

ISO 9000

## Practices in Construction

is a unique book of its kind for application of ISO 9000 management system standards in construction to develop international quality standards. It is suitable for various stakeholders in construction industry such as engineers, architects, contractors and suppliers, as also students and faculty members of engineering and management institutions.

Current ISO standards relevant to construction have been explained and other related standards referred to in the book. It is necessary to ensure implementation of international quality standards in construction projects to deliver products and services at desired levels of quality. All stakeholders in construction, therefore, have to understand and implement ISO 9000 practices in their organizations for required results. Implementation agencies of ISO 9001 standard dealing with accreditation have also been detailed highlighting the role of accreditation done by International Accreditation Forum (IAF) through Multilateral Recognition Arrangements (MLA) across the world. Quality management systems auditing has been explained as detailed in ISO standards. Besides, construction project management practices and related quality aspects have been dealt. A few case studies of implementation of ISO 9000 practices in construction have also been given.

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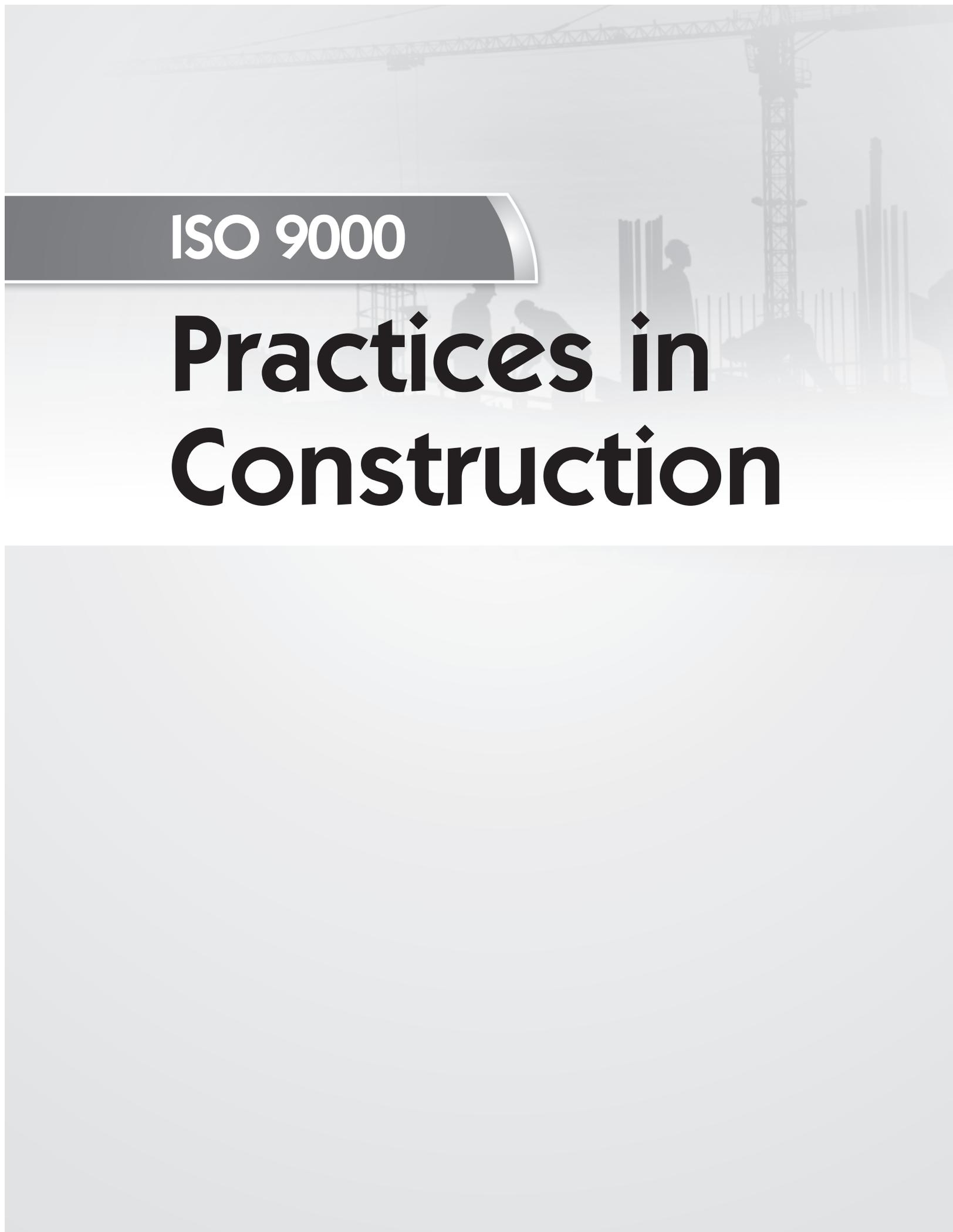
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# Foreword

