

# **PDH** NOW

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## **Engineering Ethics: Kansas City Hyatt Walkway Collapse**

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### *Course Description*

This Engineering Ethics course satisfies the 1 hour of continuing education requirement for Professional Engineer license renewal.

The course is designed as a distance learning interactive course that enables the practicing professional engineer to review the legal aspects that govern the practice of engineering.

### *Objectives*

The primary objective of this course is to emphasize the importance of ethics as a broad professional concern rather than a personal one; the engineer's obligation to society, clients, and the profession; ethical dilemmas encountered in engineering practice, and an application of professional ethics to decision making through an illustrative example.

Upon successful completion of the course, the student will be well versed in the potential life changing impacts of engineering design decisions.

### *How to Read this Course*

The student is required to thoroughly read and comprehend the project history, accident explanation and subsequent investigation.

In order to complete the course, the student must pass the quiz in the final chapter of the course. It is recommended that the student keep these questions in mind as the course is read.

### *Topics Covered*

Introduction, Project History, Original Design, Design Changes, Accident, Investigation, and Ethical Issues of the Case.

### *Grading*

Students must achieve a minimum score of 70% on the online quiz to pass this course.

The quiz may be taken three times.

The student will be asked at the end of the quiz to attest that he or she has personally and successfully completed all chapters of instruction.

The quiz may be viewed in the final chapter of this course.

### *Couse Inquiry*

This course is designed to be interactive. The student is encouraged to contact us to discuss any questions that arise while taking this course. All inquiries will be answered within two days or less. The reader can contact PDHNow as follows:

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## Introduction to the Case

On July 17, 1981, the Hyatt Regency Hotel in Kansas City, Missouri, held a videotaped tea-dance party in their atrium lobby. With many party-goers standing and dancing on the suspended walkways, connections supporting the ceiling rods that held up the second- and fourth-floor walkways across the atrium failed, and both walkways collapsed onto the crowded first-floor atrium below. (The fourth-floor walkway collapsed onto the second-floor walkway, while the offset third-floor walkway remained intact.)

As the United States' most devastating structural failure in terms of loss of life and injuries, the Kansas City Hyatt Regency walkways collapse left 114 dead and in excess of 200 injured. In addition, millions of dollars in costs resulted from the collapse, and thousands of lives were adversely affected.

The hotel had only been in operation for approximately one year at the time of the walkways collapse, and the ensuing investigation of the accident revealed some unsettling facts:

1. During January and February, 1979, the design of the hanger rod connections was changed in a series of events and disputed communications between the fabricator (Havens Steel Company) and the engineering design team (G.C.E. International, Inc., a professional engineering firm). The fabricator changed the design from a one-rod to a two-rod system to simplify the assembly task, doubling the load on the connector, which ultimately resulted in the walkways collapse.
2. The fabricator, in sworn testimony before the administrative judicial hearings after the accident, claimed that his company (Havens) telephoned the engineering firm (G.C.E.) for change approval. G.C.E. denied ever receiving such a call from Havens.
3. On October 14, 1979 (more than one year before the walkways collapsed), while the hotel was still under construction, more than 2700 square feet of the atrium roof collapsed because one of the roof connections at the north end of the atrium failed. In testimony, G.C.E. stated that, on three separate occasions, they requested on-site project representation during the construction phase; however, these requests were not acted on by the owner (Crown Center Redevelopment Corporation), due to additional costs of providing on-site inspection.
4. Even as originally designed, the walkways were barely capable of holding up the expected load, and would have failed to meet the requirements of the Kansas City Building Code.

Due to evidence supplied at the Hearings, a number of principals involved lost their engineering licenses, a number of firms went bankrupt, and many expensive legal suits were settled out of court. The case serves as an excellent example of the importance of meeting professional responsibilities, and what the consequences are for professionals who fail to.

