

INTERPRETATION OF PLANS AND SPECIFICATIONS

A Panel Discussion

by

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Q. What is to be used in computing the allowable breakage according to Section 13, Page 90 of the Standard Specifications, and what is the basis for payment?

A. Before answering the first portion of that question I would like to read a description of "Breakage" as set out in the Specifications which is very brief. It should be read so that we can all follow along together.— "Breakage shall include rock occurring only in ledge or mass formation, which (originally lying without the typical cross-section of the roadway as staked by the engineer) is so unavoidably loosened, in the opinion of the engineer, as a result of blasting or other causes as to require removal." Now to extend the definition further to bring out its full intent—it shall include rock occurring in ledge or mass rock formation behind the typical section lines in cuts, which typical section is ordinarily shown on both a plan layout sheet and cross-section sheets.

The only exception to this definition would be in cases where the field engineer makes the final determination of the typical section at the time he sets the slope stakes. For example, if the resident engineer assigned to a project in his own opinion was reasonably sure that a vertical slope or $\frac{1}{4} : 1$ slope would not stand up satisfactorily in a particular rock cut, then he has authority by the terms of the specifications to change the slope to $\frac{1}{2} : 1$ or $\frac{3}{4} : 1$ as the case may be in order to obtain the proper back slope. Therefore, all excavated material in rock cuts lying behind the defined back slope lines that have been determined by one of the methods just mentioned is termed as "Breakage". Now, that's so much for the description.

The area to be computed would be the area between the back slope line determined by the slope stakes or cross-sections on typical section sheets, and the extreme back side or sides of the excavated cut. That's the area to be calculated and paid for provided this material can be termed as legitimate breakage. In my opinion, and it has been pretty much the policy of the Highway Department, legitimate breakage would be termed as such when a contractor has made every effort to place his drill holes along the top of the cut slopes to conform with the slope stakes set by the field engineer, and further that the breakage is not caused by promiscuous blasting and gouging behind the determined back slope line with a power shovel. If he does drill, blast or gouge in a promiscuous manner, then I would say that any breakage that occurs would be termed as "no pay." On the other hand, the area should be paid in full if the material can be used between balance points in embankment sections in lieu of borrow or other types of excavation assuming, of course, that there would be no increase in cost. But if

the breakage material is wasted along embankment sections, and this is caused by methods that would be termed faulty and careless, then I would again say that it is "No Pay Breakage."

The basis for payment is determined by the method of measurement just referred to, based on a quantity not to exceed 10% of the total volume within the typical section shown on the plans or the typical section determined by the slope stakes set by the Engineer based on stations of 100 feet. In other words, if there is a total of 5000 cyds. of excavation, including breakage in a cut between Stas. of 100' (which quantity is not uncommon in mountainous territory), then the most pay breakage that could be allowed would be 10% of that total quantity.—MR. LOGAN.

Q. *On grade and drain projects requiring high type surfacing, it is the policy to construct the grade to approximately one foot below the ultimate final grade. What is the easiest and best method to follow in leaving enough yardage in the cut sections for constructing shoulders on the future surfacing project?*

A. (a) It is the policy of the Department to construct all grade and drain projects requiring high type surfacing one foot below the ultimate final grade. But in all cases the plans will govern.

(b) The easiest method for leaving shoulder material in cut sections depends entirely on the existing conditions. In the mountainous sections or in the rocky sections it is possible that you'd have to leave all material available for shoulders. However, where there is ample shoulder material I would suggest that the material be left in low cuts, that the slopes be modified to a $\frac{1}{2} : 1$ slope or $\frac{3}{4} : 1$ slope, or some slope on which it would possibly stand. The typical section could be modified; if you have a six foot ditch you could modify it into a three-foot ditch or a two-foot ditch leaving the material in place but always constructing the typical section to its full surface width. I would suggest that you always leave the material where it's easy to obtain because the easier the material is to obtain the lower price we will get when we let the contract for the shoulder material.—MR. OWENS.

I don't have much to add to Mr. Owens' statement except that some mountain counties have rock formations with a good bit of earth on top. It is sometimes possible to get up there with scrapers by providing a bench about ten feet in width. Usually this requires some cooperation from the contractor.—MR. NEISER.

In regard to the best method, that is a little difficult to answer; however, there are several methods used. I don't think it would be prohibited to leave a dirt cut narrow through its entire length on both sides, even though the cut is 10 or more feet in depth; the shoulder and ditch widths could be reduced accordingly and made sufficient to insure proper drainage until the following year when the high type surface is likely to be applied. Another method used is where 11' surface lane ($\frac{1}{2}$ width), 8' shoulder, and a 6 : 2 inslope (ditch) is required, the shoulder width has been reduced to 4' and the inslope to a 3:1 on one side, leaving the entire chunk of dirt for the shoulder material on one side only.

Another, and the most common method used, is to take the cut out full typical section width at the ditch lines and leave the dirt slopes as near vertical as they will stand. It is my belief that the latter method is the most difficult to handle both from the standpoint of the grade and drain contractor and the future contractor on the high type surface as the high type surfacing contractor will be required to virtually use razor blade methods to obtain this material for shoulders. Likewise, this method would undoubtedly be reflected in a high bid price at the time of high type surfacing, as it is very rare that we ever have sufficient width between the top of the theoretical slope and the right-of-way line to bench down and obtain the needed material which is particularly true when the cut is more than 10' deep. I don't say, however, that this method is objectional.

Now, so far I am satisfied that my neck is not out too far in regard to the

best method and, perhaps, the person who submitted this question is now more confused however, the important points to remember about projects that the plans require to be constructed one foot below grade are; first, be certain to complete all embankments in accordance with the requirements of the plans and do not substitute additional borrow material in lieu of dirt material left in place; second, use your best judgment in regard to where the material should be left in place which should be based on the quantity that can be made available at the various points based on the most economical haul of the material.— MR. LOGAN.

Q. There is some misunderstanding relative to taking samples of steel reinforcement. According to the specifications, is it permissible to use steel that has been tested at the source of supply?

A. According to Specifications, it is not permissible. During the War, commercial laboratories and the Missouri Highway Department were engaged to do some testing for us at the source of supply. This practice has not stopped, but should be diminished as rapidly as possible.— MR. BITTERMAN.

