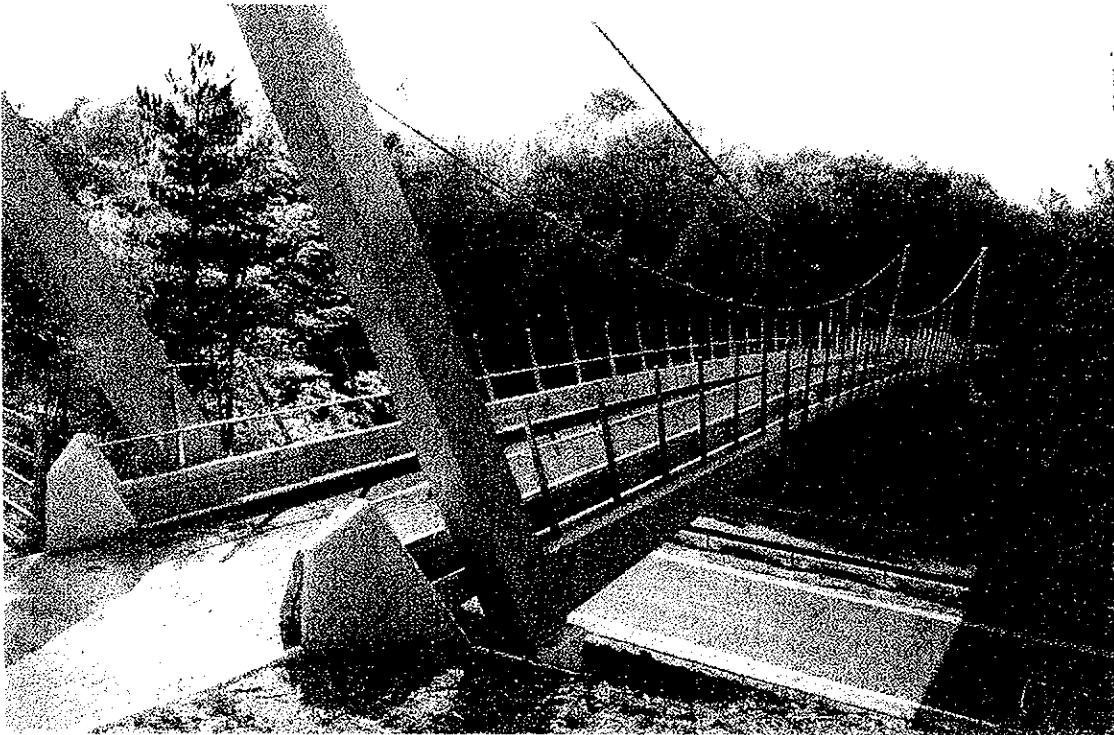




I.A.B.S.E. NEWS

BRITISH GROUP

EDITION 17 2002



The Halgavor Bridge, Cornwall.

Photograph by courtesy of IAN FIRTH - Partner, Flint & Neill Partnership, London, UK

This newsletter is distributed to all members of the British Group and a single copy is sent to the secretariat of all overseas Groups.

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Mr S J Matthews *WSP.Civils*
 Mr A J Pickett *Highways Agency*
 Dr G P Tilly *Gifford & Partners*
 Mr K R Wilson *Maunsell*

Dr C J Burgoyne *Cambridge University*
 Mr D K Doran *FCGI Consultant*
 Mr M C O'Flynn *Taywood*
 Mr W I Liddell *CBE FREng*
Buro Happold
 Mr M J Murray *Babtie*
 Dr J G M Wood *SD & S Ltd*

MEMBERS OF HONOUR OF THE BRITISH GROUP

Mr A W Hill
 The Lord Hacking
 Mr D W Quinion *FREng*
 Mr A C E Sandberg *OBE FREng*

Members of Honour may attend meetings of the Executive Committee

EXECUTIVE COMMITTEE

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Professor D A Nethercot *FREng*
Imperial College

Vice-Chairman

Dr J B Menzies *FREng Consultant*

Hon Secretary

Mr R J W Milne

Hon Treasurer

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Mr A M Low *Ove Arup*

Mr B P Pritchard *Consultant-Atkins*

Mr P J G Wigley *Railway Safety*

Mr C R Cockerton *Technotrade Structural Services Ltd.*

AIMS OF IABSE AND THE ROLE OF THE BRITISH GROUP

The International Association for Bridge and Structural Engineering (IABSE) comprises more than 4300 members in 101 countries. Founded in 1929, IABSE deals with all aspects of planning, design, execution, maintenance and repair of civil engineering structures. To fulfil its mission, IABSE organises conferences and publishes a quarterly journal, *Structural Engineering International*, as well as books and reports.

The role of the British Group in relation to IABSE is under regular review and any constructive suggestions that members may have should be addressed to the Honorary Secretary c/o the Institution of Structural Engineers.

EDITORIAL

Aided by the blinding precision of hindsight some have claimed that engineers could have done more to minimise the effects of the 11 September 2001 disasters in New York and Washington. However the fact that the final loss of life [however tragic] was only just in excess of 3000 speaks eloquently for the skill of designers.

In an interview with the *Daily Telegraph* structural engineer Leslie E Robertson, now 73 and one of the principal designers of the Twin Towers in 1963, said- *I am a methodical person, so I listed all the bad things that could happen to a building and tried to design for them.* Although the towers were designed to resist the impact of a Boeing 707 it could hardly have been anticipated that each tower would be struck by 767s fully laden with aviation fuel.

When major disasters occur I find it educational to re-visit the late Tim Hambly's seminal paper (1) *Risk evaluation and realism*. This provides a prioritised list of 27 activities where the risk is measured in terms of Fatality Accident Rates. By far the most risky activity was to be present in London during the 1665 Plague; at No: 27 [least risky] was Buildings Falling Down. Travel by air, car and train were at 12, 13 and 17 respectively. Perhaps some slight adjustment of these figures will be necessary in the aftermath of New York and the Hatfield train crash but a change in the relative status of these disasters is unlikely. Clearly more education of the public is necessary to achieve a better perception of the relative risk of disasters.

Several expert groups [including one from the IStructE] are meeting to review the events of 11 September.

Will they suggest limits on the heights of buildings [and perhaps on the capacity of passenger aircraft and supertankers] or will nothing slow the inexorable path of progress?