## People Involved

In 1976, as owner, Crown Center Redevelopment Corporation commenced a project to design and build a Hyatt Regency Hotel in Kansas City, Missouri, and on April 4, 1978, Crown entered into a standard contract with **G.C.E. International, Inc.** Professional Consulting Firm of Structural Engineers (1980 formerly called Jack D. Gillum & Associates, Ltd. changed name to G.C.E. May 5, 1983).

## Principals

*Jack D. Gillum, P.E.* - structural engineering state licensed since February 26, 1968

*Daniel M. Duncan, P.E.* - structural engineering state licensed since February 27, 1979

*PBNDML Architects, Planners, Inc., architect.*

G.C.E. agreed to provide all structural engineering services for a 750-room hotel projected located at 2345 McGee Street, Kansas City, Missouri.

On or about December 19, 1978, Eldridge Construction Company, the general contractor on the Hyatt project, entered into a subcontract with **Havens Steel Company** Professional Fabricator, who agreed to fabricate and erect the atrium steel for the Hyatt project. Eldridge was awarded the project on the basis of competitive bidding.

## Chronology of the Hyatt Regency Walkways Collapse

- **Early 1976:** Crown Center Redevelopment Corporation (owner) commences project to design and build a Hyatt Regency Hotel in Kansas City, Missouri.
- **July 1976:** Gillum-Colaco, Inc. (G.C.E. International, Inc., 1983), a Texas corporation, selected as the consulting structural engineer for the Hyatt project.
- **July 1976:** Hyatt project in schematic design development.
- **Summer 1977:** Phase. G.C.E.-assisted owner and architect (PBNDML Architects, Planners, Inc.) developed various plans for hotel project, and decided on basic design.
- **Late 1977:** Bid set of structural drawings and specifications
- **Early 1978:** Project prepared using standard Kansas City, Missouri, Building Codes.
- **April 4, 1978:** Actual contract entered into by G.C.E. and the architect, PBNDML Architects, Planners, Inc. G.C.E. agreed to provide "all structural engineering services for a 750-room hotel project located at 2345 McGee Street, Kansas City, Missouri."
- **Spring 1978:** Construction on hotel begins.
- **August 28, 1978:** Specifications on project issued for construction, based on the American Institute of Steel Construction (AISC) standards used by fabricators.

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- **December 1978:** Eldridge Construction Company, general contractor on the Hyatt project, enters into subcontract with Havens Steel Company. Havens agrees to fabricate and erect the atrium steel for the Hyatt project. Eldridge was awarded the general contractor based on a competitive bid.
- **January–February 1979:** Events and communications between G.C.E. and Havens determine design change from a single to a double hanger rod box beam connection for use at the fourth floor walkways. Telephone calls disputed; however, because of alleged communications between engineer and fabricator, Shop Drawing 30 and Erection Drawing E3 are changed.
- **February 1979:** G.C.E. receives 42 shop drawings (including Shop Drawing 30 and Erection Drawing E-3) on February 16, and returns them to Havens stamped with engineering review stamp approval on February 26.
- **October 14, 1979:** Part of the atrium roof collapses while the hotel is under construction. Inspection team called in. Their contract dealt primarily with the investigation of the cause of the roof collapse and created no obligation to check any engineering or design work beyond the scope of that investigation and contract.
- **October 16, 1979:** Owner retains an independent engineering firm, Seiden-Page, to investigate the cause of the atrium roof collapse.
- **October 20, 1979:** Gillum writes owner, stating he is undertaking both an atrium collapse investigation as well as a thorough design check of all the members comprising the atrium roof.
- **October–November 1979:** Reports and meetings from engineer to owner/architect, assuring overall safety of the entire atrium.
- **July 1980:** Construction of hotel complete, and the Kansas City Hyatt Regency Hotel opened for business.
- **July 17, 1981:** Connections supporting rods from the ceiling that held up the second and fourth floor walkways across the atrium of the Hyatt Regency Hotel collapse, killing 114 and injuring in excess of 200 others.
- **February 3, 1984:** Missouri Board of Architects, Professional Engineers, and Land Surveyors files complaint against Daniel M. Duncan, Jack D. Gillum, and G.C.E. International Inc., charging gross negligence, incompetence, misconduct, and unprofessional conduct in the practice of engineering in connection with their performance of engineering services in the design and construction of the Hyatt Regency Hotel in Kansas City, Missouri.
- **November, 1984:** Duncan, Gillum, and G.C.E. International, Inc. found guilty of gross negligence, misconduct and unprofessional conduct in the practice of engineering. Subsequently, Duncan and Gillum lost their licenses to practice engineering in the State of Missouri, and G.C.E. had its

