

Crisis Management and Real Time Response:
The Nine Steps to Success
by
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It is a fact of engineering life that deep excavations do not always perform as intended. Occasionally, such problems are sudden and dramatic, and enter the folklore as the “great...failure of (insert year of event)”. Typically, however, the problem involves movements of small scale (in absolute but not relative terms), which occur progressively over periods measurable in days or weeks. These movements may continue until a catastrophic failure occurs or an appropriate remediation is implemented. Causes for these events can include:

- insufficient and/or inappropriate site investigation;
- inaccurate geotechnical interpretation;
- undetected and/or variable site conditions;
- design deficiency;
- inappropriate construction techniques;
- insufficient control of construction quality;
- “on the fly” changes to the project which create conditions with an insufficient factor of safety; and,
- miscellaneous and environmental factors: unexpected vibrations; extreme climatic events; or substantial changes in piezometric conditions.

Most often a combination of these factors is present and active, especially in the case of sudden failures.

Fundamental Elements of Crisis Response Management

A generic nine-step framework has been created for managing a crisis situation during construction. These steps are consistent with the overall framework of problem solving, namely:

- explore, analyze and assess the situation;
- design and implement a responsive, flexible solution;
- monitor the progressive impact of the solution in real time; and,
- verify the effectiveness of the completed solution and continue to monitor long-term performance until satisfaction is guaranteed.

The duration of each step will be project-specific and, in some cases, there may be overlaps, especially in the early days. In all cases, common sense must be applied in liberal amounts, supplemented by the best project scheduling tools that critical paths can crave.

Step 1. Appoint a Project Manager. The Project Manager will act as the coordinator of the short-term emergency and the subsequent longer-term remediation efforts. This Manager should be drawn from the ranks of the Owner or Designer, and should have direct experience with the project from its conception. The Manager should be

relieved of most of his/her routine duties and empowered to seek further assistance from internal resources and external consultants. The Manager must be authorized to act independently and skilled at effective leadership. A separate “mission control” room should be established where data are collected and analyzed and technical and planning meetings are held. Every meeting should be formally documented to form the basis for “post action” reports.

Step 2. Evaluate the situation. Evaluate the situation through analysis of all available data. The Project Manager must pay special attention to documenting verbal accounts from witnesses of “the event.” Such accounts can be of great benefit in subsequent analyses, but their value closely depends on their accuracy and completeness which may rapidly recede with time.

Step 3. Implement necessary measures. Implement all necessary short-term measures which legally, administratively, or practically have to be taken. The prime directive is to safeguard human life. From a technical viewpoint, this may include installing additional instrumentation to help quantify the issue; reading existing instrumentation more frequently; inspecting the site; relocating equipment that is threatened by the event; or instructing rapid earth movements to fill excavations or provide temporary buttresses. These actions help to create a baseline, mitigate the immediate impact, identify if the situation is deteriorating further, and/or help the Project Manager determine the level of imminent danger.

Step 4. Conduct a New Site Investigation. Design and conduct a focused program of new site investigation to establish the cause of the event. This study will facilitate a conceptual remedial design and its cost estimate. It will also highlight the potential for further distress to overlying or adjacent structures. During this time, the instrumentation reading schedule of Step 3 must be maintained.

The site investigation should comprise desk and field studies. The desk study should include a review of construction and excavation records; historical performance data; instrumentation data; regional, local, and site geology; climatic and seismic records; aerial photographs; personal recollections; and published technical papers. Input from specialists active in the region can be most useful.

For the field study, the Project Manager must install investigation holes by the fastest and most economical method; conduct dilapidation surveys of all adjacent structures; and, wherever possible, compare them with corresponding preconstruction surveys.

Often, the exact causes of the problem cannot be quickly and/or definitively determined, especially when the opinions of the numerous teams of “experts” must be reconciled in a “best for project” atmosphere. It is idealistic to recommend that Step 5 not be commenced until Step 4 has been completed. However, it is critical to bear in mind that the tactic of “Fire, Aim, Ready!” is not the best way to win a battle.

- Step 5. Develop a Design for Remediation.** Assuming that the situation is to be rectified, versus monitored and/or managed by other means (e.g., abandonment, surrender), the Project Manager and the Project Manager's advisors can now develop the design for remediation. Data from Step 4 are critical. Input from specialty contractors and other experts should be sought, as appropriate, and the technical literature reviewed for case histories of similar nature. It is essential that the design clearly identifies the "measures of success". Few contractors, and even fewer consultants, will have faced such a problem before and may underestimate the difficulty of the remediation. Considerable amounts of time and money have been lost by hastily employing local contractors who try to "shoe horn" into practice their traditional, simple and conventional methods which later prove to be inadequate. Also, such contractors may have been hired on a "cost plus" or "time and materials" basis and may not be highly motivated to achieve a quick and definitive solution.
- Step 6. Hire the contractor.** Contractor selection should be done on the "best value" as opposed to "low bid" basis although the two may occasionally be the same. Emphasis should be placed on the experience, expertise, resources (human and mechanical) and work plan of the Contractor, as opposed to the estimated initial price. Engaging the "wrong" contractor will certainly lead to disappointment and dispute over schedule, performance, and cost, and inappropriate construction methods may worsen the situation. It is difficult to accurately estimate the cost of such works at this stage. The Contractor must be regarded, and must perform, as a technology partner, working in full alliance with the Owner and the Engineer.
- Step 7. Execute the work.** During this phase, all data relating to the contractor's operations and impact on the overall system and environment must be collected and evaluated in real time by the Project Manager and the "mission control" team. Only in this responsive, integrated fashion can the effect and effectiveness of the work be revealed progressively and a sound engineering basis created to instruct changes to the program, if required. These data are also valuable in the ongoing reevaluation of the soundness of the design (Step 5). This step continues until the remediation has been completed and a short-term confirmation period has successfully elapsed. Duplication of structural monitoring methods is highly advisable with most credibility given to the data generated by the most reliable and accurate system such as automated total stations, electrolevels and in-place inclinometers, as opposed to transit survey, crack gages, and visual observations.
- Step 8. Prepare the Report.** A fully comprehensive "as built" report covering all the relevant data from Steps 1 through 7 should be prepared as soon after the remediation as practical. It should contain copies of all meeting minutes, construction logs and drawings, and field instrumentation data and observations. It should include an inventory of all functional instrumentation and their reading schedule.
- Step 9. Establish Long-term monitoring.** The Project Manager must establish a regular schedule for reading all functional instrumentation sources, analyzing their data, and conducting any relevant revised site or structural inspections. A database must be

established alongside a well-defined series of protocols to follow if certain instrumentation triggers and/or threshold levels are reached. These protocols should include details of the responsible person(s) to be notified, and appropriate emergency response plans.

Deep excavation projects are extremely stressful and demanding for all participants regardless of the glamour of the project or the thrill of the challenge. These jobs demand the highest levels of leadership, management, administration and technical expertise, and skills. There is no question that, under such conditions, the adage “you find out about people in adversity” applies.

Hopefully, this nine-step framework for crisis management provides comfort, confidence and guidance to those who are given such challenges. It is further intended that this paper contributes to the basis for contingency plans or protocols that could be developed by managers and engineers engaged in major civil engineering projects involving the moving of major amounts of “dirt.”

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