The Australasian Wind Engineer

www.awes.org

Welcome Wind Engineers to the November 2011 edition of the AWES Newsletter.

First up are the latest details of the upcoming AWES workshop and Wind Loading Handbook workshop that will be held in Sydney in February 2012. The dates have recently changed on these so best check the diary and make sure you're up to date!

During the most recent international conference the (ICWE-13 in Amsterdam), the General Assembly of the International Association of Wind Engineering (IAWE) unanimously approved the use of the term the "Alan G. Davenport Wind Loading Chain" for describing Alan Davenport's approach for evaluating wind loads and wind-induced responses for buildings and structures, and the full details of this are inside this edition.

The ASCE Technical Council for Wind Engineering (TCWE) has published a short note on current North American, wind-engineering, research needs. Whilst being distributed locally by both ASCE and AAWE, this work is certainly likely to have relevance on our shores and thanks to Leighton Cochran this interesting article is published for our readers.

On other AWES matters, members are reminded that the new 2-year membership period, encompassing 2012 and 2013, will be starting soon and details on how to renew are inside.

Finally, a big congratulation to one of our own members (and key contributor to the newsletter!) Dr. John Holmes for being recently awarded the "Davenport Medal" by the International Association for Wind Engineering. The award was given to John Holmes for "his many practical contributions to modelling and analyses of wind effects on structures and development of wind load standards". Congratulations John!

Happy Reading, and see you in 2012!

Editor: Leighton Aurelius — BMT Fluid Mechanics
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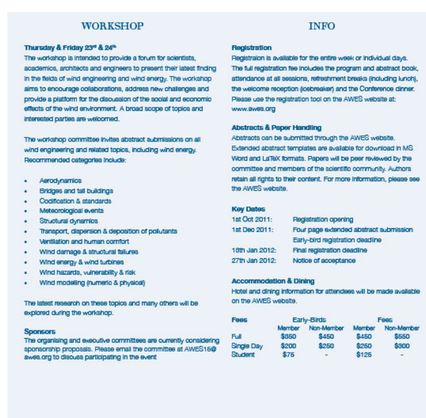


WORKSHOP

Thursday & Friday 23rd & 24th
The workshop is intended to provide a forum for scientists, academics, architects and engineers to present their latest finding in the fields of wind engineering and wind energy. The workshop aims to encourage collaborations, address new challenges and provide a platform for the discussion of the social and economic effects of the wind environment. A broad scope of topics and interested parties are welcomed.

The workshop committee invites abstract submissions on all wind engineering and related topics, including wind energy. Recommended categories include:

- Aerodynamics
- Bridges and tall buildings
- Codification & standards
- Meteorological events
- Structural dynamics
- Transport, dispersion & deposition of pollutants
- Ventilation and human comfort
- Wind damage & structural failures
- Wind energy & wind turbines
- Wind hazards, vulnerability & risk
- Wind modelling (numeric & physical)

The latest research on these topics and many others will be explored during the workshop.

Sponsors
The organising and executive committees are currently considering sponsorship proposals. Please email the committee at AWES15@awes.org to discuss participating in the event

INFO

Registration
Registraion is available for the entire week or individual days. The full registration fee includes the program and abstract book, attendance at all sessions, refreshment breaks (including lunch), the welcome reception (icebreaker) and the Conference dinner. Please use the registration tool on the AWES website at: www.awes.org

Abstracts & Paper Handling
Abstracts can be submitted through the AWES website. Extended abstract templates are available for download in MS Word and LaTeX formats. Papers will be peer reviewed by the committee and members of the scientific community. Authors retain all rights to their content. For more information, please see the AWES website.

Key Dates

1st Oct 2011:	Registration opening
1st Dec 2011:	Four page extended abstract submission Early-bird registration deadline
16th Jan 2012:	Final registration deadline
27th Jan 2012:	Notice of acceptance

Accommodation & Dining
Hotel and dining information for attendees will be made available on the AWES website.

Fees	Early-Birds		Fees	
	Member	Non-Member	Member	Non-Member
Full	$350	$450	$450	$550
Single Day	$200	$250	$250	$300
Student	$75	-	$125	-

AWES15 is coming soon…. Abstracts due at the end of this month!

