Case Study: A Fresh Look at the Citicorp Engineering Ethics Dilemma

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Meet Your Presenter

- Education:
  - B.S. “Structural Engineering” from University of California, San Diego (1990)
- Experience:
  - 2012 - Present: Structural Principal Associate at BWE, Inc. (San Diego, CA)
  - 1990 – 2012: Structural engineer at Lane Engineers, Inc. (Tulare, CA)
  - Author, *Ethics in Civil and Structural Engineering* (McGraw-Hill, 2022)
- Affiliations/Registrations:
  - California licensed civil and structural engineer
  - Subject Matter Expert (structural) for California Board of Registration for Professional Engineers, Land Surveyors and Geologists

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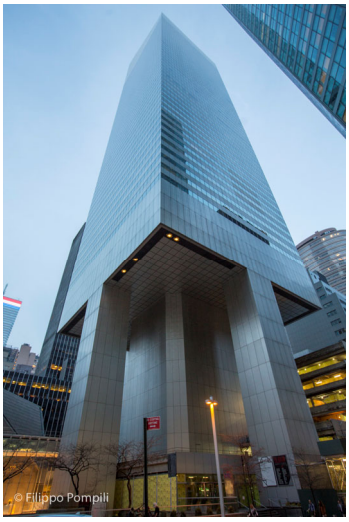
Webinar Outcomes



- Interpret ethical decisions made in this case with the NSPE and ASCE codes of ethics
- Experience research objectives and findings with a broad focus
- Learn more detailed considerations of this case
- Evaluate facts and emotional judgments when faced with highly stressful decisions
- Apply appropriate strategies for dealing with ethical dilemmas

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Webinar Outline

- Introduction
- Who is William Le Messurier (pronounced “Luh-Measure”)?
- Overview of the Story
- Evaluating the Structural Emergency
- Examining the Ethical Choices
- The Psychology of a Crisis
- Strategies for Dealing with Ethical Dilemmas and Crises
- Conclusions

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Introduction

- Due to the sensitive nature of this case, I need to make a few promises before moving on:
  - I will attempt to keep the *armchair quarterbacking* to a minimum
  - I will express professional opinions truthfully and only when founded on adequate knowledge and honest conviction [*ASCE Code of Ethics, Part 1(c)*]
  - I will comment only in a professional manner on the work, professional reputation, and personal character of other engineers [*ASCE Code of Ethics, Part 5(h)*]

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Introduction

- Main source material (from www.lemessurier.com):
  - "Legs Centered Under Each Face Carry Diagonally Braced Tower", *Engineering News-Record*, McGraw-Hill, June 24, 1976.
  - Joe Morgenstern, "The Fifty-Nine Story Crisis", *The New Yorker*, May 29, 1995.
  - Stanley Goldstein & Robert Rubin, "Engineering Ethics (Ethics in the Balance)", *Civil Engineering*, ASCE, October 1996.

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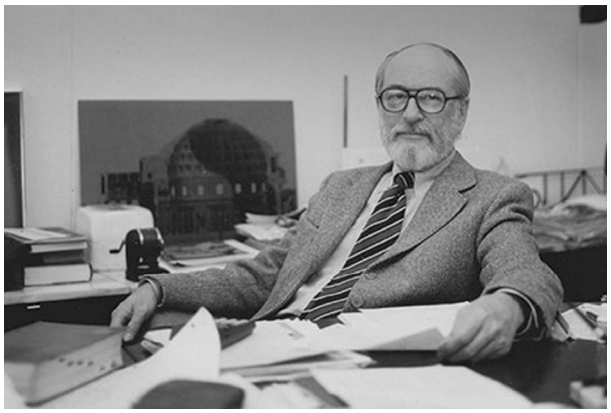
Who is William LeMessurier?



- Born on June 12, 1926 in Pontiac, Michigan
  - Youngest of 4 children
  - Early aptitudes for mathematics, music, and the arts
- Bachelor's degree in mathematics received in 1947 from Harvard College
- Studied architecture at Harverd's Graduate School of Design, then transferred to MIT's Department of Building Engineering and Construction

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Who is William LeMessurier?

