

Consulting Boards for Large Civil Engineering Projects

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Introduction

The design and construction of large civil engineering projects such as dams, bridges, water supply tunnels or hydroelectric projects commonly extend over five to ten years and cost hundreds of millions of dollars. The Owner of such a project normally sets up a Consulting or Review Board of independent experts to advise on technical issues and to monitor the progress on design and construction.

The following notes set out some guidelines on establishing such a Board. These notes are based upon the first author's experience as a member of several Consulting Boards over the past 15 years and the second author's experience in working for a knowledgeable owner that has used Consulting Boards for the past 30 years.

A Consulting Board should be composed of a small number of internationally recognised authorities in a number of disciplines. The purpose of the Board should be to provide an objective, balanced and impartial view of the overall design and construction progress on a project. The Board should not be used as a substitute for normal consulting services since members do not have the time to acquire all the detailed knowledge necessary to provide direct consulting opinions.

The function of the Board should be to act as the technical review agency for the Owner. Ideally, a Board should ask the engineers, consultants and project managers "have you considered this alternative?" rather than be asked to respond to a request such as "please provide recommendations on the best tunnel alignment". When individual members of the Owner's design team wish to seek advice on basic design issues from members of the Board, this should be done informally rather than in the form of agenda items for the meeting. This will reduce the risk of important overall concepts being missed because of an agenda over-loaded with relatively minor design details. In most cases Board members are more than willing to discuss these design details in informal meetings and, if necessary, to provide written comments and to send copies of papers when they return home after the meeting.

Composition

In our experience, the most effective Boards are very small (2 to 4 members) and are carefully chosen to cover each of the major disciplines involved in the project. For example, in the case of a large hydroelectric project involving a concrete gravity dam, an underground powerhouse and several kilometres of tunnels, the board members could be:

- A geologist or engineering geologist with experience in the type of geological conditions that exist on the site. This is particularly important when unusual or difficult geological conditions such as karst features, thermal springs or major faults are likely to be encountered.
- A rock engineering specialist with experience in dam foundations, tunnel and underground powerhouse design and construction and in rock slope stability problems.

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- A hydraulics engineer with experience in flood routing, pressure tunnel design and optimisation of flow through intakes and outlets.
- Depending on the nature and size of the job it may be appropriate to include, in addition to these 3 disciplines, a "generalist" civil engineer who has a good background in layouts, scheduling and construction techniques that may be critical in a large or complex job. This Board member could be a former Chief Engineer with a large firm or agency.

The best type of Board member is a mature individual with an established technical reputation and with wide practical experience. Personality of the member is critical since an effective Board is made up of individuals who are not afraid to state their opinions but, on the other hand, do not dominate the other Board members by dogmatic or irrational behaviour. In forming the Consulting Board the owner should not only ask each potential Board member whether they would be willing to serve on the project Board but also whether they would be willing to serve together with other potential Board members. This approach tends to eliminate Board members who have acquired a reputation for domination or inability to compromise on judgmental issues. An ideal Board does not require a chairman since it acts as a self-regulating unit.

Board members should, if possible, be independent of major consulting, contracting or equipment companies. When the ideal member is employed by such an organisation, it should be clearly stated in the letter of invitation that the organisation for which he or she works will be excluded from any major decision making role in the project.

Terms of Reference

In retaining a Board it is important that the owner set up some Terms of Reference so that it is clear to the Board members, Owner and design engineers what the Board's function and responsibilities are. These terms should be short, simple and articulate, such as an example given in Table 1, which is for a hydroelectric project that involves stabilising a potential landslide just behind a dam. Although cost is certainly important to an Owner, the primary function of any Board should be to ensure that what is being designed and built is appropriately safe both for the Owner and the general public.

Reporting

The Board should report directly to the senior technical officer of the Owner. Even if other organisations are involved in making travel arrangements, preparing reports and acting as hosts during visits, the reporting procedure should be rigidly defined and clearly adhered to.

The title of the senior technical officer (e.g. Chief Engineer) and the reporting line will vary from owner to owner but ideally this senior officer is not involved in the direction of the design group responsible for the project but rather is at arm's length to the designers. The designers themselves may retain specialist consultants to guide them on specific issues that are not the function of the Consulting Board.

