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PREVENTION - THE FIFTH AND MOST IMPORTANT PHASE IN EMERGENCY MANAGEMENT

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Abstract

The FIVE? Phases of Emergency Management explores the element of human complicity that often worsens the loss of life and property damage nominally caused by natural disasters. Mr. Martinet presents a case study of the Johnstown Flood (1889), showing how human activities set the stage for one of the greatest U.S. disasters in terms of loss of life.

He shows that the human interference leading up to the Johnstown tragedy was not the exception but rather the rule. He cites similar contributions to the losses in the Galveston Hurricane of 1900, the San Francisco Earthquake and Fire and other modern disasters.

He develops the argument that actions (or inactions) that at the time seemed quite unimportant played a critical role to greatly facilitate loss of life and property damage from a natural and inevitable cycle of nature.

Mr. Martinet then turns to his years of experience in the construction industry to show with startling photographs how the built infrastructure is deteriorating far more rapidly than most emergency managers and disaster planners can possibly know.

He argues that current mitigation programs cannot begin to address the magnitude of the real problem facing society. This presentation is directed to emergency managers, building officials, community development planners and elected officials. This is a call to re-examine some of the fundamental assumptions upon which disaster planners base the planning process.

Introduction

We are all familiar with the traditional four phases of emergency management: mitigation, preparedness, response and recovery. I believe that there is a fifth phase that we need to recognize and deal with if we are ever to begin to reduce the impact of natural and technologic disasters. But before I describe this fifth phase, I want to tell you about a disaster that happened over 100 years ago. It has been described as a natural disaster. But see if you would still call it a natural disaster when I am through.

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The Scenario

Johnstown - Pennsylvania - Thursday May 30, 1889 - Memorial Day weekend - and rain was in the air...A rain storm had come from Kansas and Nebraska and moved east. All along the storm's path there had been heavy rain, roads were washed out, and trains delayed. The U.S. Signal Service (forerunner of the NWS) had telegraphed warnings for severe local storms. When the storm hit the portion of Pennsylvania near Johnstown, an estimated 6 to 8 inches of rain fell in 24 hours. Some places in the mountains 10 inches of rain fell.

Johnstown Pennsylvania is sited at the confluence of Stony Creek River and the Conemaugh River at slightly over 1100 feet above sea level. Johnstown was built on a level flood plain and in their natural state the two rivers are 60 to 80 yards wide. Flooding was a relatively common occurrence. The first recorded flood was in 1808. Flooding followed in 1820, 1847, 1875, 1880, 85, 87 and 1888.

As the area grew, trees were cut for timber and the watershed on the hills was being stripped off. The river channels were narrowed to make room for new buildings, and to make bridge building easier. Some in Johnstown thought that the river would merely dig deeper channels. But the river beds were nearly all solid rock.

The little Conemaugh River originates at a height of about 2300 feet above sea level and drops about 1100 feet as it flows to Johnstown, with a drainage area of some 60 square miles.

Roughly 14 miles upstream from Johnstown, at an altitude of slightly over 1500 feet above sea level was the **Three Mile Dam**, also known as the **Old Reservoir**. Originally its top was 72 feet above the valley floor. It was 930 feet long. In 1889, water in the dam was normally 6 or 7 feet below the top of the dam, which covered 450 acres, and was 60 feet deep. The estimated weight of the water was 20 million tons.

The original dam was commissioned by the state of Pennsylvania in 1836, to provide a steady supply of water for a canal. The dam was built to the standards that had been used for hundreds of years. It was earth fill construction with a clay liner to prevent water seepage. To avoid erosion of the dam, a spillway was cut into the solid rock that adjoined one end of the dam. At the bottom center of the dam were 5 cast iron pipes 2 feet in diameter to control the height of the water.

<u>So far so good.</u>

In 1875 a Congressman Reilly bought the property. The only thing that he did, was to remove the cast iron culvert pipes and sell them for scrap. In 1879, the South Fork Fishing and Hunting Club was formed and purchased the dam and surrounding countryside. The club began renovations on the dam. The holes where the five culvert pipes had been were filled in with whatever was at hand, rocks, trees, hay, mud and some quantity of horse manure.

In 1880, a local Johnstown businessman who was concerned with the safety of the dam sent an engineer to evaluate the dam's condition after the renovation. The engineer noted the removal of the drainage culverts, and poor repair techniques, which resulted in a leak cutting into the embankment. The report was sent to the dam's owners, who rejected it as having no merit whatsoever. In addition to these two problems noted in the report, the new owners had made some other changes. In order to provide a wider road across the top of the dam, so carriages could pass each other, the dam had been lowered one to three feet. But the height of the spillway was not changed, so the relative safety margin between the crest of the spillway and the crest of the dam was reduced.

