

3. Provide for cooperative resolution of unforeseen problems;
4. Provide for correct sampling and testing techniques and assign well-trained personnel as inspectors on the job; and
5. Give prompt decisions concerning the acceptability of materials or items of construction.

The seller must

1. Set realistic targets for material properties and construction processes that ensure a high degree of confidence that the quality asked for is being provided (operations designed to be just good enough to get by will always be a source of problems),
2. Not take advantage of loopholes such as the absence of inspection or a lack of requirements that allow inferior materials to be used, and
3. Provide knowledgeable personnel who can recognize the conditions necessary for good results and apply corrective measures if the process goes out of control.

SUMMARY

In summary, both the buyer and seller have two courses open to them. The negative course of action available to the seller (contractor) might be described as circumvent, cajole, and cry. That is, if a requirement appears costly to live up to, the seller can look for ways to adjust the material or cut corners to lower costs. The buyer's representative can be cajoled into accepting materials or construction that might be questionable. If this fails, he or she can then complain or appeal for exceptions.

A similar negative course of action by a buyer can be described as coercion, criticism, and condemnation. The buyer can attempt to make the seller live up to the letter of requirements and timetables when there are good and justifiable reasons for delays or when unforeseen circumstances have indi-

cated a need for reconsideration of the requirements. He or she can adopt an attitude of criticism--always be on the lookout for any action that might be questioned. The buyer can also condemn any insignificant deviation from requirements and thus cause unnecessary interruptions and delays.

Obviously, neither of these negative courses of action is desirable and would most likely result in inadequate performance of the product and high costs because of litigation and replaced or reworked components.

The positive alternative available to both the buyer and the seller is to adopt the principles of communication, competency, and cooperation. Good communication is established through clear and complete specifications. Requirements must take into account not only what is wanted but also what is attainable at a reasonable cost and within a reasonable period of time. The responsibilities of each party must also be clearly understood. Competency must apply to both the buyer's and seller's representatives. They must be able to recognize deviations from the normal that can lead to problems. Finally, a spirit of cooperation must exist. Representatives of both the buyer and seller need to recognize that their primary goal is to construct a good facility. The buyer's representative is not out there just to see that the buyer is not cheated, nor is the seller's representative there only to reduce costs whenever possible so as to increase profits.

The positive approach--communication, competency, and cooperation--will optimize state-contractor relations and ensure that the best quality is attained with the materials and techniques specified with fairness to both parties and maximum benefit to the public.

REFERENCE

1. Quality Assurance. NCHRP, Synthesis of Highway Practice, Rept. 65, Oct. 1979.

Summary of Contractual Relations: An Essential Ingredient of the Quality-Assurance System

RICHARD L. DAVIS

Since competition is so much a part of life in our society, it is easy to understand how adversary relationships develop. Adversarial relations are disruptive and costly in the construction field. It is in the interest of all parties to try to reduce the waste from this friction through improved communication and understanding. It is very helpful to the completion of the job if each party is competent and cooperative.

Competition is such an important factor in the economic system of the United States that it is not surprising that it is carried to the point that it is counterproductive at times. One area in which competition often becomes excessive is in the buyer-seller relation. This relation can start out as a healthy effort by the representatives of both parties to protect the interests of their principals, but it sometimes deteriorates to the point where the representatives become adversaries.

People can become so involved in the adversarial nature of this activity that they lose sight of the more important effort to produce something of value. This can be particularly true in the construction field, where the adversarial relation can increase costs and delay the completion of vital projects.

It is essential that the parties involved learn those factors that are truly important to the success of a given construction project and not allow wasteful controversy to negate its completion. Controversy is encouraged by confusion and misunderstanding about the variation in test methods and their application to specifications. Great care should be exercised in the selection of the properties that will be used to control the work and the test methods that will be used to measure

those properties. A price is paid for every property measured and consideration should be given as to whether the gain in control of the project through the use of a test method is worth what it costs. These costs include not only the direct cost of testing but also the cost increases that the variation of the test method adds to the interpretation of the test results through misunderstandings and confusion on the job.