(1) Hambly EC & Hambly EA, *Risk evaluation and realism*. Proc ICE Civ Engng 1994,102, May 64-71.

David Doran

MEMBERSHIP NEWS

We were saddened during the year to hear of the death of Member of Honour **David Lee** FREng. during the year. A brief appreciation of David appeared in the 1 May 2000 edition of *The Structural Engineer*.

Congratulations to

David Quinion and Alec Sandberg on becoming Members of Honour of the British Group. [Please see David's letter below; our commiserations to Alec on his recent accident and our best wishes for a speedy recovery].

David Nethercot FREng and Peter Head FREng on the award of Fellowship of the City and Guilds Institute.

David Quinion writes

I express my thanks to all of you for your generous Award of Honorary Membership of the British Group of IABSE which gives Joan and I great pleasure. To participate in the activities of IABSE with exposure to the ideas, practices and problems of Structural Engineers around the World has given me a different perspective on many working practices. With many of you I have strived to convey knowledge and experience to and from our colleagues

in other countries and commend the benefits of involvement.

In my youth I was a choir boy at the small parish of St Oswalds, Croxley Green and received encouragement for a career in Structural Engineering by our Churchwarden. He was also awarded Honorary Membership by the British Group many years ago and he was of course, Dr Fred J Thomas. It is sometimes a small world.

My good wishes to you all and I hope to keep in general contact.

**THE 2001 HENDERSON
COLLOQUIUM: ACHIEVING
DESIGN QUALITY**

**Magdalene College, Cambridge,
17-18 July 2001**

In July 2001, twenty-six delegates attended the annual Henderson Colloquium in Cambridge. The event took place at Magdalene College, and as always it was both stimulating and thoroughly enjoyable.

This year's theme was "Achieving Design Quality", or to give it one of the fuller titles from the original concept for the event "The Procurement and Achievement of Design Quality in the Built Environment". The invited delegates were drawn from a wide cross-section of the industry and included private and public sector clients, architects, contractors, consulting engineers and others. The intention was to generate lively and informed debate on this important subject, and with such a broad cross-section of delegates this was certainly achieved.

The role of government policy in increasingly requiring buildings and structures to be procured under the

Private Finance Initiative was recognised and discussed. Opinions differed on whether this necessarily resulted in poorer quality designs, and both good and bad examples were illustrated, but the essential need to control design quality was recognised.

The question of what we mean by high design quality was never far from the surface in the discussions, as was the issue of procurement method. The importance of selecting not only a good designer or design team but also a suitable process by which the design might be realised was recognised by all delegates. However, there were differences of opinion as to what value to place on good design. Some contributors suggested that function, safety and economy were sufficient targets to achieve for good design, and that paying any extra for the aesthetic or delight factor was unjustifiable. Others pointed out the need to improve the quality of the environment in which we live and work, and the important value of giving people delight in their surroundings, both in terms of social well being and potential financial reward. Quality is more than sufficiency, and delegates recognised that excellence should be the target, where appropriate, even if it might cost a little more to achieve in some cases.

It was generally agreed that a whole - life approach to costing would result in greater opportunity to improve our designs, as any small additional cost (if any) for excellence becomes insignificant in the long term. This approach also helps to ensure that end user needs are taken into account, as any good design must properly address aspects such as operation, maintenance, change of use, future sale etc.

A good relationship and communication between the client and designer was agreed to be vital to achieving high quality. The client's needs must be determined from the start, and very often the designer's task includes helping his client to identify his needs clearly. The meeting heard that one of the disadvantages of some design competitions, so often hailed as the means of achieving a good design, is that they can prevent this from happening properly before a design is proposed. This can also be a problem with some D&B and DBFO situations where the designer is often far removed from the end user client through the intervening roles of contractor, financier, concessionaire and others.

Undoubtedly, achieving high quality requires a skilled designer, but it also requires an environment in which that designer is supported by a good team and is able to work effectively and efficiently towards well-defined goals. Delegates agreed that this meant placing a high value on the design and providing sufficient time in the programme for it to develop properly. Often budgets and programmes were set well before a designer is even appointed let alone consulted, and this can be a significant factor in preventing the achievement of high quality.

The role of education was also discussed, both of designers and of the general public who should be more able to appreciate the importance of high quality in the designs they see around them. This theme was taken up by the after-dinner speaker at the event, Professor Peter Carolin who spoke passionately about the importance of education in achieving design quality. Understandably, Professor Carolin referred to the high

quality of the graduates from his own course at Cambridge, and spoke of the role of a multi-disciplinary approach to the teaching of design in the context of buildings and structures.

The event ended with an opportunity to examine the diaries and papers in the Samuel Pepys library at the College. The Librarian treated the few delegates who took this opportunity to a memorable description of the great diarist and the times he recorded.

The Henderson Colloquium is always a good opportunity for delegates to stand back from their busy schedules, and take time out to reflect on important issues which affect us all. This event was no exception and appears to have been judged by all who took part to be a great success. It is intended that a summary of the debates and conclusions of the Colloquium will be published and circulated widely, in addition to the papers themselves which will be made available through the Institution of Structural Engineers in the usual way.

Ian Firth : *Flint & Neill Partnership*

COLLOQUIUM 2002

Dr Sam Thorburn FREng has agreed to chair the organising committee for a Colloquium to be held on **Risk Management** on 15/16/17th July at Magdalene College, Cambridge.

Topics under consideration for 2003 include **Resistance to Impact** and **Hazardous Conditions**.

PERSONALITY

BERNARD WEX – A TRIBUTE

‘If you want a job done and done well give it to a busy man’ This statement

could not have been more true of anyone than the late Bernard Wex.

He became chairman of the British Group of IABSE in 1979 at a time when work on the Humber Bridge was in full swing. He became Partner in Charge for the project in the early 1970's and saw the project through to completion and opening by HM the Queen in July 1981. At the time the Humber Bridge was the longest span bridge in the world, which it remained for many years.



Bernard Wex

Two other bridges for which Bernard Wex was responsible were the twin steel-box girder bridge over the river Foyle in Londonderry, Northern Ireland [a design for contractors and chosen from a design-and-build competition] and the Myton cable-stayed steel-box swing bridge in Hull.

