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NEWSLETTER

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One-Day Blast Workshop

Piroozan Aminosse reports on this successful event.

Following SECED's popular blast technical meeting in October 2005, which was a joint effort with the Institution of Structural Engineers North Thames Branch, the two organisations held another successful event, which was a one-day blast course in October 2006.

Our three lecturers were Professor Geoff Mays of Cranfield University, Dr Peter Smith of Cranfield

Contents

Figure 1 Lebanon, US Marine Corps HQ, Beirut Airport, West Beirut

University and Piroozan Aminossehe of SHAW, Stone and Webster. The course was run under the chairmanship of Piroozan Aminossehe.

The response from professionals and engineering companies was overwhelming and as a result 35 professionals attended the course.

The first lecturer was Dr Peter Smith who covered the analytical side of the subject including blast loading, blast modelling using Air3d, case history studies and the structural responses.

He started his lecture with blast modelling and with the Meyer's definition of an explosion: *"a chemical reaction or change of state effected in an exceedingly short period of time with the generation of a high temperature and generally a large quantity of gas. An explosion produces a shock wave in the surrounding medium"*.

Peter then went on to explain how blast loading could be represented using Air3d computer program.

In his case histories lecture, he provided ten examples and said that these examples were not necessarily the most recent or the most devastating examples of terrorist activity but had been selected to illustrate important different aspects of terrorist bomb blasts. Figures 1 and 2 show at a glance the terrorist explosion at the US Marine Corps HQ in Lebanon in 1983 and the devastation caused in the City of London in April 1992 and April 1993 by the Provisional IRA. On 23 October 1983, a truck entered the building and exploded. The truck contained 3600 – 5500 kg equivalent of TNT explosive material and left 241 dead and 61 wounded. The bomb detonated inside the building. Structures within a radius of 110m were heavily damaged, the damages within a radius of 170m were moderate and within a radius of 600m all glass was shattered.

In the City of London, both explosions occurred during the weekend when the City was not fully operational. The charge size was approximately 1000 kg ANFO (or equivalent) in both cases. The number of casualties was one dead in the 1992 incident and two dead plus a number of relatively minor injuries in the 1993 incident. Although the radius of damage was extensive and many building facades were breached, the modern framed structures remained generally intact and only one structure (a mediaeval church) was damaged beyond repair.

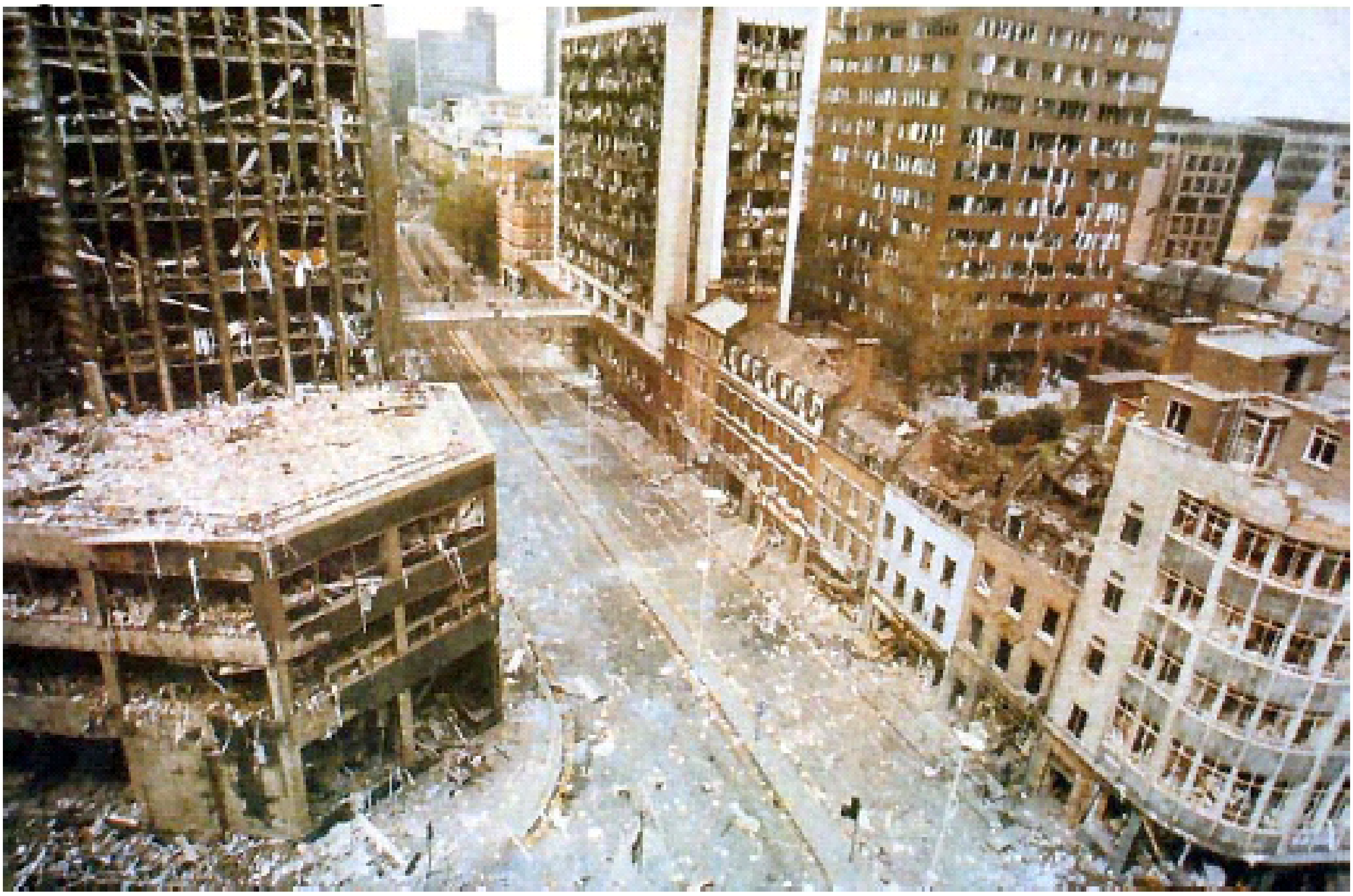

Figure 2 City of London – the financial district

He then went to the final stage of his lecture regarding the analysis of structural response to blast loading and said that in assessing the effect of a blast load on a structure the calculation of maximum responses is often sufficient for the designer instead of producing the history response of the structure. To establish the principles of this analysis, the response of a single degree of freedom (SDOF) elastic structure was considered and the link between the duration of the blast load and the natural period of vibration of the structure was established. This led to the concept of the 'impulsive' and 'quasi-static' response regimes and the representation of such response on pressure-impulse (P-I) diagrams. Examples of P-I diagrams for a particular class of building structure were then presented with the addition of a Range-Charge Weight (R-W) overlay to assist interpretation. The principles of analysis for an SDOF system were extended to specific structural elements, which could then be converted to equivalent lumped mass SDOF structures by means of 'load factors' and 'mass factors'. Total structural resistance could thus be represented by the sum of an inertial term (associated with the mass of the structure) and the so called "resistance function" (related to the structural geometries and material properties), which acted in opposition to the applied blast load.

