Sessions No. 17, 18 & 19

Course Title: Coastal Hazards Management

Session Title: Coastal Disaster Case Studies

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Time: 150 minutes

Objectives

17.1 Become familiar with several notable coastal disasters in recent history

17.2 Understand impact of coastal disasters on mitigation strategies and disaster prevention policy

17.3 Recognize changes in impact of coastal disasters on human life in last century

17.4 Recognize potential natural hazards impacts based on historical disasters and present vulnerability due to increase population trends in coastal regions

17.5 Understand that natural hazards vulnerability can be managed through the built environment and that disasters occur when natural hazards intersect with the human coast

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Scope

Session 17 (*50 minutes*) introduces students to several coastal disasters as case studies in order to understand several disasters in more depth. The disasters chosen for the case studies include: the Galveston Hurricane of 1900, the Loma Prieta Earthquake, Hurricane Andrew, and Hurricane Floyd. Descriptions of the events, their resulting impacts and lessons learned will be discussed in each case. The focus on case examples provides students with a greater understanding of the relationship between hazards and disasters and how the intersection of the two in the built environment can have devastating effects. Each case example had lasting effects on hazards management strategy and national policy. The session will end with a 15-minute video, "Guiding Principles for the Quality Redevelopment of Eastern North Carolina" to show how an example of how state and local level policy was encouraged to change after Hurricane Floyd.

Session 18 and Session 19 (*50 minutes each*) will be reserved for student presentations on a coastal disaster of their choice. The instructions for the student presentations are listed in Handout 17.1, available for copying and distribution to the students. All handouts can be found in Appendix A.

Supplemental Considerations:

The internet is a tremendous resource for background information on coastal disasters. Many of the federal government websites are reliable and provide large amounts of information for students and the public. The students should become familiar with several of the websites as powerful resources of information. For their assigned presentations, they should be encouraged to explore the resources available on the internet. However, they should also be warned to be cautious of the reliability of their sources, as some web sites are more reliable than others.

Readings:

Instructor and Student Required Reading:

Moore, R. and J. Barnes. 2004. *Faces From The Flood: Hurricane Floyd Remembered.* Chapel Hill, NC: University of North Carolina Press.

Additional Background Reading:

Abbott, P.L. 1996. *Natural Disasters.* Dubuque, IA: Wm C Brown Publishers.

Brennan, Kristine. 2002. *The Galveston Hurricane (Great Disasters, Reforms and Ramifications).* Chelsea House Publications.

National Research Council. 1994. *Practical Lessons from the Loma Prieta Earthquake: Report from a Symposium Sponsored by the Geotechnical Board and the Board on Natural Disasters of the National Research Council.* National Academy Press.

Peacock, W.G., B.H. Morrow, and H. Gladwin. 1997. Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters. Routledge.

PowerPoint slides:
Session 17

[**PowerPoint 17.1** Lecture Outline]

[**PowerPoint 17.2** Introduction: Coastal Disaster Case Studies]

[**Power Point 17.3** Case Study: Galveston Hurricane]

[**PowerPoint 17.4** Case Study: Loma Prieta Earthquake]

[**PowerPoint 17.5** Case Study: Hurricane Andrew]

[**PowerPoint 17.6** Case Study: Hurricane Floyd]

[**PowerPoint 17.7** Lessons Learned: Galveston]

[**PowerPoint 17.8** Lessons Learned: Loma Prieta]

[**PowerPoint 17.9** Lessons Learned: Andrew]

[**PowerPoint 17.10** Lessons Learned: Floyd]

[**PowerPoint 17.11** Learning from the Past]

[**PowerPoint 17.12** Preparing for the Future]

Handouts:

[**Handout 17.1** Case Study Presentation Instructions]

General Requirements:

The Instructor should review some of the additional background reading and prepare copies of handouts (*provided as Appendix A)* based on the accompanying PowerPoint presentation.

