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El Puente

Puerto Rico Transportation Technology Transfer Center Newsletter
University of Puerto Rico at Mayagüez

In this Issue:

Risks in the Use of Highways and Bridges During a Hurricane or Tropical Storm

On September 21, 1998 hurricane Georges battered Puerto Rico. Reduced to a category 3 hurricane, Georges caused the death of 12 people and serious damage to the economy and infrastructure of the island. Almost 8,000 utility poles collapsed, 96% of the population lost its electric power service and 75% of the aqueducts and sewers were ruined. The 26 inches of rain generated by the hurricane caused floods and landslides resulting in damages to Puerto Rico's highways amounting to more than $25 millions. The Puerto Rico Highway and Transportation Authority (PRHTA) assigned $47,387,567.00 for 512 highway related projects associated with hurricane Georges effects. Due to the floods, the falling down of poles, trees, masts, and traffic signals catenaries, and inoperative systems in principal arterial corridors, four municipalities experienced considerable traffic problems while the remaining suffered traffic problems associated with the island wide power outage. The estimated cost associated with the passage of hurricane Georges through the island amounts to $2,300,000,000.

Ten years after this tragic event, this article presents an overview of the risks associated with the use of local roads during an event of a hurricane and/or tropical storm and the lessons learned of this natural disaster that caused so much damage to our built infrastructure. Preventive measures before, during , and after a hurricane or tropical storm event are discussed.

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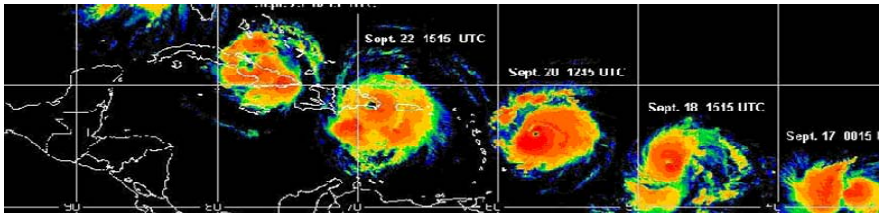
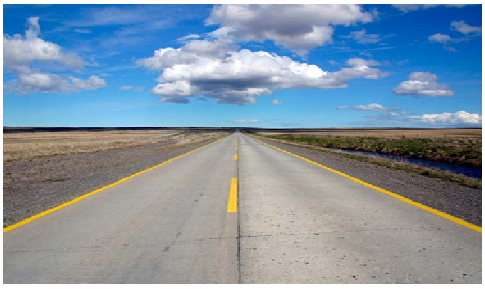


Source: NOAA

The Future of SAFETEA-LU

The Transportation Equity Act for the 21st Century (TEA-21) expired on September 30, 2003. After two years of intense debate in Washington DC, on August 10, 2005 President George W. Bush signed the Safe, Accountable, Flexible, Efficient Transportation Equity Act - A Legacy for Users (SAFETEA-LU). The expiration of SAFETEA-LU is at the end of the 2009 fiscal year. Government and nongovernmental officials have submitted several proposals for the SAFETEA-LU reauthorization in 2009.



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During an event of hurricanes and/or tropical storms the possibility of vehicle crashes increases generating safety, travel time delays to drivers and other related problems that result in injuries, fatalities and/or damage to public and private property.

Typical problems and situations on roads associated with hurricanes and tropical storms and their impact on the road network

Highway infrastructure problems associated with hurricanes and tropical storms include but are not limited to the followings:

- Collapse of roads and bridges
- Landslides and boulders on the roadway
- Falling trees, utility poles and signs obstructing the right of way
- Collapse of catenaries and traffic lights masts
- Failure in traffic operations in progressive arterial traffic signals systems
- Electrified power lines on the roadway surface
- Loose objects behaving as projectiles
- Blocked culvert and other drainage and storm water systems
- Blocked highway routes hindering the passage of emergency vehicles
- Dead animals and cattle on the roadway
- Debris in general
- Vehicular congestion on other routes
- Median barriers functioning as dams and with the potential of flooding nearby communities
- Flooding on the road network low points
- Highway gridlock

Floods and wind are the principal factors that affect the road network during a hurricane and tropical storm significantly affecting the accessibility and mobility of people and merchandise, government agencies that provide refuge and disrupting the evacuation process of people in zones prone to flooding, landslides and other high risk areas. The type and magnitude of these impacts depends upon whether it is a rural or urban highway.

