Selection and Maintenance of Ballast

Report of Committee

H. W. KELLOGG, Chairman, Div. Engr., P. M., Saginaw, Mich.;

Ballast is a very important item in securing good track and assuring economical maintenance. The primary functions of ballast are:
(1) To transmit the load from the track structure to the subgrade as evenly as possible;
(2) to hold the ties in place; and
(3) to drain water away from the ties.

It follows from the purposes for which ballast is used that the ideal ballast would possess the following properties:
(1) Retain no water;
(2) offer maximum friction to movement of the ties;
(3) not disintegrate under the action of traffic or tamping
(4) be easily worked;
(5) be free of dust; and
(6) retard vegetation.

Selection of Ballast

Many different factors and circumstances affect the choice of material for ballast, It is highly desirable that ballast be suitable for the type and density of traffic to be handled. Ballast which is satisfactory for light-traffic lines may be entirely unsuitable for heavy, high-speed traffic. The kind of ballast used will have a marked effect upon maintenance costs. However, consideration must be given to the proximity of the source of ballast to its point of application. To reduce transportation costs, it is always desirable to have as short a road haul as possible and to keep to a minimum the number of cars required to take care of a ballast job.

It may frequently happen that a better grade of ballast hauled a greater distance will prove more economical than a cheaper, inferior ballast obtainable nearby. On the other hand, savings in over-all costs may often be effected by using a lower grade ballast procurable locally than to use a higher grade involving a long haul, as it has been demonstrated on several types of more or less inferior grades of ballast. Emphasis should be placed on the fact that such decisions require analysis of all the factors to determine the relative economy, as well as careful study to determine the proper ballast section to be used.

The materials most commonly used for ballast are crushed stone, washed gravel, bank run gravel, torpedo gravel, slag, chats, cinders, and sand.

Ballast Sizes

Ballast produced for use on main lines is generally governed by standard specifications, although specifications vary between roads for the same types of ballast. The most common size of stone used is that known as 2-in. stone.. Good results can be obtained, however, by using 1-1/2-in. stone or even 1-in. or 3/4-in. sizes, and in many instances the smaller sizes are favored. Likewise, specifications covering washed gravel vary on different roads, particularly as to the percentage of crushed material and round stone. It. is very desirable that the gravel contain a large volume of crushed stones. Otherwise the ballast will not hold the ties in place under high-speed traffic, and increased maintenance costs will result.

The ballast generally considered best for high-speed mainline traffic is crushed stone, which should be as nearly uniform as possible, and of a maximum size of 2 in. It should also have sufficient hardness to resist pulverizing under tamping and traffic, and be of such quality as to withstand the elements. In the application of stone ballast to track that has been previously ballasted with other material, the track should be stripped and given a lift sufficient to insure uniform distribution of the load on the subgrade. This should be done in two operations. During the first raise the track should be brought to proper grade and then shovel tamped. After a suitable interval, during which time the track should be allowed to settle under traffic, the track should again be lifted to proper grade and machine tamped. After another interval the track should be gone over by a small surfacing force to correct any slight irregularities in line or surface.

Where there is any fine sharp material in ballast, care must be used to keep the ballast down at least to the level of the tops of the ties on high speed lines; otherwise high-speed equipment will pick up the fine material and deposit it on the rails and on the understructure of the equipment, causing it to act much as a sand blast and in some cases causing damage to the equipment and track. Crushed stone, washed gravel and slag should be dressed down about two inches below the top of the ties, with a shoulder approximately six inches in width outside the ends of the ties before the ballast is sloped down to the berm.

After the selection of the kind of ballast to be used, the responsibility of the maintenance officer in charge of the work is to make regular inspections of the ballast as unloaded from cars to see that it conforms to specifications. This may be done by taking samples of the material, or close visual inspections may be sufficient.

Maintenance of Ballast

When suitable ballast has been unloaded and the track placed in proper line and surface, it then 'becomes the duty of the maintenance officer to maintain the ballast in such a way that he will continue to have smooth-riding track. This may best be done by giving close attention to the matter of keeping the ballast clean. Where ballast has become fouled by reason of mud coming up through it from the roadbed, or foreign matter falling upon it, water will not drain away. The result invariably will be pumping joints and rough track.

