

# Research update

*Dr Chris Burgoyne, Reader in Concrete Structures, University of Cambridge and member of the Institution's research panel, has written this update*

## Advanced composites in structural engineering

The use of advanced composites in Structural Engineering is still a technology in waiting. Fibres with high strength, high stiffness, low creep and resistance to corrosion (principally carbon, aramid and glass) are available in commercial quantities, but they have yet to achieve widespread acceptance. A recent meeting of CoSACNet (Advanced Polymeric Composites for Structural Applications in Construction, organised by the University of Southampton and funded by EPSRC), held at the Institution on 30 April 2001, reviewed the state of research in the UK in the field. A number of active research topics were identified, but it was clear that the barrier to acceptance of the technology is now commercial, rather than technical. Further details can be found at the CoSACNet web

site ([www.cosacnet.soton.ac.uk](http://www.cosacnet.soton.ac.uk))

There are three principal areas of research:

- **Systems made from fibrous composites acting alone**

These are often pultrusions where the strength in the axial direction is much higher than transversely. This raises significant problems for jointing, which is being studied at both Warwick and Lancaster Universities. They are also studying buckling problems, where wider flanges and non-isotropic properties mean that interaction between local and global buckling modes need to be studied. The wide flanges also affect the torsional properties;

Cardiff University is studying the warping stiffness and the effects of shear flexibility. The use of resin causes concerns about fire and thermal effects, which is being

studied at Manchester University; significantly, FRP grating and access elements are accepted offshore where the ability to remain functional in the event of fire is important.

There is a significant amount of fundamental work on composites at Imperial College. DERA, part of which will soon be privatised, is conducting extensive studies of novel sandwich panels (where the properties of the skin layers can be adapted to contain electrical circuitry, measurement devices). It is also researching novel jointing technologies, designed to reduce the cost and improve the performance of composites.

- **Externally bonded reinforcement**

This is a field where composites are starting to become accepted. The primary market is seen as reinforced concrete, but there are also applications for masonry. Work is being carried out at Sheffield,

Glamorgan and Cambridge in all these areas. The behaviour of flexural reinforcement is well established, although the additional failure mechanisms associated with peeling or interface fracture at the composite/concrete boundary, or even within the concrete, still require study.

Shear strengthening is attractive, but the difficulty of providing an effective anchorage in the compression zone is being actively studied, as is the possibility of prestressed shear straps (at Cambridge). Southampton is studying a variety of other applications, including applications to metallic structures. Work on the development on prestressing anchorages for flexural reinforcement is underway at Surrey.

- **Composites for new-build reinforced or prestressed concrete structures**

This is yet to be applied in large amounts, mainly because the higher initial costs are only offset by savings in long-term maintenance, which is often perceived as 'someone else's problem'. There are also concerns about the ductility and deformability (which are different concepts) of using brittle fibres with concrete. In fact, because of

cracking, and also by the use of fibrous confinement in the compression zone, these sections have very good rotational characteristics. All these aspects are being studied at Cambridge and Sheffield Universities, both of which are members of the EU-funded ConFibreCrete network. The University of Bath is studying composite reinforcement for the anchorage zones of prestressed beams, and are also working on beams loaded cyclically.

At Cambridge, in July, we will be holding the fifth in the series of biennial conferences on the use of Fibre Composites in Reinforced and Prestressed Concrete Structures (FRPRCS-5). Over 110 papers will be presented, describing completed and ongoing research in these areas from the UK, Japan, Europe, USA and Canada. There is a widespread belief in the UK that we are leaders in this field, but the reality is that there has been extensive work elsewhere, much of which is of direct relevance to the topics discussed above.

- Full details of the conference, which is sponsored by the IStructE, and arrangements for registration and accommodation, are at [www-civ.eng.cam.ac.uk/frprcs5.htm](http://www-civ.eng.cam.ac.uk/frprcs5.htm).

## REPORT

### Subsidence of low-rise buildings (2nd edition)

Originally published in March 1994, the 1st edition of this guide has been the authoritative reference on the subject, and has led to many improvements in the way claims are handled, both procedurally and technically. The 2nd edition is being published to reflect current procedures and contains more comprehensive advice on tree management.

While primarily aimed at Structural Engineers, the Guide is written for a wide readership including Mortgage Lenders, Consulting Engineers, Property Valuers, Insurers, Builders, Solicitors, Surveyors, Loss Adjusters, Local Authorities and property owners.

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