Q. When a wedge or leveling course is set up in the proposal, shouldn't the specifications clearly indicate to the contractor that the tonnage set up for this item shall be used anywhere within the limits of the project as directed by the engineer and completed before any other course is laid?

A. In regard to that part of the question that says "Shouldn't it be clearly set up in the specifications", this has been rather troublesome for the reason that in many cases the leveling course as determined when an inspection of the road is made is pretty clearly defined as the spots at which it is thought that the leveling course should be applied. Frequently a Resident Engineer is assigned to that job who has not had the advantage of being familiar with the road during its most critical period — in the Spring when the road itself more clearly indicated the weaker sections.

In some cases we undertake to make a sketch map on which we indicate the exact location for the benefit of the Resident Engineer and the contractor. We indicate the exact locations for those leveling courses or half soles. In the case of wedge courses it has been our intention to try to word proposals in such a way as to clearly indicate to the Resident Engineer and the contractor that the material set up for wedge courses and leveling courses is to be applied before the surfacing course is applied and is to be applied where and as directed by the Resident Engineer. Those provisions do not appear in the specifications in the Specification Book, for the reason that they are not the same on all resurfacing jobs. We have undertaken to clarify that point in the proposal rather than in the specification. Maybe if there has been some slip up in getting those notes on the proposals that is the risk we take by not putting it in the specifications. But we think it is a proposition that does not apply in the same way to all re-surfacing jobs.— MR. JOHNSON.

I might say we have discussed this question for several hours.— Mr. Johnson, Mr. Owens and several others at Frankfort — and I think Mr. Johnson has covered it well. I'd like to add my portion to it. You can see from what I have to say that we haven't gotten together on this question. Where a wedge or leveling course is set up on the plans and is not confined to specific stations the engineer may use this material where needed within the project limits. The Maintenance Division is of the opinion that going out ahead of the normal course with leveling courses would increase the bid prices, and they say that the local maintenance crews can do this type of work in advance cheaper. However, depending on the road conditions some projects will be set up to lay the leveling course in advance of the normal course. That's dependent on the project. I think the question is a very pertinent one and we'll probably discuss it a good bit more in setting up this season's work. However, all the proposals and projects won't come out alike — they'll vary.— MR. NEISER.

Q. On a bridge painting project, at what stage is the bridge ready for painting if the contract does not call for a sand-blast item?

A. I'm not sure whether the person who made out this question referred to new bridge painting or maintenance painting but I shall make a few remarks about both contracts. First, on a new bridge, painting should be done after the paint, either red lead or blue lead, has been properly touched up so that there is a full coat of shop paint next to steel. This is an important thing because you must have that protective coat of shop paint next to steel. This is an important thing because you must have that protective coat for its inhibiting values in preventing rust.

If the person asking this question had in mind maintenance painting projects, the question arises so often as to how much cleaning should be done and, of course, the personal element enters in there. When not calling for a sand blast, as the question intimates, ordinarily the cleaning is done with scrapers and wire brushes and the object, of course, in cleaning is to remove all rust if the old paint has been broken so that it is exposed and rust is occurring on the steel. Then the shop paint is not doing its job in protecting it, and it is necessary to get all the rust properly removed so that you have practically bare metal. Then it is important that places that are difficult to get to, as around shoes and inside chord members are clean. I always look for those places that are difficult to reach and generally like to look at those surfaces first and see that the cleaning is thoroughly done; that the old paint, the loose paint, paint that isn't suitable for foundations for the new coat is properly removed, as around the shoes, on the expansion dams at the end of the bridge, inside the top chords and the upper side of the batten plates and lacing bars, all those things that are hard to reach should be thoroughly cleaned. And yet there's the human element there that causes those places to be slighted some.

I wish there was some way that we could word the contract for maintenance painting that the man doing the work, the contractor and the inspector would all agree that the job should be thoroughly done. In other words, it would be desirable to arrive at a point where we paid him so much a square foot for surface that was satisfactorily finished. It is preferable to have two or three panels of bridge satisfactorily cleaned and the inspector permitted to go over that before the contractor starts his first coat. Of course, the tendency is the sooner you can get the first coat on the sooner you are through with the hard job of cleaning and the quicker the job is finished. I've seen on spraying jobs in the last year places that are hard to reach, the painter has sprayed over a quarter of an inch of old paint and dirt on a horizontal batten plate or lateral plate. It's a question of getting that loose paint, dirt and rust removed so that we do have a suitable foundation for the new paint.—MR. TODD.

Q. Special Spec. 48-R permits a tolerance of 0.5' in grade line. Does this mean a variation from the grade of 0.5' above or below, or does it mean a variation of 0.25 above or below plan grade?

A. This tolerance means that it's 0.5' below or 0.5' above grade. It does not mean that the contractor should be permitted to construct a grade 0.5' low at one station and 0.5' above grade at the next station but is to construct a uniform grade which will be accepted 0.5' above the plan grade or 0.5' below the plan grade.—MR. OWENS.

Q. If a certain type of bituminous material is specified in the contract for prime, is it permissible to use any other type of bituminous material to perform the work?

A. I would say it is not permissible without a change order in the contract. I might add to that that we undertake to set these re-surfacing jobs up in many cases with more than one type of prime coat being permitted on the job. For instance, you will have a plant-mix job on which the proposal will state that you may use an RC-2 material or you may use the same material that is used in the

plant-mix. In those cases you may use any material that is allowed under the proposal. You cannot go beyond that material that is allowed under the proposal without a change order.— MR. JOHNSON.

Q. Should prime on road mix be applied before aggregate is spread or after aggregate is spread?

A. The conditions on the road, of course, will alter cases in many ways. There may be a particular condition on the job you have that will warrant either action. As a rule I think it is a much better practice to apply the prime coat before any aggregate is placed on the road—the reason for that being that your existing road surface may be a little bit irregular—it may be pitted and if the aggregate is applied first and is allowed to dust off and dust fill those pits in the roadway then it is most difficult to ever get a tack coat back underneath and tie your new surface down to your old surface. There might be some cases in which you would be justified in applying the aggregate first but those would be the exceptions—very much the exceptions. As a rule the prime coat or tack coat should be applied before any aggregate is applied to the road.— MR. JOHNSON.

