Minor Maintenance
Manual
For
County Bridges

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MINOR MAINTENANCE MANUAL
for
COUNTY BRIDGES

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INTRODUCTION

A county road system should provide dependable access to all tracts of land abutting legally existing public right-of-way. This road system is separate from but should be made completely compatible with the other road systems providing access to, or passage through, the county.

Like all such facilities, this important road system cannot be built and then forgotten. It must be continually monitored, maintained, upgraded, repaired, and/or replaced to overcome the ravages of time, weather, and vehicular use and to accommodate the changing usage and needs of the county. This is the responsibility of the County Highway Department.

The County Highway Department is setup to ensure the county roads are safe and allow users uninterrupted traffic flow. An especially critical link is the system of existing county bridges, many of which were constructed to carry loads lighter than are now imposed. In addition many bridges have lost much of their original strength due to rust, rot, erosion, frost damage, and neglect.

While it would be good to replace many old bridges with new, stronger, wider bridges, to do so is not economically feasible. It is necessary, therefore, to systematically inspect, repairs and maintain all bridges, new and old, to ensure they will last as long as possible.
The maintenance of bridges and their approaches is often the most neglected phase of highway operations even though a program of basic, continuing and systematic maintenance can reduce the amount of major repair work required and help extend bridges useful lives. The maintenance program should include not only care of the structure but also (1) care of the approach road immediately adjacent to the bridge, (2) marking and signing of the approach to the bridge and the bridge itself to clearly indicate load and width restrictions, overhead clearances, speed limits, and hazardous conditions on, at, or near the bridge, and (3) control of plant growth so visibility is not limited.

PURPOSE

For purposes of this manual, a distinction is made between maintenance and repair. Repairs include "substantial" reinforcing, replacing, or rebuilding parts of a structure and/or its foundations (substructure). In this manual, repairs also include rehabilitation projects such as painting and resurfacing roadways. Maintenance is essentially a matter of cleaning the structure, fixing minor damage, correcting dangerous situations if possible, and keeping the bridge surroundings policed and groomed. Some minor repair work may be necessary in maintenance, but the nature and magnitude of the job should be such that it can be performed quickly and easily by a good highway maintenance crew. Repairs, on the other hand, may need to be performed by specialized crews with more equipment and materials.
This report has been prepared to outline a routine program of bridge maintenance. While the tasks described may seem simple and insignificant, they will extend to their fullest the lives of the bridges in a system.

It should be noted that this manual covers only the maintenance of bridges and their surroundings. Bridge repair will not be covered here. Information on bridge repair can be found in the AASHO Manual for Bridge Maintenance or other publications.*

ORGANIZATION OF THE MAINTENANCE PROGRAM

Although this manual includes only the specifics of the minor maintenance of bridges, an overview of the organization of such a program gives a good background. Some reference must be made to the overall strategy employed in assuring that a reasonable and systematic job is being done.

Planning, directing, documenting, and carrying out an efficient, effective, and continuing maintenance program requires that county highway personnel be adequately organized and directed, that personnel involved in the maintenance program have clearly designated lines of communication within the department, and that a good flow of information exists between the maintenance crews, the Road Supervisor, and the County Engineer.

One or more of the county road maps should be placed prominently in the garage area so that all personnel can become

* See Concrete International, October 1983, pp. 13-24. This is a publication of the American Concrete Institute.
familiar with all the roads and bridges in the county. This map should include the number of each bridge (which should also be painted on the bridge or mounted on a sign at the bridge). The maps should also identify school bus routes and the routes with the heaviest traffic flows. This information will allow the personnel to recognize priority routes and bridges.

With this information a rough "order of importance" can be established for the designated routes. Maintenance work should be completed on each route in the order of its importance to the county. All bridge maintenance on one route should be completed before proceeding to the next route. Route users can then be confident that each route is in good condition. This will also ensure that the program isn't done haphazardly but in a systematic way; thus no bridge will be neglected.

A program of minor maintenance such as this will go a long way to ensure that the county bridges are safe and in good repair. This does not imply that major maintenance and repair can be overlooked. A well-performed minor maintenance program can help identify major repair or critical maintenance needed. This can be done if the program makes provision for the work crews to report to the Road Supervisor conditions that need repairs. In this way, the maintenance crews perform preliminary bridge inspection, pointing out the serious problems that should be taken care of.

To get this information back to the County Engineer, the
field crews should briefly report on each bridge they work on. The report should point out possible major maintenance or repair activities that are needed. Further discussion of this reporting can be found in this manual in the section the "Minor Maintenance Checklists," along with simple checklist of the jobs field crews are expected to perform on the bridges.

I. APPROACH MAINTENANCE

A. GENERAL REMARKS

The bridge approach road should provide a safe transition from the roadway to the bridge. Therefore the approach to the bridge should be included in a program of minor bridge maintenance.
B. SIGNS

There are often warning and information signs along the approach to a bridge. These may include load limits, speed limits, low clearances, or width limits. These signs should be clearly visible to the motorist, and all signs, unless otherwise specified, must be illuminated or reflectorized. Straighten or replace bent or damaged signs or posts to assure required visibility. Wipe off any dirt or debris obscuring the sign face. A wet, non-abrasive detergent cleaner suitable for washing truck or automobile finishes is helpful. Cut down brush or tall weeds that hide signs. Be sure the reflecting bridge end markers are in place, clean and clearly visible.

