ENGINEERS BOARD OF KENYA

Enhancing Professionalism

THE ENGINEERS MANUAL

PROFESSIONAL PRACTICE GUIDELINES

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PREAMBLE

Engineers make the world a better place. They make a significant contribution to the socio-economic advancement of a nation and the well-being of the society in general. This results in enhanced safety and quality of life people.

The practice of engineering requires the highest standards of competence, conduct and ethics. Engineering practice is quite vast and dynamic; some disciplines are increasingly becoming specialized, while professional practice is becoming more diverse, robust and wide in application especially with accelerated rate of change in technology as well as influence of ecology, economics, sociology, politics and changes of laws. It is evident the practice keeps on evolving from time to time, yet the principles of engineering largely remain the same. Professional engineers therefore have a challenge to take seriously their obligation to constantly improve and re-invent, but maintaining the highest standards of competence and ethics in the face of changing environment can be difficult.

In the quest to achieve a defined, systematic and consistent approach that is accountable and can assure the public of adequate safety in implementation of engineering systems and infrastructure, the Engineers Board of Kenya has prepared The Engineers Manual; Professional Practice Guidelines in line with Section 7 (1) (m) of the Engineers Act, 2011 to 'set standards for engineers in management, marketing, professional ethics, environmental issues, safety, legal matters or any other relevant field'.

The Engineers Manual will assist engineers in enhancing professionalism as it provides a framework to guide the professional judgement and action of engineers and establishes criteria for consistent quality of professional services and works. Further, the manual will enhance proper professional relationships with clients, employers and the public.

Part One, Introduction dwells on the characteristics of a profession with particular focus on the engineering profession. It outlines the professional engineering practice in Kenya and introduces the Engineers Act, 2011 and Engineers Rules 2019.

Part Two, Professional Practice Guidelines delves into the issues professional engineers encounter on a day-to-day basis and how to address them. These include; commitment to society, health, safety and environmental issues, reviewing the work of another engineer, engineer as an expert witness.

Part Three, Engineering Job Functions provides guidance on standards of professional practice in Kenya. For each job function, guidance is provided on the practical application of ethical and professional conduct themes mentioned earlier. These include project management, contract management, manufacturing, engineering education among other aspects.

The manual is expected to be of benefit to engineers as well as the general public who will have a better understanding of the general practice of engineering. The manual will also help mentor graduate engineers as well as students in engineering faculties in the Country.

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1.0 DEFINITIONS

"Act" means the Engineers Act, 2011;

"Accredited Checker" means a person registered under the Act with the powers to verify the work of a professional engineer in ensuring that the work is adequate and complies with safety requirements.

"Board" shall mean, the Engineers Board of Kenya;

"Client" means a person or an organization using the services of an engineer

"The Code" means the Code of Conduct and Ethics developed by the Engineers Board of Kenya.

"Professional Engineering Works" means professional service, consultation, investigation, evaluation, planning, designing or responsibility for supervision of construction or operation and maintenance in connection with any public or privately owned public utilities, building, machines, equipment, processes, works or projects that requires application of engineering principles and data.

"Professional Engineering Services" means engineering services and advice in connection with any feasibility study, planning, survey, design, sketch, drawing, specifications, construction, commissioning, operation, maintenance, supply of specialized engineering equipment and management of engineering works or projects and includes any other engineering services approved by the Board;

"Engineer" means a person registered under the Act as a professional engineer or consulting engineer and who holds a valid license;

"Design Engineer" means the engineer who conceptualizes and designs a project(s) including signing and stamping of design drawings, documents and specifications.

"Review Engineer" means the engineer who interprets and implements the design drawings,documents and specifications.

"Employer" in a broader sense means Client, the person named as employer in the contract data or the implementing agency or its staff under whose name the contract is signed.

“Project Engineer” means an engineer with the role of liaison between the Project Manager and the technical disciplines involved in a project;

“Project Manager” means an engineer who possesses professional skills in the field of project management with the responsibility of the planning, execution and closing of any project relating to any engineering works;

“Engineering Drawings” means the type of technical drawings used to define the requirements for engineering products, artefacts or processes. They describe particular specifications in line with acceptable standards. They include; preliminary and detailed design drawings, working and installation drawings, and instructions. All engineering drawings must be duly signed and stamped by a professional engineer.

“Engineering Project Tests” means the tests that are stipulated in a particular engineering discipline that entail checks or measurements done before project implementation, during implementation and upon commissioning of the project.

“Completion Certificate” means a certificate issued by an engineer to ascertain the quality of services and works are to the required standards.

“EMCA” means Environmental Management and Coordination Act, 1999.

“OSHA” means Occupational Safety and Health Act, 2007.

1.0 INTRODUCTION

2.1 Characteristics of a Profession

2.1.1. A profession is a learned calling requiring advanced knowledge, understanding and abilities gained from intensive and specialized education, training and practical experience.Professions tend to be highly organized and regulated, yet members participate in varied activities that typically require the exercise of discretion and judgment. Members of a profession limit their work to their areas of expertise or competence for the benefit or welfare of the public. Professional practitioners also maintain their competence throughout their careers.

