Criteria for Selecting Consultants and Deciding their Duties and Conditions of Contract

Critères pour le choix d'ingénieurs-conseils et détermination de leurs devoirs et des conditions de contrat

Kriterien für die Auswahl von Planern und Unternehmern

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1. INTRODUCTION

When Governments, politicians, industrialists, or any group of people (for convenience, hereinafter collectively called the "Client") believe a need exists for some scheme to be constructed, be it a dam, factory, multi-storey building, nuclear power station, or bridge, they themselves are immediately faced with many questions. Can it be constructed? Is it viable? Is it justified? How long will it take to plan and build? Who will design it? Who will build it? How much will it cost? Who will make sure that "the Client gets a good deal"? A myriad of such questions arise.

If a "Client" employs within his own organisation, civil engineers, structural engineers and architects thoroughly experienced in the type of project envisaged and knowledgeable on the effects of all local conditions, he will of course immediately refer his problems to this professional staff (called here for convenience the Client's Engineering Department - CED). However, to set up and maintain such a department is expensive and in many cases may not be justified at all. Furthermore, for CEDs to gain the necessary expertise takes a long time.

Certainly to create such a department, capable of covering all eventualities would be highly uneconomic. In consequence, the size and scope of CEDs vary throughout the world from large to non-existent.

Where a project, whether in a developing or developed country, falls outside the capabilities of the CED (if any) the services of the Consulting Engineer (referred to hereafter as CE) are called upon. Because of these very circumstances, the CE profession in total has a vast store of world-wide engineering knowledge

available to solve Clients' problems. Solutions range from basic civil engineering necessary for the rudiments of life, to concepts appropriate for the space age.

Some developing countries themselves possess a quite appreciable CE profession. In others, it is not yet even in embryo. The potential for contribution to the solution of engineering problems by "local" professionals must not be forgotten, nor must their very natural aspirations to widen their experience and capability. Nonetheless, they, like any CE from a developed country, should not be made responsible for work beyond their capabilities.

The first problem facing a Client wishing to employ a CE is how to make the "best" choice where in some cases the range of options appears very wide. The definition of "best" in this context, and the means by which the Client may attain it, are discussed in this paper.

The paper also gives consideration to the scope of duties which CEs can perform and brief comment is made on Conditions of Agreement for their appointment.

2. THE CONSULTING ENGINEER - DEFINITION

The term CE is applied to firms of independent Consulting Engineers. Manufacturing or contracting firms who also offer consulting services are not dealt with in the paper.

Perhaps the most effective way to describe the independent consulting engineer is to quote verbatim from the booklet entitled "about FIDIC" (1) : - (Fédération Internationale des Ingénieurs Conseils)

The Consulting Engineer is a professional Engineer in private practice. He maintains his own engineering office either alone or in association with other Engineers. He employs the necessary staff to assist in carrying out the services which he provides. His organisation may be that of a sole proprietorship, a partnership or a company. This depends on the type and magnitude of his operations and the conditions of practice set by his National Association.

He must carry out his practice on a highly ethical professional basis. The technical knowledge, experience and ability of the Consultant, his associates and assistants, must be fully adequate for the projects undertaken.

The services he provides may vary in scope from personal advisory services by one Principal to major pre-investment studies involving other disciplines under his leadership, or the complete planning and supervision of construction of large and complex projects involving the employment of many engineers and technicians.

He may practise in a narrow specialised field or cover a wide area of engineering depending on the ability of himself, his associates and staff.

The revenue of a Consulting Engineer practice is obtained exclusively from fees paid by Clients for services. The Independent Consulting Engineer cannot be directly or indirectly concerned or have any financial interest in commercial, manufacturing or contracting activities such as would tend to influence his exercise of independent professional judgement in matters upon which he advises.

FIDIC will provide potential Clients with particulars of National Associations of Consulting Engineers whose members are qualified to carry out particular classes of project.

3. DUTIES OF CONSULTING ENGINEERS

To summarise the range of duties which the CE conventionally can undertake, it is convenient to consider construction projects to be divided into five phases, namely:

A Overall feasibility investigation
B Engineering investigation
C Design
D Construction
E Post-Construction

The duties related to phases B, C and D are set out in some detail in various publications issued by certain National Associations of Consulting Engineers, for example, the "ACE Conditions of Engagement", issued in UK.