Take note of what signs may be needed for adequate signaling of the bridge. The HERPICC publication, Handbook of Traffic Control Practices for Low-Volume Roads in Indiana, has been sent to every county road supervisor's office. Chapter 5 of this handbook lists detailed requirements for sign sizes and placements on the approaches and on the bridge itself.

In addition to placing signs on the approaches and on the bridge, it is a good idea to place load limit signs at the road intersections before the bridge. This allows overloaded vehicles the option of selecting another route.

Weight Limit Signs are described in the following excerpt from the Indiana Manual on Uniform Traffic Control Devices, pages 2B-36 and 37.
2B-41 WEIGHT LIMIT (→) TONS Sign (R12-1)
White background with black legend and border

The WEIGHT LIMIT (→) TONS Sign is to be used to indicate such restrictions as are necessary to limit the load permitted on a roadway. It shall be located immediately in advance of the bridge or other structure to which the restriction applies. In the case of an extended length of road, the sign should be placed on the righthand side of the restricted roadway immediately adjacent to any intersecting road on which the restriction does not apply, so as to be clearly visible from all vehicles turning into the restricted highway.

Fig. 1 Load limit signs and bridge end markers are good, but a Narrow Bridge sign is needed to complete the signing.
Fig. 2 Sign needs to be cleaned to be easily read.
C. EROSION PROBLEMS

Check the shoulders of the road for erosion. If there are small eroded areas, fill them with any rock, gravel, or dirt immediately available. It may be most convenient to get this material from the stream bed. Tamp the fill material well to ensure it stays in place. If there are large areas of erosion notify the Road Supervisor so sufficient fill can be hauled in and placed.

If drainage from the bridge deck is causing erosion at the ends of the bridge, construct a shallow drain channel lined with bituminous material at the curb line. This channel should direct the drain water directly to the ditches where it can be handled without damaging the shoulder.

In order to help prevent erosion of the shoulders of the approach road, clean out along the approaches to make them free-flowing. Remove any branches, brush, or other obstructions from the ditches and place them away from the approach so they won't block the flow of water into the ditch.
Fig. 3 Eroded areas such as these are hazardous and need to be filled. Report problems such as this to the Road Supervisor.

Fig. 4 This hole is in need of repair to make the bridge safe. Report problems such as this to the Road Supervisor.
D. APPROACH ROADWAY

Note unevenness, roughness, tire ruts, or settlement in the approach road which would depress the surface below the level of the bridge deck; if possible fill in or otherwise correct these problems. This is particularly important in the first few feet of approach roadway at the ends of the bridge. Any transition from the roadway to the bridge deck that is not smooth will cause the vehicle coming onto the bridge to produce undesirable impact and vibrational stresses in the bridge. These tend to reduce the bridge’s life span and load-carrying ability.

Fill material and fill placement for leveling up the roadway and the bridge deck at the bridge ends varies according to the type of approach road. For a gravel approach road a well-mixed, slightly moist, clayey sand and gravel mixture (perhaps from the road side) will works well. It must be well compacted into the holes and ruts of the road. This mixture holds better and is more satisfactory than a mixture of only loose sand and gravel.

Where the approach road has a bituminous surface - and in some cases, when the surface is gravel - build a short (approximately 50 feet) bituminous strip to form a ramp from the roadway to the bridge deck.
How far from the bridge ends the approach should be maintained on the bridge setting. Generally, the higher the speed limit on the road, the further back the approach should be maintained. Indiana state law allows the approach to be maintained by money from the County Cumulative Bridge Funds for up to 500 feet from the ends of bridges, culverts, or grade separations (Paragraph 8-16-3-2.5 of Burns Indiana Statutes).

Any continuous settlement of the approach may be caused by the settlement of unstable fill, erosion of the fill from behind the abutment, or excessive burrowing of groundhogs or other animals. In the case of erosion, providing adequate ditches around the abutments and opening up weep holes through them should take care of the problem. For the other cases, excavate and replace the old fill with a well-graded sand and gravel mix or a low-density, low strength concrete mix. Do not use chunks of old roadway or similar material for fill; it seems to attract burrowing animals. In the course of excavating and backfilling, take steps to provide adequate drainage through and around the abutment as mentioned above.
Fig. 5 A rough transition from the approach road to the bridge deck such as this will cause unwanted stresses in the bridge.

Fig. 6 Pot holes such as these at bridge ends should be filled and packed.
E. GUARDRAILS

Check the guard rails along the approach to the bridge to make sure they can to withstand the impact of a vehicle hitting them. Check wooden posts for rot. Straighten and repair bent or damaged guard rails as well as possible. Record the condition of the guard rails and the posts so the Road Supervisor will know what further maintenance or repair action they might need.

Fig. 7 This guard rail has no strength to resist impact. Report it to the Road Supervisor for replacement.

F. CLEARING BRUSH AND VEGETATION

To maintain good visibility across the bridge, keep its immediate surroundings free of weeds, brush, and overhanging tree
limbs. They can hide signs and bridge end markers, be a fire hazard to wooden structures, and promote general deterioration of the structure by making it difficult to access for maintenance and inspection. Trim vegetation well back from the structure and approaches since it will grow back quickly.

