Dynamic loading of highway bridges, Ontario

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Dynamic Loading of Highway Bridges; Ontario

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The Ontario Highway Bridge Design Code (OHBDC) contains provisions for vehicle load and associated dynamic load and vibration which differ from other codes. The provisions base the design truck load and design lane load on load surveys carried out in Ontario. These design loads lead to legal loads and overload control. With such carefully selected design loads which are representative of actual traffic loads, it is essential that the additional allowance for the dynamic effects of load are also representative of actual vehicle-bridge response. The provisions for dynamic load allowance (impact) still consider that the dynamic effects of vehicles crossing highway bridges can be described in terms of an equivalent static effect that is a fraction of the design vehicle load. The magnitude of this effect depends upon the governing load, e.g., axle or design truck, and may also depend upon the natural frequency of the structure rather than span length.

Few codes are based on a limit states philosophy for both design and evaluation. Accordingly, new provisions were required for OHBDC which represent adequately the random effects of the dynamic component of load as typical design and evaluation vehicles traverse a span.

The results of the tests are presented and described in the context of a design code for highway bridges. Some existing code provisions were found unconservative for structures having a first flexural frequency lying between 2.0 and 5.0 Hz. Calibration of the load factors for dynamic load allowance for a reliability based limit states design code is described (1).

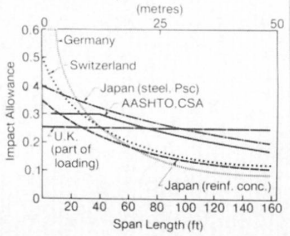
In summary, the dynamic response of modern bridges to modern vehicles is described. Provisions as to how this response might be catered for in a design code that represents the significant mechanism of vehicle-bridge interaction are given.

Reference

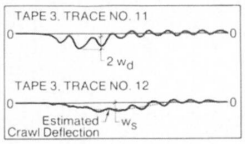
1. "Ontario Highway Bridge Design Code and Commentary", Highway Engineering Division, Ontario Ministry of Transportation and Communications, Downsview, Ontario, Canada, 1983.

DYNAMIC LOADING OF HIGHWAY BRIDGES; ONTARIO

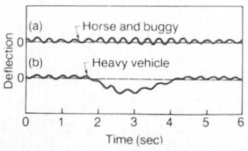
THE SITUATION
New **Limit States Design Code** in **Ontario (1979, Revised 1983).**
Prior to 1979, Legal Loads were greater than Design Loads, and Observed Dynamic Effects were greater than Design Effects. Existing codes indicate wide differences in impact values.



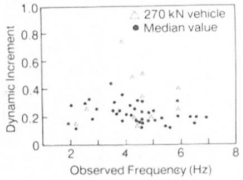
Dynamic effects are superimposed on a static, crawl deflection curve (below) so amplifying the response to static load. Increases from the static value of 30 to 40 percent are not uncommon.



A horse and buggy can excite a structure to a greater extent than a heavy vehicle.

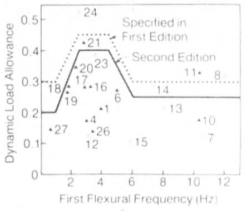


Typical field data for dynamic amplification indicate considerable scatter due to variation in vehicle type and pavement roughness. Mean amplification tends to increase with speed and to increase with bridge frequency in the range 2 to 5 Hz - typical of the bounce frequency of modern heavy vehicles (below). The results lend themselves to a statistical treatment.



Dynamic load allowance is a fraction of highway live load to cater for dynamic effects of vehicle & bridge, and riding surface irregularity.

The **DLA** for Ontario bridges is given below for both the 1979 and 1983 provisions. The envelope of observed values scaled according to the calibration process corresponds to the provisions. Data obtained in Switzerland also confirms DLA increase in the 2 to 5 Hz range.



DLA Values

Load	Value
Axle/wheel -	0.40
Two or more axles - (span less than 22 m)	0.30
Truck - (A function of frequency)	0.40 to 0.20
Lane load, UDL -	0.10
Vehicles with speed control (10 km/h) -	30% of above

DLA Values