Bernard joined Freeman Fox & Partners in 1951 after reading civil engineering at Imperial College where he obtained a 1st class honours degree. He was involved in the designs for the Auckland Harbour, Forth, Severn, Ganga and Brahmaputra bridges, as

well as several high-pressure gas and oil transmission bridges in India and Pakistan. He was also involved in the design of structural steelwork for two of the then largest coal fired power stations in Europe -- at Castle Donnington and High Marnham. He was interested in welding technology and this came in more than useful in the design checking and supervision of site fabrication of the steel lining of the Hong Kong immersed twin tube tunnel.

As well as being Chairman of the British Group Bernard was an International Vice-President of the association, Chairman of Working commission IV, member of the Technical Committee and the ruling body, the Permanent Committee. Together with the late Professor Sir Edmund Happold he was responsible for the organisation and running of the International IABSE Symposium on 'The selection of structural form' held at Imperial College, London, in September 1981, an undertaking that, if it had gone wrong, would have bankrupted the British Group! He also oversaw the British Group's residential colloquia held annually in Cambridge.

Not content with the above Bernard Wex was Chairman of the Committee of Inquiry into the collapse of the Emley Moor television tower, and first chairman of the Steel Construction Institute founded in 1986.

Bernard Wex was born in 1922. He entered the Army in 1942 and after Sandhurst was commissioned in 1943, becoming a tank commander with the 23rd Hussars. He was awarded an OBE in 1982 for his work on the Humber Bridge. He was a keen photographer [several of his photographs of the Humber Bridge are among the best taken of that structure], a woodworker,

and a cold-water swimmer. He was also interested in flying – in fact only a minor eye defect had precluded him from joining the RAF in 1942.

Bernard strove for perfection and whatever he did was of the highest quality. He is remembered as an engineer of the highest calibre, who during his lifetime was respected by all. He died on 31 July 1990 of leukaemia.

Bob Milne.

Editor's Note.

I was privileged to see Bernard just before he died when he was in Barts hospital. He was incredibly brave and an example to us all

IABSE ANNUAL LECTURE

THE DESIGN OF THE STEEL RAILWAY BRIDGES OF THE MEDITERRANEAN HIGH SPEED LINE

David Doran reports on the above lecture given at Headquarters on Thursday 6th December 2001. It was presented by Didier Martin of the SCNF Bridge Engineering Department in France. Unfortunately his co-author Phillipe Ramondenc was unable to attend.

Didier used the following framework for his lecture:-

1. A general presentation of MHSL
2. The different types of steel and composite bridges on the line
 - Composite
 - Tied arches
 - Lateral I beam
3. Specific design problems

4. Engineer/architect relationships

5. Conclusions

With the aid of more than 100 well crafted slides he presented a comprehensive account of many of the engineering problems encountered in building a line from Valence to Marseille. This represented a milestone in the 30 year development of a project that now permits high speed rail travel from Calais through Paris to the French Riviera. Speeds in the range 270-515 km/h can now be achieved thus considerably reducing travel time in journeys from North to South. Bridges varied in length from 79m to 1500 m with maximum spans in the range 24m to 124 m.

Each crossing was analysed for loading, dynamic, fatigue and seismic behaviour and then submitted to economic and architectural review. Didier emphasised the following features of the analyses:-

- Serviceability limit state [SLS] included modal analysis, dynamic analysis [which included the production of an excitation spectrum for several different types of train, including Eurostar] and also tests for passenger comfort. Deformations were checked to see that they remained within the elastic range[ie were reversible]
- Ultimate limit state [ULS] which indicated strengths not dissimilar to those obtained using BS 5400
- Fatigue using Eurocode 3 Pt 1.1 and Eurocode 1 Pt 2
- Seismic to French regulations thus imposing very heavy horizontal loads on piers and abutments.

For tied-arch bridges 4 different hanger configurations were analysed and a vertical system selected.

A great deal of care was taken with the final appearance of the bridges and the following seven were singled out for special treatment, each with its own appointed architect.

- Avignon: Architects; *M. Desvignes & J.F. Blassel*
- La Grenette: Architect; *J.P. Duval*
- Vernegues: Architect; *A. Amedo*
- Ventabren: Architect; *C. Lavigne*
- L'Arc: Architect; *B. Gaudin*
- Mornas-Mondragon: Architect; *J.P. Duval*
- Donzere: Architect; *M. Mimram*

First a technical design was made by SNCF's engineers. Drawings were then submitted to architects for their views and alternative arrangements. These arrangements were then incorporated into the final design after further engineering checks. In some cases designs underwent considerable change to improve appearance, no doubt achieved at some additional cost.

In conclusion, Didier showed a number of slides indicating satisfaction with a job well done. Great attention had been paid to quality and appearance. Detailing was carefully arranged to permit ease of inspection.

This was followed by generous applause from a full house and a vote of thanks from Professor David Nethercot FREng, Chairman of the British Group of IABSE. Unfortunately time did not permit of any discussion. However over 40 sat down to an excellent supper after the lecture.

HI-TECH THROUGH THE AGES YOUNG ENGINEERS CONFERENCE

15-16 December 2001.

Fitzwilliam College, Cambridge.

In conjunction with the Cambridge University Engineering Society Ian Liddell FREng organised the above conference and the following was the statement of the AIMS AND OBJECTIVES :-

Engineering, especially Civil Engineering, has a long and rich history that includes stories about the design and completion of major structures, biographies of personalities and the development of materials and technologies. The British Group of IABSE would like to bring some of this history to young engineers, to make them aware of past technologies and achievements and to learn the parallels that exist today. The aims are to bring together students and recently qualified graduates in a relaxed and entertaining atmosphere.

- To discuss interesting aspects of technology and processes that were innovative and significant in their time and
- To debate the relevance of current engineers education and on-going training.

Topics were introduced by a range of distinguished engineers which included Sir Jack Zunz, Leslie Robertson [USA], Professor Jacques Heyman, Peter Head, David Kendall, Ian Liddell, Holger Svensson, John Ochsendorf, Craig Schwitter, Jo da Silva and Mike Davis.

There follows an appreciation of the Conference.

