of the activities shown on the following pages, depending upon the size and scope of the project; clients need to decide what services they wish to procure and the Structural Engineer must clearly define those services that are included in the fee.

When work is to be done on an existing structure or building some of the stages may differ, and there can be more emphasis on investigations and assessments before schemes can be developed. Historic or other existing structures can prove to be a challenge with the need to assess old forms of structure, dealing with inconsistent materials, and perhaps having to seek compliance with modern legislation.

### A1.3 Contractors' Design

Often the contractor or the sub-contractors will carry out some parts of the design or detailing and it must be established where the responsibilities, liabilities and costs will lie. For example, piling sub-contractors will usually design their piles and cut-off walling, steelwork fabricators will usually design and detail standard connections between members but to the loading performance specified by the Structural engineering consultant; reinforced concrete contractors will often prepare detailed steel reinforcement drawings and bending schedules; and so on. The client and the Structural Engineer must agree who will approve such designs and details. The Structural Engineer will usually be willing and able to give approval, after any comments on submissions have been satisfactorily dealt with, subject to these tasks being included in the brief and acknowledged in the fee.

Agreement must also be reached on the way in which the construction work, both on and off site, is to be checked for compliance with the law, the contract specifications, building regulations, British Standard Codes of Practice, EU Standards and Codes of Practice where applicable, and good manufacture and workmanship generally.

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## A1.4 Electronic Information and Work Flow

When the management of the design and construction process involves the exchange of information by computers, or through an extranet site, the roles and responsibilities of the Structural Engineer have to be established. The lead consultant or project manager will probably be in charge of initiating such a system but the method of use, and access, will depend upon many factors. There may indeed be a specialist Information Communications Technology (ICT) Structural Engineer on the project. For most projects of any scale an agreement by all the supply team on how ICT will be managed is essential to effective management of the project.

## A1.5 Site visits

Structural Engineers may visit construction sites and possibly fabrication works, during the construction phase of the project, and may have staff on site on a full or part time basis who will observe activities and make observations on various aspects, including quality, to the contract administrator (Architect, lead Structural Engineer, Construction Manager). This is not supervision, which is usually the responsibility of the contractor. A term such as 'site visits' will normally be used to describe the role of the Structural Engineer during construction.

It is imperative, in these situations, that there is a clear understanding of where the costs and liabilities lie, and how they are being recovered through the fee.

A1.6 Table of Services Offered	SERVICE REQUIRED YES/NO
This is a generic list (loosely based on RIBA Plan of Work Stages) that will be adapted for each individual project. Each particular service, if selected, must be broken down into detailed individual work elements.	
<p><b><u>Stages A – B (Initial Steps, Appraisal and Strategic Brief):</u></b></p> <ul style="list-style-type: none"> <li>Project planning and feasibility studies</li> <li>Help establish the Brief for the Project</li> <li>Project assessment studies including financial analysis and site evaluation</li> <li>Project management</li> <li>Contributions to H&amp;S Plan</li> </ul> <p><b><u>Stage C (Outline Proposals):</u></b></p> <ul style="list-style-type: none"> <li>Geotechnical/Geological investigations</li> <li>Site investigations and reports</li> <li>Environmental studies and environmental impact assessments</li> <li>Sustainability studies</li> <li>Flooding analysis</li> <li>Preliminary Design/built form studies</li> <li>Contributions to H&amp;S Plan</li> </ul> <p><b><u>Stage D – F (Detailed &amp; Final Proposals, Production information):</u></b></p> <ul style="list-style-type: none"> <li>Scheme Design</li> <li>Analysis and Recommendations for Site Stability</li> </ul>	



