

14.7	MATERIAL STRENGTHS	2
14.7.4	Strengths based on date of construction	2
14.7.4.2	Structural steel.....	2
	http://www.cisc-icca.ca/content/technical/default.aspx	2
14.9	TRANSITORY LOADS	2
14.9.1	Normal traffic	2
14.9.1.1	General.....	2
14.12	TARGET RELIABILITY INDEX	2
14.12.1	General.....	2
14.12.3	Element behaviour	3
14.14	RESISTANCE.....	4
14.14.1	General.....	4
14.14.1.6	Shear in concrete beams.....	4
14.14.1.6.1	General.....	4
14.14.1.7	Wood	5
14.14.1.7.2	Shear.....	5
14.17	BRIDGE POSTING.....	5
14.17.1	General.....	5
14.18	FATIGUE	5

Revision	Clause	Date	Comment
1	14.14.1.6.1	August 2009	Clause revised to reflect changed method for shear resistance calculation

14.7 Material strengths**14.7.4 Strengths based on date of construction****14.7.4.2 Structural steel**

Commentary: Further information on historical steel grades may be found on the CISC website, specifically at the following URL:

<http://www.cisc-icca.ca/content/technical/default.aspx>

14.9 Transitory loads**14.9.1 Normal traffic****14.9.1.1 General**

Delete and replace with:

Unless specified otherwise by the Ministry, evaluation shall be to the Evaluation Level 1 loading (vehicle trains) described in Clause 14.9.1.3. The BCL-625 design loading shall not normally be used for evaluation.

Commentary: Loadings that differ from the CL1-W loadings specified in Section 14.8 may be specified by the MoT on a project-to-project basis.

14.12 Target reliability index**14.12.1 General**

If consented to by the Ministry, on low volume road bridges with AADT per lane of less than 500 and ADTT per lane of less than 100, the reliability index, β , used to determine the evaluation live load factors for Normal Traffic can be reduced by 0.25. However, the reduction in β should not be applied if the level of truck weight enforcement at the location is low and it is suspected that the number and size of overloaded vehicles is significantly higher than normal. No reduction is permissible for the reliability index used to determine evaluation dead load factors or permit vehicle live load factors.

Commentary: The evaluation live load factors for Normal Traffic loadings contained in Section 14 are based on Highway Class A traffic volumes, ADT per lane of >4000 and ADTT per lane of >1000. Although the evaluation live load factors are relatively insensitive to variations in the ADTT, very large reductions in the ADTT can slightly reduce the required live load factors. The occurrence of an extremely heavy truck is less likely as the total number of trucks in the population decreases. For Normal Traffic, the reduction in the

required live load factor for a reduction in the ADTT from >1000 to <100 is equivalent to a 0.25 reduction in the reliability index, β .

Low volume roads may be subject to a lower level of truck weight enforcement which could encourage both a greater percentage of overloaded vehicles and higher levels of overload on the vehicles. Such conditions would counteract the benefits of having a low number of trucks operating on the route.

14.12.3 Element behaviour

Add to Item (a), Category E1 the following:

This can also include timber in bending, compression parallel to grain (slender members) and tension, when element is subject to sudden loss of capacity with little or no warning and no post failure capacity,

Add to Item (b), Category E2 the following:

Timber in bearing, when element is subject sudden loss of capacity with little or no warning and with post failure capacity, i.e. crushing of timber

Add to Item (c), Category E3 the following:

Timber in shear, when element is subject to gradual failure with warning of probable failure, end splits are signs of gradual failure

Commentary: *This section does not give any guidance for timber element behavior.*

Steel in tension at net section shall remain in Category E1 but, for evaluations, the new resistance adjustment factor specified under Clause 14.14.2 shall be applied to the axial tensile resistances determined in accordance with Clauses 10.8.2(b) and 10.8.2(c).

