

with three teams. The contract was awarded at 14 cents per cubic yard. Fully 60% of the material was a mixture of clay and boulders which ranged from about two to eight inches in diameter. The most of the material was plowed with two teams and none of it required more than three. Although it plowed easily, it could not be moved to advantage with either slips or wheelers. Even after the chief engineer abandoned his specifications and classified it as loose rock, the contractor was dissatisfied, and sued the company for \$50,000. After the suit had run in the courts for a couple of years, the company and the contractor agreed to arbitrate, and let the court render a decision in accordance with the findings of the board of arbitration. In the arbitration agreement was a clause specifying that the classification should be made in strict accordance with the contract and specifications. The arbitrators rode over the line on a flat car, at the rate of 25 miles an hour, only stopping to examine one cut. They then took all the maps, profiles and note books to St. Louis, and after three or four months awarded the contractor one-half the amount he was suing for.

Therefore, I do not think it advisable to try to use specifications that differ very materially from the specifications used by the other roads. Consequently I wish to recommend the following specifications:—"Earth or common excavation shall include any and all kinds of material which can be plowed with a 10-inch grading plow drawn by a well handled team of six heavy horses or mules, with one strong man at the plow handles; and which, after plowing, can be moved with slips or wheelers fully loaded. By plowing it is intended that one plow shall be able to loosen enough material to keep at least twelve scrapers running.

"Loose rock shall include any and all kinds of material which can be plowed with either a 10-inch grading plow or a roofer, drawn by more than six mules or horses, or that cannot be moved with scrapers or wheelers fully loaded; also all detached masses of rock or boulders measuring less than 18 cubic feet each.

"Solid rock shall include all detached masses of rock or boulders measuring 18 or more cubic feet each, as well as all material which must be blasted, and is as expensive to remove as solid lime stone, or solid sand stone, which is hard enough to be used in first class masonry work. Any material that requires blasting, and may then be removed with scrapers or wheelers shall be classified as 50% solid rock and 50% loose rock."

It would be better to let all contracts unclassified. By this method the contractor would be given a profile of the line and would be permitted to make as many borings as he desired to determine the nature of the material. His price per cubic yard would then be based upon his own classification. This method leaves no room for disputes between the contractor and the company. Where this plan has been adopted it has proven very satisfactory to both the company and the contractors. Owing to the sharp competition between contractors the work does not cost any more than by the old method.

[Prof. Dalton's suggestions are of considerable interest and will, we hope, evoke discussion. We will be glad to have any of our engineering, contracting, or other readers write us their opinions on his suggested classifications for earth excavation, loose rock and solid rock, and also as to his recommendation to let contracts unclassified.—Editor.]

Work in connection with the geodetic survey of Canada has been started on the Pacific coast, the headquarters being at Victoria, B.C.

**Canadian Specifications for Classification.**

In connection with the foregoing article by Prof. Dalton, we have obtained the specifications of various Canadian railways from the chief engineers, and give the following extracts—

**ALGOMA CENTRAL & HUDSON BAY RAILWAY.**

Excavations will be classified under the following heads, namely, solid rock, loose rock and common excavation, under the following definitions:—

All stones or boulders found in excavation measuring more than 27 cubic feet, or one cubic yard in volume, and a solid quarry stone requiring drilling and blasting in order to remove it, will be classified as solid rock.

All rock commonly designated stones or boulders individually measuring in volume from one cubic foot to one cubic yard will be classified as loose rock.

All other material not classified as solid rock or loose rock will be classified as common excavation.

The price for said excavation in all the several classes thereof will be understood to cover and pay for the entire expense of removal of material excavated by any method whatever, including loading, unloading, transportation and deposition in the manner prescribed in these specifications, and in the location designated by the engineer, provided the average haul of the material so transported does not exceed 500 ft., and beyond that distance one cent per cubic yard per each additional 100 ft. will be

**A PROMINENT ENGINEER'S OPINION.**

J. G. Sullivan, Assistant Chief Engineer, C.P.R. Western Lines, writes from Winnipeg:—

"I consider the information in connection with orders, etc., of the Board of Railway Commissioners which are published in the Railway and Marine World, are alone worth more than the subscription price."

allowed when such over-haul is ordered by the engineer.

