

Objectives :

- To understand the importance of engineering practice for the benefit of public.
- To understand the need to learn and know the ethical codes of engineering practice over and above the basic science of engineering.
- To understand the professional responsibility of an engineer and to be able to carry out that responsibility in one's engineering practice.
- To learn how to resolve ethical dilemmas faced in one's profession as an engineer.
- To learn to make moral choices in interest of everyone.

4.1 Introduction

On May 24, 2019, fire broke in a coaching institute which claimed 22 young lives. For this incident, there were unethical practices done at many instances, which involved a decision by an engineer of Surat Municipal Corporation, who had regularised the illegal structure of 3 storeyed complex. The unethical practices were done by the builders and the coaching class owners. In this case, firstly, the builders built illegal construction, then there was only one exit in the top floor and to add to this the coaching institute owner added dome to add more classes. There was no fire safety either in the manufacturing unit from where the fire started, nor the coaching institute. Secondly, the SMC failed to make ethical decision of not allowing the construction. Thirdly, the fire brigade failed to reach the place on time and when they reached they were not well equipped.

The Surat case is a sad example of unethical engineering practice. It shows that how important the engineering knowledge for society and its well being is. And because the engineering practice directly affects the lives of the public, it shoulders a big responsibility of their safety

4.2 Scope of Engineering Ethics

Ethics is the study of moral principles that governs a person's behavior or conducting an activity. 'Engineering ethics' is the rules and standards that govern the decisions and actions of an engineer as a professional.

During their engineering studies, the student receive the knowledge of basic science and its application, problem-solving methodology and designing, but generally receives little training in business practices, safety and ethics.

Several cases like the above, have led to an awareness of the importance of ethics in engineering as it clearly reflects the impact of engineering on society. Moreover, engineers face situations where they have to deal with many things that are not known to them as a result of a design of new device or product. This places a few challenges on engineers as far as decisions are taken. Before putting these designs into the market or implementing the new ideas, an engineer

must see all the aspects, whether it will work well, its impact on the lives of the public, its working under different conditions and safety measures. An engineer can never be enough sure that the new design will not have a detrimental change in the society or not harm anyone at all. Hence, it is important for an engineer to be more imaginative and check all kinds of possibilities. An engineer must apply critical and creative thinking here to make sure that a new design will work safely and will not harm anyone.

Most engineers do not encounter cases like above where there is a big loss of life and the issue may create huge disturbance in the city or the country, but every engineer faces challenging situations that require careful ethical reflection and decision making. These issues in an engineering practice involves bribery, fraud, fairness, honesty and conflicts of interest. Let's think about the following case:

CASE

Satish is a principal engineer at an environmental engineering consulting firm. His main role is to advise clients on what type of action to take when they are faced with risks and liabilities while conducting certain projects. In one case, the client wanted to expand his campus upto 50 meters from the marshland. After construction, the client must ensure a proper waste management plan so that contamination has minimal effect on the surrounding habitat. The client came up with a solution that satisfied, but did not go beyond the bare minimum of state regulations. In other words, though this solution was cost-effective, it would contaminate the environment and within five to ten years hamper the flourishing of the marshland. Should Satish push for a more fiscally demanding, yet sustainable strategy--at the risk of his client backing out of the partnership altogether ?

Issues like these arise in the professional experience of most engineers. Study of ethics can help engineers make correct decisions and become better professionals. It helps sensitize the students to important ethical issues they might face in the future. The goal of learning ethics is to be able to analyse complex situations and resolve these problems in the most ethical manner.

Quick Bites :

- The work of an engineer has a great impact on the lives of the public.
- A decision taken by an engineer like a new design, level of waste disposal, constructing a building, sharing an information with outsider, etc. impacts the life of public, hence it is important that an engineer takes an ethical decision.

4.3 Accepting and Sharing Responsibilities

In the previous section, we saw that what engineers do matters a great deal. Whether it is a risk of public health or risk of an accident, it is important for engineers to understand and act on their responsibilities. But there are different ways of looking at the responsibilities. Some engineers are independent consultants or members of consulting firms, who provide services to clients. However, most engineers are corporate employees. Whether the engineers work for clients or corporate employers, they have basic job responsibilities.