2.1.2. Professions adopts distinctive Code of Conduct and Ethics that deal with relationships between their members and the public, as well as with colleagues, employers, employees and clients. Adherence to the Code of Conduct and Ethics ensures an adequate standard of competence and conduct. It establishes a relationship of responsibility and trust between the profession and the public, while maintaining respect, integrity and confidentiality among practitioners, employers and clients. The highest obligation of a profession is to the society it serves; The Public.

2.1.3. Engineering qualifies as a profession because it satisfies an indispensable and beneficial social need. In addition, its knowledge and skills are not common possessions of the public; but are a result of tested research, innovation and experience gained through education and practice.

2.1.4. Engineering is a profession in which mathematical and natural sciences knowledge acquired by study, training, experience and practice is applied with wisdom and judgement to create, invent, innovate and develop ways to sustainably and economically utilize materials and forces of nature for the benefit of humanity. Engineers are problem solvers, they are solution providers.

2.2 The Engineering Profession in Kenya

2.2.1. Engineers Board of Kenya is responsible for the registration of engineers and engineering firms, regulation of professional engineering services, settings of standards, development, and general practice of Engineering in Kenya in line with the Engineers Act, 2011.

2.2.2. There are four (4) documents very important to professional engineering practice in Kenya;Engineers Act 2011, Engineers Rules 2019, Code of Conduct and Ethics and the EngineersManual.

2.2.3. These documents define the duty of the Engineers Board of Kenya to safeguard and promote the welfare of the Public as well as the responsibilities of individual members to the public, their relations with clients, colleagues, employers, employees and the profession itself. In addition, they establish the fundamental objectives of standards of ethical and professional conduct and provide the legal foundation for enforcement of these standards.

2.2.4. The Engineers Act 2011 and the Engineers Rules 2019 establish and regulate the practice of professional engineering in Kenya with particular focus on requirements for membership, grounds for discipline and unauthorized practice offences.

2.2.5. The Code of Ethics is premised on the Engineers Act 2011. It consists of general statements of ethical and practice standards developed by Engineers Board of Kenya for the guidance of its members.

2.2.6. The Engineers Board of Kenya (EBK) works closely with the Institution of Engineers of Kenya (IEK), which is the learned society of engineers in Kenya. The objective of IEK is mainly to represent the diverse interests and welfare of engineers, promote and develop the engineering profession and encourage best practices.

2.3 Responsibilities and Privileges of Engineers under the Engineers Act, 2011 & Engineers Rules 2019

2.3.1 The Engineers Act 2011 and the subsequent Engineers Rules 2019 provide the legal framework governing the engineering practice in Kenya. The two legal documents recognize the heavy responsibility that an engineer has in safeguarding public health and safety and therefore accords commensurate privileges on an engineer.

2.3.2 The Act restricts the right to submission of engineering documents to engineers and therefore ultimately the responsibility on the engineering documents must be taken by the engineer. Section 50 (1) of the Engineers Act, 2011 states 'The right of a registered or licensed person under this Act to submit plans, engineering surveys, drawings, schemes, proposals, reports, design or studies to any person or authority in Kenya is restricted to the right to submit such documents only in relation to the discipline of engineering in which that person including a professional engineer in an engineering consulting firm, is qualified as shown in the entries in the Register'.

Section 50 (2) 'A person who is not registered as a professional engineer or firm shall not be entitled to submit engineering plans, surveys, drawings, schemes, proposals, reports, designs or studies to any person or authority in Kenya'.

Section 50 (3) 'A person who contravenes any provision of this section commits an offence.'

2.3.3 The Engineers Rules 2019 further emphasis on the ownership of engineering documents through the introduction of requisite tool. Section 10 (4) of the Engineers Rules 2019 states that 'the Board shall issue an official rubber stamp to every professional and consulting engineer registered under the Act on payment of the fees prescribed in the Third Schedule.'

Section 10 (5) 'The rubber stamp issued under paragraph (4) shall be used for approving or certifying engineering documents including design calculations, drawings, technical reports and other engineering documents.'

Section 10 (6) 'A professional engineer or a consulting engineer shall sign and date and affix the rubber stamp issued under paragraph (4) on any approval or certification given by the professional engineer or a consulting engineer.'

Section 10 (7) 'A professional engineer or a consulting engineer who fail to use rubber stamps issued under paragraph (4) and to be used as per paragraph (5) and (6) commits an offence.

2.3.4 The legal framework therefore requires highest levels of diligence from the Engineer and provides the environment for the engineer to offer the services.

2.4 The Engineers Manual for Practice in Kenya

2.4.1 This Engineers Manual is a set of guidelines that deal with engineering activities located in Kenya and engineers licensed to practice in Kenya and is governed by the Engineers Act 2011 and Engineers Rules 2019. The purpose of the guidelines is to provide interpretation and direction for the day-to-day application of engineering standards and principles to enhance consistent methods and practices that will ensure accountability in the delivery of quality engineering services and works in Kenya.

