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How Will This be Built?

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The current business climate in the San Francisco Bay Area, as well as many other areas of the country, is requiring design consultants and builders to stretch their staffs on multiple projects to meet the demands of the robust economy. For every existing client that continues to require design and construction support for their expanding business, there appears to be one or more new clients looking for the same services from the design and construction industry. In addition, these services must be delivered even quicker than before as clients try to keep pace with the industry around them. In order to satisfy the clients' needs consultants and builders must hire more staff, turn work away, and/or stretch their existing resources even further than imaginable. Given this astounding growth in the Bay Area economy and the need for almost every project to be delivered as quickly as possible, consultants and builders must figure out ways to be more efficient in every aspect of their daily work.

One of the traditional project delivery methods is for an engineer to produce a set of documents that can be given to a contractor to implement. If everything works out as planned, the contractor will build what was designed and leave the engineer alone to tackle the next demanding project. But as experience shows, this is rarely the case. In today's market, the demands for fast project delivery don't allow engineers the luxury of really doing what they do best: solving problems by analyzing several possible solutions, getting feedback from the standpoint of cost, schedule and quality, and then implementing the best solution and providing all information necessary to make it happen.

In order to succeed in this demanding environment, the engineer can take some simple steps early in the design process to help achieve dramatic results to help achieve overall project success. The process starts with the question, "How will this be built?" Obviously, this is an elementary question, but the steps that are taken to answer this question will result in defining the project in such a way that the effort expended by the entire team over the course of the project will be reduced.

When asking the question, "How will this be built?" the first concept that comes to mind is that of constructability. The earlier in the design process that this is addressed, the better. When the project involves building in or near existing facilities or services, it is imperative the engineer become familiar with the existing conditions. Out of necessity, the engineer becomes familiar with the geotechnical, civil

and structural aspects of the existing conditions. Less obvious, but sometimes more significant, are the effects new structural elements can have on the critical building services such as electrical, telecommunications, process piping, life safety, and mechanical systems. Generally, the impact occurs when the location of a new structural element requires the shutdown and relocation of some element of a critical building system that results in an impact to the project budget or the client's business operation. Identifying these problems early is critical in helping the engineer eliminate potential solutions that may prove to be unacceptable.

For example, in designing the lateral bracing for an existing building, the most desirable solution from both a performance and occupancy use perspective might be a series of steel frames. The proposed location and installation of one of the frames as designed will require shutting down and relocating the main electrical panel for the building. The impact of this work is deemed unacceptable by the client due to the cost of relocating the electrical service and the interruption of business operations during the relocation. By simply evaluating the locations of the structural frames and the impact on the project, the engineer is able to reevaluate the design early in the process.

Another aspect of constructability that is sometimes best answered by the builder is what construction equipment must be used to install the system as designed. In some cases, the equipment necessary to install some element of the design prohibits the use of that element in the design. Taken in context, something that is "prohibited" must be defined as something that may not be feasible due to not only physical constraints, but also safety, schedule or budget constraints.

The following examples illustrate the impact a physical constraint for construction equipment can have on a design. Consider the design of a new foundation system that will be installed in an existing occupied building with a basement that has a low floor to ceiling clearance. Based upon the soil conditions, a drilled pier foundation system appears to be the best "engineering" solution. Yet this system is not practicable since a drill rig will not fit in the basement. Recognizing this early on will keep the engineer from spending too much time on a solution that may not work. For a second example, a new foundation must be designed for a new building that will be located next to an existing building. Due to the existing soil conditions, the soils engineer recommends a driven pile foundation system. The existing adjacent building happens to be a testing and manufacturing facility that has vibration sensitive equipment that will be disrupted by the vibration of driven piles. With early recognition of this, the engineer is able to reevaluate the foundation system and consider other options before proceeding further with the design.

Another facet of a project that comes to mind when asking the question "How will this be built?" is the schedule. In many of today's projects, the first and foremost concern for the client is how quickly the new facility can be up and running. The design can affect the project schedule in both material lead-time and actual construction duration. With regard to material lead-time, the size and makeup of the structural elements should be determined and conveyed to the builder as quickly as possible. If the design involves steel wide flange shapes, members that need to be milled should be identified and pre-ordered so as not to impact the schedule. The construction duration is often most affected by the details of the design, which are usually conveyed at the completion of the design documents. Bolted connections generally result in less field installation time than welded connections. Shop welding can often save time over field welding, in addition to saving money and improving quality. Thus, it is important for the engineer to consider the final details as early as possible.

As illustrated in some of the examples given above, the time spent in the conceptual phase of design is invaluable in providing project success and also reducing the engineering effort put forth in designing "prohibitive" systems or elements that may require redesign later in the project. Getting early involvement from the builder can provide greater success to both the project as a whole and to the efforts put forth by the design engineers. Before expending too much effort on the design, always remember to ask, "How will this be built?" We suggest asking your builder.