A brief report should be prepared, signed and presented before the Board leaves. This report may range from 5 to 50 pages in length, depending upon the stage that the project has reached and the problems that have been encountered. With the powerful word processing facilities that are now available, preparation of such reports is entirely feasible. Occasionally, a supplementary report may be requested from one or more of the Board members if more detailed investigations or analyses are necessary and where adequate facilities are not available on site.

In some cases it is advisable to convene a short meeting with government ministers or senior executives of the Owner at the end of a Board visit so that the Board can report directly to these persons and reinforce the authority and credibility of the senior technical officer.

Meetings

Except at the beginning of the project, when more frequent meetings may be required, six monthly or annual meetings of the Board are generally adequate for major long-duration projects. Occasionally, individual Board members may be asked to make special visits in order to inspect a particularly critical phase of the project. In such cases, the individual member acts as a representative of the Board and is obliged to keep the other Board members fully informed of his or her activities.

For all meetings a carefully prepared data book should be prepared for the Board members and should then be sent by the Owner to the Board prior to the meeting. Even if the Board members are only able to scan the book en route to the meeting, they will be better prepared to concentrate on the major issues than if no materials were sent beforehand. Provided the Owner can be considered a knowledgeable owner (e.g. a power utility with its own engineering staff), the data book should be prepared from the standpoint of "this is what we are doing or what we propose" and asking for the Board's critique rather than asking the Board how to do the work. Also it is important for the Owner to include in the preface or summary of the data book a list of key issues that the Board is specifically asked to address during the meeting and provide written comment in their report. This list is not meant to limit the Board from dealing with any important aspects that are significant to the safety, design and construction of the project but it does provide a focus for the meeting and reporting. In subsequent meetings after the first, it is important that the data book include a section on the actions taken on the Board's recommendations since the previous meeting.

For the first meeting and even for subsequent meetings, it is essential to spend the first or second day on the site to get an appreciation of the site layout, geological setting, layout problems and work progress. Such a visit provides the Board members with first hand site information and creates a focus for the office meetings that follow.

A typical agenda for a Board visit is:

Day 1: Visit site and inspect critical problem areas, control facilities, field laboratories and other areas of relevance to the project.

Day 2: Meet with senior technical officer and representatives of major consulting groups for project briefing. Receive briefing notes and hear presentations from specialists in each major discipline and from the senior technical officer.

Day 3: Review reports, discuss specific aspects with project specialists. The Board may split up into individual task groups or it may wish to convene small meetings of specialists in order to discuss particular topics.

Day 4: As for day 3 and also preparation of brief report.

Day 5: Presentation of report to senior technical officer and representatives of project consultants. Brief meeting with government or senior executives, if appropriate.

Summary

In the opinion of the authors, the formation of a Consulting Board is highly desirable, if not mandatory for a successful project. Those involved in the design and construction of a major project can often become so involved in the details of the work that they find it difficult to stand back and take an impartial view of alternative approaches. The Consulting Board, with its requirement to be impartial and its years of practical experience on similar projects, can usually pin-point design deficiencies and construction problems very quickly. Once these problems have been brought to the attention of the Owner, it is surprising how often an effective solution can be found. Even in cases in which a job is controlled by a very good Engineer and constructed by a

competent Contractor, an occasional independent review can provide the Owner with the assurance that all is in order. This assurance can be important to the Owner in dealing with governments or with the general public.

Table 1 : Terms of Reference for a Consulting Board set up to advise an Owner on the stabilisation of a potential landslide just behind a dam.

To review the morphology, geology, surveillance results and other information relevant to the potential slide.

On a priority basis to assess and advise on the significance of the movements recorded to date and the potential for a large fast landslide.

To recommend to the Owner any additional investigations that they consider desirable.

To review the available seismic information including the probability of major earthquakes and advise on their possible effect on the stability of any potential slide.

To review the present surveillance system and procedures and to recommend any changes that they consider desirable.

To review and agree with any remedial action proposed by The Owner such as a drainage tunnel and/or drain holes or to recommend any alternative that they may deem appropriate to increase the stability of the slope.

To review and advise on any remedial measures adopted and the significance of the surveillance results obtained during and after their construction.

To meet and discuss the potential landslide with the responsible government officer and his representatives and with the Owner's Board of Directors as and when requested by the Owner.

To meet with the Owner and visit the site at such intervals as are appropriate and to provide a brief written report to the Owner after each such meeting and/or visit.

To provide the Owner with a final report giving the Consulting Board's assessment, the necessity for and effectiveness of any remedial measures taken and the recommended future surveillance.