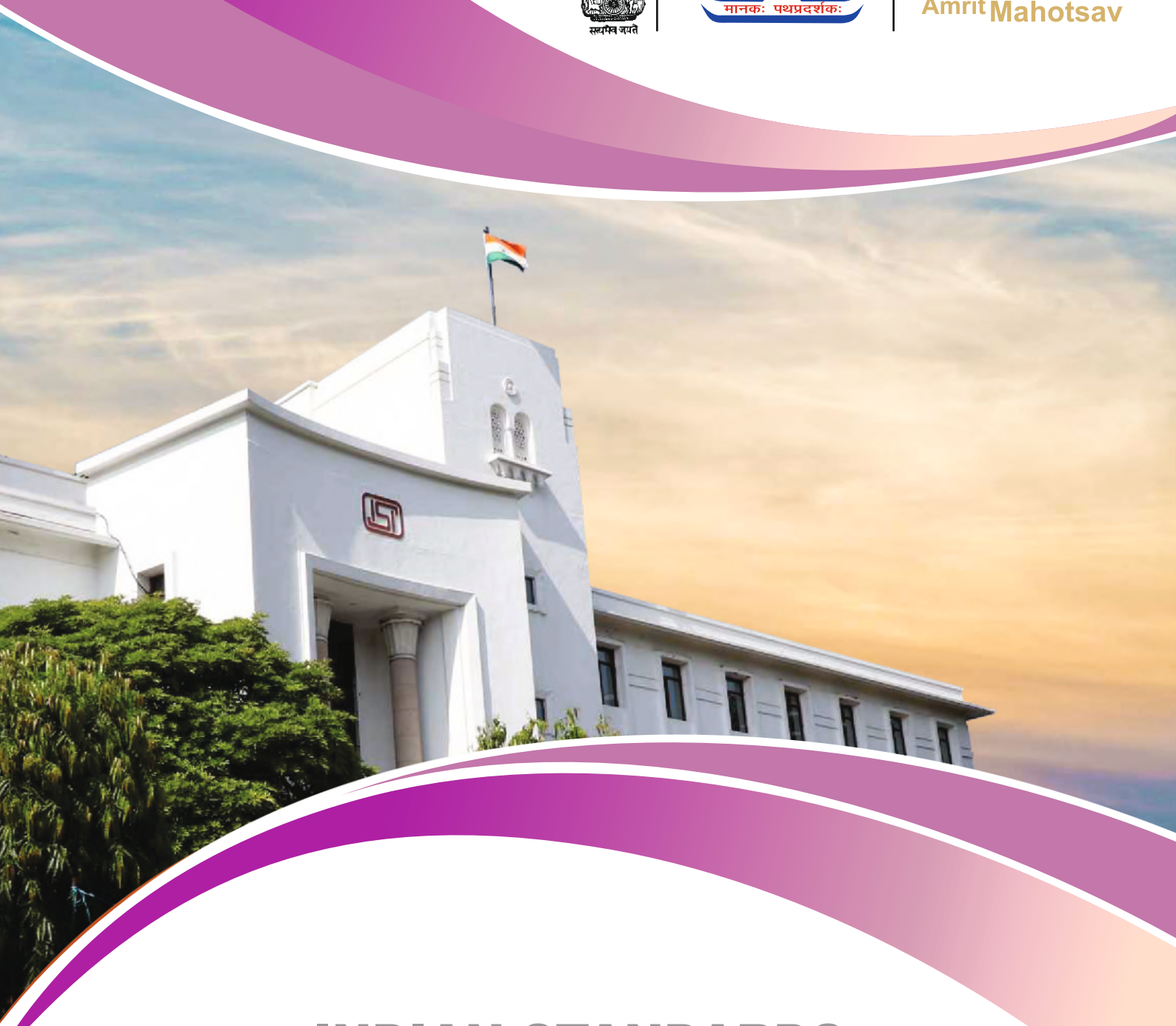