- Master's degree received at MIT in 1953, while he also worked part-time with Albert Goldberg, an established structural engineer in Boston
  - Became a partner with Mr. Goldberg in the mid-1950s
- Founded LeMessurier Associates in April 1961 at Boston, Massachusetts
  - The firm's first project was on the campus of Dartmouth College … alma mater of Fred Rogers (actor), Alexi Pappas (All-American athlete), and William Kamkwamba (inventor and engineer)

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Who is William LeMessurier?

- Honors:
  - 1961 – Appointed to the AISC Committee on Specifications (design specifications for structural steel buildings)
  - 1968 – Allied Professions Medal from the American Institute of Architects
  - 1978 – Elected to the National Academy of Engineering
  - 1982 – Appointed adjunct professor at Harvard's Graduate School of Design
  - 1988 – Elected as an honorary member of the American Institute of Architects
  - 1993 – ASCE George Winter Award
  - 1995 – Shortridge Hardesty Award
  - 1996 – President's Medal
  - 1998 – Honorary doctor of engineering at Rensselaer Polytechnic Institute (Troy, NY)
  - 1999 – AISC J. Lloyd Kimbrough Award
  - 2002 – Honorary doctor of engineering at University of Massachusetts, Dartmouth

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Who is William LeMessurier?

- Died at age 81 on June 14, 2007 in Casco, Maine (2 days after his birthday) due to complications of surgery he underwent on June 1 after a fall he took the day before (according to his daughter)
- *Presenter's commentary*:
  - At the time of the Citicorp discovery (1978), LeMessurier already had an impressive line of accomplishments and honors
  - I find it unfortunate that his name is always linked to the Citicorp design with associated terms such as "catastrophic flaw", "vulnerability to collapse", and "structural deficiency".
  - Though the Citicorp building story is commonly told as a study in ethics, I rather think it is an INCREDIBLE example of how a team of professionals quickly implemented the solution to a very difficult problem with practically no hitches

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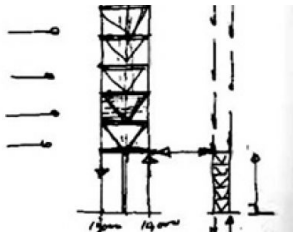
The Beginning of the Story

- Citicorp Center (601 Lexington Avenue, New York, NY)
- Hugh Stubbins, Principal Architect-in-Charge
- LeMessurier Associates, Structural Engineers (partnering with The Office of James Ruderman)
  - William LeMessurier, Principal-in-Charge (Cambridge, Massachusetts office)
  - Stanley H. Goldstein, Partner (New York office)
- In order to respect the placement of a new building for St. Peter's Church in one corner of the Citicorp Center site, William LeMessurier came up with the idea of placing the 4 major columns for the new 914-foot-tall tower at the *center of the sides*, not the corners



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The Phone Call

- The design process essentially begins in 1971 after Citicorp purchases land from St. Peter's Church
  - Governing code: NYC Building Code, amended March 1970
  - Construction begins April 1974
  - Dedicated and opened on October 12, 1977
  - Contractor: HRH Construction
- Diane Hartley, engineering student at Princeton University, completes a thesis paper on the Citicorp building on April 21, 1978 (she is in close contact with LeMessurier's New York office)
- In June 1978, Ms. Hartley calls LeMessurier's office with some questions concerning quartering winds acting on the building and placement of the legs
- LeMessurier returns the call on the same day, explaining that everything is fine and that the positioning of the legs works to their advantage in resisting the effects of this wind direction

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Identifying, Defining, and Solving the Problem

- *The Morgenstern article says* that LeMessurier's curiosity was aroused, as he thought the subject he just discussed would be a good one for students in his architecture class
  - As he reviewed the effect of quartering winds, his new calculations surprised him: strain in 4 of the 8 chevrons in each tier increased by 40% over winds applied to the building face
- A month earlier, he found out that bolts had replaced welds in the brace joints as a cost-saving measure. The bolts were designed for the anticipated forces, not to develop the strength of the braces.
- When discussing the issue with his New York office, he discovered that his team treated the wind braces as "trusses" instead of "columns", which reduced a code-mandated safety factor
- The tuned mass damper at the top of the building couldn't be relied on in a design storm event