The following summary is framed with works, primarily of a civil or structural engineering nature in mind. If at any stage the necessity arises for additional specialist assistance or specialised investigations to be carried out, the CE will so advise the Client.

3.1 Overall Feasibility Investigation (Phase A)

In this phase, initial broad studies are undertaken including questions of overall viability not limited solely to engineering considerations, but of course by no means divorced from them. In consequence, experts of many disciplines other than engineering may have to be involved. Programmes and costs will be examined on a broad basis and investigations into methods of funding the project may take place. The end product is a report upon which the Client in conjunction with his financial backers, (if any are involved) will decide if the scheme is to progress further.

3.2 Engineering Investigation (Phase B)

The study enters more deeply into the engineering aspects of the problem. Fairly detailed site surveys will be required involving especially foundation conditions and data concerning for example the incidence of wind, flood and earthquake. Other special investigations may be necessary, upon which the CE will advise both as to objectives and scope. During this phase, studies are made of alternative engineering solutions and a firm recommendation is put forward to the Client as to the type of structure which should be designed and constructed. More refined estimates of construction time and costs are provided. The end product, as in Phase A is a report.

3.3 Design (Phase C)

The design recommended in Phase B,if approved by the Client, is developed in detail by the CE who prepares drawings and advises on and prepares Contract Documents to permit the Client to obtain tenders for constructing the work.

He will advise the Client on the type of Contract to adopt and the conditions of that contract, as well as providing the technical specifications necessary for construction and bills of quantity to enable tenderers to price the work. The CE will also advise the Client both upon methods of inviting tenders and selection of tenderers. He will evaluate tenders when received and advise the Client upon the award of the job.

Some countries require checks of the structural adequacy of major works to be carried out by persons independent of the designing firm. Appropriately qualified CEs can of course undertake this work. The Client should limit the checker's role solely to that of examining the structure for adequate stability and strength and advising him and the CE of the check findings. If the Client permits the checker to require amendment to design concepts, the issue of responsibility for the final design will be totally clouded and great delays in execution of the work will almost certainly occur, all to the detriment of the Client.

3.4 Construction (Phase D)

In this phase, the CE will look to see that construction proceeds in accordance with the drawings, the specification and all other requirements of the construction contract. This will involve the CE in supervision on site and in work connected therewith in his office. The appointment of specialist inspectors to examine manufactured articles at factories away from the site may be called for. The CE will check progress of the Contractor's work in relation to programme and deal with his claims under the Contract. The CE normally has no authority to make payment to the Contractor, but certifies to the Client, usually on a monthly basis, sums of money due to the Contractor under the terms of the Contract. He will supervise the drawing up by the Contractor of final accounts for completion of payment when the project is finished.

Many projects of course involve the employment of more than one main contractor. It is part of the CEs duties to coordinate the workings of these contractors and, indeed, for major projects, CEs perform an overall management role of the many contractors involved not limited to those employed in civil and structural engineering.

By its very nature, civil and structural engineering is subject to numerous uncertainties during the construction phase. Under the terms of many contracts between the Client and the Contractor (eg Conditions of Contract (International) for Work of Civil Engineering Construction) the CE is required to act in a quasi-judicial role. He must therefore be of high professional integrity, trusted by Client and Contractor alike. In this respect it is essential that the Client, although he employs and pays the CE, should do nothing adversely to influence the latter's impartiality in administering the Contract.

3.5 Post Construction (Phase E)

By involving the CE in this phase of the work eg devising structural maintenance procedures and advising on their implementation, or perhaps setting up an organisation to run a toll bridge, the Client gains at least one benefit. The CE's expertise and intimate knowledge of the structure should ensure a good result. Probably of equal importance, however, feedback of actual experience with that

structure in use will be incorporated in the CE's next design. If that design should be for the same Client he will of course benefit from any improvements.

4. CONTINUITY OF SERVICES

Whilst the roles delineated above portray the CE in his conventional activities, they can of course be widely varied by mutual agreement with the Client.