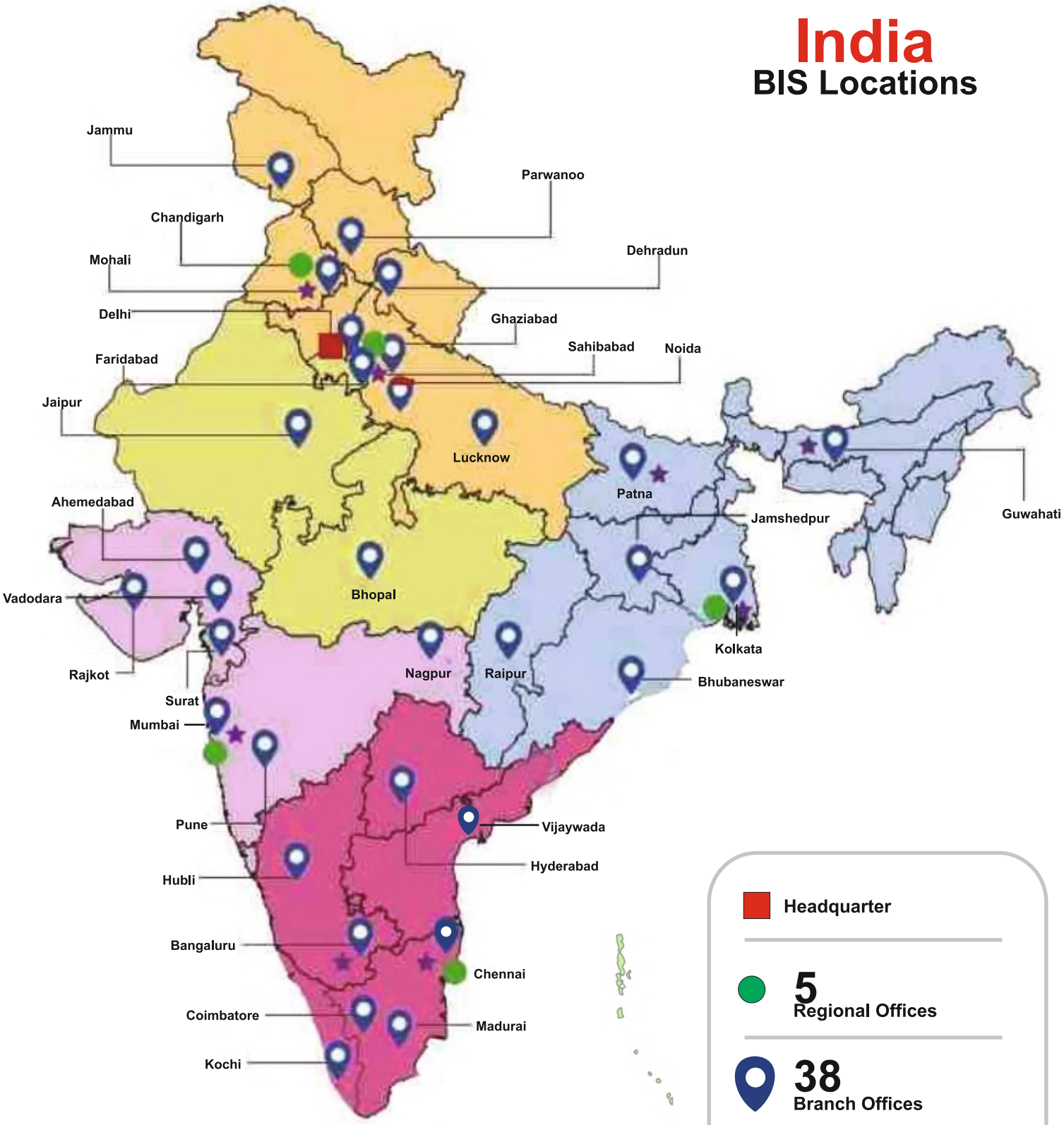


