



American Association for Wind Engineering

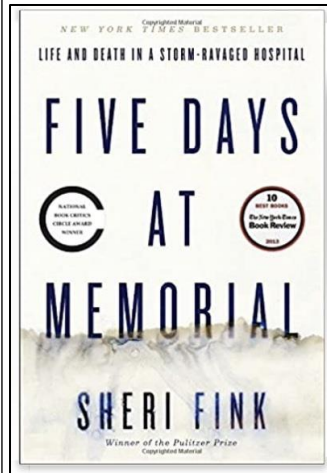
THE WIND ENGINEER

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

In This Issue

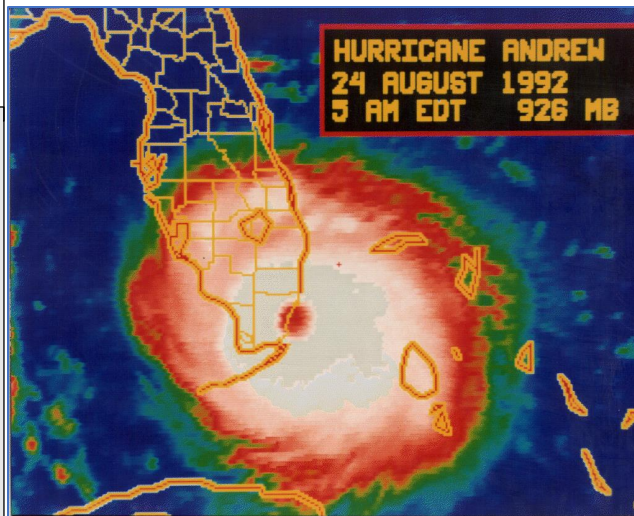
- In the news.....1
- Hurricane Andrew 30 years later.....1
- Teaching and research using computational fluid dynamics by R.P.Selvam.....3
- News & Updates.....6
- President's corner.....7

In the news: Historical Hurricanes Katrina and Andrew



Hurricane Katrina is back. Apple TV has created a multi-episode series based on Sheri Fink's book entitled "Five Days at Memorial" which chronicles the horrific events during Hurricane Katrina at Memorial Hospital in New Orleans. Real footage from the storm and flooding after the levees broke is interspersed with the scripted treatment. The series and book provide insight into what can happen during stressful times in wind related disasters.

Hurricane Andrew 30 years later: 16-28 August 1992
Damage due to Andrew was estimated to be \$25 billion. The hurricane cut a pathway through the southern Florida peninsula to the south-western Louisiana coast. *Source for all Andrew figures and information: Ed Rappaport, Hurricane Andrew, Preliminary report, National Hurricane Center, 10 Dec 1993, with Feb 2005 update.*

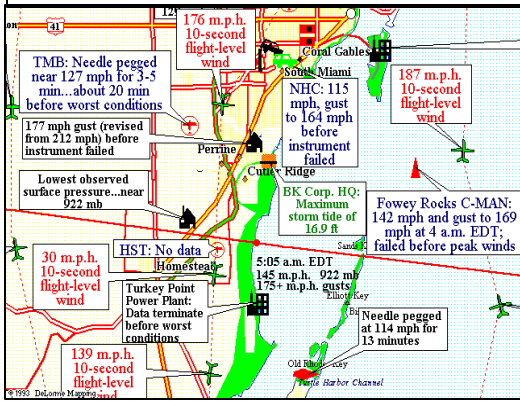


Adjacent figure: Hurricane Andrew infrared image in southern Florida on August 24th. The maximum sustained surface wind speed (1-min average at 10 meters elevation) during landfall was estimated at 145 mph, with gusts at that elevation to at about 175 mph.

