Introduction
Most local jurisdictions with authority and responsibility for road maintenance have some form of bridge maintenance program. Agencies that own bridges in excess of 20’ spans must have some form of bridge maintenance program in order to satisfy the Federal Highway Administration’s (FHWA) National Bridge Inspection Standards (NBIS), which require inspection at least every 24 months and maintenance of minimum bridge performance criteria.¹ Local agencies that have no such “regulated” bridges often have smaller structures and have some form of structured or unstructured bridge maintenance program. However, many local agencies have no structures that they consider bridges and yet they may have concrete box culverts or large pipe culverts that pose some of the same traffic safety and emergency response concerns that small bridge structures do.

Particularly for this last category of agencies, an independent and structured bridge maintenance program may be unnecessary, but the elements of inspection and maintenance should somehow be incorporated into the agency’s overall road maintenance program. This technical brief is intended to explore the elements of a bridge maintenance program that may be highly structured and independent or incremental parts of a more generic roads maintenance program.

Funding
There is no magical source of funding for these programs. However, most agencies with local ownership and maintenance responsibility for public roads and bridges are eligible for some form of regular financial assistance stemming from fuel taxes, federal highway funds, etc.
For example, in Delaware, this finds its way to individual towns in proportion to their population and miles of publicly maintained roads under the Municipal Street Aid Fund. Each state is eligible for funding for structurally deficient bridges through the federal Highway Bridge Replacement and Rehabilitation Program and the states have considerable latitude in the application of these funds – they are often used for bridge inspection, replacement of structurally deficient or functionally obsolete bridges, rehabilitation, maintenance, and distribution to local agencies to address their regulated bridges. State legislators can sometimes introduce special legislation to assist a local government or may even have access to a pool of funds for their district, so inquiries with them can sometimes be fruitful.

These various federal and state funding mechanisms will rarely cover all the needs of local bridge inspection, maintenance, rehabilitation, and replacement and some local funding will usually be necessary. As with any local funding request, it will be important to educate local elected officials so they understand the importance of bridge maintenance and the safety and financial repercussions of deferring these activities.

**Organization**

The organization of a bridge maintenance program, particularly at the local level, is often a part of a more generic roads maintenance program and may not be structured as a separate entity or crew. This can be just as effective as a stand-alone organization as long as the goals are clearly established and manpower and material resources are committed commensurate with the bridge maintenance challenges. When an agency has a number of bridges under its authority, a bridge maintenance crew is oftentimes established as a separate group of personnel and equipment, either within a larger roads maintenance organization or as a separate entity.

**Supervision**

Regardless of the structure of the bridge maintenance program, it is important that it be overseen by a supervisor with the education, experience, and authority to prioritize bridge inspections, maintenance, repairs, and minor rehabilitation. It is important that this link to local elected officials or senior local management be a champion for bridge inspection and maintenance, be capable of briefing the public on essential elements of bridge safety and maintenance, have strong leadership skills to manage subordinate personnel, believe strongly in safety for his/her personnel and the traveling public, and possess a professional curiosity that compels him/her to remain up to date on the latest techniques, products, regulations, and resources available to stretch limited funds for the greatest gain in bridge maintenance.
**Engineering Oversight**

Unless there are appropriate personnel within the organization (including the supervisor him/herself), the supervisor should procure the services of a Professional Engineer licensed in their state with appropriate bridge design, inspection, and maintenance expertise. Often, a P.E. is retained through an “on-call” contract or other form of flexible, yet controlled, contracting mechanism that allows the supervisor to obtain important engineering input in a timely fashion. A P.E. may only be called on occasionally (to inspect a small structure after a major storm, to advise on a repair technique or product, for direction on a more advanced repair or rehabilitation, etc.), but he or she will be an essential resource for the management and crew of the bridge maintenance program. While bridge maintenance often benefits from local crew innovation, the techniques and materials must be consistent with engineering standards to avoid unintentional risk to the motoring public, pedestrians, or the agency itself.

**Motivated Staff**

The supervisor of a bridge maintenance program cannot succeed without competent personnel that are motivated to succeed as much as he/she is. Whether they are laborers, equipment operators, carpenters, iron workers, welders, or crew leaders, they need to be well trained, but they ideally will be self-motivated and solution-oriented, with an independent pride in their own work. Often, this can be an infectious trait passed on during in-house/cross training of personnel. Conversely, a single crew member (or worse, crew leader) can spoil the motivation of an entire crew, so the crew leader(s) and supervisor should look for ways to encourage motivated staff through increased responsibility, independence, and empowerment and, similarly, find ways to correct the poor attitude of that rogue member before he/she has the ability to destroy the effectiveness of the crew.³

Great supervisors know that motivating staff isn’t accomplished with a single action and not everyone is motivated by the same things. Salary and benefits are always listed as the first (and sometime only) area of interest. But serious-minded crew members will be motivated in other ways, too. Having the right equipment available to them (owned, rented, otherwise) is always important. They will appreciate the ability to have their ideas heard and genuinely considered. Safety is important, ironically, even to those who have to be regularly browbeaten to follow protocols. Respect from the community and upper management for their capabilities and accomplishments finds its way to crew members far too seldom. Fairness and equity can make or break a crew’s motivation and the supervisor cannot permit even a sense that favorites are played.
Equipment
The type of equipment needed by a bridge maintenance program, along with its size and functionality, is predicated upon a number of factors. How many bridges (regulated and unregulated), box culverts, and large pipe culverts does the program inspect and maintain? Can equipment be borrowed or cross utilized between sister agencies or from the State DOT? Is there a dependable private rental facility with the kind of equipment the program may need from time to time and are rental rates attractive relative to the cost to own and maintain? What are the capital procurement capabilities of the local agency?