Cambridge Conference 2001 Report

The conference was held over the weekend immediately after term ended for Christmas holidays in December 2001. Some of the highlights, in my opinion, were the following:-

1. Listened to Leslie Robertson's moving presentation on the recently destroyed WTC, NY, later featured in an article written by Dave Parker and published in the New Civil Engineer Magazine (NCE), 10th January 2002 issue.
2. Captivated by Jo de Silva's message on potential experiences, exciting opportunities, challenges and possibilities of participating in RedR, an organisation who send graduate engineers to alleviate disasters such as flooding in Bangladesh or war torn situations such as the civil war in East Africa.
3. Intrigued by Holger Swenson's talk on his 20-year experience with building some of the largest pre-stressed concrete bridges in the world. He emphasised the importance of detailing and site experience in the make-up of future engineers.
4. Fascinated by Prof John Osc's (from the MIT, USA) discussion on the history of bridges in context with the history of America. When he was in Japan to supervise the construction of the longest suspension bridge in the world,

a typhoon blew up just as engineers were about to fit the last pre-cast section in the middle of the (2.4km) main span. They just managed to pull that piece back as the waves and winds kicked the new structure at its most vulnerable point in life of construction.

5. Representatives from the various participating universities and sectors delivered a five minute talk each on their undergraduate courses and training. The mini forum or "Question Time" after each presentation was relevant and interesting.

Among the other distinguished speakers at the conference were Peter Head, Executive Chairman of Maunsel, Sir Jack Zunz, Sydney Opera House engineer, Prof Jacques Heyman, Head of Cambridge University Engineering Department, David Kendal, inventor of today's most advanced polycomposites material available for construction, Mike Schlaich, representing the glass roofing specialist company Schlaich & Schlaich, Ian Liddell, former Chairman of ARUPS, and Sir Richard Rogers, the great architect of the Millennium Dome, who gave a memorable after-dinner speech. Overall, I can say the conference was a tremendous success, and I went away with an experience which I can say is a great turning point in my career.

My sincere thanks to Imperial College London, in particular, Dr Julian Bommer and Prof David Nethercot, for sponsoring me in this event.

G A Tan, CivSoc Imperial College London

YOUNG RESEARCHERS CONFERENCE 2001

On 21st March 2001, the Young Researchers' Conference was held at the Institution's headquarters, attracting a diverse group of the country's finest young minds and a sprinkling of, shall we say, more mature talent in the form of the judges. This was the third such conference organised by the Institution and the success of this annual event bodes well for the continuing co-operation and cross-fertilisation of ideas between industry and academia.

Researchers who were under 30 and in full time study were invited to submit abstracts of their research for consideration by the Institution's Research Panel. Nine papers were selected for oral presentation, with a further nine researchers invited to produce and host poster presentations.

The day was chaired by the President of the IStructE who welcomed the delegates to the Institution and sought to remind them that the Institution belongs as much to them as to their more senior colleagues. He invited Sir Duncan Michael to present the keynote speech, who promptly challenged the young researchers "to seek the truth that won't lie down". He reminded the audience of the need to look critically at their own work, to avoid relying on received truths and maintaining their integrity at all times. As researchers, he stressed that they have an obligation to publish and share their work in forums such as these. He encouraged all present to take advantage of the networking opportunities and to look for a catholicity of association so broadening their outlook.

The conference was turned over to the young researchers and the proceedings began in earnest. It was clear from the outset that each of the presenters had mastered the electronic medium of computerised slide show presentations and was able to provide entertaining and well illustrated material. There was a temptation at times for the oral presenters to show too much in the fifteen minutes allocated, although, this did not in general detract from the presentations. It was pleasing to note the high degree of relevance of most of the work to problems currently encountered in industry, which is a credit to both the research advisors and to such grant funding bodies as ESPRC.

At the end of each session, the researchers took questions from the floor from both the judges and their fellow researchers. Lively discussion ensued and it was clear that the conference aim of promoting an exchange of ideas was a success.

Similar interest was shown in the poster presentations, where each presenter was on hand to introduce their work. The standard was consistently high and each of the presenters had a sound grasp of their work and, in particular, its wider relevance.

At the conclusion of the presentations, the judges conferred to determine whom, of the two groups of presenters, should be awarded prizes. Judging was difficult, as the standard was high, however, two clear winners arose. The prize for the best oral presentation went to Mr Guido Morgenthal, whose clear and concise discourse on Lock-in Phenomena in Bridge Deck Dynamics helped to convey to the judges his sound understanding of his research. The prize for the best poster

presentation went to Wee Teo for his well-organised methodology and presented work on Shear Enhancement Approach for Reinforced Concrete Beams without Stirrups. Further prizes were awarded to several other presenters, reflecting the overall high standard of the day. Each prize winner received both a cash prize and a copy of the book 'Natural Capitalism - the next industrial revolution' by Paul Hawken et al.

The President drew the proceedings to a close by thanking all involved in the Conference and reflected on the very promising state of research at British universities. He welcomed the researchers' participation in the Institution's affairs and recommended that they submit papers for inclusion in the Structural Engineer.

D.K. MacKenzie

PRIZE LIST:

Oral Presentations:

First prize £400- Guido Morgenthal of Cambridge University for Lock-in Phenomena in Bridge Deck Dynamics

Second prize £300 - Leroy Gardner of Imperial College for Optimisation of Stainless Steel Design Guidance

Third prize £200 - Felix Schroeder of Imperial College for The Influence of Bored Piles on Existing Tunnels

Poster presentations:

First prize £200 - Wee Teo of Queen's University Belfast for Shear Enhancement Approach for Reinforced Concrete Beams without Stirrups

Joint Second prize £150 - Regina Sachse of University of Sheffield for

The Influence of Human Occupants on the Modal Properties of Slender Structures

Joint second prize £150 - Man Cho Choi of University of Bath for Anchorage Zones for FRP prestressed concrete structures.

**IABSE CONFERENCE
LAHTI : FINLAND 29/31
AUGUST 2001 - Report by Alain
Golay**

Innovative Wooden Structures and Bridges

Technical Programme

During the last decade, structures made from wood became a competitive alternative to structures made from other materials. The changeover was possible for many reasons. Firstly, the development and innovation of joint technology has led to technically more efficient and aesthetically more pleasing joints than those formerly used. Secondly, in composite construction, wood and timber have become an integrated part of the whole load-carrying structure. Finally, environmental issues have become a topic of concern world-wide. All these issues have been addressed during the conference.

