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GE105: Introduction to Engineering Design

Engineering Ethics

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Ethics

- A set of moral values and principles which form the standards guiding the code of conduct of individuals, organizations and professions.
- It is the principles of good and bad behaviour governing what is right and wrong conduct

Ethics as Relating to Engineering

Engineering often is based on Preventative Ethics which is based on two dimensions:

1. Engineers must be able to think ahead to anticipate (expect) possible consequences of their professional actions.
2. Engineers must be able to think effectively about those consequences and decide what is the 'ethically' correct manner to handle the situation.

Standards of Proper Conduct

Professional Ethics

The set of standards adopted by professionals to govern their actions and their particular profession, often listed in a ‘code of ethics’ * for that profession.

* NSPE-Ethics-Code-2007-July

Personal Values (Ethics)

The set of one’s own ethical commitments, usually acquired and/or developed in early home, religious, or social training; often modified over time by later reflection or experience.

Common Morality

The set of moral ideals shared by most members of a culture or society.

Engineering Ethics - Issues

- Handling, storing and disposing of hazardous (unsafe) materials
- Accepting gifts and amenities (services)
- Conflict of interest
- Report falsification and ethical misconduct
- Social obligations
- Miscommunication between engineers and fabricators (Assemblers)
 - Will be discussed later
- Engineering responsibility versus management decisions
- Safety negligence of subordinates
- accountability to clients and customers
- Plagiarism (The practice of taking someone else's work or ideas and passing them off as one's own)

Basic Ethical Concepts

- Ethical considerations are an integral part of making engineering decisions.
- The professional obligations of engineers go beyond fulfilling a contract with a client or customer.
- Codes of ethics can provide guidance in the decision-making process.
- Ethical obligations do not stop at any country's border; they are global.

Professional Codes of Ethics

- Accreditation Board for Engineering and Technology (ABET)
- National Society of Professional Engineers (NSPE)
- Institute of Electrical and Electronic Engineers (IEEE)
- American Society of Mechanical Engineers (ASME)
- American Society of Civil Engineers (ASCE)
- Society of Petroleum Engineers (SPE)

Engineering Ethics

Code of Ethics for Engineers (extract of NSPE)

Fundamental Canons (general rules)

Engineers, in the fulfillment of their professional duties, shall:

- Hold paramount (utmost) the safety, health and welfare of the public in the performance of their professional duties.
- Perform services only in areas of their competence.
- Issue public statements only in an objective and truthful manner.
- Act in professional matters for each employer or client as faithful agents or trustees.

Example: IEEE Code of Ethics

- To accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment.
- To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist.
- To be honest and realistic in stating claims or estimates based on available data.

Example: IEEE Code of Ethics

- To reject bribery (corruption) in all its forms.
- To improve the understanding of technology, its appropriate application, and potential consequences.
- To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent (relevant) limitations.
- To seek, accept, and offer honest criticism* of technical work, to acknowledge and correct errors, and to credit properly the contributions of others.

* the expression of disapproval of someone or something based on perceived faults or mistakes.

Example: IEEE Code of Ethics

- To **treat fairly all persons** regardless of such factors as race, religion, gender (sex), disability, age, or national origin.
- To **avoid injuring others**, their property, reputation, or employment by **false or malicious (cruel) action**.
- To **assist** colleagues and co-workers in their professional development and to **support** them in following this code of ethics.