There are various conceptions of responsibilities based on how engineers accept responsibility or what others expect them to do as a part of their responsibility. Moreover, when a harm is done, the responsibility is distinguished as (1) **intentionally causing harm (knowingly and deliberately)**, (2) **negligently causing harm (unknowingly but failing to exercise due care)** and (3) **recklessly causing harm (having conscious awareness that harm may occur, but neglecting it without any intention of causing harm)**. Whether the harm is caused due to any of the above reasons, engineers are morally responsible for any harm that has caused even if sometimes their supervisors or company may be legally at fault because they may have failed morally in failing to report, or even prevent such behavior on the part of the others. More importantly engineers have the responsibility to serve their employers and public in ways that prevents harm. How an engineer views her/his responsibility, depends on the three basic attitudes towards responsibility :

- 1. Minimalist view :** This view holds that engineers are responsible to conform to the standard procedures of their profession and fulfill the basic duties defined by the terms of their employment. If any harm is done due to failure of adhering to these standard procedures, then only they are held responsible. But this approach is based on the minimum requirements and it may prove to be insufficient at the time of unexpected problems. This view usually brings about a negative approach like doing only what is within one's written duties and not going beyond that. This approach is limited to avoidance and blame, and the main concern is "staying out of trouble."
- 2. Reasonable care :** This view moves beyond the minimal view's concern. While in the minimal view, it is sufficient to adhere to the standard procedures, the reasonable care view aims to prevent any possible harm to the concerned people. The professional follows all

standard procedure but evaluates the situations for any possible harm and then works to prevent it. It depends on the moral basis of an individual. The aim is to do whatever possible to avoid any kind of harm or accident.

3. Beyond one's duty : With this view, a professional assumes full responsibility and if anything wrong happens she/he sees their own responsibility. Hence, they strive to do whatever it takes to make their work better and does even more than the required standards. They always feel that they have to do the best, and it is usually inadequate." These people take such actions which are commendable but usually people around would take it for granted. Also, if they don't take these actions, most of us would not think that their not taking these actions indicate moral shortcoming. Rather than putting responsibilities on each other's shoulders, they fully assume their responsibility which are self-imposed. Most of the times, when engineers strive to do the good by putting extra efforts, they are discouraged due to shortage of time, resources limitations and other priorities.

Whistleblowing- a right and responsibility of an engineer :

Whistleblowing is an act by an employee of informing the public or higher management of unethical or illegal behavior by an employer or supervisor. There can be internal whistleblowing where an employee surpasses the immediate supervisor and reports to the higher management about the wrongdoing and external whistleblowing where the employee reports the unethical practice of one's organization to either media or law-enforcement authorities.

Whistleblowing can be considered as the responsibility of the engineer to make others aware about the unethical practices which may harm the public. It is also the right, wherein the engineer can be protected for the consequences that he might face. But, whistleblowing must be done only when there is a dire need to do so i.e. there is a clear and considerable harm that can be avoided by it, when one has complete knowledge of all facts to support one's arguments, when one has complete capability to persist through to end and face the consequences and when whistleblowing is the last resort. Whistleblowing must only be done, if you have already tried to put your point forward to your immediate authority and they haven't considered it seriously.

4.3.1 Impediments to Responsibility

Engineers fail to take up their share of responsibilities due to various reasons.

- 1. Self - interest :** Engineers like other professionals have their own ambitions. Their self-interest sometimes prevent them from looking at the interest of others and may even tempt to work contrary to their responsibilities.
- 2. Fear :** Declaring a fault after discovering it requires lot of courage. If the responsibility of

the fault is completely yours, you may have the fear of losing your reputation and career. And whistleblowing about the fault of others like your colleagues, superior or even the organization may invite lots of opposition and even loss of job.

