SCHULTE & ASSOCIATES
Building Code Consultants
3500 Creighton Road, K5
Pensacola, FL 32504
fpeschulte@aol.com
847.312.7617

FIRE PROTECTION HISTORY-PART 124: 1967 (THE HYDRAULICS OF THE PIPE SCHEDULE)

By Richard Schulte

The seventy-first Annual Meeting of the National Fire Protection Association was held at the Hotel Sheraton in Boston in mid-May, 1967, roughly 3 months after the fire which destroyed convention center in Chicago, McCormick Place. Among the technical discussions at the meeting was a presentation on a hydraulic analysis of the pipe schedule utilized to size the supply piping in a sprinkler system. The following is a brief excerpt from that presentation:

> "*Chairman Bush: We now have a very interesting change from the Technical Committee Reports to hear from two distinguished gentlemen from Great Britain who will describe their studies of Hydraulic Performance of Sprinkler Installations.*
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> *To present this subject we have Mr. Herbert Hoyle of Manchester who is recognized as one of the world's leading authorities on this important subject. He comes from Mather & Platt, Ltd. which is the leading manufacturer and distributer of fire extinguishers throughout the British Commonwealth. With him is Mr. Geddes Bray, Chief Engineer of Mather & Platt, who also has wide background and experience in fire protection engineering.*
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> *Mather & Platt is a long-time member of NFPA and both Messrs. Hoyle and Bray have been with us before and we welcome them back to the "New Boston," as the NFPA Headquarters like to call it. It is with a lot of pleasure and a distinct honor that I present to you these two members from across the water.*
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> *Mr. Herbert Hoyle: First of all I want to thank the NFPA for the privilege they have extended to Ged Bray and myself to come here today to present this paper. For many years we have been close friends with the officials of the NFPA. I trust that on concluding our remarks, some of which may be critical, that we shall continue to remain friends and that requests will not go out immediately to the FBI that our American visas should be canceled forthwith. (Laughter)*

Our investigation into sprinkler performance shows quite clearly that many of the rules are unsound, that sprinkler rules which specify the pipe sizes throughout an installation according to the cumulative number of sprinklers are unsound technically and also economically. That is the first challenge.

This work has necessitated a very great amount of hydraulic calculations. In order to avoid this tedious operation usually employed all throughout the work that has been done, suitable programs have been prepared and the results given to us from the digital computer. If you want to save yourselves a lot of headaches I can recommend this method of approach.

(*The paper presented by Messrs. Hoyle and Bray, entitled "Hydraulic Performance of Sprinkler Installations" appears in Fire Technology, Vol. 3, No. 4 (November 1967) on pages 291-305).*

Chairman Bush: Thank you, Mr. Hoyle and Mr. Bray. This is most instructive on the economic approach to sprinkler installation. I can't tell you how much we appreciate your coming over and presenting this to us. I only wish we had more time so we could go into it further, but I assure all of you that this will be published by the association for your edification."

The fact that the pipe schedule leaves something to be desired from a hydraulic standpoint had been noted on numerous occasions before this presentation. Previously, it was noted that the pipe sizing for a system remains the same, regardless of how much pressure is available for the system to operate. Wilbur Stump also noted that the pressure demand for systems sized according to the pipe schedule far exceed the 15 psi minimum specified residual pressure.

The statement that the pipe sizes specified in the pipe schedule are both inadequate and excessive is correct. In general, the small pipe in a system designed per the pipe schedule is under-sized and the large piping in a pipe schedule system is over-sized. In particular, supplying two operating with one inch pipe creates an excessive pressure demand through the second piece of one inch piping (from the end of the branch line). Today, typically only one sprinkler is supplied using one inch steel pipe and 1-1/4 inch pipe is used to supply two sprinklers. Increasing the second piece of supply piping at the end of a branch line from one inch pipe to 1-1/4 inch pipe typically allows the size of the cross mains or bulk mains to be reduced.

Was the pipe schedule included in the sprinkler standard wrong? The answer to that question is no. What was wrong was the minimum residual pressure requirements specified for the pipe schedule. If that's the case, why was the success rate for sprinkler systems designed using the pipe schedule so good?

There are a number of answers to that question. First, the residual pressure of the water supply for most sprinkler system installations designed per the pipe schedule exceeded the minimum. Second, the hydraulic demand of a sprinkler system depends upon which sprinklers activate in the system. If sprinklers, other than the end sprinkler on each branch lines, activates, then the hydraulics of the pipe schedule design greatly improves. Third, the hydraulics of any sprinkler system depends upon the number of sprinklers which operate. If only a few sprinklers operate, then both the flow and pressure demand of the system will be relatively minimal and a 15 psi residual pressure might be just fine.

Based upon the above, we can say that the “factor of safety” built into the pipe schedule systems is less than hydraulically-designed sprinkler systems. We can go one step further and say that the “factor of safety” of the pipe schedule system is indeterminate, unless the system sized per the pipe schedule is analyzed using hydraulic calculations.

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