The importance of quality in construction is well known, but despite the quality measures adopted, requisite level of quality is rarely achieved. The construction companies unfortunately have failed to institutionalize quality measures in their management systems and construction work. In an increasingly competitive market, a reliable quality management system is crucial to the successful completion of projects. The companies that establish ISO 9000 discipline will find it easier to accomplish their projects, leading to higher level of satisfaction and superior product quality.

Most government engineering departments have an in-house quality control or quality assurance unit. In Central Vigilance Commission there is also a technical audit unit (Chief Technical Examiner) to watch and monitor the quality of works in the country. Most public sector organizations also have an in-house vigilance unit to monitor their quality of works. Despite of all these measures, the quality of projects delivered generally leaves much to be desired. For a uniform quality product, the quality consciousness has to be ingrained into the ethos of the organization. The organizational structure and the project team has to be set up that it does not permit any sub-standard work to be executed. ISO 9000 series of standards propose to precisely address this issue.

The International Organization for Standardization (ISO) is a global organization that works to provide standardization across an array of products and services. Its main goal is to facilitate trade, but its focus is also on process improvement, safety, and quality in several areas. The goal of ISO 9000 is to embed a quality management system within an organization, increasing productivity, reducing unnecessary costs, and ensuring quality of processes and products. The use of “process approach” is a requirement for all ISO management system standards. ISO 9000 is a set of international standards on quality management developed to assist companies to document and maintain an efficient quality system. They are not specific to any one industry and can be applied across broad spectrum of companies. Having said this, why should one adopt these standards? Because this will result in continual improvement in operating process, reducing waste, increasing productivity, resulting in better marketing, and increasing customer satisfaction. Also, in bidding for international projects, ISO 9001 certification is often a prerequisite. Therefore, adopting of such standards widens the scope of business opportunities—enabling the organization to increase its market share and overall competitiveness. Whether you operate internationally or want to expand locally, ISO 9001 certification will demonstrate your commitment to quality.

The authors of this book have done a yeoman’s job by writing a treatise on the ISO9000 series of standards explaining in detail as to how to go about in adopting these

standards. The three authors have held high positions in engineering departments in the country and put together have nearly 125 years of experience in the field of engineering. Rarely is there such a combination of experience, mature farsightedness and administrative experience to produce such a useful document. The book is written in an easy-to-understand style in 8 chapters where the complex web of various quality related standards is explained thread bare. It is hoped that this book will help in better understanding of ISO 9000 practices and will help in raising quality standards of our construction works.

**HS Dogra**

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Member of Indian Concrete Institute  
Member of Indian Buildings Congress, and  
Member of Indian Institute of Technical Arbitrators  
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# Preface

Construction is the most important activity for growth and development of a country. By and large the construction industry is lagging behind the other industries in ensuring suitable quality standards. It is therefore, necessary to look into the quality management systems and take appropriate measures for quality improvements in construction industry. In order to deliver products and services at a consistently high levels of quality, it is considered necessary to adopt ISO 9000 practices in construction. In the Western world that is Europe and USA, most of the consultants and contractors have adopted ISO 9000 standards in their working. In order to move forward, it is necessary to ensure implementation of international quality standards particularly in major construction projects. Therefore, engineers, architects, planners, designers, contractors and suppliers, all will have to understand and implement ISO 9000 practices in their organization, to deliver products and services at desired levels of quality.

For a construction project, input is required from principal employer, consultants, civil contractor, services contractors, suppliers, subcontractors, etc. It is seen that all the agencies involved may or may not have ISO management system standard certification. The quality standards can be achieved for the project through combined effort of all concerned. Therefore, the principal employer has to ensure achieving this objective by training concerned persons of all stakeholders and developing systems and procedures according to requirements of ISO 9000 standards. The objective is to complete the project according to ISO 9000 standards and further develop maintenance services according to these standards.