The second lecturer was Professor Geoff Mays who covered the design side of the subject including an introduction to the principles of protective design and design of structural elements to resist blast loading.

He started his lecture with the terrorism activities in the UK by the IRA and pointed out that whilst engineers in Northern Ireland had been well acquainted with the effects of explosions on structures and developed guidelines to enhance building resilience, this matter had received no attention on the UK mainland until the campaign had been directed at the City of London in 1992.

He then said that after the catastrophic collapse of the Alfred Murrah building in Oklahoma in 1998, the USA government tends to address the abnormal load and progressive collapse more directly than model codes had done in the public sector.

During the first part of his lecture, he reviewed legislation in the UK, Europe and the USA and moved the discussion on to the concepts of physical security and stand-off towards reducing threat. The concept of an "optimal hardness range" was introduced in order to minimise the cost of structural hardening for a given threat scenario. Other protective measures associated with building arrangements including the protection of vital structural components and variations to the building arrangements and the need to protect humans from flying debris were discussed.

Figure 3 Progressive Collapse - Ronan Point, London, 1968

Geoff concluded part one of his speech by demonstrating the effectiveness of strengthening Federal buildings in the USA by giving the example of the resilience of the Pentagon on 9/11.

The second part of his speech focused on how to design structural elements to resist blast loading. He emphasised the role of the ductility and how flexural

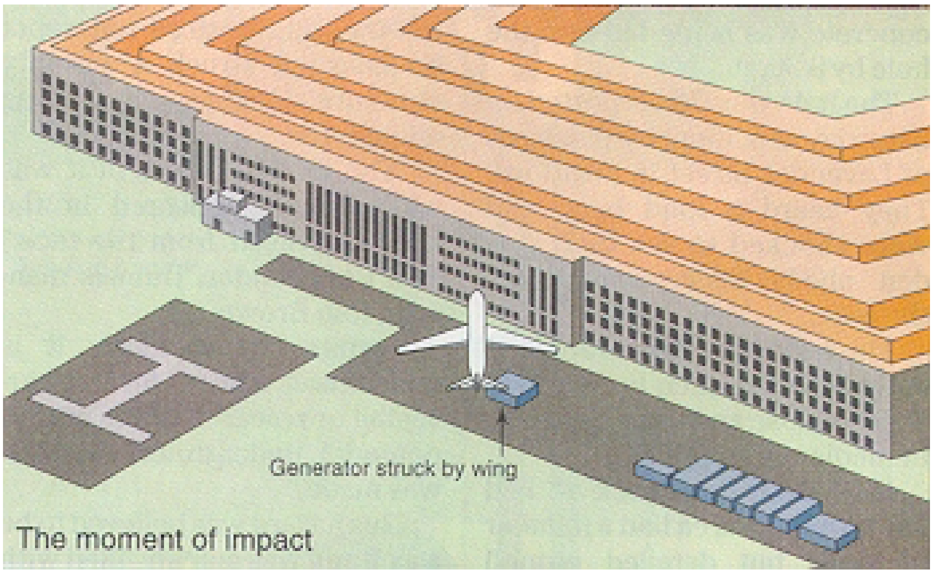

Figure 4 Structural Strength Saved Pentagon Lives on 9/11

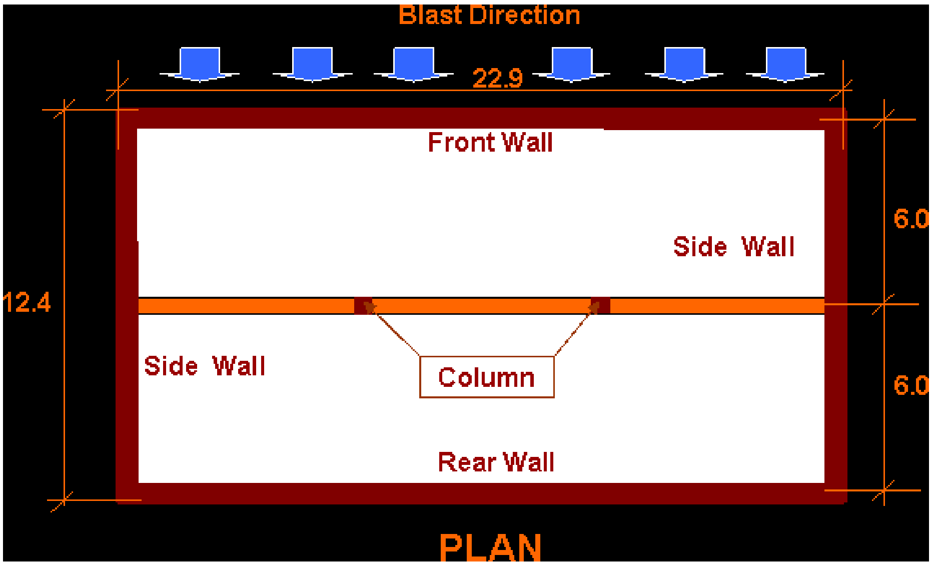

Figure 5 Coursework Example

ductility should be utilised to enhance the strength of structures without the risk of premature failure due to brittle behaviour or local instability.

He then discussed the application of the energy balance method for elements subjected to impulse loading and pointed out this method is not applicable when the structure is subjected to dynamic loading.

He concluded his lecture by illustrating his lessons through a number of examples.

Piroozan Aminossehe was the third and the last speaker. In his lecture, he covered a practical example through a workshop session.

The example was a sample blast design for a scaled down typical control building of a petrochemical complex using in-situ reinforced concrete and American codes, ASCE and ACI.

He pointed out that, although ASCE was mainly used for the petrochemical industry, the method of analysis and design used there was also applicable for other types of structures, including those structures used in the nuclear industry.

The differences between the application of the method for nuclear and petrochemical structures were also pointed out during the workshop.

The structure was a reinforced concrete box consisting of four external walls and a roof slab, which was supported by the main beam and external walls, with the main beam being supported by two columns and side walls.

The design proceeded component by component. Each component was designed as an independent uncoupled structural member.

Figures 5 and 6 show the plan of the structure and the applied blast loading respectively.