AWES Workshop and Wind Loading Handbook

Contributor: Mick Chay, Katrina Swalwell

Please note that the dates for the upcoming 15th Australasian Wind Engineering Society Workshop have changed to 23 and 24 February, 2012. The templates for abstracts for the 15th AWES workshop are now available on the website:

www.awes.org/?section=AWES15

Remember abstracts are due by the end of November!

The 15th AWES Workshop is intended to provide a forum for scientists, aims to encourage collaborations, address new challenges and provide a platform for the discussion of the social and economic effects of the wind environment. A broad scope of topics and interested parties are welcomed. The workshop committee invites abstract submissions on all wind engineering and related topics, including wind energy.

Recommended categories include:

- Aerodynamics
- Bridges and tall buildings
- Codification and standards
- Meteorological events
- Structural dynamics
- Transport, dispersion & deposition of pollutants
- Ventilation and human comfort
- Wind damage & structural failures
- Wind energy & wind turbines
- Wind hazards, vulnerability & risk
- Wind modelling (numeric & physical)

The latest research on these topics and many others will be explored during the workshop.

The date of the Wind Loading Handbook Workshop has also changed, and will now take place on 22 February, 2012. The Wind Loading Handbook Workshop will present information covered in a new AWES publication, "Wind Loading Handbook For Australia And New Zealand - Background To AS/NZS1170.2 Wind Actions"

The publication supplements and extends upon the information provided in the wind loading standard. The wind loading handbook workshop will encompass a one day series of presentations regarding the contents of this new publication. For more information and registration, please see the AWES website:

www.awes.org

2012/2013 Membership Renewal

Members are reminded that the new 2-year membership period, encompassing 2012 and 2013, will be starting soon.

Fees for the new membership period are:

- $95AUD for full members
- $40AUD for postgraduate students and free for undergraduate

Members are encouraged to renew their membership, particularly those wishing to take advantage of the members discount for registration at the upcoming AWES workshop.

Thank-you to everyone that supported the society with their membership during 2010 and 2011. We hope you will continue your support into the future.

For more information, please contact AWES membership coordinator Mick Chay at membership@awes.org

Upcoming International Conferences:

The 12th American Conference on Wind Engineering (12ACWE) is scheduled for June 16-20, 2013 in Seattle, Washington.

See www.12ACWE.org for further details.

Announcement of the Alan G. Davenport Wind Loading Chain

Contributor: Nicholas Isyumov

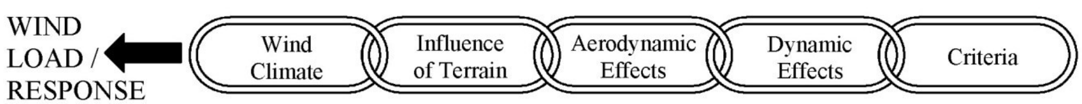
On July 12, 2011 during ICWE-13 in Amsterdam, the General Assembly of the International Association of Wind Engineering (IAWE) unanimously approved the use of the term the "Alan G. Davenport Wind Loading Chain" for describing Alan Davenport's approach for evaluating wind loads and wind-induced responses for buildings and structures.

Many of us remember Alan G. Davenport's name in connection with a number of specific technical aspects of wind engineering. These include his power law wind profiles; his spectrum of turbulence; his admittance and joint acceptance functions, which describe the spatial and temporal properties of turbulence as required in the evaluation of dynamic wind action; his gust effect factor; his pioneering use of wind tunnel model studies to chart the dynamic properties of buildings and structures; his statistical methods for predicting maximum values of extreme winds and their effects of wind on buildings and structures; and his criteria for judging the effects of wind on building occupants and pedestrians.

Notwithstanding his influence on these and many other specific aspects of wind engineering, his greatest legacy is his rational approach or "chain of thought", which ties together these various concepts in the development of the methodology for evaluating the action of wind on particular buildings and structures.

Professor Davenport's approach or chain of thought is described as follows:

THE ALAN G. DAVENPORT WIND LOADING CHAIN



Alan's approach recognizes that the wind loading on a particular building or structure is determined by the combined effects of the local wind climate, which must be described in statistical terms; the local wind exposure, which is determined by the terrain roughness and topography; the aerodynamic characteristics of the building shape; and the potential for load increases due to possible wind-induced resonant vibrations.