The purpose of writing this book is to make Indian construction projects and products and services equitable to international standards of quality. This book will help consultants, planners, suppliers and contractors to move towards planning and implementing the ISO 9000 standards and helping in augmenting the performance, and improving the productivity and efficiency of the organization. ISO 9000 is a proven method of building a quality track record that will withstand the closest scrutiny even in the most competitive environment. ISO 9000 practices in construction enable construction professionals to implement quality standards and procedures precisely suited to their needs and responsibilities.

Engineering institutions, i.e. IITs, NITs, other engineering collages, polytechnics, etc. should also consider including in their curriculum, studies about ISO standards for engineering students. Some institutes have incorporated elementary introduction to ISO provisions in their engineering studies. However, it is considered desirable to have extensive coverage in syllabus for adopting ISO standards in construction. For postgraduate studies special courses can be introduced to cover this field of

knowledge. India is a fast moving from a developing country to the status of a developed country. Dissipation of knowledge about ISO 9000 standards to different stakeholders connected with construction works, and implementation of ISO standards is a correct step in the direction of delivering products and services at a consistently high levels of quality.

**KB Rajoria**

# Acknowledgements

This book is dedicated to Indian Buildings Congress (IBC), in view of long-standing association of the authors with this national organization promoting quality and sustainability in built environment. We express our sincere thanks to Shri Pradeep Mittal, President of Indian Buildings Congress and members of the Executive Committee for their support and encouragement in this endeavour.

It was considered desirable to get views and suggestions from some outstanding professionals of our country in this field. Accordingly we approached Shri P Krishnan, Faculty in Engineering Institutes and former Director General, Central PWD, Shri V Suresh, Chairman of Indian Green Buildings Congress and former Chairman and Managing Director, HUDCO, Shri Anil Jauhri, former CEO, National Accreditation Board for Certification Bodies, Quality Council of India and Shri ANSP Sastry, international consultant on management systems, specialist in ISO 9001 and former Director, BIS. We are grateful to them for their valuable suggestions which have been suitably incorporated in the book.

We express our gratitude to Shri KK Kapila, CMD, Intercontinental Consultants and Technocrats Pvt. Ltd, for providing technical support, in the writing of this book. We are also thankful to Shri Shobit Uppal, Deputy CMD of Ahluwalia Contracts (India) Ltd. We have visited their projects duly accompanied by Shri Amarjeet Singh, DGM, Ahluwalia Contracts (India) Ltd. We are also grateful to Shri Jagmohan Lal, former Additional DG, CPWD, for providing case study pertaining to construction project implemented by him as per ISO standards.

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# Introduction

In order to achieve the objective of implementing quality management systems according to ISO 9000 standards, it is necessary to have a comprehensive study of related standards and the background of development of these standards. The detailed study of ISO Standards related to quality and other standard, has been compiled in this book which will help in achieving implementation of quality in construction. The construction industry does not have streamlined mandatory procedures, rules and regulations. It needs self-imposed and initiated policies in respect of quality management to be followed by the Government and the construction industry set up, to establish and implement ISO 9000 practices in construction.

The basic understanding of ISO management system standards and implementation will help construction industry in India to move forward to international levels in quality. The quality management principles will help to mitigate many of the problems pertaining to quality that are expressed by the different stakeholders in the construction industry. Products and services will be delivered with highest quality on a timely basis at a reasonable cost to the owner. By implementing the ISO 9000 quality management standards in the construction company measurable results will be achieved with incremental and continuous improvement. The improvement will be visible in functioning of every department in the company. A greater harmony will exist in execution of a construction project leading to higher levels of quality and customer satisfaction with project delivered on time and at a fair price.

Chapter 1 deals with historical review of development of built environment and quality in India. Development of built environment in India is as old as the history of the civilization. The earliest remains of building activity in India dates back to the Indus valley civilization. Among India's ancient architectural remains, the most characteristic ones are temples, chaityas, stupas and other religious structures in ancient India. Temple architecture of high quality workmanship was developed in almost all regions. The distinct architecture style in different parts of the country was a result of geographic, climatic, ethnic, racial and historic diversities. This has led to creation of an epic built environment in the Indian scenario.