An example might help to clarify this relation. Some years ago, a state highway department was writing a specification requirement for controlling the variation of asphalt content in bituminous mixtures. They decided that a specification limit of ± 0.3 percent would be set for asphalt content of bituminous concrete. I pointed out that the major component of variation is due to the distribution of the various individual pieces of aggregate. In other words, the asphalt content of large pieces of aggregate is much lower than that of smaller pieces of aggregate. Therefore, the asphalt content of a test portion rises or falls with the number of large pieces of aggregate that it contains. This is a chance variation that had been shown to have 95 percent probability limits of ± 0.5 percent for bituminous concrete of the type specified. I pointed out that about 20 percent of the test results would be outside the specification limits of ± 0.3 percent due to chance causes in the measuring system. This was something about which the contractor could do nothing. The state highway department said that they wanted to set a goal for contractors to strive to attain.

I went back after one paving season and asked how the ± 0.3 -percent specification was working. I was told that it was performing very satisfactorily. On examining the test results, a little more than 20 percent of them were outside the specification limits. No action had been taken in connection with any of the out-of-specification material. This specification was, in fact, not a specification because no mechanism was set up for eliminating any material no matter how far out of the specifications it might be. If a specification is to be written,

it is important to set the limits so that they are meaningful and realistic in relation to the testing and sampling variation.

Abdun-Nur, in a paper in this Record, spoke eloquently of the need to focus on the whole process of obtaining quality in a contract or project. He urged us not to be sidetracked into only a portion of the quality picture or into fruitless controversy or adversary relations. He emphasized the importance of considering the total system for controlling quality.

Steele and Higgins, in another paper in this Record, emphasized the importance of being fair. Under our system of open bidding, unfairness nearly always results in higher costs, often without compensating benefits. They also stressed keeping channels of communications open in order to improve performance and save money.

Thompson, also in a paper in this Record, spoke of the importance of the contractor's knowing how to produce a quality product at a high level of productivity. He also spoke of the fact that the contractor could put all of his or her efforts into increasing productivity and quality under a properly devised quality system. Waste or increased costs are the result of a poor quality system, where the contractor cannot meet the required specifications no matter what he or she does because the specifications were improperly devised.

Dunn, in a paper in this Record, spoke of a proper quality-assurance program from the point of view of the Federal Highway Administration. He commented that the West Virginia Department of Highways used the same work force in the 1970s as in the 1960s to meet a work load that was five times higher than that of the 1960s. Further, although perfection was not achieved, the quality-assurance system is working in practice.

Halstead, also in a paper in this Record, spoke of optimizing state-contractor relations from the research point of view. He spoke of the problems that can arise between an engineer and contractor and how each can diminish them through reasonableness and conciliation.

Contractual Requirements and Design Philosophies Employed to Minimize Adversary Relationships: Eisenhower Memorial Tunnel, Second Bore

PHILLIP R. McOLLOUGH

The Colorado Department of Highways awarded a contract to construct the first bore of the Eisenhower Memorial Tunnel on October 3, 1967. The tunnel was opened to traffic on March 8, 1973, two years behind schedule and had a cost overrun of approximately 125 percent. Substantial difficulty was encountered in constructing the tunnel due to the bad ground conditions that existed in the eastern half of the tunnel. A redesign was necessary and the project contract was modified to a cost contract to complete the eastern portion of the tunnel. Not only did the ground conditions deteriorate, but the working relationship between the owner and contractor developed into a classical adversary relationship. With the previous construction history indelibly impressed in the owner's mind, steps were taken in June 1973 to develop a design to complete the facility by driving the second bore. Considerable attention was given to development of a workable design and equitable contract

provisions that would share and minimize risks involved. The second bore contract incorporated equitable contract provisions along with two new provisions that provided for the establishment of a project review board to handle major construction disputes and escrow documents (contractor's bid documents) to serve as a basis for evaluating the contractor's bid. The escrow documents would also facilitate equitable settlement of major construction disputes. The contract for the second bore was awarded to the joint venture contractor of Peter Kiewit Sons Company and Brown and Root on August 11, 1975. The contract was completed successfully nine days early, within budget, and approximately three percent under the engineer's estimate. The contract and its provisions, along with the design, helped to produce an outstanding product.