Preventive measures prior, during, and after a hurricane and/or tropical storm

Prior to the arrival of a hurricane or tropical storm to the island the following tasks should be performed:

1. Cutting of tree branches near electric power lines.
2. Cleaning of river channels that traditionally overflow in similar events or situations.
3. Training technicians in the use of chainsaws to cut fallen trees.
4. Signalize of evacuation routes in the principal highways of the primary and secondary network including ports.
5. Installation of Variable Message Signs (VMS) on strategic locations on the pavement networks.

During a hurricane or tropical storm among the measures and actions that must be executed are:

1. Use of trained personnel day and night to handle this type of situation.
2. Provision of the necessary high-visibility safety apparel needed to perform the assigned tasks.
3. Deployment of sufficient portable electric generators on strategic places in municipalities and administrative agencies around the island.
4. Coordination, exchange or loan of commercial motor vehicles belonging to adjacent municipalities or to the Department of Transportation and Public Works (DTOP) to assist in the cleanup of debris on highways.
5. Interagency coordination that includes the Civil Defense, Firefighters, PRHTA, DTOP, Port Authority, Federal Emergency Management Agency (FEMA), the Puerto Rico Police, and other pertinent state agencies, including 911.
6. Installations of VMS in locations were landslides have occurred threatening the safety of highway users.

On this hurricane season we all have the responsibility of preventing the recurrence of previous mistakes associated with deficient infrastructure that can create a safety hazard to our citizens. The lessons learned in Puerto Rico can be of used to mitigate the effects of hurricanes and tropical storms in 2008 and in future years.

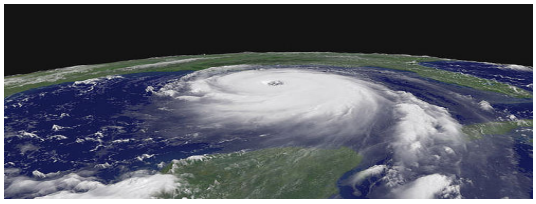
Author: Benjamín Colucci PhD, PE, PTOE

Source: NOAA, El Nuevo Día

Did you know that the first hurricane name list only used women names? Beginning in 1979 the National Hurricane Center began using male names, twenty seven years after it began christening hurricanes.

Basic terms and definitions associated with hurricanes:

- **Advisory**: A formal announcement issued by the National Hurricane Center (NHC) that states the location, intensity, direction of travel, and speed of a tropical storm or hurricane.
- **Bulletin**: A public release made during periods between advisories, announcing the latest details on the storm or hurricane.
- **Eye:** The roughly circular area of comparatively light winds that encompasses the center of a severe tropical cyclone or hurricane. It is either completely or partially surrounded by the eyewall cloud.
- **Eyewall:** Cloud wall that surrounds the hurricane eye were the strongest wind and rain are found.
- **Hurricane**: A violent storm originating over tropical waters, with winds near its center reaching 74 mph and higher that develops on the North Atlantic, the Gulf of Mexico, the Caribbean Sea and the east North Pacific. A hurricane is known as a typhoon on the northwestern Pacific Ocean and as a cyclone on the Indian Ocean.
- **Hurricane Warning:** A public announcement that indicates sustained winds of 74 mph or higher associated with a hurricane are expected in a specified coastal area in a period of 24 hours or less.