From beginning of twentieth century, developmental activities were taken up extensively by Government agencies and included buildings and roads, dams and irrigation projects, water supply and sanitation, housing, railways, airports, etc. Modern structures constructed in pre independence era include Rashtrapati Bhavan, North and South Block in New Delhi and many other buildings, of excellent workmanship, durability and quality. Indian architecture progressed with time and assimilated many influences that came in as a result of India's global discourse with other regions of the world. After Independence of India in 1947, construction works

were taken up both through, public sector and private sector agencies which resulted in continuous growth in construction sector over a period of time.

There had been many stages of development in strategies for managing quality in construction works. Inspection for quality was considered appropriate for the quality management in the construction industry. Further quality was also controlled by inspections, monitoring and feedback. Therefore, quality assurance methods became prevalent in construction works for the implementation of planned and systematic activities to achieve quality. Quality assurance was essentially treated as a preventive activity against defects and had to be systematically planned in advance. This included identification and planning of the checks, inspections and quality assurance measures.

Chapter 2 deals with the historical background of quality. It is important to visualize growth and development of quality management systems in construction industry. Quality used to be synonymous to craftsmen's skill during pre-industrialization period. High quality product was considered a pride of workmanship. The advent of industrial revolution and evolution of different concepts of quality laid the foundation of modern quality management systems. The industrial revolution led to the transition from craftsman made limited number of products to the mass manufacturing through machines. The second industrial revolution started in 1870, primarily in Britain, Germany and United States, as also in France, Italy and Japan. It later spread throughout Western Europe and continued till the start of World War I in 1914. Quality systems started developing since beginning of 20th century and became a critical element of business in Japan after World War II, and later a vital business element in US during 1980 onwards.

Many prominent Quality Gurus such as Shewhart, Deming, Juran and others have emerged within the quality field, but some have stood out as key figures for developing different aspects of quality. Their ideas, concepts, and methods are brought out in brief to explain evolution of thinking about quality over a period of time. Later on, International Organization for Standardization (ISO) played an important role in industry removing barriers in trade between nations by publishing international standards. The ISO 9000 family of standards on quality were first published in 1987. Presently, quality is underlying concept to improve performance of business organizations and is required to be built into the products and services. The construction industry is lagging behind in their realization that the customer satisfaction is key to success, and that through planned activities, an organization can be made more efficient, productive and profitable while producing a superior quality at optimum price.

Chapter 3 deals with ISO 9000 Family and Related Standards. It is worth mentioning that prior to introduction of ISO 9000 standard, ISO 8402 Quality Management and Quality Assurance Vocabulary standard was used. Current edition of standards are: ISO 9000:2015-QMS—Fundamentals and Vocabulary, ISO 9001:2015-QMS—Requirements and ISO 9004:2018—Quality Management—Quality of an Organization—Guidance to achieve sustained success. ISO 9000 standard deals with definitions and terminology used to explain concepts used by ISO 9001 and ISO 9004 standards. The ISO 9001:2015-QMS is a business management tool which creates a way of doing business in present day context. The ISO 9001:2015 management system is applicable to each and every aspect of the organization, i.e. from understanding client's requirement to delivery and post-delivery activities. The organization's efficiency, output and quality are aligned and executed optimally by use of ISO 9001

model. It provides a structure through which the management of an organization can control the resources and output of its business in an optimum manner as also monitor quality. The ISO9001 business model outlines the organization's vision, mission, strategies, infrastructure, organizational structure and operational procedures. It supports the delivery of products and services through application of effective and continually improving systems, whilst enhancing customer satisfaction.

ISO's Annex SL Directives represents a framework which provides guidance as to how future ISO Management System Standards (MSS) should be written. The aim of Annex SL was to enhance the consistency and alignment of MSS by providing a unifying and specified high level structure, identical core text and common terms and core definitions. These directives state that all management system standards will use a consistent structure as also common text and terminology. On account of Annex SL directives, ISO 9001:2015 became consistent in structure with other Management System Standards (MSS)—such as ISO14001:2015—Environment Management System and, ISO 45001:2018—Occupational Health and Safety Management System Standard. Other important relevant standard for construction industry includes, ISO 19011:2018—Auditing Management Standard.