No rock excavation will be allowed for beyond the limits of the base and slopes as specified. All rock loosened by explosives beyond the slope must be removed at the expense of the contractors, but if required to make up the embankment, will be paid for at the price for common excavation.

**CANADIAN PACIFIC RAILWAY.**

Grading will be classified under the following heads: solid rock, loose rock, hard pan and earth.

Solid rock will include rock in solid beds or masses in its original position, which cannot be removed without blasting, and boulders or detached rock measuring one cubic yard or over.

Loose rock will include all detached rock or boulders measuring more than one cubic foot and less than one cubic yard, and all shale, slate, soap stone, disintegrated granite, and other soft rocks, which can be removed without blasting, though blasting may be occasionally resorted to.

Hard pan will include cemented gravel, hard pan, indurated clay or combinations of the same whose hardness is such that if in a suitable location could not be plowed by an average four horse team.

Earth will include all other material such as loam, clay, sand, quick sand, gravel, muskeg, angular rock fragments, and small boulders.

Material borrowed for embankment will not be classified higher than loose

rock, without prior written authority of the engineer.

Material in slips, slides and subsidences extending beyond slope lines will not be paid for, unless such occurrences were beyond the control of the contractor and not preventable by the use of due care and diligence.

The classification of material from slides will be in accordance with its condition at the time of removal regardless of prior condition. Measurements of overbreak in rock cuts will be the space originally occupied by material before the slide occurred, regardless of the classification of same.

Measurements will usually be made in excavation. In prairie or level country, where the embankments largely exceed the excavations, measurements will be made in embankments.

**GRAND TRUNK PACIFIC RAILWAY.**

Grading will commonly be classified under the following heads: solid rock excavation, loose rock, and common excavation.

Solid rock excavation will include all rock found in ledges or masses of more than one cubic yard, which in the judgment of the engineer, may be best removed by blasting.

All large stones and boulders measuring more than one cubic foot and less than one cubic yard, and all loose rock, whether in situ or otherwise, that may be removed by hand, pick or bar; all cemented gravel, indurated clay, and other materials, that cannot, in the judgment of the engineer, be plowed with a 10 in. grading plow, behind a team of six good horses, properly handled, and without the necessity of blasting—although blasting may be occasionally resorted to—shall be classified as loose rock.

Common excavation will include all other material of any character whatever, not classified as solid or loose rock.

Material in slips, slides and subsidences extending beyond slope in cuttings, will not be paid for, unless, in the opinion of the engineer, such occurrences were beyond the control of the contractor and not preventable by use of due care and diligence.

The classification of material from slides shall be made by the engineer, and will be in accordance with its condition at the time the slide is being removed, regardless of prior condition.

**GRAND TRUNK RAILWAY.**

All material excavated will be classified as solid rock, loose rock, common excavation, or such additional classifications of material as may be established before the award of the contract.

Solid rock shall comprise rock in solid beds or masses in its original position which may be best removed by blasting; also all detached masses of rock or boulders, each of which measures one cubic yard or over.

Loose rock shall comprise all detached masses of rock or boulders of more than one cubic foot and less than one cubic yard, and all other rock which can be properly removed by pick and bar without blasting; although steam shovel or blasting may be resorted to in order to facilitate the work.

Common excavation shall comprise all other materials of whatever nature that do not come under the classification of solid rock or loose rock, or such other special classifications as may be established before the award of the contract.

D. C. Macdonald, Division Freight Agent, C.P.R., Regina, Sask., writes:—"I cannot afford to be without the Railway and Marine World."

A site has been purchased at Fort Francis, Ont., by Alexander Bruce and Co., upon which it is proposed to establish a plant for preserving railway ties. It is proposed to put up a plant capable of handling 1,000,000 ties a year.