Some Clients consider it preferable not to give all five phases listed under (3) to the same CE. However, with the possible exception of Phase A, it is extremely difficult to see the logic of such a procedure save in very exceptional circumstances.

The reason sometimes advanced for the employment of a different firm for Phase A is that the very wide ranging nature of some feasibility studies may be beyond the scope of a CE firm, well qualified to carry out the subsequent phases. Further argument says there is no pressure upon the CE appointed solely for Phase A to pronounce a scheme viable when he knows that whatever the outcome of his study, his employment relates only to that phase. The latter argument of course only has merit if it is assumed that the CE will not be objective in his studies. The best answer is to choose a firm which not only has the reputation of being objective, but also encompasses most of necessary expertise to conduct both the feasibility study and the detailed engineering. Any gap in expertise can be covered by the CE voluntarily associating with himself a similar firm able to supply the missing skills.

If a different firm is appointed for Phase A it must be remembered that only a report will be passed to the CE commissioned for the Engineering Investigation and Design phases. He thus has had no direct access to all the circumstances and subtle nuances which might influence the design of the works. Such lack of contact and personal involvement cannot be advantageous.

Even more serious however in the writer's view, are the arguments against phases B, C and D being carried out by other than one firm or group. If different firms execute each of these phases, inevitable split responsibility results. Almost certainly some lack of understanding of what was in the mind of the CE in the previous phase also must arise. Major projects rarely go strictly according to plan and it is therefore highly desirable that thinking should be traceable to the original source and arguable at that level. This applies especially to matters arising in the construction phase when quick reference to the designer because of changed circumstances found at site, may be urgently required.

Put in its simplest terms, the CE performing any phase can repudiate any decisions, estimates, programmes or designs executed in earlier phases, unless he himself performed them. It therefore appears to be the Client who is the main loser if at least phases B, C and D are not awarded to the same CE.

5. ASSOCIATION OF CE FIRMS

Nothing said here should be construed as an argument against the employment, where appropriate, of more than one CE on the same project. For example, in the case of a major bridge to be constructed over a big river, having notoriously

bad meandering characteristics, an amalgamation of bridge expertise of one firm with hydrological and river control experience of another, would be highly apposite. In such circumstances, the two CE firms should freely agree to associate, so that the Client is in effect dealing with only one organisation.

Other causes for association may arise in connection with the employment of local and foreign CEs. Such associations should be freely entered by the parties and not be "shot gun" marriages.

Clearly the designs by foreign CEs should suit, as far as possible, the use of local manpower, skills and materials. For example, what might be a first-class bridge design in welded steel could be a nonsense in a country having neither steel nor welders but possessing timber, cement and good stone. However, special circumstances, e.g. the need for very long spans in perhaps an earthquake-prone area could make a steel structure the correct choice even in such a country. Clearly the CE has to make a judgement in each case and the knowledge of local professional firms concerning indigenous skills and materials can be of considerable help in such matters.

Naturally Clients in developing countries wish their own professional men to acquire expertise in "developed technology", thereby progressively reducing reliance on the services of foreign CEs. Most Clients too are anxious to conserve foreign exchange and employment of their own nationals as much as possible whilst foreign participation is reduced, conforms to this wish.

Nonetheless the Client, it is suggested, should be particularly wary to ensure that foreign CEs only rely upon local professional services within the capabilities of the latter group. Reliance beyond these limits would not be in the interest of the Project and thus the Client.

6. "BEST VALUE"

Clients throughout the world, whether in developing or developed nations, wish to be sure that they are obtaining the "best value" for money. The view of what is "best value" will probably vary from place to place and does not necessarily relate solely to the cost of the project under consideration. In developing countries, employment and training of local professional manpower is important, as are designs utilising, where appropriate, local materials, skills and resources. Punctuality, i.e. maintenance of programme, is also extremely relevant and, of course, has cost connotations. Other matters such as aesthetics or environmental considerations may not be directly quantifiable in cost terms but, in some cases, may be of overriding consequence.

