Abstract

This research addresses the truck axle loads in Sudan in order to suggest design axle loads for roads and bridges in Sudan. Truck axle loads are the most critical parameter governing the design of roads and bridges. This research is one of a series of comprehensive studies required to achieve Sudanese road and bridge standards and standard loading criteria.

The study reviews design standard used in Sudan for roads and bridges , namely British Road Notes No 31 by computing the design loads (ESAL) according to the British Standards. In some cases, the American standards (AASHTO) are used. Bridges in Sudan are designed according to the British Standards BS 5400 and in some cases design loads are computed according to the American standards (AASHTO).

Also the study covered the rules and criteria issued by National Authorities to control axle loads. Recently and datDuring the exploration of oil, large numbers of trucks were put in service to haul heavy goods and equipments, thus negatively impacting the condition of roads and bridges in Sudan.

In this study data on the existing trucks in Sudan was collected and was classified in accordance to the axle arrangement and axle type and number in the different types of axles. The equivalent single axle loads corresponding to each wheel for each one of these trucks were calculated. Data was also collected from the different available weighing stations on National highways. Also, the equivalent loads for a single axle were computed for each type of vehicle and for each

one of the mentioned loads. The gross vehicle weight was computed in accordance to the American bridge formula for the HS-20 truck.

The largest truck, trailer or combination was applied to a standard simply supported bridge with one lane width and again with two lane width and analyzed using the Structural Software Robot Millennium. The resulting girder maximum shear forces and bending moments for the selected Sudanese trucks, the standard British loads (HA+ 30 HB) and the standard American HL-93 truck were computed.

The loads analysis results indicate that the single axle causes the highest effect on the road since its effect is 1.5 times the double axle and twice the effect of the triple axle. It was also found that the 16% increase allowance (Ministry Allowance) increases the effect on the road by more than 77% for all axles and that the 21% increase (Ministry Allowance + unauthorized increases) increases the effect on the road by more than 110%. It was also found that modifying the standard tandem and triple axles in trailers and semi-trailers increases the payload by 14% but it increases the effect on the road by more than 120%, more than 130% with the 16% Ministry Allowance and more than 140% with the 21% unauthorized overloads. In addition, all trucks examined in accordance with the American Bridge Formula had more effect on the bridges than that from a standard HS20 truck.

Also for the bridges it was found that the bending moments and shear forces resulting from the suggested Sudanese truck loads were lower than those resulting from applying the standard HA+30HB standard British load (this applies for single and two-lane applications). However, the bending moments and shear forces from these

Sudanese trucks were higher than those resulting from application of the American HL-93 loading for the simply supported girders (both single and two-lane cases). It was found that three trucks caused the maximum bending moments and shear forces in the simply supported girders examined. It is therefore suggested to consider them as basis for highway loads in Sudan.

In the future more research may be carried out on all these trucks based on data collected from weighing stations for the trucks with standard axles and those with modified axles in accordance with the governing laws to reach a standard Sudanese design load. Research should also be carried out on trucks carrying special overloads exceeding the legal limit which use special Tractors and trailers to come up with equivalent single axle loads and to determine their effects on bridges.