The course was concluded with a Q & A session in which the participation of audience was particularly enthusiastic and the session was ended with the applause of the audience.

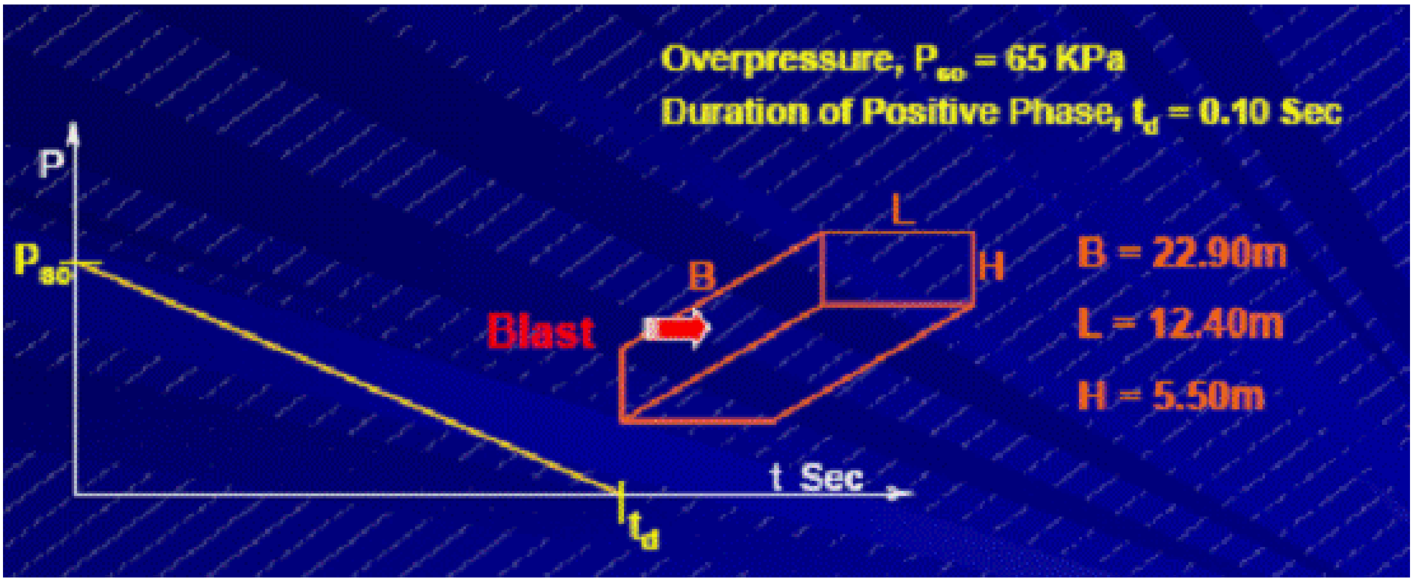

Figure 6 Applied Free Field Blast Wave

Monitoring Millimetric Ground Movements from Space

The European Space Agency's GMES Terrafirma Project by **Chris Browitt** (1), **Alice Walker** (1), and **Mustafa Aktar** (2)

(1) European Mediterranean Seismological Centre, 91680 Bruyeres-le-Chatel, France cbrowitt@staffmail.ed.ac.uk
(2) Kandilli Observatory, KOERI, Istanbul, Turkey, aktar@boun.edu.tr

INTRODUCTION

Synthetic aperture radar interferometry (InSAR) has been available to us for over a decade, providing ground deformation data at cm precision. In the past 5 years, however, new ways of processing satellite radar images have been developed (Ferretti et al, 2001) that allow ground movements to be mapped and monitored down to 1 mm per year, over wide areas; thereby opening up new opportunities for practical applications.

In Figure 1, early results of this breakthrough by Tele-Rilevamento Europa (TRE), show a number of striking ground movement features over a 5-year period; a result which also illustrates the value of ESA's archive of radar scenes stretching back to 1992.