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Identifying, Defining, and Solving the Problem

- LeMessurier flew to Canada on July 26th to visit the Boundary Layer Wind Tunnel Laboratory (Alan Davenport) to have the scientists run more simulations
  - It turned out that "real world" wind events could set up additional vibrations, making the magnitude of forces and phenomenon of movement more complex

- LeMessurier consulted with a colleague in Cambridge, then went up to his cabin on Sebago Lake in Maine on July 28th to thoroughly study the problem and come up with a solution
  - He wound up producing a 30-page document that detailed the mistakes that he discovered (called "Project SERENE")
  - He developed a solid solution involving the addition of 2" thick steel plates to be welded over the bolted joints

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Notifying Stakeholders

- Upon his return to the office (Monday, July 31st), he tried to contact the architect, Hugh Stubbins, but he was out of town. LeMessurier spoke with Stubbins' lawyer, who advised him not to tell Citicorp until he spoke with his own liability insurance carriers.
  - Attorneys with the Northbrook Insurance Company warned him not to speak with anyone else about the matter

- On the following day, LeMessurier met with more lawyers from Northbrook and convinced them that there was a real problem
  - The statistical probability of a catastrophic failure occurring was once every sixteen years
  - The insurance company brought in Leslie Robertson (WTC engineer) for feedback and advice

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The Response of a Well-Tuned Machine

- With Leslie Robertson on board, the team was ready to inform the owners (Citicorp) and set the repair plan into motion
- On August 2nd, LeMessurier and Stubbins secured a meeting with Citicorp's executive vice president, John Reed, and went over the problem
  - An explanation was given as to how repairs could be made with very little interruption of the tenants' working spaces
- On that same day, emergency generators were brought in to assure the continued operation of the tuned mass damper, and Citicorp coordinated personnel as needed

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The Response of a Well-Tuned Machine

- On August 3rd, the engineers, owners, and engineers from a steel erection company (Karl Koch Erecting) visited the building, exposed some of the joints, and went over the retrofit plan, determining it to be feasible
- MTS Systems Corporation, who manufactured the tuned mass damper, were brought on board to provide full-time technical support to keep the machine working during the repairs
- Robertson recommended the building be fitted with strain gauges to monitor movement
  - He also assembled an advisory group of weather experts to make predictions 4 times each day
  - Hurricane Ella came up on the radar during the repair process (it wound up veering away)

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The Response of a Well-Tuned Machine

- On Monday, August 7th, Arthur Nusbaum, veteran project manager for HRH Construction, received the final repair drawings from LeMessurier's office and worked on coordination efforts with Koch
- That same day, Citicorp officials met with Mike Reilly, director of disaster services for the American Red Cross. An emergency plan was created, which included the police and the mayor's Office of Emergency Management, that would evacuate the building and the surrounding neighborhood in the event of a wind alert.
  - The Red Cross could mobilize close to 2,000 workers to provide food and shelter

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The Response of a Well-Tuned Machine

- On the morning of August 8th, the owners issued a *partially true* press release (3 paragraphs)
  - Engineers who designed the building *recommended* that certain connections in the wind bracing system be strengthened
    - Having been decided *based on* new wind tunnel data produced (this is partially true)
  - The engineers have assured us there is no danger
  - "We wear both belts and suspenders here" (a reporter was told during an interview)

- City officials were informed of the true emergency and the solution in the afternoon of the same day (they commended LeMessurier for his courage and candor)
  - They assured Nusbaum that they would work closely with trusted welding inspectors who could quickly certify welders for the job

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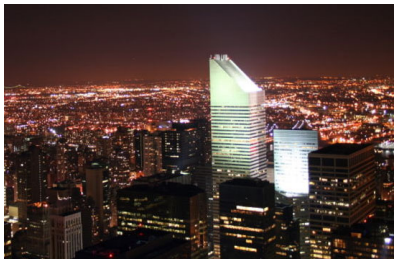
The Story Becomes Public

- LeMessurier had a detailed sequence worked out of which joints should be repaired in which order
  - "I was constantly calculating which joint to fix next, which level of the building was more critical, and I developed charts and graphs of all the consequences: if you fix this, then the rarity of the storm that will cause any trouble lengthens to that."
- Work began on Wednesday, August 9th and the weather watch ended on September 13th. Work concluded in October (1978).