Q. Sometimes when No. 610 aggregate is hauled from a stockpile it has a considerable amount of moisture. Would it be economical to determine the amount of moisture and make up this tonnage when applying the aggregate?

A. No. Usually it will not run more than 1%.— MR. BITTERMAN.

Q. How may sand streaks and air pockets be eliminated in a concrete structure?

A. I imagine this question is brought up by the fact that in a large number of structures we have been eliminating the usual finish with a carborundum brick. On inspection of the exposed face of the wing or main wall of an abutment or pier the appearance is not quite satisfactory for a new bridge, so the question of how to eliminate these sand streaks and air pockets has come up. A sand streak, as I understand it, is caused by a settlement of the plastic concrete in the forms forcing the water upward. I remember in building the Burnside Bridge the surface of the concrete on the piers showed considerable sand streaking—it was like a map of the Mississippi River—it started in a small tributary and it grew as it went upward until it became a large channel.

This condition, I think, occurs all through the mass as well. You've seen those little boils on the top of newly placed bridge floor slabs. That's piping or sand streaking inside the mass. In order to eliminate that or to reduce it, one of the main things I think is that the sand should have plenty of fines so that this channel cannot start up through the concrete. Then the cement may be a little bit lumpy or the cement itself may not be ground as fine as it should. Of course a lumpy cement would be some contributing factor toward causing the sand streaks.

After the mix is designed with the proper water-cement ratio, mixing proportions, and consistency, it is imperative to control the quantities of ingredients entering into successive batches in order to gain concrete of uniform quality. That means that there should not be any channels through the concrete which will permit the sand streaking to start and, of course, reduce the possibility of water forcing through these channels, washing the cement particles off the sand and leaving the sand without any cementing value on the face of the bridge pier or abutment.

The second portion of the question regarding air pockets, I think, refers to these small air bubbles. When you remove the forms you find them all over the exposed surface and I think one aid in reducing them would be to use a sharp steel instrument or spade along the upper twelve inches of the form to remove the air. A slight tapping with a rubber headed mallet or hammer of some sort on the outside of the forms will probably reduce the air pockets to some extent.— MR. TODD.

Q. How much of the work set out in Section 15 (Final Dressing) of the Standard Specifications, should be required of the contractor on Grade and Drain

and Traffic Bound macadam construction on which shoulder material is to be left in the back slopes:

- a. When item of Final Dressing is omitted?
- b. When Final Dressing is a pay item?

A. Well, I don't think that any part of the Specifications for Final Dressing should be applied in either event, my reasons being that the Specifications for Roadway Excavation provides for the necessary typical section required without the added refinements. They provide that the typical section shall be graded to the lines shown on the plans which means that the centerline grade, shoulder grade, and the grade for the bottom of the ditches must conform to the typical section. Therefore, when Final Dressing is intentionally omitted as a bid item it is for the obvious reason that the refinements required by the Specifications for final dressing — such as the string lining of shoulders, rounding of ditches and back slopes — are not wanted or needed for the desired results. In cases where dirt is left in cuts I can hardly see where any part of the Specifications for this item is applicable and personally I don't think it should be paid for in such instances. The State, however, thinks otherwise and is of the opinion that this method will cheapen the overall cost on this item and have so covered it by a plan note, and we have gone along with them so far to this extent.— MR. LOGAN.

On recent plans we are placing a note stating that final dressing will be paid throughout the project regardless of whether the contractor final dresses the entire project and that gives the contractor a chance to average his price and makes it a little simpler in determining the quantity by the engineer.— MR. OWENS.

I think we'll relieve that situation somewhat. It's our present policy on new grade and drain jobs coming up to eliminate the item of final dressing and put it on the high type surfacing when that comes along, and we're going to rely on finishing the section as Mr. Logan explained in the beginning, on the grade and drain projects.— MR. NEISER.

Q. *On a Road-Mix, Bituminous Surface contract, what should be done when the existing base has worn down to solid rock and there is nothing set up in the contract to cover this? Is it possible to include this in ditching and shouldering or would it come under shaping the roadway for surfacing?*

A. I don't know that I know exactly what the person who asked the question had in mind. I take it that the reference is to an initial treatment on an existing traffic bound road. Assuming that that question does refer to an existing traffic bound road on which a contract has been let for bituminous surfacing, I can see no way under the contract that you could require the contractor to remove rock from the subgrade if such an item was not included in his contract. It may be a case where not sufficient work was done in the preparation of the plans and contract and in such cases perhaps the best thing to do would be to undertake to correct conditions with Department forces prior to the application of the Bituminous Surface by contract. I think it would not be correct to undertake to do the work as ditching or shouldering or as shaping the roadway. In other words, it might be considered an item that is needed to be done and that was omitted from the contract and then could only be done by supplemental contract or by Department forces prior to the work that the contractor is supposed to do.— MR. JOHNSON.

Q. *On some summary sheets there often appears a typical section for approaches, however, after work gets under way the question often arises as to whether or not all approaches should be constructed according to this typical section. How can such plans be interpreted so that only certain approaches should be constructed according to the typical section?*

A. I tried to interpret that question the best I could — I'll answer it but if there are any questions I will try to go into it further. Where approaches require a special typical section they should be identified by station numbers. The typical section for entrances as shown in the Standards will apply in most cases. There

may be a difference in shoulder width that would cause the entrance to a typical section to be modified slightly to fit the typical roadway section shown by the project. Where approaches require a medium or high type surfacing they will be identified by station numbers on the plans.— MR. NEISER.

Q. Please elaborate on the intent and provisions of Special Specification No. 45 covering the surface finish of exposed concrete.

A. The intent of this specification undoubtedly was to reduce the cost of the finished structure. Just how much that reduction in cost has occurred I am not prepared to say, but I have a copy here of that specification and will just run over the seven provisions briefly covered by that specification. First, all exposed surfaces should have suitable form lining. Let me say that if these seven provisions are not complied with then it is the duty of the inspector or resident engineer to require those surfaces to be rubbed in the usual way according to our Standard Specifications of 1945.