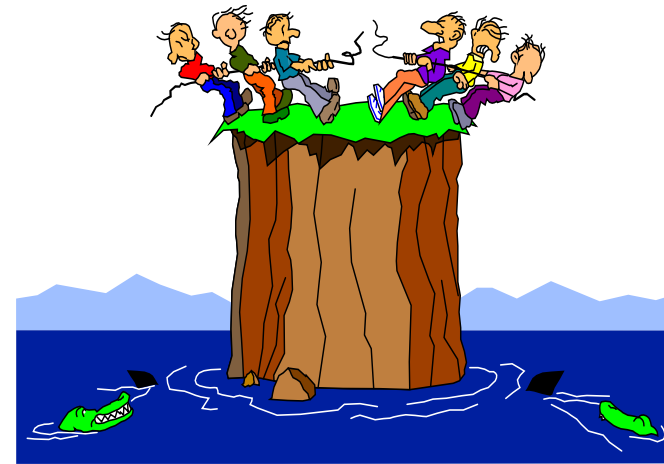
Personal Ethics - everyday examples

- Software piracy
- Expense account padding (Adding unnecessary material or expenses for the purpose of increasing the cost claim)
- Copying of homework or tests
- Income taxes
- “Borrowing” nuts and bolts, office supplies from employer
- Copying of Videos or CD’s
- **Plagiarism**
- Using the copy machine at work

Ethical Issues are Seldom Black and White

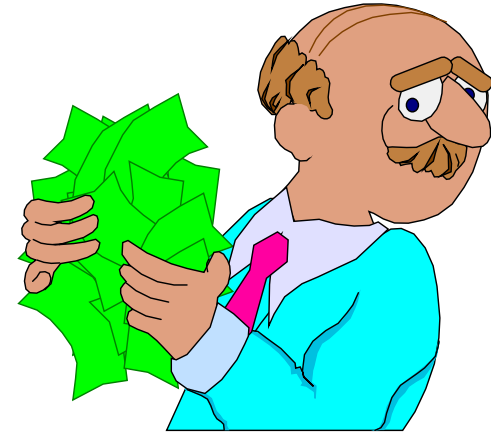
Conflicting demands:

- Loyalty to company and colleagues
- Concern for public welfare
- Personal gain, ambition (**aspiration**).



Ethical standards are usually relative and personal, there is seldom an absolute standard

Moral Dilemmas



Kickbacks* (offering of services with the intent to influence)

A County Engineer in Virginia demanded a 25% kickback in secret payments for highway work contracts he issued. In 1967 he made such an offer to Allan Kammerer, a 32 year old civil engineer who was vice president of a young and struggling consulting firm greatly in need of the work. Kammerer discussed the offer with others in the firm, who told him it was his decision to make. Finally Kammerer agreed to the deal, citing as a main reason his concern for getting sufficient work to retain his current employees. (Martin and Schinzinger, pg 14)

* a payment made to someone who has facilitated a transaction or appointment, especially illicitly.

More Moral Dilemmas

Waste dumping

“On a midnight shift, a botched (spoilt) solution of sodium cyanide, a reactant in an organic synthesis, is temporarily stored in drums for reprocessing. Two weeks later, the day shift foreman cannot find the drums. Roy, the plant manager, finds out that the batch had been illegally dumped into the sanitary sewer. He severely disciplines the night shift foreman. Upon making discrete inquiries, he finds out that no apparent harm has resulted from the dumping.” (Martin and Schinzinger, pg 32)

Should Roy inform government authorities, as is required by law in this kind of situation?

Whistle-Blowing

Always the LAST RESORT, it indicates serious corporate culture problems.

Can be internal as well as external.

Definition depends on one's point of view: (Martin and Schinzinger, pg 214)

“Whistle-blowing” - the act of a man or woman who, believing that the public interest overrides the interest of the organization he/she serves, publicly “blows the whistle” if the organization is involved in corrupt, illegal, fraudulent (fake; false), or harmful activity. (Nader, Petkas, and Blackwell, 1972)

Examples of problems that might warrant whistle-blowing

- Incompetence (Inability)
- Criminal Behavior
- Unethical Policies
- Threat to Public Safety
- Injustices to Workers

Moral Guidelines to Whistle-Blowing

(ref. Richard T. DeGeorge)

It is morally permissible (allowable) for engineers to engage in external whistle-blowing concerning safety:

1. If the harm that will be done by the product to the public is serious and considerable.
2. If they make their concerns known to their superiors.
3. If getting no satisfaction from their immediate superiors, they exhaust the channels available within the corporation, including going to the board of directors.

Moral Guidelines to Whistle-Blowing

(ref. Richard T. DeGeorge)

In order for whistle-blowing to be morally obligatory (essential) however, DeGeorge gives two further conditions:

4. He [or she] must have documented evidence that would convince (prove) a reasonable, impartial **observer*** that his [or her] view of the situation is correct and the company policy wrong.
5. There must be strong evidence that making the information public will in fact prevent the threaten serious harm.