He also recognized that clear criteria must be in place for judging the acceptability of the predicted loads and responses. These include the effects of wind on the integrity of the structural system and the exterior envelope and various serviceability considerations which influence performance and which determine habitability. The latter include the wind-induced drift, the effects of wind-induced motion on occupants and the usability of outdoor areas of the project, as well as its immediate surroundings.

In his papers Alan referred to this process for evaluating wind action as the wind loading chain. This was in recognition that the evaluation of wind loading and its effects relies on several interconnected considerations, each of which requires scrutiny and careful assessment. With analogy to a physical chain, the weakest link or component of the process determines the final outcome. Little is gained by embellishing strong links but much is lost by not paying attention to the weak ones.

Alan and others have written about this wind loading chain and have used this chain concept to describe and solve specific wind engineering problems. Perhaps the most lucid raison d'être for this "chain" was articulated by Alan himself in his Chapter 12 of the book entitled "Engineering Meteorology", edited by Eric Plate and published by Elsevier Scientific Publishing Company in 1982. This chain or multiplicative process for arriving at wind loads has been adopted in many building codes and standards.

Not only is it effective for formulating the loads and responses to wind action, it is also a powerful model for evaluating the reliability of the final outcome. For example, the coefficient of variation of the predicted wind action is to a good degree of approximation equal to the square root of the sum of squares of the coefficients of variation of the individual links.

In the case of wind loads, the coefficient of variation (CV) can be approximated as follows:

$$CV_{wind\ load} \approx (CV^2_{reference\ wind\ pressure} + CV^2_{wind\ exposure} + CV^2_{aerodynamic\ shape} + CV^2_{dynamic\ action})^{1/2}$$

It is most fitting that the IAWE has decided to posthumously honor the late Alan G. Davenport by adding the "Alan G. Davenport Wind Loading Chain" to the wind engineering terminology. This is done in recognition of Alan's many contributions to the development of wind engineering. It is hoped that the usage of the term "Alan G. Davenport Wind Loading Chain" to describe the wind loading process, as Alan developed it, will keep both the man and his work in our memory.

Wind Engineering Research Needs

Contributor: ASCE Technical Council for Wind Engineering (thanks to Leighton Cochran)

The ASCE Technical Council for Wind Engineering (TCWE), chaired by Ted Stathopoulos, has published a short note on current North American, wind-engineering, research needs (authored chiefly by Peter Irwin). This has been distributed locally by both ASCE and AAWE, and as the TCWE team thought that this work is certainly likely to have relevance beyond North America the article is published below.

Wind storms are one of the greatest natural causes of damage and loss of man-made structures and material. They come in various forms but hurricanes, tornadoes and downbursts produced by thunderstorms, extra-tropical depressions and local topographically induced phenomena such as down-slope winds are the main types of wind to be considered.

Major events like Hurricanes Andrew and Katrina cause loss of life, injury and tens of billions of dollars' worth of damage in one single event. They are in the news for many weeks. Also, every year the local extreme winds caused by thunderstorms routinely cause death and destruction on a smaller scale but much more frequently. Although there have been significant advances in knowledge of the effects of wind on structures since the early 1960s, it is true to say that much of this has been gained on a shoestring budget. Funding for wind research has been tiny compared with that thrown into seismic-engineering research, despite the fact that in North America losses due to wind storms have historically far outweighed those due to earthquakes (Figure 1).

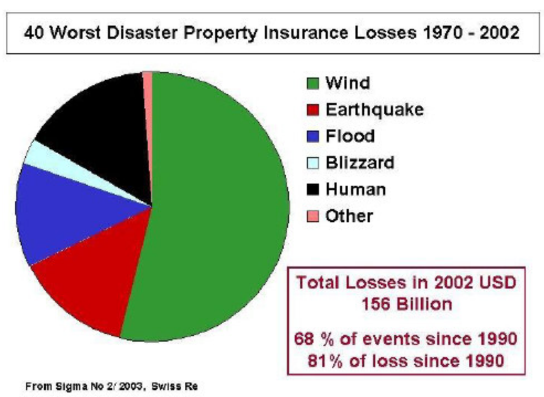


Figure 1: Insured losses from wind events are substantially larger than other causes.