- **Hurricane Watch:** A public announcement for specific coastal areas that hurricane conditions are possible within 36 hours.
- **Tropical Depression:** A tropical cyclone in which the maximum sustained surface wind speed is 38 mph or less.
- **Tropical Storm:** A cyclone in which the maximum sustained surface wind speed ranges from 39 mph to 73 mph.
- **Tropical Storm Warning:** A public announcement that indicate sustained winds within the range of 39 to 73 mph associated with a tropical cyclone that are expected in a specified coastal area within 24 hours or less.

(Adapted from FEMA, USCG, telemundo51.com)

Center News

The EXPO Hurricane and Secure Homes held in Plaza Las Américas, is an educational campaign that informed the attendees on how to protect their lives and property prior, during and after a hurricane event. The activity organized by architect Astrid Díaz and meteorologist Ada Monzón, was held from July 28 to August 3, 2008. In this event, invited professional speakers in the fields of engineering, architecture and electrical power supply gave presentations to the audience to create awareness on how to protect their homes form tropical hurricane events.

Dr. Colucci speaking with the audience at the event on August 1, 2008.

Dr. Benjamín Colucci, the Director of the Puerto Rico Transportation Technology Transfer Center, participated during the evening session of Friday, August 1, 2008, presenting the topic **Risks in the Use of Highways and Bridges During a Hurricane or Tropical Storm Event.**

To obtain a copy of the presentation by Dr. Colucci please visit www.uprm.edu/prt2.

From left to right: Astrid Díaz, Dr. Benjamín Colucci and Ada Monzón

(continued from page 1)

It is estimated that in the next 50 years, the United States and its territories need to invest at least $255 billion annually to repair the existing transportation system and introduce emerging technological the security of users and promote economic and social development. Currently, annually only less than 40% of this quantity is invested.

Consequences of inaction by the governmental sector

The lack of strategic action in addressing current and future transportation system problems would have serious implications in the security of users, the quality of life and the economic development of the nation.

The National Surface Transportation Policy and Revenue Study Commission identifies at least eight (8) consequences of not taking decisive action in accordance with present and future transportation challenges:

1. Continuous deterioration of the transportation system. The collapse of the Interstate I -35W bridge on the Mississippi River, were 13 people died, is an example of the deteriorated transportation infrastructure that was not upgraded to the standards.

2. Highways fatalities will continue to increase. In 2006 nearly 43,000 people died on the United State highways. If the safety measures needed on highways are not financed more people will most likely continue to die.

3. Vehicular congestion will continue to increase. For the year 2002 approximately 58% of the US highways experienced significant traffic congestion. According to the Texas Transportation Institute (TTI) the United States economy lost $78 billion due to vehicular congestion in terms of gas and man-hours lost. In the next 50 years, a 50% increase of the population is expected which translates to increasing travel times.

4. Continuous underinvestment in all modes of transportation. Even with a significant expansion in highway capacity the projected increase demand will not be satisfied if other modes of transportation are not financed.

5. Excessive delays in the financing of projects resulting in the unnecessary expenditure of public and private funds.

Source: National Surface and Transportation Policy and Revenue Commission

6. Persistent conflict between transportation policies and other national policies.

7. Transportation financing will continue to be politicized.

8. Stagnation of economic development. The deterioration of the transportation system would reduce the competitiveness of the United States economy.

The financing problem

A significant amount of money is needed to finance the repair, expansion and improvement of the transportation system and the current financing mechanism do not generate the necessary funds. The Highway Trust Fund (HTF) is an example of a financing and investment mechanism that no longer produces the necessary funds to satisfy the demand. This fund uses gas and vehicle taxes to maintain and construct the national highway system. However, inflation has reduced significantly the gas tax purchasing power and improvements in fuel efficiency have meant lower gas tax revenue per mile travelled. This example illustrates the need for innovative financing in order to address the growing needs of the transportation system infrastructure.