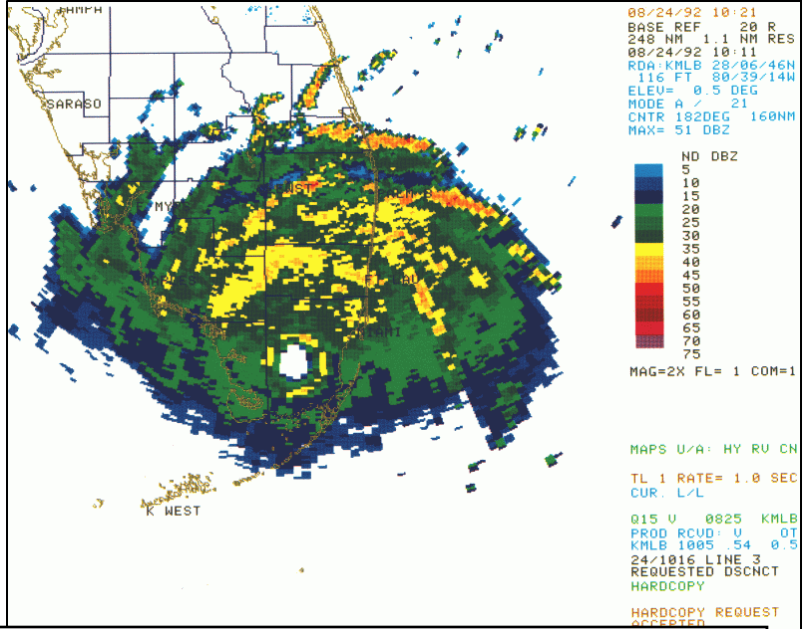


NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

Wind speeds in southern Florida



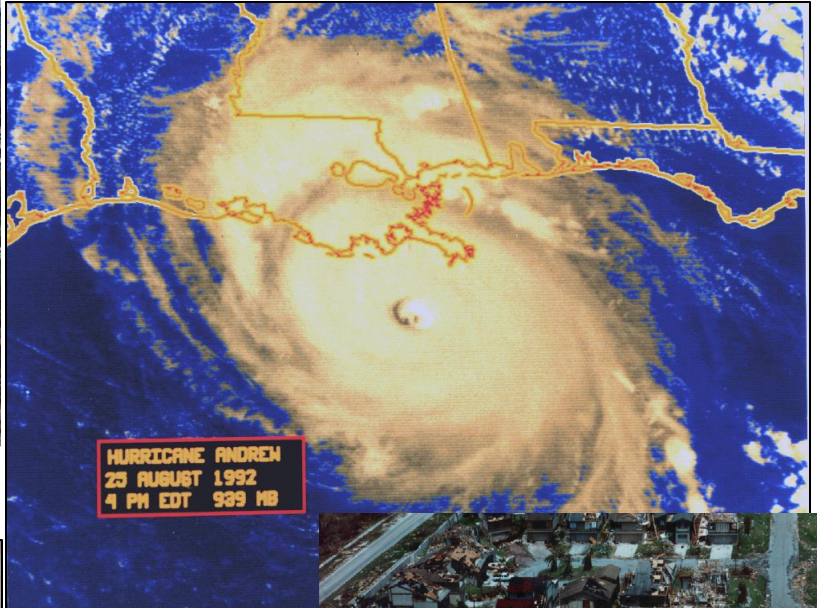
August 24, 1992 in Florida. DBZ = decibels.



Damage to Homestead, FL



August 25, 1992, approaching southwestern Louisiana



Palm tree in Homestead



Damage to single family homes was devastating (Louisiana).



Teaching and Research Using Computational Fluid Dynamics (CFD) for Wind Engineering

By R. Panneer Selvam, email: rps@uark.edu

CFD is an emerging tool in wind engineering and often, it is called *computational wind engineering* (CWE) in the wind engineering community. In recent years extensive papers have been published in wind engineering related journals. My journey on CFD application for wind engineering began in the Fall of 1982. During that time, the solution of the Navier-Stokes equation was challenging work due to limitations in the development of numerical techniques, computer speed and computer memory. Recent developments in high performance computing made it possible to routinely analyze and design using CFD in the aeronautical area. The wind engineering community started to develop and apply CFD for research and industrial applications.