The first one then that should be complied with is form lining of ply wood or equal or single thicknesses of ply-wood of sufficient strength to act as sheathing and form lining as well. Metal or equal may be used in panels as large as practicable to minimize joints. We've never used the metal forms yet that I know of but the question has arisen two or three times in the last year. Why not use those metal forms? So far it has not been proven quite the economical thing to do for the type of structure under consideration. The second provision that the forms are properly oiled with clear paraffin oil that will not stain the concrete. Then the form must be properly tied so that there are no projections of more than a quarter of an inch, and then the forms are properly tied and braced so there isn't a bulge. This is a very liberal tolerance; three-quarters of an inch in 10 feet. I know that you men seldom get a bulge that large.

There must be no honeycomb spots or spots on any face of the column or wall or other surface that don't exceed one percent of that surface. If it doesn't have more than 1% of honeycomb or patched area the contractor is still in the clear and would not have to rub it. "Any other small surface defects have been satisfactorily corrected as specified in the 1945 specifications." That would probably refer to sand streaking or air pockets or pitting on the surface of exposed concrete. Then we have the last general clause that the resultant surface has been approved by the engineer as to color, texture and smoothness. It is important that the resident engineer make the decision at once whether to require rubbing or not.

Concrete can be rubbed the first time as soon as it's hard enough. Then you don't dig out the sand and cause brick marks or cause the coarser aggregate to be exposed. The first rubbing must be done at just the right time. If you wait too long so the mortar in the concrete has set up, then the mortar which has been worked up by the brick will not reset to the mass of concrete properly. The first rubbing must be done in warm weather the next day on a vertical face or as soon as the forms can be removed. Therefore, the inspector and the resident engineer should make that decision right there. When that contractor has not complied with these seven clauses, then he should go ahead and rub this particular surface. That will, however, result in a little patchwork.

You get one pour on a pier and one surface doesn't meet with the specifications as interpreted by the resident engineer, then surface finishing must be done on that particular area on that pier. Maybe, the next lift does not need it. But that is the interpretation that has been given to that specification; the contractor still doesn't have to rub the whole pier. May I digress a moment. I don't know just how much has been saved by this surface finish specification but I have felt personally that it would be well to go back to 1945 Standard Specifications, and from it eliminate the rubbing inside the culvert barrel at its inlet and outlet, the curbs of the overhanging portion of a deck-girder bridge, and under the outer

girders of a deck-girder bridge. All of those surfaces which you can't get to before the concrete is so hard that you can't get the surface intended when you start to rub it. If we could possibly eliminate those clauses which are now in the Standard Specification of 1945, I believe that we would do well because the finishes we are getting on those surfaces are not the same kind of finishes we are getting on the bridge as a whole because the concrete is too old and has attained greater hardness than would allow suitable finish.— MR. TODD.

Q. Assuming that a face — say a face of a wing wall or abutment or a pier had about 25% air bubbles along the face of it and some sand streaks — would they require a contractor to rub that under the specification?

A. We probably would. There's one clause here that we might fall back on if there's any disagreement. "Any and all small surface defects have been satisfactorily corrected as specified." It's a matter of judgment there as to when you are going to rub and when you are not under that special specification. We held a meeting in each of about four districts with all the Resident Engineers who could get there, and we tried to interpret that specification while we were standing there looking at a bridge or a culvert with the forms just removed.— MR. TODD.

Q. Shouldn't there be a specification written permitting the engineer to specify softer asphalts on weaker bases?

A. The Department's Specifications provide for this.— MR. BITTERMAN.

Our specification does not permit that now and probably shouldn't for the reason that often times the Design Division is, I think, in a better position to know the history of the road and the weakness of the road than the Resident Engineer who is assigned to the job after the contract is let. The Design Division too takes into account the question of the volume and rate of traffic when determining the grade of asphalt, and they have access to the information on traffic that perhaps is not readily available to the Resident Engineer.— MR. JOHNSON.

Q. Shouldn't there be other definite limitations placed on the control of transporting hot-mix asphalt besides the one limiting temperature?

A. Yes. The mixture should be delivered and spread on the Roadway within one hour of being dumped from the mixer and in ample time to secure thorough compaction during daylight hours.— MR. BITTERMAN.

Q. What is the proper procedure for patching bituminous surfaces and concrete surfaces with bituminous materials?

A. That is a pretty good question. Any surface or any pavement that is to be patched — whether it be a bituminous surface or a Portland Cement concrete pavement — must first of all be thoroughly cleaned. There must be an application of a tack coat or prime coat sufficient to tie the new surface or the patch to the existing surface. That question could possibly refer to a concrete pavement, as to whether or not the concrete pavement itself should be dealt with by means of mudjacking or removing some of the concrete pavement prior to re-surfacing or patching. If that was the intent in the question, we undertake to follow a general policy of correcting or removing broken slabs of concrete pavement that are not resting on the sub-grade throughout. In other words, the rocking slabs, slabs that move under traffic should be corrected before a bituminous surface is placed upon them. It may be possible to do that by mudjacking, it may be necessary to break the slab down and remove it, or it may be possible to break it down and leave it in place.

As the question applies to patching I think the item of cleaning and applying a tack coat and applying a patch before the tack coat gets dirty where traffic has used it — for instance before they've tracked mud on it and rendered it useless — is perhaps of most importance. Now the patching itself may be mixed in place or it may be pre-mixed and hauled to the job. In any case it should be thoroughly mixed and well coated with the proper amount of bituminous material and it should be thoroughly compacted. Compaction on small patches, if the traffic isn't

too heavy, can be done by rolling with the rear wheel of a dual-tired truck. For our own forces we do have some small rollers. In some cases on extremely low traveled roads the traffic will compact some of these patches without too serious damage. It is a thing that must be considered with its local circumstances. Patches are so different — the local conditions must govern in most cases. — MR. JOHNSON.

Q. What method should a contractor use to get proper compaction in widening existing roadway fills by approximately 2' on each side?

A. I would not know how he could get compaction on a 2' widening on each side of an existing deep embankment. However, there is a provision in the Specifications for placing material on existing embankment sections that require that furrows or steps be dug along the side of the existing embankment after which the added material is to be distributed over the slopes uniformly, but that would not necessarily add to the compaction although it would undoubtedly cause the material to stay in place better. It would be possible, however, to compact the extra width for a depth of possibly two or three feet from the top by the use of sheepsfoot rollers, but I don't know of any practical method for compacting the total length of the slope.— MR. LOGAN.

Q. Shouldn't special specification 48-R be changed to include rolling for embankment compaction in accordance with 1945 standard specifications?