* Person not involved in a particular situation, and therefore able to give a fair opinion or piece of advice.

Case Studies in Engineering Ethics

- If you designed a system that required a **gasketed** connection and you did not have **sufficient data** to predict performance across a spectrum of conditions?

Case 1:

THE CHALLENGER DISASTER (Jan. 28, 1986)

<http://www.youtube.com/watch?v=j4JOjcDFtBE>

Pressure from Management leads to:

- Poor Engineering Judgment.
- Entire crew lost (7).
- Space program set back years.
- Lost public confidence.



Case Studies in Engineering Ethics

- If you designed an automobile component that later proved to fail under certain conditions and could be replaced for \$11 under a recall?

Case 2:

THE FORD PINTO GAS TANK (1978) -corporate decision based on a Benefit/Cost analysis

BENEFIT ANALYSIS

- 180 deaths, 180 serious injuries, 2,100 burned vehicles
- At a cost of \$49.15 million

COST ANALYSIS

- \$11 per vehicle to recall
- Total cost of \$137 million

*How appropriate is it to use figures like this?

*If not appropriate, what are other options?



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Ford Pay

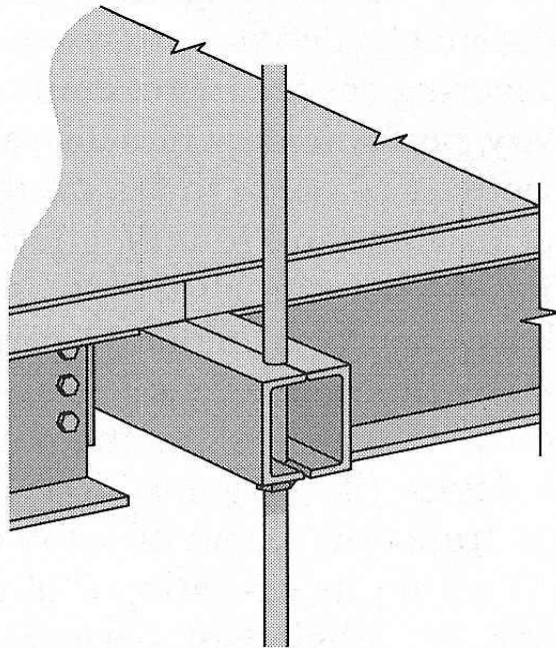
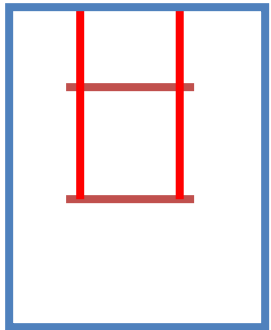
- Over 500 documented deaths related to rear-end collisions in the Pintos
- Lawsuits and personal injury cases totaled over \$450 million even as Ford continues to argue the car was safe if driven correctly
- Company nearly folded after the lawsuits and low sales due to lack of trust in Ford products



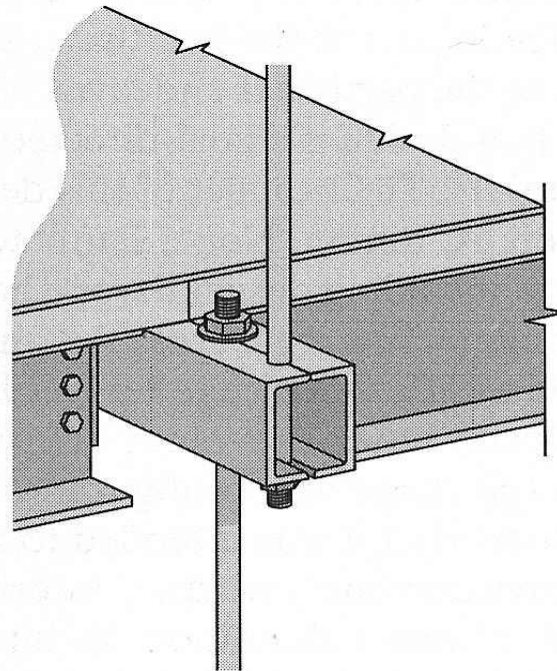
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If you were asked to sign off on a set of shop drawings that had come from a reliable vendor with whom you had a very good working relationship?

