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Useful Structures
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Rugby
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5th October 2007

Dear Stephen

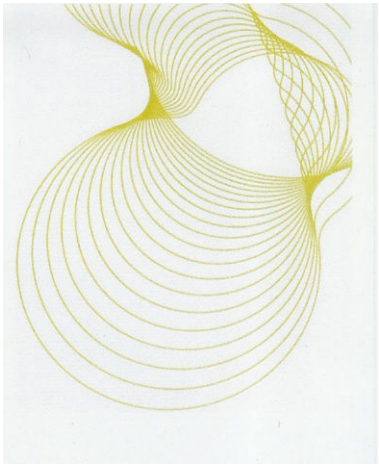
Demountable Structures

About BRE and the Author: Details of BRE and the author are provided in Appendices A and B respectively. To summarise this information: BRE provides its Clients with independent, authoritative advice upon all aspects of buildings and building design. The author has had over 20 years of experience of wind engineering and is a recognised expert in this field.

Scope of BS6399 Part 2 1997: The scope of this British Standard covers land-based buildings and components thereof located in the UK. The scope does not cover buildings that are more than 300m in height, nor does it not apply to buildings which are particularly susceptible to dynamic excitation. Providing any building complies within this scope, BS6399 gives methods for determining the gust peak wind loads.

With regards to site location, BS6399 takes into account the overall variation of windspeed across the UK, effects of the height of the site above the ground, the surrounding topography (e. hills, cliffs), and the effect of upstream surface roughness. All of these parameters affect the windspeed, and a structure must be designed to withstand the effects generated by the local wind. Each location must be individually (e.g. by post-code), considered and the structure designed according to the local wind conditions at that location. Note that this means that a istructure designed for one part of the UK is not necessarily suitable for other UK locations without fresh consideration.

UK Building Regulations: Building regulations apply to all buildings erected in the UK, save for specific exemptions contained in a schedule attached to the regulations. There are differences between the Building Regulations for England and Wales, Scotland and Northern



Ireland. Nevertheless, under current provisions, most temporary buildings which remain on site for less than 28 days are exempt from Schedule 2 of the UK Building Regulations. Hence Schedule 2 applies to all buildings remaining on site for 28 days and longer.

Relevance of BS6399: For reasons given below, BS6399 Part 2 is the only UK wind loading Code of Practice that should be used to calculate the wind loads.

The value of the gust wind speed used to calculate the wind loads according to B86399 depends upon a large number of site-dependant variables (such as topography, altitude, surrounding fetch, distance from sea, etc). These variables need to be assessed at each site location.

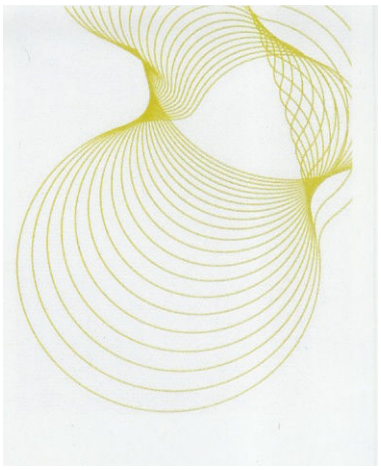
CP3 and Wind Loading Codes Before BS6399: BS6399 Part 2 supersedes CP3: Chapter V, which has since been withdrawn. CP3 was developed at a time before a fully probabilistic approach to wind engineering had become established. In the drafting of BS6399, a number of anomalies needed to be corrected, and the results from the latest parametric wind tunnel investigations were incorporated.

References to 'Euronorms': In the UK, buildings can not presently be designed according to any Eurocodes. This is because not all of the National Annexes (which contain information required to design UK buildings) have been published. For the purposes of compliance with UK Building Regulations. there are no European methods for wind loading calculation that can be used in the UK. Note that using foreign wind loading Codes of Practice to design buildings in the UK will not necessarily produce a safe design. This is because the UK tends to have higher windspeeds than mainland Europe. and factors of safety may not be consistent with the UK approach.

Potential Risks: It is recommended that BS6399: Part 2 is the UK wind loading Code of Practice that is used for the wind loading design of all buildings in the UK. This Code has been designed with great care to ensure that buildings designed to withstand these wind loads are both safe and economic. Before the Code was published, a number studies and calibration exercises were undertaken to ensure that the Code gives design values that meet these aspirations.

Note that British Standards are not mandatory, and using them does not confer immunity from legal obligations. However, if a building is not designed according to BS6399. insufficient strength in the structural design could result in failure or permanent deformity of structural members. The public liability insurance of a professional engineer, specifier or purchaser undertaking such an activity is likely to be prohibitive.