The content of Session 17 should be presented as a lecture. Class discussion can be encouraged throughout the course of the lecture period. Those students who have been through a coastal disaster may have valuable insight and experience to share with class members. The instructor should informally poll the class to elicit "real life" stories of disaster experiences to enhance

lecture and discussion. Students should read the required readings before class and can also use the additional readings as resources for further investigation. The end of the session will use a video, "Guiding Principles for the Quality Redevelopment of Eastern North Carolina", to illustrate state and local efforts to learn from a disaster and apply that knowledge to mitigation. (The instructor should obtain the video from the North Carolina Division of Emergency Management Hazard Mitigation Section: http://www.dem.dcc.state.nc.us/mitigation/contact_us.htm). Sessions 18 and 19 will be reserved for student presentations on a selected coastal disaster of their choice. The instructions for the presentation assignment can be found in Appendix A as Handout 17.1.

The following slides will be used for the lecture outline:

[**PowerPoint 17.1** Lecture Outline]

Objective 17.1: Become familiar with several notable coastal disasters in recent history

Requirements:

The content should be presented as lecture, supported by PowerPoint slides.

The following slides will be used during this objective:

[**PowerPoint 17.2** Introduction: Coastal Disaster Case Studies]

[**Power Point 17.3** Case Study: Galveston Hurricane]

[**PowerPoint 17.4** Case Study: Loma Prieta Earthquake]

[**PowerPoint 17.5** Case Study: Hurricane Andrew]

[**PowerPoint 17.6** Case Study: Hurricane Floyd]

Remarks:

I. Introduction: Coastal Disaster Case Studies

[**PowerPoint 17.2** Introduction: Coastal Disaster Case Studies]

1. A natural hazard is a natural process that occurs under certain extreme environmental conditions in the atmosphere, on the earth's surface, or under the ground.

2. There are many different types of natural hazards, such as tornadoes, blizzards, drought, wildfire, volcanoes and earthquakes. ***Coastal hazards are those natural hazards that occur at the interface between the ocean and the shoreline.*** The hazards that are most uniquely tied to the coastal zone were presented in Sessions 6 and 7. Meteorological and geological hazards that are not as unique to the coastal zone were introduced in Sessions 8 and 9.

3. Coastal disasters occur when natural hazards occur in the coastal zone where there is human settlement. There have been many coastal disasters in the past, including some very destructive disasters in other countries.

4. This session will discuss four US disasters in more detail. These disasters include:

   - Galveston Hurricane of 1900
   - Loma Prieta Earthquake
   - Hurricane Andrew
   - Hurricane Floyd

II. Case Study: Galveston Hurricane

[**PowerPoint 17.3** Case Study: Galveston Hurricane]

A. Description of the Event

1. Unnamed Galveston Hurricane (September 8, 1900)

   - Affected states: Texas

   - The hurricane that hit Galveston, TX was the 6th most intense to hit the United States mainland from 1900 – 2000.

   - This hurricane was at category 4 strength on the Saffir-Simpson Scale at landfall and had a minimum central pressure of 931mb (27.49 inches).

   - The 20 foot storm surge completely inundated the city of Galveston.

   - Wind speeds reached an estimated 125 mph, with actual recorded measurements at 102 mph when the cities' sole anemometer broke.

B. What were the Impacts

1. This hurricane has been deemed the **deadliest** hurricane to ever hit the United States and the worst coastal disaster in United States history.

   - Over 8000 (maybe up to 10,000-12,000 including the entire island of Galveston) people died from this catastrophic event primarily from the storm surge.

   - One third of the city was destroyed including 2,636 houses and a loss of 300 feet (1500 acres) of shoreline.

   - An estimated $26.619 Billion in damages (normalized to 1995 dollars by inflation, personal property increases and coastal county population changes) were incurred.

III. Case Study: Loma Prieta Earthquake

[**PowerPoint 17.4** Case Study: Loma Prieta Earthquake]

A. Description of the Event

1. Loma Prieta Earthquake (October 17, 1989)

   - Affected states: California

   - At 5:04 PM Tuesday, October 17, 1989 a magnitude 7.1 earthquake struck the San Francisco area.
     - It took place during the 86th World Series Game between the Oakland A's and the San Francisco Giants, and
     - during the beginning of rush hour traffic

   - The quake lasted a total of twenty seconds and was centered 60 miles south of San Francisco along a dangerous stretch of the San Andreas Fault.

   - More than 7,000 aftershocks between magnitudes of 1.0 and 5.4 were felt within one year of the quake.