- Everyone involved kept the secret project safe, until Joe Morganstern learned about the crisis (supposedly at a dinner party) and contacted LeMessurier for an interview in late 1991
  - The full story was printed in *The New Yorker* on May 29, 1995

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Poll Question No. 1

- What was the name of the hurricane that threatened the repairs to the Citicorp building in Autumn 1978?
  - Audrey
  - Ella
  - Fontina
  - Zumba

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Evaluating the Structural Emergency

- We still may not know the whole story about the structural evaluation of the building
  - LeMessurier prepared a 30-page document to identify the mistakes that combined to create the crisis
  - "A series of miscalculations that flowed from a specific mindset" (Morganstern)
  - Upon hearing LeMessurier's summary, Robertson agreed there was "a very serious problem" (*ibid*)

- *Presenter's commentary*:
  - There was so much on the line for LeMessurier … he had to be sure. He persistently sought advice, asked for more current wind data, and went to great lengths to make sure he understood the problem. He exercised conservatism, because he only had this one chance to make corrections.

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Evaluating the Structural Emergency

- The solution was required only for wind brace *connections*, not members
- We are told …
  - The bracing system was unusually sensitive to quartering winds
  - New wind tunnel findings indicted a potential vibratory effect in a real storm
  - Welded connections were changed to bolted ones during construction
    - The design forces used for the bolts were based on perpendicular winds
    - In calculating these forces, the New York team also considered the diagonal braces to be viewed as "trusses" (not "columns"). Column elements only allowed ¾ of the dead load to be considered in resisting overturning, but trusses had no such restriction. This exacerbated the problem as LeMessurier perceived and calculated it.
- The issue of *quartering winds* turns out to be an interesting one

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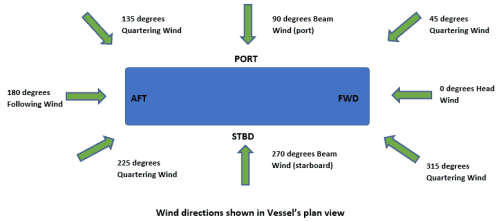
Quartering Winds – Considered in the Design



Wind directions shown in Vessel's plan view

- We are told in multiple papers that consideration of quartering winds was not required by the NYC Building Code during the time of the building's design
- 1938 NYC BC (C26-349.0): "All structures … shall be designed … to resist, in the structural frame, horizontal wind pressure from any direction."
- 1968 NYC BC (C26-904.0): "Wind shall be assumed to act in any direction."

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Quartering Winds – Considered in the Design

- Morganstern's article makes it sound like LeMessurier never *considered* quartering winds in the original design, but he must have
  - Statements obtained by Eugene Kremer (reference given later) from engineers who worked on the project explained that LeMessurier did consider them, and it had been determined that they did not govern the design
    - It sounds like they were considered from an overall perspective, such as for stability, but likely not on a more refined and detailed level
- Stanley Goldstein: "With legs at the corners, the biggest problem in a quartering wind is that the overturning moment stresses are resisted by only two legs with the others acting as pivots. With the legs at the midpoint of the faces, in a quartering wind they are all working." (*Engineering News-Record*, June 24, 1976)

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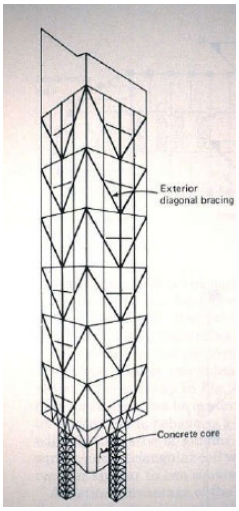
Quartering Winds – Considered in the Design



