# The Longest Railway Tunnel in the World

In this issue of *Engineering News,* Gen. Henry M. Chittenden, of Seattle, describes the project which he has worked out with much painstaking detail for building a railway tunnel 30 miles in length under the main range of the Cascade Mountains. The building of this tunnel would enable the railway traffic between Puget Sound ports and the interior, which now has to be lifted vertically to an elevation of 2,500 to over 3,300 ft. in crossing the Cascade range by the present railway lines, to pass under the main range at an elevation of only 1,200 ft.

It is not merely the waste of the energy required to elevate this traffic, amounting to over 60,000 tons daily, to a height of 1,300 to 1,800 ft., which the tunnel would save. A much more important advantage, as General Chittenden points out in a graphic manner, is the elimination of the expense and risk involved in the maintenance of the large mileage of steep grades on the present railway lines across the mountains. The extent to which this huge mountain barrier hinders commerce and intercourse between the great fertile agricultural section on the eastern side of the mountains and the commercial centers on the coast, is hardly realized in the East.

Perhaps the most striking illustration of the advantages of the proposed tunnel route over the present mountain lines is the statement that the time of passenger trains would be reduced, between the east side and the west side of the mountains, from the present schedule time of 3 hours to 40 minutes, and the time of freight trains from 10 hours to 1½ hours.

The estimated cost of the proposed tunnel and approaches is $50,000,000, and this in itself a few years ago would have been sufficient to compel the dismissal of the project as chimerical. At the present day, however, railways are investing sums in the improvement of their facilities which would have staggered the imagination of financiers a quarter century ago. Announcement has just been made that the Great Northern Railway Co. proposes to expend in this very region probably a third of this amount to convert its lines from steam to electric traction, encouraged thereto doubtless by the success of the very large investment for the same purpose made by the Chicago, Milwaukee & St. Paul on its lines in Montana and Idaho.

Among other notable instances in recent years of heavy outlay for reconstruction of existing railways, are the building of the Central Pacific Ry. across Great Salt Lake to avoid the heavy grades over Promontory point, the work done by the Union Pacific in the improvement of its main line in Wyoming, and on the eastern side of the continent the two great pieces of reconstruction work undertaken by the Lackawanna R.R. to improve its main line in western New Jersey and eastern Pennsylvania.

When any of these large works of railway reconstruction are compared with the Cascade tunnel project, it is at once evident that what each of them accomplished in the improvement of grades and alignment is insignificant compared with the advantages which would result from this great tunnel enterprise. By way of illustration, take the Rogers Pass tunnel now nearly completed on the Canadian Pacific Ry. This work has involved the building of 18 miles of new railway line and a 5-mile tunnel. The summit elevation is reduced 540 ft. and the length of snow sheds from about 5 miles to less than 1 mile, but the maximum grade on the line is still 2.2%, and of course the maximum train load that can be hauled is unchanged. To effect this improvement the Canadian Pacific has deemed it worth while to carry out work involving a total expense of probably not less than $8,000,000, while the traffic affected is only that of a single railway line.

In comparison with this the 30-mile Cascade tunnel projected by General Chittenden would lower the summit elevation on the Great Northern Ry. 2,166 ft.; would save 48 miles of distance on its line to Tacoma; would reduce the maximum grade from 2.2% to 0.6%; and would eliminate curvature amounting to 6,855°. Most important of all, the tunnel would be available not for the traffic of a single railway, but for the traffic of all the railways terminating on Puget Sound.

In his paper in this issue General Chittenden briefly outlines the computations which indicate that the proposed tunnel would pay a large return on its cost. Of course, for a complete determination, the matter would have to be gone into in far more detail than is possible within the limitations of space in a technical journal. Such rough comparisons as that suggested above, however, and similar ones which any engineer can make for himself, as well as the figures given by General Chittenden, indicate that the traffic benefits resulting from the tunnel would yield an ample return on its cost.

To understand this, it must be borne in mind that the tunnel would be used almost wholly for through traffic, and this means of course that the traffic through it would be concentrated in very long trains. The Chicago, Milwaukee & St. Paul on its electrified lines across Montana and Idaho is handling freight trains weighing 3,000 to 3,500 tons behind the tender on grades up to 2%. On the Cascade tunnel line, with its maximum grade of only 0.6% and its freedom from sharp curvature, there should be no difficulty whatever in handling trains of this length or greater. Passenger trains through the tunnel would be chiefly the through transcontinental express trains. Eventually some local traffic between the east side and west side of the mountain may develop, but is never likely to become considerable. Operating through this tunnel on the absolute block system, with its light grades and with its long tangents, trains could safely be spaced much closer together than they are on the present outside lines over the mountains.