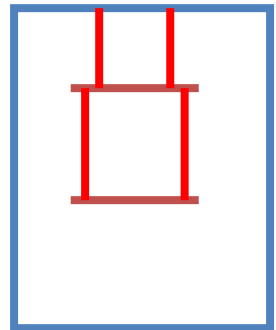
Case 3: THE HYATT REGENCY WALKWAY (Kansas City, 1981)



Original Detail



As Built



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Case 3....

THE HYATT REGENCY WALKWAY (Kansas City, 1981)

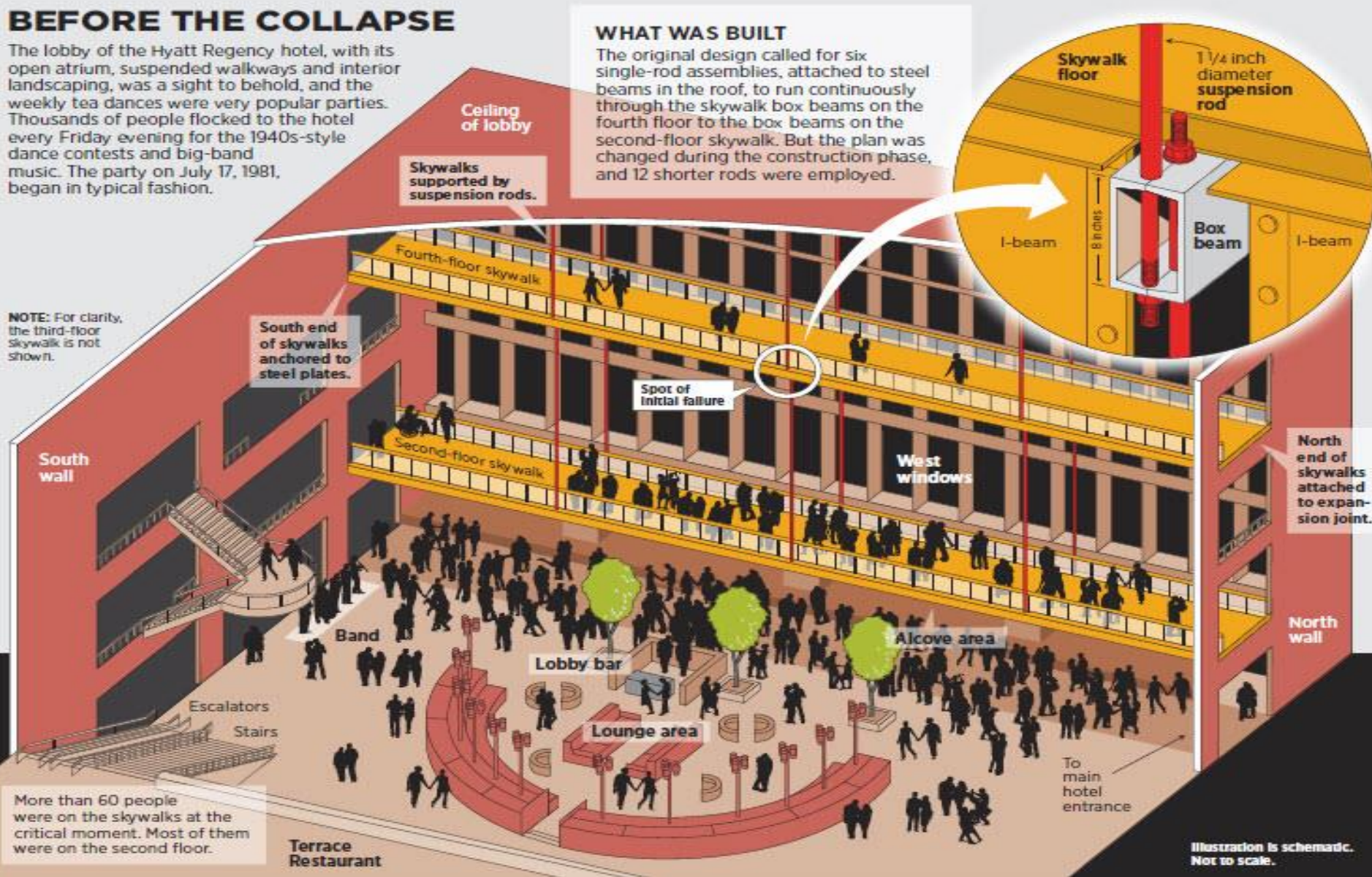
- Support system was changed in the shop drawings by the steel fabricator.
- Engineer failed to review the shop drawings and therefore did not discover the change.
- The change doubled the load on the supports
- 32 ton walkways collapsed.
 - 114 deaths
 - 200 injuries
- Engineers prosecuted