A. Special specification 48-R pertains to rural secondary projects and rural secondary projects are built for cheap construction. Requiring a sheepsfoot roller would run up the cost on these projects. I would say that is why we are not using sheepsfoot rollers. I think we should use them and it might be false economy that we are not using them. Time will tell that.— MR. OWENS.

Q. Describe the way to classify Borrow Excavation as opposed to Roadway Excavation.

A. That's an old timer — all I can do is to refer to the specification on Borrow Excavation. The first sentence is as follows: "This work shall include the removal and satisfactory disposal of all material taken from pits isolated from the finished cross-section of the road. Borrow excavation shall be allowed only between points shown on the plans as 'Borrow' and obtained from designated Borrow pits." Most of the trouble which has come up in the field on borrow is due to the plans. I find some of our own men in the Design Division are not clear on the subject. We've discussed time and again and pointed out what Borrow excavation is. A recent example of it is on a plan sheet showing balance excavation between balance points. Somebody had made a correction in one balance point and unthinkingly wrote in Borrow excavation instead of balance excavation. Well there it is on the plan and it goes out in the field that way. I think most of the trouble on that question is in the plans. Actually it has to be designated on the plans as Borrow. I think we can confine most of it to isolated Borrow pits. We have been using it in some places on the plans where it should have been roadway excavation.— MR. NEISER.

Q. Would there not be a considerable reduction in quantities or elimination of overruns, if the shrinkage factors on grade and drain projects were estimated from the values in final quantities on past construction?

A. I doubt it. The shrinkage factor, as well as the swell factor now used on most of the projects have been determined from construction projects finished a long time back. In other words, it has been much of a standardized practice over the years to use a shrinkage factor most of the time as 20% and a rock swell ranging from 15% to 35%. Now to take some recently completed construction projects for example, I doubt very much if you would get much more valuable information to cause any drastic changes in either factor since they were obtained in this same manner many years ago. I say that for the reason that I am reasonably certain that no mass diagram is used throughout on a construction project to determine the actual distribution for all the material excavated since it is only necessary on a construction project where overhaul is likely to be involved, and

unless you do know the actual balance points of all the materials distributed I know of no other way to determine accurately shrinkage and swell factors from a completed construction project.

Several years ago, for a period of time, it was the policy to call on the Laboratory at Frankfort to make soils analysis of the soils on which high type pavements were programmed and to furnish the shrinkage and swell factors to be used on plans based on these analyses, and during that period the more or less standardized factors were changed to conform with these analyses which as I recall applied only to the grade, drain and traffic-bound surface types usually followed within a year or two with a high type surface. This information was developed in conjunction with the Proctor density and standard compaction tests at the time the analyses for the soils were made and were used particularly where the Specification for "Extra Compaction" for embankments was applicable. I don't think this is standard practice at the present time, although it still may be used occasionally.

Again, I don't know how the present system could be improved by checking back over recently completed construction projects unless the exact quantities and classification of the materials excavated and distributed between balance points were known. I happen to be familiar with some sections of grade and drain projects where exact balance points were determined in dirt cuts where on the same projects the shrinkage factor varied as much as 7 or 8% within a range of one-half mile. This, of course, was due to the character of the soil. It appears to me that the soils analysis method for determining these factors should be used in combination with past experience.— MR. LOGAN.

Q. What are the benefits of Air-Entraining Cement in the construction of small drainage structures and bridges? Is it permissible to change brands of cement in a structure?

A. These are two distinct questions. I must confess that I haven't had much experience with air-entraining cement in small drainage structures and bridges. The benefits derived from air-entraining cement are the increased workability which allows the use of lower water cement ratio; less tendency for the aggregates to segregate and then there's a slight increase in the volume of the concrete which increases the proportion of the mortar in the mix and results in a slight decrease in quantity of fine aggregate. The air-entraining cement mixes more readily and requires less time to get the same amount of mixing than would be required for the ordinary Portland Cement. There is less bleeding in the concrete or piping or sand streaking. The air-entraining cement will improve the durability some.

Disadvantages: the main one of course is to reduce the strength of the concrete in compression, flexure and bond. This admixture may reduce it as much as 10 or 15% depending on how much you add; but that, I think, is not such a serious factor. We have an ample factor of safety in concrete. I'd like somebody else to discuss that, someone who has probably had more experience with air-entraining cement than I have. Air-entrainment shouldn't be confused with air pockets. Air-entrainment is simply a minute, well distributed, completely separated air bubbles through the mix which causes additional lubrication and aids in mixing.

"Is it permissible to change brands of cement in a structure?" According to the 1945 Specifications the answer is "no". Two years ago we had a real shortage of cement and we did in some isolated cases permitted the use of a different brand of cement in the footing of a structure from that used in the rest of the structure, but generally we have held, in my recollection, pretty close to that requirement. The reason probably is that different brands of cement will make a difference in the color of the concrete—in the exposed concrete—and I believe that is one of the main reasons why it is in the specifications.— MR. TODD.

Q. On heavily traveled highways, the amount of crushed stone now used for traffic bound surfacing seems insufficient. Could a larger quantity be set up on construction contracts?

A. We've discussed that matter in the office several times — some projects have required a considerable amount of additional stone depending on the traffic volume. It has been decided to continue to use the three inches normally set up on grade and drain projects and add to this if needed — It may be added to while still a construction project, or maintenance can add the stone which they usually do if it is necessary. It depends on the time of the year when the stone is placed and how soon the project is let. Some projects require more stone than others. However, surface or floater stone is often objectionable at the time of high type surfacing. That's about as well as I can explain why we are holding to three inches loose depth.— MR. NEISER.

Q. In the preparation of traffic-bound surfaces, is the No. 6, No. 610, or even a longer graded aggregate (containing more fine) best from the standpoint of binding qualities and less of material under traffic?

A. I personally feel like it's the best size stone we have for that purpose.— MR. NEISER.

Q. Are you referring to both 6 and 610 or to 610?

A. Well, we use 6 and 610. — MR. NEISER.

Q. You use them separately don't you?

A. Yes.— MR. NEISER.

My first opinion would be to use the 10 and the 6 separately.— MR. OWENS.

