tional right-of-way will be required and adjustments of adjoining buildings will be necessary. The cost will be considerable but it will be less now than in the future. An essential part of a belt railway will be a car ferry service on Burrard Inlet connecting with tracks on the north shore. The route proposed for the belt railway is the only practicable one by which the railways terminating in Vancouver and vicinity can be connected with each other, with water terminals and industrial sites. The railway is a necessity for the proper development of the harbor; the land proposed to be acquired on Burrard Inlet at Port Moody and Heaps' Mill is the best available land for development into industrial sites for leasing on reasonable terms; water front is required in the vicinity of the point where the belt railway meets Burrard Inlet for transfer purposes and car ferry and the Kitsilano site is the best available point for extension of the harbor at economical cost for use in the near future.

Growth Will Be Large .- The cost of the lands, railways and wharves proposed will be considerable, but will probably at the present time be less than estimated for in future years and any less comprehensive plans would probably be quite ineffective and a very much larger scheme such as the Point Grey breakwater would involve a larger expenditure than could be incurred at this time and cause a serious delay. The growth of the business of Vancouver harbor in the next few years will undoubtedly be very great and long before the proposed works are fully completed the revenue from the leases of completed portions should pay interest on the capital required and on completion provide a surplus for use in extensions as required and by the time the harbor has outgrown the plans outlined, the financing of extensions towards Point Grey should be comparatively easy. If these works are not carried out there is little doubt that industries will go elsewhere-where sites can be obtained cheaper and that industries now here will lose business they would otherwise obtain. By beginning now on the plans outlined we will ultimately see Vancouver one of the best equipped harbors in America, as it ought to be by reason of the excellent natural harbor it has to commence with, and by reason of the good equipment, one of the busiest.

PARTITION OF LOAD IN RIVETED JOINTS.

(Continued from page 392.)

"It is felt," says Mr. Batho, "that much of the usefulness of the theory given depends upon whether the rivets in a joint are in shear or whether they act by holding the plates together by friction. The later experiments on the slip of rivets seem to show that at working loads the latter is the case, and the results of the experiments described in the present paper seem to bear this out. The writer has in hand experiments which he hopes will give definite information on the subject."

The following is a resumé of the principal contents of Mr. Batho's article, as summarized by him:---

I. It is shown that a riveted joint may be considered as a statically indeterminate structure, and that a series of equations may be obtained for any joint by means of the Principle of Least Work, giving the loads carried by each of the rivets in terms of a quantity K, which depends upon the manner in which work is stored in, or by the action of, the rivets.

2. This theory is applied to various types of joints, and the modifying effects of non-uniform distribution

of stress in the plates, unequal partition of the load between the two cover plates, and a difference in the modulus of elasticity of the middle plate and the cover plates are also considered.

3. It is shown experimentally that extensometer measurements on the outer surfaces of the cover plates of a riveted joint are sufficient for the determination of the mean stresses in the plates, and that the partition of the load among the rivets may be determined from such measurements. It is also shown that, at any rate after the first few loadings, the distribution of strain in the plates of a joint is not altered by repeated loadings.

4. It appears that if there is any frictional hold between the plates, it acts only over those portions in the immediate neighborhood of the rivets. All the experiments tend to show that friction does not play an important part, but further experiments are necessary on this point.

5. Experiments made on a number of specimens having a single line of rivets and loaded in tension give results in close agreement with the theoretical considerations. They also show that the longitudinal stresses in a portion of the cover plate between two consecutive rivets are a minimum along the line of rivets, rising to a maximum at the edges of the plates.

6. The experiments show that the value of K for a joint having a given ratio of width of cover plate to rivet pitch and a given number of rivets varies approximately directly as the load and inversely as the area of the rivets. An empirical rule is given for its value in joints similar to the experimental specimens, but a more general rule cannot be given until further experiments have been made. A theoretical estimate is made of the value of K for a rivet acting in shear, and the result is shown to be within the range of the experimental values.

7. Both the experimental results and the theoretical deductions show that:---

(a) In a double-cover butt joint having a single line* of rivets, the two end rivets and the two rivets on each side of the junction of the middle plates take by far the greater part of the load at all loads within that, causing permanent deformation of the plates or rivets, the actual proportion decreasing slowly as the load increases;

(b) If, in such joints, the total area of cross-section of the cover plates is equal to that of the middle plates, these four rivets take equal loads, but if it is greater the end rivets take greater loads than the others, the difference increasing as the area of the cross-section of the cover plates increases;

(c) If two plates of uniform width and equal thickness are connected by a single line of rivets to opposite sides of a gusset plate of uniform width, the first and last rivets take the greater part of the load, but if the gusset plate increases in width from the first to the last rivets, the partition of load is more uniform.

The results already obtained allow the general manner of partition of load in any riveted joint, in which there is no eccentricity of connection, to be estimated, and it is hoped that, when further experiments have given general laws for the value of K, it will be possible to predetermine the exact load that will be carried by each rivet. The practical value of this is obvious.

^{*}By "line of rivets," meaning a number of rivets arranged in a straight line parallel to the axis of load, as distinctive from a "row of rivets," meaning a number of rivets arranged in a straight line perpendicular to the axis of load.