after one of the great football games"; and he adds: "The conclusion seems irresistible that loads of 180 lbs. per square foot may actually occur in exceptional cases; that 160 lbs. must frequently occur; that 140 lbs. must be common on station platforms, in corridors and in many other places frequented by throngs of people." In the present day of rapid giant automobile trucks, the case for roadway loads is different. One such motor truck for which data are available has a weight of 17 tons on an over all area of 140 sq. ft., or 243 lbs. per square foot, when carrying no more load than its rated capacity. As there is no inspector at the junction points of highways, it is altogether probable that the overload on such trucks is not kept down to the 10 per cent. common with freight cars, and the actual load may be expected to run up sometimes to 300 lbs. per square foot of the space occupied when the truck is at rest. (Trucks with much greater weights per square foot than this are operated in this city, but they are reported as never used on bridges.) Of course, the whole roadway of a bridge would not be covered with such trucks in close contact both longitudinally and transversely; and if they were so placed, they would not be able to operate at speed. But such loads covering a third of the roadway area would be quite possible and might run at moderate speed. That the specified allowance for impact is none too large for such loads, any observing man will admit after seeing and hearing such trucks run across a bridge with a plank floor, or one on which even small pebbles are found.

Errors of Erection

If errors in erection have been found, so that members are transposed or misplaced on the pins, or if a test with the hammer indicates uneven distribution of stress between the pairs or sets of tension members intended to work together, due attention must be given to these facts in determining the capacity of the bridge.

Composite Stringers

Composite stringers, as two or more timbers or beams of different depth, or flitched beams with timber between I-beams or channels, present two possible conditions to the investigator. If the component parts are constrained to equal deflection, the load is considered as distributed in the way which would cause such equal deflection, in which case the capacity of the combination is less than the sum of capacities of the components. If unequal deflections may take place, the distribution of the load is determined by the theory of least work, or so as to produce equal unit stresses in the extreme fibers, if of similar material, or proper relative stresses if of unlike material.

Safety of Derailed Cars

Any type of construction which makes no provision for the safety of a derailed car is very undesirable. One such which seems to be popular is a flitched beam with the rail spiked directly to the timber stringer, which is bolted between two I-beams or channels, with no floor between the stringers at all adequate to support a car if it leaves the rail. Another similar construction is a double stringer of I-beams or channels with spiking pieces between, which rest on horizontal separators of short pieces of channel riveted to the beams. Fortunately, many bridges with such stringers have heavy plank floors laid on top of the stringers, so providing for the safe passage of a derailed car if it does not get too far away from the track stringers. A danger in many highway bridges is that a car may leave the rails and the support provided for it and get on to that part of the bridge where the stringers were designed for lighter loads; perhaps also nearer the centre of floorbeams competent to carry a car only near one end.

Investigation of Compression Members

Compression members should sometimes be investigated on three different bases, each with its proper length and radius of gyration:—

(a) In the plane of the truss.

(b) In the plane of the members, perpendicular to the plane of the truss.

(c) In a plane normal to the least radius of gyration of the member or of one of its components.

In case (a) the effective length may be taken as the distance between centres of connections (or sometimes less) instead of the distance between the theoretical panel points.

Pony trusses without proper side support for the top chords call for careful consideration as to what should be taken as the unsupported length of such chords. No general rule for such cases can be laid down, but each must be considered on its own merits, according to the specific conditions.

Riveted Connections

The value of a rivet whose grip is more than four diameters is decreased about 1 per cent. for each 1/16 in. of this excess. Attention may here be called to the fact that the diameter of a rivet which fills the hole is 1/16 in. greater than its diameter before driving.

Rivets in reamed holes, if equally well driven, are worth much more than in punched holes for several reasons:—

(a) Because in the reamed hole the rivet upsets more readily to completely fill the hole;

(b) Because it has its full section for its full length without a possibility of offset or shoulder;

(c) Because, on account of both facts just mentioned, the rivet also exerts greater pressure on the parts riveted together, increasing the friction between the surfaces in contact;

(d) Because whatever burr is formed in reaming the hole adds to the friction between the parts.

The rivets of top flanges of deck girders and stringers, especially in very old bridges, are sometimes found to be insufficient for local loadings.

In riveted connections the spacing is often so close as to leave insufficient metal between to develop the rivets. If this is found to be the case the value of the net section is used, rather than the rivet value, in determining the value of the detail. The same trouble is often found near the ends of a girder, where the desire to save 1/16 in. in the thickness of the web leads the careless or ignorant designer to crowd the rivets unduly. This reduction of thickness of web is in other ways not always real economy, as it may necessitate additional stiffeners costing more than is saved in the web.

Floorbeams

End floorbeams of swing bridges or of fixed spans adjacent to such bridges are often found to be lighter than the intermediate floorbeams, through a mistaken notion that the loads for these floorbeams are only half as great. As a matter of fact, the actual live load is usually much larger (often double or even more), and even the dead load is sometimes greater than on the intermediate floorbeams, for the overhang of the floor gives not only an extra loaded length, but also a leverage which makes the force acting on the floorbeam greater than the weight of the load itself. In addition to the direct loads, the extra impact due to the open space between the fixed and movable spans adds greatly to the effect of the live load, which is still further increased by a possible difference in level of the floors of the two spans.

Pedestals and Rockers

Often pedestals for truss bridges, and sometimes rockers for long plate girders, are found to be too short to provide fully for longitudinal thrust or webs are too thin to support their loads and resist transverse shocks without stiffening diaphragms. In a similar way pin plates on compression members of pin trusses, or joint gussets of riveted trusses, are frequently found to be too thin to give a radius of gyration for the unsupported length of jaws comparable to the radius of gyration of the member as a whole for the whole length of the member.

Loop Hangers

Loop hangers for floorbeams are frequently found to be deficient in the details. Loop hangers of liberal size may bear upon clip angles which have insufficient strength, either in themselves or by stiffeners bearing upon them, to prevent