B. What were the Impacts

- Over 62 people died and 3,700 injuries occurred. Most of the deaths were from a collapse of highway overpasses.

- Over 18,000 homes were damages and 963 destroyed. Over 2,500 other buildings were damaged and 147 were destroyed.

- 12,000 people were displaced.

- Damage and business interruption estimates reached as high as $10 billion, with direct damage estimated at $6.8 billion.

- Seven surrounding counties were declared disaster areas by President Bush.

- San Francisco had 22 structural fires and over 500 reported incidents during the seven hours after the quake hit. These ranged from rupture of gas mains to fuel spills. Damages to water supply lines caused problems with fire response.

IV. Case Study: Hurricane Andrew

[**PowerPoint 17.5** Case Study: Hurricane Andrew]

A. Description of the Event

1. Hurricane Andrew (August 24, 1992)

- Affected states: Florida, Louisiana

- A small but ferocious hurricane, named Andrew, slammed into southern Florida. Andrew also then made landfall on the Louisiana coast a few days later

- The hurricane had a central pressure (922 mb), which is the third lowest this past century for a hurricane at landfall in the United States.

- Andrew was upgraded to a Category 5 hurricane by NOAA's Tropical Prediction Center on August 22, 2002. Primarily a wind event, NOAA's National Hurricane Center had a peak gust of 164 mph—measured 130 feet above the ground—while a 177 mph gust was measured at a private home.

B. What were the Impacts

1. Hurricane Andrew was the **costliest** US disaster

- This hurricane caused $27 billion dollars worth of destruction and 61 deaths.

- Over 125,000 homes and businesses were damaged or totally destroyed mainly due to high winds.

- The unprecedented economic devastation was along a path through the northwestern Bahamas, the southern Florida peninsula, and south-central Louisiana. Florida, especially hard, with violent winds and storm surges.

- In Dade County (FL.) alone, the forces of Andrew resulted in 15 deaths and up to one-quarter million people left temporarily homeless. An additional 25 lives were lost in Dade County from the indirect effects of Andrew.

- The direct loss of life was remarkably low considering the destruction caused by this hurricane.

V. Case Study: Hurricane Floyd

[**PowerPoint 17.6** Case Study: Hurricane Floyd]

A. Description of the Event

1. Hurricane Floyd Inland Flooding (September 1999)

   - Affected states: North Carolina, Connecticut, Delaware, Florida, Maine, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, South Carolina, Vermont, and Virginia

   - "Floyd was a large and intense Cape Verde hurricane that pounded the central and northern Bahama islands, seriously threatened Florida, struck the coast of North Carolina and moved up the United States east coast into New England. It neared the threshold of category five intensity on the Saffir/Simpson Hurricane Scale as it approached the Bahamas, and produced a flood disaster of immense proportions in the eastern United States, particularly in North Carolina."[1]

   - As Floyd neared the North Carolina coast late on the 15th, its maximum winds decreased below category three status. Hurricane Floyd made landfall near Cape Fear, North Carolina on September 16th as a category two hurricane with estimated maximum winds near 90 knots. Floyd was losing its eyewall structure as it made landfall. [1]

   - Floyd then weakened to a tropical storm and moved swiftly along the coasts of the Delmarva peninsula and New Jersey on the afternoon and early evening of the

16th, reaching Long Island by September 17th. The system decelerated as it moved into New England. [1]

- "Heavy rainfall preceded Floyd over the mid-Atlantic states. Hence, even though the tropical cyclone was moving fairly quickly, precipitation amounts were very large.
    - Rainfall totals as high as 15 to 20 inches were recorded in portions of eastern North Carolina and Virginia. At Wilmington, North Carolina, the storm total of 19.06 inches included a 24-hour record of 15.06 inches.
    - Totals of 12 to 14 inches were observed in Maryland, Delaware, and New Jersey. New records were set in Philadelphia for the most amount of rain in a calendar day, 6.63 inches. In southeastern New York, rainfall totals were generally in the 4 to 7 inch range but there was a report of 13.70 inches at Brewster. Totals of nearly 11 inches were measured in portions of New England." [1]

- Storm surge values as high as 9 to 10 feet were reported along the North Carolina coast.