After removing vegetation, recommend to the Road Supervisor that spraying to control further growth be performed by the appropriate crew.

Fig. 8 Overhanging tree branches and weeds hide the bridge from motorists approaching it; cut it back.
II. ROADWAY MAINTENANCE

A. GENERAL REMARKS

Bridges are obviously a critical part of the county road system. They determine size and weight limitations of the road system. They are most vulnerable to damage caused by the vehicles, as well a damage done by nature in the form of erosion, corrosion, decay and deterioration. For all these reasons bridges require special maintenance attention.

Damage from nature is caused mainly by the presence of water and the effects of temperature change. Trapped moisture causes corrosion in metal, deterioration of concrete, and decay in wood. Because of this, it is very important to provide a drainage channel for any water that gets on the structure and to clean off of the bridge any dirt or debris which could hold moisture against the structure. This is the fundamental rule of bridge maintenance and will be repeated in more specific form for each bridge component outlined below.

Damage from vehicles is less likely when the bridge is visible and marked well enough for the driver to cross it without hitting anything. The deck must also be clean and dry enough that the chance of the vehicle slipping or sliding on the bridge is minimal.

B. DRAINAGE SYSTEMS

1. General Information

It is especially important that a bridge deck - whether it is made of wood, concrete, or asphalt - be kept as clean and dry
as possible. Dirt retains moisture and so prolongs wetness, which accelerates bridge deck deterioration. Dirt and moisture contribute to the following:

a. **Danger to a vehicle** - by increasing the tendency towards skidding, sliding, and being "out of control".

b. **Danger to the structure** - by retaining moisture on the deck in contact with the rest of the bridge, promoting rot in timber, corrosion of steel, and deterioration of concrete.

c. **Danger to the road surface** - by providing wheels with abrasive material that will grind away the roadway surface.

2. Deck Drainage

Good deck drainage is a **must**! This requires that dirt, debris, and any other material which could absorb and hold water be removed from the bridge deck. Use shovels, steel-bristled brooms, or a jet water spray to clean all such material (including any scattered dirt or gravel, etc.) completely off the bridge.

Make sure that the gutters of the bridge are clear and that all drainage devices (grates, scuppers, downspouts, etc.) are clean and operating. Use high-pressure water jets, metal probes, or other appropriate tools to clear these openings and channels. Be careful not to punch holes in the downspouts when using metal probes or similar tools.
Fig. 9 Good deck drainage is impossible here because of the buildup of dirt and gravel in the gutter and outlet.

Drains must not empty onto the structural members of the bridge, because the water and road chemicals cause deterioration of the members. If possible, adjust the downspouts away from the members to prevent this. Report drains that can’t be redirected to the Road Supervisor.
Fig. 10 Drains such as this one should be extended so that they will not discharge onto structural members like the girder on the right.

C. DECK MAINTENANCE

1. Wood Decks

Wood decks are generally built in two layers. The main structural components are wood plank timbers cut as long as the bridge is wide and placed transversely across the bridge. These planks, when laid flat, are placed tightly against one another and are attached solidly to the underlying stringers. This is done using metal clips or by a ramset gun. Ramset installation should be used only on creosoted timber that can be expected to remain in place for a number of years. Where decks are constructed of dimensioned lumber such as 2x4, 2x6, etc., each board
should be nailed to the adjacent one with the last one toenailed into place. Again, these should be solidly attached to the stringers at frequent intervals with clips. On low volume bridges, it may be better to leave 1/2" gap between boards to provide an escape for surface water, snow melt, etc.

The second layer of timbers defines the traffic lanes of the bridge roadway. The timbers (in strips 3 to 5 planks wide) are laid flat and run parallel to the roadway centerline. These are called the "running boards" or "treads". There are normally two such strips of planking for each traffic lane, but in a few counties a center strip for horse-drawn vehicles is required. These form the traffic surface of the bridge. These planks are spiked to the transverse layer of timbers.

Both layers of timber must be regularly maintained and evaluated for soundness. If any plank in either layer is broken or shows signs of rotting out, replace it as soon as possible. Check tie-down clips, and replace them as needed.

Fig. 11 Steel tie-down clips are used to fasten timber planks to steel stringers.
The treads or running boards are the most vulnerable part of the timber deck. These planks will eventually be broken, shattered, or worn out by traffic. They also tend to warp upward and pull loose in dry weather. If the planks don't need replacement, pull any loose, old spikes and drive new ones where the wood is sound. A tightly connected wood deck will last longer, be less noisy, and be safer than a deck with loose planks. If any plank is dangerously damaged, replace it with a new one.

![Image of treads]

Fig. 12 Treads such as this need to be secured or replaced to improve deck life, safety, and the noise level on the bridge.

Also check the structural cross-timbers. Replace any broken planks or any planks showing signs of rot or serious distress. When replacing these transverse timbers, note that ramsetting the
planks in place provide a very secure connection, but replacing the deck timbers may be very difficult without pulling the stringers out as well.

When replacing rotten or damaged planks or timbers one cannot expect more than 5 years service from untreated planks. Salt-treated or creosoted planks last from 10 to 20 years. Creosoted cross boards will also help protect the steel stringers they lay across since creosote is oil based. Creosoted lumber is also likely to be readily available. Wear heavy gloves and use protective cream when handling lumber to make sure that hands are not exposed to the creosote, which burns skin.

