

# The Complete Book on Construction Materials

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Construction industry is the largest consumer of material resources, of both the natural ones (like stone, sand, clay, lime) and the processed and synthetic ones. Each material which is used in the construction, in one form or the other is known as construction material (engineering material). No material, existing in the universe is useless; every material has its own field of application. Stone, bricks, timber, steel, lime, cement, metals etc. are some commonly used materials by civil engineers. Selection of building material, to be used in a particular construction, is done on the basis of strength, durability, appearance and permeability. The stone which is used in the construction works, in one form or another is always obtained from the rocks. The rocks may be classified in four ways; geological classification, physical classification, chemical classification and classification based on hardness of the stone. Various kind of rocks come under these classification for example; igneous rocks, plutonic rocks, sedimentary rocks, silicious rocks, stratified rocks etc. brick is the most commonly used building material which is light, easily available, uniform in shape and size and relatively cheaper except in hilly areas. Bricks are easily moulded from plastic clays, also known as brick clays or brick earth. Bricks can be moulded by any of the three methods; soft mud process, stiff mud process and semi dry process. There are various kinds of bricks; specially shaped bricks, burnt clay bricks, heavy duty bricks, sand lime bricks, sewer bricks, refractory bricks, acid resistant bricks etc. lime is an important building material, it has been used since ancient times. Lime is used as a binding material in mortar and concretes, for plastering, for manufacturing glass, for preparing lime sand bricks, soil stabilization etc. Concrete is a construction material obtained by mixing a binder (such as cement, lime, mud etc.), aggregate (sand and gravel or shingle or crushed aggregate), and water in certain proportions. Based on the binding materials, the common concretes can be classified as; mud concrete, lime concrete, cement concrete and polymer concrete. World demand for cement and concrete additives is projected to increase 8.3 percent annually in next few years.

This book basically deals with rock and stone, formation of rocks, classification of rocks, geological classification, metamorphism physical classification of rocks, chemical classification, classification based upon hardness of the stone composition of stone (rock forming minerals), igneous rock forming minerals, sedimentary rock forming minerals, texture of the rocks, types of fractures of rock, uses of stone, natural bed of stone, aluminium and magnesium alloys, mechanical properties of a partially cured resin, DMA characterization, chemical advancement of a partially cured resin, differential scanning calorimeter characterization, chemical mechanical relations, moisture content as a variable, wettability and water repellency of wood, fungal and termite resistance of wood etc.

The book provide wide coverage of building materials such as stone, bricks, lime, mortars,

concrete, asbestos, gray iron, cast iron, steel castings, aluminium, wood, architectural paints and so many others with their applications in building construction. The book is resourceful for all professionals related to construction field, technocrats, students and libraries.

## 1. STONE

Introduction

Rock and Stone

Formation of Rocks

Classification of Rocks

Geological classification

Metamorphism

Physical classification of rocks

Chemical classification

Classification based upon hardness of the stone

Composition of Stone (Rock-forming Minerals)

