making of suitable decisions regarding loads, unit stresses and general design; in consequence whereof the clauses touching upon these essential questions will refer to the various classes suggested. The engineer on important bridges will still be expected to use his professional judgment and his knowledge of local conditions, either of which may justifiably lead him to a combination or modification of the classes above outlined or of the clauses in the specification referring thereto.

Movable Bridges.—The specifications cover the design of the structural work for all kinds of movable spans, and include clauses governing the design of the machinery and machine parts of hand-operated swing bridges. In the case of power-operated swing spans, bascule or vertical lift bridges, where the machinery is an all-important feature of the construction, it is recommended that the design of these features be referred to an engineer specializing in this work.

Floors.—For bridges built under Classes 1 and 2 a careful description of the floor system to be employed should be supplied by the responsible engineer, preferably by drawing or detail sketch. Special care should be taken to indicate the proposed method of carrying street car tracks.

A "permanent" floor shall be understood to signify a floor where the base consists of either: (*a*) Reinforced concrete slabs; (*b*) concrete or brick jack arches; (*c*) buckle or trough plates carrying the concrete matte.

A floor where the base is wood, whether creosoted or not, will not be considered permanent.

Under Class 1 a permanent type of floor is everywhere demanded and the pavement or upper course shall be of granite setts, brick, asphalt, macadam, or treated wood blocks as determined by the engineer.

Under Classes 2 and 3 the character of the floor will be specified directly by the responsible engineer, but it is stipulated that the stringers shall be of steel and the structure shall be designed to carry at the specified unit stresses a floor consisting of a reinforced concrete base with a pavement of 4-inch wood blocks or any other heavier type which may subsequently be laid.

Under Class 4 a wooden floor is permitted, but the adoption of steel stringers is recommended.

Under Class 5 the lightest type of wooden floor is allowed, but even here an enquiry into the probable ultimate economy of longer panels with steel stringers is suggested.

Sidewalks.—Under Class 1 sidewalks shall also be permanent, and shall have a cement finish to the slab or a special wearing surface of asphalt or granolithic paving. For the remaining classes sidewalks may be of wood at the discretion of the responsible engineer.

Wooden Floors.—Wooden stringers shall not be used on greater spans than 15 feet and shall have a width of not less than 3 inches or one-fourth of their depth. They shall lap by each other on the floor beams to give each a full bearing and shall be bolted together, using washer separators not less than one-half inch thick in order to secure free circulation of air.

Wheel Guards.—On wooden floors wheel guards, of 6 x 4-in. timber, shall be provided at each side of the roadway and shall be supported on 2-inch blocks spaced not over 5 feet, held in place by a three-quarter inch bolt through the guard, the blocking piece and the timber floor. The splices in wheel guards shall be half lap joints 6 inches long, and shall occur over the blocking pieces.

For permanent floors the wheel guard will, generally, be formed of concrete effectively protected by steel angle rubbing pieces.

Scuppers.—On permanent floors of any description suitable scuppers shall be provided not less than 20 feet apart, so arranged to carry all drainage clear of steelwork.

Live Loads.—The varied character of the loads applied to highway bridges renders it impossible to include in a general specification a statement of the precise loading to be used on every bridge and any table of suggested typical loads must be recognized as necessarily having the following limited purposes:—

(*a*) To guide the responsible engineer in his choice of a structure in regard to capacity and efficiency.

(*b*) To indicate to non-technical officials or to engineers not specially experienced in bridge-work, what constitutes accepted good practice.

(*c*) To guard against the possibility of a structure being provided, which is insufficient to meet the immediate requirements or those reasonably certain to occur in the future.

On the other hand, the specifications should not prevent the building of very light bridges, which, while sufficiently strong to withstand the vertical and vibratory loadings, should be able to compete successfully in the matter of first cost and maintenance with the alternative wooden construction. The majority of existing light structures, which would fall under the 5th class, above indicated, have not been built to any of the recognized standard specifications, and, indeed, no present specifications in vogue in Canada permit of this, nevertheless necessary, class of bridge. With the idea of meeting both the financial and service requirements of such cases, the permissible loadings under Class 5, as well as certain other limitations, are less exacting than in the existing standard specifications.

Two Main Divisions.—The loading on a highway bridge, naturally, falls under two main divisions, the assumed uniformly distributed load and concentrated wheel loads. The first division will consist, generally, of crowds of people, animals in droves or a large number of light vehicles. Crowds of people, such as quickly gather at accidents or for sight-seeing, on city bridges, are seldom productive of 100 lb. sq. ft. average load, and for moving loads this figure would, undoubtedly, cover all cases to be provided for at ordinary unit stresses. Classes 1 and 2 are likely to experience such loads at frequent intervals and for almost unlimited lengths, while classes 3 and 4 may receive the same intensity of loading but far less often, and over smaller areas. Animals in droves, will never exceed 60 lbs. per square foot and for Class 5 this would represent the maximum load.

The second division will include all classes of heavy vehicles, such as street cars, auto trucks, horse-drawn lorries and road-making machinery. Local conditions alone can determine the type and magnitude of loading for which steel should be proportioned.

In bridges of Classes 1 and 2 the proximity of factories, wharves, railway yards, the nature of the street car service, the possibility of loads, due to building materials, cable spools, heavy guns, steam rollers, or traction engines must all be duly considered in specifying the applied concentrations. It may also be noted here that the authorities owning these classes of bridges are also generally empowered to regulate traffic, and it will devolve upon their executive engineer to consider the principle of equity involved in the question, whether the publicly owned bridge should be capable of accommodating some unusual "freak" load, avoidable at a certain cost to the transportation company, or whether the traffic regulations should not control the use of the bridge for such purposes on the basis of engineering economics.