

## SPECIFICATIONS AND SPECIFICATION WRITING

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Gentlemen the prime objective when you start a job is to get the *biggest value* for the *taxpayer* while spending the least money. To accomplish this object, *specs* play a very big part.

Before taking up the matter of specifications, I should like to tell you an incident related by Robert Louis Stevenson.

The famous Eddystone Lighthouse was built in 1759 on an exposed ledge or rock off the south coast of England by John Smeaton, a pioneer. The Duke of Argyll on an inspection tour once asked Smeaton: "Pray who *taught* you." To which Smeaton replied: "If it please your grace, I might say that I was *self-taught*." The idea expressed by Smeaton was prevalent to much of our early road building. But the road builder of today has an important advantage over those of the past. *He* can draw on the experience of others and make that experience part of his own. In a meeting such as this a great many ideas are exchanged. You, as individuals, benefit from the exchange of experiences and the people of Kentucky benefit. You have in Frankfort a most efficient Highway Department on which you can always call when in doubt, and we, here at the University always stand ready to help you solve some of your more difficult problems, whenever it is possible.

As you all know the State Highway Commission has prepared a very comprehensive set of specifications which cover in *great detail* work that is done on State highways. These specs are the *road builder's Bible*.

As the Holy Bible is God's inestimable gift to man; so the Standard specs are the Highway Commission's gift to the County road builder. But as the Holy Bible must be properly interpreted to yield up its great *truths*, so must we use and interpret the Standard Specifications to get our best results. When as mankind we are in trouble and doubt we turn to the Holy writ for guidance and help, so when we as engineers are in trouble and

doubt as to how we should carry out a certain local project, we are always able to turn to our *road Bible*, the Standard Specifications. They are a rock on which we can stand.

Those little electrostatic charges which ultra-fine grains possess; the properties of some minerals which cause them to expand their atomic structure and admit foreign elements in the presence of certain agents; and the introduction of agents to neutralize the undesirable properties of fine grained soils, all offer intriguing possibilities for combatting problems of sub-grade support. Certainly the greatest problems lie in the realm of soil particles of this size. There is not a whole lot to report along these lines, except that in our cooperative research here between the University and the Highway Department we have succeeded in isolating the smallest of individual particles. Furthermore we have found a way of looking at an image of it. If you want to visualize its actual size, imagine a small glass sphere no larger than the lead in the end of this pencil crushed to the point where it would form about 7500 individual particles of equal size. That is the size of a small particle of clay.

The ultimate objective of all of this is not only to identify and understand these very fine, highly reactive soil grains, but also to find ways of making them practically inert or completely stable. We would like to make the soil something that it isn't—a synthetic material so to speak. If and when we achieve this we should have reached perfection. That's asking a lot, but as was the case with the three crows in Walt Disney's version of the little elephant with enormous ears, "You've seen everything when you see the elephant fly." When we reach the point of complete and permanent stabilization of the very fine grained soils in our subgrades, truly we too will have seen the elephant fly.

As I said a minute ago, you want to get the *most real value* for the *taxpayers' money* and a good well drawn specification helps materially to accomplish this aim.

To form a really good binding contract there must be what the lawyers call a *meeting of the minds* and as any businessman will tell you each side must profit by the bargain.

First you must know *exactly* what you want; and then and then only you must convey your ideas to the contractor so that he

will know exactly what you have in *your mind*. That is what specifications are for.

If we were dealing only with high class reputable contractors you could take them into your office, tell them what you wanted and be reasonably sure that you would get a good bid and a good job. But unfortunately all who use your specs do not come under that classification, and we must write our specifications with the *cheap crooked dishonest* individuals in mind. There must be no loop-holes through which they can slide. 95 per cent of our contractors, supervisors and engineers are honest hard working men trying to do their best. While we must protect ourselves, we must not make the spec so rigid that they can not turn in a first class job.

The *first prerequisite* of *good specs* is that you know your subject and what you want, from A to Z. Then use the Standard Specifications as your base. *Don't try to be too original* except in rare incidents; the *more original* a specification is the *poorer it is*. On the other hand, *don't* copy paragraphs that you yourself do not understand. For instance in the old days when brick pavement was in vogue in the upper Mississippi Valley, in which the foundation consisted of broken stone filled with sand and properly rolled, this clause was commonly inserted in the spec: "The sand shall be rolled with constant light watering to prevent licking up." What in the world does the latter part of this sentence mean. Possibly the originator had an idea which he thus imperfectly expressed; others evidently not knowing what it meant adapted the clause for fear that otherwise they would prepare a defective specification.

*Clearness* in all details, both in the plans and specifications is a protection for *both* the *taxpayer* and the *contractor*. In one case the contractor is unable to do improper work or avoid the execution of essential details and on the other hand he can know *exactly* what the engineer requires. He can regulate his bid accordingly without adding a percentage to cover uncertain work, which he may be obliged to do but which is not clearly specified. Let me give you an extreme case. Here is a single sentence lifted from an old Spec: "All timber standing where levee is to be constructed may be held by the contractor as his own and he will be allowed an excess of 25 per cent price per cubic yard for fill-

ing said muck ditch as in the levee embankment; also the contractor will be required to add 10 per cent to the height of the levee above the grade line to allow for settling of same." Gentlemen: you are not building levees but this will illustrate what we mean when we said make the specifications *clear*. This one sentence contains just *four* different ideas. Make your sentences short and snappy.