- According to Ms. Hartley's thesis paper:
  - "They (the structural engineers) discovered that mid-face placement of legs would work to structural advantage: this arrangement would significantly decrease the stresses resulting from a cornering wind, for example." (p. 99)
  - "When combined with an external chevron-bracing system, wherein the legs became extensions of the central mast columns, the resulting solution proved more efficient than a moment-resisting tube in handling wind forces, according to William LeMessurier." (p. 99)

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Quartering Winds – Considered in the Design

- According to Ms. Hartley's thesis paper:
  - "In a building such as the Citicorp tower, it is crucial to study the effects of a cornering wind, wherein a greater contributary area of building face is affected." (p. 376)
  - "The portion of the tower face affected is doubled. Therefore, a multiplication factor of (0.71)(2) = 1.42 is in effect in a cornering wind condition as compared to a perpendicular-face wind condition." (p. 377)
  - "In most structures, the increase in corresponding overturning moment experienced in a cornering wind is aggravated by decreased building resistance … with the Citicorp tower mid-face leg positioning, more effective resistance is provided against a cornering wind." (p. 377)
- Diane Hartley, "*Implications of a Major Urban Office Complex: The Scientific, Social, and Symbolic Meanings of Citicorp Center, New York City*", April 21, 1978, Princeton University Archives, Princeton, NJ.

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Quartering Winds – NIST Study (2019)

- On July 23, 2019, research scientist Dat Duthinh, Ph.D. and a team with the National Institute of Standards and Technology (NIST) employed the latest tools and meteorological data to evaluate the phenomenon of quartering winds applied to the Citicorp tower

- Using high spatial and temporal resolutions, the team was able to calculate the building's response and focus on overall behavior (overturning moment) as well as individual member effects (chevron braces, the subject of the repairs that were made)

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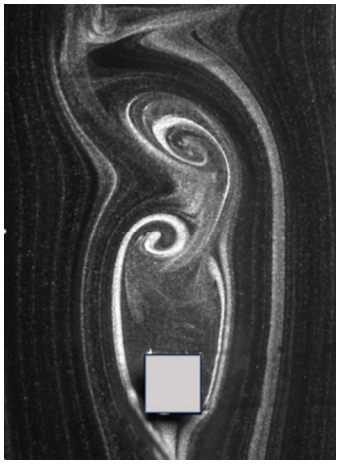
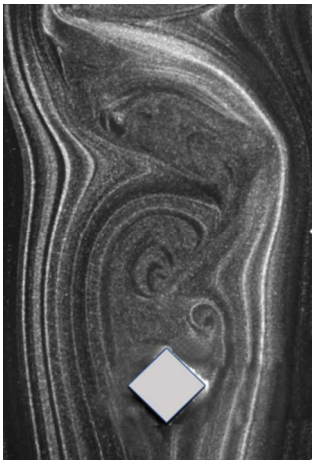
Quartering Winds – NIST Study (2019)



- The along- and across-wind overturning moments in the corner wind case were about 20% and 50% lower (respectively) than their counterparts in the face wind case
- The peak axial forces in the mid-side columns and the peak demand-to-capacity indices of the chevron braces induced by corner winds were lower by 20% to 30% than their counterparts due to face winds
- *Team's conclusion*: LeMessurier's original response to Ms. Hartley's interest in quartering winds was correct and the decision to strengthen the structure deserves to be revisited



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Examining the Ethical Choices

- On January 22, 1999, the National Society of Professional Engineers Board of Ethical Review (NSPE BER) published a sample opinion case entitled, "Duty to Report Unsafe Conditions/Client Request for Secrecy" (Case No. 98-9), which is about a hypothetical problem identical to Citicorp

NSPE

- Engineer A discovers an omission in his calculations
  - Architect and client advise secrecy
  - Detailed evacuation plans are made; repairs have a high probability of success
- Engineer B (city engineer) believes the public, especially building occupants, have a right to know
  - The architect and client convince him that the "right to know" is superceded by the consequences of a possible public panic if they are notified

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Examining the Ethical Choices

- Conclusions:
  - "The desire to avoid public panic is certainly a legitimate factor in deciding upon a course of action. However, withholding critical information from thousands of individuals whose safety is compromised over a significant period of time is not a valid alternative for the conditions presented."
  - "Engineer A should have informed the architect and client that, while he has an obligation of confidentiality to them, he has this ultimate, paramount obligation to see that the public is protected. He should have let them know that he must inform the *appropriate authorities* …"
  - "The argument could be made that Engineer B constitutes the *appropriate authority*. However, given the magnitude of the situation, it was incumbent for Engineer A, as well as Engineer B, to vigorously advocate actions necessary for public protection and notification to higher authorities. By not doing so, both engineers failed to hold paramount the obligation for public safety."

