AMAS Course on Reliability-Based Design and Optimisation
RBO'03 – (pp.411–412) – Warsaw, September 15-18, 2003

Assessment of structures endangered by impact

K. JUNG

Klokner Institute, CTU in Prague
Šolinova 7, 166 08 Prague 6
Czech Republic
jung@klok.cvut.cz

Incidents where a train derails on the approach to a structure and collides with the structure are rare. However, the potential consequences are very severe so that the risk cannot be ignored. An accident near Eschede in 1998 where 101 people died is well known. Risk assessment of structures located in the vicinity of traffic lines enables to make optimal decision about their location taking into account safety of people.

The safety assessment of structures near railways endangered by trains is based on quantitative risk analysis and risk assessment. The frequency of accidents and extent of damage are determined for various hazard scenarios. The proposed poster presents optimization of distance of structure supports to the centre of railway. The method can be used for assessment of new structure as well as existing structures.

The event tree method is applied in the study taking into account the economic and social consequences of derailment. The results are determined using spreadsheet program Microsoft Excel and software MathCAD. The study is based on recommendations provided in UIC 777-2. It is hardly possible to model the behaviour of a derailed train. Moreover, there are no physical models that would permit a clear and realistic evaluation. For these reasons a very simple derailment model has been accepted.

The following main parameters are taken into account: number of tracks, railway switches on approach to a bridge, speed and type of train, number of trains per day and travelling direction, number of passengers, lateral distance of supports from the centre of rails. The analysis is performed assuming a road bridge width of 9 m, crossing perpendicularly the two-line railway, design speeds of 120 km/h and 160 km/h and railways with switches The average

number of trains per day passing under the structures is 200 for double track (100 trains per travelling direction). Perceived risk is expressed in monetary terms.

The costs are calculated taking into account a cost of preventive and protective measures. For new constructions only the additional costs due to a longer span of a bridge deck have to be considered, while for existing constructions the cost of demolition, replacement and safety elements must be also taken into account. The optimum measures may be derived using a graph. The investment cost due to protective and preventive measures are plotted against the perceived risk. The optimum distance is found as the first point to the left of marginal cost tangent, which is intersected by a horizontal line moving upwards from the cost axis. If the marginal cost tangent crosses the point on the y-axis then the additional measures are not justified.

The poster shows selected results of analysis based on recommendations of UIC Code. It is found that for speed 120 km/h the optimal distance of bridge support is 3 m and for speed 160 km/h distance is 7 m.