If a wood deck has been given a surface coat of bituminous material, repair any holes or depressions in the surface in addition to keeping the deck clean, dry and free-draining. Remove the surface over a large enough area so that the underlying deck can be checked and repaired if necessary. Then replace the surface removed with new asphaltic topping. Also, inspect the underside of the deck to determine the extent of any damage revealed by the check.

Bring decks that are in poor condition to the attention of the Road Supervisor so repair work can be planned. Always check decks for decay and deterioration, and report these conditions.

2. Concrete Decks

Concrete decks must also be kept clean and dry. In addition
to cleaning, a thorough Spring flushing of concrete decks which have been exposed to deicing salts is recommended. This is done to remove all traces of salt and chemicals used in winter snow and ice removal.

Fig. 13 Clean dirt and gravel of concrete decks to prevent moisture from being held against the concrete. Water will eventually deteriorate the concrete.

Check concrete decks for cracks, scaling, spalling, and "pop-outs". The presence of cracks isn’t necessarily a sign of structural weakness. Cracks can develop in any direction due to the shrinkage and creep of the concrete as it sets. However, a consistent pattern of fairly large cracks may be a sign of trouble; report this back to the Road Supervisor for further investigation.
Generally, seal all cracks against moisture penetration.

Seal a group of many small cracks with no particular pattern by spraying the deck with a sealant compound. This could be a 50-50 mixture of boiled linseed oil and kerosene (or mineral spirits). A thin coat of asphalt solution might also be used. This procedure would seal small shrinkage and creep cracks but it has two drawbacks. The first is that it can make the deck slippery. Therefore, always follow an application of oil with immediate placement of chips or sand. The second is that it requires follow-up applications, since it wears off.

Report large, open cracks in the deck or any other concrete member to the Supervisor so repair can be scheduled. Remove all dirt and debris, as well as all loose or damaged concrete, from these cracks. The width of crack can even be chipped or routed to a depth of 1/2 to 3/4 inch to remove damaged material and to form a trough to control the flow of the sealant compound. Flushing the crack with a high-pressure water jet is advisable. After it has been thoroughly cleaned and has had time to dry (an air jet could be used for drying if necessary), completely fill and seal the crack with a sealant compound. An epoxy compound, hot asphalt, or some such compound that will set but not shrink will be satisfactory. The sealant must adhere to the crack wall and still be elastic enough to adjust to change in the crack width caused by temperature or stress change, so that no moisture can penetrate the crack.
Fig. 14  This precast concrete deck has water draining between the precast sections. Prevent this sealing the seam with a liquid polyurethane joint sealant.

For pop-outs, scaling, spalling or other larger areas of damaged concrete, check first to determine the extent of the damaged concrete. If the damaged area is relatively small and of shallow depth, treat it a maintenance item. If the damage is deep enough to reach the reinforcing steel, it needs major repair.

When the depth of damage is relatively shallow, thoroughly clean all dirt and debris from the damaged area, and chip out and remove all loose or damaged concrete. Undercut very slightly the edges of the area in order to form a positive "locking" effect to keep the patch in place. Fill the damaged area with a bituminous patching material, and compact it well. In some situations a very stiff and specially designed concrete patching mixture could be used, but this is still a questionable procedure. Selection of the type of patch to be used is the responsibility of the Road Supervisor or County Engineer.
When carrying out minor maintenance tasks, it is very important that the maintenance crew inspect both the road surface and the underside of the deck. Water which stands on or seeps into the concrete will cause deterioration. Make every effort to prevent this. If reinforcing bars have been exposed by the deterioration of the concrete, report it to the Road Supervisor so that repair work can be initiated.

Precast concrete sections often have cores or voids in them. Keep the drain holes on these sections open to prevent moisture buildup inside the member.

Fig. 15 Exposed reinforcing bar such as this is a serious problem. Notice the ice around the steel has probably come about from water draining down through the deck. Report this type of situation to the Road Supervisor.
D. Bridge Rails

Bridge rails should be strong enough to withstand the impact of a vehicle and should be able to deflect the vehicle back into its traffic lane. Check the railings and their connections to see if they appear adequate for this job. If they do not, report their deficiencies to the Supervisor.

Straighten and repair bent or damaged railing as well as possible.

Loose ends on railings are particularly dangerous since they could act as spears when hit, piercing a vehicle and killing or injuring an occupant.

Fig. 16 The railings on this bridge are obviously inadequate and need to be replaced.
Fig. 17  Detail of a connection from the same bridge shows the inadequacy of the railings.

E. EXPANSION DEVICE MAINTENANCE

Bridges must be able to expand and contract during changes in temperature or severe stresses will build up in the deck and superstructure of the bridge. The severity of these stresses depends on the length of the bridge; on short bridges they may be negligible.