While acknowledging these considerations, the writer believes that in most cases "best value" can be related to overall financial cost of the project. In civil or structural engineering, this cost can be examined in three main stages, namely: -

(a) Pre-construction
(b) Construction
(c) Post-construction

The costs associated with (a) are primarily those of feasibility studies, site investigations and actual design. During (b) the costs are obviously the charges

of the Constractor for men, materials and plant to construct the project, together possibly with the costs of land on which to build it plus some relatively small costs associated with supervising the work. Post-construction (c) encompasses the costs of maintaining the structure throughout its life and possibly repayment of a loan, plus interest, used to finance the scheme.

Clearly, in terms of the overall project cost, the "best value" for the Client is that which will make the total cost of Stages (a) + (b) + (c) a minimum. In this context it is important to note that the costs of (b) + (c) are far greater than that of (a), so that for all practical purposes if (b) + (c) is a minimum, (a) + (b) + (c) will also be a minimum.

A scheme or structure containing unnecessary material i.e. "over-designed" will be "over-costly" when constructed (Stage (b)). Conversely an "under-design" using less material than is necessary could be constructed for less but would most likely give rise to greater maintenance costs in Stage (c). The "over-design" or "under-design" could unquestionably cost the CE himself less than an "adequate design". Thus low cost for Stage (a) is no guarantee of a low cost for Stages (b) + (c) - probably the reverse.

Only careful design and associated work in Stage (a) can minimise the total cost of Stages (b) and (c). In other words, additional money well spent in Engineering Study and Design can be saved many times over in construction and maintenance.

It is of course common practice to appoint for the construction Stage (b), the Contractor who offers the minimum price to execute the work. Nonetheless sub-standard materials or workmanship cannot be permitted, for although they can save the Contractor money they may well result years hence in maintenance problems adding considerably to the Client's costs in Stage (c). The CE therefore has to supervise the Contractor to ensure that the objectives of the design are achieved.

The lesson to Clients is clear. Do not skimp on the CE's services during Stages (a) and (b). Unwise savings then could well lead to much bigger expenditure later.

7. METHODS OF CHOICE

7.1 General Comment

It is perhaps natural for Clients without much experience of construction, faced with a somewhat bewildering number of potential CEs, to assume that the end product will be the same whichever one is chosen. If that were the case, the best way of choosing a CE would certainly be to adopt the firm whose fee was the smallest.

The discussion in the preceding section should indicate the error of that view. However a simple hypothetical numerical example may perhaps serve to illustrate more effectively the drawbacks of fee competition. CE-A requires a fee of 0.5 Million for his services in connection with the design and construction of a bridge which costs 10 Million to build, upon which capitalised maintenance costs 2 Million. CE-B cuts his services to the bone and charges 0.35 Million, but his bridge is "over-designed" and is not a good concept for the particular site,

in consequence requiring considerable maintenance. It costs 14 Million to construct and capitalised maintenance is 3 Million. Obviously the Client who saved 0.15 Million in fees by using CE-B would have rendered himself a great disservice.

Most National Associations of CEs oppose competition on the basis of fees since they will operate generally against the Client's interests. Many funding agencies also take the same view. What then are the alternatives?

7.2 Choice by Reputation

If the CED considers that the contemplated project lies outside its scope, it will almost certainly advise the Client of the necessity to employ a CE. The Client, in his own interests, should seek a firm which will do Stage (a) (Section 6) thoroughly, which has the necessary design "flair" for the project and can supervise efficiently the construction of the work. The engineers within the CED, being professional men, will have an interest in the engineering world around them and may well be able to recommend a CE whose work they know by reputation to conform to these requirements. Such knowledge would come from reading the technical press and attending world-type engineering symposia and colloquia at which engineering problems and projects are discussed. Perhaps the advice might come from another Client similarly placed who had found a certain CE particularly good.

The Client himself can enquire of the senior partner of the CE firm concerned if he is able to carry out the work. Naturally a prudent Client might not be content with the answer "yes". He or his representative would visit the offices of the CE firm in question to ensure that the people with the "know-how" were available to carry out the project, that adequate staff numbers existed and that the Client had every reason to suppose that on his projected job the CE would maintain his good reputation.

Clients, not unnaturally, may feel that CEs should visit them. Many firms of CEs of course maintain contact with potential Clients who are thus made aware of the firm's interest in working for them. However, when making serious investigations in relation to an intended appointment, there is no doubt that the Client will learn far more about a firm by visiting it himself than he will by having senior members of the firm coming to see him, naturally trying to give the best impression they can of their organisation.

