

ELEMENTS OF MODERN CONSTRUCTION MATERIAL

PROF. SANJEEVA NARAIN SINGH

Construction Manager

Salalah International Airport Project
ECC Division, Larsen & Toubro Ltd.
Salalah, OMAN

PROF. (DR.) TABASSUM ABBASI

Head of Department

Department of Civil Engineering
IIMT College of Engineering,
Greater Noida, Uttar Pradesh, INDIA

ELEMENTS OF MODERN CONSTRUCTION MATERIAL

Copyright© : Prof. Sanjeeva Narain Singh
Publishing Rights® : VSRD Academic Publishing
A Division of Visual Soft India Pvt. Ltd.

ISBN-13: 978-81-972449-3-3
FIRST EDITION, JUNE 2024, INDIA

Printed & Published by:
VSRD Academic Publishing
(A Division of Visual Soft India Pvt. Ltd.)

Disclaimer: The author(s) / Editor(s) are solely responsible for the contents compiled in this book. The publishers or its staff do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the Author(s) or Editor(s) or Publishers to avoid discrepancies in future.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the Publishers & Author.

Printed & Bound in India

VSRD ACADEMIC PUBLISHING
A Division of Visual Soft India Pvt. Ltd.

REGISTERED OFFICE

154, Tezab mill Campus, Anwarganj, KANPUR–208003 (UP) (IN)
Mb:9899936803, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

MARKETING OFFICE

340, FF, Adarsh Nagar, Oshiwara, Andheri(W), MUMBAI–400053 (MH) (IN)
Mb:9956127040, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com



INSPIRING QUOTES

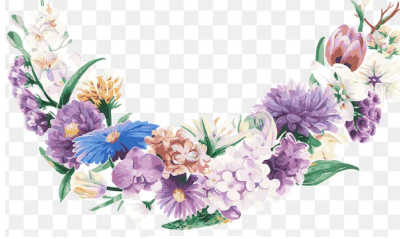
“You can dream, create, design and build the most wonderful place in the world; but it requires people to make the dream, a reality...”

---Walt Disney

“The real beauty of a building is seen when the right finishing material touch its walls, floor and ceiling with a pinch of lighting effect...”

---Prof, Sanjeeva Narain Singh

This Book is Dedicated



To
The Very Source
of our



“Exhistence & Inspiration”
Our Lovely Parents
Dear
“Father & Mother”



PREFACE

Construction materials have been used since ancient times depending upon their local availability worldwide. Due to advancement in technology available to mankind at different times in the history of our existence, materials to be used for construction have also undergone a sea change. Right from use of mud, straw, wood, stone, bamboo to burnt clay bricks, steel, iron, ice for igloo in cold countries to reinforced concrete in high-rise buildings, there are a vast array of materials in use worldwide depending upon the climatic conditions and terrain.

Construction material has a direct impact on the health of human beings. Due to climate change, major thrust is on reduction of energy consumption in its manufacture. Construction material should be environment friendly and fire resistant.

Alongwith the research, innovation and discovery of new technology, a material that has been engineered to have improved desirable properties is known as modern construction material. Although concrete, aluminium and steel are commonly used modern materials ; due to recent advancement in their engineered properties, they have changed the way we manufacture and use products.

Our main focus is also to engineer a modern construction material that is cheaper, without compromising on its strength, durability and quality for construction of eco-friendly and cost-effective buildings and structures.

Whole book on Modern Construction Material is carved into five Units of study material. First Unit covers basics of Modern Construction Material including properties and their uses. The materials covered are flyash bricks, cement blocks, calcium silicate bricks, RFPC and GFRG.

Second Unit tells all about geosynthetics and bituminous

material covering properties and uses of fire-resistant paints, tiles, bricks and glass, light weight concrete and waste material-based concrete.

Third Unit describes in detail Modern Construction Material Concrete, ferro-cement and fibre reinforced concrete, high density concrete, nuclear concrete, heat resisting and refractory concrete.

Unit Four of the book deals with Composite and Chemicals in modern concrete with use of polymers, fibre reinforced polymers, sulphur and sulphur-infiltrated concrete.

Last but not the least, Unit Five educates us all about Modern Waterproofing and Insulating Material and their uses. It explains thermal, acoustics and electrical insulating materials apart from giving the concept of polymer floor finishes.

This book is dedicated to Civil Engineering Students, practising Engineers and Researchers worldwide with the aim of enriching their knowledge in Civil Engineering Modern Construction Material which are used on modern construction projects worldwide. It is based on a standard University syllabus practised in India in standard and renowned premier engineering institutions in many countries.

 Author(s)


ACKNOWLEDGEMENT


Thank You, Divine Almighty ! mystery of the Universe, for letting there be Construction Materials, Human Brains, Divine Technology, Life Sustaining Elements on the only planet Earth in this Galaxy of Milky Way. The present book on Modern Construction Material is an amalgamation of our thoughts, Teaching and Industry Experience of Civil Engineering Scholars, Professionals and Practitioners.