Figure 1: Insured losses from wind events are substantially larger than any other cause

Wind is also a very significant source of clean energy and wind farms are proliferating in many countries including the USA. The technology is developing rapidly not only in terms of the hardware but also in areas such as assessing the best sites, predicting and maximizing the power that can be obtained, dealing with environmental concerns such as noise, and tying the wind energy sources into the conventional power grids. In future the further development of effective wind power systems will require considerable research effort. Countries that have the most active research programs in wind power are most likely to become the leaders in providing equipment and services on a worldwide basis.

Much of the knowledge gained in the impact of wind on structures has come from project specific studies on large structures such as tall buildings, stadiums and arenas, and long span bridges. For these projects the research takes place in an ad hoc manner and the funding for this is absorbed within the design costs of each project. Often the wind engineering budget per project is in the $100,000 to $1,000,000 range. This “hidden” research funding, while allowing some advances to be made in small steps, does tend to be mostly of limited scope, because in the end the needs of the project must take precedence over any more lofty long term research goals. As a result the advances in general knowledge of the behaviour of wind, wind statistics and wind loading of structures has been slow and sporadic. To make major advances a protracted and persistent research effort must be maintained over many years and have stable funding.

The vast majority of structures are not tall buildings, long span bridges, stadiums or arenas and do not receive the type of special attention the big projects receive. Funding for wind engineering research into this great majority of structures and the code wind provisions by which they are mostly designed has been pitifully small in the USA. As a result most structures are built using relatively crude information on wind loading, and this is because of the scarcity of research funding for this field. A similar situation exists for snow loading, which is closely linked to wind since most of the highest loading occurs in drifts caused by the interaction of snow with wind.

With the above as background the following subjects are seen as in great need of future research.

- The wind loading of buildings is highly sensitive to shape. Very few shapes are handled in standards like ASCE-7. As a result designers are frequently uncertain how to interpret the standard for their particular building, because it does not look like any of the shapes for which load provisions are given. Added to this is the fact that the limited wind provisions that are given in ASCE-7 and other North American codes and standards are based on wind tunnel tests done over 30 years ago. Since then the technology of wind tunnel testing has advanced and can produce much more data, faster and with greater precision. Therefore, an extensive program of wind tunnel testing to establish design pressure coefficients for a wide range of different shapes is needed. One specific example has been suggested by the ASCE Committee on Special Structures: their Tensioned Fabric Structures Task Committee has pointed out the lack of any useful design, wind-load data in ASCE-7 for the dual-curvature smaller roofs (saddle and cone shapes) that form a huge part of that industry.

- Wind loading is also sensitive to the surroundings of a building. Clearly the surroundings can be highly variable. Therefore, in parallel with item 1, research is needed into the uncertainties caused by this variability and the way that these can be accounted for in the code provisions for wind and the associated load factors. This topic needs a research team with expertise not only in wind loading and wind tunnel methodology but also in structural liability and risk. A test program with a range of potential surroundings is needed in order to establish realistic values of parameters like coefficient of variation that are used in structural reliability assessments. To establish appropriate levels of reliability achieved by code loads and load factors, Monte Carlo simulation methods should also be applied.

- The analysis of extreme meteorological wind data has in the past mostly assumed that all wind data can be treated as part of a single population of events. In reality the events are due to several different types of phenomena such as outlined in the first paragraph. Research is needed into the consequences for design loads of analysing the different types of wind storm as distinct populations.

The vertical profiles of wind velocity and turbulence tend to differ in the different storm types and this could make current assumptions inaccurate for some types of structure.

- In recent years substantial advances in meteorological modelling have been made, primarily as a result of developments in the field of weather forecasting. Research into how these techniques might be applied to improving the wind maps in North America could bring substantial benefits. Currently the wind maps are based on highly simplified analyses of ground based data obtained at airports. Regional differences tend to be lost in the scatter caused by local anomalies of the weather station and its surroundings. Advanced meteorological modelling tools can be used to detect true regional differences and eliminate scatter resulting from use of local ground based data alone.