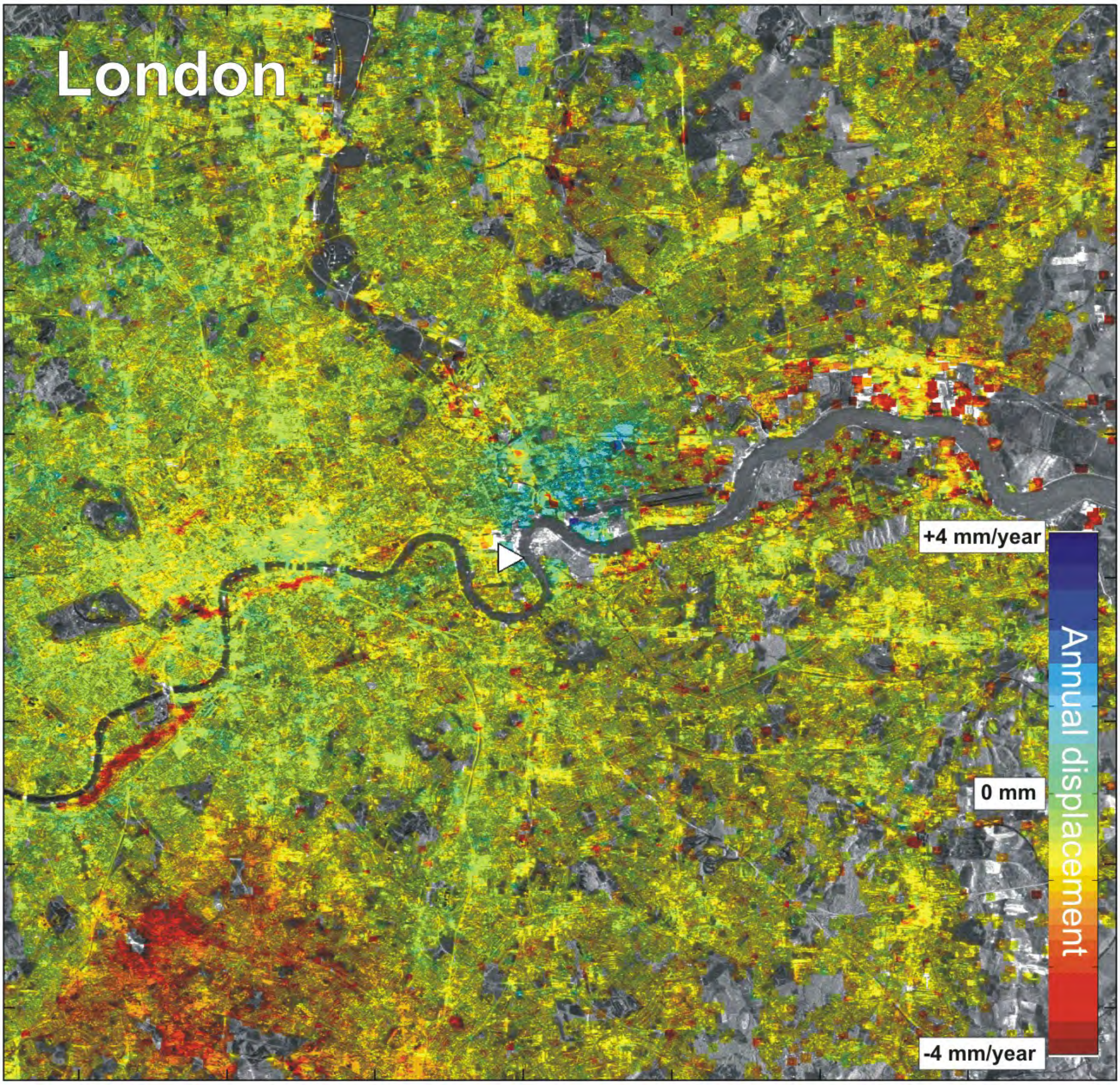

Figure 1 Interpolated permanent scatterer InSAR (PSI) image of a 900 km^2 area of London. (Red indicates subsidence, blue indicates ground heave). (**Courtesy of NPA and TRE**).

In this PSI image of London, the average number of PS points used is greater than 200 per km^2 over the 5-year study period, 1995-2000.

The blue patch indicates ground heave of 2mm/yr where paper making, printing and brewing industries withdrew 30-40 years ago ending groundwater abstraction. Groundwater flooding of basements has been noted following the recharge.

In the bottom left, parts of the Streatham area are subsiding around 3mm/yr, correlating with a lowering of the water table. Above this red patch, a SW-NE linear feature is subsidence over an electricity tunnel.

Above that, a red ribbon, W-E crossing the River Thames, follows the recent extension of the London underground. At 3mm/yr, this was a level of subsidence predicted by engineers and monitored on the ground by them over the 5 yrs.

Further down the Thames to the East, small patches of subsidence are observed along the river banks in the old docks area, which is being developed and renewed extensively. Concern is whether local subsidence increases flood risk, the greatest risk to London in the face of climate change and the possible tilting downwards of SE England. Further studies of these areas have been prompted by the PSI result.

GMES TERRAFIRMA RATIONALE

The GMES Terrafirma project, sponsored by the European Space Agency, and initiated and managed by Nigel Press Associates (NPA) proposes to deliver a ground movement hazard information service for Europe, based on this new technology. The presentation of this paper is aimed at informing specialists, planners and the community at large about the new approach to the assessment of risks from ground movements across Europe and beyond (including, subsidence, landslides, compressible soils, earthquake vulnerability, mines and engineered excavations). It will achieve this through practical examples of how ESA's radar satellites, 800km up in space, can create data that, when coupled with expert knowledge, and ground-based geoscience and engineering information, provides insights into these problems at a level of detail which was technically unprecedented until now. Few cities and towns are without ground movement risks, and Terrafirma is focused on urban areas where its services can have the greatest impact in leading to a safer, less vulnerable environment, free from the massive economic losses which are impacting on our societies at present. In Italy, alone, the cost from landsliding is estimated to be between €1 and 2 billion, annually.

As we continue to become a more urbanised society, often with construction spilling onto marginal land, the problem worsens, and the need for policy-makers, planners, engineers, and the public, to be better informed, is heightened. Innovative approaches are needed, and this is the niche that GMES Terrafirma is filling.

Within two years, every European Union country will have at least one city with satellite radar coverage processed to reveal small ground movements of around 1 millimetre per year. Landslide sites will also be examined. That information will be in the hands of national geoscience centres and engineers for expert interpretation utlilising their own data and expertise. They, in turn, will engage with the relevant authorities in their countries to ensure take up, and action on the hazards which will be seen in great detail and, in many cases, for the first time. It is intended that these national cities will lead to national initiatives for further studies across each country, and that the examples will be shared across borders to ensure that the community of Europe benefits from the experience of its collective experts and from our European Space Agency's investments in leading edge technology for practical purposes.

GROUND VULNERABILITY MAPPING

Since Terrafirma started in 2003, radar satellite data for many cities, from Dublin to Haifa and Moscow to Sofia, have been used to map their ground movements, exploiting the 14-year archive of raw information now held by the European Space Agency. Within this project, a particular focus has been Istanbul with its great heritage of buildings, its 10 million population and its vulnerability to large earthquakes. The city has a long historical record of earthquake damage related to the well known North Anatolian Fault that passes only a few tens of kilometres away beneath the Sea of Marmara. During the last 5 centuries, at least 8 earthquakes with magnitudes greater than 7.0, have occurred close to Istanbul causing high casualties and damage. In 1912 and in 1999, two earthquakes ruptured both ends of the Marmara Sea, leaving the central submarine section as the most likely one to slip within coming decades. Recent studies show that the probability of an earthquake of magnitude greater than 7.0 affecting Istanbul within the next 30 years is now 53%, taking into account stress transfer from the Izmit earthquake of 1999.

Rapid growth of the population (a ten-fold increase in the last 50 years) has resulted in the production of a large volume of building stock within a limited time period, often not compliant with the required quality standard. It is estimated that about 65% of the total building stock does not satisfy the present earthquake regulation code.

Stimulated by the Izmit earthquake, a considerable effort is being devoted to the assessment of the risk in the urban areas including the compilation of inventories of the built environment. Istanbul Metropolitan Municipality has taken the initiative for an extensive microzonation project, which will

