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WIND DRIFT DESIGN CONSIDERATIONS FOR STEEL FRAMED STRUCTURES

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OUTLINE

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Abstract: -

The world is developing at a very fast pace, also population in urban areas is also increasing with it due to change in demographics, and thus strong and durable buildings are the need of the hour. The design of steel framed buildings must take into consideration the lateral drift of the structure due to wind loading and any serviceability issues that may arise from this lateral movement. This paper focuses on one of these issues, damage to nonstructural components. It is an important issue which may significantly impact the buildings structural performance and economy. Furthermore, because these serviceability issues are not codified, there is a wide variation among design firms in how they are dealt with, leading to a greater economic disparity.

Keywords*: -* *drift limits, damageability, considerations, observations.*

INTRODUCTION

On the most basic level, structures are designed for strength (safety) and serviceability (performance). Adequate strength is obtained by designing structural members against buckling, yielding, instability and fracture in accordance with the applicable building code specifications. Serviceability issues include deflection, vibration and corrosion but with respect to wind the issues of concern are deformation (drift) and motion perception (acceleration). This paper focuses on damage to nonstructural components as a result of

Drift. Serviceability issues are dependent on the type of building and the needs of the owner or occupants. For these reasons, and because they are not life-safety related, current Indian building codes do not regulate serviceability issues. Because these issues are not codified, choices on appropriate designs are left to the engineer's judgment. Designing for drift is important for both strength design, where second order (P-Delta) effects can create instability, and for serviceability.

Drift Limits and Damageability

Drift limits are imposed for two reasons: to limit second order effects and to control damage to nonstructural components. Although drift may also be limited to ensure human comfort, this thesis does not cover this issue. Limiting second order effects is necessary from a strength perspective while controlling damage to nonstructural components is a serviceability consideration. For serviceability issues several topics need

To be discussed: the definition of damage, drift/damage limits to be imposed and the appropriate return interval to use when calculating wind loads.

Definition Of Damageability

Traditionally drift has been defined in terms of *total drift* (the total lateral displacement at the top of the building) and *understory drift* (the relative lateral displacement occurring between two consecutive building levels). Drift itself is not very useful in defining damageability as a total roof drift of 15 in. may be acceptable in a 40 story building but certainly not in a 10 story building and likewise an acceptable understory drift is10 dependent on the story height. But when drifts are divided by heights the result is a drift ratio or *drift index*. The drift index is a simple estimate of the lateral stiffness of the building and is used almost exclusively to limit damage to nonstructural components.

Equation 2.1 defines the drift index.

Drift index = displacement/height (2.1)

Referring to Figure 2.1, a total drift index (Equation 2.2) and an understory drift index (Equation 2.3) can be defined as such:

Total drift index = total drift/building height = deflection*/H* (2.2)

Understory drift index = understory drift/story height= deflection (2.3)

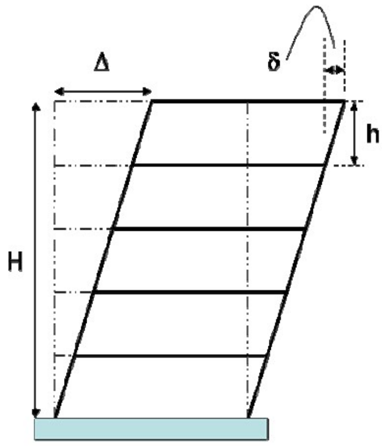

Figure 2.1: Drift Measurements

$$DDI = 0.5 * \left[\frac{X_A - X_C}{H} + \frac{X_B - X_D}{H} + \frac{Y_D - Y_C}{L} + \frac{Y_B - Y_A}{L} \right] \quad (2.4)$$

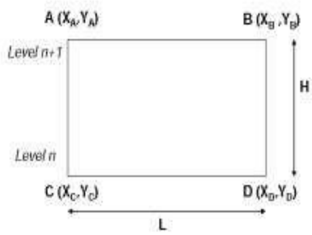

Figure 2.2: Drift Damageable Zone

DDI MEASURE

Observations Made by Government Authorities

The two frames were subjected to identical lateral wind loads. The drift damage index in Table 2.1 was computed using Equation 2.4. For the unbraced frame (Frame M), drift damage is overestimated in the two outer bays by using the traditional understory drift index. Conversely, damage in the outer bays of the braced frame (Frame X) is severely underestimated using the drift index (which doesn't account for the vertical component of racking) while the damage in the middle-braced bay is overestimated. This overestimation is due to the rigid body rotation which causes little damage, in and of itself.

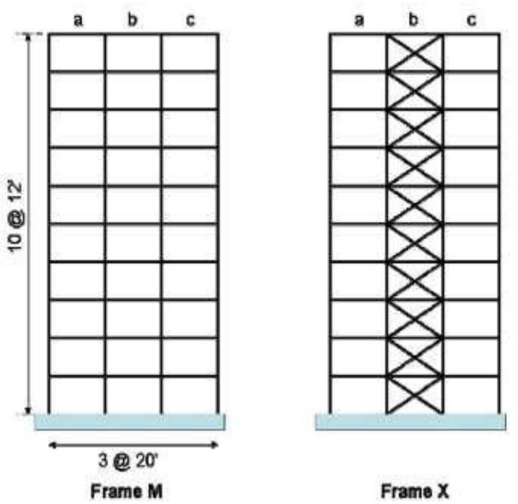

Figure 2.3: Drift Indices and Drift Damage Indices

Table 2.1: Drift Indices and Drift Damage Indices

		Interstory Drift Index (1)	Drift Damage Index (2)	Shear Distortion (%)	(2)/(1)
Frame M (unbraced)	Bay a	0.00267	0.00219	0.219	0.820
	Bay b	0.00267	0.00267	0.267	1.000
	Bay c	0.00267	0.00219	0.219	0.820
Frame X (braced)	Bay a	0.00267	0.00358	0.358	1.341
	Bay b	0.00267	0.00083	0.083	0.311
	Bay c	0.00267	0.00358	0.358	1.341

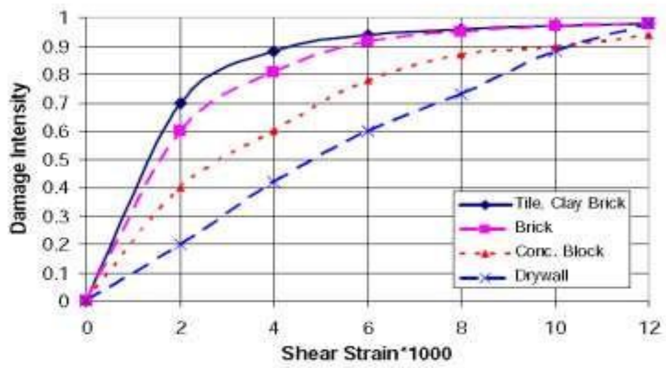

Figure 2.5: Shear Strain vs. Damage Intensity

Factors Affecting Design Wind Loads
***Mean Recurrence Interval**
***Wind Velocity**
***Topography and Roughness of the Surrounding Terrain**
***Wind Directionality**
***The Buildings Dynamic Characteristics**

Conclusion

This paper effectively establishes the key points of the wind drift design relating to steel structured frames. It has been realized that without proper re-valuation of Indian codes this kind of design methodologies cannot be implemented fully. Thus, there is a quick need of updating the current literature relating to this issue, then only this idea could be implemented properly into practice

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