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BEFORE THE COLLAPSE

The lobby of the Hyatt Regency hotel, with its open atrium, suspended walkways and interior landscaping, was a sight to behold, and the weekly tea dances were very popular parties. Thousands of people flocked to the hotel every Friday evening for the 1940s-style dance contests and big-band music. The party on July 17, 1981, began in typical fashion.

NOTE: For clarity, the third-floor skywalk is not shown.



WHAT WAS BUILT

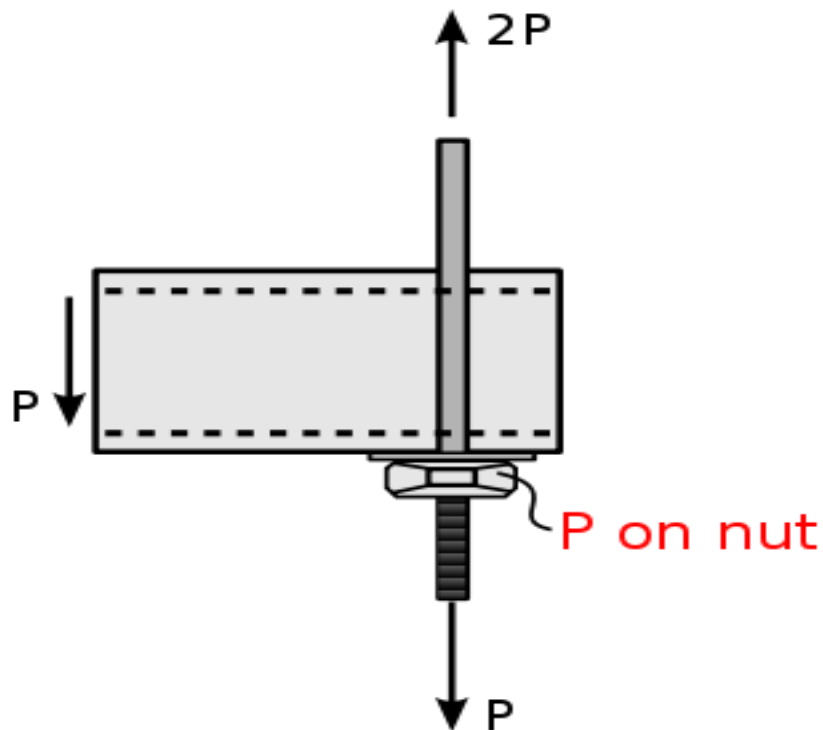
The original design called for six single-rod assemblies, attached to steel beams in the roof, to run continuously through the skywalk box beams on the fourth floor to the box beams on the second-floor skywalk. But the plan was changed during the construction phase, and 12 shorter rods were employed.

Illustration is schematic.
Not to scale.