2.4.2 These general guidelines provide the basis for engineering planning, design, execution and management of the professional engineering services and works/projects. These projects include; construction of infrastructure(housing, roads, power lines, sewer lines), manufacturing industries, processing factories, agriculture, water and irrigation industry, mining and extraction, oil and petroleum industry, marine industry, energy industry etc.

2.4.3 The engineer must comply with applicable and accepted external regulations in rendering professional works and services. The guidelines for professional practice will dwell on the following key areas;

- Engineering designs and contract administration
- Engineering project management practices
- Manufacturing engineering practices
- Engineering operations

2.4.4 The Board shall ensure the set out purpose of these guidelines are adhered to, through;-

a. Enforcing, monitoring and maintaining the conduct and code of ethics for engineers.
b. Monitoring of the set occupational health and safety aspects in the practice of engineering
c. Advocacy and promotion of best practices in engineering.
d. Effective and efficient enforcement of compliance to enhance quality.
e. Carry out inquiries on matters pertaining to registration of engineers, engineering consulting firms and the practice of engineering as a whole.

3.0 PROFESSIONAL PRACTICE GUIDELINES

3.1 Application of the Code of Conduct and Ethics for Engineers

3.1.1 The Board developed The Code, which forms the framework for responsible professional practice as it prescribes standards of conduct to be observed by all engineers and firms registered under the Engineers Act, 2011.

3.1.2 Professional engineers shall conduct themselves with honour and dignity, be truthful, honest, and trustworthy, safeguard human life and welfare and make the best use of the environment through conservation and sustainability. They are also called to serve the public, their employers, clients and colleagues with fairness, equity, courtesy and fidelity. They should strive to increase the competence and prestige of the engineering profession and support the professional and technical societies of their disciplines.

3.1.3 Professional engineers should perform services only in the areas of their competence, issue public statements in an objective and truthful manner.

3.1.4 Engineers shall be guided in all their professional relations by the highest standards of integrity. Engineers shall be beyond reproach and shall not indulge themselves in corruption, mismanagement of resources and any other illegal activity that will bring disrepute to the dignity of the engineering profession and compromise the safety and welfare of the public.

3.1.5 Engineers shall report to the Board or other appropriate agencies any illegal or unethical engineering decisions or practices by engineers or others.

3.1.6 Engineers shall be aware of and ensure clients and employers are made aware of societal and environmental consequences of actions or projects and endeavor to interpret engineering issues to the public in an objective and truthful manner.

3.1.7 A good understanding of the code of conduct and ethics enables the engineer to provide professional services to the public in a more conscientious manner. Further details of the Code of Conduct and Ethics are spelt out under Schedule Six (6) of the Engineers Rules 2019.

3.2 Commitment to Society

3.2.1 The conduct of professional engineers should always be guided by the need to recognize that professional ethics are founded on integrity, competence, devotion to services and enhancement of public welfare. Therefore the actions of each professional will enhance the dignity and status of the profession. Engineers should diligently complete their undertakings in good conscience, putting aside self-interest while demonstrating concern for the expectations and welfare of the public. Engineers should advance public knowledge of the profession and should serve in public affairs when their professional knowledge may be of benefit. They should serve on public boards, boards of directors, management and leadership and other avenues. Engineers should be on the forefront in formulation and implementation of policies that would influence socio-economic development. Engineers should be alive to the current challenges facing the society and device problem solving ways. Engineers indeed should endeavor to participate in society at all levels, from community affairs to public office, with integrity, tact and decorum.

3.3 Advertising

3.3.1 Professional engineers using advertising to promote their services should not mislead the public. They should apply the following principles;

i. Advertising and promotional activities relating to professional engineering services should comply with basic rules of acceptable engineering practice and code of ethics.

ii. The dignity and status of the profession and its members should be preserved.

iii. Statements made or implied should be truthful, factual and precise, without exaggeration or misrepresentation.

iv. Comparison with, or criticism of, services offered by other engineers, either directly or indirectly, is inappropriate.

v. Words that suggest or pictures that illustrate, without a proper disclaimer, portions of a project for which the advertiser has no responsibility, thus implying greater responsibility that the advertiser incurred, are inappropriate.

vi. Claims of greater responsibility for a specified project than is actually the case are inappropriate.

vii. Appropriate indications of co-operation by associated firms or individuals in specified projects should be included.

viii. The Engineers Stamp should not be used for advertising or commercial purposes.

3.4 Safety, Health and Environment Aspects; Concept of Green Engineering

3.4.1 Safety, health and environmental issues are paramount for professional engineers in Kenya. They are enshrined in the Code of Ethics with references on public safety and occupational safety. Engineers must be aware of their responsibilities with regard to safety as it affects the performance of their engineering activities.

3.4.2 Professional engineer is vested with the great responsibility of harnessing the resources of nature for the benefit of humanity. This requires designing and operating systems with great emphasis and consideration to environmental conservation and sustainability. The engineering decisions, designs and operations should not compromise the natural environment. Unsustainable engineering designs and work impact natural ecosystems negatively and ultimately makes survival of humanity be at risk.