225 participants from 40 countries attended the Conference "Innovative Wooden Structures and Bridges", Lahti, Finland, 29 - 31 August 2001. It presented the newest developments and achievements in wooden structures' research and technology. The Conference was organised by the Finnish Group of IABSE, the Association of Finnish Civil Engineers RIL and the Helsinki University of Technology / Bridge Engineering. The

following Keynote Sessions were presented:

New Technologies for Timber Structures

Prof. Julius Natterer, Switzerland

Developments and Research in Wooden Structures in Australia and New Zealand

Prof. Keith Crew, Australia

Seismic Performance of Wooden Buildings

Prof. Isao Sakamoto, Japan.

Themes addressed at concurrent sessions included: Architecture and Innovation, Durability and Fire Resistance, Design and Analysis, Houses and Buildings, Bridges, Special Structures, Joints and Connections, Composite Construction, Materials and Testing, Rehabilitation, Seismic Aspects.

Posters were presented at a live video-recorded session, with the audience seated comfortably in the Main Hall, and following the presentation on a wide screen. Authors were given five minutes for commenting on their posters, which were visited on the previous day by the Conference attendants. This was new at an IABSE conference, and it offers a number of promising advantages for the future of poster presentations.

Thanks

The IABSE Conference in Lahti was the first IABSE Conference solely devoted to timber structures. It was very well conducted by the Organising Committee, chaired by Mr. Yrjö Matikainen, and the Scientific Committee chaired by Prof. Arne Jutila, Chairman of the Finnish Group of IABSE. RIL staff under the

leadership of Mr Jyrki Keinänen did an excellent job, all contributing to the pleasant atmosphere of the Conference. All speakers, committee members and chairs have contributed to the success of the event. They deserve a hearty vote of thanks from IABSE.

REPORT and CD

"Innovative Wooden Structures and Bridges"

IABSE Conference Lahti, August 2001

The Keynote Lectures, papers and posters presented have been collected in a Report and a CD and are a valuable contribution to the design, construction, operation, maintenance and rehabilitation of wooden structures. The papers, 100 altogether, represent the streamlines of the current research and practical applications. The overview of the latest research results and examples of good practice will contribute to a useful Conference Report for the owners, designers, contractors and wood industry, in developing and producing even more advanced wood and timber structures in the future.

Lahti Conference Report
Vol 85 (Book and CD)
100 contributions in English, 614 pages
Book: 6 pages per contribution
CD: 6 pages per contribution
Format: 170 x 240 mm
Published in August 2001

Price (Book and CD):

IABSE Members: CHF 80.-
Non-members: CHF 160.-
plus mailing costs

The Report is available from:

IABSE, ETH Honggerberg CH – 8093
Zurich

A NEW CD-ROM PROJECT:

'AN INTRODUCTION TO THE ENGINEERING OF HISTORIC STRUCTURES'

Introduction to the Project

The study of outstanding engineering works can be immensely rewarding, for all engineers. An appreciation of how engineers have solved problems with different materials and construction techniques gives a fuller understanding of engineering solutions than can be gained purely from involvement with the detailed design of typical modern structures with state of the art analysis and design. Furthermore, an increasing amount of the engineers work is involved with existing old structures, which must be modified, strengthened, or altered. A prerequisite to the success of this work is an understanding for how the structures were built, the materials used, and how they work. The CD-Rom is intended to widen the young engineers horizons, and stimulate further interest in the engineering of structures.

It is a common observation from students that undergraduate civil and structural engineering courses devote little time to studying completed engineering projects. Where opportunity and time can be made, however, the student derives great benefit from leaving the classroom to explore completed engineering works – old and new. This project is aimed at creating a CD-Rom to inform young engineers, and stimulate interest in an increasingly important aspect of a Civil Engineer's professional work.

Ultimately, the practice of studying unfamiliar and uncommon works of

engineering should tend to furnish the mind of engineers, and contribute to their ability to diagnose problems, and supply ingenious, but soundly engineered solutions

Scope

The project has been limited to the best examples, which demonstrate important aspects of historic structures effectively.

Historic structures include both 'landmark' structures of any age (ie can include recent millennium projects for example), and older structures where techniques and materials are quite different from those in current use.

As a primer to the subject, the CD-Rom will necessarily have limitations, and will not contain a comprehensive catalogue of structures, details, and examples. The scope may be widened in a subsequent project if sufficient demand exists.

- Create video and still images of aspects of a variety of historic structures.
- Limit work to selected examples in the UK and Europe for this project.
- Focus on buildings and amenities, with some outstanding bridge works for completeness.
- Obtain best guides, knowledge and expertise on historic structures.
- Design a practical, simple, but effective means of delivery of the information, using

authoring software and CD-Rom.

Target Audience

The principal users of the CD-Rom are undergraduate and graduate engineers.

In Britain there is a wealth of engineering heritage around us, this CD-Rom will be designed to stimulate an interest in personal study into completed engineering works. Personal study of this kind motivates the student to the exercise of a proactive enquiry. This takes the undergraduate beyond the normal boundaries of undergraduate studies, and starts an interest in engineering which may enhance an entire career.

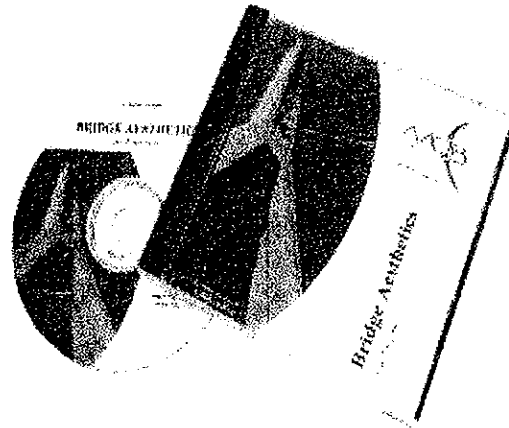
Material planned for the CD-Rom could be a useful project primer for 4th year MEng students who need to extend the range of their knowledge and skill.

Conservation and refurbishment requires a fundamental understanding of the engineering of historic structures. This project aims to be an introduction – not a manual – to assist younger engineers in a voyage of discovery of a rich engineering heritage in Britain.

About the Author

David Morris is a chartered civil and structural engineer with teaching experience at the University of Sheffield (1994 – 1996). A previous multimedia CD-Rom project culminated in the production of 'Bridge Aesthetics for Engineers, a multimedia CD-Rom'. The work was successfully completed in 1999, and has been taken up by consultants, local

authorities, universities, colleges, and Libraries in the UK and abroad.