Even though more than 25 graduate students from my research group conducted research in CWE they had to learn CWE the hard way, i.e., on their own with some help from me. For more than 10 years, I have been trying to develop course material to help them to learn CFD for wind engineering much faster. In the Fall of 2014, I taught a CFD class for the first time, and in this class all the students wrote their own programs. That was a disaster. Half of them wrote the code and the other half didn't have the interest to do it. Next time, in the Fall of 2016, I decided to teach as an application type course wherein students used the CFD code I developed but learned how to interpret the results. They would do certain benchmark problems such as flow in a cavity, backward facing step, and flow over circular cylinder as a project. I had used this method in my finite element methods class for more than 30 years and it had always worked well. The Fall 2016 CFD course was recorded, and distance education students take it once a year all around the country. Information regarding the distance education program at the University of Arkansas (UARK) can be found here: <https://mse.uark.edu/>. The CFD along with all other MSE courses are available to both degree seeking and non-degree seeking students.

I felt that the traditional CFD course does not address many of the wind engineering application needs. Therefore, I added many applicable examples relevant to wind engineering and consequently reduced the numerical portion of CFD. Then I offered a new course called **CFD for wind engineering** in the Fall of 2020. This course is also available online and is offered once a year via the UARK distance education program. Before applying CFD, wind turbulence is introduced and students are required to calculate the wind spectrum for a given wind data. The benchmark problems like flow over a 2D hill, flow around 3D building with and without inflow turbulence, and flow around a 2D rectangular cylinder are considered. The last two problems were time dependent ones and hence require more computer time. The programs could be run on a personal computer. The next revision included expanding the course material, adding chapters on OpenFOAM (open-source software) for wind engineering, and a chapter on advanced topics which will be included in a new edition of my book forthcoming in October 2022. Additional book details are provided in Selvam (2022). The OpenFOAM application chapter is an expansion of two education papers (Mansouri et al, 2022 and Verma et al. 2022). The case files to learn the OpenFOAM application for civil engineering is also available at the github web page: [rpsuark \(rpsuark\) / Repositories · GitHub](https://github.com/rpsuark). If anyone is interested in offering the class, I will be very happy to provide the CFD programs and input files I used in the class. Please feel free to contact me via the email provided above. In addition to the CFD and CFD for wind engineering courses, I also offer courses in finite element method, structural dynamics, and matrix methods of structural analysis every year as a distance education class.

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Even though CWE research has been conducted for the last 37 years at the UARK, last 20 years have been far more relevant. The computation of critical velocity for flutter of a bridge section using free motion is very efficient as reported in Selvam et al. (2002). Many researchers routinely use this approach as compared to the forced motion approach. The work by Selvam and Millet (2003 & 2005) on tornado forces on a building is just a beginning to understand the tornado forces. Here, a 3D engineering vortex model is allowed to interact with a building. This method has the flexibility to behave similar to a tornado in the field as reported in Dominquez and Selvam (2016 & 2017). They explained using a 2D model, when a tornado interacts with a hill, why there is damage on one side sometimes and damage on the other side some other times as reported from field observation (Selvam et al. 2015 a & b) as shown in Figures 1 and 2. In recent years, we also used CFD to validate vortex chamber models with and without a building present as reported in Verma and Selvam (2021) and Verma et al. (2022). To compare with chamber models, different criteria were identified and the CFD results were in good comparison with chamber measurements. Of the two approaches (engineering model and chamber model), which one is more reasonable to predict tornado loads on structures will be determined in time.