Another factor of great importance in considering the capacity of such a tunnel is that it should be possible to operate it with an approximately uniform flow of traffic through the 24 hours of the day. On an ordinary railway, the traffic has often as sharp peak loads during the 24-hour period as the load curve of an electric-lighting station. Such load peaks are necessary in handling local passenger and suburban traffic, and to a considerable extent in local freight traffic. They are not necessary, however, in handling through traffic. The Chicago, Milwaukee & St. Paul, in installing electric operation on its Idaho and Montana division, put in operation, probably for the first time in the history of American railroading, the plan of so distributing its train movements as to give an approximately uniform train movement throughout the day. It was necessary to do this in order to purchase electric power at a favorable figure,

and in the movement of the through traffic, which constitutes the chief business of the line, no great difficulty appears to have been found in putting the system into operation.

It is self-evident that where traffic can be thus equally distributed, the capacity of a double-track railway is enormous. With trains spaced no closer together than 10 minutes and uniform train movement through the 24 hours, 144 trains per day each way can be moved. Taking in connection with this figure the enormous tonnage of freight now handled in a single train, it is evident that the traffic capacity of the Cascade tunnel would be ample to take care of all the business tributary to it for as long as can be foreseen. Furthermore, that traffic promises to be enough to make the tunnel profitable.

Some questions may be raised as to the practicability of successfully operating a tunnel of such unprecedented length, although such questions will be raised by laymen rather than engineers. If it is practicable to operate the Simplon tunnel, 12 miles long under the Alps, which has now been in use for a dozen years, it would be practicable to operate a 30-mile tunnel under the Cascades.

Ventilation need present no more difficulty with the longer tunnel than with the shorter. On the Cascade tunnel there will doubtless be at least two intermediate shafts which can be used for ventilation as well as for construction purposes, and there is abundance of water power going to waste to provide forced ventilation if that were necessary. It is likely that when the traffic became sufficiently dense to make the question of ventilation important, then natural ventilation would result through the heat developed by the electric motors in the tunnel, which would cause the ventilating shafts to act like huge chimneys. In the cool climate of Washington, the air drawn in would always be at low temperature.

Train movements need offer no more difficulties in a 30-mile tunnel than in a 12-mile tunnel. General Chittenden's estimate in fact provides for sidings at intervals along the tunnel line to enable a disabled car or locomotive to be got out of the way temporarily without blocking the main line for any great length of time.

General Chittenden's paper is not only interesting from its review of the possibilities of the Cascade tunnel, but because it calls attention anew to the possibility of very long tunnels to improve railway operating conditions elsewhere. Up to the present time electric traction on steam railways has had its chief application in the operation of city terminal lines and in the operation of existing tunnels where the smoke from steam locomotives became seriously objectionable. It has hardly as yet been realized outside the engineering profession that the electric locomotive in combination with the present day possibilities in fast and economical tunnel driving has shown a way whereby radical reconstruction could be undertaken on the summit divisions of some main line railways with the prospects, at least, of large profits.

The advances in tunneling practice, too, have given a different basis for computing problems of railway relocation involving the use of long tunnels. The next decade or two, therefore, may witness not alone the realization of General Chittenden's great scheme, but of the driving of a long tunnel by the Pennsylvania to lower the summit of its main line across the Alleghenies, from its present elevation of about 2,200 ft.; or the Lackawanna or the Lehigh Valley may undertake a long tunnel to save part of the long climb now necessary to lift the anthracite coal from the Wyoming Valley over the mountains on its way to markets at tidewater.

# Letters to the Editor

## Concrete Buildings Are Free from Depreciation

Sir—Referring to the comparative costs of factory buildings of standard mill construction and of reinforced concrete, published in your issue of Nov. 9, p. 884, the writer from long experience in constructing both types of buildings would say that in general, a slow-burning mill construction building can compete with a reinforced-concrete building when the floor loads are light and the spans are short. With heavy loading and long spans on the other hand, the reinforced-concrete building has a decided advantage.

The question of comparative costs is also dependent on the number of skilled contractors available for reinforced-concrete construction in the locality as well as the restrictions of union labor.

A great many insurance companies do not make the difference in rating between slow-burning construction and absolutely fireproof construction that should be made. Many owners have spoken to the writer about this matter saying that they can not see why insurance men rail at the American public for building burnable buildings when they make no inducement in insurance rates which will compensate an owner for the increased expense of a non-burnable building. A properly designed and properly constructed reinforced-concrete building, however, is not only fireproof, but is subject to little or no depreciation. On the other hand, a slow-burning mill construction building does depreciate with time, and the depreciation will more than wipe out the difference in first cost in ten years.

ERNEST McCULLOUGH,
Fireproof Construction Bureau,
Portland Cement Association.

Chicago, Ill., October 19, 1916.

## Land Surveying in Texas

Sir—J. M. Howe's article on "Land Surveying in Texas," in *Engineering News*, of Oct. 19, arouses memories of rough surveys in my native state, where my father was for some years in the General Land Office at Austin. There he had charge of and issued state patents on surveys, filed with so-called land script. Subsequently, as a