certificate of authority as an engineering firm revoked. American Society of Civil Engineering (ASCE) adopts report that states structural engineers have full responsibility for design projects.

Duncan and Gillum are now practicing engineers in states other than Missouri.

### Background: Structural Failure during the Atrium Tea Dance

In 1976, Crown Center Redevelopment Corporation initiated a project for designing and building a Hyatt Regency Hotel in Kansas City Missouri. In July of 1976, Gillum-Colaco, Inc., a Texas corporation, was selected as the consulting structural engineer for the project. A schematic design development phase for the project was undertaken from July 1976 through the summer of 1977. During that time, Jack D. Gillum (the supervisor of the professional engineering activities of Gillum-Colaco, Inc.) and Daniel M. Duncan (working under the direct supervision of Gillum, the engineer responsible for the actual structural engineering work on the Hyatt project) assisted Crown Center Redevelopment Corporation (the owner) and PBNMML Architects, Planners, Inc. (the architect on the project) in developing plans for the hotel project and deciding on its basic design. A bid set of structural drawings and specifications for the project were prepared in late 1977 and early 1978, and construction began on the hotel in the spring of 1978. The specifications on the project were issued for construction on August 28, 1978.

On April 4, 1978, the actual written contract was entered into by Gillum-Colaco, Inc. and PBNMML Architects, Planners, Inc. The contract was standard in nature, and Gillum-Colaco, Inc. agreed to provide all the structural engineering services for the Hyatt Regency project. The firm Gillum-Colaco, Inc. did not actually perform the structural engineering services on the project; instead, they subcontracted the responsibility for performing all of the structural engineering services for the Hyatt Regency Hotel project to their subsidiary firm, Jack D. Gillum & Associates, Ltd. (hereinafter referenced as G.C.E.). According to the specifications for the project, no work could start until the shop drawings for the work had been approved by the structural engineer.

Three teams with particular roles to play in the construction system employed in building the Hyatt Regency Hotel, were contracted for the project:

1. PBNMML and G.C.E. made up the "design team," and were authorized to control the entire project on behalf of the owner.
2. Eldridge Construction Co., as the "construction team," was responsible for general contracting.
3. The "inspection team," made up of two inspecting agencies (H&R Inspection and General Testing), a quality control official, a construction manager, and an investigating engineer (Seiden and Page).

On December 19, 1978, Eldridge Construction Company, as general contractor, entered into a subcontract with Havens Steel Company, who agreed to fabricate and erect the atrium steel for the Hyatt project.

G.C.E. was responsible for preparing structural engineering drawings for the Hyatt project: three walkways spanning the atrium area of the hotel. Wide flange beams with 16-inch depths (W16x26) were used along either side of the walkway and hung from a box beam (made from two MC8x8.5 rectangular



channels, welded toe-to-toe). A clip angle welded to the top of the box beam connected these beams by bolts to the W section. This joint carried virtually no moment, and therefore was modeled as a hinge. One end of the walkway was welded to a fixed plate and would be a fixed support, but for simplicity, it could be modeled as a hinge. This only makes a difference on the hanger rod nearest this support (it would carry less load than the others and would not govern design). The other end of the walkway support was a sliding bearing modeled by a roller. The original design for the hanger rod connection to the fourth floor walkway was a continuous rod through both walkway box beams.

