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QUASIBRITTLE FRACTURE MECHANICS: AN APERÇU OF RECENT ADVANCES AND FECUND TRENDS

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As befits a plenary closing keynote, the presentation begins with a brief overview of historical development of the quasibrittle fracture mechanics in general, and concrete in particular. If one overriding historical scheme should be identified, it is the inevitable involvement of a large material characteristic length which, in contrast to brittle fracture, cannot be ignored. Its ignorance is epitomized by many historical controversies which to today must be perceived as moot – e.g., an arrogant letter in 1925 of Harvard prof G. Swain to S.P. Timoshenko, a guru of elasticity, disputing the veracity of stress concentration factors at holes (as we must see it today, both were right, depending on the material characteristic length).

Today we can rejoice that the edifice of quasibrittle fracture mechanics of concrete, the product of a large number of researchers over the last several decades, is virtually complete. Nevertheless, there is a cornucopia of important and difficult problems of interdisciplinary and multi-physics nature. They include chemo-hygro-thermo-mechanical fracture, nano- and micro-meter scales, probabilistic mechanics, big systems (e.g., progressive collapse), extreme loads (impact, shock), computational modeling (e.g., coarse-graining vs. fracture localization), fracture property enhancement by fibers, nanotubes, graphene platelets, etc., as well as ramifications to numerous other quasibrittle materials. After highlighting some of these problems, the goal of incorporating fracture mechanics, particularly the size effect, into the design code provisions is emphasized.

In closing it is pointed out that while ACI is now the only major concrete society that has no size effect in its shear strength provisions, it is the only one that does not have a wrong size effect yet. Thus it could still be the first to do it right, by adopting for the design code the energetic size effect of quasibrittle fracture mechanics.