- The classification of exposure categories is still left much to the judgment of individual designers. They have to judge how rough the terrain is upwind of a site for each direction of importance, and they rely on simplistic descriptions given in code documents. With current GIS technology, satellite information and databases such as Google Earth it should be feasible to go to a web site, feed in your latitude and longitude and obtain on line a terrain roughness category or exposure coefficient as a function of height for any given wind direction. The development of this technology is feasible and would bring many benefits in improved consistency and accuracy. The choice of exposure category is one of the major sources of uncertainty in predicting wind loads from code provisions.

- Wind tunnel tests on scale models are relied on heavily for determining wind loads on buildings, especially the larger structures. However, there are only a few rare cases where the real structure has been instrumented during or after construction so as to measure the wind loads and structural response. Information from such an instrumentation program provides invaluable guidance on the accuracy of existing prediction methods and ways to improve them. In the absence of a good body of full scale data current prediction methods probably err on the conservative side, which causes additional construction cost and use of more resources than necessary. Billions of dollars can potentially be saved annually by in construction by spending a few tens of millions on structural monitoring programs focused on wind.

- Similar to or in conjunction with (6) above, full scale building monitoring could also lend valuable information to structural engineers in developing structural models that better represent the actual building properties, including stiffness and the degree of cracking allowed for various return periods from serviceability to ultimate limit state.

- Research needs to continue into the response of structures to tornado and thunderstorm downburst winds. This area of research is fairly new but methods of simulating these winds at small scale have been explored using specially designed wind tunnels and look promising. Tornados and thunderstorm downbursts are a significant cause of damage each year and ways of reducing this could pay big dividends. The impact of these winds on code requirements needs to be accounted for in a more rational way than is currently the case.

- One area that has not received enough attention is the way that many ordinary low-rise structures actually respond to wind and snow loads. The detailed load paths and mechanisms of failure of many low rise structures built using traditional materials and methods are not well understood. Past research has shown that relatively small changes can have a dramatic impact on this type of structure's ability to withstand extreme loads. One example is the simple use of hurricane straps to secure the roofs of houses in hurricane areas. For the cost of a few dollars major improvements in safety are achieved.

- The changing climate of the earth has the potential to alter the frequency and strengths of extreme wind and snow storms. Research into these effects is still at the rudimentary stages and this topic needs to be more vigorously pursued.

- The snow load provisions in codes and standards are relatively primitive compared with the structural analysis software currently available to determine the effect of a given load. Thus, the potential benefits of the advanced structural software go to waste due to the low level of accuracy of the inputs. The heaviest snow loads are the drifting, i.e. through the interaction with wind. Therefore there are great potential benefits to be gained by developing improved knowledge of this interaction and through further developing methods for predicting extreme snow loads under different climate conditions.

- The field of wind energy has a number of research needs. Methods for predicting the power available from a given site, taking into account the local terrain, do exist but need substantial improvement. Methods based on the full power of the latest Computational Fluid Mechanics and weather forecasting tools need to be explored. As well many aspects of wind turbine behaviour are not fully understood, particularly their dynamic response to fluctuating wind loads, which if well researched could lead to substantially improved overall lifetime performance.

- The installation of small turbines on buildings is becoming more popular but their performance in the complex air flows near a building is often disappointing due to lack of understanding of these airflows. Widespread use of such small installations is unlikely to take place until such problems are understood and solved.

- The application of Computational Fluid Dynamics methods in wind engineering looks promising. It is already being used for a number of special applications such as flow over complex terrain, the comfort of pedestrians around buildings and wind loads on individual products such as satellite dishes. Continued development of these methods could lead to better understanding of many of the problems in wind engineering.

The tools and knowledgeable experts to do the above research exist but funding to put them to work has been missing. As a result the wind (and snow) provisions in even the most advanced standards such as ASCE-7 are not nearly as effective as they could be. The beneficial societal impact of the improved knowledge coming from such a program would be enormous, saving many lives and injuries and reducing by billions of dollars every year the cost of construction and the cost of damage from wind storms.

Well, that's it for this edition of the AWES Newsletter. Many thanks must go to our contributors.

As always, a newsletter cannot exist without news, so any stories, photos or information on upcoming events will always be appreciated.

Cheers,

Leighton Aurelius
AWES Newsletter Editor.

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