INDIAN STANDARDS ON BUILDING MATERIALS

BUREAU OF INDIAN STANDARDS
Ministry of Consumer Affairs,
Food and Public Distribution
Government of India

भारतीय मानक ब्यूरो
उपभोक्ता मामले, खाद्य और
सार्वजनिक वितरण मंत्रालय
भारत सरकार

India
BIS Locations



Headquarter

5 Regional Offices

38 Branch Offices

8 Laboratories

— Training Institute (NITS)

सत्यमेव जयते

मानकः पथप्रदर्शकः

Azadi Ka Amrit Mahotsav

ABOUT BIS

Bureau of Indian Standards (BIS), the National Standards Body (NSB) of India was established under the *BIS Act*, 1986 and came into existence on 1 April 1987 assuming the functions of the erstwhile Indian Standards Institution (ISI). The ISI was established on 6 January 1947. *The BIS Act*, 2016 came into force on 12 October 2017 superseding BIS Act 1986. *The BIS Act*, 2016 provides for the establishment of a national standards body for the harmonious development of the activities of standardization, conformity assessment and quality assurance of goods, articles, processes, systems and services and for matters connected therewith or incidental thereto.

BIS through its core activities of standardization and conformity assessment, has been benefiting the national economy by providing safe, reliable and quality goods; minimizing health hazards to consumers; protecting the environment; controlling over proliferation of varieties; promoting exports and imports substitutes, etc. The standardization and conformity assessment schemes of BIS apart from benefitting the consumers and industry also support various public policies especially in areas of product safety, consumer protection, food safety, environment protection, building and infrastructure development, etc.

BIS also represents India in international standards bodies like International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) and participates actively in the international standardization work undertaken by these bodies. BIS presents the national viewpoints on new areas taken up for international standardization and on various draft international standards during the process of development of these standards so that the country's interest is protected and reflected in these standards. This also enables the BIS technical committees to consider adoption of the international standards as Indian Standards, with or without modifications, in order to enable our products and services to integrate with global trade and commerce.

What are Standards?

Standard is a document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

Importance of Standardization

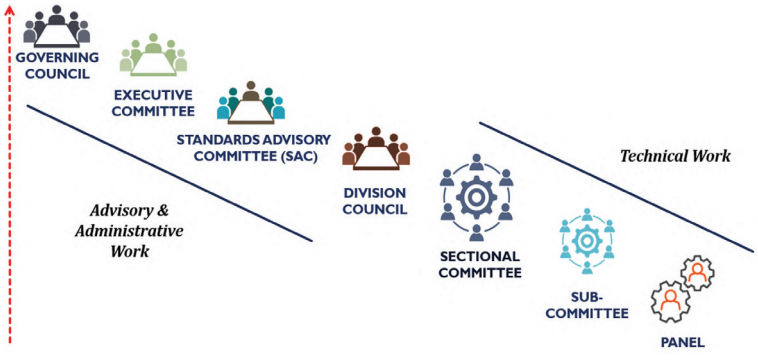
Standardization is the process of developing technical standards through consensus of different parties.This standardization aims to address one or all of compatibility, interchangeability, variety control, safety, environment protection, product protection and fitness for purpose. Standards provide numerable benefits to the technologists, producers, consumers and traders besides defining purpose for each of these entities.

Standards can be formulated at various levels ranging from an individual through National (IS) to International level (ISO). Also, depending on the subject in hand, standards can be made on various aspects such as terminology, specification, sampling, testing, code of good practice, systemes and services.

STANDARDIZATION ACTIVITY OF BIS

Standardization Structure

There are 16 Technical Departments formulating standards in various subject areas. Corresponding to these departments, 16 division councils exist. Each division council has several sectional committees working under it. The standards cover important segments of economy and help the industry in upgrading the quality of their goods and services.

