



THE WIND ENGINEER

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

In this issue:

Simplified Method for Evaluating the Impact of a Transportation Network on Post Hurricane Access to Healthcare Facilities	1
President's Corner	3
U.S. Department of Commerce Gold Medal Awarded for Research on Joplin Tornado	3

Simplified Method for Evaluating the Impact of a Transportation Network on Post Hurricane Access to Healthcare Facilities

Yuepeng Cui, National Wind Institute, Texas Tech University
 Daan Liang, National Wind Institute, Texas Tech University
 Linguang Song, University of Houston

Healthcare facilities including hospitals and clinics play a critical role throughout a hurricane by providing continuity of medical care for patients admitted before a storm and serving a large number of people seeking medical treatments in its aftermath.

The focus of this study is to examine the interdependency between transportation and healthcare systems during the aftermath of hurricanes. More specifically, it has the aim of developing a simplified method for estimating the daily level of access to hospitals as affected by road conditions after a storm. This method takes into account of road closures and the hospital operation status that can be used quickly to calculate the hospital service population, an indicator of community wellbeing. It provides an efficient way to measure temporal and spatial changes in the process of recovery and al-

low scenario-based analysis for decision-making support.

The common reasons for road closures were flooding, debris in roadway, high water and power lines down on road surfaces. Road closure was coded in the TxDOT database with two states: impassable and passable. Traffic would be totally prohibited at a specified location or link if coded as impassable while traffic could go through but with added cost (i.e. travel time or travel distance) to its normal condition if coded as passable. At its peak, approximately 322 kilometers were deemed impassable and 64.4 kilometers were passable, and 30,633 kilometers were normal out of a total of 31,020 kilometers of roads within the Houston MSA. As seen in Figure 1, roads in the passable condition were returned to null by the end of September while roads in the impassable condition were reduced to the level of approximately

(Continued on page 2)

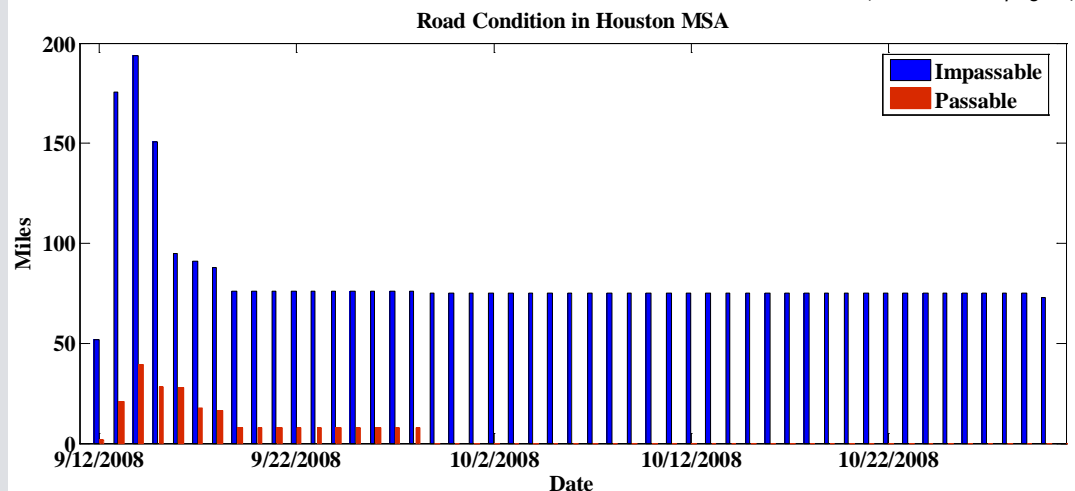


Figure 1. The Time History of Road Closure (Impassable and Passable) in Houston MSA



(Continued from page 1)

129 km due to extensive damage to State Highway 87, Interstate Highway 45 and State Highway 275 in Galveston County, TX. After September, 27, 2008, TxDOT restored most of its network except for several roads remaining closed to traffic. TxDOT also identified and recorded the reasons for road closures in the database.

Data

The database was maintained by TxDOT and included road closure information for all interstate highways, state highways and farm to market roads.

Methodology

To estimate the level of access to medical facilities in the aftermath of a storm, two indicators are defined: Hospital Service Area (*HSA*) and Hospital Service Population (*HSP*). Assume *N* hospitals within a given boundary (county in this case) and Hospital *i* ($1 \leq i \leq M$) is designed to serve residents living in its neighborhood. The access to this hospital is provided by a road network whose spatial layout and design speed would determine the size of area (*HSA*) or population (*HSP*) being served. One can calculate *HSA* for Hospital *i* given a maximum travel time allowed (T_{max}) in minutes. In other words, HSP_i would include all areas from which a person can reach Hospital *i* within less than T_{max} . If T_{max} is set to a small number, there could be more parts of a community not being served by any hospitals. On the contrary, some parts could be served by more than one hospital if T_{max} is large. Therefore, choosing the proper value for T_{max} will affect the result of the analysis.