Expansion joints take many forms, depending upon the span length of the bridge. For short bridges the expansion joint is often just an open slot at one end of the bridge that has been filled with a semi-elastic material. As the bridge expands, the material is compressed to occupy less space. Upon cooling, the bridge shortens and the elastic material expands to fill the joint.
Sliding plate expansion devices are commonly found on longer bridges since more of an opening is required for movement at the bridge ends. A steel plate covers the opening and is attached to the deck on one side and rests in a steel seat on the other side. This creates a small depression across the roadway as deep as the thickness of the plate and as wide as the gap left by the movement of the bridge. Keep this expansion gap clean and free of any obstructions so the plate can slide easily.

Fig. 18 This sliding plate expansion joint is frozen due to being filled with dirt and gravel.

There are several other types of expansion joints, but they operate on the same principles as one or the other of these.

The basic job to be done on any expansion joint is to keep it open so that the bridge is free to expand and contract. To do this, clean dirt and gravel out of the expansion joints. A
high-pressure sprayer could be used for this if the joint is fairly open at the time of spraying. It is important to clean the joints before summer while the temperatures are still cool and the expansion joints are more likely to be open. Before freeing the expansion joint on a truss bridge, make sure that the bottom chord is in good shape. Sometimes the abutment thrusts against the truss and takes the load off the bottom chord. If the load is suddenly put back on a severely rusted bottom chord, it could fail, causing collapse of the bridge.

Seal open joints with a liquid polyurethane joint sealant to keep dirt and gravel from re-entering the joints once they have been cleaned out.

![Image of open joint](image)

Fig. 19  This open joint is ready for the application of joint sealant to prevent dirt and gravel from closing it.
III. SUPERSTRUCTURE MAINTENANCE

A. GENERAL REMARKS

The superstructure of a bridge includes its main structural members, its secondary bracing members, its floor system, and its bearings. Should these components not be maintained, failure of the main structural members will lead to collapse of the bridge. Bent or rusted out secondary members cannot properly brace and support the main structural members. Failure of the floor system will not necessarily cause the bridge to collapse, but the bridge would become impassable. Failure of the bearings could lead to either the collapse or impassability of the bridge.

Bridge superstructures are generally constructed of wood, concrete, or steel and the details of maintenance following will deal with superstructures or these materials.

No matter what the material the superstructure is constructed of, the primary job is to keep it clean and dry. Clean dirt and debris from the flanges of beams and stringers, truss members and joints, and any other place it has gathered. A high-pressure water jet is very useful for this. It is also imperative to direct drains away from the superstructure since water discharging onto the superstructure will eventually lead to its deterioration.
B. WOOD SUPERSTRUCTURES

County bridges often have wood floor systems. Details of maintaining these floor systems are included in Chapter II, Section C1 and will not be repeated here except to emphasize the necessity of using treated lumber when replacing wood planks, beams, and stringers.

C. CONCRETE SUPERSTRUCTURES

Pay close attention to cracks, spalls or chipped or broken-off pieces in concrete superstructures. These defects allow dirt, water, and chemicals to get into the structure, deteriorate the concrete, and rust out the reinforcing steel. Ultimately this will result in the loss of the bridge's structural capacity. Seal or patch the defects in the concrete to prevent this. Where it is practical use the methods describe in Chapter 2, Section C.2. Where overhead work is required, seal using shotcrete, gunnite, or a spray-on sealant.

D. STEEL SUPERSTRUCTURES

Many county bridges have steel superstructures in the form of steel girders or steel trusses. Take special care when cleaning steel superstructures since steel is very vulnerable to rust. This is critical because most steel sections are relatively lightweight and are considerably weakened by a large amount of rust. Report any rust holes found in the steel to the Road
Supervisor.

Trusses are frequently hit by automobiles. The resulting bent member may or may not require replacement, depending on what type of member it is. Should the bent member be a tension member, replacement won't be necessary unless it is cracked or has begun to yield. Otherwise it will gradually straighten itself. (Tension members can be generally identified as the lighter truss members. The bottom chord is a tension member). Replace a tension member by fastening steel cables to the panel points at each end of the member to be replaced and jacking the cables with a "come along". Then remove and replace the tension member.

Replace bent compression members. A bent compression member is likely to buckle under lighter loads than it was designed for. (Compression members are generally the heavier, built-up members. The top chord and end post are compression members). Before replacing a compression member jack a strut in place to take the load off the member.

Should a panel point require replacement, it is necessary to take the load off the joint by jacking. Do this by jacking against the floor beam from a jacking crib set below the bridge or through the bridge deck. The jack crib should be made up of at least 4 x 4 timbers; it can be placed on a 50-gallon drum filled with gravel. Place the crib securely on firm, level ground. Jack through the deck by drilling holes through the deck and con-
necting the floor beam to a jacking beam laid along the length of the bridge. Then jack the cables so the load of the floor beam is transferred to the jacking beam. When the load is removed from the panel point, it can be replaced.

These rules should always be followed when performing the above work.

1. Make sure the jack capacity is adequate. The jack should be able to carry approximately twice the estimated load placed on it.

2. All cables, struts, and jacking beams should be oversized to carry about twice the estimated load.

3. 3/4" plywood should be placed between load points (e.g. the point of contact between a jack and beam) to avoid damage to bridge members.

4. Never jack excessively since a stress reversal may result causing damage to the truss.

5. Always measure members to be replaced before jacking to ensure the same sized member is returned.

The tasks described above are beyond the scope of the minor maintenance program. They are described here to make the maintenance crew aware of problems they can report to the Road Supervisor so work can be scheduled.
Fig. 20 Dirt collecting in a truss joint like this could lead to rusting of the joint.