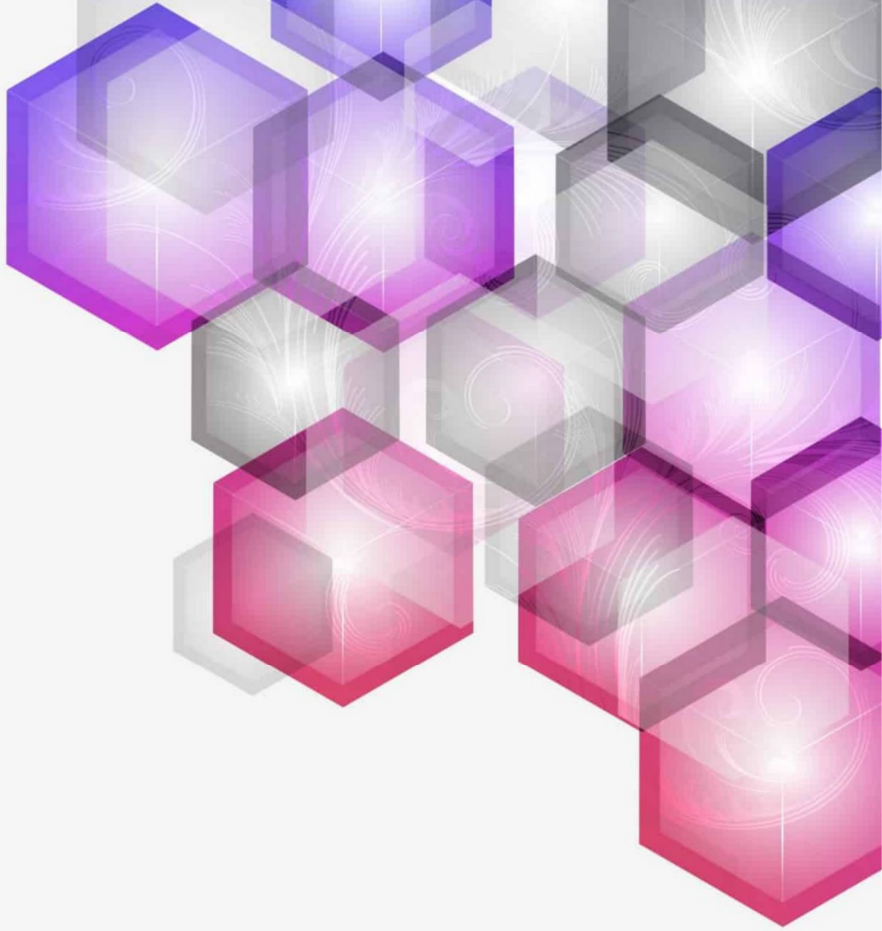
We are deeply indebted to the Research Scholars whose contribution to the understanding of Modern Construction Material in the background of changing dynamics of Construction Technology that have evolved in the modern era has defined a new set of lifestyle and comfort in luxury living.

We owe a deep sense of gratitude to our family members, especially children for their constructive co-operation and peaceful atmosphere in writing this book.

VSRD Academic Publishing (A Division of Visual Soft Indai Private Limited) staff and management deserve special thanks for their valuable guidance and facilities provided by them for bringing out this edition so explicitly.

 *Prof. Dr. Tabassum Abassi*

 *Prof. Sanjeeva Narain Singh*



SYLLABUS

UNIT 1

Introduction, properties, and uses of modern building materials: fly ash bricks, soil – cement blocks, calcium silicate bricks, red mud jute fibre polymer composite (RFPC), glass reinforced gypsum.

UNIT 2

Introduction, properties, and use of: geosynthetics, bituminous material, fire resistant materials (chemicals, paints, tiles, bricks, glass), metals, light – weight concrete, mass concrete, waste material-based concrete.

UNIT 3

Introduction, properties, and use of: Ferro cement & fibre reinforced concrete, different types of fibres, high density concrete, nuclear concrete, heat resisting & refractory concretes, prefabricated systems.

UNIT 4

Introduction, properties, and use of: Polymers, fibre reinforced polymers, polymer concrete composites (PCCs), sulphur concrete and sulphur – infiltrated concrete.

UNIT 5

*Introduction, properties, and use of: Conventional and modern water proofing materials, Conventional and modern insulating materials (thermal, sound, and electrical insulating materials).
Concept of polymer floor finishes.*

UNIT 6

Advanced Innovations in Concrete - Bendable Concrete, Concrete Canvas, CSF & GGBFS Concrete, Light-Weight Concrete, HVFA Concrete, Hydrophobic Concrete, Pigmented Concrete, Self-Curing Shrinkage Free Concrete, Self-Compacting Concrete (SCC), Translucent Concrete; Advanced Innovations in Cement – Light Generating Cement, Photo-Catalytic Cement, Self-Healing Cement, Self-Levelling Concrete topping Cement, Ternary Blended Cement ; Recycled Aggregate ; Rammed Earth & Clay as Construction Material; Liquid Granite & Sensitile as advanced interior finishing works material.