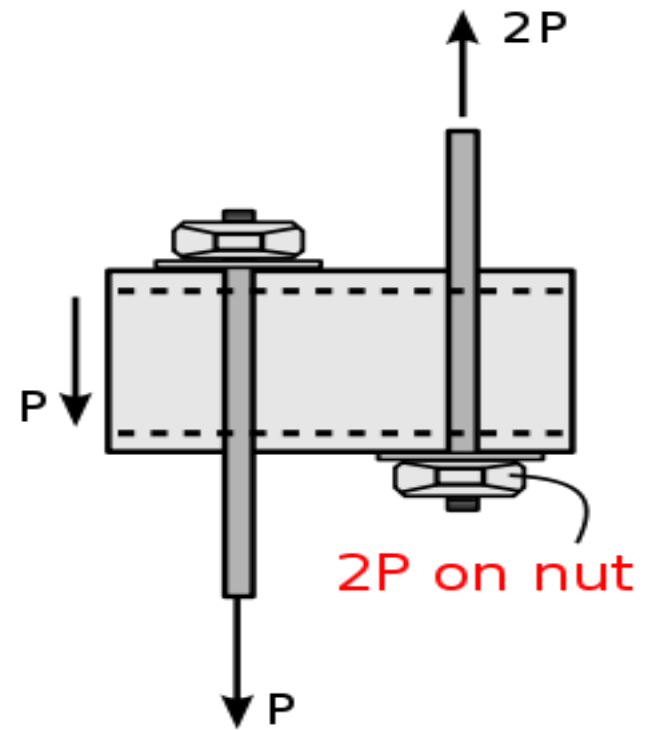
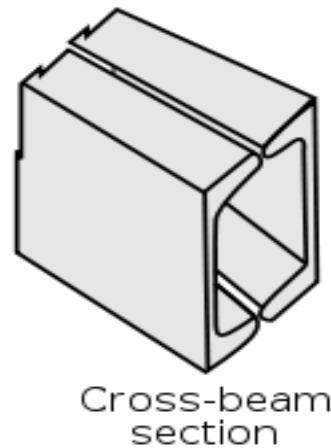
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Case 3....

THE HYATT REGENCY WALKWAY (Kansas City, 1981)



