

The problem of determining permissible loads for bridges is involved. This is due to the fact that the critical stresses produced in bridges by heavy vehicle loads are influenced by no less than seven variables. The seven important variables which must be taken into account in the calculation of critical stresses for even a simple span bridge are as follows:

1. Span lengths
2. Gross weight of vehicle
3. Wheel base length of vehicle
4. Number of axles
5. Spacing of axles
6. Distribution of gross weight among the axles
7. Repetition of load applications (fatigue)

If all of these variables are taken into account by use of conventional methods, the only way in which the stress producing characteristics or effects of various heavy vehicle types and loadings on a given bridge can be determined accurately is by making a complete analysis of the stresses for that particular bridge, produced by each individual vehicle under consideration. And though such an analysis for any particular vehicle or loading on a given span is not too difficult, it is, to say the least, tedious and time consuming, if all possible combinations are investigated.

The percent of live load overload which can be tolerated is a function of the type of structure and the length of span. As Figure 2 shows the ratio of dead to live load varies with the length of span for any particular type of structure. The lighter the structure is the most critical the overload becomes.

We see from Figure 2 that for a 60' span the live and dead load moments using a H15 loading are equal. With a 60% overload of the live load, the actual overstress in the structure would be 30%. Later, when we discuss fatigue loading we will have more to say on this subject in regard to stress ranges.

The present formula and tables which show the loads on 32,000 lbs. tandem axles which produces a 30% live load overstress are shown in Table II. The unit stresses used in highway bridge design provide a factor of safety of approximately 1.8 applicable to the stresses from the assumed design loads. Recurring overstresses up to 30% of H15 bridges maintained in good condition are not considered by some to be extremely objectionable. This is a subject on which uniform agreement among the bridge engineers and other highway officials of the states is unobtainable. When the present formula and tables contained in "Policy on Maximum Dimensions and Weights of Motor Vehicles to be Operated Over the Highways of the United States" were adopted, major opposition was overcome after a defeat of a first proposal, which included a table based on the formula

$$\frac{N-1}{N-1}$$

$W=500 \frac{N-1}{LN+12N+36}$ modified. The general feeling seems to be that with a

$$\frac{N-1}{N-1}$$

small frequency of overloads some sacrifice can be made on the safety and life of the structure. Therefore, a $\frac{2}{3}$ majority of AASHO members has accepted the 30% overstress. (Constant in formula becomes +32.)

Along this line it should be noted that the 1965 AASHO Specifications contain the following overload provision. "The following provision for overload shall apply to all loadings except the H20 and HS20 loadings. Provision for infrequent heavy loads shall be made by applying in any single lane an H or HS truck as specified, increased 100 per cent, and without concurrent loading of any other lanes. Combined dead, live and impact stresses resulting from such loading shall not be greater than 150 percent of the allowable stresses prescribed herein. The overload shall apply to all parts of the structure affected except floor slab."

The question arises as to when the conditions of traffic change from an infrequent heavy load to a load which should be the design loading. This question can only be answered by an analysis of the traffic at each bridge.

It would be worthwhile to explain here that although the design load has remained relatively constant at H15 for the major percentage of the bridges, the load carrying capacity on newer bridges has generally increased. This is due to the increase in roadway width. For the typical I-Beam or R.C.D. Girder bridge with four or more members the loads for an extremely heavy loading in one lane are generally distributed more uniformly than our specifications provide.

The AASHO road test has provided basic information on the equivalent effects of single- and tandem-axle weights on both rigid and flexible pavements for the conditions of the road test. This information is a basic requirement in establish-