The axial tensile resistances for effective net sectional areas, A_{ne} and A'_{ne} , specified in Clause 10.8.2(b) and (c) contain a 0.85 reduction factor to account for the reduced warning of failure that may be provided if fracture occurs on the net section prior to yielding of the component on the gross section. The provisions of Clause 14.12.3 address the same issue by effectively increasing the factored loadings on components that provide little or no warning of failure.

The intent of both these provisions was to individually provide an additional margin of safety against this type of failure. Applying both of these provisions for evaluations results in the component being penalized twice for the same behaviour. To remove this double penalty, a new resistance adjustment factor has been developed to remove the reduction in the component

resistance while maintaining the increased factored loadings. The new resistance adjustment factor is specified under Clause 14.14.2.

14.14 Resistance

14.14.1 General

14.14.1.6 Shear in concrete beams

14.14.1.6.1 General

Delete and replace with the following:

Concrete beams shall have their shear resistance calculated in accordance with Clause 8.9.3 with the exception that the factored sectional shear force and factored bending moment used to calculate longitudinal strain of the member, ϵ_x in Clause 8.9.3.8 is given by:

$$V_f = \alpha_D V_{DL} + F (\alpha_L V_{LL})$$
$$M_f = \alpha_D M_{DL} + F (\alpha_L M_{LL})$$

where, a value for F is first assumed, and the calculations repeated, iterating the value of F, until V_r from Clause 8.9.3.3 converges to the value of V_f given above. The value of F at convergence is the live load capacity factor. All other aspects of Clause 8.9.3.8 remain unchanged, except as modified in Clauses 14.14.1.6.2 and 14.14.1.6.3.

Commentary: *The shear design provisions of Clause 8.9.3.8 are based on the Modified Compression Field Theory (MCFT). Simplifications were made to the theory to create a suitable procedure for the design of new concrete beams. According to the MCFT, the shear resistance of a concrete member depends on the longitudinal strain ϵ_x of the member. The longitudinal strain in turn depends on a number of factors such as the amount of longitudinal reinforcement and the applied loads including the applied shear force. Thus according to MCFT, the shear resistance of a concrete member depends on the applied shear force at failure. Iteration (trial and error) is therefore generally needed to determine the shear resistance of a member according to MCFT. A simplification in Clause 8.9.3.8 that avoids iteration is the longitudinal strain ϵ_x being calculated from the design forces rather than the forces at shear failure. This is a reasonable assumption for design as the shear resistance is adjusted through the selection of stirrup quantity and concrete section properties to be approximately equal to (slightly greater than) the design shear force V_f .*

The simplifying assumptions described above for design cannot be used for determining the ultimate shear resistance for evaluation. The sectional shear force V_f , the corresponding bending moment M_f , as well as any applied axial force N_f used in Clause 8.9.3.8 to determine longitudinal strain ϵ_x , which in turn is used to determine shear resistance, must be the sectional forces that result from the total bridge loading that causes shear failure. Thus evaluating

the shear resistance of existing concrete beams using Clause 8.9.3 requires trial and error.

One method of doing these calculations is to include the Live Load Capacity Factor (F) in the equations for calculating V_f and M_f and iterate the value of F until V_r equals V_f .

14.14.1.7 **Wood**

14.14.1.7.2 **Shear**

The size factor (k_{sv}) given in Clause 14.14.1.7.2, shall be applied to both sawn timber and glue-laminated beams. The value of longitudinal shear (f_{vu}) for glue laminated beams shall be taken from Table 9.15.

14.17 **Bridge posting**

14.17.1 **General**

Replace the third sentence of the first paragraph with the following:

Posting requirements for a bridge evaluated as being deficient shall be determined by the Ministry of Transportation's Regional Bridge Engineer.

Commentary: *MoT posting requirements and standards vary from those specified in Clause 14.17.*

14.18 **Fatigue**

For fatigue in riveted connections, the stress Category "D" shall be used in determining the allowable range of stress in tension or reversal for base metal at the net section of riveted connections.

Commentary: *This category will be useful during the evaluation and rehabilitation of existing riveted bridge structures.*