It is understood that structures are being designed according to 'Euro-Norms', 'NV French Standards', 'DIN Standards', and using other methods. For the reasons noted above, these



other methods may not be appropriate for the UK wind conditions, and therefore using such methods could produce unsafe structures. If such methods are used, they should demonstrate that the wind loads calculated exceed the loads calculated according to BS6399.

If the above demonstration is not undertaken. then such a structure could be underdesigned. In this situation the building or structure would fail structurally at a lower windspeed than had the structure been designed according to BS6399.

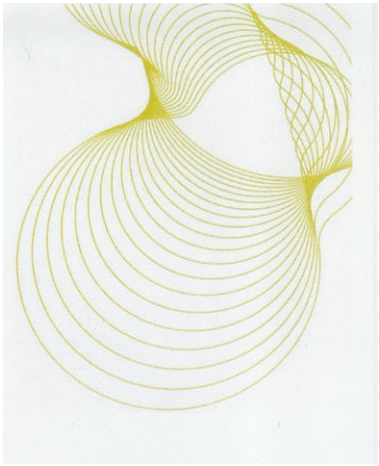
Should a structural failure occur and it is demonstrated that a) the structure was under designed to meet the UK wind conditions, or b) that the UK wind loading Code of Practice was not used for whatever reason, the liability and costs for damages/injuries/fatalities are likely to be awarded against the designers of that structure.

BS6399 Calculations. On behalf of Useful Structures, I was commissioned to consider wind loads on structures which were calculated according to the BS6399 methodology. Using calculation notes supplied by Useful Structures, I have checked in detail both the methodology and the calculations for the following products, and I confirm that the wind loads acting on the products comply with the BS6399 methodology.

- REVOLUTION (also referred to as ALPHA)
- PROSTOCK ALU (also referred to as BETA)

Yours sincerely

Gordon Breeze
Senior Consultant
For and on behalf of BRE Telephone: +44 (0) 1923664585 Email: BreezeG@bre.co.uk



Appendix A - About BRE

BRE is the UK's leading centre for research and consultancy on:

- *construction quality, process and productivity*
- *environmental impact of construction, sustainability and whole-life performance energy efficiency of buildings*
- *renewable energy in buildings*
- *certification*
- *aircraft cabin environments*
- *building performance - structures, materials and systems*
- *prevention and control of fire*
- *risk science*

A complete review of BRE's services can be found on BRE's website at www.bre.co.uk.

BRE is committed to making its comprehensive expertise and experience available to the benefit of those involved in the construction and associated industries, from multinational companies and government departments to individual architects and builders. It does this through:

- *commissioned research, development and testing programmes for individual clients and consortia,*
- *consultancy and advice*
- *product testing for certification purposes*
- *Best Practice programmes (e.g. Energy Efficiency; Construction Best Practice)*
- *publication of BRE Digests, Good Building Guides, Good Repair Guides, research reports, books,* e_ .
- *conferences, seminars, workshops and other events*
- *training*
- e-commerce activities (including BRE's on line bookshop at *www.BREbooksho/J.com)*

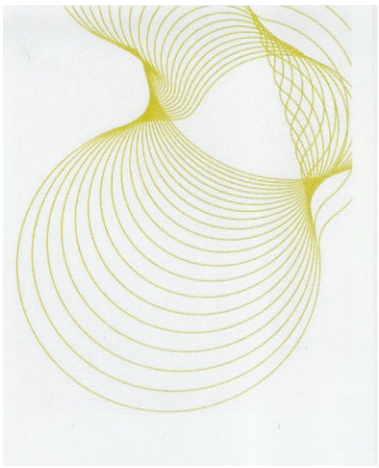
BRE operates from four sites:

BRE Garston, *near Watford - the main site, with* a *range of special- and general-purpose laboratories and test facilities,*

BRE Scotland, *at East Kilbride - serving the particular needs of the construction communities in Scotland and Northern Ireland.*

BRE North East, *at Middlesbrough* - a *specialist facility for large and full scale testing work* ***BRE Highlands,***

at Inverness - servicing the North of Scotland



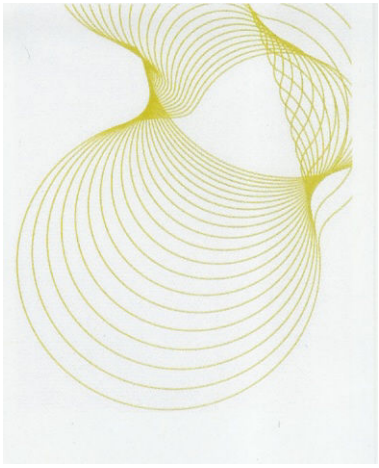
BRE's areas of activity are represented by centres of excellence, organised into three divisions:

Construction	BRE Environment
• *Ground engineering and remediation* • *Concrete* • *Timber* • *Structural performance* • *Steel construction* • *Building Fabric* • *Heritage, archaeology, stone and masonry* • *Waste and recycling* of *construction materials* • *including design for deconstruction* • *Whole Life Performance*	• *Acoustics* • *Environment and Health* • *Environmental Engineering* • *Water* • *Productive Workplace* • *Sustainable Construction* • *Aviation - aircraft cabin environments* • *Energy consultancy* & *research* • *Programme management expertise for the Carbon Trust's Action Energy programme and the Energy Saving Trust's Housing Energy Efficiency BestPractice programme* • *Management* of *the Integrated New and* • *Renewable Energy in Buildings (INREB)* • *Faraday Project* • *Policy support, analysis and energy* • *modelling associated with the English* • *House Condition Survey* • *Energy and innovation in housing* • *Housing energy economics* & *statistics* • *Building integration* of *renewable energy* • *Energy* & *greenhouse gas emissions* • *modelling* • *Impact assessment* of *major initiatives and programmes* • *PFI Unit* & *Non-domestic database unit*
BRE Fire and Certification (incorporating LPC and LPCB)	

• *Certification* of *products, services, systems*
• *and personnel*
• *Issuing* of *European Technical Approvals*
• *(ETAs)*
• *Notified body under the Construction*
• *Products irective (CPo)*
• *Fire safety engineering*
• *Fire safety design*
• *Fire testing including:*
  • *Reaction to fire*
  • *Fire suppression*
• *Structural fire performance*
• *Fire resistance*	

BRE and BRE Trust also have a number of subsidiary companies operating in specific market sectors, these include:

.***BRE*** *Waste and Environmental* ***Body Ltd*** *(BREWEB), established to provide* a *means for companies to use Landfill Tax credits to fund environmental research at BRE and elsewhere*



.***BRE*** *Bookshop,* a *joint venture company between BRE and EMAP Construct, established to* _. .h"_h __,./ ___*/n..f* ,."n<,f_, *",fi"nj,.,/",f,.,"/ rH* ,i,./,.,C' *h"rovC' ",nrl ranrorlC' frrom* _R1= *!:>nrl* QkQIMhQrQ

About BRE Trust

After 75 years in the public sector, BRE became a private company in March 1997 and is now owned by BRE Trust (formerly the Foundation for the Built Environment or FBE).

BRE Trust is a research and education charity for the public benefit, registered by the Charity Commission (registered charity number 1092193). All of the companies owned by BRE Trust contribute their profits to supporting the Trust's mission...

to champion excellence and innovation in the built environment

BRE Trust achieves this by funding and managing a strategic research programme in the built environment sector. By 2004 BRE Trust was supporting about 50 research projects and nearly 20 PhD scholarships, and had committed more than £4 million in funds. During 2005 the BRE Trust will establish a strategic research and development partnership with four UK universities. BRE Trust aims to strengthen the UK's capacity to carry out leading-edge building environment research and promote its practical application.

This Partnership is developing centres of excellence at four UK universities in the following built environment topics:

.Fire Safety Engineering at the University of Edinburgh

.Innovative Construction Materials at the University of Bath

.Sustainable Building Design in the Welsh School of Architecture at Cardiff University

.Energy Utilisation Research at the University of Strathclyde

Associated with each Centre is a new Research Chair, the holder of which will also be the Centre Director. The Research Chairs are being funded jointly by the BRE Trust and the four universities, with The Royal Academy of Engineering and The Welsh Development Agency contributing to the Chairs in Fire Safety Engineering and Sustainable Building Design respectively.

While working in different fields, each Centre and associated Research Chair will have some common objectives, including:

.Seeking and promoting new areas of research

.Fostering cross disciplinary and other programmes to benefit industry

.Providing innovative programmes of education and continuing professional education

The BRE Trust comprises some 160 members - firms, professional bodies and other organisations drawn from a wide spectrum of construction, building owner and associated interests. It was created to ensure that BRE remains independent of specific commercial interests, and retains its reputation for objectivity and impartiality in research and consultancy. In addition, BRE Trust gives BRE a direct rol",tit"\n",hin \Afith tho

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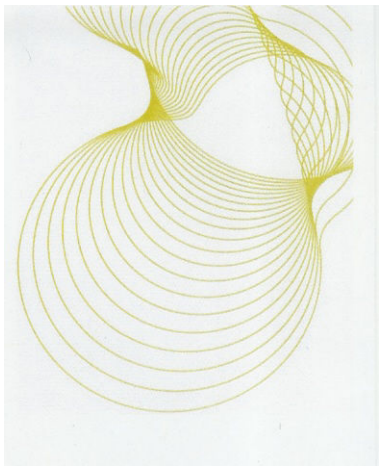
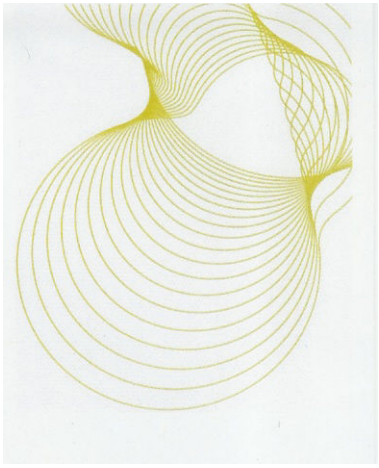