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<p>Ground improvement works</p> <p>Drainage, Roads etc</p> <p>Retaining Walls</p> <p>Foundation design</p> <p>Piling:</p> <ol style="list-style-type: none"> <li>full design for competitive tender</li> <li>Preparations of Performance Schedules to seek competitive designs from specialist contractors</li> </ol> <p>Ground improvement</p> <p>Structural design:</p> <ol style="list-style-type: none"> <li>fully detailed designs for competitive tenders</li> <li>preparation of performance requirements to allow competitive designs from specialists</li> </ol> <p>Structural detailing:</p> <ol style="list-style-type: none"> <li>reinforced concrete members and bending schedules</li> <li>areas of special structural/aesthetic importance</li> <li>advice on design of secondary structures such as facades, needs of specialist equipment installation etc</li> <li>Waterproofing design of basements</li> </ol> <p>Risk Analysis and Risk Management</p> <p>Contributions to H&amp;S Plan</p> <p><b><u>Stages G – H (Tender Documents &amp; Tender Action):</u></b></p> <p>Preparation of contract documents</p> <p>Preparation of tender documents</p> <p>Construction management</p> <p>Evaluation of bids</p> <p>Contract management</p> <p>Contributions to H&amp;S Plan</p> <p><b><u>Stages J –K (Mobilisation to Practical Completion):</u></b></p> <p>Site inspections</p> <p>Provision of site staff</p> <p>Approval of payments to the contractor</p> <p>Advice on contractual claims</p> <p>Review of contractor's submissions e.g. fabrication drawings</p> <p>Review or preparation of as-built drawings</p> <p>Commissioning and decommissioning</p> <p>Valuation services</p> <p><b><u>Stage L (Practical completion and following):</u></b></p> <p>Investigation of post-completion problems</p> <p>Forensic services</p> <p>Technical training</p>	
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Operation and maintenance advice	
<b><u>Others:</u></b> Research and development, Value Structural engineering. Due diligence Expert Witness Special investigations	

## APPENDIX A2 - Checklist for Choosing a Structural Engineer

The list below provides a guide to clients when selecting a Structural Engineer; the client should request the Structural Engineer to provide information in his proposal against these items, as appropriate:

- past experience;
- past performance record (e.g. completed on time and to budget);
- details of organization;
- record of working with other members of the team (if known);
- demonstrations of technical competency;
- evidence of staff training and development at all levels (e.g. Investors-in-People);
- financial control system;
- size and categories (by qualification and experience) of staff;
- availability of key staff with the relevant experience;
- statement to show the Structural Engineer's understanding of the project;
- capacity to carry out the work, proposed scope of services being offered in order to carry out the works effectively;
- details of Quality Management System (e.g. ISO 9001 & 14001);
- details of ICT (information communication technology) systems;
- knowledge of local conditions;
- proposed way of handling the project;
- outline programme;
- office where the work will be performed;
- preferred terms of payment;
- any conditions for subcontracting part of the commission;
- professional liability and public liability insurances;
- limitations of liability;
- the period for which the Structural Engineers' proposals shall be held valid.

To make comparisons manageable, the size and format of the proposal should be limited to a certain number of pages chosen by the client.

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## APPENDIX A3 - Indicative Plan of Work for Client and Structural Engineer

This schedule consists of two columns; that on the left gives the role of the client and on the right the role of the Structural Engineer. It is intended that this schedule be used as guide; the exact extent of the work required will, obviously, depend on the nature of the project and the extent of the brief. Clearly, not all items listed below will be relevant to each project.