3. **Self-deception** : Sometimes, engineers do things which may be unethical, because they may have self-deceptive excuses like “I am doing this for my organization” or “it works this way only”. Such self-deceptions avoid them to fulfil their responsibilities as a professional.
4. **Ignorance** : Lack of knowledge that a design is not safe enough naturally acts as a barrier to an engineer’s responsible act. This lack of knowledge is sometimes due to the lack of willingness to go through the challenge one might have to face in solving the problem and sometimes due to lack of time due to pressure of deadlines.
5. **Different perspectives** : Sometimes failure of understanding various perspectives may lead to not being able to see a problem that is otherwise very clear. This is not intentional but as we tend to think with our own perspectives, we may not be able to analyse from different point of views and fail to recognize the problem.
6. **Lack of acceptance of authority** : Engineering codes of ethics emphasizes the importance of engineers exercising independent, objective judgement in performing their functions. This is called professional autonomy. But most engineers work in supervision of their bosses and so it is difficult for them to work with independent and objective judgement. This results in their inability to exercise their responsibility as engineers.
7. **Groupthink** : Many engineering decisions have failed just due to groupthink. When a collective decision has to be taken, usually the members of the group agrees even if they do not want to. First of all, there is less fear of failure as it is a collective decision. Members are not more serious about morality because it is not their individual decision. Also, they are not ready to be the reason for creating a disturbance in what is already going on and due to the strong feeling of belongingness, they agree with all. Finally, the major role of groupthink is the pressure from the group leader to agree with the decision. Thus, groupthink poses a challenge in thinking critically and members go with the flow even if they find there is a flaw.

4.4 Responsible Professionals and Ethical Corporations

To understand who is a professional, let us first understand the meaning of a profession. A work that requires sophisticated skills, the use of judgement and the exercise of discretion, which is not routine and is not capable of being mechanized and significant public good results from it, is called a profession. To be a professional, one requires extensive formal education and not simply a

training or apprenticeship and there are societies or organizations that are controlled by members of the profession who set the standards of conduct for professionals and admissions to professions.

Obviously medicine and law are accepted as professions, but let us see if we can say that engineering is also a profession. Certainly, engineering requires sophisticated skills and particular knowledge which is obtained through extensive training through formal education for four years. Engineering design involves judgement of how to use available materials and components to resolve certain problem. If we consider discretion, then there is a need to keep the employer's and client's information confidential. Another meaning of discretion is to think with independent will. And for new designs, the engineer requires discretion. Also, though once a new technology is developed it is copied and the work becomes mechanized, but the application of every tool and technology and new designs can never be mechanized. Finally, an engineer's work has a huge impact on the society and it is for the good of the people by providing ways of communication, transportation, energy resources, fulfilling needs of shelter, clothing, agriculture and medical equipments. There are controlling societies for different branches of engineering which defines the code of ethics and responsibilities entailed in being an engineer.



Fig. 4.4.1

4.4.1 Professional Responsibilities

The following are the few important responsibilities that engineers have :

1. **Confidentiality** : The prime responsibility of any professional is confidentiality. In medicine and law, it is very obvious that confidentiality be maintained of the patients and clients respectively, but in engineering also it is an engineer's obligation to keep the information of the employer and client confidential. Any information of an organization, like

test results and data, unreleased product and designs, how the business is run, etc. can be used by competitor to gain advantage and hence must be kept confidential in interest of the organization. Engineers working in government departments especially for defence industry have even more stringent requirements to keep confidentiality. Though it is obvious to an engineer about what to keep confidential and from whom, there are instances where there are gray areas. Here, the decision mainly depends on the moral values of the individual.

2. **Conflict of interest** : Any profession provides conflict of interest and it is important for a profession to avoid such situation. There may be conflict of interest between the engineer and the organization or the public. The engineer may compromise the need of the public for one's own interest and this may result into various accidents occurring due to engineering / design failure. Taking bribes to give permissions for work that is not within the code of ethics or illegal, sharing the information of tender with a company where you have financial or other interest, or avoiding more work to go into the depth of the case are some example of giving-in to self-interest at the cost of public or organizational interest.

