



Verification Of The Sufficiency Of Adjustment Of Mass For Compensating The Accidental Eccentricities (IS 1893:2016 Clause 7.8.2)

Objective and Scope of Study

- To Compare torsional Provisions imposed by different countries
- 3 one storey models are created with 5% unidirectional mass eccentricity (CM), 5% stiffness eccentric model (CS) and combination of both i.e., (CM-CS).
- All the 3 models are subjected to linear incremental dynamic analysis by considering Chamoli ground motion and twist is calculated.

What Codes say

- Comparison is made for Torsional irregularity, Accidental eccentricity and amplification factor for static eccentricity by considering 4 codes as shown in Table 1

Table 1. Comparison of Torsional provisions

Comparison parameter	IS1893:2016	ASCE 2016	BS EN 2004	NZS:2004
Torsional Irregularity	$\Delta_{min} > 1.5\Delta_{max}$ $T_x > T_x \text{ or } T_y$	$drift_{max} > 1.2drift_{avg}$	$e < 0.3r$ $r > l$	$\frac{d_{max}}{d_{avg}} < 1.4$
Accidental Eccentricity	$\pm 0.05 b$	$\pm 0.05 b$ or $\frac{A}{A(0.05b)}$ $A_x = \left(\frac{\delta_{max}}{1.2\delta_{avg}}\right)^2$	$\pm 0.05 b$	$\pm 0.1 b$
Amplification factor for static eccentricity	1.5	-	-	-

Observation and Discussion

- Torsional response generated by moving mass centre away from geometrical centre is negligible when compared to the response generated by moving stiffness centre.
- Adjustment of mass is not complete solution for addressing torsion created due to various eccentricities.
- A constant value of 1.5 for dynamic amplification of static eccentricity need to be revisited as very few countries have associated a factor for amplification of static eccentricity. Rather, dynamic analysis shall be made compulsory.
- When torsional response of mass eccentric model is negligible, torsional response of combined model is equal to stiffness eccentric model

