

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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