UNIT 7

Wood – Cross Laminated Timber (CLT), Electrified Wood, Transparent Wood; Bamboo ; Recycled Paper – Papercrete, Richlite Honeycomb Matrix made of Aluminium, Nomax, Thermoplastic, Steel, paper, clay ; Auxetic Honeycomb Matrix ; Flexicomb Aluminium Foam ; Carbon Fiber ; Graphene as advanced innovative material.

TABLE OF CONTENTS

UNIT – I

BASICS OF MODERN CONSTRUCTION MATERIAL

1.1.	INTRODUCTION.....	2
1.2.	FLY ASH BRICKS	5
1.3.	SOILS-CEMENT BLOCKS.....	17
1.4.	CALCIUM SILICATE/SAND LIME BRICKS.....	24
1.5.	RED MUD JUTE FIBRE POLYMER COMPOSITE (RFPC)	30
1.6.	GLASS REINFORCED GYPSUM	37
1.7.	QUESTION BANK	40

UNIT – II

GEOSYNTHETICS AND BITUMINOUS MATERIAL

2.1.	INTRODUCTION.....	42
2.2.	BITUMINOUS MATERIAL	51
2.3.	FIRE RESISTANT MATERIALS	59
2.4.	METALS	68
2.5.	LIGHT WEIGHT CONCRETE	71
2.6.	MASS CONCRETE	78
2.7.	WASTE MATERIAL BASED CONCRETE	79
2.8.	QUESTION BANK	82

UNIT – III

CONCRETE AS MODERN CONSTRUCTION MATERIAL

3.1.	FERRO-CEMENT	83
3.2.	FIBRE REINFORCED CONCRETE	87
3.3.	HIGH DENSITY CONCRETE.....	99

3.4.	HEAT RESISTING AND REFRACTORY CONCRETE	106
3.5.	PREFABRICATED SYSTEMS.....	114
3.6.	QUESTION BANK	118

**UNIT – IV
COMPOSITES AND CHEMICALS IN MODERN
CONCRETE**

4.1.	POLYMERS.....	131
4.2.	FRP (FIBRE REINFORCED POLYMERS).....	139
4.3.	PCC (POLYMER CONCRETE COMPOSITE).....	146
4.4.	CONSIDERATIONS IN PCC CONSTRUCTION	149
4.5.	APPLICATIONS OF POLYMER CEMENT CONCRETE.....	150
4.6.	SULPHUR CONCRETE	151
4.7.	SULPHUR INFILTRATED CONCRETE	155
4.8.	QUESTION BANK	160

**UNIT – V
MODERN WATERPROOFING AND INSULATING
MATERIAL**

5.1.	WATER PROOFING MATERIALS	165
5.2.	THERMAL INSULATING MATERIALS	179
5.3.	SOUND INSULATING MATERIALS.....	184
5.5.	POLYMER FLOOR FINISHES.....	198
5.6.	QUESTION BANK	204

**UNIT – VI
ADVANCED INNOVATIVE CONSTRUCTION
MATERIAL - I**

6.1.	INTRODUCTION.....	196
------	-------------------	-----

6.2.	INNOVATION IN CONCRETE.....	198
6.3.	INNOVATION IN CEMENT	213
6.4.	RAMMED EARTH AS INNOVATIVE CONSTRUCTION MATERIAL	220
6.5.	RECYCLED AGGREGATES AS INNOVATIVE CONSTRUCTION MATERIAL	224
6.6.	LIQUID GRANITE AS INNOVATIVE CONSTRUCTION MATERIAL	228
6.7.	SENSITILE – THE INFUSION OF LIGHT INTO MATERIALS	244
6.8.	QUESTION BANK	251

UNIT – VII
ADVANCED INNOVATIVE CONSTRUCTION MATERIAL-II

7.1.	INTRODUCTION.....	272
7.2.	WOOD AS INNOVATIVE CONSTRUCTION MATERIAL.....	276
7.3.	RECYCLED PAPER.....	284
7.4.	BAMBOO AS INNOVATIVE CONSTRUCTION MATERIAL.....	288
7.5.	HONEYCOMB MATRIX AS INNOVATIVE CONSTRUCTION MATERIAL	299
7.7.	CARBON FIBRE AS INNOVATIVE CONSTRUCTION MATERIAL	320
7.8.	GRAPHENE AS INNOVATIVE CONSTRUCTION MATERIAL	335
7.9.	GRAPHENE CONCRETE: POTENTIAL USES.....	359
7.10.	QUESTION BANK	365

