

tor's choice of method. Due to that choice, the benefits include greater competition, lower costs, conservation of resources, and more flexibility.

Departments of Highways and Transportation and other highway contracting agencies should consider end result specifications at every opportunity because of the possibility for improved least cost construction.

EQUIPMENT USE RESTRICTIONS UNDER METHOD TYPE SPECIFICATIONS

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Construction equipment has evolved greatly from the early part of this century to the present time. During this period of rapid technological advancement, method specifications have played an important role in advancing the use of various types of construction equipment and many types of construction processes.

Looking back at the early construction equipment, the requirements from past specifications and the development of specifications for more modern equipment types reveal many interesting facts. Why were specifications written in a format using method requirements and why do some specifications remain basically unchanged with time?

In the early days of technological development in construction equipment, the manufacturer of new types of equipment was the expert in its mechanical operation and functional proficiency. Therefore, one method of specification development was that when an agency wrote a specification to provide for the use of a particular type of equipment, the manufacturer's specifications were usually used as a guide. Often these original specifications became "gospel" and for some reason, and sometimes to the detriment of progress, have been maintained in later specifications because "that's the way it has always been done -- and it works." (If it is not broke - don't fix it).

Today we find ourselves still using this same procedure. The new equipment of recent time, i.e., cold milling machines, concrete grinding machines, recycling equipment (both hot plant and in-place types), pavement cleaning units, pressure grouting units and others, have specifications incorporated in many contracts using manufacturer's specifications as guidelines. Cold milling equipment, drum mix plants and diamond grinders are examples of these new types of equipment.

As engineers, we generally tend to be very detailed, cautious and conservative. If we are unfamiliar with a piece of equipment or a process, we write specifications which are very detailed, using all of the information we can gather from manufacturers, other agencies, research, etc., in order to make certain we will not get anything less than what we want. Hot surface recycling is an example of the type work and equipment in which we have limited exposure and may tend to over spec.

Another avenue for the development of method specification is "a reaction to a bad experience using a particular piece of equipment or process."

Equipment manufacturers and transportation agencies seem to conduct schools and seminars year after year to cover some of the same subjects over and over. These efforts are generally predominant in the areas of asphalt and concrete production and placement. These areas are the ones in which agencies generally have the strongest method specifications. Because we continually have problems in these areas, the tendency seems to be

to use method specifications in an attempt to cure the problems. This is too often the case of one bad apple spoiling the whole barrel. Each of you can probably think of a case where this process of specification development has taken precedent over the engineering and research process.

Method specifications have the potential of being too detailed and often redundant. First, under the method type, equipment to be used in accomplishing a particular type work has specifications that require certain capabilities or impose certain constraints. In some cases, method specifications also state how the particular piece of equipment is to be operated. In addition, method specifications generally set minimum requirements for the end product. The vibratory roller is the type of equipment which may have amplitude and vibration, operating speed and minimum density requirements.

Occasionally, however, a method specification will only provide for the "how to's" and "with what's" and leave the engineering properties of the finished product to be acceptable with no testing. Rolling of thin plant mix seals is an operation in which only "how to" roll is specified with the final density a product of this type rolling.

Equipment performance under method specifications has, over the years, generally been favorable. For the most part, our highway system, and for that matter, our entire modern public transportation system, was built through the years using variations of method specifications. The product that has resulted by using method specifications has generally been that which substantially meets or exceeds the minimum requirements.

Occasionally, though, we have jobs on which a major percentage of the work meets the minimum specification requirements with some quantity falling below the minimum but reasonably acceptable under certain limiting conditions (price reduction, adding material). In this latter case, because of the dual interpretation that can be given method specifications, potential for a dispute over standards of performance exists. The contractor will maintain that he followed all the methods specified and the fact that the end product does not meet specifications is not his fault but was caused by the owner. In turn, the owner takes the position that the contractor did not satisfactorily follow the methods specified and that if the methods had been properly followed the work would have met the minimum end result requirements.

Who loses in a situation like this? Often, the legal ramifications of our contracts yield a settlement where there is no winner -- not even the public. Compromise settlements, because of legal or operational considerations, often resolve the contract dispute but leave a project with a compromised end product. This dual characteristic of method specifications can be viewed as an entrapment to both parties and one which in most cases is unnecessary. Therefore, contracting agencies must decide what is most critical and necessary when specifying equipment requirements, and, in general, should specify only that requirement.

I am sure that many of you have been involved in discussions where it has been proclaimed that considerable savings could be experienced if method specification constraints were not imposed on equipment design characteristics, operational procedures or minimum numbers.

Method specifications, it can be said, have a tendency to inhibit the use of alternative equipment features. Equipment manufacturers continue, through research and development to design the most

advanced and productive equipment for use in accomplishing the various types of construction processes being performed today. However, method specifications inhibiting any phase of the work may limit the use of the most productive innovations in the total work process.

These, however, are only a few of the problems that we experience using method specifications. How often have we experienced the requirements of method specifications not being followed but the final product exceeding the minimum specified end result requirements. In cases of this nature the contractor may be able to perform the work for less and thereby effect a savings for the owner if he were not restricted in his productivity by the method specifications.

Likewise, equipment manufacturers could utilize the same theory and "economize" equipment by maximizing productivity to accomplish minimum end product results.

This type problem carries forward to the State highway agencies using method specifications. The Federal Highway Administration (FHWA) will cite the instances where method specifications are not being followed to the letter of the law but end product requirements are being met. These matters have to be resolved between the agency and the FHWA.

Should changes be made in contract requirements which specify "methods"? Yes and No! Changes should be made in the public interest. Requirements which are redundant and yield no benefit to the finished product or add no economics to the construction process should be changed. Normally, these changes from method to end-result specifications should be made in equipment requirements and work processes in which expertise of application has been transferred to the user. Many types of equipment have been with us long enough that adequate expertise in application has long been transferred from the manufacturer to the industry contractors and agency engineers.

New types of equipment or new innovative attachments to existing equipment are in the category where the expertise remains generally with

the manufacturer and until time and usage transfers the expertise to the user, method specifications remain a viable application for insuring correct use of the equipment or device so long as the specifications are updated with industry developments and refinements. Care must be taken, in all cases, when using method specifications in this area so as not to limit the use of any particular brand of equipment which can adequately perform. In addition, areas of particular concern may require the use of method specifications in order to add uniformity of instruction to those contractors who may not be sufficiently knowledgeable to accomplish the work satisfactorily without sufficient instructions and/or constraints.

Specifications, either the method type or end-result type, relative to either equipment, materials or processes, have long been both the "common ground" and "battleground" of manufacturers, contractors, engineers, and notwithstanding, lawyers. Today, the public expects the respective agencies of government to "know what works", "specify it" and "expect no less, within reasonable limits" from the contractors performing the work. These demands leave little room for ineffective and costly method specifications or for statistically based end-result specifications which allow contractors to perform less than desired work with predetermined price reductions. Certain method specifications place unnecessary restrictions on equipment and productivity while statistically based end-result specifications, with predetermined price reductions for lesser quality work do not provide for the public "to get the quality of work it demands" or for that matter deserves.

Therefore, it is our job as engineers, equipment manufacturers and contractors to establish acceptable parameters for the various types of work being performed, set minimum acceptable standards and tailor a combination of effective methods and/or end-result specifications that will provide for the equipment manufacturers and construction industry to produce the desired results in the most efficient and cost effective manner.

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