3.4.3 Professional engineer should spearhead an environmental impact assessment (EIA) when designing a solution to a problem. This will enable him identify, predict and analyze impacts on the physical environment as well as social, cultural and health aspects and will also inform decision makers, the Public and other stakeholders the environmental consequences of implementing a proposed project.

3.4.4 Engineers should therefore be well versed with relevant laws affecting the engineering practice such as the Occupational Safety and Health (OSHA) Act 2007 and the Environmental Management and Coordination Act 1999.

3.4.5 Engineers must ensure occupational health and safety measures are strictly adhered to. This should be done through provision of safety policy or guidelines, safety and environmental management plan, training programme on safety, existence and adequacy of occupational health management system and presence of trained safety officer; environmental officer and occupational health practitioner.

3.4.6 Assuring safety in all aspects of an engineer's work can be difficult, but it is the responsibility of all professional engineers to take this mandate seriously. Engineers are expected to know more than the average citizen does where safety, health and environmental issues are concerned.

3.5 Reviewing the Work of Another Professional Engineer

3.5.1 To begin a review, the reviewing engineer should assemble the original instructions, basic data, amendments, feasibility studies, specific design assumptions and any other relevant information on the project. The reviewer should understand the mandate and conditions applying to the review. To assist this, it may be desirable to have written instructions that specify the mandate.

3.5.2 The reviewer must carry out the review on factual and technical grounds, strictly within the mandate but mindful of the overriding public interest. Reviewers must be temperate in their judgement and must assume responsibility for their opinions, while giving appropriate credit to the work of other professional engineers.

3.5.3 If the review is of the work of another professional engineer who is still working on the project (either through an employment or an agreement to provide professional services), he/she must be informed of the review. The reviewer should only undertake the assignment when he/she has confirmed that the original engineer is aware of the review. This obligation is restricted to the provision of an engineering review.

3.5.4 As stipulated in Section 12 (3) of the Code of ethics and conduct for engineer, 'an engineer engaged in private practice shall not review the work of another engineer for the same client, except with the knowledge of such other engineer, or unless the connection of such engineer with the work has been terminated.' Section 12 (4) 'an engineer in governmental, industrial or educational employment is entitled to review and evaluate the work of other engineers when so required by their employment duties.

3.5.5 The reviewer must administer the review contract and evaluate professional engineering services and works at arms-length so that the professional engineer of record remains fullyresponsible for the design. The acceptance of mutually agreed upon changes does not relieve the original design engineer of responsibility for the work under review. The employment agreement or contractual arrangement at the time of the review does not affect the responsibilities of the reviewer discussed above.

3.5.6 Once the review is complete, the reviewer has no further right or obligation to disclose the findings to the professional engineer whose work has been reviewed. Generally, the client would not permit disclosure of the findings and the contractual obligation of the reviewer is to the client. The reviewer should, however, seek approval of the client in writing to inform the other professional engineer of the general nature of the findings and, if appropriate, should try to resolve any technical differences.

3.5.7 As part of peer review, it is good practice for professional engineers have their work be routinely reviewed as part of ongoing quality control and professional development. If the reviewer finds design changes are necessary, he/she should inform the professional engineer who executed the design of these findings and the reasons for the recommended changes. During the design stage, the professional engineer and the reviewer may agree to change the proposal. They must not, however, agree to any change suggested by the reviewer that could result in an unworkable installation, would conflict with relevant code or would create a risk of damage or injury.

3.6 The Importance of Accredited Checkers

3.6.1 An accredited checker is a consulting engineer registered by the Board and is mandated to evaluate, analyze and review the engineering designs and perform such original calculations with a view to determine the adequacy of the design and compliance with safety requirements.

3.6.2 With reference to Engineers Rules 2019, a report prepared by an accredited checker includes the following:-

i. Codes of practice used for the works being checked.
ii. Standards and specifications of materials adopted for the works.
iii. Analysis of the safety features checked.
iv. Observations or suggestions for amendments or alternative solutions on designs consistent with his terms of reference and applicable standards, codes and local by-laws and regulations.
v. Any other engineering detail that might have a bearing on the adequacy and safety of the works.

3.6.3 An accredited checker will play an important role in ensuring safety of engineering projects by carrying out independent checks on the designs prepared by the design engineer to minimize the risk of design errors due to lapses by the design engineer. Accredited checkers will be given sufficient time to carry out their checking so that any design inadequacy could be corrected. The accredited checkers system is akin to a safety net to ensure safety of engineering projects.Undertaking the work of an accredited checker when one is not registered by the Board is prohibited. Section 24 (3) of the Engineers Act, 2011 states *'A person shall not perform functions or duties under this Act as an accredited checker, unless that person is registered by the Board'.*

3.7 Expert Testimony

3.7.1 Professional engineers, in the course of their practice may be called to give expert testimony either in a legal setting or the general media. The expert witness is utilized in the justice system to provide clear explanations of complex technical matters and provide reasoned, defensible opinions and conclusions for both the professional and the public.