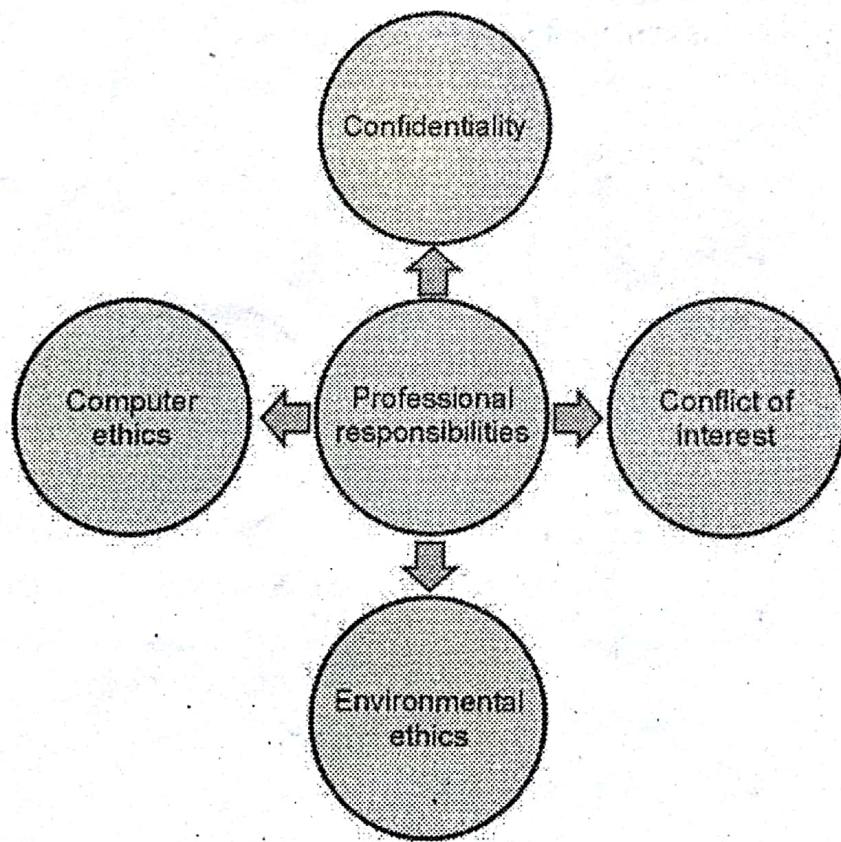


Fig. 4.4.2

3. **Environmental ethics** : One of the most important issues faced by the world is that of environmental deterioration. Engineers have partly contributed to these problems and are also doing researches to counter them. The detrimental effects of use of technology has made the societies and corporations more alert about them and hence have laid down various norms for the organizations and engineers to carry out their responsibilities for environment

protection. For example, there are standards for minimum level of certain gases and chemicals that are released by factories. But these standards are sometimes compromised. To be able to carry out this responsibility fully, engineers must take help of physicians, biologists and public health experts. It may be a costly affair to carry out various tests and takes more time, but in the long run the decisions taken will be beneficial for the whole society.

4. Computer ethics : With the increasing use of computers in all fields, it provides a challenge of unethical use of it. Firstly, computers can be used for robbery, crime and blackmailing others. The anonymity of its usage gives ease to the criminals. Secondly, there is privacy issue for the information about individuals and organizations. Leak of such information of individuals leads to harassments in terms of repeated phone calls from telecallers or even harassments in terms of subtle teasing. Thirdly, hacking is used to access private information and change or destroy some important information. Many organizations have developed the codes of ethics for computer use. They are the guidelines for the ethical use of computers.

Quick Bites :

- A professional must maintain the information of clients and organization confidential.
- A professional must always work to avoid conflicts of interest so that the decisions taken are always ethical.
- There are situations where there is a conflict of self-interest, organizational interest and the public good. At such a time the professional faces dilemma and have to take a decision which is morally correct.
- There are various norms laid down by controlling societies for engineering firms about the level to which they can dump the wastes in the environment and these norms must be followed strictly.
- With every work being done on computers, there are ethical issues like robbery, privacy, harassment, data loss and misuse of data.

4.5 Resolving Ethical Dilemmas

Though there are laws governing the conduct and action of an engineer and there are clear morally right and wrong decisions, often engineers face situations where there is a dilemma of what is right and wrong. To resolve this dilemma, following techniques are used :

1. Line drawing : In this approach, a line is drawn along which various examples and hypothetical situations are placed. At one end, is placed 'positive paradigm' and on the other 'negative paradigm'. Then, all the hypothetical situations and examples are listed and placed on the line at a distance based on how near it is to positive or negative paradigm.

good done and to reduce the harm done. Here the cost-benefit analysis is done. If the benefit is more than the cost involved, then it can be considered to be morally correct.

2. **The Rights Approach** : Other philosophers and ethicists suggest that the ethical action is the one that best protects and respects the moral rights of those affected. This approach starts from the belief that humans have a dignity based on their human nature per se or on their ability to choose freely what they do with their lives. On the basis of such dignity, they have a right to be treated as ends and not merely as means to other ends. The list of moral rights -- including the rights to make one's own choices about what kind of life to lead, to be told the truth, not to be injured, to a degree of privacy, and so on -- is widely debated; some now argue that non-humans have rights, too. Also, it is often said that rights imply duties -- in particular, the duty to respect others' rights.