The block function was used in ArcGIS to calculate the non-overlapping service area for each hospital (ArcGIS 2012). The block function calculated various statistics (e.g., maximum, minimum, and mean) for a fixed set of non-overlapping windows or neighborhoods. At the beginning, neighborhood was created at the top left corner of the road network by ArcGIS. Neighborhood was a specific area determined by the travel time or travel length of the service area. And then the minimum bounding rectangles

were calculated to define the size of the output block. The block function partitioned the remaining area of the road network for each county into defined blocks (as no blocks can overlap each other). Since the hospital location was identified in each block and the travel time was calculated in each specified non-overlapping neighborhood of each block, the result values could be assigned to every hospital in the minimum-bounding rectangle of the specified neighborhood.

Results

For county-by-county comparison across time scales, a hospital access indicator *HAI* is defined at *t* as

$$HAI = \frac{\text{Hospital Service Population}_t}{\text{Hospital Service Population}_{\text{before Storm}}} \quad (1)$$

Hospital access indicator (*HAI*) in Figure 2 reached its lowest point on September, 14, 2008, one day after the storm landfall. Although Road SH0146 and IH 0045 in Harris County, TX, reopened on September 17, 2008, due to the need of removing debris one lane was again closed to traffic on September 18, 2008. As the result, the value of *HAI* dropped. It nearly returned to its pre-storm level at the end of October, but didn't fully recover until the East Houston Regional Medical Center (EHRMC) in Harris County, TX, and the University of Texas Medical Branch Hospital in Galveston County, TX, reopened.

References

ArcGIS Help Library. ArcGIS Resource Center. (2012). Retrieved February 5, 2013, from http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/What_is_Network_Analyst/004700001000000/

U.S. Department of Transportation Federal Highway Administration. (2008). <http://www.fhwa.dot.gov/planning/processes/tools/nhpn/>

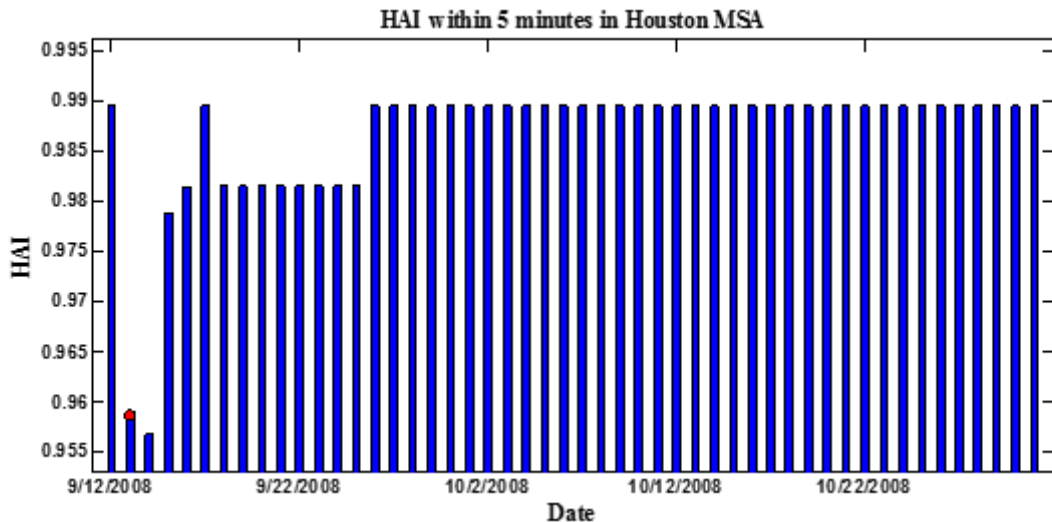


Figure 2. Daily Values of *HAI* at 5-min before and after Hurricane Ike for Houston MSA



President's Corner

G'day!

On behalf of the AAWE I want to wish you all a productive 2015. I would particularly like to welcome new members, as well as thank continuing members, both individual and corporate, for their support.

This is my first newsletter as incoming President of the AAWE and I am looking forward to working with the membership and interested parties over the next two years to promote

wind engineering, our organization, and grow interest in our field in the Americas region.

I would like to thank the Board members who have recently completed their terms; Mr. Steve Camposano, Drs. Anne Cope and Dorothy Reed, as well as continuing directors; Drs. David Prevatt and John Schroder, and Mr Bill Coulbourne for all their contributions and efforts. I also must thank Dr. Steve Cai who has quietly gone about his work as secretary/treasurer for many years allowing us to function smoothly and Dr Hector Cruzado for his fantastic efforts putting out a regular Newsletter. Finally, I would like to offer my sincere thanks to Dr. Greg Kopp for all his efforts as President over the past two years, and also for all the input he has given to the Board and to me during the transition period.