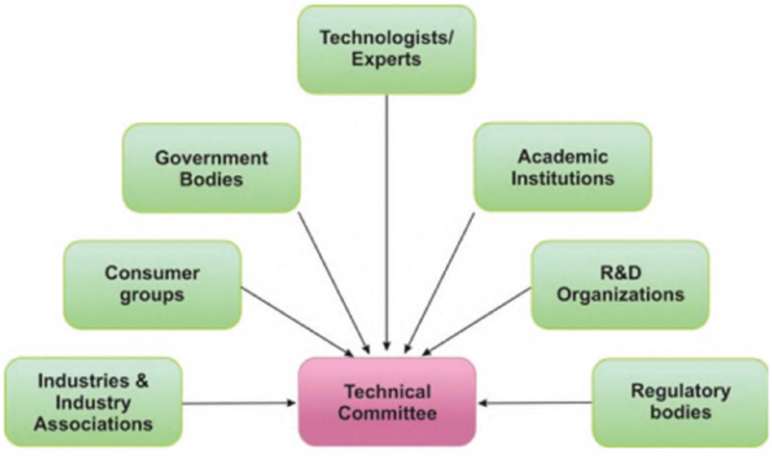


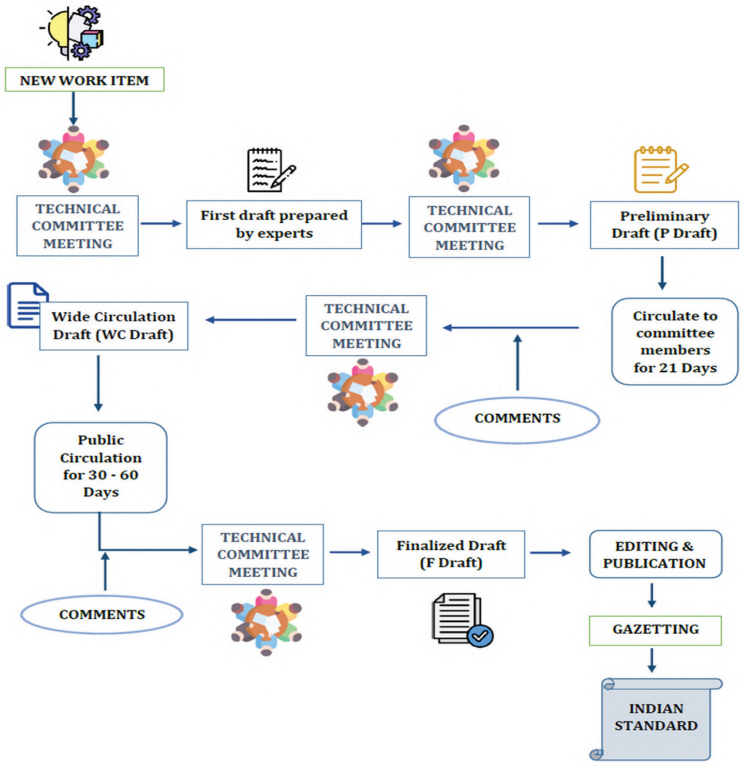
Ayush Division Council (AYDC)	Chemical Division Council (CHDC)	Civil Engineering Division Council (CEDC)	Electro-Technical Division Council (ETDC)
Electronics & Telecommunication Division Council (LITDC)	Food and Agriculture Division Council (FADC)	Mechanical Engineering Division Council (MEDC)	Management and Systems Division Council (MSDC)
Metallurgical Engineering Division Council (MTDC)	Medical Equipment & Hospital Planning Division Council (MHDC)	Petroleum, Coal & Related Products Division Council (PCDC)	Production and General Engineering Division Council (PGDC)
Transport Engineering Division Council (TEDC)	Textile Division Council (TXDC)	Water Resources Division Council (WRDC)	Service Sector Division Council (SSDC)

Standards Formulation Process

The Indian Standards are developed by technical committees that are representative of various stakeholders having interest in the relevant subject of standardization under the scope of such committees through a process of consultation so that views of all are given due consideration and a consensus is evolved in formulating a standard. The stakeholders involved in national standardization can broadly be categorized as industry, consumers/ users, technologists (R&D and scientific institutions, academia, individual subject experts, etc) and government departments/regulators.

The process of standards development of BIS is aligned with accepted international best practices that are based on the core principles of openness, transparency, impartiality and consensus. The process begins with the identification of the standardization needs of the given sector or subject following which the development of the standard is taken up and planned bythe relevant technical committee. Apart from consultation within the technical committees, draft standards are also open for public views/comments.





Standards Development Process Flow

Standardization in the Sector of Civil Engineering

Civil Engineering Division Council, CEDC of BIS deals with the standardization in the field of Civil Engineering including structural engineering; building materials and components; planning, design, construction and maintenance of civil engineering structures and built environment; construction practices, sustainability in built environment and safety in buildings. However, the scope of work of the Council excludes those subjects which specifically relate to water resources development and management as the same is dealt by the Water Resources Division Council of BIS.

CEDC is working towards achieving the above goal through 38 Sectional Committees, list of which is given below, covering wide range of subjects from basic building materials, design and construction to very high technical areas like offshore installations, ports and harbours, cyclone resistant structures, etc.

Total number of standards published by CEDC (as of October 2023) is 1835.

The work of the Council and the 38 Sectional Committees is managed by the Civil Engineering Department of BIS.

List of Sectional Committees under CEDC :