Q. You'd use them separately but you would never use 6 or you would not recommend 6 alone?

A. No.— MR. OWENS.

Q. In other words, sixes and tens in combination you think are best?

A. That's my opinion — someone else, may have another opinion.— MR. OWENS.

There's been quite a bit of discussion on a small top size stone in our 6 or 610 specification. We haven't used it so I really don't know. On new grading I'm inclined to agree with Mr. Owens — the 6 and the 610 are best on a new grade. On replacing stone — and I'm not sure that this question even applied to replacement stone — we try to follow the policy of allowing the District Engineers to use their own choice and most of them use 610. A few of them, I think, still use No. 6 stone for replacements. We prefer 610.— MR. JOHNSON.

Q. How soon after placing Class F or Class I surfacing material should initial rolling begin? How long should rolling be continued?

On the Class F type I don't see why it shouldn't begin immediately. In other words, after the material has been spread with the paving machine, the rolling should follow not more than three or four hundred feet or just far enough back to permit proper shaping and edging. The top temperature of the prepared material at the plant for this type is not more than 225° F. and for that reason I would not know of any cause for delaying the rolling.

For the Class I type, the top temperature of the prepared material at the plant is 325° F. On several occasions I have noticed that where slag aggregate was used in the mix and the temperature held up near the high range, rolling had to be delayed for a short period to prevent the material picking up on the roller. In such cases, it has been necessary to either reduce the temperature or delay the rolling to some extent depending on the conditions. When a limestone or sand filler is used in the mix and the temperature and other conditions are right, I don't know any reason for holding up the rolling much longer, if any, than on the Class F type.

In regard to the length of time to be rolled, the Specifications provide that the material shall be rolled until it is thoroughly compacted. On the Class I surface, the Specifications require that each 1600 sq. yds. of surface shall be given at least eight hours rolling. It is my understanding that the Highway Department has

prepared a revised Specification for rolling on both types liberalizing the Specifications to some extent, which will probably be applicable of some of this year's work.—MR. LOGAN.

Q. *When asphalt cement is used in bituminous surfacing how much, if any, rolling should be done after the material has cooled to atmospheric temperature? (This operation is usually referred to as back rolling.)*

A. A sufficient amount of rolling to meet the requirements of Specifications stated below:

8 hours for 1600 sq. yds. Surfacing

8 hours for 2000 sq. yds. Base or Binder.—MR. BITTERMAN.

I believe, Mr. Bitterman, that question applies to back rolling; that is, after maximum compaction is obtained behind the paving machine; possibly it refers to going back with the roller one or two days later to iron out the surface. Personally, I don't think the surface requires much back rolling. However, it is usually the practice to start back rolling the following day and make one round trip over the full width of the surface and not more than two round trips to iron out any small irregularities that might have occurred in the riding surface.—MR. LOGAN.

Don't strip the asphalt or crush the aggregate. When that starts it's time to get off with the roller.—MR. OWENS.

Q. *How much compaction is required for bituminous concrete "Class I surfaces according to the Department's Specifications?"*

A. Each 1600 sq. yds. of surface shall have not less than 8 hours of actual rolling time by roller weighing not less than 10 tons nor more than 12 tons. For base, binder, or wedge course, each 2000 sq. yds. shall be rolled not less than 8 hours with the same type of rolling equipment specified above.

Surface Rolling requirements = 100 Lin. Ft. per hr. for 18' Roadway; 90 Lin. Ft. for 20' Roadway.

Base, Binder & Wedge Requirements = 100 Lin. Ft. per hour for 20' Roadway. A density of 90 to 95 should be required for surfacing, and from 80 to 90 for base and binder.—MR. BITTERMAN.

"The Specifications for rolling Class I surface require that at least two rollers weighing not less than 10 tons, nor more than 12 tons, shall be required and as many additional rollers of the same weight as will be necessary to give each 1600 square yards of surface course not less than 8 hours of actual rolling time." This is the present and only specification requirement that I know of for obtaining the desired compaction for Class I bituminous surfaces.—MR. LOGAN.

Q. *According to the specifications, stumps may be left in place if the embankment is 24" or more in depth. There is some confusion as to what length stump may be left in place above the ground line. Page 54 — No root more than 3" in diameter shall be within 18" of the finished grade.*

A. When the item of clearing and grubbing is included as a bid item, the Specifications require that trees and stumps 6 inches or larger in diameter at a point 6 inches above the ground line shall be cut within 3 inches of the ground line.

The confusion referred to by the one requesting this information is evidently caused by the definition for grubbing, Par. (6), which paragraph is in the same section as Clearing & Grubbing and is quoted as follows:

Grubbing — "All bushes, hedge fences, trees and stumps within the line of slope stakes (except those occurring under embankments of more than 24" in depth) shall be grubbed up so that no root more than three (3) inches in diameter shall be within eighteen (18) inches of the finish grade, or within six (6) inches of the surface of any slope."

Therefore, the *exception* in the definition for "Grubbing" is intended to apply in instances where the full item of "Clearing and Grubbing" is not applicable and not included as a bid item, as, for example, the item of "Removing Trees and

Stumps." I don't recall of any instance where it would be necessary to include both the item of "Clearing & Grubbing" and the item of "Removing Trees and Stumps" within the same limits on any project. The item of Removing Trees and Stumps has been used in instances where there is no apparent signs of vegetation within the construction limits and defined right-of-way lines other than one-half dozen or so old dead stumps.

An example of this would be where a bridge structure with short fill approaches is to be constructed in a swampy bottom and there actually is no clearing to be done; it has also been used to cover work in cities and small towns where clearing is not necessary. Therefore, it is my interpretation of the Specifications that when Clearing & Grubbing is included as a bid item that trees and stumps 6 inches or larger in diameter at a point 6 inches above the ground line shall be cut within 3 inches of the ground line, and those within the actual construction limits or slope stakes shall be grubbed up so that no root more than 3 inches in diameter shall be within 18 inches of the finished grade or within 6 inches of the surface of any slope; further, that when "Trees & Stumps" is a bid item and clearing is not applicable, stumps occurring under embankments more than 24 inches in depth may remain in place. In all instances it would be necessary that they not be nearer than 18 inches of the finished grade. I believe the paragraph for grubbing should be clarified, or better still, revised.—MR. LOGAN.

Q. What conditions cause slippage on Class F surfaces and how may they be prevented? Why is slippage less prevalent with MC-5 than PAC-7?