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Examining the Ethical Choices

- Relevant ethical precepts from NSPE Code of Ethics 1964 – 1980:
  - "The Engineer will be honest and impartial, and will serve with devotion his employer, his clients, and the public."
  - "He will be realistic and honest in all estimates, reports, statements, and testimony."

- "The Engineer will have proper regard for the safety, health, and welfare of the public in the performance of his professional duties. If his engineering judgment is overruled by nontechnical authority, he will clearly point out the consequences. He will notify the proper authority of any observed conditions which endanger public safety and health."
- "He will regard his duty to the public welfare as paramount."

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Examining the Ethical Choices

- Similar principles in the current ASCE Code of Ethics:
  - "Engineers, first and foremost, protect the health, safety, and welfare of the public."
  - "Engineers act as faithful agents of their clients and employers with integrity and professionalism."
  - "Engineers keep clients' and employers' identified proprietary information confidential."
- LeMessurier was advised to keep silent by lawyers representing multiple parties, which leads to perhaps the most cited ethical dilemma of the case: deceive the public in order to protect ("faithful agent") the client
  - From what we know, however, it does seem as though appropriate measures WERE taken to protect the public as well

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Examining the Ethical Choices

- The fear of causing mass panic is certainly an important and valid consideration
- Gustave Le Bon, a French social psychologist born in 1841, formulated the *contagion theory*, which argues that crowds cause people to act in a certain way
  - Hypnotic influence
  - Irrational, emotionally charged behavior
  - A decline in personal responsibility
- Fear of causing a mass panic was used as justification in this case for untruthful (or partially truthful) public statements and avoiding the story altogether
  - This fear is certainly valid (the NSPE agreed), and it also serves as a plausible argument that the welfare of the public WAS given consideration and WAS upheld

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Examining the Ethical Choices

- Furthermore, it does seem as though sufficient measures were implemented to protect the welfare of the public throughout the repair process
  - Work commenced quickly and was finished in record time
  - Around the clock surveillance was provided for the tuned mass damper and to monitor the movement of the building with any wind gust
  - Weather reports and predictions were made multiple times each day
  - An extensive evacuation plan was ready for immediate implementation
  - LeMessurier knew exactly what sequence the repairs needed to follow: fixing the most vulnerable joints first, then moving systematically through the rest. Every day that passed during the repair process *improved* the building's survivability.
- Does this justify a lack of honesty with the public?
- Does this justify silence about the event for almost 17 years?

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The Psychology of a Crisis

- When something is elevated to the level of a crisis, people generally take in, process, and act on information differently
  - Communication may be exaggerated or strained
  - "Fight-or-flight" reasoning may dominate the process of deciding a resolution
- The Citicorp question *became a crisis* when LeMessurier discovered his New York team defined diagonal bracing elements as "trusses", not "columns", which required a lower safety factor by AISC
  - This happened about a month after the initial call from the student in New Jersey

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The Psychology of a Crisis

- According to the CDC ("CERC: Psychology of a Crisis"), people generally take in information during a state of crisis in 4 ways
  1. We simplify messages
     - Due to an inability to juggle multiple facts
     - Due to an inability to remember as much information as normal
     - Due to the misinterpretation of differing action messages
     - We may not attempt a logical and reasoned approach to decision making, rather rely on habits and long-held practices

In LeMessurier's case, the initial simplification of the problem was an *important part* of defining the solution

He returned to a "free body diagram" concept to outline the student's question (and the resulting response)

After this initial simplification, however, he understood and administered the steps needed to add complexity to the real-world issue at hand