Proposals for the new bill that will replace SAFETEA-LU

Several proposals have been submitted for consideration for the new bill that will replace SAFETEA-LU. The proposals that were presented in the summer 2008 to be considered in the new include:

1. National Surface Transportation Policy and Revenue Commission Study

2. The Interim Report of the National Surface Transportation Infrastructure Financing Commission

3. Proposed Infrastructure Banking Legislation

4. Proposed Climate Change Legislation

5. Proposal by the US Department of Transportation

6. Testimony to House Transportation and Infra-

structure Committee, Panel on Transportation Challenges in Metropolitan Areas

7. Metropolitan Mobility Caucus

Nine (9) conclusions highlighted from the testimonies, studies, reports, and legislations previously described are as follows:

1. Underinvestment is affecting the transportation system.
2. A fundamental shift in financing strategies is needed. The current programs should not be authorized in their current form.
3. Federal programs associated with transportation systems should be simplified and consolidated.
4. Investment decisions must be executed after rigorous cost and benefit analysis.
5. Creation of a program explicitly focused on system maintenance is a must.
6. The gas tax is not enough to finance the transportation system long term needs.
7. Tolling and congestion pricing should be used for greater system efficiency.
8. New technological innovations should be examined to determine the potential pricing strategies.
9. A new approach should be taken for metropolitan transportation problems, which should include greater governmental cooperation and use of public transportation.

At the nongovernmental, the American Road & Transportation Builders Association (ARTBA) proposes a 10 cent increase of the gas tax and the creation of a critical commerce corridors program. This critical commerce corridors program consists of eliminating bottlenecks, widening highways and expanding access routes to airports and seaports.

The Puerto Rico Transportation Technology Transfer Center will continue informing in future editions of "El Puente" the latest development and status of SAFETEA-LU legislation applicable to Puerto Rico.

Adapted from a Ronald Kirby Presentation, the National Surface Transportation Policy and Revenue Study Commission Final Report and the Interim Report of the National Surface Transportation Infrastructure Financing Commission

Seminars and Future Events

The Puerto Rico Transportation Technology Transfer Center will be offering the following seminars:

November 20-21, 2008
Selection and Inspection of Safety Barriers in Road Safety Audit
Location: St. Croix, USVI

December 4, 2008
Effective Time Management
Location: CIAPR, Mayaguez

December 10, 2006
Applied Hydraulic Modeling in H-H Studies for Puerto Rico
Location: UPRM

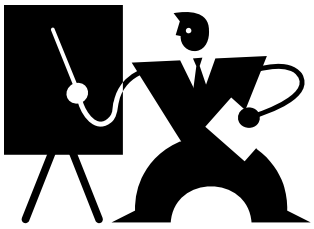
For more information regarding the Center's seminars please contact:

Grisel Villarrubia
Telephone: 787-834-6385
Email: gvilla@uprm.edu
www.uprm.edu/prt2

Conferences:

January 11-15, 2009
88th TRB Annual Meeting
Location: Washington D.C.
Contact: 866-229-3691 or 301-694-5243

June 1 & 5, 2009
2009 Region 4 LTAP Annual Meeting
Place: San Juan, Puerto Rico
Contact: Gisela González
Telephone: 787-834-6385
Email: ggonzale@uprm.edu



Pothole Repairs Guidelines for Tropical Conditions in Puerto Rico

Local street and highway potholes often appear in seasons of high precipitation in tropical areas like Puerto Rico or as a result of poor compaction, utility failures, inadequate pavement thickness or a combination of factors. This pavement distress can cause vehicle crashes resulting in the fatalities and potential tort liability to highway agencies.

In the following paragraphs a 15 step by step process is prepared to assist local highway officials to fix this structural and functional failure.

1. Establish the most adequate traffic control measures depending upon the traffic, speed and classification of the highway being repaired to insure necessary field precautions to workers and road users. The traffic measure must meet the requirement of the Manual on Uniform Traffic Control Devices (MUTCD), Part 6 – Temporary Traffic Control or the equivalent manual or guidelines developed by your agency or your local transportation technology transfer center.