3.7.2 The decision to offer service as an expert is solely that of the individual engineer based on his/her education, experience, competence, reputation and confidence. It will be a great advantage to the profession that more professional engineers serve as experts.

3.7.3 The expert witness should present reasonable and defensible conclusions with conviction and authority. The engineer should review the available facts thoroughly, fairly and impartially. He/she should not exclude any relevant information to create a view favoring either party to the dispute.

3.7.4 The engineer must ensure he/she is aware of all parties involved, identify, and declare any conflict of interest to the client, whether it is real, potential or perceived. He should obtain a written acknowledgement of the conflict from the client in the event the client continues with the services of the engineer.

3.7.5 Distinguishing between an engineer's qualifications and his/her current competence is important to obtain the most appropriate expert witness. Absolute confidentiality for the client is paramount.

4.0 ENGINEERING JOB FUNCTIONS

4.1 Engineering Project Management

4.1.1 Projects are usually undertaken to provide a specific deliverable within a defined duration. An engineer plays an integral role in successful implementation of engineering projects. This entails detailed steps from project scoping through team selection to production and post-project evaluation.

4.1.2 Engineering project management encompasses the following;

- Accurate project scoping/conceptualization
- Feasibility studies
- Comprehensive project planning, clear definition of project deliverables
- Engineering design and documentation
- Project execution
- Careful project monitoring, adherence to project schedule and budget through project review and evaluation
- Project testing and commissioning

4.1.3 Where an engineer is the project manager, it is important that before commencing a project, an engineer should determine the scope of the project and its requirements; staffing, skills, project timing and budgetary constraints.

4.1.4 It is important that engineering solutions and projects are guided by feasibility studies, technical audits and evaluation where applicable so as to identify an appropriate solution.

4.1.5 In formulating the project implementation team, the engineer should be cognizant that each team member for the project brings in specific skills. Professionalism requires that the project engineer ensure that all team members have the training and experience to accomplish the tasks assigned to them.

4.1.6 The Fundamental Canon 4(b) in the Code of Ethics is an Engineer shall “Perform services only in the areas of their competence.” Work assignments given should take into account the specialties of individual engineers, their years as professionals, and their familiarity with the task(s) they will perform.

4.1.7 As the project is being implemented, the project engineer must ensure that the team carries out work to all stipulated specifications.

4.1.8 The project engineer is responsible for ensuring that they provide all specified outputs on schedule and within budget.

4.1.9 All engineers must ensure they are familiar with regulations pertaining to their discipline. It is vital to obtain permission or prepare applications for permits before proceeding with specific project tasks.

4.2 Engineering Design Considerations

4.2.1 Engineering design must meet the requirements of the relevant codes, authorities and standards. Involving other professionals in the design process may be necessary in light of other relevant legislation to the limits of the design engineer's competencies.

4.2.2 Engineering designs must be backed by relevant design computations clearly indicating the design criteria, assumptions (if any), design outputs, quantity check off sheets and any other relevant design considerations.

4.2.3 The engineer should inform the client when the need arises of involvement of other professionals or specialists and prepare terms of reference for these supporting professionals. The engineer should also work with other team members throughout the design process to ensure they have input all relevant aspects of the design process.

4.2.4 The design engineer should seek adequate information from the client especially on the technical requirements. He should not rely on incomplete data or assumptions.

4.2.5 Where necessary, an in-depth investigation and analysis needs to be conducted. For instance geological investigations in road construction or weather pattern in design of solar or hydroelectric power generation.

4.2.6 All assumptions must be clearly defined.

4.2.7 Environmental, social and safety aspects must be identified and incorporated in the design by the engineer. The engineering design should enhance sustainability and posterity.

4.3 Engineering Reports, Drawings and Specifications

4.3.1 The engineer responsible for engineering design must ensure that the design report and / or drawings has the following attributes:-

i. Has calculations prepared and specify systems as appropriate to meet the requirements for the design.

ii. The design should be presented in clear, complete contract drawings.

iii. All the design drawings should indicate the purpose of the drawing (preliminary, detail, working drawings, installation, feasibility, as-built drawings, etc.) the issue date, and, for those considered final, be stamped and signed by the design engineer.

iv. Is prepared in an appropriate scale as the purpose of the drawings is to represent the design clearly and concisely.

v. In case the selected scale or the complexity of the design makes the drawings difficult to read and interpret, separate detail drawings should be provided.

vi. Drawings should incorporate schematics and diagrams for all major systems.

vii. They should provide layouts for all systems where necessary for clarity, with large-scale details, elevations and sections properly cross-referenced.

viii. Drawings should include symbol lists and typical details for all equipment, accessories and systems.

ix. They should also include schedules where necessary to define special features of construction or finishes.

x. The design engineer should initial all drawings as they are revised, indicating the date of revision.

xi. In preparation of the final drawings and specifications, the engineer should analyze and design all systems to meet applicable regulations.

xii. The engineer would be required to liaise with regulatory bodies and government agencies.

xiii. Liability for design work remains with the design engineer who must ensure that all aspects of work meet engineering as well as regulatory standards. However, the review engineer equally bears responsibility, as she must ensure that the project is well implemented by providing sufficient supervision and guidance in the project life cycle.

xiv. The engineer should prepare specifications for all work for which he is responsible in a standard format using standard term for materials and processes consistent with the plans.