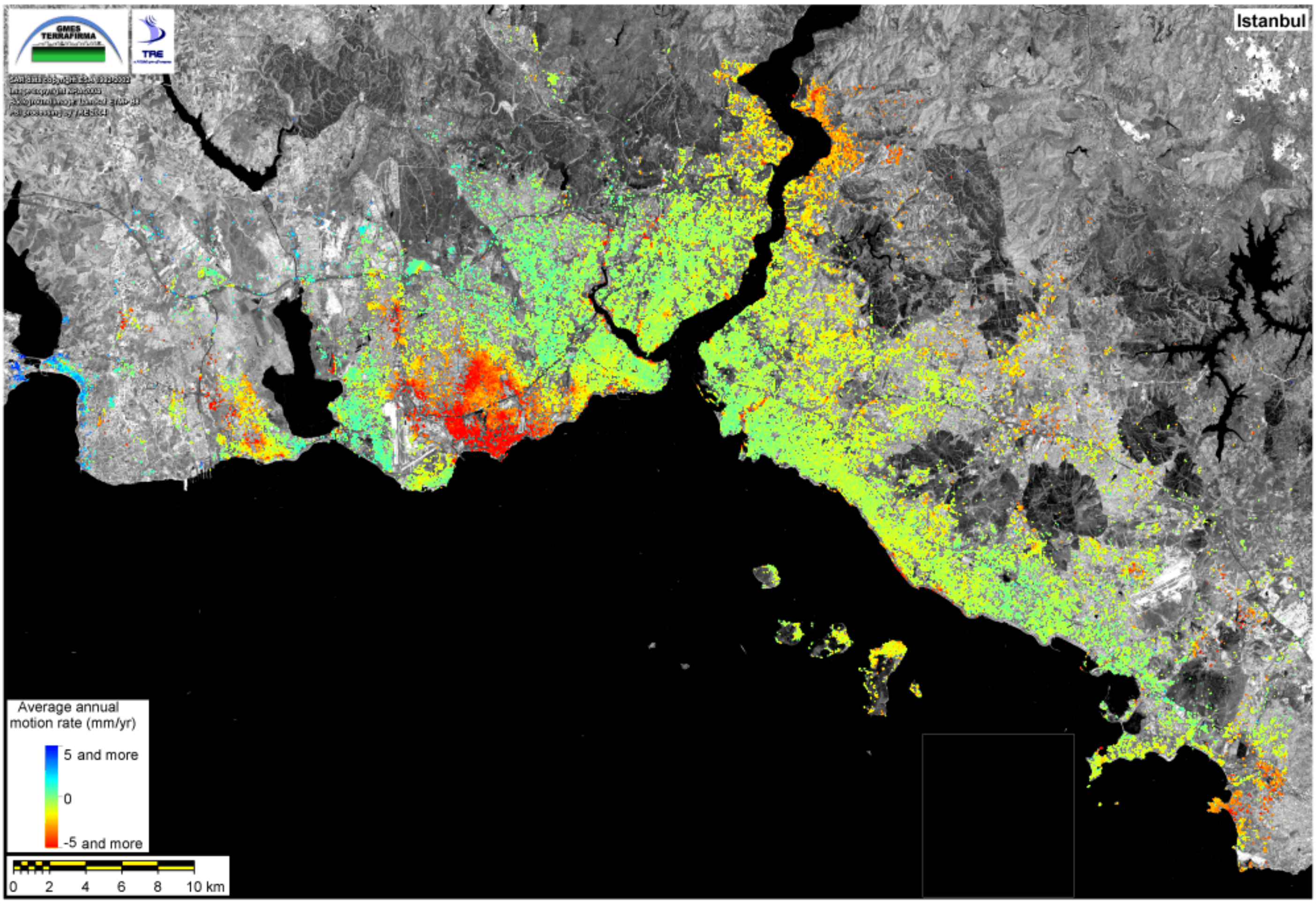

Figure 2 – Effective Subsidence Map of Istanbul. (Derived from PSI data, with green showing stability, through yellow, to high subsidence areas in red). (**Courtesy of TRE and Terrafirma**).

eventually cover the entire metropolitan area. Satellite and ground-based techniques will be integrated, including a drilling campaign and the PSI results produced by GMES Terrafirma.

The new PSI studies have yielded a subsidence map (Figure 2) giving first-hand evidence of the high degree of spatial variability of the ground conditions throughout the urban area of Istanbul. The data from 13 years of observations not only show the general trends that correlate well with the local geology but also help to reveal other characteristics at a smaller scale which would otherwise remain undetected.

This subsidence map covers a large area of 50x30 km, and shows a striking pattern that supports the existence of a widespread subsidence on the western part of the city (red coloured area in contrast to the green ones that are stable). This corresponds to the areas that were rapidly urbanised during the last two decades on the smooth topography of young sedimentary ground cover.

In contrast, the eastern part of the city, which includes the historical part, is located mostly on solid rock, and is generally stable. Within it, however, there are critical localised zones revealed by the PSI study (see below and Figure 3).The average subsidence of 2-3 mm/year detected in the western part, is probably due to consolidation and compaction triggered by extensive water pumping activites that are well documented by local municipalities. This subsidence is a clear sign of the presence of unconsolidated soft sediments which cause high amplification factors for seismic ground motion. In fact, much of the destruction caused by the Izmit earthquake was concentrated in the western part of the city, even though the earthquake was well to the East. This emphasises the importance of understanding ground conditions and vulnerability for earthquake loss mitigation and risk assessment.

The eastern part of Istanbul, including the ancient city, is located mostly on hard rock, and the PSI study shows subsidence only on a very local scale. It picks out ancient riverbeds and coastal fills (Figure 3). Ancient riverbeds are abundant since the region has experienced sequences of rapid uplift and inundations during the recent geological past, leaving behind deep and narrow gorges filled alternately with coarse gravel and sand. These narrow riverbeds are barely reflected in the actual topography, and in most cases are completely hidden below the modern city development. A similar situation exists for coastal formations such as the ancient estuaries and bays that were filled