### Structural change

Events and disputed communications between G.C.E. engineers and Havens resulted in a design change from a single to a double hanger rod box beam connection for use at the fourth floor walkways. The fabricator requested this change to avoid threading the entire rod. They made the change, and the contract's Shop Drawing 30 and Erection Drawing E-3 were changed.

On February 16, 1979, G.C.E. received 42 shop drawings (including the revised Shop Drawing 30 and Erection Drawing E-3). On February 26, 1979, G.C.E. returned the drawings to Havens, stamped with Gillum's engineering review seal, authorizing construction. The fabricator (Havens) built the walkways in compliance with the directions contained in the structural drawings, as interpreted by the shop drawings, with regard to these hangers. In addition, Havens followed the American Institute of Steel Construction (AISC) guidelines and standards for the actual design of steel-to- steel connections by steel fabricators.

As a precedent for the Hyatt case, the **Guide to Investigation of Structural Failure's** Section 4.5, "Failure Causes Classified by Connection Type," states that:

Overall collapses resulting from connection failures have occurred only in structures with few or no redundancies. Where low-strength connections have been repeated, the failure of one has led to failure of neighboring connections and a progressive collapse has occurred. The primary causes of connection failures are:

1. Improper design due to lack of consideration of all forces acting on a connection, especially those associated with volume changes.
2. Improper design utilizing abrupt section changes, resulting in stress concentrations.
3. Insufficient provisions for rotation and movement.
4. Improper preparation of mating surfaces and installation of connections.
5. Degradation of materials in a connection.
6. Lack of consideration of large residual stresses resulting from manufacture or fabrication.

### Roof collapse

On October 14, 1979, part of the atrium roof collapsed while the hotel was under construction. As a result, the owner called in the inspection team. The inspection team's contract dealt primarily with the investigation of the cause of the roof collapse and created no obligation to check any engineering or design work beyond the scope of their investigation and contract.

In addition to the inspection team, the owner retained, on October 16, 1979, an independent engineering firm, Seiden-Page, to investigate the cause of the atrium roof collapse. On October 20, 1979, G.C.E.'s Gillum wrote the owner, stating that he was undertaking both an atrium collapse investigation as well as a thorough design check of all the members comprising the atrium roof. G.C.E. promised to check **all** steel connections in the structures, not just those found in the roof.

From October-November, 1979, various reports were sent from G.C.E. to the owner and architect, assuring the overall safety of the entire atrium. In addition to the reports, meetings were held between the owner, architect and G.C.E.

In July of 1980, the construction was complete, and the Kansas City Hyatt Regency Hotel was open for business.

### Walkway collapse

Just one year later, on July 17, 1981, the box beams resting on the supporting rod nuts and washers were deformed, so that the box beam resting on the nuts and washers on the rods could no longer hold up the load. The box beams (and walkways) separated from the ceiling rods and the fourth and second floor walkways across the atrium of the Hyatt Regency Hotel collapsed, killing 114 and injuring in excess of 200 others.

One investigation report gave the following summary:

*The Hyatt Regency consists of three main sections: a 40-story tower section, a function block, and a connecting atrium. The atrium is a large open area, approximately 117 ft (36 m) by 145 ft (44 m) in plan and 50 ft (15 m) high. Three suspended walkways span the atrium at the second, third, and fourth floor levels. These walkways connected the tower section and the function block. The third floor walkway was independently suspended from the atrium roof trusses while the second floor walkway was suspended from the fourth floor walkway, which in turn was suspended from the roof framing.*

In the collapse, the second and fourth floor walkways fell to the atrium first floor with the fourth floor walkway coming to rest on top of the second. Most of those killed or injured were either on the atrium first floor level or on the second floor walkway. The third floor walkway was not involved in the collapse.

## Aftermath

Photographs taken by Dr. Lee Lowery, Jr., P.E., shortly after the collapse:



Photo of still-hanging third floor walkway. Note the free-standing stairs from the second to the third floor in the background. With its columnless design, the stairs seem to be floating in air. The lobby was indeed a masterpiece of architecture and engineering which, had it been executed properly, would have provided its owners with profit and the public with a stunning atmosphere for years.