B. What were the Impacts

1. A total of 13 states were issued federal disaster declarations – **the most declarations** for a single event than ever before. This disaster also holds the record for the **largest** (peacetime) **evacuation** in US history.

    - FEMA funding = $725.7 million

    - "There were 57 deaths that were directly attributable to Floyd, 56 in the United States and 1 in Grand Bahama Island.
        - The death toll by state is as follows: ***North Carolina 35***, Pennsylvania 6, New Jersey 6, Virginia 3, Delaware 2, New York 2, Connecticut 1, and Vermont 1. Most of these deaths were due to drowning in freshwater flooding. Floyd was the deadliest hurricane in the United States since Agnes of 1972." [1]

    - "In the United States, the Property Claims Services Division of the Insurance Services Office reports that insured losses due to Floyd totaled 1.325 billion dollars.
        - Ordinarily this figure would be doubled to estimate the total damage. However, in comparison to most hurricane landfalls, in the case of Floyd there was an inordinately large amount of freshwater flood damage, which probably alters the two to one damage ratio.

- ***Total damage estimates range from 3 to over 6 billion dollars***." [1]

- "According to preliminary information provided to the Federal Emergency Management agency, **over 2 million people were evacuated for Floyd** in the United States. This is probably the largest evacuation in U.S. history." [1]

- The flooding was made even worse due to the already saturated soils from Hurricane Dennis two weeks prior to Hurricane Floyd. Hurricane Dennis took place from September 4-6, 1999
    - "In Princeville, under 12 feet of water, rescue choppers roared over the town of 1,600. The nearby Tar River, already 13 feet above flood stage, was expected to rise another 2 feet."[2]
    - "For example, rainfall at Clayton was 5.0 inches during Sept. 4-6 and 7.33 inches during Sept. 14-16. At Whiteville, rainfall was 1.51 inches during Sept. 4-6 and 16.76 inches during Sept. 14-16. **Rocky Mount received 7.02 inches during Sept. 4-6 and 16.18 inches during Sept. 14-16,** or nearly half the annual average rainfall in just two 3-day periods."[3]
    - Preliminary assessments indicate that flood levels in much of the Tar River Basin (NC) were at the 500-year recurrence interval. (500-year flood flow has a 0.2-percent chance of being equaled or exceeded during any given year at a particular location.) [3]
    - "In addition to the extreme flooding in the Tar River Basin, previously unsurpassed flooding also occurred in the Cashie, Northeast Cape Fear, and Waccamaw River Basins." [4]

- "Flooding caused massive damage to Eastern North Carolina's highway infrastructure, closing numerous local routes, as well as such major highways as Interstate 40, Interstate 95, and U.S. 70, 64 and 264. These U.S. highways are vital evacuation routes and also serve as alternate routes to Interstate 40. Many communities became inaccessible by land. Airports closed temporarily, and all 23 airports east of Interstate 95 sustained damage. NCDOT recorded over 2,100 damage sites to its 78,000-mile highway infrastructure. Flooding made recovery efforts difficult and dangerous."[5]

- After Hurricane Fran in 1996, the sewage treatment plants in the Raleigh/Durham area of NC (Orange, Wake, and Durham counties) dumped 120 million gallons of raw sewage into local streams and river. Two weeks after Hurricane Floyd came through the state, 14 sewage treatment plants remained under water.[4]

- "Similarly, 50 hog lagoons were flooded after Hurricane Floyd. The rapid expansion of intensive livestock operations in the eastern part of NC has created environmental problems with stormwater runoff. Waste from NC's 9 million hogs

is stored in open pit lagoons. The heavy rains from recent hurricanes caused several waste lagoons to overflow and spill nitrates and coliform bacteria into nearby creeks and streams. These waste by-products are harmful to marine life and to humans when they seep into streams and well water."[4]

- "Shorebird migration is no doubt being seriously disrupted by Hurricane Floyd, and it is even possible that many coastal species will be pushed to far-inland sites. Perhaps many sandpipers, plovers, knots, and others will end up feeding and roosting in agricultural fields in eastern Tennessee or Kentucky." Also of concern is the endangered Northeast breeding population of roseate terns. [3]
    - "Stewart reported that hurricanes have the ability to massively change wildlife habitats of barrier islands, coastal marshes and forests. He said some of these habitats such as beaches and dunes initially change rapidly but in time sometimes return to their former structure. 'But sometimes changes from hurricanes result in permanent loss of upland and marsh habitat. Hurricanes are important elements that shape these truly dynamic coastal systems.'" [3]

Objective 17.2 Understand the impact of coastal disasters on mitigation strategies and disaster prevention policy

Requirements:
The content should be presented as lecture, supported by PowerPoint slides.