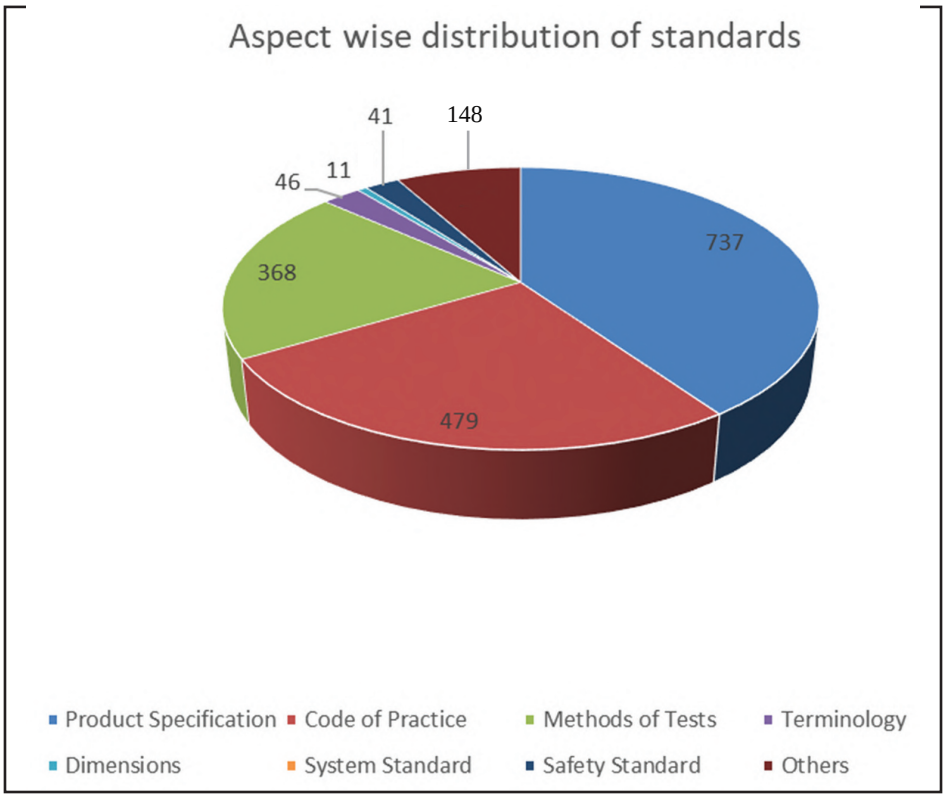
Sl No.	Committee No.	Title of the Committee
1	CED 02	Cement and Concrete Sectional Committee
2	CED 03	Sanitary Appliances and Water Fittings Sectional Committee
3	CED 04	Building Lime and Gypsum Products Sectional Committee
4	CED 05	Flooring, Wall Finishing and Roofing Sectional Committee
5	CED 06	Stones Sectional Committee
6	CED 07	Structural Engineering and Structural Sections Sectional Committee
7	CED 09	Timber and Timber Stores Sectional Committee
8	CED 11	Doors, Windows and Shutters Sectional Committee
9	CED 12	Functional Requirements in Buildings Sectional Committee
10	CED 13	Building Construction Practices Sectional Committee
11	CED 15	Builder's Hardware Sectional Committee
12	CED 20	Wood and Other Lignocellulosic Products Sectional Committee
13	CED 22	Fire Fighting Sectional Committee
14	CED 24	Public Health Engineering Sectional Committee
15	CED 29	Construction Management Sectional Committee

16	CED 30	Clay and Stabilized Soil Products for Construction Sectional Committee
17	CED 32	Prefabricated Construction Sectional Committee
18	CED 35	Furniture Sectional Committee
19	CED 36	Fire Safety Sectional Committee
20	CED 37	Structural Safety Sectional Committee
21	CED 38	Special Structures Sectional Committee
22	CED 39	Earthquake Engineering Sectional Committee
23	CED 41	Water Proofing and Damp-Proofing Sectional Committee
24	CED 43	Soil and Foundation Engineering Sectional Committee
25	CED 44	Methods of Measurement of Works of Civil Engineering (Excluding Water Resources Development) Sectional Committee
26	CED 45	Safety in Construction Sectional Committee
27	CED 46	National Building Code Sectional Committee
28	CED 47	Ports, Harbours and Offshore Installations Sectional Committee
29	CED 48	Rock Mechanics Sectional Committee
30	CED 50	Plastic Piping Systems Sectional Committee
31	CED 51	Planning and Housing Sectional Committee
32	CED 53	Cement Matrix Products Sectional Committee
33	CED 54	Concrete Reinforcement Sectional Committee
34	CED 55	Sieves, Sieving and Other Sizing Methods Sectional Committee
35	CED 56	Hill Area Development Engineering Sectional Committee
36	CED 57	Cyclone Resistant Structures Sectional Committee
37	CED 58	Sustainability of Built Environment Sectional Committee
38	CED 59	Smart Cities Sectional Committee

For scope and the list of standards developed by each of the above sectional committees, visit the following link:

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/dgdashboard/committee_sso/committeeDetails/63

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/pow_details?tecd=63



Indian Standards of Building Materials

Building Materials

Building materials form a basic component of any built structure. Towards ensuring safe and robust structure, the quality of such materials is important. Standards play an important role in defining such requirements and to establish them in practice.

Innumerable numbers of materials are used in building construction and several hundreds of Indian Standards have been listed in the Building Materials chapter of the National Building Code of India 2016.