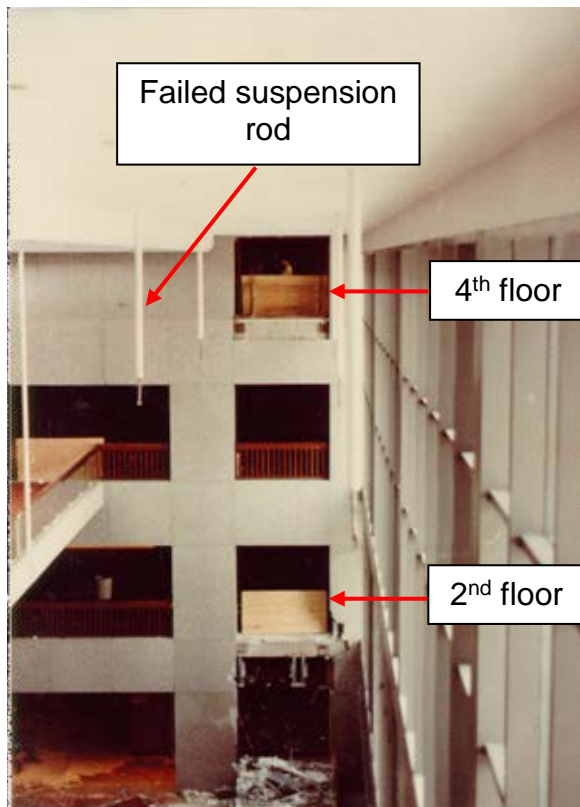
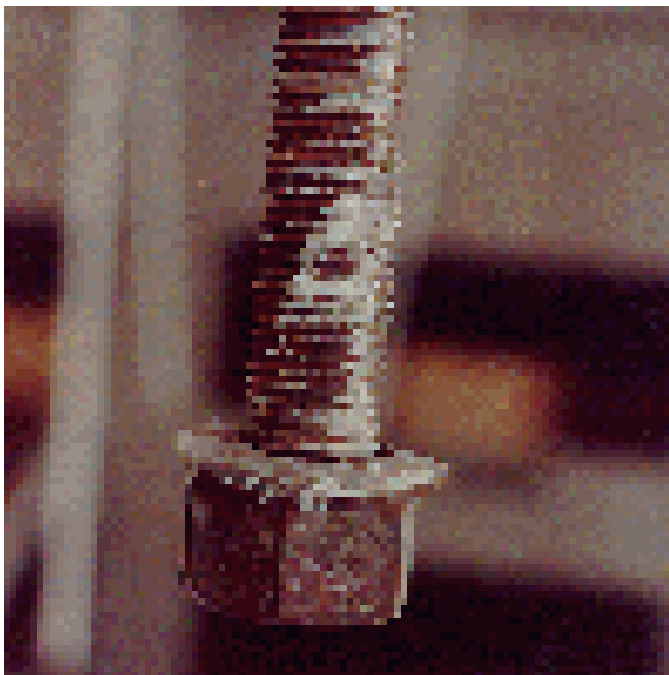


Photo of intact hanger rods from fourth floor walkway opening.



General view of the lobby floor, during the first day of the investigation.



Close-up photo of the hanger rod threads, washer and supporting nut. Note the deformation caused in the washer as the beam slipped around it.



Close-up of one of the fourth floor beams.