The following slides will be used during this objective:

[**PowerPoint 17.7** Lessons Learned: Galveston]

[**PowerPoint 17.8** Lessons Learned: Loma Prieta]

[**PowerPoint 17.9** Lessons Learned: Andrew]

[**PowerPoint 17.10** Lessons Learned: Floyd]

Remarks:

VI. Lessons Learned: Galveston

[**PowerPoint 17.7** Lessons Learned: Galveston]

1. The aftermath of this hurricane resulted in important changes to the city of Galveston

    - These changes included:
        - raising the elevation of the city by some 17 feet by pumping in sediment from the Gulf of Mexico,
        - raising over 2000 buildings, and
        - constructing a six mile long seawall to protect the city.

2. Changes in the way America viewed storms also occurred.

    - These changes included:
        - The importance of weather observations and awareness to such hazards as storm surge became more evident.
        - The Galveston example has been used as a worst case scenario that forecasters, planners, and emergency managers try to avoid at all costs.
        - Much emphasis has been placed on the storm surge threat from hurricanes in the last century. It is still considered to be the largest potential hazard associated with a hurricane, thus many resources in the area of hurricane planning and mitigation have centered on storm surge probability and vulnerability.

VII. Lessons Learned: Loma Prieta

[**PowerPoint 17.8** Lessons Learned: Loma Prieta]

1. This earthquake ended decades of tranquility in the San Francisco Bay region. It was a wakeup call to prepare for the potentially even more devastating shocks that are inevitable in the future.

2. Since 1989, the work of the U.S. Geological Survey (USGS) and other organizations has improved understanding of the seismic threat in the Bay region, promoted awareness of earthquake hazards, and contributed to more effective strategies to reduce earthquake losses. These efforts will help reduce the impact of future large quakes in the San Francisco Bay region.

3. Much has been written about the fact that there were "no real surprises" in the Loma Prieta event. Well-designed and well-constructed buildings performed well, while poorly designed and constructed structures did not.

    - Implicit in this statement is the thought that someone can define "poorly designed and constructed." We can place unreinforced masonry buildings in this category, and they have long been identified as a problem.

- It is not as easy to identify other hazardous buildings as a class of structures. Some insight into what might be hazardous can be found by looking at damage statistics, which show that of the over 27,000 structures damaged, only 900 were reported to be of unreinforced masonry.

- The overwhelming majority of the damaged structures, classified by type, were wood-frame residential, a classification long ignored and presumed not to be potentially dangerous or the source of economic loss.

4. Since the Loma Prieta Earthquake, greater attention has been focused on the Nation's urban regions threatened by strong earthquakes, because these areas have the most people at risk, the largest inventory of structures, and the densest and most complex infrastructure.

   - Communication of earthquake-hazard information to the public and to those in business and government responsible for decisions and actions has also been strengthened.

5. In a published USGS report "Probabilities of Large Earthquakes in San Francisco Bay Region, California", experts projected 2-in-3 odds for one or more destructive earthquakes (>magnitude 7) to strike the Bay region from 1990 to 2020.

6. The 1971 San Fernando Earthquake was the original impetus for revising California building codes as well as infrastructure retrofitting, especially bridges. However, seismic retrofitting made great strides after the Loma Prieta Earthquake.

   - The California Department of Transportation (CALTRANS) developed a procedure for evaluating and ranking risk of the more than 20,000 bridges in California. Research conducted by several universities after the Loma Prieta quake have gone into a bridge design and retrofitting plan that is still in the process of being implemented.

7. Scientists changed the way they think about earthquakes in the U.S. as well following the Loma Prieta quake.

   - The quake revealed the vulnerability of urban areas, especially areas that were built on unconsolidated sediments and/or fill. These areas are more vulnerable to liquefaction an will shake more violently during a quake of the same magnitude as surrounding areas with harder substrates.