In answer to the first part of the question, I would say the greatest cause of slippage of a Class F surface on an old pavement, or any other bituminous resurfacing on an existing pavement, is failure to properly clean the existing surface and properly apply the tack coat. There are other causes, such as the presence of water, which may enter the pavement either through the resurfacing from the top or through the existing surface through the bottom, but I think slippage can be prevented in most cases if the existing surface is properly cleaned, the correct quantity of tack coat is applied, and the resurfacing is applied before the tack coat is allowed to become covered with foreign substance by traffic.

In regard to the second part of the question, I didn't know that slippage was less prevalent with MC-5 than with PAC-7. Maybe in some localities this is true, but generally speaking, I think the PAC-7 is no more susceptible to slippage than is the MC-5. I think it is a case of improper handling of the resurfacing rather than difference between the MC-5 and PAC-7 material.—MR. JOHNSON.

This is evidently due to insufficient prime or dirty roadway. The MC-5 has a distillate and this has a tendency to drain and act as a prime.—MR. BITTERMAN.

Q. (a) When a contractor is required to construct and maintain a detour, what standards are expected by the Highway Department? Is the Department directly responsible for payment for the surfacing material?

(b) In case the contractor damages a detour during grading operations, does the Department pay for surfacing material?

A. (a) There is no definite standard for detours however, the contractor would be expected to keep the detour in a passable condition, free of pot holes and having a smooth riding surface with the proper drainage. The Department will be responsible for the payment of surfacing materials if the detour is a bid item.

(b) If the contractor damages a detour during grading operations then it would be his obligation to repair this detour.—MR. OWENS.

Q. In case the Department elects to use a county road for a temporary detour, is the Department responsible for repairs and maintenance on that road?

A. The Department is responsible for maintenance and repairs of any road used as a detour. This is covered in Bulletin No. 2019, issued by the Maintenance Office on June 27, 1949.—MR. JOHNSON.

Q. We are unable to find anything in the specifications which requires a

contractor to pour joints in newly constructed curb and gutter or sidewalk which is constructed adjacent to any type of base other than cement concrete pavement. Was this intentionally omitted from the specifications and, if so, for what reason?

A. This is covered by Article 6.16.3-B (b)-(2) on page 412 of the 1945 Specifications. Although no pavement other than the rigid type is mentioned specifically, the reference to rigid type is made in order to cover certain features that go with rigid pavements and not to exclude the flexible pavements. In other words, this specification applies to all types of pavements, and only those parts that can be used with nothing but rigid pavements are special things. Sidewalks are covered in Article 6.25.4 on page 430, and here again it is not limited to sidewalks built only with contracts for rigid pavements.—MR. NEISER.

Q. What are the specification provisions covering the laying of Bituminous-Coated Corrugated Metal Pipe with regard to paved inverts?

A. The Department's 1945 Specifications do not include paved invert, but where used, the paved section should by all means be placed down.—MR. BITTERMAN.

We do not have a specification on paved inverts. Special Specification No. 1 covers Bituminous-Coated Corrugated Metal Pipe.—MR. NEISER.

Q. Please clarify the provisions for aligning shoulders on fill sections on Rural Secondary Roads.

A. Shoulders should be uniform and regular with a machine finish. There should not be any bulges in the embankment section and all waste material should be distributed in a uniform manner to eliminate any ugly appearance. All boulders should be below the finished shoulder line.—MR. OWENS.

Q. What is the best way to obtain a good center joint on a Class F bituminous surfacing project where an Adnum Paver is used?

A. This is a matter of opinion; however, I think the best method to obtain a good center joint is to start rolling from the outer edge and roll to the center joint. When you have rolled within about 6" of the center joint I would then place the roller on the previously laid section and pinch the joint with the rear wheel of a 3-wheel roller.—MR. OWENS.

Q. Is it compulsory for each contractor to have a timing device on all concrete mixers? If not, why not?

A. Page 142 of 1945 Specifications covers this. Batch type paving mixers for concrete paving must have a timing device. For all others, a time limit of mixing is required.—MR. BITTERMAN.

It is not compulsory for each contractor to have a timing device on concrete mixers. There is a time limit for the mixing of concrete mixes; however, this can be determined by other means than a timing device on the mixer.—MR. OWENS.

Q. Property owner has a home located within the right of way on a construction project, and he has been notified to move it a number of times. Can he be forced to move it even though he can not secure another house and this structure is not interfering with construction?

A. If the house is not in line with construction and the property owner is unable to find another home you should use your judgement about having the property owner move. It is my opinion that we could force him to move if we have a clear title to the property. It would be expected that if the property owner did not move at once that you notify him, and keep after him to move or you might end up with a permanent residence on the right of way.—MR. OWENS.

This is dependent on how lenient the Department wants to be, and the hardship involved. By mandatory injunction the Department can move the house.—MR. NEISER.

Q. What means is open to the Resident Engineer on a Rural Secondary Project when the 40-foot right of way does not provide sufficient fill material or when space for wasting material such as rock is not available within the 40-foot right of way?

A. The deeds for Rural Secondary Projects cover all necessary right of way to construct the road and a stipulation is placed in each Rural Secondary deed, which is as follows:

"It is further agreed and understood by the parties hereto that said party of the first part does hereby grant to the party of the second part a license for the use of any additional land required for the purpose of drainage and for the construction of slopes, drainage structures, channel changes and borrow pits as are deemed necessary by the Kentucky Department of Highways."—MR. OWENS.

Q. *Is it permissible to backfill around structures without proper compaction according to the regular specifications if Special Specifications No. 48-R applies?*

A. Yes. There is a new Specification No. 48-R-1 which clarifies this.—MR. NEISER.

Q. *Recently we have noticed several instances where settlement has occurred adjacent to drainage structures. Compaction adjacent to structures is well covered by the Specifications, but shouldn't some type of stabilizing material be added to the backfill material during backfilling adjacent to structures?*

A. No. If back-fill is compacted to a density equal to that of surrounding soil. If greater density is obtained, a hump is likely to occur; if less density is obtained, settlement will occur.—MR. BITTERMAN.

Q. *What are the disadvantages in the use of Air-Entraining Cement?*

A. It requires closer inspection to obtain the correct air content. Too much air results in a loss of strength. The time limit on finishing is shorter.—MR. BITTERMAN.