Method

The work requires four key stages, although the detail and presentation is likely to evolve.

1) Research

Initial sources consulted include: ICE Library; Panel for Historic Engineering Work; IStructE Informal Study Group.

Further information to be gleaned from discussions with experts, prior to assembling the best published information available.

From this basis, the potential range of structures to cover may be identified, along with the depth of detail it is possible to cover.

2) Site visits to collect material for program

There is no substitute for first hand appreciation of the engineering that forms the subject matter of the program. One of the objectives of this program is to encourage engineers to undertake their own studies, and therefore the program

aims to demonstrate the benefit of doing this.

In some cases, better photographs and even video clips are available from site staff, but without a personal visit to the site, the exercise remains somewhat academic.

3) Design and production of the CD-Rom

It is widely acknowledged that Macromedia Director is the most comprehensive authoring software for both web based and CD-Rom based programs. A subsidiary objective of the project is to make a limited version of the program available from a web site.

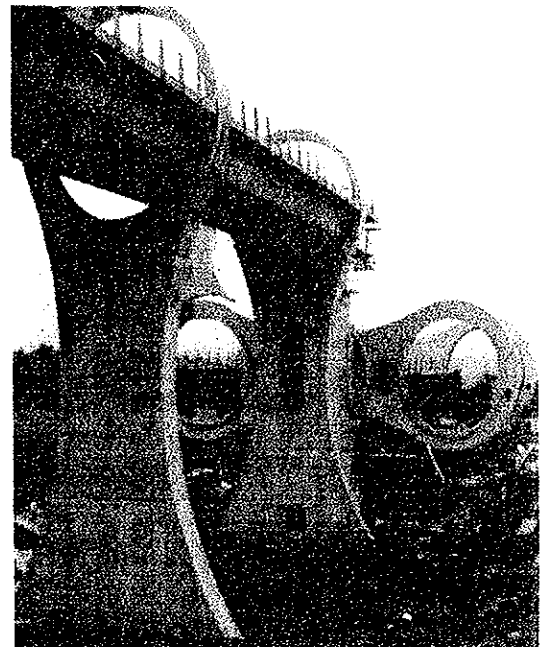
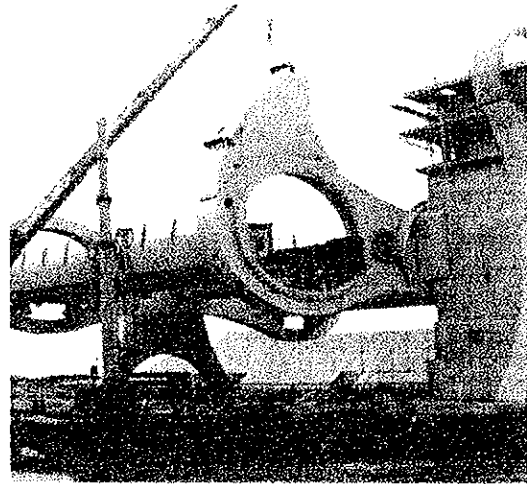
4) Consultation

An informal workshop meeting is to be held with interested parties to discuss draft content and get feedback. The result of this exercise will guide final revisions of this work, and identify further work to extend the scope of the CD-Rom.

Examples of the Content

Work on the project has started with two contrasting boatlifts:

The £20m Falkirk Millennium Wheel will lift boats 34m between the Union, and Forth of Clyde canals. This is the world's first rotating boatlift. The mechanism comprises a complex assembly of 1000t of structural steel plus hydraulic controls, supported on curved reinforced concrete supports.



*Installation of the embellishments to the wheel
[October 2001]*

In contrast, the Anderton Boat Lift is a £7m refurbishment of the Victorian 'Cathedral of the Canals'. The original 1875 riveted wrought iron with cast iron structure used hydraulic rams to lift the boats 15m between the Trent and Mersey Canal, and the River Weaver at Northwich in Cheshire.

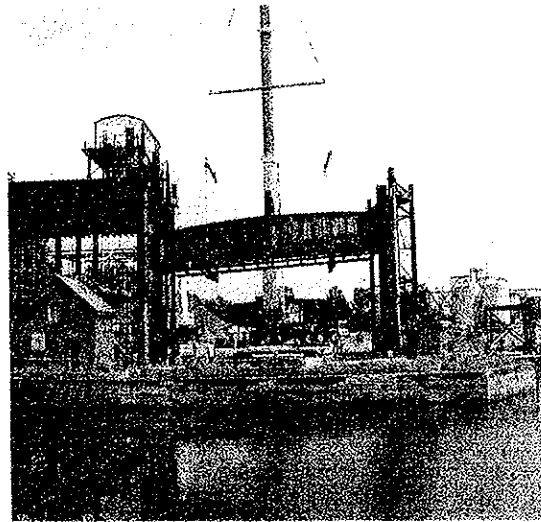
Problems with the rams led to the introduction of the 1908 replacement pulley system. The structure was taken out of service in 1982, after severe

corrosion was discovered in important load bearing elements. The current restoration work has involved the re-introduction of a refurbished hydraulic ram mechanism, whilst retaining the original pulleys as part of the scheduled monument (under the watchful eye of English Heritage).

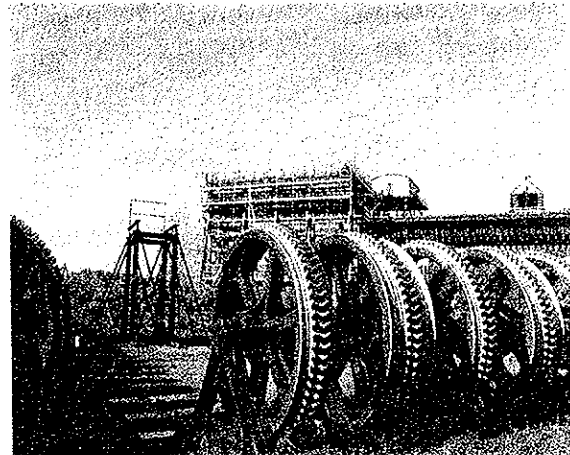


The Anderton Boat Lift prior to its closure in 1982.