4.3.2 The project engineer should protect the organization against the exposure of trade secrets or sensitive information. He should limit liability in case a recipient copies or modifies material without authorization.

4.4 Role of Engineer in Tender Administration

4.4.1 An engineer may prepare or assist in the preparation of bid documents. The client may request the engineer to provide conditions covering unit prices, estimated quantities, alternative prices and separate prices required from the contractor.

4.4.2 Where an engineer is required by a client to call for bid documents and evaluate the submitted documents for compliance with design, the engineer shall, without any undue influence and based on his involvement in analyzing bids, recommend the most suitable contractor(s) to the client and the preferred materials or systems.

4.5 Contract Management and Construction Management

4.5.1 A contract is any agreement between two or more parties where one party agrees to provide certain deliveries or services, and the other party agrees to pay for those deliveries or services.

4.5.2 Contract management is a continuous process, starting with analysis and evaluation of the customer's inquiry, and carrying on until contract closure, upon fulfillment of all contractual obligations.

4.5.3 Engineers should be familiar with the conditions of contract for applicable engineering works and services and are required to take a lead role in contract management for engineering works and services.

4.5.4 An engineer involved in tender documentation should ensure that conditions of particular applications provide the necessary contractual provisions for the execution of the works. In so doing, the engineer should appraise the client on the implications and risks inherent in application of such conditions of particular applications.

4.5.5 To ensure effective contract management, Risk Management is paramount. This entails identifying, monitoring and managing all risks and opportunities over the life of the project contract to achieve the project objectives and value for money outcomes. In addition, risks not identified cannot be pro-actively managed or mitigated, which can be very costly not only monetary, but also safety and welfare of the public. Risks cannot be correctly identified unless there are clear projects objectives that provide an unambiguous description of success for the project.

4.5.6 Record keeping is essential to ensure that events can be recalled at a later stage. There are several main types of records that need to be kept including:

i. Site diary.
ii. Drawing register.
iii. Written notices, correspondence and site instructions.
iv. Site photographs.
v. Contractual documents.
vi. Occupational health and safety documents.

4.6. Records and Documents Management

4.6.1 The most important document for any engineering project is the contract document. This details all the rights, responsibilities and obligations of the parties to the contract. The Contract document should therefore be safeguarded at all times. There should always be a copy of this document available for site personnel to refer to. Other contractual documents are also important and should be stored carefully. Documents that have contractual reference include: -

i. The main contract with all its parts.
ii. Subcontracts.
iii. Labour contracts
iv. Plant - hire agreements.
v. Delivery notes.
vi. Work programmes.
vii. Site - meeting minutes.
viii. Notifications for inspections.
ix. Correspondence with the employer/employer's representative.
x. Payment certificates.
xi. Completion certificates.
xii. Daily labour sheets, materials, and equipment usage where work is performed on a cost reimbursable basis.
xiii. Health and safety file containing relevant health and safety documents.

4.6.2 There are standard records that need to be kept which are needed for contractual reasons. Information kept for projects may include:

i. Details of date & day.
ii. Weather records eg rainfall , temperatures etc.
iii. Personnel schedule.
iv. Equipment schedule.
v. Record of any reportable accidents that occur.
vi. Production targets and achievements.
vii. Site instructions received.
viii. Drawings received.
ix. Issues that are causing delays.
x. Work that is to be rectified.
xi. Site meetings held and the date for the next one.

4.6.3 Engineers should ensure that there is an active site diary where applicable. The diary should be kept by the contractor's site agent or site manager responsible for the site. This site diary should keep specific information relating to the work that is done each day, what problems were encountered, what instructions were issued by the employer's representative (Reviewing engineer, project manager), what drawings were received, and production and milestones achieved.

Each project is different and the site diary for each contract will change depending on the type of work to be done.

4.7 Project Execution

4.7.1 In engineering projects, the application of engineering does not end with the delivery of project design and drawings to the owner or developer. A comprehensive and excellent engineering design does not assure the owner or the public that the project will be effectively and efficiently implemented with regard to sound engineering principles, standards and practice.

4.7.2 Diligent supervision of project implementation is necessary to ensure, in the interests of public health and safety that;

i. Those with responsibilities relating to the project execution appreciate the nature of the engineering role in supervision of works and services;

ii. That the implementation proceeds in accordance with the engineering design and engineering judgments required to be made during the course of implementation and that these decisions are made by professional engineers with reference to the applicable standards.

4.7.3 The project engineer is expected to maintain accurate documentation throughout a project. This includes but is not limited to; site Instructions issued, tests results, approved drawings, accident reports, equipment on site, weather records (where need be), visitors records among others.

4.7.4 The project engineer is expected to provide sound technical advice to the client throughout the implementation phase. Where possible, regular appraisal meetings should be scheduled with the client to review progress and address any emerging challenges.