   - Loma Prieta forced U.S. scientists to focus more attention on mitigation instead of prediction. Therefore funding sources have shifted to working on mitigation strategies such as seismic design and retrofitting than on earthquake prediction. It was realized

that there was more dollar for dollar return for mitigation than for a few more seconds of earthquake warnings.

VIII. Lessons Learned: Andrew

[**PowerPoint 17.9** Lessons Learned: Andrew]

1. The result of the damage caused by Hurricane Andrew caused a change in building code policy in south Florida. Building codes established in South Florida after Hurricane Andrew are the toughest in the nation.
   - Fourteen years later, one thing is clear: If you are buying a newly constructed home, it will cost you thousands of dollars more because of Andrew-prompted building code changes.
     - The new codes add about $4,000 to $6,000 to the typical three-bedroom, two-bath, 1,500 square foot home: an increase of 4 to 5 percent.
   - The state used to have 467 separate building codes. Now one code is in place that has many interpretations.
   - The new code, through stricter requirements for siding and roof shingles, is supposed to reduce the amount of flying debris and make it less likely that a piece of your neighbor's roof will smash through your window.
2. The costliest coastal disaster in U.S. history touched every homeowner in Florida when insurance companies scrambled to cover losses.
   - The effects can still be felt. Insurance premiums doubled and even tripled for many south Florida homeowners because of Andrew.
   - This storm caused cost-conscious insurance companies to redefine what they consider risk and what a cost-conscious homeowner expects as an annual premium.
   - But the storm also exposed serious flaws in the Florida insurance market. Premiums were too low. Insurers did not have enough capital. Everyone underestimated the devastation a major storm could wreak on the state's aging, wind-sensitive housing stock.
   - For nearly a decade, Andrew was the disaster by which all others were measured.

IX. Lessons Learned: Floyd

[**PowerPoint 17.10** Lessons Learned: Floyd]

1. Many policy changes occurred after this disaster at the federal, state, and local levels based on what was learned from Floyd. Several are as follows:

    - A large realization to come from Floyd was that the floodplain maps were outdated. FEMA began floodplain Q3 mapping as well as management policy changes, such as restrictions of the location of certain facilities in floodplain.

    - NC became the first Cooperating Technical State to participate in the floodplain mapping initiative and has a flourishing Floodplain Mapping Program that has been updating each FEMA floodplain map by riverbasin

    - NOAA evaluated the lessons learned for the use of spatial data and Geographic Information Systems Analysis during Floyd. This report can be found at: http://www.csc.noaa.gov/hfloyd/

2. The importance of taking a proactive role through planning for hazard mitigation (rather than reaction) came to the forefront of policy making after Floyd, especially in North Carolina. At the end of this session, a short video will go in depth as to the recommended strategies for the redevelopment of flooded areas after Floyd.

3. Changes also occurred in state policy for evacuation plans based on new clearance time calculations across multiple state boundaries.

    - For example, Floyd resulted in the creation of the ETIS (evacuation transportation information system)
    - The NC DOT composed new Action Items that contain a comprehensive list of specific tasks to improve operations in evacuation situations. These Action Items can be summarized into the following recommendations.

    "* Create a Statewide Operations Center
    * Develop Provisions for Emergency Food and Lodging
    * Complete the Emergency Operations and Procedures Manual and Provide Training
    * Improve Emergency Traveler Information
    * Optimize Emergency Procurement and Deployment of Materials, Equipment, and Personnel
    * Improve Emergency Communications Resources
    * Complete Evacuation Planning and Develop Operations Procedures
    * Continually Update Policies and Procedures for Emergency Road Repair and Debris Removal
    * Optimize Federal Emergency Reimbursement Documentation Procedures Including Automation

* Improve Inter-and Intra-Agency Emergency Coordination"[5]

Objective 17.3 Recognize changes in impact of coastal disasters on human life in last century

Objective 17.4 Recognize potential natural hazards impacts based on historical disasters and present vulnerability due to increase population trends in coastal regions

Requirements:
The content should be presented as lecture, supported by PowerPoint slides.

