Pedestrian Disaster Preparedness and Emergency Management of Mass Evacuations on Foot

by the

NYSDOT Office of Integrated Modal Service,

for the

Queens Hospital Center

Emergency Management Committee’s

Conference on Emergency Preparedness

Queens, New York – 2/13/08
Walking is the Predominant Mode of Urban Evacuation under these circumstances:

- Immediate catastrophic events that result in total highway and transit system shutdown.
- A lack of special equipment needed to meet a particular threat limits emergency response.
- Self-evacuation of most first responders occurs due to a nuclear/chemical/biological disaster.
- Where there is a chance of survival by walking as far away from the danger zone as possible.
How Does Walking Out Make Sense?

1. It will be impossible to drive or haul out all evacuees (ambulatory & non-ambulatory).
2. The need to make capacity available for the hospitalized, the institutionalized, and the homebound to be conveyed to safety.
3. When the “walk-out zone” feeds into a regional evacuation strategy that applies all travel modes (surface, marine, and air).
4. The shorter the distance, the greater the number of people who can walk to safety.
When it’s at all possible to walk to relative safety and/or to other modes, this is what people do, as was seen in:

- 1980, and 2005 Public Transit Strikes in NYC,
- 9/11 Attacks in NYC and Washington, D.C.,
- August 2003 Northeast Power Blackout,
- Hurricane Katrina’s impact on travel for the car-less population in New Orleans.
- A Next Event is a Matter of When, Not if it will Occur! Will We Prepare for Evacuation on Foot?
Most Evacuation Plans Do Not Address Sudden Catastrophes

- New York City would rely on its transit system – based on the assumption that it would remain operational/manned (a 2006 NYU survey found that 53% of New Yorker’s would drive or use a taxi).
- The Bay of Naples (Italy), with 4 million people from Naples to Sorrento, would primarily rely on a commuter rail system in case of a sudden and catastrophic volcanic eruption and/or earthquake.
Recognizing the Value of Pedestrian Evacuation

- “The major forms of transportation…after the attack were walking, etc…” (Source: USDOT Draft Report – Effects of Catastrophic Events on Transport. System Management and Operations: NYC – 9/11, 4/21/02)

- “Develop a transportation plan that steers pedestrians…to predetermined thoroughfares.” (Source: Enhancing NY City’s Emergency Preparedness, NY City Emergency Response Task Force, 10/28/03)

- “Emergency response plans need to consider the movement of pedestrians as well as vehicles.” (Source: Learning from the 2003 Blackout, from Public Roads, Volpe Ctr., USDOT/FHWA, September/October 2004)
When Walking Is Faster!

- The University of Minnesota ran computer models of evacuation routes, and found that because of the time people took to get to their cars, and the traffic jams that created – leaving the car behind was the best option under the following scenarios:

1. For a one mile evacuation radius from the impact zone (applies to Minneapolis, Mn.).
2. For Evacuation volumes greater than 5,000 per square mile, walking is faster.
Developed by the Univ. of Minnesota, the US Army, and Minnesota DOT, for macro level simulations,

A heuristic algorithm that models capacity as a time series and uses a capacity constrained approach,

Provides high quality solutions at a reduced cost compared to linear programming approaches,

CCRP is contra-flow, scalable to the number of evacuees and the size of the network,

Can be applied using Arc GIS graphics, and is applicable to vehicular, and pedestrian traffic.
## Four Scenarios in metropolitan area, Evacuation Zone Radius: 1 Mile Circle, daytime

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Population</th>
<th>Vehicle</th>
<th>Pedestrian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A</td>
<td>143,360</td>
<td>4 hr 45 min</td>
<td>1 hr 32 min</td>
</tr>
<tr>
<td>Scenario B</td>
<td>83,143</td>
<td>2 hr 45 min</td>
<td>1 hr 04 min</td>
</tr>
<tr>
<td>Scenario C</td>
<td>27,406</td>
<td>4 hr 27 min</td>
<td>1 hr 41 min</td>
</tr>
<tr>
<td>Scenario D</td>
<td>50,995</td>
<td>3 hr 41 min</td>
<td>1 hr 20 min</td>
</tr>
</tbody>
</table>
We Now Have Empirical And Photographic Evidence That Walking Is Faster