Having chosen the CE he would like to employ, the CE has to satisfy himself that the fees the 'firm' wishes to charge are reasonable. For this purpose, the Client can refer to the Conditions of Agreement and Scales of Fees published by most National Associations of CEs. While such scales apply primarily to work in the CE's own country, nonetheless they will give some guidance to the overseas Client in agreeing conditions and negotiating reasonable fees with his chosen CE.

Of course there is nothing whatsoever new about these suggestions, they are the old-fashioned way of solving the problem. For all that, many world-wide examples exist of major projects demonstrating that this method is one of the most effective ways of obtaining the desired result. This remains the method of choosing CEs in many highly cost-conscious developed countries.

7.3 Choice by Submission

Many funding agencies to whom developing countries look for financing construction projects, are not happy for CEs to be chosen by reputation as outlined above. They require the presentation to the Client of formal submissions upon which the appointment is then decided. Many Clients in developing countries without the involvement of funding agencies, also adopt this procedure.

Generally, submissions are required to contain details of the size and resources of the CE firm and its experience, especially that relevant to the project in hand. Information is provided on the Partner (s) to be in charge of the project and the principal members of staff, especially relating to the experience and qualification of these people. Methods of working are stated and notional timetables given for the various phases of the work eg feasibility study, engineering report, design and possibly proposals for supervision of construction. Estimates of man-months of each class of person to be utilised are usually required. These latter estimates give some idea of overall likely costs, although some funding agencies require that no statement of actual fees should be made with the submission but should be provided separately, the idea being of course that choice should be made on the grounds of merit and not fee competition. To this end fees should be discussed only after the selection on merit has been made.

If a statement of fees is not included with the submission the method clearly has a similar intention to the one outlined under the heading "Choice by Reputation", and really represents a formalisation of this system. Unfortunately, however, some Clients while employing "selection by submission" do not treat consideration of fees in the manner described. Even apart from this however, the method does have a number of practical disadvantages both from the point of view of CEs and, in consequence, their Clients.

Submissions for overseas work can involve a great deal of time and travelling by partners and staff of CE firms to investigate local conditions before they can make proposals. Much staff time is also taken up in the preparation of documents. In consequence, the costs are very high in relation to CE's incomes. If all work is awarded to the CE profession on this basis, the cost of these submissions in the end is paid by Clients.

One American Federal Client, recognising some at any rate of the unnecessary costs arising from the system, stated in a recent enquiry: -

> "Unnecessarily elaborate brochures or other presentations beyond that sufficient to present a complete and effective proposal are not desired and may be construed as an indication of the offeror's lack of cost-consciousness. Elaborate art work, expensive paper and bindings, and visual and other presentation aids are neither necessary nor wanted."

Another disadvantage of the method is that by requiring in effect competition by submission, CEs may make proposals for several jobs, in the same way as Contractors bid for many contracts knowing that they cannot possibly get them all. Staff may simultaneously be theoretically committed to a number of schemes which, if only two or three were awarded to the CE, might force him to employ additional personnel in senior positions whom he did not know and, in consequence, whose work might not be up to the appropriate standard.

When Contractors find themselves in this position and if their work suffers in consequence, most often it is the Contractor who will be forced to bear the brunt of any extra cost arising. Falling in standard of CEs' work can be much more difficult to see. It may only result in a design unnecessarily expensive to construct, a fact perhaps detectable solely to the expert eye but the extra cost from such a cause will be borne by the Client.

Unless very carefully examined and understood, statements of man-months can themselves be misleading. For example, in connection with a concrete bridge, one CE may intend, as in British practice, to execute a detailed design and make all the working drawings himself. His submission will include the man-months necessary to enable this to be done which will in consequence be reflected in his fees. Another competitor may intend, perhaps in line with his standard national practice, to provide General Arrangement drawings only, from which the Contractor will have to prepare the detail design and all the necessary detail drawings, perhaps even of an alternative scheme. This latter CE in consequence shows many fewer man-months and, of course, a smaller fee. A Client is misled however if he thinks that employment of the second CE will cost him less than the employment of the first. Since the Contractor will have to carry out design calculations and make working drawings in the second case, the charge will be included in his tender, although it is extremely unlikely that the Client could ever identify it.