Of course, to be successful, we need participation from you, our membership. There are several ways you can participate and contribute:

- First, we will be having an election shortly to fill the 3 empty positions on our Board of Directors and for a President-Elect. Please send me your nominations by April 1 for these open positions.
- Second, AAWE is also the sponsor of the 8th International Colloquium on Bluff Body Aerodynamics and Applications to be held in Boston June 5-9, 2016 under the co-chairmanship of Drs Luca Caragolia and Chris Letchford. Please watch for advertisements for this important international conference in our calendar.
- Third, we are always looking for articles for this newsletter. Please do not hesitate to send articles on your research findings or interesting projects, or even ideas for special issues, to either Dr. Hector Cruzado (hcruzado@pupr.edu) or to me.

We are interested in ways we can make AAWE more relevant to you and to enhance the implementation of our mission "to promote and disseminate technical information in the research community". If you have any questions or comments about AAWE, please do not hesitate to contact me.

As this is the second time I have headed a national Wind Engineering Organization (previously chair of the Australasian Wind Engineering Society), I will finish where this welcome began, if our organization is going to succeed, everyone needs to:

'Avagoyamug'!

CHRIS LETCHFORD

President, AAWE
letchc@rpi.edu

U.S. Department of Commerce Gold Medal Awarded for Research on Joplin Tornado

The United States Department of Commerce (DoC) has awarded a DoC Gold Medal to four scientists and engineers for their investigation on building performance, warnings, and human behavior in the 2011 Joplin, MO tornado. The medal is awarded for distinguished performance characterized by extraordinary, notable, or prestigious contributions that impact the mission of the Department of Commerce in the United States and throughout the world.

The recipients of the medal include Long Phan, a structural engineer and Erica Kuligowski, a disaster sociologist of the National Institute of Standards and Technology (NIST), Frank Lombardo, a wind engineer from Rensselaer Polytechnic Institute (formerly of NIST) and Dave Jorgensen, Chief of Warning Research and Development at the National Oceanic and Atmospheric Administration.

The EF-5 rated Joplin tornado caused 161 fatalities (the deadliest tornado on the official record) as well as damaging over 8,000 structures and causing nearly \$2B dollars in insured losses. The significant amount of loss in Joplin prompted NIST to investigate the causes of this disaster. To determine the possible causes, the Joplin team pioneered the integration of four key tornado components: storm characteristics, building performance, human behavior and emergency communications. As a result of the investigation, a total of 16 recommendations were developed to improve standards for building design and construction, public shelters and emergency communications that can significantly reduce deaths and economic costs caused by tornadoes. These recommendations included development of:

- Performance-based standards for tornadoes
- Standards for design and construction of critical facilities to remain operational during a tornado
- Nationally accepted codes and standards, as well as uniform guidance for clear, consistent and accurate emergency communications.

The NIST final report on the Joplin tornado can be accessed at: http://www.nist.gov/manuscript-publication-search.cfm?pub_id=915628

The DoC Gold Medal will be presented to the recipients at a ceremony in Washington, DC on January 27, 2015. The photo shows the four recipients being honored in a separate ceremony at NIST in December 2014.



From left to right: Long Phan, Erica Kuligowski, Dave Jorgensen and Frank Lombardo

AMERICAN
ASSOCIATION FOR
WIND ENGINEERING



Established in 1966

A professional organization dedicated to the advancement of the science and practice of Wind Engineering and the solution of national Wind Engineering problems through transfer of new knowledge into practice.

Corporate Members of AAWE

Boundary Layer Wind Tunnel Laboratory, University of Western Ontario

www.blwtl.uwo.ca

Cermak Peterka Petersen, Inc.

www.cppwind.com

Insurance Institute for Business & Home Safety

www.disastersafety.org

National Wind Institute, Texas Tech University

www.wind.ttu.edu

Risk Management Solutions, Inc.

www.rms.com

Rowan Williams Davies & Irwin, Inc.

www.rwdi.com

SOH Wind Engineering LLC

www.sohwind.com

Weidlinger Associates Inc.

www.wai.com

President

Dr. Chris Letchford
Rensselaer Polytechnic Institute
letchc@rpi.edu

President Elect

Vacant

Past President

Dr. Greg Kopp
University of Western Ontario
gakopp@uwo.ca

Secretary/Treasurer

Dr. Steve C.S. Cai
Louisiana State University
cscai@lsu.edu

Newsletter Editor

Dr. Héctor J. Cruzado
Polytechnic University of Puerto Rico
hcruzado@pupr.edu

Board of Directors

Mr. Steven Camposano
High Velocity Hurricane Protection Systems
steve@category5.com

Dr. Anne Cope
Insurance Institute for Business & Home Safety
acope@ibhs.org

Dr. David O. Prevatt
University of Florida
dprev@ce.ufl.edu

Mr. William L. Coulbourne
Applied Technology Council
bcoulbourne@atcouncil.org

Dr. Dorothy Reed
University of Washington
reed@u.washington.edu

Dr. John Schroeder
Texas Tech University
john.schroeder@ttu.edu

American Association for Wind Engineering

1415 Blue Spruce Drive
Fort Collins, CO 80524
Phone: 970-221-3371
Fax: 970-221-3124
www.aawe.org
aawe@aawe.org