

Quality Assurance

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This paper discusses the Department of Highway's current venture into a bituminous quality assurance program, including past experience, mix gremlins, current results, and what is being discussed for the future.

Quality assurance draws its control concept from the familiar bell curve. When you went to school, a few people made F's, a few more made D's (which together, when plotted, develop the front of the bell shape), several made C's (the top of the bell), a few made B's, and fewer made A's (the back of the bell shape). If several material test results are plotted on a graph, the numbers will form the same bell shape. Poor material production quality control will cause the bell to be somewhat flat, and good quality control will form a bell shape that is narrow and tall.

In 1973, we worked with the bell curve and developed end result specifications. We first simulated what would happen under actual job conditions using this procedure then added the new statistical specifications to four highway contracts during 1976. The end results were satisfactory, but the contractor, the aggregate producers, and our field personnel disliked the procedure. We had reviewed our pavements on an annual basis for several years. Except for very few cases, they were performing well. The main concern was asphalt flushing in the wheel tracks, which was corrected by specification changes. Little did we know that the mix gremlins were coming. The major mix gremlins are:

- 1) from 1969 to about 1982, there was approximately a 600 percent increase in trucks;
- 2) in 1983, truck gross weights increased from 73,280 pounds to 80,000 pounds, and axle weights increased from 18,000 to 20,000 pounds;
- 3) truck tire pressures went from 80 psi to 110 and 120 psi, and in Pennsylvania, 140 psi was recorded;
- 4) in the late 1970s, E.P.A. said, "Do not allow fines to go out the mixing plant stack; capture them".

In the early 1980s, we tried to deal with some of these gremlins individually, but under the cookbook specifications could not react quickly enough. In 1985, we began to notice increased pavement rutting, which had not been a particular problem before. (Even individual dual truck tire ruts were noticed in the pavement surface.) Indiana is not alone in this problem. All states have expressed concerns at meetings of the American Association of State Highway and Transportation Officials (AASHTO).

During the 1986 Road School session, several discussions were held and a committee was formed. The committee consisted of knowledgeable people from

the Indiana Asphalt Paving Association, the Indiana Mineral Aggregates Association, the Asphalt Institute, the Federal Highway Administration Bituminous Materials Laboratory, Rose Hulman, and responsible department engineers. This was the beginning of Indiana's current quality assurance program. During 1986, the group developed specifications and a certified technician program, and tested the ideas on some four to seven contracts. Of course, we drew from the information obtained in our 1976 work.

Under the current program, roadways with 5,000 ADT or more will have a quality assurance specification. The contractor who gets a quality assurance job must have a highway certified technician. These technicians are certified through a joint program with the Indiana Department of Highways and Rose Hulman. Hands-on training and testing is performed at Rose Hulman. State highway inspectors also must be certified.

The contractor performs a marshall mix design of each type of bituminous mixture in a department approved design laboratory. He sends his results and some of the materials to be used to the state highway department where all is checked and either approved or disapproved.

During the completion of the project, the contractor is responsible for producing the mix, and we test it on a random basis. The contractor does not know when or where. In some cases, we test the material, but do not publish the results until a certain amount is placed (usually 2,000 tons for base material). Allowable tolerances were developed using the bell curve. If the contractor produces within the allowable tolerance, he gets 100 percent pay; if not, he gets less than 100 percent. If it is totally unacceptable, he must remove the material and replace it. All tolerances are stated in the contract. We randomly test certain gradations, asphalt content, V.M.A., and roadway compaction from specified lots and sub-lots.

The procedure places mix responsibilities on industry, where it belongs, and allows industry some flexibility in producing, paving, and compacting the mixtures. We had seven quality assurance contracts in 1986, 31 in 1987, and 45 are planned for this construction season.

Quality assurance is working. More uniform and stable bituminous mixtures are being produced by Indiana contractors. Indiana contractors received 99.6 percent of the contract bid price for their 1987 work, which covered 890,000 tons of mix. Improvements in technical training at several levels have occurred. I hear contractors and aggregate producers both say, "We know more about our business now than ever before." State certified industry technicians are closely controlling the materials used in the bituminous mixtures.

As to the future, we will apply the bell curve to more of our specifications in Indiana. We will retreat further from the work of mixing, which belongs to industry. Our current inspectors will receive intensive training to help them become certified construction and materials testing technicians who have a broad background in several areas. Each technician will have to demonstrate his abilities both by written test and the ability to perform. These valuable employees will be mobile and perform a wide variety of jobs with skill and minimal supervision. We will use the random sampling process more and more, and technicians will go where random sampling has determined that problems exist.

Quality assurance is working for us, and I encourage any city or county to use this approach on heavily travelled streets or roads. If the future follows the past,

bigger and heavier trucks may come. A current AASHTO committee states that radial truck tires have a roadway contact pressure of nearly double just under the tire sidewalls. If you have not looked recently, you may already have problems.