The two boatlifts have identical function, albeit on a different scale. The engineering work has been very different, as the Falkirk boatlift was built in a green field site to modern standards, and the design was built to the drawings with little further involvement from the designer. The refurbishment of Anderton, however, required careful assessment of the existing structure, before the detailed scope of work could be fully established. As refurbishment work involved dealing with a Scheduled Ancient Monument, different structural materials and unusual structural arrangements, a dedicated team of site based design engineers was essential to the efficient execution of the project.



Dismantling of the 60t caissons with a 1000t crane.



The refurbished cast iron pulleys from the 1908 mechanism

Other projects to be researched for the project include:

*** A Victorian Steel Railway Bridge**

Strengthening of the cross girders on a 100 year old railway bridge, without disrupting railway operations.

*** The repair and strengthening of cathedral roofs and spires.**

*** The Restoration of Brighton West Pier.**

This unique Grade 1 listed structure has been gradually disintegrating since its closure in the 1980's. However, many cast iron elements have been

recovered from the sea bed in good condition, ready for refurbishment, and re-use.

*** Clifton Suspension Bridge**

Work on Brunel's 214m span suspension bridge began in 1831, but stopped in 1842. The bridge was eventually completed in 1864 in memory of Brunel, who died in 1859.

Funding, Resources, and Programme

The project is substantially funded by the ICE's Research and Development Enabling fund, with the research and programme design undertaken by the author. The prototype is expected to be available for review by the end of 2002.

How IABSE Members Can Help

Are you involved in a restoration project?

Are you involved in engineering work for a 'landmark' structure?

Are you able to arrange a site visit for the author?

Do you have access to background information, papers and drawings?

If so, your assistance would be very welcome, and the author would be very pleased to hear from you.

David Morris

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THE CONSERVATION OF BRIDGES

Introduction

Conservation involves work on a structure that alters it to retain its structural merit but can make changes that are in keeping. It can include restoration to its original form,

preservation exactly as it is without improvement or repair, or improvements such as strengthening and change in use. In the past conservation has been mainly related to buildings and the various Acts and Guidelines refer to 'buildings' whereas they actually encompass all types of historic or significant structure and should more correctly refer to 'structures'. With the exception of the most notable examples, bridges have tended to be overlooked. Transport authorities have often preferred to demolish and replace rather than carry out conservation. However, this attitude has changed in recent years and the engineer is being presented with new challenges and the need to learn new disciplines.

In England historic bridges having special merit have been heritage listed as being Ancient Monuments, or Grade 1, 2* or 2 listed structures. There are some 525 Ancient Monuments (14 on trunk roads) and 6325 listed bridges (8 on trunk roads). It follows that the burden of conservation of road and footbridges lies with Local Authorities.

Conservation of historic or listed bridges is especially demanding as it is usually necessary to carry out works in a short time frame causing minimum interruption to traffic. It is also necessary to ensure that the load carrying capacity is adequate while meeting the requirements of Heritage Authorities. Good conservation involves minimal change in appearance and minimal introduction of new materials.

Past experience

Over the years there have been many ill-conceived schemes where original material has unnecessarily been removed and the modern replacements

have turned out to be either incompatible or inadequate for the job. An example of the latter is the Wheeling Suspension Bridge in the US, where protection of the main cable was 'improved' by application of neoprene wrapping. Unfortunately moisture entered and caused some of the wires to corrode and break. Seven years after application it was necessary to remove the neoprene and revert to the traditional method of protection. This experience underlines the need to have a proper understanding of historic materials and designs and to appreciate that it is unnecessary, if not wrong, to try to improve on a traditional method that has performed satisfactorily for upwards of a hundred years. Closer to home, when Gattonside Footbridge of 1826 was rehabilitated in 1992-93 much of the elegant ironwork that had survived for some 160 years was unnecessarily replaced causing adverse comment from conservationists.

One of the most controversial schemes resulted from the catastrophic fire damage to Stephenson's Britannia rail bridge. The enforced removal of damaged ironwork and insertion of a roadway and steel arches left little of the original superstructure and completely changed the appearance. This caused an outcry from European engineers who recognised the significance of the structure. It is doubtful whether the same course of action would be followed today.

Considerable damage has been inflicted on historic bridges, some of them listed as historic monuments, by the utility companies. Unsightly pipework has been bolted to the sides of masonry arches completely spoiling the appearance of their side elevations or trenched through the fill sometimes breaking into the extrados of the arch barrel and seriously weakening it.

Removal and repositioning of the pipework is prohibitively expensive so that it is rarely done and never for the sake of appearance.

Present Attitudes

There are now numerous organisations and local pressure groups taking an interest in historic bridges the foremost being English Heritage and its counterparts in Scotland, Wales and Northern Ireland. The ICE's Panel for Historic Building Works (PHEW) organises an annual competition for Heritage Awards in order to reward and publicise good schemes and techniques.** The awards made in 2001 included a particularly enlightened one for Winston Bridge in County Durham. Here a 32m span masonry arch bridge set in a dramatic location had been assessed and found to be under strength. A contract was placed to carry out the necessary strengthening but as part of the engineering process it was accurately surveyed and re-assessed using state-of-the-art structural analysis. Hidden strength was identified and it was shown that strengthening was not required. This was seen as being the purest form of conservation. Recognition that structural analysis and doing nothing is a form of conservation is an important step as bridges have too often been unnecessarily strengthened or replaced in the past.

An example of unnecessary replacement is given by Worm Bridge, a 5.8m slab deck reinforced with rolled steel joists placed 457mm apart but having no transverse reinforcement. There was no evidence of distress but conventional analysis showed that there was inadequate strength and it was necessary to replace the structure. Prior to destruction it was loaded

tested and partially failed under a patch load of 220 tonne compared with a calculated value of 38.6 tonne. Although Worm Bridge had no great merit it exemplified the need to consider carefully the potential mechanism of collapse and carry out a full structural analysis before condemning a structure.

Role of Archaeologists

Nowadays archaeologists invariably attend work on historic bridges in order to record and interpret newly exposed parts of the structure. This enables a better understanding to be obtained of the origin and development of the structure through time. In masonry arch bridges the fill can sometimes be a rich source of information, for example minor Roman artifacts were discovered in Woolbeding Bridge during strengthening work involving excavation and placement of a concrete saddle. However it is more common to find that the material has been disturbed or replaced in the past. Bridges are often built on historic sites where there may be evidence of earlier structures. At Wallingford a new crossing of the River Thames coincided with a Bronze Age settlement dated circa 2000 BC. Much was learned about diet and trading from the archaeological dig.

