EVALUATION OF THE METHODS FOR CALIBRATION OF OPTIMAL LOAD AND RESISTANCE FACTORS BASED ON STRUCTURAL RELIABILITY THEORY

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In the code calibration based on structural reliability theory, the purpose is to provide partial safety factors for obtaining safe and economical structural design (Gayton et al., 2004). This goal can be achieved by taking statistical characteristics of loads and resistance parameters into account. In this context, different reliability methods are presented for different kind of problems in a way that each one is appropriate for a special kind of problem depending on the nonlinearity of limit state function (Beck et al., 2010; Bojórquez et al., 2017).

In this paper, an algorithm is proposed for code calibration based on structural reliability theory, which leads to a uniform level of reliability for a variety of limit states. This method is based on computing derivatives of limit state function with respect to random variables for reliability assessment which results in increasing the efficiency of the algorithm. In this context, the partial safety factors for two cases including a limit state with different design situations, statistical parameters and target reliability indices are computed.

In the first case the limit sate Equation 1 with a constant target reliability, the effects of an increase in K_l, the ratio of live to dead load, on the load factors including dead, live, and wind load and resistance factor are investigated.

$$\varnothing R = \gamma_D . D + \gamma_L . L + \gamma_W . W \tag{1}$$

The results illustrated in Figure 1 show a slight increase in $\varnothing$ and $\gamma_{D,a}$ significant increase in. γ_L, and a significant decrease in γ_W. This process is also performed for the second case by changing the ratio of wind load to dead load (Kw).

Finally, the optimal partial safety factors for the limit state with different design situations are computed by two different methods, namely minimum penalty function method and weighted factors method. The comparison of the results shows that the minimum penalty function method (method 1) leads to the partial safety factors obtained only from design state with dead-to-live load ratio of 1. On the other hand, the weighted factors method (method 2) leads to the partial safety factors contributed by all design states. Consequently, the weighted factors method is more suitable for problems with high number of design states and reliability analyses.

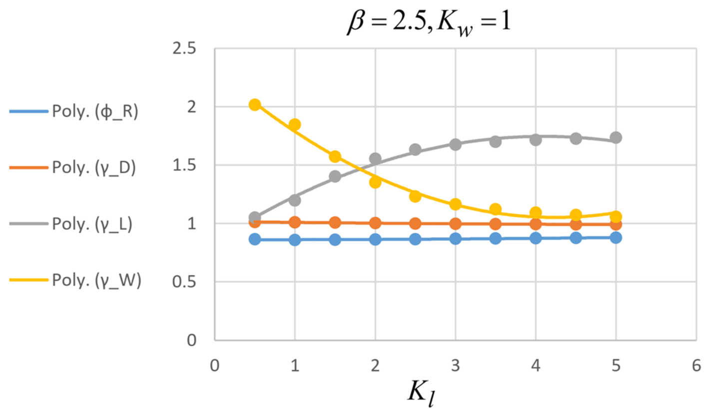

Figure 1. The effects of changing K_L on partial safety factors.

REFERENCES

Gayton, N., Mohamed, A., Sorensen, J.D., Pendola, M., and Lemaire, M. (2004). Calibration methods for reliability-based design codes. *Structural Safety*, *26*(1), 91-121.

Beck, A.T. and Souza Jr, A.C.D. (2010). A first attempt towards reliability-based calibration of Brazilian structural design codes. *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, *32*(2), 119-127.

Bojórquez, J., Ruiz, S.E., Ellingwood, B., Reyes-Salazar, A., and Bojórquez, E. (2017). Reliability-based optimal load factors for seismic design of buildings. *Engineering Structures*, *151*, 527-539.

Norton, T.R., Mohseni, M., and Lashgari, M. (2013). Reliability evaluation of axially loaded steel members design criteria in AASHTO LRFD bridge design code. *Reliability Engineering & System Safety*, *116*, 1-7.