ROTATIONAL MEASUREMENTS IN STRUCTURES – WHY AND HOW? - ENGINEERS' PERSPECTIVE AND EXPERIENCE

by

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SUMMARY

Complete time-space characterization of a point on a deformable body is achieved by measuring or theoretically including three translational (*x, y* and *z*) and three rotational (θ_x, θ_y and θ_z) degrees of freedom in the Cartesian coordinate system. Whether it is the Earth's surface or a structural system, this generic concept remains unchanged. However, traditionally, ground motion measurements have been limited to three translational components. On the other hand, during design and analysis processes and in laboratory testing of structural members, components or systems, engineers have been measuring, assessing and computing rotations in addition to translational deformations. The significant actions caused by rotations of sections, members, joints, and a structure as a whole describe in fact the behaviour and, in turn, performance state of a structure. For bending, torsional, twisting, rocking and other important behavior of a structure, rotations are the main variables. Therefore, under seismic and gravity loads, measurements of rotation in instrumented structures have paramount importance to better understand and assess the deformational behavior for performance evaluation of the structural systems. In this paper, examples of quantification of rotational behavior are provided from data retrieved from instrumented structures during strong shaking events. It is shown that rotations are computed from actual measurements of displacements computed from accelerations recorded with uniaxial translational accelerometers. In the vast majority of instrumented structures, to date, rotational sensors have not been utilized. For example, as of writing of this paper, the authors are not aware of any building that has utilized rotational sensors in its instrument arrays. Despite this deficiency, it is shown, in all presented cases, that rotations can be computed from measurements of uni-directional translational sensors.