Track newly ballasted with stone or hard slag and properly put up should, under normal conditions, require a minimum of surfacing for a considerable period, after which an occasional out-of-face surface lift of about two inches may be given and the necessary tie renewals made. In most instances this latter work requires the use of very little additional ballast. It is a practice, however, that cannot be followed in all cases.

The topography of the railroad, type of traffic, kind of subgrade, and other factors have a direct effect on the condition of the ballast. On heavy grades, cinders, engine sand and material spilling out of cars will tend to foul the ballast. In places where the subgrade is principally clay, this material tends to work up into the ballast, especially on the low sides of curves. When these conditions occur, the only alternative is to clean the ballast.

Cleaning Ballast

There are several methods of cleaning ballast. For spot work the simplest method is to break out the caked ballast with hand picks or mechanical cribbing forks. The ballast is then removed from the cribs outside of the rails, and from inside the rails if necessary, which may be done with shovels, or by means of a special cribbing bucket which is pulled through the cribs by a winch mounted on a small crawler tractor. The ballast is then screened with forks and thrown back into the cribs.

Some railroads have utilized large ballast cleaning machines which require the use of a locomotive and work train, while other roads use off-track "moles," or use both on different sections of the road. The "mole," which

cleans the ballast beyond the ends of the ties, is a development of the tendency toward the use of off-track equipment for maintenance work. Both types of machines do a successful and economical job.

In maintaining washed gravel ballast, cleaning is not recommended as in the case of stone or slag. After main-line track newly ballasted with washed gravel has been run over for a period of five to seven or eight years, depending on the traffic, the trackmen begin to experience difficulty in maintaining smooth track with ordinary spot surfacing. This track should lie then given a two or three-inch lift, necessary tie renewals made, and new ballast added as needed. When possible to obtain, a small amount of 1/4-in. crushed stone mixed with the gravel produces excellent results. Due to subgrade and other varying physical conditions, no track will show the same deterioration of the ballast throughout a given stretch or subdivision, and in places the ballast will be found caked to the approximate consistency of concrete. Such spots should be stripped and fresh gravel added. One place where this condition occurs most frequently is at road crossings, where, in some cases in open country, it has been found practical to lift the track about twelve inches and have the highway department build up the highway approaches to the new railroad grade.

Disc Some Track

On secondary lines where traffic is not heavy, tracks ballasted with washed gravel and bank run gravel can be maintained by track forces for many years with ordinary spot surfacing, providing proper attention is given to drainage. On track of this type the ballast shoulder tends to become crushed, causing the water to be seated around the ties. A ballast-discing machine operated over this kind of track once or twice each year will help keep the ballast loose and porous, and will also retard the growth of vegetation. Cinder ballast, torpedo gravel and other types of ballast used on branch lines may be maintained successfully in the same manner as bank-run gravel.

In conclusion, it may be stated that the large expense of track surfacing, which on some roads amounts to 50 per cent of the total maintenance labor expense, may be greatly reduced by selecting the proper ballast, after considering all factors involved, and by giving close attention to the matter of keeping the ballast clean.

DISCUSSION

The discussion of this report dealt in part with the difficulty that is apparently being encountered on some railroads in maintaining track on ballast-deck bridges to the proper line and surface. Explaining the practice on his road, chairman Kellogg said that some difficulty of this nature had been encountered where crushed stone ballast containing relatively large particles was used. As a result,. ballast having a maximum size of 1-1/2 in. was adopted. Chairman Kellogg also stated that 3/4-in. ballast had been used on ballast-deck bridges, and he expressed the opinion that ballast of this size would probably give the best results.

In another phase of the discussion it developed that various railroads are having difficulty maintaining track to good line and surface that is ballasted with washed gravel from which all fines have been removed. E. L. Banion (A.T. & S.F.) reported that this difficulty had been overcome successfully on his railroad by mixing sharp washed sand with the gravel.