The club also added a screen of iron rods to prevent the stocked fish in the lake from going over the spillway. This only slightly reduced the flow of water, but it now created a trap for debris when the water was running fast over the spillway. Additionally, the dam sagged slightly in the middle. The middle of the dam may have been one to four feet lower than the ends of the dam. The center of the dam should have been the highest and strongest, but the reverse was true. Before the South Fork Fishing and Hunting Club bought the dam, the water level had been maintained at about 40 feet. But the Club raised the water level to nearly 60 feet, almost to the top of the dam.

In the 1880's there were many scares that the dam would fail. The first came on June 10th, 1881, when a flash flood caused a rumor that the dam was going to fail. On this occasion, a group of local men went to the dam and inspected it. The local paper reported that all seemed to be well with the dam, and that the water was still two feet from the top of the dam. And in any event, the paper mused, there was plenty of land between the dam and the town for the water to spread out. This was the first of many such scares for the residents of Johnstown. All of which proved to be just "cries of wolf." But on Friday May 31st, the previous night's rain had begun to raise the level of the rivers at about a foot per hour. By ten o'clock in the morning, water filled most of the basements in town.

In years previous, local municipal ordinances had fixed the width of the Stony Creek River at 175 feet, and the little Conemaugh River at 110 feet. But below the conjunction of the two rivers, the river was only 200 feet wide. 85 feet of river had simply been legislated right out of existence.

That morning, Johnstown locals had gathered near the rail yards to watch the rivers rise. Every indication was that the wooden bridge above the railroad station was going to wash out, and it promised to be a grand spectacle. Between noon and 1 o'clock, a telegraph message came into the East Conemaugh dispatcher's tower: "South Fork Dam is liable to break. Notify the people of Johnstown. Prepare for the worst." A few minutes later the message arrived in Johnstown. The freight agent glanced at it, but did not read it. He later said that he had heard these warnings before. The two men in the station who did read it laughed out loud. Two more warnings were sent from the dam to Johnstown, and both were ignored. Observers at the dam estimated that the water was rising an inch every ten minutes. The dam was three miles long, up to a mile wide in places, and 60 feet deep.

Shortly after 3:00 p.m., the dam broke and over 2,200 people perished.

Would you still call this a *natural* disaster?

In Johnstown and at the dam, over the years, people had made almost every mistake possible to guarantee that disaster would happen. But was this an unusual event? Not really. In most American disasters human complicity has played a significant role in creating what are termed "natural" disasters." Certainly, the forces of nature create conditions that precipitate disastrous loss of life and property. But almost always, the human involvement is a major contributor to the losses of life and property from so-called "natural disasters."

In the Galveston hurricane of 1900 that killed over 6,000 people, the citizens of Galveston received not even 1 warning about the approaching storm, even though the weather forecasters in Florida and Washington, D.C. knew of its existence. But they also "knew" that a hurricane **could not** move from the Carib0bean as far west as Texas. Cuban weather forecasters, who better understood the serious threat, attempted to make notification. But at the request of the Weather service, the Cubans were denied access to the telegraph cables, which in the aftermath of the Spanish American War, were still controlled by the U.S. Military.

The huge losses from fire in San Francisco in1906, were in part a result of an inadequate fire main system. Even though Fire Chief Dennis T. Sullivan, made a study of the system and requested funds for making badly needed improvements to the system, the City council did not want to spend the money. For decades, we here in California minimized and even attempted to completely deny the existence of earthquake faults. It was not until 1938 that the first "official" map of known faults was published by the State Division of Mines and Geology.

In July 1944 in Hartford Connecticut, the Big Top of the Ringling Brothers, Barnum and Bailey Circus caught fire and burned, killing 165 persons, mostly women and children. Spectators at the scene were amazed at how fast the big top burned. As usual, the previous spring, the tent had been waterproofed, with a mixture of paraffin and white gasoline.

The Oakland Hills fire of 1993 demonstrates the losses possible when homes are built in the urban-wild land interface without respect for the inherent dangers involved.

Local governments across the country regularly permit, and even participate in land development in high-risk areas without sufficient safeguards to prevent catastrophic losses when the inevitable dangerous cycles of nature occur.