Appendix B - **About the Author**

Gordon Breeze is _ Chartered Civil Engi[)eer who has been actively involved in the field *of* Wind Engineering *for* over 20 years, and is an elected committee member *of* the UK Wind Engineering Society. He has particular experience *of* environmental and wind loading activities, which have included taking measurements at full-scale, and undertaking model scale testing in environmental wind tunnels.

For 10 years (between 1988 and 1998) the author worked closely with Tom Lawson who developed guidelines *for* pedestrian comfort that are widely accepted in the UK (the so-called 'Lawson Comfort Criteria'). During that time, he carried out over 130 wind environment wind tunnel investigations and developed data acquisition and analysis programs *for* assessing and presenting the results *from* wind tunnel studies.

After leaving Bristol University, the author joined BRE as a Senior Research Engineer in the Wind Loading Section. Following an internal reorganisation at BRE, the author is now a Senior Consultant in the Building Technology Group. In this capacity he undertakes and manages environmental and wind loading experimental studies. His commercial activities also include undertaking environmental wind desk studies, and reviewing work undertaken by other test laboratories.

The author's CV and career history are provided below.

NAME
CURRENT POSITION

GORDON BREEZE
Senior Consultant, Structural Engineering

ACADEMIC QUALIFICATIONS

BSc Aero Engineering (2.2)
MSc by Research in Wind Engineering

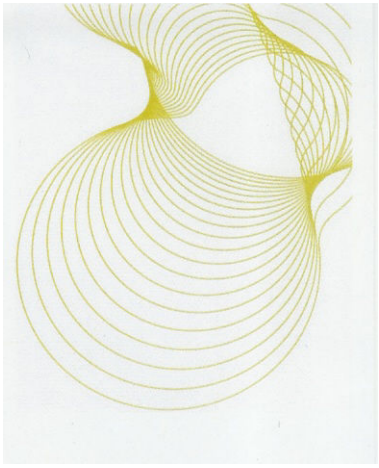
PROFESSIONAL QUALIFICATIONS

MICE, CEng

CAREER SUMMARY

1998

Senior Consultant in Wind Engineering Section *of* Building Technology Group at BRE, Garston, Watford.



1983-85

Senior Installation Engineer in Powerplant Technology Dept. at Rolls-Royce plc, Moor Lane, Derby, 1985-88.
Research assistant undertaking MSc. by Research at Cranfield Institute of Technology.
Thesis: Lateral Correlation of Horizontal and Vertical Components of Gusts in High Speed Winds.

1985-88

EXPERIENCE

I presently specialise""in the following activities: wind tunnel testing of building models
testing full scale building accessories weather-tightness testing of roof coverings

My representative duties are presently:
representing the OD PM at BSI committee meetings
active committee member of the UK Wind Engineering Society.

My management experience includes:
managing all aspects of small technical consultancy jobs
managing a large laboratory at BRE (houses the largest wind tunnel on the BRE Garston site, as well as a number of smaller test rigs).
managing a large government sponsored research program

In addition to the above, my experience also includes:
developing a business as a consultant for assessing environmental wind impact giving expert witness evidence at a major public planning enquiry
designing and commissioning a major BRE facility for carrying out a proposed CEN test to simulate the effect of wind pressure
involvement with calibrating the forthcoming Eurocode on Wind Actions.

PAPERS & PUBLICATIONS

Extensive Wind Engineering publications including most recently:

.Breeze G. Preliminary Findings of Aerodynamic Tests and Water Penetration Investigations Upon Pitched Roof Vents. Procs of 3rd EACWE Wind Engineering Conference, Eindhoven, July, 2001. Breeze G. Fatigue Life of a Large Flag Pole in the Middle East. Procs of 5th UK Conference on Wind Engineering, University of Nottingham, Sept, 2002.
Breeze G. A Pragmatic Method of Estimating Turbulence Length Scales. Procs of 5th UK Conference on Wind Engineering, University of Nottingham, Sept, 2002.
Breeze G. Eurocode EC1-4 - Calibration for Use With Buildings. Procs of 5th UK Conference on Wind i=nninc..::>rinn Ilni\ll::>rcit\l nf l\lnttinnh",m !=:",nt ?()()?

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