CLIENT	STRUCTURAL ENGINEER
<b><u>A. Initial Steps &amp; Appraisal</u></b> <ol style="list-style-type: none"> <li>1. Give preliminary brief to the Structural Engineer and explain the relationship with the rest of the team</li> <li>2. Ask the team what the client's duties are under the CDM regulations and what statutory approvals are needed</li> <li>3. Give the team copies of all relevant documents about the site and ask them to make a site visit</li> <li>4. Ask the Structural Engineer for an initial appraisal of any site constraints and for recommendations on a sub-soil survey, a topographical survey, and the need for an environmental impact assessment and a contamination investigation</li> <li>5. Receive and review reports and sketches from the team on the feasibility of the project</li> <li>6. Consider alternative design and construction approaches and their cost implications</li> <li>7. Instruct Structural Engineer on site investigations</li> </ol>	<ol style="list-style-type: none"> <li>1. Prepare preliminary brief with the client</li> <li>2. If appointed as Planning Supervisor advise client on duties</li> <li>3. Have a walk over the site and observe any constraints</li> <li>4. Prepare an initial report on constraints and make recommendations on the need for surveys, assessments, and investigations</li> <li>5. Assist the team in preparing a feasibility report for the project</li> <li>6. Prepare alternative preliminary designs with approximate calculations and sketches</li> <li>7. Obtain tenders for site investigation and other surveys</li> </ol>
<b><u>B. Strategic Brief</u></b> <ol style="list-style-type: none"> <li>1. Confirm the key objectives in the light of the information from the team</li> <li>2. Confirm the Structural Engineer's brief and agree this with an exchange of correspondence or a formal contract</li> <li>3. Agree a schedule of deliverables with each member of the team for each stage</li> <li>4. Agree the fee and the division of work between team members and disciplines</li> </ol>	<ol style="list-style-type: none"> <li>1. Write a method statement on the way the design will be approached</li> <li>2. Agree the brief with the client</li> <li>3. List the deliverables for each stage</li> <li>4. Advise on the likely need for specialist reports (environmental and site studies, condition surveys, structural appraisals and special loading conditions)</li> <li>5. Agree the fee</li> </ol>
<b><u>C. Outline Proposals</u></b> <ol style="list-style-type: none"> <li>1. Ask the team to determine the concept design, procurement and construction methods and to provide cost plans and programmes</li> <li>2. Consider with the Lead Consultant the</li> </ol>	<ol style="list-style-type: none"> <li>1. Help the team to prepare a master programme and develop a sub-programme for structural activities taking special note that structural drawings may be needed before complete information is</li> </ol>

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CLIENT	STRUCTURAL ENGINEER
<p>implications of the Structural Engineering recommendations</p> <ol style="list-style-type: none"> <li>Discuss the options with the team until decisions are reached</li> <li>Continue to develop the brief</li> <li>When agreement is reached approve the outline proposals and the cost plan</li> </ol>	<p>available from other members of the team. This may have cost and programme consequences</p> <ol style="list-style-type: none"> <li>Obtain specialists' reports on site investigation, special material tests and other surveys and appraisals</li> <li>Produce loading drawings for the structure</li> <li>Prepare a report and give recommendations on site conditions and options for infrastructure works and foundations including any implications from potential contaminants</li> <li>Consider possible alternative solutions and provide sketches, drawings and reports as are appropriate</li> <li>Make preliminary calculations for key elements</li> <li>Assist the team to make recommendations for procurement and construction</li> <li>Help with the cost plan and outline construction programme Contact the relevant building authorities</li> <li>Modify the brief if there have been changes to the scheme</li> <li>Describe the assumed method of construction, including any design constraints (via a Precedence Network if applicable)</li> </ol>
<p><b><u>D. Detailed Proposals</u></b></p> <ol style="list-style-type: none"> <li>Ask the team to produce detailed proposals</li> <li>Receive a detailed proposal from the team showing spatial arrangements, materials and appearance, and a cost estimate</li> <li>Obtain feedback from the team on the situation with statutory authorities</li> <li>After discussion, and after possible amendments have been made, approve the detailed proposals</li> </ol>	<ol style="list-style-type: none"> <li>Prepare and check sketches, drawings, specifications, and preliminary calculations for the main elements of the structure to enable the team to produce their parts of the design and for the cost plan to be developed</li> <li>Agree any unusual aspects of the project with the building authorities</li> <li>Provide a report, or give input to a report by the lead designer or project manager, in sufficient detail to enable the client to make decisions on proceeding to the next stage</li> </ol>
<p><b><u>E. Final Proposals</u></b></p> <ol style="list-style-type: none"> <li>Develop the proposals with the team until the technical aspects are finalised, the cost estimate is acceptable, and the procurement strategy is agreed</li> <li>Ask the team for advice on the</li> </ol>	<ol style="list-style-type: none"> <li>Update the loading drawings and method statement</li> <li>Prepare and check sufficient calculations, drawings, schedules and specifications to give confidence that the structural content</li> </ol>