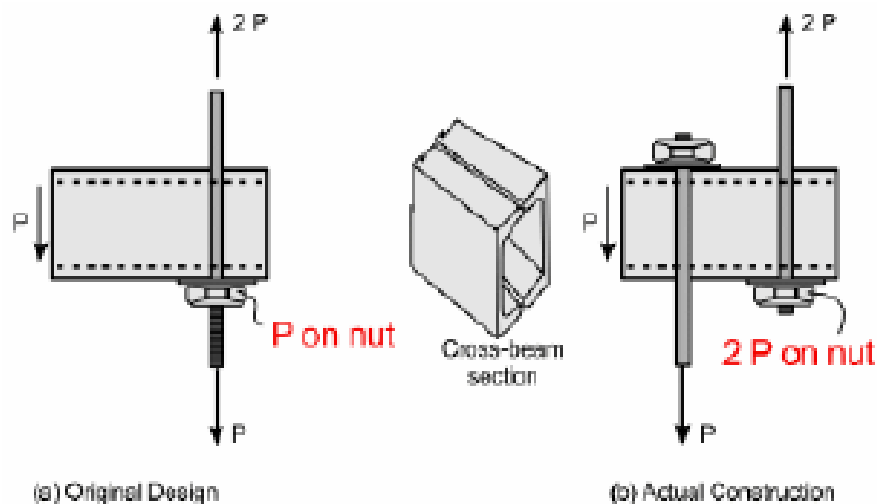


Underside view of one of the fourth floor beams.

Following the accident investigations, on February 3, 1984, the Missouri Board of Architects, Professional Engineers and Land Surveyors filed a complaint against Daniel M. Duncan, Jack D. Gillum, and G.C.E. International, Inc., charging gross negligence, incompetence, misconduct and unprofessional conduct in the practice of engineering in connection with their performance of engineering services in the design and construction of the Hyatt Regency Hotel. The NBS report noted that:

*The hanger rod detail actually used in the construction of the second and fourth floor walkways is a departure from the detail shown on the contract drawings. In the original arrangement each hanger rod was to be continuous from the second floor walkway to the hanger rod bracket attached to the atrium roof framing. The design load to be transferred to each hanger rod at the second floor walkway would have been 20.3 kips (90 kN). An essentially identical load would have been transferred to each hanger rod at the fourth floor walkway. Thus the design load acting on the upper portion of a continuous hanger rod would have been twice that acting on the lower portion, but the required design load for the box beam hanger rod connections would have been the same for both walkways (20.3 kips (90 kN)).*

*The hanger rod configuration actually used consisted of two hanger rods: the fourth floor to ceiling hanger rod segment as originally detailed on the second to fourth floor segment which was offset 4 in. (102 mm) inward along the axis of the box beam. With this modification the design load to be transferred by each second floor box beam-hanger rod connection was unchanged, as were the loads in the upper and lower hanger rod segments. However, the load to be transferred from the fourth floor box beam to the upper hanger rod under this arrangement was essentially doubled, thus compounding an already critical condition. The design load for a fourth floor box beam-hanger rod connection would be 40.7 kips (181 kN) for this configuration. ...*



Fourth Floor Box Beam Connection Detail

*Had this change in hanger rod detail not been made, the ultimate capacity of the box beam-hanger rod connection still would have been far short of that expected of a connection designed in accordance with the Kansas City Building Code, which is based on the AISC Specification. In terms of ultimate load capacity of the connection, the minimum value should have been 1.67 times 20.3, or 33.9 kips (151 kN). Based on test results the mean ultimate capacity of a single-rod connection is approximately 20.5 kips (91 kN), depending on the weld area. Thus the ultimate capacity actually available using the original connection detail would have been approximately 60% of that expected of a connection designed in accordance with AISC Specifications.*

During the 26-week administrative law trial that ensued, G.C.E. representatives denied ever receiving the call about the design change. Yet, Gillum affixed his seal of approval to the revised engineering design drawings.

Results of the hearing concluded that G.C.E., in preparation of their structural detail drawings, "depicting the box beam hanger rod connection for the Hyatt atrium walkways, failed to conform to acceptable engineering practice. [This is based] upon evidence of a number of mistakes, errors, omissions and inadequacies contained on this section detail itself and of [G.C.E.'s] alleged failure to conform to the accepted custom and practice of engineering for proper communication of the engineer's design intent." Evidence showed that neither due care during the design phase, nor appropriate investigations following the atrium roof collapse were undertaken by G.C.E. In addition, G.C.E. was found responsible for the change from a one-rod to a two-rod system. Further, it was found that even if Havens failed to review the shop drawings or to specifically note the box beam hanger rod connections, the engineers were still responsible for the final check. Evidence showed that G.C.E. engineers did not "spot check" the connection or the atrium roof collapse, and that they placed too much reliance on Havens.