Q. *Please interpret specification on untreated timber.*

A. All contact surfaces shall be treated with hot creosote oil. This means all surfaces in contact with Earth, Metal, or other Wood.—See page 288. Sec. 5.33 A-4.—MR. BITTERMAN.

Q. *Please discuss treated timbers on the basis of the relative merits of creosote Osmo Salts (7.20.11), and Wolman Salts (7.20.12) treatments.*

A. Our experience has been that Creosote is far superior to the Salts Treatment.—MR. BITTERMAN.

Q. *(a) On Rural Secondary roads, who makes the decision as to whether a bridge on one of these projects shall be taken over for State maintenance?*

(b) Is the Highway Department obligated to take over for maintenance all bridges on which it has made repairs?

A. In answer to the first part of the question, District Engineers have been instructed by Bulletin No. 2037, issued by the State Highway Engineer on August 17, 1949, to not submit Maintenance Acceptance Reports on sub-standard bridges which are not reconditioned or replaced on rural secondary projects. The decision as to whether or not a bridge is sub-standard, I think from this Bulletin, is made by the District Engineer. Of course, he may consult any of the Central Office personnel before making this decision.

In regard to the second part of the question, I am not sure of the answer. The Department has in the past expended funds for the repair of bridges and has failed to assume the maintenance obligation on these bridges. Beyond this statement, I do not know the answer to the question.—MR. JOHNSON.

Q. *Does the Department have any plans for convincing County Officials of the advantage of using a larger portion of their RS and RH money on sub-standard drainage structure?*

A. The Department is attempting to replace all sub-standard drainage structures on Rural Secondary and Rural Highway Projects as far as the money allocated for this work will go and at the same time building a large mileage of this type of road. It is impossible to replace all sub-standard drainage structures and still build additional mileage. As soon as the many miles of Rural Secondary and Rural Highway Projects are completed, that are now needed, the Department will then start replacing more of the sub-standard drainage structures.—MR. OWENS

Q. Is not the use of local gravel often false economy? It seems that some such local materials are not as good as A-2 soils.

A. Any usable local gravel should be better than an A-2 soil.—MR. BITTERMAN.

Q. In water bound macadam base course construction, what is the maximum tonnage one roller can satisfactorily roll?

A. Based on actual performance record over a period of years it was determined that one roller can handle satisfactorily approximately 250 tons in one nine-hour day. However, this determination was based on what one roller would just about take care of in a nine hour day, but does not necessarily follow that three rollers will satisfactorily provide for 750 tons per nine-hour day, particularly when operations are carried on simultaneously on several of the courses (insulation, first and second bases) and they are far removed from one another; in fact, too far to justify moving rollers back and forth. This usually occurs when stone is obtained from more than one source of supply and at one of the operations one roller is called upon to handle more than 250 tons in nine hours, and the other two, of course, reduced accordingly.—MR. LOGAN.

The maximum tonnage that one roller can satisfactorily roll on a water bound base course is approximately 250 tons per day.—MR. OWENS.

Q. What is the best method of preventing slips in fills? If slips occur, how can they best be handled?

A. Slips in highway fills do not fit into any fixed pattern. Each slip is a problem within itself and the measures that correct one will not necessarily correct another one. Probably the best method of preventing slips in highway fills is to make a thorough study of the existing soil and drainage conditions so as to be reasonably sure that a fill is not placed upon an existing soil that will not support the weight of the fill because of the character of the soil or the local drainage conditions. Also, it is important to not use a soil in a fill that has characteristics that will not permit the fill to remain in place. After a fill is built and a slip occurs, an effort should be made to determine whether the slip is caused by underground water lubricating a plane at the top of an impervious material or whether the slip occurs as a result of the soil having characteristics that create a saturated fill, causing the soil to lose its stability. In the former case, it may be possible to break up the plane at the top of the impervious material by blasting and to intercept the underground water by a system of underground drainage or in the up-hill ditch line. In the case of a saturated fill, it may be necessary to remove the fill and replace it with a selected material. In many cases, it is perhaps wise to shift the roadway into the hill and simply move away from the slip.

Slips create one of the most troublesome problems of highway maintenance and although we use many means for correcting them, we are seldom sure that any method will cure the condition but we are forced to use what appears to be the best method and if does not work, then resort to some other method.—MR. JOHNSON.

Q. For Portland Cement Concrete Pavements, are there any advantages in contraction and expansion joint assemblies that are not of the Illinois type?

A. We do not know what is meant by the Illinois type joint assembly. We have 4 approved load transfer devices.—MR. NEISER.

I presume that applies to the uniform thickness type slab versus the Illinois type (thickened edge).

In my opinion, assuming that all other design features are similar, there is no advantage of placing contraction and expansion joints in one of these types and leaving them out of the other type.—MR. LOGAN.

Q. How can better compaction be accomplished on Rural Secondary Projects?

A. The only way to obtain better compaction on Rural Secondary Projects would be to require the use of sheeps-foot rollers, but as mentioned before we are building a low cost road and we have to use low cost methods.

You can require the contractor to place the fills in layers not to exceed 12" thickness.— MR. OWENS.

Q. Why aren't deeper ditches called for on Rural Secondary Projects?

A. A one-foot ditch should be ample for this type project, except in unusual cases.— MR. NEISER.

Q. Discuss Breakage in Earthwork

A. I assume that whoever submitted this question has reference to how to pay for breakage when solid rock and common excavation was included in the same section. Allowance for breakage not utilized shall be limited to an amount not to exceed in any station of 100-feet, 10 percent of the actual quantity required for the same station of 100-feet within the lines as set by the engineer. This would include the solid rock as well as common excavation.— MR. OWENS.

Q. Must the Resident Engineer on a Rural Secondary Project abide entirely by promises made to property owners by the County at the time right of way was secured?

A. If these are right of way considerations then it is the County's responsibility. In the construction of Rural Secondary Projects we should not do anything other than what is on the plans or what has been included in the deeds as a special stipulation to the property owner.— MR. OWENS.

Q. What are the best methods for preventing base failures in highways that are being built?

A. By: 1. Soil tests.
2. Examination of rock cuts before refilling.
3. Correct wet spots by drainage before surfacing.— MR. NEISER.

Q. Should prime on road mix be applied before aggregate is spread or after aggregate is spread?

A. Before.— MR. NEISER.