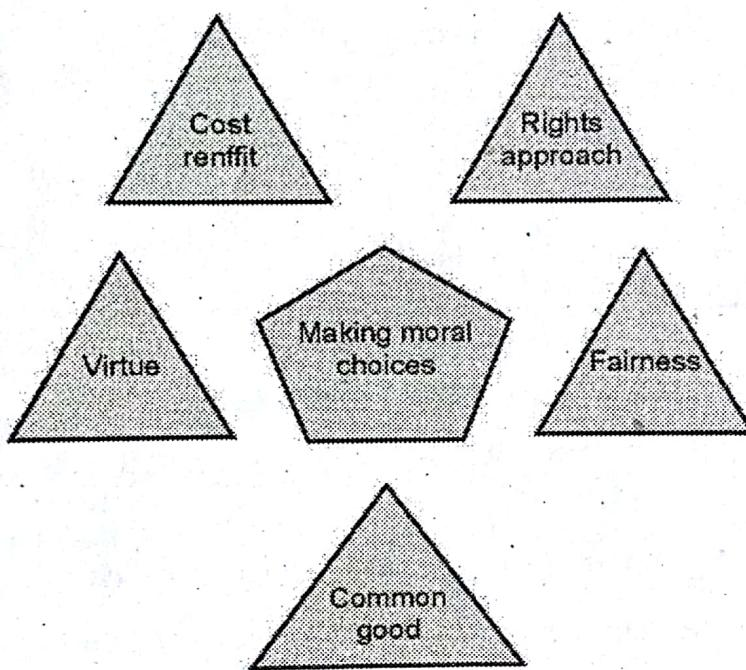


Fig. 4.6.1

3. **The Fairness or Justice Approach** : This approach is based on the belief that all equals should be treated equally. Today we use this idea to say that ethical actions treat all human beings equally--or if unequally, then fairly based on some standard that is defensible. We pay people more based on their harder work or the greater amount that they contribute to an organization, and say that is fair. But there is a debate over CEO salaries that are hundreds of times larger than the pay of others; many ask whether the huge disparity is based on a defensible standard or whether it is the result of an imbalance of power and hence is unfair.

4. **The Common Good Approach** : This approach suggests that the interlocking relationships of society are the basis of ethical reasoning and that respect and compassion for all others -- especially the vulnerable -- are requirements of such reasoning. This approach also calls

attention to the common conditions that are important to the welfare of everyone. This may be a system of laws, effective police and fire departments, health care, a public educational system, or even public recreational areas.

5. The Virtue Approach : A very ancient approach to ethics is that ethical actions ought to be consistent with certain ideal virtues that provide for the full development of our humanity. These virtues are dispositions and habits that enable us to act according to the highest potential of our character and on behalf of values like truth and beauty. Honesty, courage, compassion, generosity, tolerance, love, fidelity, integrity, fairness, self-control, and prudence are all examples of virtues. Virtue ethics asks of any action, "What kind of person will I become if I do this?" or "Is this action consistent with my acting at my best?"

A case of ethical dilemma in the daily work life of an engineer :

Nayasha is a new employee in a startup that produces LCD displays for large venues such as shopping malls. Part of her job is to troubleshoot the malfunctioning these displays.

One of the important clients reported that the display units at their venue was not working properly since 2 months. Nayasha went to the site and examined the displays and found out that her company had sold the units that was from a bad batch. She wanted to tell this to the site owners as they were very important clients, but if she did that, it would cost the reputation of her company and her company would have to install new units at no cost. If she doesn't inform, the company will do the replacement for a cost which would be unethical. Nayasha knew that her manager would like her to take an option which costs her company the least, but at the same time she wanted to be honest as they were company's important customers.

What should she do?

Quick Bites :

- To make moral choices one can use the utilitarian approach, the rights approach, fairness, common good and virtue approach.
- The utilitarian approach weighs the cost against the benefit but may go wrong when only one person is harmed against benefit of many, but it is a huge loss for that person.
- Rights approach helps in making decision based on the right of an individual on how she/he must be treated, but those rights can only be decided by the people in question.
- The fairness good approach is based on the belief that all equals must be treated equally.
- The common good approach is based on the welfare of everyone under common conditions.
- The virtue approach is based on the ideal virtues on which our character is based. These virtues are mainly guided by religious beliefs, spiritual practices or personal moral values.