Due to evidence supplied at the Hearings, a number of principals involved lost their engineering licenses, a number of firms went bankrupt, and many expensive legal suits were settled out of court. In November, 1984, Duncan, Gillum, and G.C.E. International, Inc. were found guilty of gross negligence, misconduct, and unprofessional conduct in the practice of engineering. Subsequently, Duncan and Gillum lost their licenses to practice engineering in the State of Missouri (and later, Texas), and G.C.E. had its certificate of authority as an engineering firm revoked.

As a result of the Hyatt Regency Walkways Collapse, the American Society of Civil Engineering (ASCE) adopted a report that states structural engineers have full responsibility for design projects.

Both Duncan and Gillum are now practicing engineers in states other than Missouri and Texas.

The responsibility for and obligation to design steel-to-steel connections in construction lies at the heart of the Hyatt Regency Hotel project controversy. To understand the issues of negligence and the engineer's design responsibility, we must examine some key elements associated with professional obligations to protect the public. This will be discussed in class from three perspectives: the implicit social contract between engineers and society; the issue of public risk and informed consent; and negligence and codes of ethics of professional societies.

### Ethical Issues of the Case:

This case centers on the question of who is responsible for design failure. As an ethical issue,

Who is ultimately responsible for checking the safety of final designs as depicted in shop drawings?

When we take the implicit social contract between engineers and society, the issue of public risk and informed consent, and codes of ethics of professional societies into account, it seems clear that the engineer must assume this responsibility when any change in design involving public safety carries a licensed engineer's signature. Yet,

In terms of meeting building codes, what are the responsibilities of the engineer? The fabricator? The owner?

If we assume the engineer in the Hyatt case received the fabricator's telephone call requesting a verbal approval of the design change for simplifying assembly, what would make him approve such an untenable change? Some possible reasons include:

- Saving time and money
- Avoiding a call for reanalysis, thereby raising the issue of a request to recheck all connector designs following the previous year's atrium roof collapse.
- Following his immediate supervisor's orders.
- Looking good professionally by simplifying the design.
- Misunderstanding the consequences of his actions.

These reasons do not, however, fall within acceptable standards of engineering professional conduct. Instead, they pave the way for legitimate charges of negligence, incompetence, misconduct, and unprofessional conduct in the practice of engineering. When the engineer's actions are compared to professional responsibilities cited in the engineering codes of ethics, an abrogation of professional responsibilities by the engineer in charge is clearly demonstrated. But what of the owner, or the fabricator?

What if the call was not made? While responsibility rests with the fabricator for violating building codes, would the engineers involved in the case be off the hook? Why or why not?

The Hyatt Regency walkways collapse has resulted in a nationwide re-examination of building codes. In addition, professional codes on structural construction management practices are changing.

What measures can professional societies take to ensure catastrophes like the Hyatt Regency Walkways Collapse do not occur?

Should Gillum and Duncan be allowed to practice engineering in other states? Why or why not? What is the engineering society's responsibility in this realm?



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### Resources Used to Develop This Course

*Engineering News Report*, published by the National Society of Professional Engineers (NSPE), kept vigilant watch over the case. Of particular interest are the following articles:

"Hyatt Walkway Design Switched," July 30, 1981.

"Hyatt Hearing Traces Design Change," July 26, 1984.

"Difference of Opinion: Hyatt Structural Engineer Gillum Disputes NBS Collapse Report," September 6, 1984.

"Weld Aided Collapse, Witness Says," September 13, 1984.

"Judge Bars Hyatt Tests," September 20, 1984.

"Hyatt Engineers Found Guilty of Negligence," November 21, 1985.