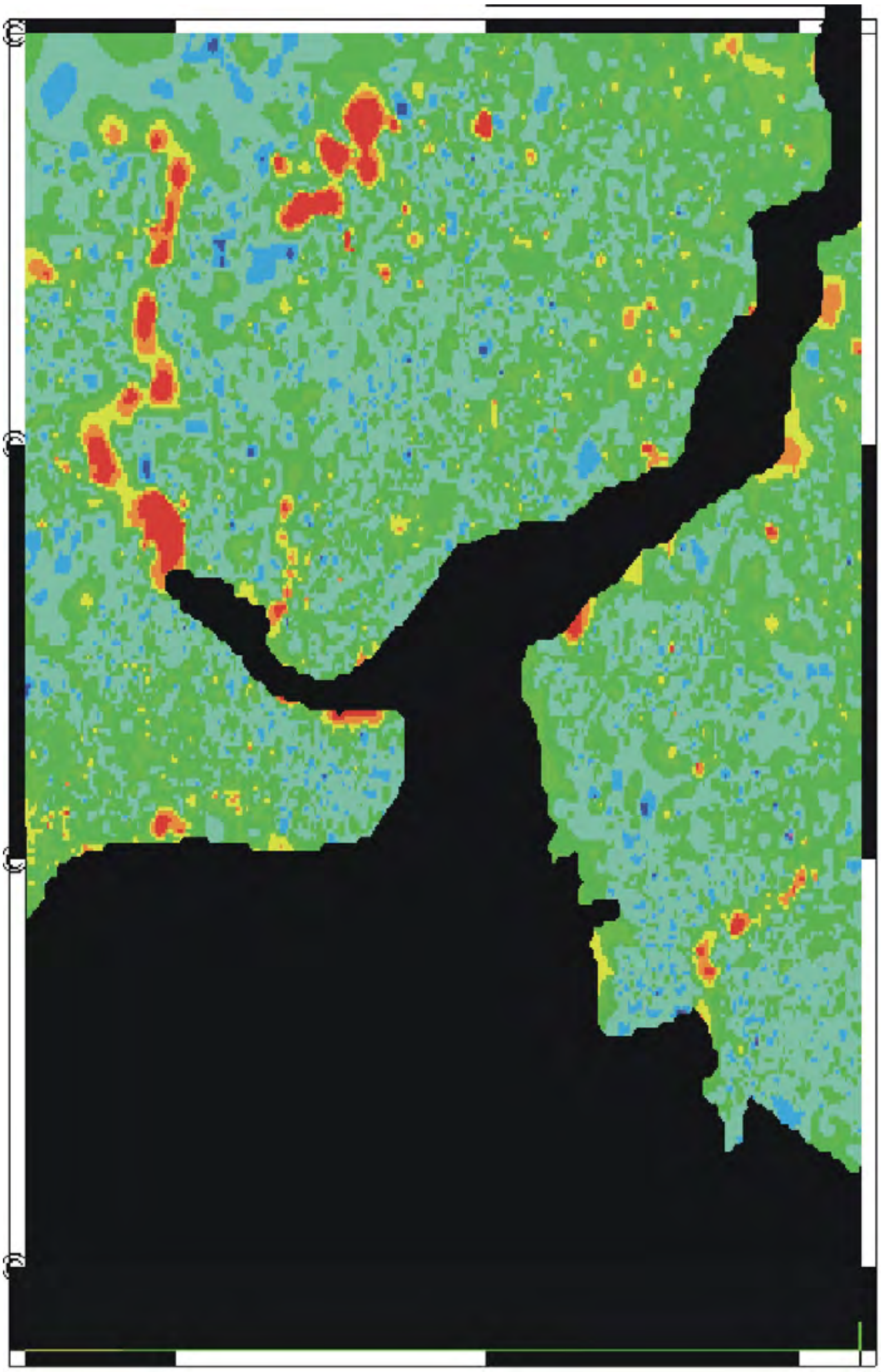

Figure 3 – Detail of PSI subsidence data (red) which reveals vulnerable soft foundation geology in the ancient river channels and coastal embayments of Istanbul. (**Courtesy of TRE and Terrafirma**).

with sediments over time, both naturally and artificially. In fact, the coastline of the ancient city was not at all a linear one as it appears today but a rugged one with small ports and harbours, as can clearly be seen in XVIth century engravings.

CONCLUSIONS

The European Space Agency's GMES Terrafirma project is yielding examples, across the European-Mediterranean region, which show the dramatic contribution that PSI can make to understanding ground movements and vulnerability that pose threats to our urban communities.

The potential for extensive mapping and follow-up monitoring, over wide areas at low cost, is a breakthrough which can make a difference to reducing risk through planning and mitigation measures, when coupled with surface-based geological and engineering expertise, and data.

This paper has illustrated a number of applications in relation to tunnelling, groundwater and earthquake vulnerability; others include landslides and mining.

ACKNOWLEDGEMENTS

The authors would like to thank the Terrafirma Project Core Team, led by the Nigel Press Associates (NPA), Tele-Rilevamento Europa (TRE) for the PS processing, and the European Space Agency (ESA) for its sponsorship of the project and its radar satellite data.

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www.terrafirma.eu.com

Seismic Response Spectra for the Design of Nuclear Facilities

Prompted by the Q&A session at SECED's September 2006 meeting, "Earthquake Engineering in the 21st Century", **Andrew Coatsworth** from HMNII seeks to set the record straight.

There appears to be a mistaken belief amongst some engineers that HMNII does not accept the principle of Uniform Hazard Spectra (UHS), but requires the PML piecewise linear spectra (PLS) to be used.

It may be useful to set the record straight, to comment on the relative significance of the issue of spectra, and to indicate what the UK nuclear industry needs to do if it wishes, despite the relative significance, to advance from the PML PLS.

HMNII recognizes the PML PLS to be based on dated technology and on data, which could now be replaced with more and better data. That is not to say that changes in the science necessarily mean that the PML PLS is not a good standard.

HMNII does not set design standards to be used for nuclear facilities. HMNII accepted the principle of UHS at least 13 years ago (eg Reference 1). I re-iterated this at the BNES/SECED Symposium in 2004, as reported in the SECED Newsletter (Reference 2). However, HMNII has reservations about the UHS actually submitted as part of nuclear safety cases to date.

Moreover, HMNII is not convinced that resolution of these issues is the most effective means for the UK nuclear industry to reduce any excessive conservatism in its earthquake engineering.

The PML PLS is not onerous compared to other spectra used internationally, including across the Channel. In those cases where the seismic capability of non-seismically designed nuclear structures in the UK has been determined using high confidence of a low probability of failure (HCLPF) methods, the vast majority of structures have been found to withstand 0.25g PML PLS with ALARP improvements almost entirely limited to issues of anchorage etc of the contained plant. If non-seismically designed structures can be shown to reasonably withstand seismic loading as defined in the PML PLS, then the appropriate use of performance based design methods should enable reasonably economic design, even with the higher confidence expected of design as distinct from assessment.

For the most part the UK nuclear industry chose not to adopt these HCLPF methods for the assessment of its existing structures, but mainly to use elastic analysis with evaluation of capacities based on design codes. Unsurprisingly the resulting seismic capacities have appeared low. The industry has seen engineering seismology, rather than more realistic methods of assessment, as the solution.

The science of seismology has produced about 150 intensity scales in as many years, but engineers require in design data either stability or sufficient conservatism as to accommodate changes in design basis over the lifetime of a facility. At the SECED meeting on 27 September 2006 Prof Bommer mentioned that ground motion studies made now would appear dated in 10 years time. However, nuclear facilities with perhaps a 50 year design life must be demonstrably safe throughout their lives, and this requires robust design data to be used. The changes over the last 50 years in UK codes and standards concerning wind loading - perhaps a more exact science than earthquake ground motions at present - are a salutary lesson to those who urge HMNII acceptance of the latest trends in design spectra. I sometimes cite live floor loadings and the HB loading vehicle for highway bridges as loads, which have little substance in reality, but over the years have proved to be useful concepts.

For all their recognized technical flaws the PML PLS have a pedigree that should not lightly be discarded:

- The PML PLS have been thoroughly reviewed;
- They were examined at the Sizewell B Public Inquiry;
- They have been scrutinised internationally by the European body developing criteria for a Light Water Reactor (LWR), which recommended they be developed for any future European LWR (Reference 3);
- They compare closely with the Eurocode 8 horizontal Type 2 (relevant for the UK) spectra (see Figure 1).