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The Psychology of a Crisis

2. We hold onto current beliefs
   - People tend not to seek evidence that contradicts beliefs that they already hold
   - We tend to exploit conflicting or unclear messages about an issue by reinterpreting it as consistent with existing beliefs
   - Reputable experts can disagree on the level of threat, risks, and advice and differing viewpoints can leave us with increased uncertainty and fear
     - The result is an even more stubborn loyalty to what is familiar to us
     - Credible sources are key

In LeMessurier's case, he held to the belief that the original design was adequate … but he was curious enough to revisit the drawing board

His extensive experience, as well as that of his team in New York, earned them the right to "hold onto current beliefs"

Unfolding disclosures, however, drove LeMessurier to dive in further (bolts instead of welds, trusses instead of columns, hurricane season)

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The Psychology of a Crisis

Avenues sought for confirmation that there was a problem: New York office, code consultation/interpretation, Davenport's wind tunnel data, a trusted associate in Cambridge

Avenues sought for confirmation that the solution was feasible: Hugh Stubbins (architect), Leslie Robertson (brought on board by liability insurance attorneys), Arthur Nusbaum (HRH Construction), City officials

3. We look for additional information and opinions
   - Before taking action, we usually want confirmation of messages we are receiving
   - We turn to the television, radio, or other news agency to find out how the public is reacting
   - We turn to credible leaders for advice

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The Psychology of a Crisis

Timing during the crisis was remarkable

Time to respond to the student's question: within 1 day

Time to launch a more detailed investigation, consult with experts and colleagues, perform an independent analysis, define a workable solution (from the time of the initial phone call): less than 2 months

Time from LeMessurier's report to Hugh Stubbins to completion of repair welding: less than 3 months

4. We believe the first message
   - Since the speed of a response to a crisis is critical, we may begin to speculate and fill in the blanks in the absence of information
   - The first message we receive may, in fact, be correct, but more accurate information usually follows that can better guide a response or solution
   - When facing a crisis, messages should be simple, credible, and consistent
   - Effective messages should be repeated, come from credible sources, be specific to the emergency at hand, and offer a positive and executable course of action

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Poll Question No. 2

- According to the CDC, what is one of the reasons people may *simplify messages* when taking in information during a crisis?
  - They (the people) are dumb
  - Politicians cannot be trusted
  - The media cannot be trusted
  - An inability to juggle multiple facts

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Strategies for Dealing with Ethical Dilemmas and Crises

- The term "dilemma" usually involves an *undesirable or unpleasant choice*, but it can also simply refer to a *difficult situation or choice*
- In terms of ethics, a dilemma requires a choice between two (or more) options, none of which is completely acceptable or agreeable
- Example:
  - "Hold paramount the safety, health, and welfare of the public." (NSPE Code of Ethics, Part I.1)
  - "Avoid deceptive acts." (NSPE Code of Ethics, Part I.5)
  - Decision: It is more agreeable to deceive the public about impending danger that is safely under control (behind the scenes) in order to avoid unnecessary panic that could make things much worse

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Strategies for Dealing with Ethical Dilemmas and Crises

An effective strategy often involves a sequence of logical steps

- Step 1: Clearly define the problem
- Step 2: Outline a general set of risks that may define potential solutions
- Step 3: Develop a set of requirements, such as precepts of engineering codes of ethics and construction standards
- Step 4: Determine what is known and what still needs to be determined (within the time available)
- Step 5: Consult with trusted colleagues and seek legal advice (as needed)
- Step 6: Identify and evaluate solutions, then execute the chosen solution

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Strategies for Dealing with Ethical Dilemmas and Crises

Acceptance and execution of a suitable solution to an ethical dilemma may be done through a variety of strategies

- Strategy 1: Decide which option offers the greater good or the lesser evil
  - In his book *Metaphysics of Ethics*, Immanuel Kant (1724 – 1804 CE) defines "beneficence" as an office of charity, or something that fulfills the definition of a universal law, because we would want the very same thing for ourselves
    - Beneficence = the pleasure that one takes in the prosperity and happiness of others
    - The solution which produces the greater good for others may be the most appropriate choice