Igneous rock forming minerals

Sedimentary Rock Forming Minerals

Texture of the Rocks

Types of Fractures of Rock

Uses of Stone

Natural bed of Stone

Seasoning of Stones

Characteristics or Qualities of Stones

Characteristics of principle Building Stones

Properties

Decay or Deterioration of Stones

Preservation of Stone

Artificial Stone

Important point to be Considered before Starting Quarrying

Methods of quarrying Stone

Various Operations of Blasting

Precautions in Blasting

Blasting materials

Making of Primer Cartridge

Storing of explosives

Handling of misfires

Dressing of Stone

Machines Required for Quarrying Stone

## 2. BRICKS AND OTHER CLAY PRODUCTS

Introduction

Brick Earth and its Constituents

Sources of Brick Earth

Qualities of Brick Earth

Chemical composition of Brick Earth

Functions of the constituents of Brick Earth

Harmful Ingredients

Pebbles of Stones and Gravel

Alkaline-Salts

Limestone and Kankar

Vegetation and Organic Matter

Manufacture of Clay Bricks

Selection of site  
Preparation of Clay  
Weathering Process  
Tempering process  
Moulding of bricks  
Soft mud process  
Procedure  
Stiff Mud Process  
Semi Dry Process  
Drying of Bricks  
Natural Drying  
Artificial Drying  
Burning of Bricks  
Clamp  
Intermittent Kilns  
Continuous Kilns  
Classification of Burnt Clay Bricks  
Introduction  
Properties of Burnt Clay Bricks  
General Quality of Bricks  
Dimensions and Tolerances  
Water Absorption of Bricks  
Efflorescence  
Strength of Bricks  
Testing of Bricks  
Test for Compressive Strength  
Test for Water Absorption  
Test for efflorescence  
Test for warpage  
Special Bricks  
Specially shaped Bricks  
Burnt Clay Facing Bricks  
Heavy Duty Bricks  
Perforated building bricks  
Sand lime Bricks  
Sewer Bricks  
Acid Resistant Bricks  
Refractory Bricks  
Manufacture  
Acid bricks  
Basic Bricks  
Neutral Bricks  
Building Tiles  
Process for Manufacturing Roofing Tiles  
Process for Manufacturing Flooring and Wall Tiles  
Specifications for Building Tiles  
Earthenwares  
Glazed Earthenware Tiles  
Terracotta  
Stoneware

### 3. LIME

General

Properties of Lime  
Uses of Lime  
Source of Lime  
Some Important Terms and their Definitions  
Varieties of lime  
Classification of Lime  
Uses of fat lime  
Classification of Lime According to I.S. 712-1984  
Indian Standard Specification for Lime  
Manufacturing process  
Description of Each Stage of Operation  
Field Control Test for Assessing Quality of Lime  
Manufacture of Fat Lime  
Advantages of continuous kiln  
Manufacture of Natural Hydraulic Lime  
Manufacture of Artificial Hydraulic Lime  
Storage of Lime  
Field Slaking of Lime and Preparation of Putty  
Objective of Slaking  
Slaking Process  
Determining the Slaking Nature of Lime  
Slaking Procedure for Quick Slaking Lime  
Initial Preparation  
Methods of Slaking Lime  
General Precautions in Slaking  
Slaking Procedure for Medium and Slow-slaking Limes  
Running  
Maturing  
Making Coarse Stuff and Putty from Hydrated Lime or Powder  
Coarse Stuff  
Putty  
Storage after slaking  
Testing of Lime  
Classification of binding materials  
Precautions to be taken in handling lime  
Properties of Lime

#### 4. MORTARS

Definitions  
Sand  
Classification Based on Fineness  
Bulking of Sand  
Desirable Properties of Sand  
Function of Sand in Mortars  
Fineness Modulus of Sand  
Tests for Sand  
Selection of Sand for Use  
Substitutes for Sand  
Types of Mortars  
Special Mortars  
Properties of Good Mortar  
Test for Mortars  
Precautions in using Mortar

## 5. CONCRETE

Introduction

Lime Concrete

Preparation of lime Concrete

Laying of Lime Concrete

Properties of Lime Concrete

Use and Precautions

Water

Coarse Aggregate

Grading of Aggregate

Proportioning of Fine Aggregate to Coarse Aggregate

Maximum Size of the Aggregate

Measurement of Cement Concrete Ingredients

Significance of Bulking of Sand

Water Cement Ratio (W/C Ratio)

