Reducing seismic vulnerability

A moderate earthquake in 2002 damaged newly built masonry and RC buildings and structures in North Andaman Island which were disproportionate to the intensity of shaking in the area (VII on MSK scale). Many well-known unfavourable structural features that seriously undermine seismic resistance of structures, e.g., open-ground-storeys, out-of-plane instability of unsupported slender walls, short-column effect, and discontinuous load paths for lateral loads due to offsets in plan and elevation, were repeated in many of the newly constructed buildings, adding to their seismic vulnerability. And, the 2004 Sumatra earthquake caused a similar intensity of shaking in the same region: buildings and structures that were affected in the 2002 event, were once again damaged, and in many cases more severely, rendering them unusable and irreparable.

The public and professionals ignored the lessons learnt and continued to design and construct without accounting for earthquake effects due to a variety of reasons. These include: (a) Widespread ignorance of earthquake-resistant design and construction among the civil engineering community, (b) Lack of accountability for the non-performance of structures, (c) Absence of structural codes and guidelines for seismic evaluation of existing structures and their strengthening if found deficient, (d) Lack of professional experience and expertise to carry out such seismic upgrades; and (e) Above all, a general lack of genuine desire and concern for seismic safety in the region which is highly seismic active. Rai and Murty (page 1681) warn that the 2004 earthquake offers fresh reminders of the lessons, and an opportunity for corrective action. In the absence of proactive efforts, these lessons could be wasted yet again.

Non-Förster distance dependence of FRET

Since Lupert Stryer termed fluorescence resonance energy transfer (FRET) between a donor and an acceptor as a ‘Spectroscopic Ruler’ in 1978 (Stryer, L., Annual Review of Biochemistry, 1978, 47, 819–846), it has become an immensely popular tool to study equilibrium and dynamical properties of polymers and biopolymers in the condensed phases and is now being widely used in conjunction with single molecule spectroscopy. The main reason of its widespread use is the strong distance dependence of the rate of FRET. This rate is usually assumed to be given by the Förster expression, discussed by Harjinder Singh and Bagchi (page 1710).

Several recent experimental and theoretical studies have shown that the Förster expression can be of limited validity if the size of the donor and/or the acceptor is comparable to the distance separation. In such cases, one may expect much weaker distance (even as weak as \(1/R^6\)) dependence. This has been shown by explicit quantum calculation of the distance and orientation dependent transfer rate between a segment of polyfluorene and tetraphenylporphyrin. Interestingly, optically dark states (that is, those not accessible by fluorescence spectroscopy) can make significant contribution to the energy transfer rate – clearly these contributions are neglected in the Förster expression. In addition, in case of energy transfer from a dye to a nano-metal particle, the distance dependence can be completely different and can reduce to \(1/R^6\) dependence at long distance and even weaker at short separation. Thus, the use of ‘spectroscopic ruler’ requires considerable care for measuring short distance phenomenon.

Mixed convection and dynamical systems behaviour

Nonlinear systems are known for a rich structure of solutions. Still it is surprising to see periodic behaviour in a mixed convective flow generated by steady boundary conditions and involving secondary vortices. Deshpande and Srinidhi (page 1720) say that such a flow has been detected in a mixed convection problem inside a lid-driven cavity while solving numerically the Navier–Stokes and the energy equations. Further, in a narrow range of values of the two parameters, Reynolds number and Rayleigh number, certain classical features of dynamical systems like bifurcation, hysteresis and period doubling are seen. There are also other interesting features in the flow like symmetry in the spanwise direction and its loss, stagnation points in the interior of the flow, closed streamlines in three dimensions and change in the number of primary vortices. Even though the overall heat transfer is not sensitive to these changes, its distribution is highly dependent on them. These results show the effectiveness of the computations in detecting and characterizing such subtle features.