2. Delineate the distressed pavement area with a piece of chalk or paint. Be sure that the area immediately adjacent to the pothole has no cracks and that it is in good condition to adequately bond with the new patch.

3. Prepare the pothole. Cut the deteriorated pavement material with a cutting tool.

4. Remove part of the base course staring at the center of the hole and moving toward the sides of the delineated line. Be sure that the sides of the hole are completely vertical to provide a good adhesive surface for the patch material.

5. Remove all debris and loose material from the hole including free water. Use compressed air or a broom for these purpose.

6. Apply a thin coat of asphaltic emulsion to the vertical sides of the hole when using a hot mix patch material. This coating will provide the necessary bond between the existing and new surfaces. Do not apply a tack coat to the vertical sides of the hole for cold mix patch material since the characteristics of this mix will bond to the existing surface.

7. Fill the hole with the proper patch material (hot mix asphalt or a proprietary patch material) using a shovel or an approved tool for that purpose.

8. Compact the patch material at the corners with a tamper.

9. Bring the material to the proper level for compaction slightly above the top surface of the hole equivalent to the diameter of a pencil.

10. If holes are deeper than five inches (12.5 mm) fill with more than one layer compacted separately as necessary.

11. Use a small roller or vibratory plate to compact the surface of the hole with at least two passes or the number of passes approved by the agency.

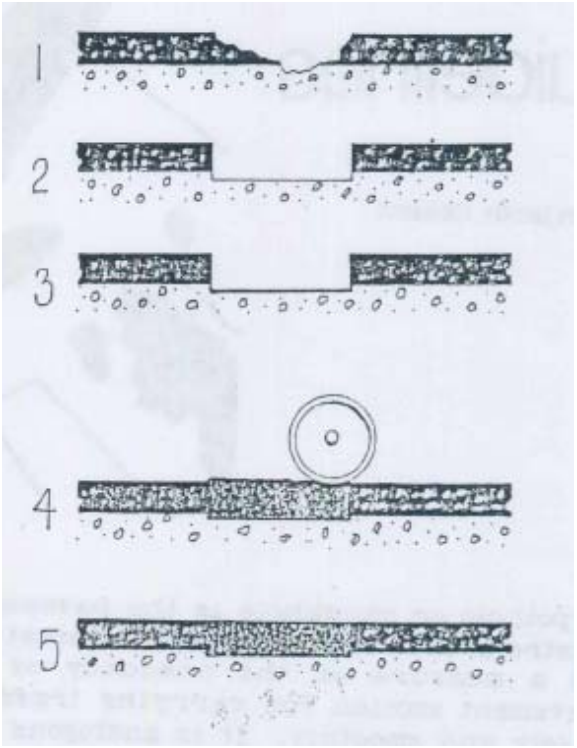
12. Seal the patch edges to avoid water and moisture to penetrate the hole.

13. Clean the rehabilitated area.

14. Remove all work zone traffic devices following MUTCD, Part 6 – TTC guidelines.

15. Resume normal traffic flow.

A simplified five (5) steps graphical representation of the pothole repair process is shown below.

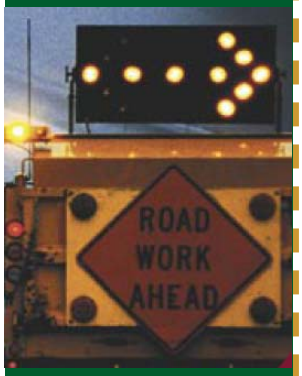


Things to avoid in the process of repairing a pothole.

On occasions, due to an emergency situation agencies perform the reparation process without the adequate soil preparation. In some cases vertical sides to confine the asphaltic mix are omitted. If this emergency solution is performed the agency must consider that the effectiveness and useful life of the reparation may be reduced by heavy traffic and rain, therefore the crew must redo the reparation sooner than expected.

Lesson: Repair it correctly from the get go!