Chapter 4 deals with ISO 9000 Quality Management System Requirements and Guidelines, clause wise requirements and their relevance to quality in construction. Benefits to an organization for implementing a Quality Management System based on ISO 9001:2015 are: (i) Product/services meeting customer and regulatory requirements, (ii) enhanced customer satisfaction, (iii) addresses risks and opportunities associated with context and objectives, (iv) demonstrates conformity to specified QMS requirements. In this chapter, consideration has been given to each specified requirement of the ISO 9001 standard and its application to the construction organizations. The chapter covers the guidelines and clarifications for requirements given in ISO 9001 standard.

It is necessary to understand, corresponding provisions of ISO 9000:2015—Quality Management System—Fundamentals and Vocabulary, and ISO 9004:2018-QMS for Sustained Success of Organization. It is important to fully appreciate, specific requirements of ISO 9001:2015. Therefore, in this chapter for clauses of ISO 9001:2015, related and corresponding provisions of these ISO 9000 family standards have been explained.

Chapter 5 deals with implementation agencies of ISO 9001. Accreditation is the formal recognition by an authoritative body regarding the competence to work to specified standards. The apex role for ISO 9001 accreditation authorization is done by International Accreditation Forum (IAF) through Multilateral Recognitions Arrangements (MLA) for mutual recognition across the world. In India, Quality Council of India is performing its pivotal role in the specific areas of accreditation as well as for Quality Promotion. As part of QCI, National Accreditation Board for Certification bodies (NABCB) is signatory of IAF MLA for ISO 9001. Other certification bodies also work in India which are accredited by other equivalent accreditation bodies working in other countries. Bureau of Indian Standards (BIS) is national standard body accredited by NABCB for ISO 9001.

Chapter 6 deals with quality management system auditing. ISO 9000 standards emphasize on the importance of QMS audit and review of its results by management. The terms and definitions related to QMS audit are given in ISO 9000:2015. Audit is also a concept class pertaining to terms and definitions mentioned in ISO 9000

Standard. ISO 19011 standard provides guidelines for auditing management systems which cover guidance on management of audit programme, on planning and conducting of management system audits, as well as on the competence and evaluation of auditor and an audit team. Auditing is characterized by reliance on a number of principles. These principles should help to make the audit an effective and reliable tool in support of management policies and controls, by providing information on which an organization can act in order to improve its performance. The seven principles and processes of auditing covered in ISO 19011:2018 are the same for auditing of different management systems developed on Annex SL framework basis.

The use of “process approach” is a requirement for all ISO management system standards in accordance with Annex SL. Auditors should understand that auditing a management system is auditing an organization’s processes and their interactions in relation to one or more management system standard(s). The audit is completed when all planned audit activities have been carried out.

Chapter 7 deals with construction project management practices and quality aspects. Main stages of construction project life cycle consist of project formulation and appraisal, project development, planning for construction, tender action, construction, commissioning and handing over. A construction project is an endeavour of the project team on behalf of owner/client to create a built facility as per defined functional objectives. Quality management in construction aims to achieve required functional and physical characteristics of a constructed facility through meticulous planning and effective quality management practices. Quality management concepts also have a positive effect on time and cost of the project. The vital role of quality management is to ensure that a construction work is able to achieve its full life span with least maintenance costs.

Chapter 8 deals with implementation of ISO 9000 in construction: Case studies of organizations, who have implemented relevant ISO management system standards in their working. Amongst major principal employers, CPWD followed ISO 9000 for their Parliament Library Building Project. Similarly PWD Delhi also followed ISO 9000 standards for their flyover projects. Amongst the fore-running organizations worth mentioning are M/s ICT Pvt. Ltd., New Delhi, a consultancy organization of repute, and M/s Ahluwalia Contracts (India ) Ltd., a leading construction organization of the country.

As the customers push for higher levels of quality continues, the efficient construction related companies will become more quality focused and cost competitive. Reorganization of organizational structure and positive attitudes about quality are imperative to an organization in today’s scenario. The organization that delivers quality products consistently will continue to grow and prosper. This growth should be enhanced through sound quality management system and its implementation to achieve higher levels of performance and customer’s satisfaction.

It is hoped that this book will help in better understanding of ISO 9000 practices in construction. This should help India’s construction standard to become equitable with international level of quality standards.