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CLIENT	STRUCTURAL ENGINEER
<p>consequences of any subsequent changes on cost and programme</p> <ol style="list-style-type: none"> <li>3. Approve the final proposals</li> <li>4. Design Freeze – Note that any changes after this stage will have implications on cost and programme</li> </ol>	<p>is sound and that the structure can be built in a sensible and economical manner</p> <ol style="list-style-type: none"> <li>3. Integrate into the design any specialists' calculations or drawings</li> <li>4. Prepare typical details for connections, bearings, joints and intersections</li> <li>5. Design Freeze - Note that any changes after this stage will have implications on cost and programme</li> </ol>
<p><b><u>F. Production Information</u></b></p> <ol style="list-style-type: none"> <li>1. Ask the team to prepare production information and costing information for tender purposes depending upon the procurement route that has been chosen</li> <li>2. In the case of reinforced concrete work, confirm with the Structural Engineer whether they will produce the rebar drawings and bending schedules or whether this will be done by the contractor</li> </ol>	<ol style="list-style-type: none"> <li>1. Prepare production information for tender purposes in conjunction with the other team members. This will include general arrangement drawings, typical details and specifications with enough detail to enable tenderers to price the work. Check tender calculations and drawings before issue</li> <li>2. Submit drawings and calculations to the building authorities or for certification by approved persons</li> </ol>
<p><b><u>G. Tender Documents</u></b></p> <ol style="list-style-type: none"> <li>1. The team will produce tender documents in sufficient detail to enable tenders to be obtained depending upon the procurement route that is being adopted</li> <li>2. Ask the team for a pre-tender cost estimate</li> </ol>	<ol style="list-style-type: none"> <li>1. Assist the client with interviewing tenderers and explaining the project to them</li> </ol>
<p><b><u>H. Tender Action</u></b></p> <ol style="list-style-type: none"> <li>1. When the tenders are returned ask the team for advice on selecting suitable persons and/or firms to carry out the work</li> <li>2. Ask the team for advice on the relative merits of tenders, prices and estimates</li> <li>3. If necessary instruct the team to revise the production information to make adjustments to the tender sum acknowledging that additional work may have implications for the fee</li> </ol>	<ol style="list-style-type: none"> <li>1. Assist the client with advice on the relative merits of tenders, prices and estimates</li> <li>2. If instructed by the client, revise the production information to make adjustments to the tender sum and advise whether this is included in the fee agreement</li> </ol>
<p><b><u>I. Mobilisation</u></b></p>	

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CLIENT	STRUCTURAL ENGINEER
<ol style="list-style-type: none"> <li>1. Instruct the team to issue production information as required in the building contract</li> <li>2. Ask the team for advice on the appointment and duties of site staff</li> </ol>	<ol style="list-style-type: none"> <li>1. Agree a schedule of deliverables with the team and the contractor</li> <li>2. Issue construction drawings and other information in sufficient detail to enable the contractor to construct the project</li> <li>3. Make recommendations to the client on site staff</li> </ol>
<p><b><u>J. To Practical Completion</u></b></p> <ol style="list-style-type: none"> <li>1. Instruct the team making visits to the works and attending relevant site meetings</li> <li>2. Ensure that the Structural Engineer and others in the team provide further information reasonably required for construction, and recognise that modifications may be required which may affect the fee arrangements</li> <li>3. For inclusion in the Health &amp; Safety File (CDM Regulations – UK), ask the team to provide final as-built drawings of the project</li> </ol>	<ol style="list-style-type: none"> <li>1. Visits the works at agreed intervals and attend relevant site meetings</li> <li>2. Supervise resident Structural engineering staff and decide on the reports to be written and how instructions are to be given to the contractor</li> <li>3. Provide further drawings and information as are reasonably required for construction</li> <li>4. Examine and comment on detailed designs, shop fabrication drawings, standard details, rebar schedules and specialist specifications submitted by the contractors or sub-contractors. Approval will be given when agreement is reached</li> <li>5. Carry out modifications to designs and drawings as instructed by the client noting that modifications are generally an extra to the agreement between the client and the Structural Engineer</li> <li>6. Provide final drawings to the client</li> </ol>
<p><b><u>K. After Practical Completion</u></b></p> <ol style="list-style-type: none"> <li>1. Ask the team to identify defects and make final inspections and give advice on settling the final account</li> </ol>	<p>Assist the team in identifying defects, make final inspections, and give advice on settling the final account</p>