Transportation Management Plans in 23 CFR 630 Subpart J



Source: FHWA

The Federal Highway Administration (FHWA) updated the regulation Traffic Safety in Highway Work Zones and Street by publishing the regulation Work Zone Safety and Mobility Rule found in Title 23 CFR 630 Subpart J. Changes to the regulation were implemented to address the security and mobility impacts caused by work zones not only in the project physical site, but also in the corridors, roads and regions where the project is located.

The new considerations respond to the need for more repairs and reconstructions given the aging highway system which requires more work zones while traffic volume and congestion increases. This situation causes serious inconveniences to road users, affects the transportation system efficiency, and puts pressure on agencies and contractors to compress their work plans. Given the aforementioned situation, the regulation introduces new provisions regarding the concept of Transportation Management Plans (TMP).

Transportation Management Plans

A TMP provides a series of coordinated strategies and describes how they will be used to manage the impact of a project's work zone. The TMP includes a Temporary Traffic Control Plan (TTC), a Transportation Operation component (TO) and elements of public information (PI) on significant projects. The TTC plan is responsible for traffic safety and control of the work zone, whereas the TO deals with operations and management of the transportation system in the area impacted by the TTC zone. Examples of TO measures are trav-el demand management, signal retiming, use of Intel -ligent Transportation Systems (ITS), and traffic incident management, among other. PI strategies to convey information to the user prior to and during the trip include the use of information pamphlets, websites, radio messages and Variable Message Signs (VMS). For non significant projects the TMP may consists only of a TTC plan.

TMP Benefits

Six (6) major benefits of the TMP include:

- It addresses the TTC zone impacts on safety and mobility at the corridor and network level.
- It improves the safety of workers and travelers around the TTC zone.
- It minimizes impacts on the local community and businesses.
- It keeps the public informed.
- It improves intra and interagency coordination.
- It improves the efficiency and effectiveness of the preparation, cost and duration of the works.

A Six (6) Step by Step Process to Develop and Implement a TMP

To develop and implement a TMP the following six (6) steps must be followed:

Step 1: Gather all information relevant to the project. It includes the project characteristics, potential impacts, and mitigation strategies.

Step 2: Identify the needs the TMP must address. The TMP is developed in accordance with the project significance on the basis of the relevant information gathered and the transportation agency's policy. The regulation identifies three development levels, namely basic TMP (TTC), intermediate TMP (TTC/ optional TO or IP), and major TMP (TTC/TO/ IP).

Step 3: Identify stakeholders. They can be internal, like different departments within the agency, or external, such as communities, businesses, the police or the local government. Stakeholders can provide valuable information in regards to the different strategies to be used to minimize the TTC zone impacts.

Step 4: Develop the TMP. It must consider the projects limitations, the mitigations strategies proposed and an implementation cost estimate.

Step 5: Update and review periodically the TMP. It must be modified as the project progresses through its different development stages and specific information becomes available, therefore, continuous monitoring during the construction phase is required.

Step 6: Final Evaluation. After the construction is completed, a TMP performance assessment must be carried out to improve the effectiveness of future implementations.

Frequently Asked Questions (FAQ's) and Answers in regards to the Work Zone Safety and Mobility Rule:

Who does this rule apply to?

To all states and local agencies that receive federal funds for roads, specifically to all highway construction projects financed entirely or in part by federal highway funds.

What is a significant project?

An individual or combined adjacent projects, that will generate sustained work zone impacts to levels greater than those tolerable to state policy and/or engineering judgment.

Who is responsible of developing and implementing TMPs?

Agencies must develop and implement the TMP taking into account stakeholders input. The Rule requires that both the agency and the contractor designate a trained person on project level to implement the TMP and other aspects of the projects safety and mobility.

The Puerto Rico Transportation Technology Transfer Center is planning to conduct seminars to inform professionals in the transportation and related areas on the new provisions of the Work Zone Safety and Mobility Rule.

Available at http://ops.fhwa.dot.gov/wz/index.asp

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