*Ambiguity always adds to the cost of a job.* For self protection the honest contractor must increase his bid price, while the dishonest contractor may get the bid at a lower price and later tries to cut corners using the ambiguous clauses as his shield. And in this connection, gentlemen, it rarely pays to go to *Court*, because you will find the cards stacked against you before you call your first witness. The average jury think and decide the facts under the psychological urge that here is a big rich County with lots of money to spend trying to grind this poor contractor into bankruptcy.

Use *good English* and don't hesitate to *repeat words*. In writing reports we sometime dislike to repeat a word where other words might express the same general thought. We do this so that the report will read smoothly, but this is *not* what should be done when writing *specifications*. Words never mean *exactly* the same thing. Take for example part of the specifications on which the \$2,000,000 Bronx-Valley sewer contract in New York was let. Here the engineer described the concrete to be used as 1:2:4 mix. He then went on to describe a *batch* to consist of one barrel of cement; two barrels of loose sand and four barrels of stone. Now as you gentlemen know the volume of a barrel of cement is 3.185 cubic feet; while a barrel of sand or stone is 3.25 cubic feet. The inspecting engineer of course insisted that the contractor follow the formula that gave the richest mix which was really 1:1.68:3.38. When the job was complete the contractor put in his bill for this more expensive mixture and doggone if the Court didn't allow him an extra \$36,000. The failure here to repeat ideas exactly cost the State of New York \$36,000.

Be sure to describe *common words* that might have more than one meaning. Very often even technical words will have more than one meaning. For instance, *ton*, it may mean 2000 lbs. or it may mean 2240 lbs. In most localities a cord is 128 cubic

feet, but there are many places it may be only 100 cubic feet. Be sure, where there is any place that a word can have two meanings, to specify just what you mean.

*Brevity*—Don't use a lot of words where a few would answer the same purpose. Take for example this clause from a contract telling how to set concrete forms. It reads: "The mould may be fixed or moveable, but must be rigid when in place, so as to form the concrete accurately." Twenty-one words that could easily have been expressed by a simple phrase, by saying that it should be "a good and workmanlike job."

Avoid *indefinite specifications*. They are often included for vicious, dishonest purposes. No bidder without *inside information* knows what is required. When you introduce an indefinite clause you put too much discretion in the *hands* of the field inspector and too much *doubt* in the head of the bidders. The honest contractor will bid high to protect himself, while the inexperienced bidder will bid low and hope to get away with something. Here is an example of an apparently innocent clause taken from a recent specification that got into our Courts: "The concrete shall be made one part by *volume* of Portland cement  $2\frac{1}{2}$  parts by volume of sand and 5 parts by volume broken stone." A specification like this is often a fruitful source of controversy for there is a great difference in the volume of cement depending upon whether it is packed in a barrel, shaken down in a measuring box, or merely cast loosely into such a box. Let's see how our *road building Bible*, the Standard Specifications, describe such a mixture: I now read from the Standard Specifications: "Every cubic yard of concrete in place shall contain not less than one and five tenths (1.5) barrels of cement. "A barrel shall contain 376 pounds net." Certainly there can be no misunderstanding here as to how much cement is required. I think that this illustration will drive home to you the importance of following the *Standard*.

It is always much easier to introduce *general* and *indeterminate* words and phrases than to be specific but they will invariably produce one of those ever present devils *high cost* or a *slipshod job*. Think about this while I read this contract clause. "Such lumber as is required shall be of a suitable character for the purpose intended of straight grain and free from all de-

fects." Can't you see the predicament you would find yourself in if you were in the contractor's shoes bidding on this work. If you figure on using straight grained perfect lumber your bid might be *high*, whereas if you took a chance and bid on lumber *you thought* might be *suitable* and the inspector thought otherwise, you might wind up doing the job at a loss. Don't use *indeterminate terms*.

And don't write specifications that are *unfair* to the contractor. Don't insist that the contractor has to take all the risks. If subsoil or hidden conditions may be encountered, it's *not* fair to require that the contractor should have to bear the cost of doing work he had not anticipated. In the formation of such a contract, there never is true *meeting of the minds*. Skip clauses that introduce *unnecessary severity*. Some years ago a factory was found that produced bricks that would absorb only 1½ per cent of moisture and a clause containing this restriction was written into a project contract that required 6,000,000 brick. Certainly the bricks were obtainable, but the brick yard that was producing them could only turn out 500,000 per year, and so after awarding the contract this clause had to be stricken out.

*Ambiguous specification; a lot of words* often expose the ignorance of the writer and suggests to the contractor that the engineer, not knowing his stuff, can be easily manipulated. Be very sure that before you receive any bids that the contractor knows exactly what you expect him to do. Don't keep anything hidden or up your sleeve. I think that the *State Highway Department* has an excellent method of handling situations like this. Before they receive any bids, they invite all the prospective bidders to meet with their engineer at some definite time and place. When they get together, the project with all plans and specifications is gone over thoroughly in the field. Any questions regarding the work can then be taken up and answered, any doubtful points in specifications are explained so when the bidder makes up his bid he knows exactly what he is expected to do.

And now, gentlemen, just a word to sum up. Make your specifications *brief, clear and precise*, copy the *State specifications* wherever you can, and be *fair* to all bidders. Don't forget that if there are eight bidders, the contractor is playing an eight

to one shot and is gambling real money when he prepares his bid. Have your specifications written so that you get them all off to a fair start, and you in turn will find that you are getting the *most value for the taxpayers' dollar*.