At a minimum, the program will need access to some form of utility truck or trucks, if for no other reason than to carry tools and tow rented equipment. Typically, this would be a full size pickup truck with sufficient payload capacity, tow capacity, and hitch equipment to carry and tow the loads reasonably anticipated without overloading the engine, transmission, cooling system, or frame.

Beyond this most basic need, the equipment that will be necessary, at least from time to time, can be extensive. Any number of hand and small power tools will be necessary (e.g., mechanics tools, hammer drills, saws, brooms, shovels, chain saws, concrete finishing tools). Traffic management materials, such as cones, barrels, barriers, signage, and flagging paddles will be necessary for most bridge maintenance. Tools such as compressors, jackhammers, sand blasters, welders, torch kits, and dewatering pumps will be needed, at least from time to time. Larger equipment, such as dump trucks, backhoes, skid loaders, and equipment trailers will be commonly needed. Other equipment or material systems will be needed at times also (e.g., debris collection systems, concrete forms).

Many areas of the country now have local equipment rental companies with robust lines of service. If these exist in your area, they can be a tremendous resource for types of equipment, large and small, that you need from time to time only. As always, weighing the realistic usage in a given year and the associated rental costs against the capital and operational costs (including insurance and maintenance) will help determine the best course of action.

Training
Staff training should be part of the operations plan of a bridge maintenance program and the nature of training sessions should be reflective of the challenges of the agency’s structures and the background and experience of the staff. From nuts and bolts workshops that deal with specific maintenance techniques or materials to larger picture training that provide a better understanding of how bridges are designed and how they fail, the more training opportunities
you can provide to staff, the better prepared they are likely to be for the surprises that ultimately arise.

Training can be structured (workshops, seminars) or informal (peer to peer mentoring) and it can be outsourced to commercial training groups, it can be found in local T³ or LTAP programs, and it can be developed in house. A typical training plan involves multiple sources.

Safety

A culture of safety is a vital element in a bridge maintenance program. Personal protective clothing and equipment (e.g., high visibility safety vests, hard hats, steel toed boots, eye protection, gloves, hearing protection, chaps for chainsaw operations, ropes or handrails on slopes, and safety harnesses) are just the beginning of a safety program. Training in safety, including regular tailgate safety briefings, keeps awareness high. Insisting that protective equipment be worn and that all personnel work in at least pairs (a buddy system, if you will) is important. Keeping all equipment in good working condition can help avoid unnecessary accidents.

But a true culture of safety can rarely exist within an organization without the enthusiastic example of all layers of management and it is important that safety rules be applied without exception. Managers on site should wear the same safety equipment as the rest of the crew, even if they are unlikely to be engaged in the activity. Visitors (elected officials, department heads, visiting dignitaries, residents, etc.) should be (however diplomatically) required to wear at least basic protections, such as safety vests and hard hats (keep some extras on hand for just such purposes). And remember, just one dismissive remark from a “higher up” can seriously damage the staff’s commitment to safety, so remind all layers of management from time to time of the dividends that your safety culture pays and the important role they play in supporting it.

Bridge Safety Management

Bridge safety is about more than just routine maintenance and repairs. Routine inspection of all structures (even the smaller ones) is important and regulated structures must be inspected at least every 24 months. Load ratings should be updated whenever the condition of the structure has changed materially and, when necessary, load limitations must be posted prominently at the structure and advance warning signs should be considered to keep prohibited vehicles from turning onto routes unaware, at which point they may decide to defy the prohibition instead of turning around. For bridges that are deteriorating but not yet under
rehabilitation or replacement, techniques such as lane narrowing may be an acceptable means of continued but limited traffic movements in the interim.

A willingness to close structures when there are not available means to keep them open to traffic in a safe manner must be part of the decision matrix and the local public agency must designate someone with the authority to close the structure when a Professional Engineer has inspected it and determined that it is unsafe for even limited loadings.

Finally, a bridge maintenance program and the public it serves benefit from routine public relations and information campaigns. Keeping the public informed as to the conditions of structures in the area, the inspections that are carried out, the maintenance that is performed, repairs that are made, and the other tools available to keep the traveling public safe increases the public’s confidence in the bridge maintenance program.

The Delaware T² Center’s full-time Engineer position was established with the primary mission of providing transportation advice and technical assistance to Delaware municipalities. Contact Matt Carter at matheu@udel.edu or at (302) 831-7236 for assistance.

The Technology Transfer (T²) or Local Technical Assistance Program is a partnership among state universities, state departments of transportation, and the Federal Highway Administration. There are 58 centers throughout the United States with primary missions to promote training, technology transfer, and research project implementation at state and local transportation agencies.

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1 This is an oversimplification of the Standards, as there are differing frequencies for such items as scour protection and other considerations; the point here is that all bridges in excess of 20’ require inspection at least every 24 months. See FHWA Questions and Answers regarding the NBIS, http://www.fhwa.dot.gov/bridge/nbis/index.htm.

2 This is no job for someone who believes they learned everything they need to know ten years ago.

3 The author acknowledges that this is easier said than done.