BIS has formulated various standards on some of the frequently used building materials as listed below:

- Cement
- Aggregate
- Concrete
- Reinforcing and Prestressing Steel
- Bricks and Blocks
- Timber and Plywood
- Innovative Materials

Cement

Cement is a binding material which is most widely used in building and civil engineering construction. When mixed with water, it sets and hardens. It is formed from argillaceous (containing silica) and calcareous (containing calcium) rocks. Composition of cement includes lime (65%), silica (20%), alumina (3-5%), magnesia (1-3%),

iron oxide (0.5-6%), alkalies (0.5-1%) and Sulphur trioxide (1-3%). It is mainly classified as Hydraulic and Non-hydraulic cement.

At present, a total of 17 Indian Standards (as tabled below) are available on hydraulic cement, out of which 16 standards can be used for both buildings and structures.

Sl No.	IS Number	Year	Title
1	IS 269	2015	Ordinary Portland cement – Specification (*sixth revision*)
2	IS 455	2015	Portland slag cement – Specification (*fifth revision*)
3	IS 1489 (Part 1)	2015	Portland pozzolana cement – Specification: Part 1 Flyash based (*fourth revision*)
4	IS 1489 (Part 2)	2015	Portland pozzolana cement – Specification: Part 2 Calcined clay based (*fourth revision*)
5	IS 18189	2023	Portland Calcined Clay Limestone Cement – Specification
6	IS 3466	1988	Specification for masonry cement (*second revision*)
7	IS 6452	1989	Specification for high alumina cement for structural use (*first revision*)
8	IS 6909	1990	Specification for supersulphated cement (*first revision*)
9	IS 8041	1990	Specification for rapid hardening Portland cement (*second revision*)
10	IS 8042	2015	White Portland cement – Specification (*third revision*)
11	IS 8043	1991	Specification for hydrophobic Portland cement
12	IS 8229	1986	Specification for Oil-well Cement
13	IS 12330	1988	Specification for sulphate resisting Portland cement
14	IS 12600	1989	Specification for low heat Portland cement
15	IS 16415	2015	Composite cement — Specification
16	IS 16993	2018	Microfine ordinary Portland cement – Specification
17	IS 15895	2018	High alumina refractory cement – Specification

The Indian Standards on cement specify the list of basic raw materials, options of manufacture (by inter grinding process or by inter blending process), the physical requirements, chemical requirements, the associated Indian Standard test methods to determine the requirements. Typically, the physical requirements spelt out to be met in line with the necessary test method standard cover the following:

- Fineness — IS 4031 (Part 2)
- Setting time — IS 4031 (Part 5)
- Compressive strength — IS 4031 (Part 6)
- Transverse strength — IS 4031 (Part 8) (*optional*)
- Soundness — IS 4031 (Part 3)

The chemical requirements spelt out to be met by any cement in line with the necessary test method standard cover the following:

- Lime saturation factor
- Insoluble residue
- Magnesia
- Sulphate content
- Loss on ignition
- Chloride content
- Alumina/Iron oxide

If the cement is of sub-standard quality and the lot is to be rejected, the rejection can be done on the basis of:

- Non-compliance with relevant Indian Standard.
- Cement in bulk storage at the factory:
  - If stored for over **six months** prior to shipment, it must be retested.
  - It shall be rejected if found to be non-compliant with the relevant Indian Standard.
- Cement in bags held in local storage (e.g., vendor's stock):
  - If stored for **more than three months** after completion of tests, it must be retested.
  - It shall be rejected if found to be non-compliant with the relevant Indian Standard.

Such cement conforming to the Indian Standard require to be delivered in specified bags/containers; the requirements for marking on such bags have also been listed in the cement standards to cover also the following:

- Type of cement
- Performance improver
- Name and address of manufacturer with his trademark
- Batch/control number (Date/week/month of manufacturer)
- Net quantity of cement
- Best before date (3 months)

Aggregates

Aggregates are important components for making concrete and properties of concrete are substantially affected by various characteristics of the aggregates used. Aggregates from natural sources form the major variety used for making concrete, mortar and other applications. Based on their size, they are categorized as coarse and fine aggregates.

Coarse and fine aggregates are the two essential ingredients for making concrete. The Indian Standard **IS 383 : 2016** 'Coarse and fine aggregates for concrete – Specification (third revision)' covers both naturally sourced aggregates as well as those manufactured as a by product from industries. This standard covers fine aggregates that are 4.75 mm and below in size which can be any of:

- Natural sand
- Crushed sand (stone sand and gravel sand)
- Mixed sand
- Manufactured fine aggregate (commonly known as manufactured sand)

The coarse aggregates specified in IS 383 covers those aggregates more than 4.75 mm which can be from any of:

- Uncrushed gravel/stone
- Crushed gravel/stone
- Partially crushed gravel/stone

Manufactured from other than natural sources (by processing/thermal means). Recycled concrete aggregates (RCA) and recycled aggregated (RA) comes under this category.