Some CEs, wise in the way of submissions, adopt this sort of tactic quite legitimately of course, to give semblance that their work content is reduced, or that they work more efficiently. Very careful and expert cross-questioning is in fact necessary to highlight these sorts of difference between submissions.

Another device which can be adopted to provide apparent efficiency of working and thus cut down on the number of man-months involved in design, is for the CE simply to employ an existing design of his own to which he makes minimal amendments, adapting it to make it fit the conditions of the job and site in question. If the CE knows his appointment will depend on minimising his own time or costs, he has no incentive whatsoever to propose extra investigation or design work although these might well minimise the cost of actual construction. The Client will certainly get a "tried" design in these circumstances, but he may wind up paying more for the structure than if it were "tailor made" or rather "tailor designed".

This last point is relevant only where creativity or original thinking can save money. There is of course no point in spending time developing new solutions where a routine solution would be very suitable. The Client should trust the CE's judgement of the situation which should not in any way be pre-empted by the conditions attaching to the CE's appointment.

Last - but by no means least - the importance of the brief issued by the Client when seeking submissions from CE's cannot be overstated. The Client should be clear in his own mind what it is he wants and the brief should reflect that clarity of thought. Otherwise the submissions will not be made on a common basis and will therefore be extremely difficult to judge. Such a situation is obviously of no benefit to the Client and is unfair to the CE's making the submissions. If a Client is uncertain as to the content of the enquiry he proposes to issue, inviting submissions,he could doubtless appoint a CE to advise him upon the matter.

7.4 Design and Build

The Design and Build system cannot be regarded as a method for the Client of choosing a CE. However, it merits inclusion in this discussion for the light it sheds on the question of choice and because, contrary to superficial appearances, the services of a CE or his equivalent, in the writer's view, remain essential to the Client.

Almost undoubtedly the largest sum of money associated with any construction project is that which is expended during actual building (Section 6, Stage (b)). It can therefore be argued that if this cost is minimised and certain precautions taken in respect of the Post-construction Stage ((c) of Section 6), near maximum economy will have been attained. The "Design and Build" System operates on this basis without the Client having to choose a CE, for the design, based on judgement of his reputation or by means of competitions through fees or submissions.

In the "Design and Build" system, someone - often a CE - undertakes the initial feasibility study for a scheme and prepares an engineering report. From this report, the parameters governing the design of the desired structure are laid down and these, together with an outline design, are issued to firms of Contractors who enter bids based on designs which they themselves individually create. In the tender phase, the Contractors develop these designs in considerable detail to enable them to price the cost of construction. The Client usually awards the Contract to the firm which has submitted the lowest bid for which the Client's adviser, either a CED or a CE, considers the design to be adequate.

Contractors are only too well aware that an appropriate design concept, coupled with good engineering detailing, is a vital ingredient in minimising construction costs so necessary in a competitive tendering situation of this type. It is interesting therefore to reflect that Contractors bidding in design and construct tenders very often themselves appoint CEs to investigate the sites and prepare designs for them. The choice is made on the Contractor's knowledge and judgement of the CE's flair and ability to produce economic designs for the type of structure involved, not on the basis of submissions or fee competitions.

"Design and Build" appears to be quite an efficient system but it too has its drawbacks. If five Contractors tender, then five designs will have been prepared in considerable detail as compared with only one in the conventional system. Those costs will have to be paid for by someone. They will enter into the overhead charges of each of the five Contractors, which eventually some Client must pay. Furthermore, the Client himself requires the services of a technical adviser, which may well involve the appointment of a CE not only to carry out the initial feasibility study and prepare the design specification, but to examine and thoroughly check the lowest tender design for compliance with requirements. After all the Contractor's designer may find himself excessively influenced by the needs to keep costs to the barest minimum to secure the work. It must be remembered too that technical codes of practice issued by developed countries for civil and structural engineering design are in many cases highly complex with significant differences between the design criteria of the nations. Comparison of international "Design and Build" tenders can thus be very difficult if the "technical rules" governing designs are not made uniform throughout.