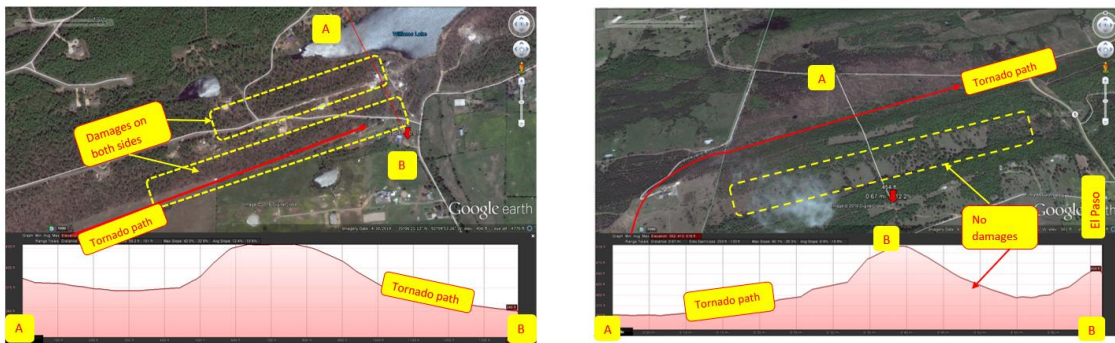


Figure 1. Tornado damage observed for 2014 Mayflower tornado (a) both side of the hill and (b) one side of the hill

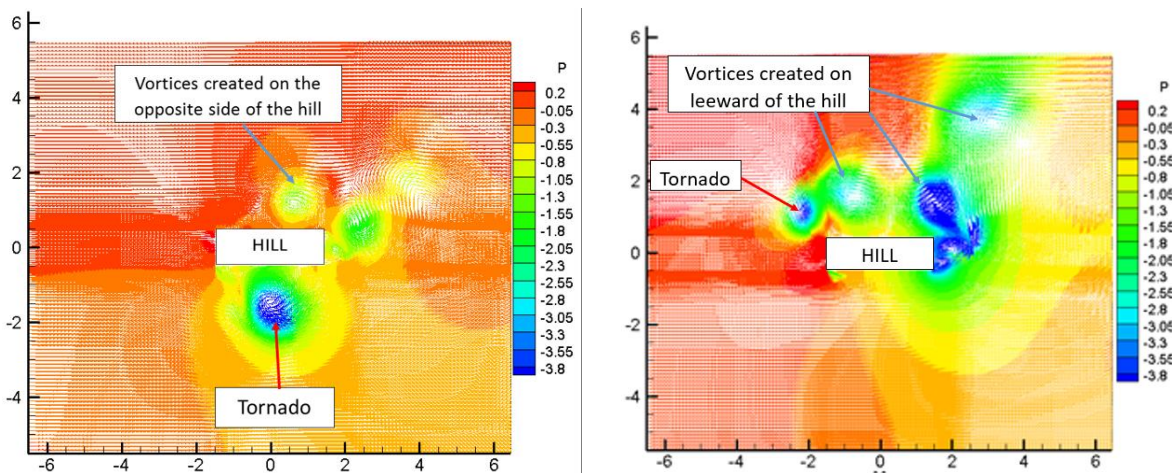


Figure 2. CFD model study illustrating the damage (a) vortex on both side of the hill and (b) vortex on one side of the hill

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For a safer design of low-rise buildings and to mitigate damages due to severe winds, one needs to know the peak pressure on the buildings. This is a major challenge, and several researchers have been actively pursuing this research. For the success of CFD application, specifying proper inflow turbulence at the inlet is the key. In the recent years, our group has investigated eleven different inflow turbulence generators for wind engineering applications as reported in Mansouri et al. (2022a & b). Certain methods performed better than other methods, but additional research is needed. The paper by Mansouri et al. (2022a) brings out the connection between grid spacing and inflow turbulence parameters and their effect on peak pressure computation. The status is that the computed peak pressure is in reasonable comparison with the wind tunnel measurements for one case study and more research is needed for the others. Overall CWE is advancing much faster than I thought and there is more room to contribute for everyone.

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NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

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Dr. Selvam

The AAW E Board of Directors is calling for proposals from the Americas region to host the 15th Americas Conference for Wind Engineering (ACWE) in 2025. The Americas Conference for Wind Engineering (ACWE) provides an opportunity for scientists, engineers, architects, educators, and practitioners to discuss wind science and engineering, as well as wind energy research.

The ACWE is held every four years. The 14th ACWE hosted by the National Wind Institute at Texas Tech University in 2022 was delayed by one year due to Covid. The AAW E Board would like to hold the 15th ACWE in 2025 to maintain the original four-year schedule.