Case Study

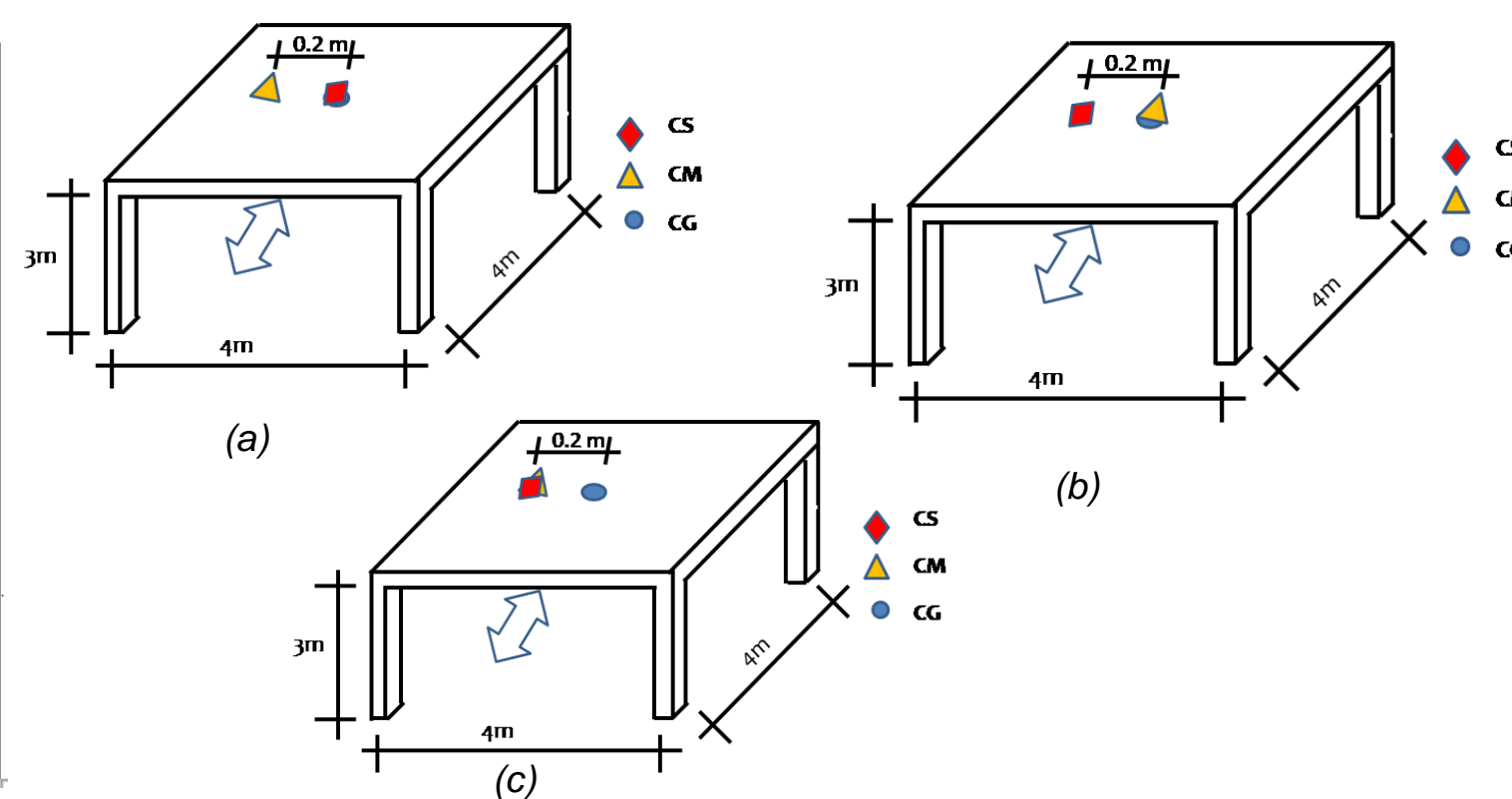


Fig 2. Eccentric models: (a) Mass (b) Stiffness and (c) Mass & Stiffness

Results

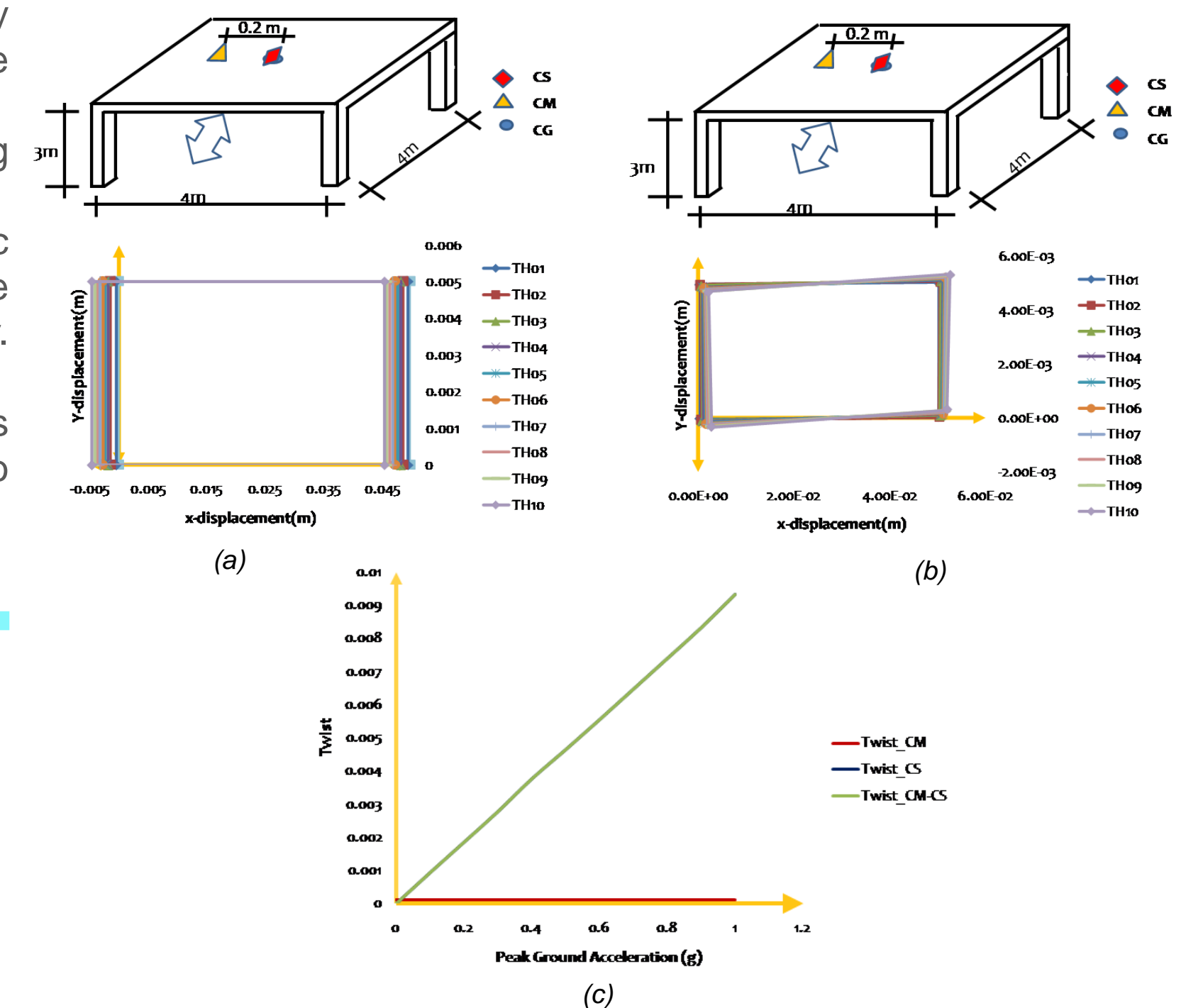


Fig 3. (a) Twist profile of CM model (b) Twist profile of CS model (c) PGA vs Twist for CM & CS models

Conclusion

Adjustment of mass is not universal solution for torsion. In this line few countries like New Zealand had already changed accidental eccentricity from 5% to 10%.