Fig. 21 Clean off dirt and debris on the flanges of girders and beams to prevent moisture from being held against the steel.
Fig. 22 Report rusting through a steel girder to the Road Supervisor. Bird droppings could have added to the corrosion here. Note the nest.

E. BEARINGS

The bearings support the bridge. The expansion bearing should be free to move to allow expansion and contraction; it is usually a roller, rocker, sliding plate or some other device that allows movement. At the other end of the bridge is an unmoving fixed bearing. The bearings are a primary place for dirt and debris to build up and cause rust problems. Remove all dirt and debris from around the bearings so there will be nothing to interfere with their action. When the bearings are clean, spray oil into the expansion bearing to inhibit the formation of rust and to aid in the free movement of the bridge. As with expansion devices, check the bottom chord of a truss before freeing an expansion bearing.
Fig. 23 Remove weeds and dirt from bearings.

Fig. 24 Dirt and debris around the bearings will cause them to rust over.
IV. SUBSTRUCTURE MAINTENANCE

A. Abutments

The abutments serve the dual purpose of supporting the bridge and acting as a retaining wall for the end of the approach. Approach settlement, water pressure build-up, and tree roots can all bear against these structures. These forces could eventually topple the wing walls or the entire abutment if corrective action isn’t taken. The best indication of forces against the abutments or wing walls is cracking or tilting if they are made from concrete, or missing sections of masonry if they are constructed of stone.

The amount of repair work that should be done on cracks in the abutments varies according to the situation. If an old wingwall has cracked away from the breast wall and shows no sign of tilting or moving and appears to be adequately serving its purpose as a retaining wall, grouting the crack with a stiff mortar mix will suffice. Before grouting, thoroughly clean the crack and chip out a groove for the mortar to key into. Should it appear that the cracks are relieving water pressure behind the abutment, drill weep holes into the abutment and provide ditches to relieve water pressure before the crack is filled.

Before drilling weep holes, contact the Road Supervisor to see if there is any way to determine the location of the reinforcing steel so it won’t be damaged. After drilling the hole, a sleeve should be grouted in it to prevent the deterioration of the abutment.
ABUTMENT TERMINOLOGY

X-SECTION
BACK WALL
BRIDGE SEAT
FOOTING
BREAST WALL
BACK WALL
WING
FOOTING
BRIDGE SEAT
BREAST WALL
When movement and tilting of the abutment are apparent, major repairs may be in order. For small, single-span bridges with concrete decks on steel stringers, welding a stud across the ends of the stringer may control the movement. On larger structures, a new abutment may have to be poured against the existing one.

In some cases of slight tilting, it may be possible to shim the abutment back vertically and then grout in the void caused by the shimming operation.

Replace damaged or missing stones in masonry abutments. Chip out old mortar and loose stone pieces. If the cavity is small, grouting it may suffice, but a new stone may be required for larger cavities.

In some cases, the surface deterioration of either a concrete or a masonry abutment may be such that a complete refacing with shotcrete, gunite, or poured in place concrete is warranted. Before this is done, completely clear the surface of all dirt and loose concrete or stone.

Another problem area on abutments is the bridge seat. This area is a prime collector of dirt and debris, so pay special attention to cleaning it out. Be especially aware of clearing vegetation from this and all other areas of the abutment. Roots and tentacles work their way into small cracks and fissures in the concrete or masonry and hasten deterioration. When the bridge seat has been thoroughly cleaned, seal it with a concrete sealant or repeated application of boiled linseed oil/kerosene solution.
Severely deteriorated bridge seats may require replacement. This entails jacking up the end of the bridge and forming and pouring a new seat.

Of the work described above, only cleaning and sealing is part of a minor maintenance program. However, the crews performing the minor maintenance should inform the Road Supervisor of further repair work needed.

Fig. 25 The masonry abutment wall has completely crumbled away from underneath the bearing. Report this to the Road Supervisor immediately.
Fig. 26  Report the cracking in this wingwall to the Road Supervisor. This was caused by the roots of the tree pushing on the wall.

While under the bridge, check for groundhog or other rodent holes under the abutments or wing walls. Extensive burrowing could cause approach fill settlement or erosion around the area of the hole. Use a long pipe to place a gas odorizer such as "Capitan" in the hole. An unpleasant-smelling material such as this will to drive out the animals. After using the odorizer fill the holes found with clay soil and rock and tamp it in as firmly as possible. Note where problems of this type are found so that they can be periodically checked for further burrowing.
B. Piers

Much of the maintenance of the abutments is also applicable to the piers. In addition, any evidence that water from the roadway is deteriorating or damaging the pier should be investigated. The source of the water should be located and directed to the proper drains. Clean and seal the pier cap in the same manner as described for the bridge seat.

Tilting or settlement of the piers may be compensated for by shimming as described for the abutments.

Remove and haul away any brush or debris collecting around the base of the piers. Such debris can create turbulence in the stream which causes scouring and the eventual undermining of the pier.

Bring all indications of distress in the pier (settlement, tipping, cracking, deterioration, etc.) to the attention of the Road Supervisor immediately.