IS 383 also cover all-in-aggregates which comprises both fine aggregate and coarse aggregates in a single mixture.

Concrete

It is the most widely used building construction material used all across the world and building block of the modern infrastructure. Concrete is a composite material formed by mixing cement, water, fine and coarse aggregates, and admixtures. Concrete mix design is a method of determining the right proportions of cement, water, sand and aggregates in order to achieve the required target strength. The proportioning is carried out to achieve specified characteristics at specified age, workability of fresh concrete and durability requirements. IS 10262: 2019 provides the guidelines for concrete mix proportioning. This standard has been divided into five sections as follows:

Section 1 General

Section 2 Ordinary and standard grades of concrete

Section 3 High strength grades of concrete

Section 4 Self compacting concrete

Section 5 Mass concrete

The consideration of air content in design of normal (non-air entrained) concrete mix proportion, has been reintroduced in this standard, as the following table :

Table on Approximate Air Content

Sl No.	Nominal Maximum Size of Aggregate	Entrapped Air, as Percentage of Volume of Concrete
i)	10.0 mm	1.0
ii)	12.5 mm	0.8
iii)	20.0 mm	0.5

Section 3 High strength grades of concrete

High strength concrete is the concrete that has characteristic compressive strength of 65 N/mm^2 or more. This section provides the guidance for selecting mix proportion for M65 or above. Usually, for high strength concrete mixes, specially selected cementitious materials and chemical admixtures, that is, super plasticizers are used, and achieving a low water–cementitious materials ratio (w/cm) is considered essential.

Section 4 Self compacting concrete

Self compacting concrete (SCC) may be used in precast concrete applications or for concrete placed on site. SCC is used to cast sections with highly congested reinforcement and in areas that present restricted access to placement and consolidation, including the construction of tunnel lining sections and the casting of hybrid concrete filled steel tubular columns. It may be manufactured in a site batching plant or in a ready-mixed concrete plant and delivered to site by truck mixer. It may be placed either by pumping or pouring into horizontal or vertical forms.

A concrete mix can only be classified as self compacting concrete, if the requirements for all below mentioned characteristics are fulfilled:

a) Filling ability (Flowability),
b) Passing ability,
c) Segregation resistance, and
d) Viscosity

The above tests shall be carried out as per IS 1199 (Part 6).

Section 5 Mass concrete

Mass concreting is used for structures like dams and other massive structures. For such large structures, measures need to be taken to cope with the generation of heat from hydration of cement and attendant volume change to minimize cracking.

The primary objective of proportioning for mass concrete is to establish economical mixes of proper strength, durability and permeability with the best combination of available materials that will provide adequate workability, easy placeability and least temperature rise after placement.

In mass concrete structures, generally lower grade of concrete (say M 15 or M 20) and higher sizes of coarse aggregates [maximum nominal size of aggregate (MSA) 40 mm, MSA 80 mm and MSA 150 mm] are used. In certain cases, like thick raft foundation, retaining wall, etc, mass concreting may be of higher grade of concrete.

Production of Concrete

Various stages in the manufacturing of concrete mix are listed below:

1) Batching
2) Mixing
3) Transportation
4) Placing
5) Compaction
6) Curing
7) Finishing

Tests on Fresh Concrete

Various tests on fresh concrete includes slump test, compacting factor test and vee-bee consistometer test which are used to measure the workability and fluidity of the concrete mix. IS 1199 is a series of standards dealing with methods of testing, sampling and analysis of fresh concrete. Its various parts are listed hereunder:

SI. No.	IS No.	Title
1	*IS 1199:1959	Methods of sampling and analysis of concrete
2	IS 1199 (Part 1):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 1 Sampling of fresh concrete (*first revision*)
3	IS 1199 (Part 2):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 2 Determination of consistency of fresh concrete (*first revision*)
4	IS 1199 (Part 3):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 3 Determination of density of fresh concrete (*first revision*)
5	IS 1199 (Part 4):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 4 Determination of air content of fresh concrete (*first revision*)
6	IS 1199 (Part 5):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 5 Making and curing of test specimens (*first revision*)
7	IS 1199 (Part 6):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 6 Tests on fresh self compacting concrete (*first revision*)
8	IS 1199 (Part 7):2018	Fresh Concrete – Methods of sampling, testing and analysis: Part 7 Determination of setting time of concrete by penetration resistance (*first revision*)
9	IS 14959 (Part 1):2001	Determination of water soluble and acid soluble chlorides in mortar and concrete - Method of test: Part 1 Fresh mortar and concrete