Regarding the last point, there is no reason to believe either the Eurocode or the PML PLS to be 'correct'. Indeed, Reference 4 notes that both may underestimate loads for soft soils in regions of low to moderate seismicity, such as the UK. However, to adopt spectra, such as the UHS that HMNII has so far received, which are less demanding than those of the Eurocode spectra, would be a bold move for nuclear facilities.

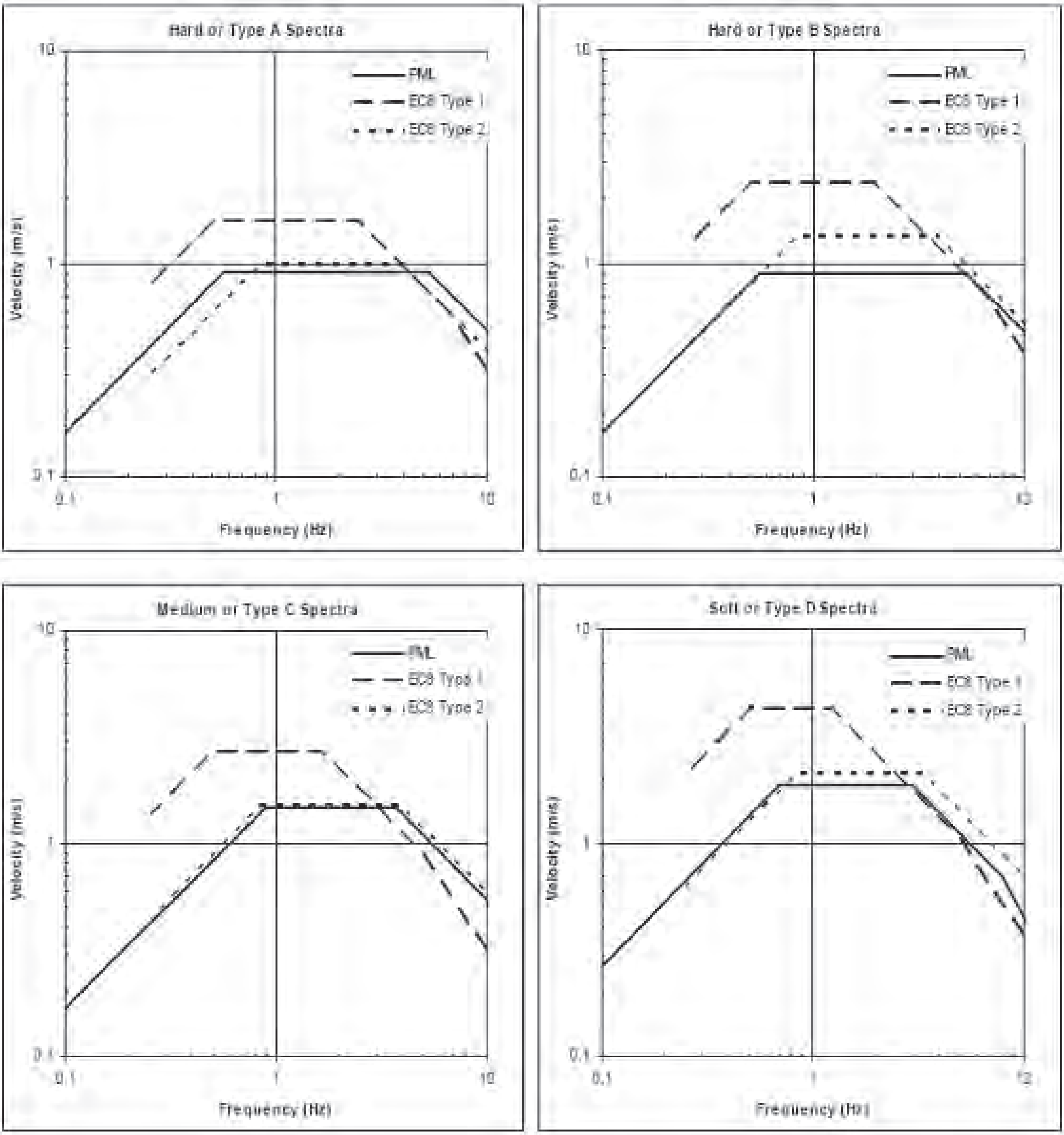

Figure 1: Comparison of normalised PML PLS and Eurocode 8 horizontal spectra.
(**Reproduced by courtesy of Arup**)

Mr Edmund Booth [speaker at the September 2006 meeting] cited Sir Isaiah Berlin's interpretation of the fragment by Archilochus (7th-century b.c.e.) The fox knows many things, but the hedgehog knows one big thing, and suggested that earthquake engineers needed to be foxes. Similarly Reference 5 took a wide-ranging view of earthquake resistance and noted that "the emphasis of the nuclear industry in seismic research for 20 years has been on attempting to reduce the design basis seismic hazard, which in the end remains uncertain. A better balance would devote more effort to understanding seismic performance, where there are real gains to be achieved."

If the industry nonetheless wishes to advance from the PML PLS, eg for the construction of new nuclear facilities in a few years time, it needs to:

- work with a multi-disciplinary expert team working to the rigours of the original Seismic Hazard Working Party;
- additionally include consideration of the engineering design process;
- show that the resulting deterministic design process will result in a design which meets the overall risk targets;
- subject the outcome to Independent Nuclear Safety Assessment.

Such a comprehensive study would be necessary to produce seismic design ground motions sufficiently robust to withstand close national and international scrutiny without being vulnerable to growing knowledge over the next several decades. Importing technical methodologies used elsewhere, but without the full range of disciplines and management of uncertainty is unlikely to withstand rigorous assessment. Detailed design of proposed nuclear facilities that seek to deviate from the established practice of the PML PLS are otherwise undertaken at considerable commercial risk.

HMNII is not inflexible, but does require a robust demonstration of safety - the public expects nothing less.

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The Eleventh Mallet-Milne Lecture

Saving Lives in Earthquakes: Successes and Failures in Seismic Protection Since 1960.
By **Robin Spence**, Cambridge University, 30th May 2007 at the Institute of Civil Engineers, London.

This will look at what we have and have not achieved in reducing the risks to human life from earthquakes in the last 50 years. It will review how success has been achieved in a few parts of the world, and consider what needs to be done by the scientific and engineering community globally to assist in the future task of bringing earthquake risks under control.

The first part of the talk will re-examine what we know about the casualties from earthquakes in the last 50 years. The second part will look in more detail at what has been achieved country by country. The final section of the talk will argue that it can be useful to view earthquake protection activity as a public health matter to be advanced in a manner similar to globally successful disease-control measures.