Interested parties should send a one-page proposal to Dorothy Reed at Dorothy.reed@aawe.org by **September 30, 2022** for consideration. The Board will consider all proposals and announce its selection this fall.



Dr. Reinhold

Congratulations to **Dr. Timothy Reinhold!** Reinhold was awarded the **Jack E. Cermak Medal** from ASCE. He recently retired from the Insurance Institute for Business & Home Safety (IBHS) after almost fourteen years. Prior to IBHS, Tim had a very successful academic career at Clemson University and spent ten years as a consulting engineer in the US, Canada and Denmark. He was at NIST for five years after he earned BS, MS and Ph.D. degrees from Virginia Tech. He serves on the ASCE7 Wind Loads subcommittee and the SBCCI Wind Load subcommittee.

Changes in the AAW E Board will occur in 2023. Board members Dr. Luca Caracoglia of Northeastern University, Dr. Catherine Gorle of Stanford University, and Dr. Ioannis Zisis of Florida International University, will be rotating off the Board after their terms expire in December. The AAW E Board thanks these members for their contributions and support over the past several years. AAW E will also need a new President-Elect as Dr. Murray Morrison will become AAW E President in 2023. An election committee is being set up to solicit nominations for all positions and hold elections of candidates. Please look for an email soon.

President's Corner

Dear Members:

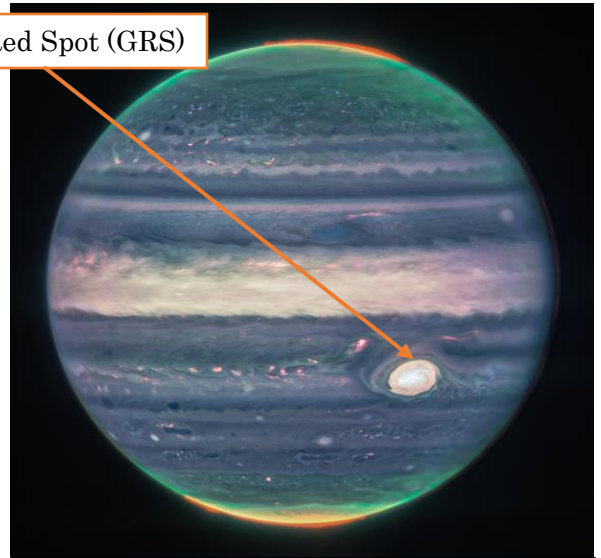
In my last letter, I mentioned my fondness for science fiction and novels about planetary travel. I've been pretty excited during the past couple of weeks to see lots of (real) images from space. In recent days, images of Jupiter from the James Webb Space Telescope, an international program of NASA, with the European Space Agency and the Canadian Space Agency, have been published. Jupiter, as shown in the adjacent figure from blogs.nasa.gov, is the largest planet in our solar system, and it is home to the largest storm in the system. The Great Red Spot (GRS) of Jupiter is a huge storm that has been swirling for centuries.

The GRS actually looks white in the image due to the coloration used in processing. This storm is 10,000 miles across – the diameter of Earth is 7917.5 miles - and it has been observed for about 200 years. Can you imagine a 200-year storm on Earth? Recent observations suggest that the GRS may be shrinking, but it is not clear if it will continue to get smaller. Wind engineers of the future will have to contend with these types of issues when planet colonization begins. Lots of possibilities await.

With best wishes,

Dorothy

Great Red Spot (GRS)



Webb NIRCам composite image of Jupiter from three filters – F360M (red), F212N (yellow-green), and F150W2 (cyan) – and alignment due to the planet's rotation. Credit: NASA, ESA, CSA, Jupiter ERS Team; image processing by Judy Schmidt.

Sources: blogs.nasa.gov (2022); *Science*, 28 Oct 2021, Vol 374, Issue 6570, pp. 964-968, [DOI: 10.1126/science.abf1396](https://doi.org/10.1126/science.abf1396); NPR Morning Edition, Brendan Byrne, Nov. 2021.

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