The Client will also be very wise to employ the CE to supervise the work of construction to ensure that specified standards are met, otherwise costs of maintenance in the long term could be high.

It will be seen that the system in the example above involves employing six CEs or their equivalent on one project, where the conventional system would employ only one.

8. CONDITIONS OF AGREEMENT BETWEEN CLIENT AND CE

Reference has been made in this paper to National Associations of Consulting Engineers. Many of these Associations have been elected to FIDIC which, at the time of writing, numbers 29 Member Associations, some themselves from developing countries.

FIDIC maintains contact with the World Bank, UNDP and many other agencies and, in consequence, is well aware of the requirements of such bodies.

It has published, inter alia, two international "Model Forms of Agreement and International General Rules for Agreement" between Client and Consulting Engineer, one in respect of Pre-investment Studies, the other dealing with Design and Supervision of Construction of Works. Description of these Conditions would be out of place in this paper, but perusal of the documents will give overseas Clients guidance as to reasonable conditions of employment for CEs. Alternatively, Agreements can of course be made generally in line with the terms of the CEs own National Association or the Client's own National Association of Consulting Engineers, if one exists in that country.

No indication of fee levels is given in the two FIDIC booklets since obviously the matter on a world-wide basis is far too complex for any detailed scales to be set down. However, national Conditions of Agreement set down recommended fee scales in detail.

Some brief general comments by the writer about fees may not however be inappropriate here. CEs' fees usually are calculated upon on of three bases, namely: -

(1) Lump sum
(2) Time related (man-hours or similar)
(3) Percentage of Construction Costs

In the UK for example, many Government CE appointments in connection with design and construction are paid for using method (3), while method (2) finds favour for investigation work of a general engineering character and of a pre-construction nature.

For works overseas, especially in unusual locations where no local Association exists and where neither Client nor CE has previous relevant experience to go upon, it may be very difficult for either party to arrive at reasonable fees on a percentage of construction costs basis, since the CE's costs as well as the construction costs may be difficult to estimate in these circumstances. In such cases, time related fees may be the best compromise, perhaps in conjunction with a lump sum. It has to be understood that such time-related fees must cover the CE's overheads which can be very high.

It is usual for all approved out-of-pocket expenses such as travelling, cables, printing and employment of specialist advisers, etc, to be reimbursed by the Client. As far as supervision of actual construction is concerned, normal

practice is for all payments to be on a man-month basis in respect of the CE staff on the site. All the provisions of this paragraph refer to items which are difficult to estimate. Certainly employment of specialist advisers and supervision of construction should be on this basis to ensure no reduction of standards.

9. CONCLUSIONS

Independent Consulting Engineers exist to provide a service to their Clients, in connection with all phases of construction projects from initial conception through to maintenance. Their services cover schemes ranging from the simplest to the most novel and complex. More information about them can be obtained from Fédération Internationale des Ingénieurs Conseils.

Appropriately chosen Consulting Engineers can greatly assist their Clients to achieve their construction objectives and to keep overall costs to a minimum.

To these ends the choice of Consulting Engineer should be based on his technical competence, design flair, especially to suit local conditions, and project management ability. In short, merit should be the criterion for his selection.

Clients are ill advised to constrain Consulting Engineers to curtail feasibility studies, design work or site supervision simply to reduce charges. Greatly increased costs to the Client, out of all proportion to the savings, are likely to result during construction and subsequent use of the structure, if work in the preceding phases has been of inadequate scope.

One Consulting Engineer or group of Consulting Engineers in association, should ideally be responsible for all phases of the work from initial studies to maintenance in service. Certainly engineering studies, engineering design and supervision of construction should be the responsibility of only one firm or one association. The work is likely to be more effectively carried out with this arrangement and the Client cannot be faced with problems arising from divided responsibility.

Association of Consulting Engineer firms should result from complementary expertise or specialised local knowledge in combination with foreign technology. Such associations should be voluntary and not "shot gun marriages".

FIDIC has published two papers dealing with Agreements between Clients and Consulting Engineers, these publications do not deal in detail with fees. National Associations of Consulting Engineers publish documents dealing with fee scales, but these are designed in general for work executed within the particular country.

References:

FIDIC : International Federation of Consulting Engineers
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