Based on the findings of the CCRP model, the researchers found that a walking-based evacuation within a one mile radius is roughly three (3) times faster than trying to drive out on congested roads (based on an assessment of Twin Cities, Minneapolis-St. Paul, Minnesota test sites by the University of Minnesota).
<table>
<thead>
<tr>
<th># of Evacuees</th>
<th>200</th>
<th>2,000</th>
<th>10,000</th>
<th>20,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Driving</strong></td>
<td>4 min</td>
<td>14 min</td>
<td>57 min</td>
<td>108 min</td>
<td>535 min</td>
</tr>
<tr>
<td><strong>Walking</strong></td>
<td>18 min</td>
<td>21 min</td>
<td>30 min</td>
<td>42 min</td>
<td>197 min</td>
</tr>
<tr>
<td><strong>Driving/Walking</strong></td>
<td>0.22</td>
<td>0.67</td>
<td>1.90</td>
<td>2.57</td>
<td>2.72</td>
</tr>
</tbody>
</table>
The Implications of these Findings for High Density Urban & Suburban Evacuation for Sudden Events

When evacuees exceed 5,000 per square mile:

- Potential life saving benefits go well beyond downtown central business and walking districts.
- This threshold includes urban residential, office buildings/parks, and major sidewalk-based retail areas.
- This threshold also includes high density residential suburbs with quarter acre lots, multistory towers, and large “edge cities.”
- Some major event and recreational venues.
Integrating Pedestrians into Disaster Preparedness & Evacuation Activities

1. Establish Pedestrian Evacuation Planning & Operational Strategies (Short Term Actions). These actions are called “Walk-out Plans.”

2. Implement low cost improvements to provide more pedestrian capacity, as consistent with ADA Transition Plans (Mid-Term Actions).

3. Revise Regulatory & Zoning Guidance to enhance pedestrian safe access as required by the ADA law, and to better facilitate mass evacuations on foot (Long Term Actions).
Operations (Short Term): Basic Logistics of a Walk-Out Plan

1. Establish a cordon area where walking is the fastest mode (using evacuation model),
2. Designate priority pedestrian evacuation routes (paths/lanes) within those areas.
3. Safety zones at the fringe provide access to high/single occupancy vehicle pick-up areas, transit, sea, air travel modes, etc.,
4. Requires educating the public – since their first reaction may be to drive.
5. Emergency response teams would evacuate those “at risk” (hospitals, nursing homes, the homebound, latch-key children, etc.).
Washington, DC is developing a Plan.

Minneapolis-St. Paul Evacuation Plan recommends walking within a 1 mile radius of the CBD or the disaster site.

Cleveland Downtown Business District recommends walking for a sudden threat.

Norfolk, Va. offers the option to leave on foot, and walk to pick-up/transfer sites.

Charlotte, N.C. City Center Evacuation Plan advises walking for a direct/sudden threat.
Operations (Short Term): Manage Pedestrian Use of Travel Lanes When Feasible

1. Travel lanes may be clogged or obstructed with abandoned vehicles or debris.
2. Vehicular traffic and surface transit may still be active during the evacuation.
3. Driver confusion may make pedestrian use of travel lanes hazardous.
4. Lanes may be restricted to emergency, military, and government vehicles/personnel.
5. Manage necessary pedestrian use of travel, and bridge lanes in catastrophic emergencies.
Operations (Short Term): Manage Gateways During Catastrophic Emergencies

1. Major events (terrorism, power outage, natural disaster, transit strikes, etc.) will involve pedestrian surges at bottlenecks.

2. Military/law enforcement personnel should fully anticipate and strategically plan for these pedestrian traffic surges.

3. Travel lanes used for pedestrian surges should be pre-designated for the quick removal of debris/abandoned vehicles.
Operations (Short Term): Benefits of Elevated Highways for Pedestrian Evacuation in Flood Prone Locations

- Temporary refuge for pedestrians (since rising flood water may prevent other options).
- Can be used as a staging, pick-up, and/or emergency relief drop-off location.
- A shoulder can be reserved for pedestrian use during contra-flow/managed lane use.
- These structures should be considered for hurricane and earthquake reinforcement.
How Pedestrian Evacuation Fits Into A Major Metropolitan Evacuation Plan

- While accommodating walking to safety pick-up points is essential for most evacuees, the timely availability of carpool, transit, intercity bus, rail, ferry, and air transportation is critical to successfully complete the regional evacuation task.