4.8 Project Review, Appraisal, Monitoring and Evaluation

4.8.1 The review during implementation of engineering projects requires the appropriate engagement of a professional engineer and has to be in line with the Code of conduct and ethics for engineers.

4.8.2 The reviewing engineer is assigned by the client and is responsible for the interpretation of engineering design plans and documents as well as the review of other relevant documents and specifications to ensure that the contracted works comply with the engineering design.

4.8.3 The engineer must inspect the work as it proceeds to ensure that it conforms to design work and his direction.

4.8.4 Normally, the engineer engaged to carry out a project review is the design engineer. When this is not the case, and if it is feasible, the selected professional engineer carrying out the review should contact the design engineer, with the owners' approval.

4.8.5 The reviewing engineer should liaise with the design engineer to ensure that on-going interpretation is correct. Furthermore, the reviewing engineer should notify the owner and the design engineer of any changes to the design prompted by conditions encountered during construction.

4.8.6 The design engineer should be available to provide information to the review engineer in so far as is practical.

4.8.7 The responsibilities expected of the engineer conducting the review include;

i. Interpretation of drawings and specifications;
ii. Reviewing tender documents, equipment and material specifications, supplier qualifications, and manufacturer's manuals for conformance with specifications;
iii. Where applicable visiting the site to review works or services on a frequency commensurate with the size and complexity of the project to see if the on-going works or services are in compliance with the design document;
iv. Initiating quality control and materials testing programs, when relevant, to determine conformance to the specifications and interpreting the test results.

4.8.8 The engineer must review the project at appropriate intervals to be in tandem with the regulatory requirements and make appropriate comments as to the adequacy of the installation.

4.8.9 If the reviewing engineer is not the design engineer, he must also communicate to the design engineer, when possible, concerning any contemplated changes to the design, and noted above.

4.8.10 Construction review should be rigorous. After initial discussions with the owner or designated representative(s) of the owner, the reviewing engineer should begin the process by calling a meeting with the contractor to discuss relevant matters of the project to ensure the intent of the design is clear, including any special conditions or procedures to be applied during construction.

4.8.11 The engineer should adopt a format for project review reports to be prepared at specified intervals during construction whose content will include at least:-

i. Clear identification of the project.
ii. The date of the report.
iii. Status of construction on the review date.
iv. A summary of review work; and
v. Documentation of approved changes and other relevant issues such as weather and safety.

4.8.12 All changes should be clearly described with reasons for any alterations to design, any changes to the contract value, and any changes to the project schedule. Any changes that alter the contract value or the project schedule should be approved by the client before implementation. This provides protection from disputes with other parties involved in the construction process and for defense against future claims that may arise.

4.8.13 The reviewing engineer usually reports to the owner or a designated representative of the owner. As the construction commences, the engineer should consult with the owner concerning the appropriate level of inspection. Consideration should always be given to the requirements of all the regulatory authorities.

4.8.14 Where necessary, an accredited checker would be deployed to ascertain the works of the design and/or review engineer.

4.9 Commissioning

4.9.1 Commissioning of projects entails static and dynamic testing of the engineered systems applicable, upon completion of a project. Testing must confirm that these systems can operate as specified by the design engineer.

4.9.2 The first phase ensures familiarity with the design of the relevant systems and their objectives. The second and third models require the prime consultant and the owner to co-ordinate and manage the commissioning function in relation to design and product services.

4.9.3 Even though commissioning is associated with completion of a project, the commissioning engineer should be involved from the conceptual design stage.

4.9.4 Where the commissioning engineer is not the design engineer, he should review the concept design, design drawings and specifications. This endeavor will enable the commissioning engineer familiarize him/herself with the design and its objectives.

4.10 Final Review and As-Built-Drawings

4.10.1 The main purpose of final review is to identify any remaining deficiencies that the contractor must deal with before the engineer confirms that the constructed works are in accordance with the design documents.

4.10.2 The engineer is expected to provide comprehensive as-built drawings of the project for the efficiency and effectiveness in;-

i. Maintenance.
ii. Operations.
iii. Safety.
iv. Future considerations, e.g. expansions, upgrading.

4.11 Inspection During the Warranty Period

4.11.1 The owner may request further engineering inspection after construction completion, but before expiration of the warranty period to determine any deficiencies that could have arisen in the meantime.

4.11.2 As Final review, the reviewing engineer should conduct the inspection in the presence of both the owner and contractor. The results of the warranty inspection is a list of identified deficiencies, which should be submitted to the contractor and copied to the client.

4.12 Manufacturing

4.12.1 Engineers in manufacturing organize and manage the processing and production of goods. It requires planning, on manufacturing practices, research and developing of processes, machines, equipment and tools integrating the systems to produce quality products in an efficient and cost effective manner.

4.12.2 Advanced manufacturing processes require carefully planned division of labour and extensive specialization of functions. Engineers in manufacturing need to recognize that people are at the heart of manufacturing and therefore organizing them is paramount.

