DRAINAGE AND STRUCTURE — MAINTENANCE

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Along with the presentation of this paper some slides will be shown to illustrate some of the problems of bridge maintenance.

The subject of drainage and structure maintenance could be divided into several sections but time would not permit going into details. Drainage will be discussed first.

The discussion of drainage will pertain only to proper maintenance of the channel under and adjacent to the structure. The first requirement for economical maintenance is the proper location of the drainage structure, but since the location of the structure is not a maintenance responsibility we must maintain the existing channel to provide maximum efficiency.

In many cases structures that were designed and built to provide for the proper opening have been allowed to grow up with bushes and trees until very little water can pass under some of the spans. As a result, this may encourage scour under the span that is unobstructed. Drift that is allowed to accumulate around piers, bents and the walls between multiple barrel culverts will not only obstruct the opening under the structure but will become a fire hazard in dry weather.

Frequently some of the openings on multiple barrel culverts and pipes become stopped up. This could be avoided in many cases if the inlets and outlets are properly maintained to allow the flow of water to be distributed to all openings. In cases where the stream is parallel to or nearly parallel to the road and then turned abruptly through the structure at the inlet, there will be a tendency for one side of the structure to silt up. Little can be done to improve the condition except to keep the inlets and outlets clean.

The maintenance of drainage could be classified into two general classifications—routine and repair.

Routine maintenance should include keeping the roadway clean. Clean the bridge seats around the shoes and bearing plates on top of piers and abutments. Keep all weeds, brush and trees cut that obstruct the openings under the bridge. Keep drift removed from the bridge. On bridges with concrete floors, keep the joints in the floor sealed with crack and joint filler. All of this work could be done by the county crew.

On repair maintenance this would include the work that the county crew did not have the equipment or the know-how to do to keep the structure in good condition. This work should be done by special crews or by contract.

So you may be more familiar with the problems of bridge maintenance in the Highway Department, let me give you a few statistics.

We are now maintaining more than 4200 drainage structures that are classified as bridges—that is, 20′ or more between abutments. Of that number, more than 400 have a load carrying capacity of less than 15 tons, about 600 have a roadway width of less than 18′ and about 30 have a vertical clearance of less than 14′. From the above figures you can see that about 10% of our bridges have a load carrying capacity of less than 15 tons.

I have been speaking of structures that are classified as bridges. We do not have a complete record of the structures (exclusive of pipes) that are too small to be classified as bridges, but it is reasonable to assume that they will outnumber those that are classified as bridges.

The problems of bridge maintenance are many. A few of these problems will be discussed at this time:

(1) Many of our bridges were built in the horse and buggy days and were not designed to carry the heavy loads that they are now required to carry.

(2) Many of our old steel bridges that were taken over from the counties had been allowed to rust for years and have weakened some of the members. Some of the members are loose and should be tightened.

(3) We have a number of wooden bridges that need replacing. Some have masonry substructure with steel or wood stringers and wood floors. A few years ago a treated wooden floor on a bridge was estimated at last 20 years. Today we have had some of these same type floors to last less than 5 years. The reason being that the traffic and loads have increased and also the lumber is inferior to that we used in pre-war days.

(4) A number of our concrete bridges that are 25 years or older are showing signs of deterioration. This is common where inferior aggregates were used in the concrete.

(5) Many of our bridges are too narrow and on poor alignment. Some are being hit and damaged continually. Some of the truss spans have been hit so many times that the truss will not carry the load and it has been necessary to place bents under each floor beam. Handrails are being damaged continually by overhanging loads, truck beds and vehicles going out of control.

(6) In sections of the coal fields in the Eastern and Western part of the State, the acid bearing water is so strong that it will eat through a metal pipe within a short time. Also within a short time it will expose the coarse aggregates in concrete and will eat the mortar from the joints of stone masonry.

(7) On a number of our reinforced concrete deck girder spans, the spans are sliding on the piers and abutments. This has caused the concrete in the pier caps to spall in most cases. The joints between the spans are becoming wider and allowing foreign matter to fill the joints so that when the span expands, the material will not compress and the span is forced to move in another direction.

You may ask what is being done to correct these conditions. First let me say that we are starting an annual inspection of all drainage structures so that we may be more familiar with the conditions and corrective measures may be taken where necessary to prevent damage or maybe failure of the structure. When going out or sending someone out to make these inspections, go dressed for the occasion. If you were starting out to go hunting or fishing you wouldn't be wearing your best clothes and I can assure you if a thorough inspection is made, that you will run into as tough going as if you weer hunting or fishing.