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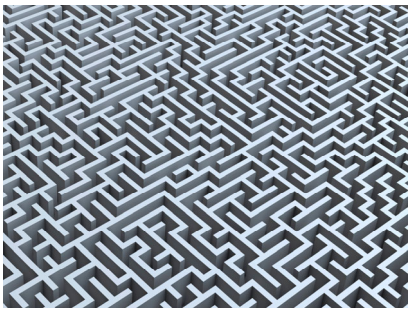
Strategies for Dealing with Ethical Dilemmas and Crises



- Strategy 2: Refute the "fact" that there is even a dilemma at all
  - Natural human emotions (fear, shame, regret) can cloud one's ability to rationally define a situation
  - There may not be enough information about the problem to conclusively proclaim a dilemma exists
  - This is not a denial of reality – it simply means that our first impressions may not be accurate (we are not gods)
- *Suggestion*: Perhaps what may be perceived as an "act of deceit" is simply an act of logically, and with professional judgment, selectively disclosing information that one thinks will best serve the situation (pessimists may reach different conclusions than optimists)
- *Suggestion*: Perhaps "acknowledging one's errors" is simply a matter of favoring one legitimate code interpretation (or application) over another

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Strategies for Dealing with Ethical Dilemmas and Crises

- Strategy 3: Reconsider or rephrase the problem in order to bring about a range of alternative solutions

- Solutions that we would initially be inclined to accept are commonly based on a set of norms that we have learned and accepted over the years
  - This is very difficult to change, but rephrasing a problem does not mean giving up one's accepted set of ethical standards
  - We may need more information in order to form a better judgment of the facts
  - The problem may affect a smaller population than originally thought, which can lead to a different subset of solutions

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Conclusions

- The Citicorp story is most often told as a stellar example of strong professional ethics that should serve as an inspiration
  - However, researchers have pointed out that ethical tenets were also broken, and these deserve to (at least) be discussed
    - "The Engineer … will be honest and impartial, and will serve with devotion his employer, his clients, and the public." (NSPE Code of Ethics, 1964 – 1980)

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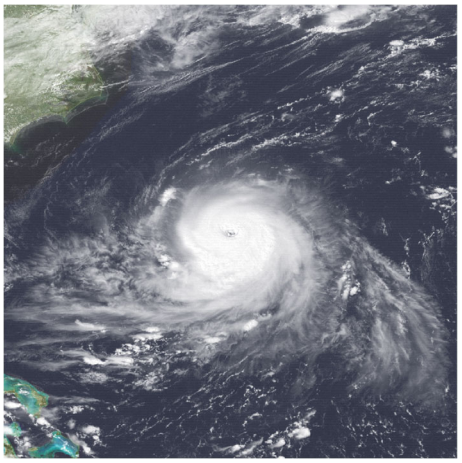
Conclusions

- Research over the years appears to validate the original sensibility and adequacy of the Citicorp building's design to quartering winds
  - LeMessurier's original opinion (based on professional judgment, experience, and data at the time) was that quartering winds did not govern the design
    - In doing a deeper dive, however, he discovered an unexpected potential vulnerability that became exacerbated by a change in the connections, differences in code interpretation, and factors of safety



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Conclusions

- Although the Citicorp story is typically told from the viewpoint of engineering ethics, I think the more exciting story is about how LeMessurier was able to evaluate and solve a perceived problem (under incredible stress), and to lead a diverse team of professionals in a complex and successful venture
  - His actions illustrate a highly logical and driven approach
  - His solution was directed primarily by an acceptable margin of public safety, using the most current data and resources available, and not just a quick, cheap fix

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Conclusions

- Lessons:
  - When faced with a potential crisis, the first step is to honestly determine whether there is a crisis in the first place
    - This can be helpful in the decision-making process
  - Seek advice on both technical and ethical matters when developing potential solutions to a crisis-like problem (don't ignore the "ethics equation" in the problem)
  - Approach ethical dilemmas with brutal honesty and careful analysis
  - Clearly communicate in a timely fashion
  - Share your own lessons learned for the benefit of other engineers

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Other Important References of Interest

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Questions?

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