But this presentation is not about history and events past. This presentation is a clear and unambiguous look into future disasters. Very rarely are damages from disasters solely the result of a single catastrophic event or failure. Almost always, the structural fatalities of any system are the result of a series of seemingly random and disconnected micro-failures. Let me give you a small example of what I mean.

A man has an important job interview at 10 o'clock. He gets up in plenty of time, and even allows himself an extra 45 minutes for what is normally a 25 minute trip by car. This morning however, his spouse accidentally leaves the empty coffee pot on and it cracks. But our hero needs a cup of coffee, and so he gets the old drip coffee maker down from the cupboard. He waits a few extra minutes for the coffee to be ready, but still has plenty of time. He hurriedly leaves the house and goes into the garage, locking the house behind himself, when he realizes that he left his car key in the kitchen. But being a good emergency planner, he has a back up. He keeps a spare house key in the garage. But suddenly he remembers that he gave it to a friend a few days ago, when the friend was returning a borrowed tool. His cushion of time is narrowing, but he is resourceful. He goes next door to his elderly neighbors, who seldom drives any more, and keeps his car well maintained to borrow the car for this emergency. Unfortunately, his neighbor tells him, the starter is broken, and the mechanic is coming today to repair it. But his advance planning has still left him enough time to take the bus. The neighbor reminds him that the bus drivers are on strike. He calls for a cab, but the dispatcher tells him that it will be an hour before he can send him a cab, because of the transit strike. He uses the neighbors phone to call his appointment to cancel.[2]

What caused this man to miss his important appointment?

Human failure: forgetting the coffee pot, locking himself out of the house?
Mechanical failure: broken starter motor?
Environmental failure: transit strike and taxi overload?
System design: he can lock the house door without the key?
Procedures: warming up coffee in glass pot, not giving himself even more time?

Had any one of these relatively minor and disconnected incidents not happened, the man would have presumably made his appointment. This same sort of chain of failures can often be seen in so called natural disasters, or as we like to call them, acts of God. The term "act of God" assigns blame to the Divine, and coincidentally expunges humans of any guilt associated with causing the disaster or contributing to the consequent damage.

Certainly there are massive climatologic, seismic, and technologic events that precipitate floods, strong winds, earth movements, explosions, fires and other events. But upon close examination, the damage caused during these events almost always has some roots of human contribution, some elements of human action that either enabled the disaster in the first place, or exacerbated it.

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[2] Perrow, Charles, Normal Accidents, 5

We continue to build homes on flood plains, on top of unstable ground, at the bottom of a hill of unstable ground, adjacent to and even directly over earthquake faults, and close to every conceivable source of natural and man made disaster possible. We then act amazed that homes are destroyed as a result of an act of nature that we knew was inevitable, and then we quickly declare it to be an act of God.

So far we have looked at the broader view of disasters, and their human components. But there is deeper aspect of this issue. Not only can big mistakes and obvious errors contribute to disasters, but small hidden faults can contribute to failures with the same degree of magnitude.

To examine this theory in some detail, I am going to talk about a field that I know quite well, and in which I have many years of actual experience.

I grew up in a family of builders, including my father, my grandfather, and uncles. For over twenty-five years I have held a general contractors license in California. I worked as a carpenter, superintendent, and estimator in the construction industry.

I'm going to tell you about the real world of tract home construction, and how it directly affects what we do as emergency managers. And this is not just a California problem, it is a problem across the country.

How are tract houses built?

Tract homes are built mostly by professional developers and managers, with a lot of help from amateurs. Let me explain.

Developers buy a piece of raw land, and hire planners and architects to design a community of homes. The planners layout the streets and lots. On some projects, they will include parks and open space areas. What they don't do is to analyze the long-term consequences of building in a particular area relative to natural or technological hazards that may exist in that area. The decision to build has already been made by the developer.

Architects and planners normally do not address anything more than the minimum issues of drainage and seismic risk. Their job is to create a community of homes that will sell quickly and bring the greatest economic return to the developer. They have no vested interest in creating safe and strong homes, beyond the minimal requirements of the building code.

Soils engineers are commonly used, because soil properties will affect how the foundation is built. But the foundation may be the last part of the house to be engineered.

When an architect and engineer design a large commercial or industrial building, they must do a structural analysis based upon the design of the building. Individual parts of the structure, such as the steel framing or concrete columns and walls may need to be increased in size or strength depending upon the engineering analysis. The analysis is a series of mathematical calculations that are based upon the known characteristics of a particular construction material and how it performs under certain stresses.