No charge to attend. Seats allocated on a first come, first served basis. Informal reception follows the lecture. Tickets are available in advance at a cost of £10. See www.seced.org.uk for more information.

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NOTABLE EARTHQUAKES JULY - AUGUST 2006

Reported by British Geological Survey

YEAR	DAY	MON	TIME UTC	LAT	LON	DEP KM	MAGNITUDES ML	MB	MW	LOCATION
2006	**3**	**JUL**	**14:52**	**52.64N**	**1.88W**	**8**	**1.6**			**WALSALL**
2006	**3**	**JUL**	**15:17**	**56.87N**	**5.19W**	**4**	**1.5**			**LOCH EIL**
2006	**8**	**JUL**	**20:40**	**51.21N**	**179.31W**	**22**			**6.6**	**ALEUTIAN ISLANDS**
2006	**9**	**JUL**	**21:09**	**56.16N**	**4.90W**	**2**	**1.5**			**LOCHGOILHEAD**
2006	**17**	**JUL**	**08:19**	**9.25S**	**107.41E**	**34**			**7.7**	**JAVA, INDONESIA**
At least 665 people killed, another 9,275 injured, around 1,623 buildings either destroyed or damaged, over 870 boats destroyed and many roads damaged in Jawa Barat and Jawa Tengah. All deaths and damage were as a result of a tsunami that was generated, with maximum wave heights of 4.6m, recorded at Widarapayung.										
2006	**22**	**JUL**	**01:10**	**28.00N**	**104.14E**	**56**		**5**		**SICHUAN, CHINA**
A landslide in Yanjin County killed 22 people and injured 106 others.										
2006	**29**	**JUL**	**00:11**	**37.26N**	**68.83E**	**34**			**5.6**	**TAJIKISTAN**
Three people (all children) killed, 19 injured and over 1,900 houses either destroyed or severely damaged in the Qumsangir District.										
2006	**7**	**AUG**	**22:18**	**15.78S**	**167.80E**	**141**			**6.8**	**VANUATU ISLANDS**
2006	**14**	**AUG**	**16:40**	**51.09N**	**3.01W**	**6**	**1.9**			**BRIDGWATER**
2006	**18**	**AUG**	**20:45**	**63.36N**	**0.88W**	**20**	**3.8**			**NORWEGIAN SEA**
2006	**20**	**AUG**	**03:41**	**61.03S**	**34.37W**	**10**			**7**	**SCOTIA SEA**
2006	**24**	**AUG**	**21:50**	**51.15N**	**157.52W**	**43**			**6.5**	**KAMCHATKA**
2006	**25**	**AUG**	**00:44**	**24.41S**	**67.03W**	**184**			**6.6**	**ARGENTINA**
2006	**25**	**AUG**	**05:51**	**28.01N**	**104.15E**	**22**		**5.2**		**SICHUAN, CHINA**
One person killed, 31 injured and several buildings destroyed due to landslides in the Doushaguan and Yangin areas.										
2006	**29**	**AUG**	**16:05**	**56.49N**	**4.38W**	**12**	**1.9**			**KILLIN**
2006	**1**	**SEP**	**10:18**	**6.76S**	**155.51E**	**38**			**6.8**	**PAPUA NEW GUINEA**
2006	**4**	**SEP**	**15:47**	**54.64N**	**3.08W**	**6**	**2.2**			**KESWICK**
2006	**26**	**SEP**	**19:34**	**52.04N**	**3.14W**	**19**	**2.1**			**HEREFORD**
2006	**28**	**SEP**	**06:22**	**16.59S**	**172.03W**	**28**			**6.9**	**SAMOA ISLANDS**
2006	**29**	**SEP**	**13:08**	**10.88N**	**61.76W**	**53**			**6.1**	**TRINIDAD**
Three people injured in the Port-of-Spain area and several buildings damaged on Tobago and in California, Trinidad.										
2006	**29**	**SEP**	**18:23**	**10.81N**	**61.76W**	**52**			**5.5**	**TRINIDAD**
One person killed in Gasparillo, Trinidad.										

Issued by: Davie Galloway, British Geological Survey, November 2006.
Non British Earthquake Data supplied by: The United States Geological Survey.

International Symposium on Seismic Risk Reduction

26-27 April 2007 at Romanian Academy, Bucharest, Romania.

The first day will be devoted to the presentation of the results of JICA project, and the second day will contain presentations from contributors. Participation is free.

For further information visit: http://cnrrs.utcb.ro/issrr2007/issrr2007.html

Forthcoming Events

28 March 2007
Using base isolation to increase the safety of structures in seismic areas: recent projects and code developments.
ICE 6.00pm

25 April 2007
AGM and This Year's Earthquake

26 and 27 April 2007
International Symposium on Seismic Risk Reduction. The JICA Technical Cooperation Project in Romania.
Romanian Academy, Bucharest, Romania.

30 May 2007
The 11th Mallet-Milne Lecture: Saving lives in earthquakes: successes and failures in seismic protection since 1960. By Robin Spence, Cambridge University.
ICE 6.00pm

SECED Newsletter

The SECED Newsletter is published quarterly. Contributions are welcome and manuscripts should be sent on a PC compatible disk or directly by Email. Diagrams, pictures and text should be in separate electronic files.

Copy typed on paper is also acceptable. Diagrams should be sharply defined and prepared in a form suitable for direct reproduction. Photographs should be high quality (black and white prints are preferred). Diagrams and photographs are only returned to the authors on request.

Articles should be sent to:

John Sawyer,
Editor SECED Newsletter,
c/o The Secretary,
SECED,
Institution of Civil Engineers,
Great George Street,
London
SW1P 3AA, UK.

E: john.sawyer@projectservices.com

SECED

SECED, The Society for Earthquake and Civil Engineering Dynamics, is the UK national section of the International and European Associations for Earthquake Engineering and is an affiliated society of the Institution of Civil Engineers.

It is also sponsored by the Institution of Mechanical Engineers, the Institution of Structural Engineers, and the Geological Society. The Society is also closely associated with the UK Earthquake Engineering Field Investigation Team. The objective of the Society is to promote co-operation in the advancement of knowledge in the fields of earthquake engineering and civil engineering dynamics including blast, impact and other vibration problems.

For further information about SECED contact:
The Secretary,
SECED,
Institution of Civil Engineers,
Great George Street,
London SW1P 3AA, UK.

SECED Website

Visit the SECED website which can be found at http://www.seced.org.uk for additional information and links to items that will be of interest to SECED members.
Email: webmaster@seced.org.uk