"Hyatt Ruling Rocks Engineers," November 28, 1985.

"Construction Rescuers Sue," August 7, 1986.

"Hyatt Notebook: Parts I and II." *Kansas City*. October 1984 and November 1984.

Missouri Board for Architects, Professional Engineers and Land Surveyors vs. Daniel M. Duncan, Jack D. Gillum and G.C.E. International, Inc., before the Administrative Hearing Commission, State of Missouri, Case No. AR840239, Statement of the Case, Findings of Fact, Conclusions of Law and Decision rendered by Judge James B. Deutsch, November 14, 1985, 442 pp.

This volume contains the findings, conclusions of law and the final decision of the Hyatt Regency Walkways Collapse case, as rendered by Judge James B. Deutsch. The volume contains both the findings of the case and an excellent general discussion of responsibilities of the professional engineer.

Pfrang, Edward O. and Richard Marshall. "Collapse of the Kansas City Hyatt Regency Walkways." *Civil Engineering-ASCE*, July 1982, pp. 65–68.

Official findings of the failure investigation conducted by the National Bureau of Standards, US Department of Commerce. Among its conclusions was this: "Even if the now-notorious design shift in the hanger rod details had not been made, the entire design of all three walkways, including the one which did not collapse, was a significant violation of the Kansas City Building Code."

[https://www.nist.gov/publications/investigation-kansas-city-hyatt-regency-walkways-collapse-nbs-bss-143?pub\\_id=908286](https://www.nist.gov/publications/investigation-kansas-city-hyatt-regency-walkways-collapse-nbs-bss-143?pub_id=908286)

Engineering Ethics: Kansas City Hyatt  
Walkway Collapse

Quiz Problems

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1. On \_\_\_\_\_ occasions Gillum requested funding to have a full-time project quality control representative on the job site, but these funding requests were not approved by Crown.
  - a. 2
  - b. 3
  - c. 4
  - d. 5
  
2. The organization given the task of investigating the walkway collapse was:
  - a. The National Society of Professional Engineers
  - b. The Kansas State Board
  - c. Federal Bureau of Investigations
  - d. National Bureau of Standards
  
3. What policies and procedures changed based on what was learned from the disaster?
  - a. All construction must be inspected by an independent structural engineer hired by the jurisdiction's inspection agency
  - b. A 2<sup>nd</sup> professional engineer stamp was required on all structural design drawings
  - c. Steel fabricators were prevented from performing engineering functions
  - d. A certified welding inspector was required on all structural steel fabrication
  
4. What structural member failed causing the walkway collapse at the Hyatt Hotel Kansas City in 1981?
  - a. Box beam connection
  - b. The steel cable support
  - c. The connecting bolt
  - d. The support column
  
5. Who was ultimately held accountable for the collapse?
  - a. The design engineer
  - b. The steel fabricator
  - c. The hotel owner
  - d. All of the above

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6. While under construction in 1979, \_\_\_\_\_ collapsed
  - a. a portion of the seventh floor deck structure
  - b. a portion of the tower scaffolding
  - c. a construction crane
  - d. a portion of the atrium roof
  
7. The structural collapse resulted in \_\_\_\_\_ deaths.
  - a. 99
  - b. 104
  - c. 109
  - d. 114
  
8. The construction contract for the project was awarded based on \_\_\_\_\_
  - a. time and materials
  - b. negotiations
  - c. competitive bidding
  - d. design-build
  
9. The steel fabrication and erection sub-contractor (Havens) represented itself to customers as being capable of providing \_\_\_\_\_
  - a. architectural services
  - b. demolition services
  - c. engineering services
  - d. recycling services
  
10. Due to evidence supplied at the Hearings:
  - a. a number of principals involved lost their engineering licenses
  - b. a number of firms went bankrupt
  - c. many expensive legal suits were settled out of court
  - d. all of the above
  
11. I have personally and successfully completed each chapter of instruction. You must answer true to complete this course.
  - a. True
  - b. False