The following slides will be used during this objective:

[**PowerPoint 17.11** Learning from the Past]

Remarks:

X. Learning from the Past

[**PowerPoint 17.11** Learning from the Past]

1. Overall, each of these disasters taught us valuable lessons. Several major realizations that translated into policy changes include:

   - Building code improvements are necessary
   - National Flood Insurance Policies need revision
   - Red Cross Shelter Policy changed
     - ex: to no shelters in a Category 4 surge zone

2. The changes since the Galveston Hurricane have shown that changes in policy and technology have drastically changed over the last century, dramatically reducing the number of deaths from coastal disasters in the coastal zone despite increasing populations.

   - Due to the lack of prediction and notification of the coming storm, people were simply caught off guard. No evacuations took place and the majority of the people that were killed drowned in their homes.

- This storm has long been used as an example of how far the United States has come in weather forecasting and prediction, especially in the area of hurricanes.

- Today satellite imagery, sophisticated modeling, large observation networks, and public warning systems will prevent this type of catastrophe from happing again. But it makes us realize how serious a threat a hurricane can be to a coastal city that is not prepared.

3. In the more short term, Hurricane Andrew demonstrated the present vulnerability due to increase population trends in coastal regions.

    - In terms of Hurricane climatology, ***Andrew proved the idea that it doesn't matter how many hurricanes or tropical storms are predicted in a given year, it only takes one major landfalling storm to cause major devastation.***

    - 1992 was climatologically supposed to be a hurricane season with a relatively low number of predicted storms due to the influence of the El Nino Southern Oscillation dampening effect on Atlantic hurricanes. Andrew was also was the first named storm in 1992 and it is fairly rare for early storms to be as intense as Andrew was.

    - This being said, Andrew is still used as the example of how vulnerable the populated coast is to a landfalling category 5 and that it really one takes one storm to change the course of history, policy, and lives.

Objective 17.5 Understand that natural hazards vulnerability can be managed through the built environment and that disasters occur when natural hazards intersect with the human coast

Requirements:
The content should be presented as a brief introductory lecture, supported by PowerPoint slides, and then followed with a short video, "Guiding Principles for the Quality Redevelopment of Eastern North Carolina".

The following slide will be used during this objective:

[**PowerPoint 17.12** Preparing for the Future]

Remarks:

XI. Preparing for the Future

[**PowerPoint 17.12** Preparing for the Future]

1. In learning from historic and recent disasters, it is important to attempt to manage the built environment to reduce vulnerability to future disasters.

   - Disasters as devastating as Galveston, Loma Prieta, Andrew and Floyd show that the worst disasters occur where natural hazards meet the human coast.

   - The natural hazard cannot be managed, but in order to reduce the risk to those natural hazards and thus disaster, the human coast can be managed.

   - In order to prepare for the future, will be necessary to manage growth and development in the coastal zone.

2. The following video provides an example of the mitigation efforts in North Carolina that came as a result of Hurricane Floyd.

   - *Note to Instructor: Session 17 will end with the viewing of the video, "Guiding Principles for the Quality Redevelopment of Eastern North Carolina", by the North Carolina Division of Emergency Management. If there is time left in the session after the completion of the video, the Instructor is encouraged to discuss the content of the video with the students to panel their reactions.*

     After the video, the assignment of a presentation should be explained (after the distribution of Handout 17.1). Time should be properly allocated at the end of the session to allow for clear instruction of the assignment and for answering questions.

Appendix A: Handouts

Handout 17.1: Case Study Presentation Instructions

1. Each student must present a case study of a coastal hazard to the class.

2. The presentation must not be shorter than 6 minutes or last longer than 8 minutes, with approximately 2 minutes for questions.

3. PowerPoint slides, overhead slides, or handouts are all acceptable formats for the presentations.

4. The presentation must cover (but is not limited to) the following topics:

    - A short description of the hazard

    - A description of the event

    - What happened/what were the impacts?
        - Ex: human, environmental, structural, infrastructure, etc.

- What can be learned in general?