Proportioning of Concrete Mixes

Cube strength of Concrete

Properties of Cement Concrete

Slump Test

Factors Affecting Proportions of Concrete

Strength of Concrete

Mixing of Concrete

Transporting the Concrete

Placing of Concrete

Consolidation or Compaction of Concrete

Finishing

Curing of Concrete

Removal of Form Work

Joints in Concrete

Some other Types of Cement Concretes

Form Work

## 6. ASBESTOS

Introduction

Commercial Focus

Asbestos Sheets and Boards

Asbestos Cement Pipes

## 7. ASPHALT, BITUMEN AND TAR

Introduction

Terminology

Asphalt/Bitumen

Other Allied Terms

Bituminous Materials

Bitumen Felt/Tar Felt

Specifications and use

Other Bituminous Materials

Tests for Bitumen

Tar

## 8. GRAY IRON

The Metastable Iron-Iron Carbide System

Solidification of an Fe-C-Si Alloy  
Chemical Composition Effects  
Carbon  
Silicon  
Silicon Content and Graphitization  
Sulfur and Manganese  
Phosphorus  
Gray-iron Specifications  
Heat-treatment of Gray Iron  
Machinability  
Wear Resistance  
Strength  
Stress Relief  
Alloying Elements  
Effect on Microstructure  
Chromium  
Molybdenum, Molybdenum-Nickel  
Nickel  
Silicon  
Copper  
Aluminum and Titanium  
Effect on Properties

## 9. CAST IRON

Definitions  
Chemical Composition  
Composition and Graphitization  
Solidification Process  
Microstructure  
Graphite  
Cementite  
Ferrite  
Pearlite  
Steadite  
Austenite  
Properties of Cast Irons  
White Irons  
Chilled Iron

## 10. STEEL CASTINGS

Introduction  
Molding Processes And Sands  
Green-sand Molding  
Refractoriness  
High permeability and Low Moisture Content  
Organic and Other Additions  
Green-sand-molding Casing Defects  
Dry-sand Molds and Skin-dried Molds  
Other Types of Molds  
Molding Methods  
Cores  
Hot-tear Formation  
Metal penetration

Burn-on  
Ceroxides  
Core and Mold Washes

## 11. ALUMINIUM AND MAGNESIUM ALLOYS

ALuminum Alloying Principles  
Copper  
Heat-treatment of Cu-Al Alloys  
Silicon  
Magnesium  
Magnesium and silicon

## 12. DUCTILE IRON

Solidification Of Ductile Iron  
Development of Graphite Spheroids  
Role of Magnesium  
Control of the Common Elements  
Carbon  
Silicon  
Sulfur  
Phosphorus  
Other Elements  
Melting Practices  
Acid Cupola Melting  
Desulfurization  
Basic Cupola Melting  
Induction-furnace Melting  
Magnesium Treatment  
Inoculation  
Engineering Properties

## 13. MALLEABLE IRON

Melting  
Batch-Melting Process  
Engineering Properties  
Pearlitic Malleable Irons  
Other Malleable Irons

## 14. RESIN CHARACTERIZATION

Introduction  
Scope  
Mechanical Properties of a Partially Cured Resin – DMA Characterization  
Chemical Advancement of a Partially Cured Resin – Differential Scanning Calorimeter  
Characterization  
Chemical-Mechanical Relations  
Moisture Content as a Variable  
Flake Bonding  
Measurement of Pressing Environments  
Resin Penetration  
Practical Application

## 15. THERMO-GRAVIMETRY OF WOOD REACTED WITH FLAME RETARDANTS

Introduction

Experimental Methods  
Results and Discussion  
Phosphorus And Nitrogen  
Thermogravimetry  
Flame Test  
Conclusions

## 16. WETTABILITY AND WATER REPELLENCY OF WOOD

Introduction  
Experimental  
Wood materials  
Automated surface tension analyzer  
Computer program: wood wettability study  
Graph  
Contact angle from attractive force  
Contact angle from work of adhesion  
Surface free energy estimation  
Interaction parameter calculation  
Aging effect  
Results and Discussion  
Aging effect  
Surface free energy estimates  
Interaction parameter calculation

## 17. FLAME RETARDANT TREATMENT OF WOOD

Introduction  
Materials and Methods  
Preparation of specimens  
Treatment of specimens  
Leaching  
Dimensional stability tests  
Thermogravimetric analysis  
Results and Discussion  
Treatment of specimens  
Leach resistance  
Dimensional stability  
Thermal degradation  
Conclusions

## 18. FUNGAL AND TERMITE RESISTANCE OF WOOD

Introduction  
Materials and Methods  
Fungal evaluations  
Termite evaluations  
Reaction time and chemical analysis  
Results and Discussion  
Decay Resistance  
Chemical Analysis  
Conclusions