V. CHANNEL MAINTENANCE

A buildup of debris in the channel near a bridge can eventually lead to some serious erosion problems around the wing walls, abutments, and approach slopes. When the debris begins to accumulate it causes the stream to be partially dammed. This causes the water to slow down and deposit the soil particles it had been carrying. Eventually the buildup of this silt and debris can form a small island, which deflects the flow of the stream channel into the abutments and approach slopes, causing them to
erode.

The removal of debris from the channel of anything but a very small, shallow stream falls into the category of periodically scheduled major maintenance. However, this task is easily done for the many bridges that are over small, shallow streams. Remove debris from all the right-of-way beside, under, and around the bridge. Included in the task is the cutting of brush under the bridge. Place the debris and brush well away from the bridge or haul it off.

If it appears that some objectionable or destructive stream flow behavior is caused by conditions outside of the right-of-way boundaries, ask the land owners if they will correct the situation or allow the maintenance crew to correct it. (Examples of this might include an fallen tree, a collection of limbs and brush, a fence crossing the stream that has collected weeds and brush,). Always get the land owner's permission before doing any work on their land.
Fig. 27  The log laying across the stream has begun to build up debris behind it. This shows how problems get started.
Fig. 28. Remove the debris under this bridge to avoid a silting of the stream which could cause the channel to be deflected into the wing walls or abutments.

Fig. 29. An extreme example of debris build up.
VI. RECURRING PROBLEMS

All bridge maintenance crews should report to the Road Supervisor any problems that continually need attention. On a particular bridge such problems may have a more serious underlying cause, which should be looked into by the Road Supervisor.

MINOR MAINTENANCE CHECKLISTS

Two checklists have been incorporated into this minor bridge maintenance program. These lists serve two purposes; (1) to be a concise guide for the workers to follow while in the field performing the maintenance and (2) to alert the Road Supervisor to the more serious maintenance and repair problems on the bridges.

The first list, the Minor Maintenance Checklist, simply contains a step-by-step listing of the jobs the crews should perform on a bridge. It is a condensed version of the information presented in the Minor Maintenance Manual.

The second list, the Bridge Maintenance Report, is a series of questions about the condition of the bridge that should be filled out by the maintenance crew and given first to the Road Supervisor, then County Engineer. The information on this list will alert the Engineer to any serious bridge problems requiring his attention. This report is only intended to provide the County Engineer with a rough idea of problems he may or may not have.
Implicit is the assumption that the Engineer knows his bridge inventory well enough to interpret the very basic information this report presents. Note that the questions deal only with what the crew observes while doing their normal jobs. They are not assumed to be qualified bridge inspectors, so their reports should not be construed to be a detailed bridge inspection reports. Their reports are merely meant to provide feedback and information to supplement inspections.
MINOR MAINTENANCE CHECKLIST

A. Bridge Approach

1. Check Signs on both ends of bridge.
   Warning and Information Signs (straighten, clean, and cut weeds).
   Bridge End Markers (clean and visible).
   Check Guard Rails along approach (repair and straighten).

2. Clear Weed, Brush, and Overhanging Limbs.
   Require clear visibility of bridge.
   Police and clean area around bridge.
   Remove all debris from site.

B. Side Ditches and Stream Channel

1. Clear side ditches of all brush, weeds and debris.

2. Clear debris and obstructions from stream channel through full width of R.O.W.

3. Eliminate all brush growing under the bridge.

C. Erosion of Bridge Approach

1. At gutter line on shoulder - fill any eroded areas.

2. At gutter line, build (if needed) paved channel to carry water to side ditch at non-erosive velocity.

3. Check shoulders for erosion signs - fill and tamp erosion channels.

D. Condition of Approach Road Traffic Lanes

1. Fill all ruts.

2. Check transition from road to bridge - must be smooth.

3. Build short bituminous ramp to provide transition in difficult cases.

E. Bridge Structure

1. Cleaning Deck

   Clean all dirt, gravel, trash and debris from deck.
   Clear all gutters and all drainage outlets.
   Remove any obstructions causing ponding of water.
   Direct deck drains away from all structural components.
2. Deck Maintenance (Wood Decks)

Check transverse planking for breaks, rotting, or any weakness. Replace individual planks if needed.
Check longitudinal "tread" planks for damage, excessive wear, breaks, shattering, looseness or rot. Replace damaged planks - re-nail old planks if required. Pull any protruding nails and replace.

3. Deck Maintenance (Concrete Decks)

Clean, check depth, and flush all open cracks. Dry such cracks and fill totally with liquid asphalt or other such sealing compound. Make notes on any system of patterned crack and report them to road supervisor.
For small shrinkage cracks (those not fully opened) check with road supervisor about a spray coat sealant.
Pop-outs, surface deterioration, or chuck holes in deck must be cleaned thoroughly and packed smooth with bituminous road surface mixture. Provide a mechanical "lock" to hold patch in place. Eliminate "low" spots to prevent water ponding.

F. Expansion Joints

1. Deck expansion joints should be identified and cleaned.

Remove dirt, gravel, debris and other obstructions from expansion joint opening. Do this when bridge is cool so joint is as wide open as possible.
For open expansion joint slot, fill the opening with an elastic joint sealer compound or a special compressible composite joint filler.
For plate covered joint slot, clean the sliding surface of any obstructions and treat sliding surface if necessary to make it free operating.

