It has been fashionable and not altogether inaccurate to describe the US as an importer of Construction, outlines recent trends in the US construction market. Urban developments on the initiative for American-led world class developments.

Technological States

For many decades it has been fashionable – and not altogether inaccurate – to describe the United States as an importer of the so-called new technologies. These innovations typically refer to developments made in Europe and Japan in the fields of ground treatment, ground improvement and ground retention/structural support.

Such technologies were developed, usually be speciality geotechnical contractors, in response to the market needs associated with urban, industrial and infrastructure development and redevelopment. The years following 1945 have seen a massive growth in the construction of tunnels through and under heavily populated areas for utilities and transportation projects; construction of deep excavations in soils and in rocks; provide new foundation systems for existing structures threatened by new loading conditions (including seismic); in the improvement of marginal sites (natural and artificial) to accommodate subsequent urban, industrial or transportation facilities; and in the need to rehabilitate major hydraulic structures.

Hence one can identify the genesis of these 'new technologies' in Europe and the Far East, including:

●**For ground treatment:** several sophisticated grouting methods including jet grouting, compensation grouting and enhancements to more traditional permeation grouting methods. In addition, special attention has been paid to the QA/QC aspects of these techniques, and to developing the role of computer monitoring and data analysis; the growth of the mechanical mix-in-place method, of which Seiko's SMW (Soil Mixed Wall) method is typical.

●**For ground improvement:** refinements of the vibro techniques used for soil densification and stone columns; to extend applications into artificial materials and underwater situations; improvements in soil drainage and freezing methods, especially where applicable for large site preparation.

●**For ground retention and structural support:** routine use of permanent high capacity ground anchors as tiebacks and as tie-downs, development of new diaphragm wall equipment, such as the rock mill for use in low headroom conditions, or for deep walls through difficult soils and rocks; improved micropiling and soil nailing techniques; improved equipment and techniques for large diameter piles (caissons), high technical performance and QA/QC.

The demands of the US construction market have changed dramatically in recent years, and these changes have now created an urgent demand for these 'new technologies' previously noted. For example, major road arteries are being built *through* (and under) existing cities instead of just between them, as is the case with the work in Boston. In these same cities, mass transit schemes are being built (Los Angeles) or radically expanded (Washington DC, San Francisco) combined sewer overflow projects are being built (Los Angeles) or radically expanded (Washington DC, San Francisco) combined sewer overflow projects are being initiated (Milwaukee, Chicago), and urban sites and infrastructures redeveloped (New York). Such works must typically be undertaken in difficult ground (natural and artificial) with high water tables, through networks of existing underground services, and in proximity to (or under) existing structures whose existing foundations may not always be well known. In addition, of course, there are always the environmental and political challenges of conducting such works in the midst of large population centres with ponderous bureaucracies.

For all these reasons, a visitor to a typical large, older American city – on either seaboard – will now see the whole range of new technologies being practiced, just as two or three decades ago in London, Paris, Munich, Milan, Barcelona, Tokyo and Hong Kong.

Equally challenging have been the demands posed by the fear of major seismicity. While even marginally active areas have introduced seismic building codes into standard practice, the focus remains on the Pacific Coast and in the Lower Mississippi/Carolinas area. In the former, recent 'wake up calls' such as Loma Prieta and Northridge events have precipitated a massive retrofit program of thousands of transportation structures including both the Bay and Golden Gate bridges. So significant are the redesign

of new technologies in ground engineering. **Donald Bruce** of contractor Nicholson
on the seaboards and massive seismic retrofitting programmes, he predicts, are now providing

parameters that the limits of even the 'new technologies' are being challenged, in terms of unit size and capacity. Regarding new construction, both vibrodensification and vibro replacement techniques are standard on major projects from San Diego to Vancouver, and the benefits of compaction grouting are also being widely used for soil densification.

The major focus in the seismic south east is somewhat different, setting aside some major urban structural retrofits involving base isolation. Rather the major concern is the anticipated performance of numerous high embankment dams ownded by both Federal (US Army Corps of Engineers) and private (numerous utilities) bodies. Such dams may be over 50m high and thousands of meters long, and they cannot be drawn down. Instead, in situ remediation will be necessary to satisfy revised safety criteria. Generically, mitigation can be provided by desiccation, isolation, densification, increased cohesion, or in situ reinforcement. However, such remediations are extremely complex (and expensive) issues, and no one technique will always be 'the best choice'. This is in contrast to the ongoing programme of concrete dam repair which continues apace, with clear emphasis on post tensioned anchors, sophisticated grouting and new drainage systems. Seepage control under existing embankment dams is provided by grouting, diaphragm walls or overlapping large diameter pile cut-offs (eg Beaver Dam, Arkansas).

Demands of the US construction market have changed dramatically in recent years, and these changes have now created an urgent demand for these 'new technologies'

Gradually, with the new technologies, new approaches to procuring and administering complex geotechnical works are finally developing. For example, contractor design-build opportunities are becoming more frequent, wherein the consultant may actually work for the contractor. Additionally, more sophisticated bidding practices are becoming more common, permitting the contractor scope to leverage knowledge and experience, although cost remains usually the prime factor in making the award. The pragmatic concept of partnering is flourishing as the industry struggles to disassociate itself from the involvement of attorneys and the depressing familiarity of litigation.

These changes are dictating the need for a new breed of geotechnical speciality contractor – no longer just required to be a broker of men, equipment and materials tied to a restrictive 'cookbook' and a prescriptive specification. Instead, the European type of specialist is emerging, with higher tech profile and a problem solving attitude. It is no coincidence, of course, that such companies typically have European 'connections', which may range from full ownership to 'technical assistance' relationships. As a warning recent history has been strewn with the bones of foreign specialists who set up in the US without significant strong local ties.

The speciality geotechnical construction industry in the US may well have an annual value of $1billion - double that if piling is included. Traditional ways of doing business are changing in response to new technical demands and effective foreign input. It remains a very fragmented business, however, challenged by geography and shaped by keen competition at national, regional and local level. Within the next ten years, however, significant restructuring will occur and a new trend towards consolidation (by acquisition or inability to compete profitably) will result in fewer participants but each of considerable size, power and scope of service. The response of the current players in the next two years will shape the industry for decades, given the unique volatility of the current technical, contractual and management challenges.

One likely consequence will be that the US will become a net 'exporter' of technologies, building on expertise developed in problems whose scale and complexity will have surpassed those of the Old and Oriental Worlds.

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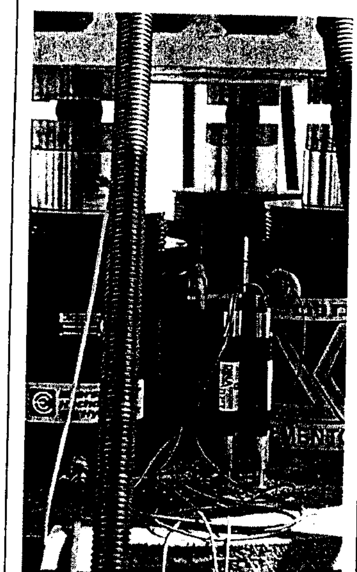
Cover and right: *Assembling the reaction load frame for Cementcal's 2200t static pile load test. (page 19). Photograph Paul Wheeler*



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