(a) Original design

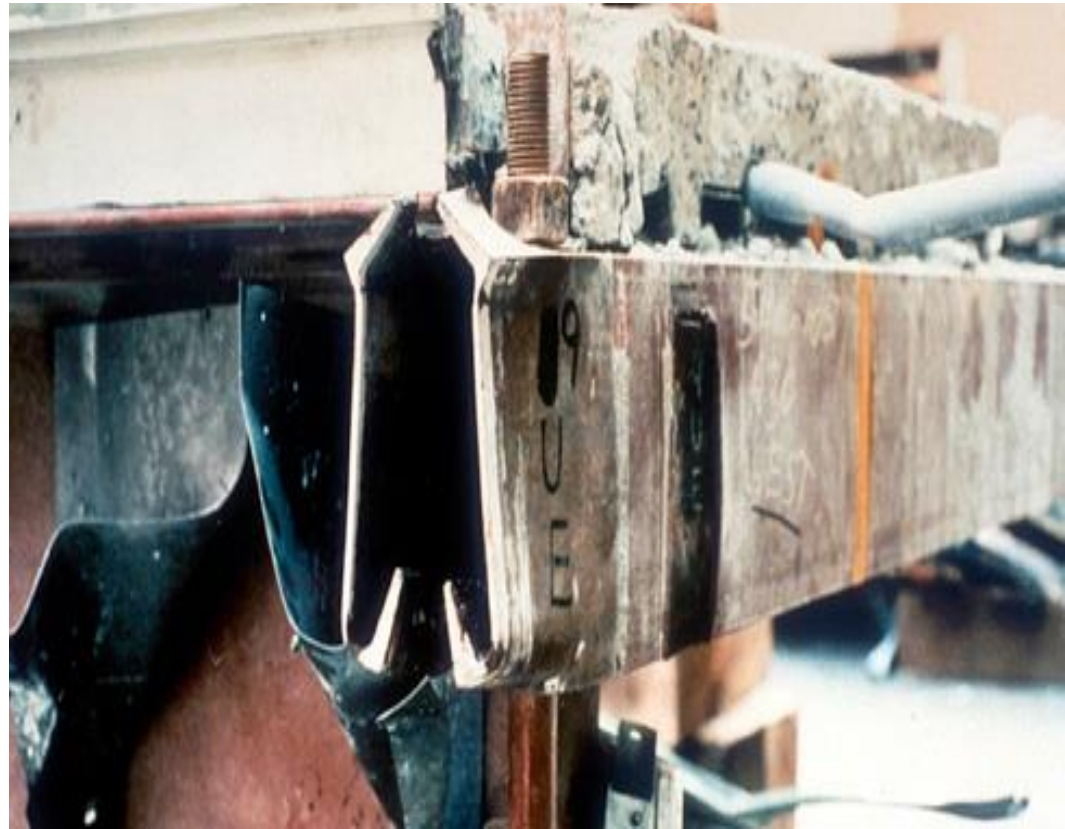
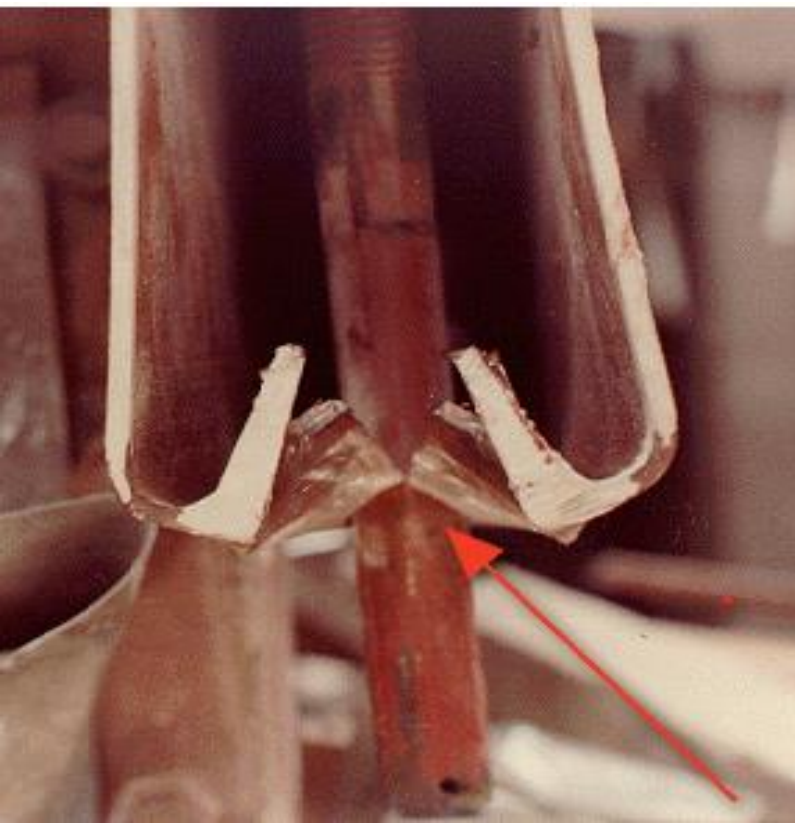


(b) Actual construction

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Case 3....

THE HYATT REGENCY WALKWAY (Kansas City, 1981)



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The five cornerstones of ethical behavior

1. Do what you say you will do.
2. Never divulge (disclose) information given to you in confidence.
3. Accept responsibilities of your mistakes.
4. Never become involved in a lie.
5. Never accept gifts that compromise your ability to perform in the best interests of your organization.

Top ten question you should ask yourself when making an ethical decision

1. Could the decision become habit forming? If so, don't do it.
2. Is it legal? If it isn't, don't do it.
3. Is it safe? If it isn't don't do it.
4. Is it the right thing to do? If it isn't, don't do it.
5. Will this stand the test of public inspection? If it won't, don't do it.
6. If something terrible happened, could I defend my actions? If you can't, don't do it.
7. Is it just, balanced, and fair? If it isn't, don't do it.
8. How will it make me feel about myself? If it feels lousy (bad), don't do it.
9. Does this choice lead to the greatest good for the greatest number? If it doesn't, don't do it.
10. Would I do this in front of my mother? If you wouldn't, don't do it.