(1) The first of the problems mentioned were weak bridges. Many of the old bridges we have under maintenance are steel trusses. Usually, they have a weak floor system but the trusses are strong enough for a 10 to 15 ton gross load. On these bridges that are not to be replaced in the near future, we are strengthening the floor system so that it will carry a load equal to that of the trusses or a gross load of 15 tons. When it becomes necessary to replace the existing floor on a bridge, the stringers and floor beams should be investigated far enough in advance to determine what can be done to increase its load carrying capacity if it has a rated capacity of less than 15 tons. It may be necessary to replace the stringers with new ones or if the existing stringers are 7″ beams or larger (depending on the length), additional stringers may be added. Sometimes the floor beam is weak and can be strengthened by welding another beam under the existing one. It is not good practice to put a new floor on a bridge with weak stringers unless the bridge is to be replaced within a few years. The life of the floor is shortened by excessive deflection in these weak stringers.

(2) *Weakening of steel bridges by rusting and loose members.* Slide #1 shows the rusted condition that is common around the shoes and the lower end of batter posts. Slides #2, 3 & 4 show a tension member with tightener in place and after the member has been tightened. By this method we are able to tighten the member without cutting it. This is done by heating and shortening a section of the member.

(3) *Wooden bridges and steel bridges with wooden floors.* We have started a program of replacing wooden floors with metal plank floors on some of our steel bridges. Contracts have been let for this type work on 6 of our larger bridges. We are planning to buy some pre-cast concrete spans to replace some of the wooden spans that have good substructures.

(4) *Repairing deteriorated concrete.* We are purchasing the equipment and will start a gunite crew repairing these bridges. Slides #5 & 6 show a bridge in Allen County that is in need of immediate repairs. Slide #7 shows a concrete pedestal on the Tyrone Bridge in Anderson County. This pedestal supports one end of a 225′ deck truss span. Slide #8 shows the pedestal after it has been repaired by guniteing. Slide #9 shows the handrails on the same bridge that need some kind of protective coating to stop deterioration. Slides #10 and 11 show deteriorated concrete in Menifee County. We will start repairing these bridges with gunite this spring.

(5) *Narrow bridges that are being hit by trucks and other vehicles.* We are replacing some of the old pre-cast concrete rails with metal guardrails fastened to the outside curb with steel beam posts. On the narrow truss spans we can only hope to get them replaced with new bridges.

(6) *Acid conditions in coal fields.* Slide #12 shows the effects of this acid on concrete. This bridge is on US 41 in Hopkins County and was completed in 1938. A jacket of bituminous coated corrugated pipe filled with blacktop has been placed around this column. Slide #13 shows the effects of acid water on multiplate arches. We plan to coat this type of structure with bituminous material or some other approved coating.

(7) *Concrete spans sliding on piers and abutments.* Slide #14 shows a bridge in Anderson County that has moved more than 2″. Slides #15 & 16 show the crushing effect this sliding has on pier caps. We are using cold applied mastic to fill the joints between spans, thinking that this will keep foreign matter out of the joints when they contract and allow the span to expand on a line parallel with the road.

Some of the parapets are failing on steel bridges. Most of these failures are on bridges that have concrete pavement approaches. We are cutting out a section about 4″ wide across the concrete pavement at each end of the bridge and filling with bituminous material to help remove this pressure from the ends of the bridge. Slides #17, 18, 20, 20 & 21 show the condition of the Salt River Bridge at West Point. Parapets have failed at each end of the bridge and are shoving the end spans toward the center spans.

I have not mentioned slope walls around abutments as a major problem, but last year we had a number of failures during the extreme high water in March. Slide #22 shows one of these failures over Barren River in Allen County. The fills around abutments are more likely to wash out when protected with concrete slope walls than they are if the fill is protected with riprap or if the fill is made of rock.

In spite of a limited budget and insufficient crews on bridge maintenance in some of our districts, we are making numerous improvements on our bridges.

Contracts have been let for more than $600,000.00 worth of these improvements since July 1st of last year. We have advertized for bids on about $200,000.00 more work to be let this month.

The special bridge crews are doing a good job in maintaining and improving our bridges. We realize that there is plenty of room for improvement and must be on the alert for better and cheaper ways of getting the job done.