4.12.3 Manufacturing engineers specify machinery, equipment and human resources in totality to create quality products in an efficient manner. They desire to minimize production costs, maximize productivity, meet or exceed quality standards and ensure reliable and safe processes are adhered to.

4.12.4 Manufacturing processes are usually housed in plants built specifically for manufacturing activities. Within the plants are specialized machinery and equipment, arranged in such a way as to minimize energy and human effort required to produce given outputs. Much effort of manufacturing engineers is to find opportunities of cost control by further reducing the resources, capital and labour inputs required for production.

4.12.5 Other than producing products at minimum cost, the engineer must ensure that both the production process and resulting product are reliable and safe. He must eliminate process arrangements that might compromise employee or public safety. He must guard against design defects in manufactured products that could reduce the utility or safety of these products for consumers.

4.12.6 The manufacturing engineer should account for any possible or known hazards inherent in the processes or equipment operation and must seek ways to reduce or eliminate these situations.

4.13 Manufacturing Engineering Practice

4.13.1 Manufacturing engineering practices generally covers the following major tasks:-

- Design of manufactured products.
- Design and installation of production equipment.
- Design and implementation of manufacturing processes.
- Maintenance of production equipment.
- Worker safety.
- Protection of the environment.

4.13.2 While on job, manufacturing engineers are designers, implementers and managers. As designers, they are tasked with designing of products that function reliably in their intended purpose, are safe, marketable and cost-efficient.

4.13.3 Manufacturing engineers usually develop policies and procedures for operations that would address unanticipated problems in the project/process. This is done within company policies and procedures.

4.14 Operations & Maintenance

4.14.1 Most engineering projects have a given life after they are implemented or constructed; the lifetime/lifespan. Buildings, roads, bridges, sewer lines, power lines are usually designed to last 50 years or more. With upgrading and replacement of ageing components, some products of engineering design have lasted for many years, way beyond the anticipated lifetime of the project.

4.14.2 The safe and effective attainment of the design life of an engineered product relies on good operations and maintenance (O&M) practice. As products, structures and infrastructure age, they must be managed, inspected and where necessary, replaced in part or completely. O&M engineers are involved in this process of monitoring and managing engineering creations. They must monitor and maintain equipment and facilities to ensure their safe and effective operation.

4.14.3 O&M engineer ensures that buildings, factories or machinery in their care are maintained in good working order at all times and are capable of performing the functions for which they are intended. This role is important to the safe, effective and reliable operation of such facilities or systems.

4.14.4 Since the responsibility of operations and maintenance usually requires day-to-day attention, the O&M engineer is usually an employee as opposed to a consultant or contract employee. O&M engineers may also require consultants or contract engineers to provide specialized expertise.

4.14.5 An important aspect in operation and maintenance engineering practice are the up-to-date O&M manuals. These inform all the team members of their responsibilities and interrelationships. Adherence to the procedures established should ensure the highest level of performance and safety for employees and users. Types of O&M engineering manuals may include:-

i. Operational and management responsibility.
ii. Staffing.
iii. Regulatory requirements and operating standards, including testing procedures.
iv. Normal, alternate and emergency operations.
v. Reporting requirements.
vi. Safety considerations.

4.14.6 Preventive maintenance is paramount in reducing costs and improving reliability. Effective maintenance requires scheduled inspection and record keeping. It is the objective of preventive maintenance programs to plan maintenance and minimize unplanned maintenance.

4.14.7 Proper record keeping is an important aspect for O&M engineering practice. Some of the records are classified as follows:-

i. Operation and performance records.
ii. Descriptive and inventory records.
iii. Maintenance records.
iv. Financial or cost control records.
v. Personnel records.

4.15 Engineering Education

4.15.1 Professional engineers with the responsibility of teaching engineering play an extremely crucial role in enabling the engineering students develop to their full potential to be inventive, innovative, dynamic and thriving engineers. This is because they set the direction and example the students have to follow. It is important the educators are not only well grounded in terms of engineering theory and principles, but also well versed in practice. This way the learners are able to connect and visualize the application.

4.15.2 The professional engineer who is an educator should emphasize on the Code of conduct and ethics. He/she should inculcate the importance of maintaining the highest standards of integrity and dignity as an engineer.

4.15.3 The educator needs to go an extra-mile and conduct a research, write papers, come up with an innovation/invention. This will challenge the learners who will be inspired to do even more. In addition, the educator should keep abreast with the current technologies to effectively contribute to the development of the learners.

4.15.4 The educator should create a link between the academia and the industry. This will motivate the learners to be in touch with the real challenges on the ground and start developing ways of solving problems.

4.15.5 The professional engineers needs to be good in communication and articulation of the often perceived difficult concepts to make it easier for the learners to interpret and understand.

4.15.6 The educator should encourage authenticity in assignments and research. Plagiarism, academic dishonesty, falsification of data and documents, mistreatment of students' assistants should never be allowed.

VISION

A safe, efficient and effective engineering
infrastructure, system and processes for Kenya

MISSION

To ensure production of competent engineers and quality engineering services through regulation, capacity building and enforcing compliance with set engineering standards for improved socio-economic development

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