- Were there policy outcomes as a result of the disaster?
  - Ex: changes in local, state or national policy

5. The following are examples of disasters that may be selected for a presentation.

- *If a student has a particular interest in presenting a disaster that is not on this list, that student should be encouraged to do so.*

I. Hurricanes and other Meteorological
   a. Hurricane Camille – 1969
   b. Great Midwest Flood – 1993
   c. El Nino – 1982/83 and 1997/98
   d. New England Hurricane – 1938
   e. Storm of the Century – 1993
   f. Great Okeechobee flood and hurricane – 1923
   g. Florida Keys Hurricane (labor day) – 1935
   h. New England blizzard – 1978
   i. East Coast blizzard – 1888
   j. Hurricane Hugo – 1989
   k. Hurricane Georges – 1998
   l. Hurricane Fran – 1996
   m. Ash Wednesday Storm - 1962

II. Earthquake
   a. San Francisco – 1906
   b. Northridge – 1994

III. Fire
   a. California Fires – 2003

IV. Avalanche
   a. Wellington, WA – 1910

V. Oil Spill
   a. Exxon Valdez – 1989

VI. Volcano
   a. Mt. St Helens - 1980

Appendix B: Course Developer References

Alesch, Daniel J. and Petak, William J. 1986. The politics and economics of earthquake hazard mitigation : unreinforced masonry buildings in Southern California. TH1095 .A43 1986.

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Drabek, Thomas E. 1994. Disaster evacuation and the tourist industry. G155.U6 D73 1994.

Drabek, Thomas E. 1983. Earthquake mitigation policy : the experience of two states

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Appendix C: Power Point Graphics Citations
Session 17

PowerPoint 17.1
- (Source: NC Division of Emergency Management)

PowerPoint 17.2
- (Source: http://www.vetmed.ucdavis.edu/whatsnew/article2.cfm?id=1105)
- (Source:http://www-ed.fnal.gov/lincon/w01/projects/earthquakes/earthquake%20photo4.jpg)

PowerPoint 17.3
- (Source: http://www.ngdc.noaa.gov/paleo/hurricane/images/wea00590a.gif)
- (Source: http://www.noaanews.noaa.gov/stories/s496.htm)

PowerPoint 17.4
- (Source: Red Cross)
- (Source: USGS)
- (Source: http://www.exploratorium.edu/faultline/engineering/damagemap.html)
- (Source: http://www.seismo.berkeley.edu/seismo/faq/1989_0.html)

PowerPoint 17.5
- (Source: http://www.aoml.noaa.gov/hrd/hurdat/Andrew-figures.html)

- (Source: http://www.chron.com/cs/CDA/story.hts/nation/1544102)
- (Source: NOAA)

PowerPoint 17.6

- (Source: NCSU)
- (Source: http://www.dem.dcc.state.nc.us/mitigation/photos1.htm)

PowerPoint 17.7

- (Source:http://www.cnn.com/interactive/space/0309/explainer.hurricanes/gal.storm.surge.OLD.jpg)
- (Source:http://www.islandnet.com/~see/weather/events/1900hurr.htm)

PowerPoint 17.8

- (Source: USGS)
- (Source: http://www.goldengatebridge.org/projects/seismicsummary.html)

PowerPoint 17.9

- (Source: http://www.newcomerinfo.com/building-codes.htm)
- (Source: http://www.stormsmart.com/bb1gdoor.html)
- (Source:http://orpermits.homestead.com/Newsletter.html)

PowerPoint 17.10

- (Source: http://www.dem.dcc.state.nc.us/mitigation/photos2.htm)

PowerPoint 17.11

- (Source: NOAA)

PowerPoint 17.12

- (Source: http://www.gu.edu.au/centre/gccm/content01.html)
- (Source: http://www.wb2020.qld.gov.au/rgmf/rgmf_map.htm)

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[1] http://www.nhc.noaa.gov/1999floyd_text.html
[2] http://www.usatoday.com/weather/huricane/1999/atlantic/wfrescue.htm
[3] http://www.usgs.gov/public/press/public_affairs/press_releases/pr1043m.html
[4] http://www.common-sense.org/?fnoc=/common_sense_says/99_october
[4] http://www.usgs.gov/public/press/public_affairs/press_releases/pr1043m.html
[4] http://www.common-sense.org/?fnoc=/common_sense_says/99_october
[5] http://www.doh.dot.state.nc.us/operations/FloydLessons/5.html