

Unless the curvature is so sharp as to be limiting in its effect, there is no serious objection even on the best class of road to a few sharp curves where the amount saved by their use is sufficient to justify their introduction. The conditions which cause curves to be limiting are when they are so sharp as to prevent the use of the higher grades of modern equipment, and when they limit the haulage capacity of the locomotives, or their speed.

Modern equipment is so constructed as to traverse safely 14 degree curves, and much sharper with guard and hold up rails. The standard compensation for curvature on grades is 0.04 foot per degree. A 10 degree curve is thus equivalent, as far as resistance is concerned, to a 0.4% grade; and a 15 degree curve to a 0.6% grade. On a 0.4% it is only necessary that the grade on a 10 degree curve be made level in order that the resistance be not increased. The same thing applies to a 15 degree curve on a 0.6% grade. It is, therefore, evident that on a road whose ruling grades are 0.4% 10 degree curves are not limiting to the haulage capacity of the locomotives, nor are 15 degree curves on a 0.6% grade.

The easy riding speed is dependent on the amount of the allowable elevation of the outer rail. If the maximum be set at six inches, this speed per hour would be :—

on a 3 degree curve	60 miles per hour
“ 4 “	50 “
“ 6 “	40 “
“ 8 “	35 “
“ 10 “	30 “

The safe or allowable speeds would be 10 miles per hour greater.

With the track properly elevated, equipped with tie plates kept in good line and surface, and curves provided with proper easements, 10 degree curves are no more disagreeable to ride over at speed of 30 miles per hour than are 3 degree curves at 60 miles per hour.

The reduction in speed for one mile from 50 to 30 miles per hour only means the loss of 0.8 minutes. To take an extreme case—the Twentieth Century Limited runs from New York to Chicago, 980 miles in 20 hours, or at an average of 49 miles per hour. The introduction of one hundred 10 degree curves each one of which required a slacking of speed to 30 miles per hour for a distance of one mile would increase the running time of such a train by one hour and twenty minutes. Such an increase on a road 1,000 miles long would in nine cases out of ten have no ill effect. A 10 degree curve so long as to require the reduction of speed to an average of 30 miles per hour for a mile would in practice be a very rare occurrence.

It is evident the use of curves as sharp as 10 degrees does not prohibit the employment of modern equipment or limit the haulage capacity of the locomotives. It has no effect on the speed of freight trains, or on passenger trains where the average speed including stops is not greater than 30 miles per hour. A few such curves only slightly affect the running time where speeds are high.