In single-family homes, and two story apartment construction, when conventional wood framing construction techniques are used, and the openings in the walls for the windows and doors do not exceed certain limits, an engineering analysis may not be required. A competent carpenter will know the rules of thumb to produce a strong building.

However the operative phrase is "competent carpenter" Construction is hard work, and housing is some of the hardest physically, and production schedules are very tight. Non-union labor is common and "Piece work" is a typical practice. Piece work, is where a worker is paid by each piece that he produces, rather than by an hourly wage. The faster a carpenter can frame a house, the more money he can make. There is relatively little incentive for doing quality work.

It is not uncommon for so called carpenters to only be able to do a few limited but very repetitive tasks. Many carpenters cannot read blueprints, and do not understand the basic physics of wood frame construction.

When I worked as an assistant superintendent on a tract of homes, there were over a hundred carpenters who worked on the project at one time or another. But only three of these carpenters could have built the entire house from start to finish. They were the layout man, the roof cutter and the stair cutter. Only these three people could read and understand blue prints and to the mathematical calculations necessary to layout the positions of the walls, and build roofs and stairs, the two most mentally demanding chores in home construction. Most of the other so-called carpenters would just follow the lead of these three and nail together the components that they cut and marked.

One of the most basic elements in building construction is called a shear panel. A shear panel is what gives a wooden frame its ability to resist seismic forces and the force of high winds.
Use folding box example

Properly applied, shear panels are absolutely essential for a building to be able to resist the forces of earthquakes and high winds. Some type of plywood or manufactured wood wafer board is the most common material for shear strength. However, in homes with large openings for doors, windows or garage doors or where there is a second story above the garage, moment resisting steel frames are also very effective. Moment resisting steel frames are heavy structural steel beams that will resist damage from earthquakes. Properly nailed gypsum wall board can also be used to provide a small part of the shear value in a structure.

Wood-frame structure.

Another potential weakness in the process is the use of "engineered components" Engineered components are structural elements that are carefully designed by registered engineers and mass produced to speed up the construction process and ensure a structure that can withstand seismic and wind forces.

These engineered components are tested in laboratories before approval by the building code officials. Correctly installed, they provide greater strength and speed up the construction process. But in the laboratory, tests are prepared by master craftsmen, who use great care and precision in assembling the test. Actual installations in the field often bear little resemblance to test conditions. For one line of engineered metal brackets used to hold wooden framing members together, the manufacture produces 23 different types of nails and screws. Each of hundreds of different brackets require different nails or screws to meet the performance standards established during the testing process. You will see in the next slides, that using the right size or type of screw or fastener is a small problem, next to using no fastener at all.

So we see that homes are not always the solid structures that they appear to be from the outside and that homes can and do contain series of disconnected construction defects that appear to be relatively minor.

We also have seen that under certain circumstances apparently minor and separate defects can be linked in ways that no one could have ever imagine, and that this un-imagined linking can produce catastrophic failures.

<u>We are building disaster problems faster than we can ever solve them.</u>

Mitigation is the touted as the way to eliminate disaster hazards to reduce loss of life and property. But, what about PREVENTING them in the first place? What if we stopped building defective structures, structures that fail when natural forces press against them, shake them and flood them. Prevention, can give us a fresh start.

Mitigate: To make or become less severe, less rigorous, or less painful; moderate

Prevent: To act in anticipation of an event, to stop or keep from happening, make impossible by prior action

Over time by using both mitigation and PREVENTION, we can begin to make some real gains on the defective building stock of this country that will fail in disasters.

We don't mitigate in a year, the problems that we create in one day of home building.

We have some of the best building codes in the world. But they are not yet doing the job that we want. PREVENTION will be difficult, it will be unpopular, but it will be our only chance of truly reducing the ever-growing cost of disaster.

We need to become aware of what is happening in our city and county building and safety departments and in community development and planning departments. Unless we educate ourselves and others, and form alliances with those who regulate community development and construction, we will fall ever further behind in our efforts to create disaster resistant communities.

I have not even mentioned mobile homes and manufactured housing whose quality standards are even worse. I have ignored illegal construction, where no engineering at all is used, no permits are ever pulled and no inspections ever performed. Illegal room conversions and garage conversions add another huge layer to this pile of disaster pick up sticks.

If we can't begin to prevent some of the problems that directly and substantially contribute to disasters, we will remain victims without a clue and without a prayer.

I strongly urge our profession to consider taking off the blinders and work with others to make PREVENTION the fifth phase of disaster management.

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