- For example, it is estimated that between 300,000 and one (1) million people may have evacuated Manhattan Island (New York County) by ferry, barge, motor or tugboat on 9/11/01, from both public & private carriers.
Capacity (Mid-Term): Improve Pedestrian Traffic Flows

1. Widen sidewalks/crosswalks to match existing and latent pedestrian traffic.
2. Add permanent pedestrian access during bridge rehabilitations/reconstructions.
3. Use signal phasing, progression, timing, and coordination to improve safety on foot.
5. Include pedestrian traffic within the urban portions of managed/contra-flow facilities.
6. Use ITS for lane/shoulder designation use.
Capacity (Mid-Term):
Other Facilities That Support Pedestrian Evacuation

1. Shared Use Paths (also known as Trails), including storefront and residential bicycle, pedestrian, and multiuse routes.

2. Seismic and Hurricane Resistant Bridges That Cross Geographical Barriers, and Limited Access Highways (Freeways).

3. Accessible At-Grade Pedestrian Paths, Walkways or Alleys That Connect With Homes, Plaza’s, Schools, Garages, Etc...
Compliance with Americans with Disabilities Act (ADA) Transition Planning Supports Evacuation

- Prioritized retrofits including sidewalks, curb ramps, detectable warnings, accessible street crossings, etc. to improve safety and mobility.

- Accommodate people who use mobility aids such as wheelchairs, scooters, walkers, etc... who have good, fair, and limited stamina.

- ADA compliant public rights-of-way facilitate travel to pick-up points and transfers onto high occupancy vehicles, rail, sea, air, etc...
Capacity (Mid-Term): Practices To Be Avoided

1. Restricting At-Grade Pedestrian Access (it can degrade accessible route sufficiency, connectivity, directness, and continuity).

2. With the Exception of Flood Prone Areas: Pedestrian Bridges (can be susceptible to partial or total structural collapse).

3. Pedestrian Tunnels (can be susceptible to flooding, collapse, and having entry and exit points susceptible to obstruction).

Planning (Long Term):
Integrate into Regional & Local Planning, Zoning, Building Codes, Permits & Impact Fees

- Building Codes & Environmental Regulations Should Require Expanded Sidewalk and Crosswalk Capacity with Higher Densities.
- For Gateways, plan for ample non-motorized (pedestrian and bicycle) transportation capacity along bridges and shorefront trail networks.
Planning (Long Term): Establish/Restore Local Street Grid


2. A dense “grid” pattern improves access on foot, with its shorter blocks, and more intersections where vehicles stop.

3. Short blocks and frequent cross streets create the potential for more direct routing – which is essential for safer pedestrian traffic and evacuations.
GRID DENSITY (Source: Pedestrian And Transit Friendly Design, Reid Ewing, Florida DOT, March 1996)
The first and only guidance from FHWA that is about managing mass evacuations on foot was issued in March 2007.

While it’s described as cursory, helpful insights in captioned text called “Selected points important for practitioners” are often instructive.
Primary Deficiency With Recent Federal Guidance

While concerns were expressed in the guidance about the impact of pedestrian evacuation on vehicle traffic, the subsequent discussion provided in the March 2007 Final Report does not adequately address any basic facts and/or parameters for discerning specific solutions. Therefore, the guidance is vague, and easily subject to misinterpretation and misapplication.
Need To Clarify This Major Guidance Deficiency

- Since no facts or basic parameters are provided to discern how to balance mass evacuation on foot with outbound vehicular evacuation during a sudden catastrophic event, the follow basic facts and parameters are provided for saving as many lives in the shortest possible time.
Basic Facts & Parameters for Balancing Pedestrian & Vehicle Traffic Needs

1. When it’s faster to evacuate on foot, that mode of traffic must be accommodated within the competent management of all surface, marine, and air modes of traffic.
2. Two-way access must be maintained for first responders, and all “at-risk” populations.
3. Unlike human life, vehicles can be replaced.
4. Each mode can serve a critical/lifesaving role or act as an impedance if not managed.
5. Our primary mission is to save as many lives, as quickly as possible.
Your Questions & Comments Are Welcomed!

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