G. Bridge Structural Components

1. Truss Bridges

Clear debris from truss joints, flanges of truss members, or any pockets that have collected debris, gravel or dirt.

2. Girders and Beams

Clear any debris found on flanges or on any bracing occurring on the structure.

3. Handrails and Curbs

Repair any bent, broken, or missing parts of the bridge handrail or curbs.
4. Bearing Devices

Bearing devices are points where bridge structure is attached to the sub-structure (piers, abutments, or other supports). Identify the "fixed" and movable bearings. Clear all dirt, disintegrated concrete, debris of any kind which collects around the bearings — fixed or movable. Especially clear any obstruction that would prevent movable support from being able to function. Once cleared, spray with oil to prevent rusting and to assist movement.

H. Substructure

1. Abutments

Note cracking of main wall or wing wall. Assess serious movement of any part of the abutment. Report out-of-plumb components and any serious deterioration of the abutment and report it to the county road supervisor.

Note any erosion of stream that may undermine the abutment, and, eliminate cause.

Fill and tamp any rodent holes along base of the abutment and its wing walls.

2. Piers

Note and correct any water drainage on pier or the pier cap.

Note any cracks or deterioration of pier. Repair where possible and/or report conditions to county road supervisor.

Check for undermining of pier foundation and correct cause if possible.

Check pier for "plumb-ness" or any signs of movement. Report any findings to the county road supervisor.

I. General Assessment

1. Serious repairs or conditions which seem unsafe should be reported to the county road supervisor for special investigation and evaluation.

2. Constantly recurring maintenance items that are associated of any particular bridge should be called to the attention of the county road supervisor.
BRIDGE MAINTENANCE REPORT

A. IDENTIFICATION:

1. County ________________________________
2. Bridge No. ________________________________
3. Location (Route No.) ________________________________
4. Date of Report ________________________________
5. Maintenance Crew ________________________________

B. BRIDGE TYPE:

6. Deck Material: Wood _____ Concrete _____ Asphalt Overlay_____ 
7. Superstructure Type: Truss___ Girder___ Beam___ Other________
8. Superstructure Material: Wood_____ Steel _____ Concrete____
9. No. of Spans: ____________ Total Length: ____________

C. MAINTENANCE REPORT:

10. Signs At Site:
    Speed Limit, Posted Value ________ Condition __________
    Load Limit, Posted Value ________ Condition __________
    Clearances, Posted Width ________ Condition __________
    Posted Height ________ Condition __________
    Bridge End Markers: Adequate ________ Condition __________
11. Brush & Weed Control: Cut ________ Sprayed ________
12. Approach Road, Shoulders & Ditches:
    Side Ditches: Cleared ________ Erosion Filled ________
    Shoulders: Cleared ________ Erosion Filled ________
    Needs Major Work __________________
13. Stream Channel: Cleared ________ Needs Attn ________
14. Approach Guard Rails: Type ________ Repaired ________
    Needs Attention __________________
15. Transition - Road to Bridge: Improvement Made ________
    Needs Further Work ________
16. Structure:
   (a) Overall Condition:  Good _____ Fair _____ Needs Repair_____
   (b) Condition of Deck:  Good _____ Fair _____ Repaired ______
   (c) Type of Repair:  Wood - Planks Replaced ____________
                       Planks Re-attached ____________
                       Other __________________
                       Concrete - Cracks Filled ____________
                       Surface Disintegrated ______
                       Holes in Surface ________________
                       Needs Attention _______________
                       Bituminous Overlay - Surface Smooth ____________
                       Surface Repaired ________________
                       Needs Attention ________________
   (d) Deck Cleared of Dirt, Gravel and Debris:
       Much material removed _______ Light removal ______
   (e) Deck Drainage Performance:
       Good _______ Fair _______ Needs Improvement____
   (f) Drainage Outlets:  Adequate ___ Poor ___ Needs Revision____
                         Drainage clears structural members ____________
                         Drains cleared and open ___________________
   (g) Roadway Expansion Devices:
       Type: Filled Opening _______ Sliding ______
       Condition: Cleared _______ Needs Repair_______
   (h) Damage to Superstructure:
       Repair Needed: Yes _______ No _______
       Damage: Cracks ___ Broken or buckled components___
                Missing components _______
   (i) Damaged Superstructure Components and Evaluation:
       Handrails: Repaired ____ Needs Replacement _____
       Curb: Repaired ______ Needs Rebuilding_______
       Structural Members: Lightly Damaged ____________
                            Needs Replacement __________
       Stringers: Corroded _____ Cracked ______
                 Buckled _____ Needs Repairs _______
                 Needs Replacement ___________________
       Other: ________________________________
(j) Bearing Devices:
    Expansion Bearings: Cleared and movement accommodated ______ Needs Repair ______
    Fixed Bearings: Cleared of Debris __________
    Condition: Good ____ Fair ____ Damaged ______

17. Substructure
   (a) Abutments: General Condition:
       Good _______ Fair _______ Poor _______
       Maintenance Performed: __________________________

   (b) Piers: General Condition:
       Good _______ Fair _______ Poor _______
       Maintenance Performed: __________________________

D. NOTES TO ROAD SUPERVISOR: