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"Standardizing Mechanical Inspections of Movable Bridges", Brad Hollingsworth Consult'g Engr. Ft. Washington, Pa.

STANDARDIZING MECHANICAL INSPECTIONS OF MOVABLE BRIDGES

INTRODUCTION

This paper discusses both the technical and managerial considerations and benefits of standardizing mechanical inspections of movable bridges. It is written to stimulate thought and discussion not as a "How To" manual, since each bridge owner has his own specific needs and in-house capabilities.

Considerations which must be addressed in the development of standardized mechanical inspection programs are:

- Owner - Consultant relationship.
- In-house capabilities of the Owner.
- Level of inspection required.
- Frequency of inspection required.
- Standardization of forms.
- Computerizing the data.
- Evaluation of the data.
- Necessity of AASHTO power calculations and stress analysis.
- Condition rating system to be used.
- Information distribution and storage.

Benefits which will be attained by the use of standardized mechanical inspections are:

- o Quality assurance.
- o Increased safety and reliability.
- o Consistency of inspection, maintenance and repair cost.
- o Long term cost savings.
- o Ability to categorize machinery condition.
- o Ability to predict remaining life.
- o Ability to plan both long and short term rehabilitation/replacement.

CONSIDERATIONS

The Owner-Consultant relationship is critical to the development of a good program. Thorough communication is a necessity. The Consultant must know what information the Owner needs, what the Owner intends to do with the information, what end product the Owner expects, and both the long and short term plans of the Owner. The Owner must know what he needs from the Consultant and the capabilities of the Consultant(s) likely to do the work. Although either an Owner or a Consultant could develop a standard program, the best results will occur if they work closely together in the development. In the case of an Owner with a large number of bridges, a pilot bridge should be investigated and

the results evaluated before contracting to do a significant number.

Some questions to ask during the development are:

- Who does routine, cursory or biennial inspections? In-house staff or Consultant(s)?
- Who does in-depth inspections with recommendations for rehabilitation? In-house staff or Consultant(s)?
- How many bridges must an Owner maintain before an in-house inspection staff is economically justified?
- Is a variety of inspectors good or bad? Do two individuals inspecting the same thing report its condition as the same? Will two individuals inspecting the same system find things the other missed?
- Who is the "expert"? The Consultant? Or is the Owner the expert and going outside simply due to lack of manpower?
- Has the Owner shared all his plans and expectations?
- Has the Consultant shared his true capabilities?
- Who evaluates the field data? In-house staff or Consultant(s)?
- Who coordinates and manages the program? In-house staff or Consultant(s)?

- Who insures consistency among different inspection teams? In-house staff or Consultant(s)?
- Who signs off on the final product? In-house staff or Consultant(s)?
- How is the data manipulated into useful information? By hand or completely by computer? By in-house staff or Consultant(s)?
- What are the minimum qualifications of the inspection team? Professional Engineers? National Institute for the Certification of Engineers and Technicians (NICET)? Certified Bridge Inspectors (CBI)?
- What standardized training or experience is required? Where can it be found?
- What specialized tools are required? Supplied by the Owner or Consultant(s)?
- What safety precautions are necessary?
- What are the responsibilities of the inspection team? Report data only? Evaluate the data? Recommend repairs or replacement?

Once these, and many other, questions are resolved, the Owner and Consultant can begin to hash out the more technical details of the program.

The level and frequency of a standardized mechanical inspection program will depend on a number of things, such

as: the quality, level and frequency of past inspections; the age of the bridge(s); the condition of the bridge(s); the past maintenance requirements and history of failures; the frequency of operation; and the criticality of vehicular and marine traffic. In most cases it would seem advantageous to develop both a biennial and in-depth standard mechanical inspection program. Typical frequency would, of course, be every two years for the biennial, and in-depth inspections might be conducted every six years. The level of inspection must be clearly defined by the program. A detailed Scope of Work must be included. Too often, the level of inspection is dictated by the availability of funds instead of the need for determining the condition of the machinery.

The standardization of forms will provide for consistency of the collected data and the ability to computerize the data. The forms must reflect the structure of the computer data base if the data is to be computerized. The same sketches with the same nomenclature would be taken to the field by the inspectors. The sketches and forms would be supplied by the Owner, not generated by the inspector each time. With the use of fill-in-the-blank inspections forms, the Owner must still assure that a qualified Consultant is selected for this specialized service. The inspectors and evaluators need to be educated in the proper use of the forms. Each bridge or bridge type would have its own forms to be updated

during the inspection. This would make the results easier to interpret and compare as well as identify fast wearing components. Computerization allows large quanities of data to be stored and easily sorted by bridge, component, condition, and many other criteria. The data base must store the information in a way that allows the Owner to get the information he needs quickly. The program must be readily useable by staff with minimal experience in computers. Newer data base programs, with the use of optical scanners, allow photographs and video to be stored in the computer with the written data.

AASHTO power calculations and stress analysis are essentially a load rating of the machinery. The power calculations need only be done once unless a significant change is made to the bridge. These calculations show the horsepower required to move the bridge in the specified time under all conditions. A single bridge Owner may have an array of bridges that vary in age and "standards" to which the machinery was designed. The use of one current set of design standards provides a baseline to compare different bridges. The stress analysis uses the actual motor output torque or a theoretical value from the power calculations and applies it to each mechanical component to attain the stress level in each component. This information shows which components are prone to failure and where accelerated wear may occur. The stress analysis can take into account

existing wear and increase the stress level accordingly. This information can be used to determine which components are currently overstressed and set safe wear limits on the various components. As with the power calculations, the stress analysis need only be done once unless there is a change in the drive system. A standard inspection program should include both these calculations on each bridge to compare the adequacy of the bridge(s) machinery systems and develop wear limits and remaining life estimates.

A standard rating system must be established. A numeric system with clear definitions allows the ratings to be easily sorted by computer and two inspectors to rate the same condition with the same number.

A record of the inspection must be distributed and filed. A complete record may be saved on magnetic tape or diskette in addition to hard copy. The records should be stored in at least two separate locations, preferably in fireproof vaults. The records should be stored for a predetermined length of time and the report should be distributed to a predetermined set of individuals and/or agencies. The issue of distribution and retention of information should be addressed in a standardized mechanical inspection program.

BENEFITS

The benefits of a standardized mechanical inspection program are numerous. Because the scope is well defined and the reports are consistant, the quality of the inspection can be assured. The components to be inspected and the method of inspection will be built into the program. The safety of marine and vehicular traffic, as well as maintenance and operating personnel, will be improved. The reliability of the system will be improved which will better serve the public and reduce expensive "middle of the night" maintenance calls. A standard program will expedite compliance with Federal, State, and Local requirements. A better inspection program will reduce liability. The cost of inspection will be consistent and more easily budgeted. Long term inspection and maintenance costs will be reduced. With the information from a standardized mechanical inspection program, it will be possible to categorize the mechanical condition of the bridge(s), predict the remaining useful life, and plan and budget long and short term rehabilitation or replacement.

CONCLUSION

Owners and Consultants should work together in developing standard machinery inspection programs to better protect and serve the traveling public.