## 19. WEATHERING OF WOOD

Introduction

- Early History
- The Weathering Process
- Weathering Factors
- Property Changes
- Weathering of Wood-Based Materials
- Protection Against Weathering
- Film-forming Materials
- Penetrating Finishes
- Summary

## 20. ARCHITECTURAL PAINTS

- Introduction
- Exterior Paints for Wood
- Characteristics of Wood Siding
- Binders for Exterior House Paints
- Pigments for Colored Paints
- Microorganisms in Paints and Coatings
- Formulating Exterior Paints for Wood
- Interior Paints for Plaster and Wallboard
- Exterior Emulsion Paints for Masonry
- Exterior Solution Type Paints for Masonry
- Interior and Exterior Enamels
- Enamels for Wood and Concrete Floors

## 21. BUILDING CONSTRUCTION ADHESIVES

- Introduction
- Advantage of Using Adhesives in Construction
- Elastomeric Adhesives
- Gap-Filling Phenol Resorcinol Adhesives
- Polyurethane Adhesives
- Resorcinol Resin Adhesives
- Casein Adhesives
- Polyvinyl Acetate Resin Emulsion
- Phenolic Resin Adhesives
- Melamine-Urea Resin Adhesives
- Urea Resin Adhesives
- Epoxy Resin Adhesives
- Contact Cement

## 22. FLOORING

- Domestic Flooring
- Institutional Flooring
- Industrial Flooring
- Types Of Epoxy Flooring
- Self-levelling Floors
- Trowelled Floors
- Epoxy Terrazzo
- Future Developments In Epoxy Floors

## 23. MINING

- Adhesion And Grouting
- Remedial Uses
- Concrete Crack Repair

- Bonding Concrete to Concrete
- Bonding Reinforcements
- Epoxy Bonding in New Structures
- Fire Resistance
- Bulk Mechanical Properties
- Creep
- Miscellaneous Bonding Applications

#### 24. GROUTS FOR LEVELLING: MISC. APPLICATIONS

- Miscellaneous Applications
- Soil consolidation
- Tile grouts
- Epoxy laminates for concrete moulds
- Resin concrete

#### 25. GLASS

- Structure
- Composition
- Single-Phase Glasses
- Properties
- Manufacture and Processing
- Economic Aspects

#### 26. CEMENT

- Clinker Chemistry
- Hydration
- Cement Paste Structure and Concrete Properties
- Manufacture
- Portland Cements
- Special Purpose and Blended Cements
- Nonportland Cements
- Economic Aspects, Production, and Shipment
- Specifications and Types
- Uses

#### 27. INSULATING MATERIALS

- Introduction
- Thermal Insulation
- Terminology Related to Thermal Insulation
- Requirements of Thermal Insulating Materials
- Types of Insulating Materials
- Air Spaces
- Aerated Concrete
- Gypsum
- Expanded Blast Furnace Slag
- Sprayed Asbestos
- Vermiculite
- Coconut Fibres
- Cork Board
- Rock Wool
- Cellulose
- Cellular Plastics

Fibre Glass  
Sound Insulation  
Terminology  
Units of Sound  
Velocity of Sound  
Acoustics  
Noise  
Requirement of Sound Insulating Materials  
Types of Acoustical Materials  
Acoustic Pulp  
Acoustical Plaster  
Unifil Acoustical Plaster  
Limpet Asbestos  
Thermacoustic  
Prefabricated Boards or Tiles  
Glass Fibres  
Composite Units

## About NIIR

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Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Start up Business Opportunities, entrepreneurship projects, Successful Business Plan, Industry Trends, Market Research, Manufacturing Process, Machinery, Raw Materials, project report, Cost and Revenue, Pre-feasibility study for Profitable Manufacturing Business, Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Business Opportunities, Investment Opportunities for Most Profitable Business in India, Manufacturing Business Ideas, Preparation of Project Profile, Pre-Investment and Pre-Feasibility Study, Market Research Study, Preparation of Techno-Economic Feasibility Report, Identification and Section of Plant, Process, Equipment, General Guidance, Startup Help, Technical and Commercial Counseling for setting up new industrial project and Most Profitable Small Scale Business.

NPCS also publishes various process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.

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