Guidelines

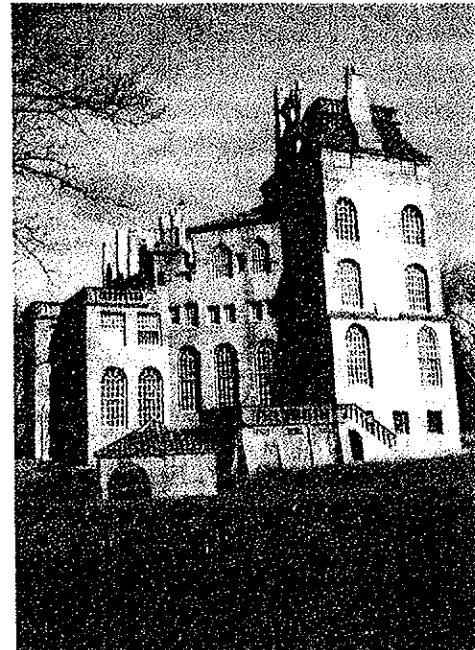
In recognition of the need for guidelines on conservation, The Highways Agency retained Gifford and Partners to prepare a report dealing with good practice in relation to all types of bridge. This covers masonry, timber, iron and steel, concrete, suspended bridges and movable bridges. Other sections deal with parapets, ancillaries, legislation,

architecture and archaeology. The report is to be published by Spon in 2002.

** The IstructE also have a Heritage Award.

Dr Graham Tilly – *Gifford & Partners*

THE FONTHILL MUSEUM



This is a large castle or chateau set in parkland and surprisingly is to be found in Doylestown, Pennsylvania. Why show a photograph of it here? It is built of cast in situ concrete and is the DIY result of the efforts of its owner using up to a dozen labourers. Doing It Yourself by owners is not to be encouraged by contractors but no doubt they would like to trace the source of this evidently productive labour force. Consulting engineers and Architects may note and not approve that the owner did his own conception and designs. So who was this unusual owner and why choose to build himself a castle?

Henry Mercer was born in 1856, graduated with a law degree and then

pursued his interests in archaeology and history with a particular interest in architectural tiles. He assembled a large collection of ancient tiles and the more recent examples in America of Germanic and Moravian origins. He decided to encourage the use of such tiles by establishing his own tileworks adjacent to a new home. His proposed home was also to enable him to display his collection and the products of his own works based on designs in that collection.

He had studied notable buildings around the world and decided to build a castle reflecting his own tastes and needs. His ideas apparently developed as he built out laterally and vertically. He had already decided that he would design and build it himself using cast in situ concrete as this would enable him to shape the rooms to meet his requirements and connect them with curving passages and winding staircases. He also chose concrete for its non combustibility.

Work commenced in 1908 so it will soon be a century old and is already scheduled as a National Historic Landmark. Not many people, let alone archaeologists, would commence such a challenge but they might well consider the working life of any such construction. In 1910 he also started to build the tile making and pottery works. Work on the house commenced alongside an old traditional timber house but it was soon literally consumed by the new building rather like a wild fig tree strangling and replacing the host tree up which it climbed. Doors and many items from the old one were reused through the new house.

Henry Mercer's castle has 44 rooms including 10 bathrooms and 5 bedrooms, 32 stairwells, 18 fireplaces

and an electric lift. It is not difficult to lose a companion since every room, including bathrooms, has at least two doorways but not always of the same shape or size. Nearly everything possible is made of concrete or cementitious product including many of the built in items of furniture and the glazing bars of most of the 200 windows. The main walls are of cavity construction which reduces condensation and facilitates the distribution of plumbing, central heating and electrical services. Henry saw no joy in rectangular rooms or repetition. Rooms may have columns wherever it is necessary to support further construction above and their sizes and shapes were dictated by their use as surfaces, rounded or flat, for the display of his tiles individually or in small assemblies. The main displays of the architectural tiles are a riot of shapes, scenes and colours and include 1564 from his collection and a greater number of his own products. The concrete finishes are generally as struck and in the tileworks much rougher than in the house; in fact really rough. The suspended floors are of shallow arches formed by casting on sand moulding supported by falsework. Some soffits have tiles inset in them.

Henry Mercer was clearly an eccentric from other aspects of his lifestyle but he delighted in his unusual concrete "Exhibition Home". His own tiles now decorate a number of public buildings. By building in concrete he may as an archaeologist have anticipated a long life for it and a permanent exhibition for his life's interest. I doubt he would have expected the "do not touch" signs on the concrete which are there for durability and not stability concerns!

David Quinion FREng.

INTERNATIONAL REPRESENTATION

Negotiations are proceeding between London and Zurich to achieve better representation of UK members on Working Commissions. It has been noted that the performance of these Commissions is extremely variable and that some require rejuvenation.

STRUCTURAL ENGINEERING INTERNATIONAL

May I remind all members of the ongoing opportunity to have articles published in *SEI*. The journal continues to grow in stature and is an excellent showcase for British engineering.

The rules for publishing a paper are relatively simple and I would be pleased to hear from anyone who may wish to provide such material. Many articles, such as project profiles, are only two to four pages in length so the demand on authors is not all that great.

House rules for potential authors may be found in the IABSE Website www.iabse.ethz.ch

Before embarking on an article it is prudent to submit to Zurich, for consideration, a 100/200 word synopsis.

If I can help in any way please contact me as below.

David Doran *SEI* *UK*
Correspondent

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email David.Doran@btinternet.com

CALENDAR 2002

- **15/16/17 July 2002** Henderson Colloquium at Magdalene College Cambridge – *RISK ASSESSMENT*.
- **21-23 August 2002** Second International Conference in Pusan, Korea. – *ADVANCES IN STRUCTURAL ENGINEERING AND MECHANICS*
- **11-13 September 2002** IABSE Symposium in Melbourne, Australia. – *TOWARDS A BETTER BUILT ENVIRONMENT – INNOVATION, SUSTAINABILITY AND INFORMATION TECHNOLOGY*
- **5 December 2002** IABSE British Group Annual Lecture. *Speaker to be announced*. This will be preceded by the AGM and followed by the Annual dinner.

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[The British Group is indebted to Sandberg's for the wording of this disclaimer.]

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