* indicates standard is under revision

Tests on Hardened Concrete

Hardened concrete is the concrete that must be sufficiently strong to withstand design loads and must be durable enough for the estimated environmental risk. The properties of hardened concrete are listed below:

- Compressive strength
- Flexural tensile strength
- Split tensile strength
- Creep and shrinkage
- Rate of gain of strength
- Modulus of elasticity
- Permeability

Various standards for testing of hardened concrete are tabulated below:

SI. No.	IS No.	Title
1	*IS 516:1959	Methods of tests for strength of concrete
2	IS 516 (Part 1/Sec 1): 2021	Hardened concrete - Methods of test: Part 1 Testing of strength of hardened concrete: Section 1 Compressive, flexural and split tensile strength (*first revision*)
3	IS 516 (Part 2/Sec 1): 2018	Hardened concrete - Methods of test: Part 2 Properties of hardened concrete other than strength: Section 1 Density of hardened concrete and depth of water penetration under pressure (*first revision*)
4	IS 516 (Part 2/Sec 2): 2020	Hardened concrete - Methods of test: Part 2 Properties of hardened concrete other than strength: Section 2 Initial surface absorption (*first revision*)
5	IS 516 (Part 2/Sec 3): 2022	Hardened Concrete — Methods of test: Part 2 Properties of Hardened Concrete other than strength: Section 3 Oxygen permeability index (*first revision*)
6	IS 516 (Part 2/Sec 4): 2021	Hardened concrete - Methods of test: Part 2 Properties of hardened concrete other than strength: Section 4 Determination of the carbonation resistance by accelerated carbonation method (*first revision*)
7	IS 516 (Part 4):2018	Hardened concrete - Methods of test: Part 4 Sampling, preparing and testing of concrete cores (*first revision*)
8	IS 516 (Part 5/Sec 1): 2018	Hardened Concrete - Methods of test: Part 5 Non-destructive testing of concrete: Section 1 Ultrasonic pulse velocity testing (*first revision*)
9	IS 516 (Part 5/Sec 2): 2021	Hardened concrete - Method of test: Part 5 Non-destructive testing: Section 2 Half-Cell Potentials of uncoated reinforcing steel in concrete (*first revision*)
10	IS 516 (Part 5/Sec 3): 2021	Hardened concrete - Methods of test: Part 5 Non-destructive testing of concrete: Section 3 Carbonation depth test (*first revision*)
11	IS 516 (Part 5/Sec 4): 2020	Hardened concrete - Methods of test: Part 5 Non-destructive testing of concrete: Section 4 Rebound hammer test (*first revision*)
12	IS 516 (Part 6):2020	Hardened concrete - Methods of test: Part 6 Determination of drying shrinkage and moisture movement of concrete samples (*first revision*)
13	IS 516 (Part 8/Sec 1): 2020	Hardened concrete - Methods of test: Part 8 Determination of modulus of elasticity: Section 1 Static modulus of elasticity and poisson's ratio in compression (*first revision*)
14	IS 516 (Part 11):2020	Hardened Concrete - Methods of test: Part 11 Determination of Portland cement content of hardened hydraulic cement concrete (*first revision*)
15	IS 14959 (Part 2):2001	Determination of water soluble and acid soluble chlorides in mortar and concrete - Method of test: Part 2 Hardened mortar and concrete

* indicates standard is under revision

Types of Concrete

Different types of concrete used in the construction industry are:

1. Self compacting concrete
2. Fibre reinforced concrete
3. Aerated concrete
4. Prestressed concrete
5. Ready mixed concrete
6. Structural light weight concrete
7. Refractory concrete
8. Pumped concrete, and many more.

IS 6461 (Part 4): 1972 – Glossary of terms relating to cement concrete Part 4 Types of concrete provides terminology related to different types of concrete.

Non-Destructive Testing of Concrete

Non-destructive test is a method of testing existing concrete structures to assess the strength and durability of concrete structures. In this method of testing, we can measure the strength of concrete without loading the specimen to failure (i.e. without destructing the concrete). Nowadays, this method has become a part of quality control process. It also helps us to investigate crack depth, micro cracks and deterioration of concrete.

Non-destructive testing of concrete is a very simple method of testing but it requires skilled and experienced person having some special knowledge to interpret and analyze test results.

Indian Standards related to NDT of concrete are:

a) IS 516 (Part 5/Sec 1): 2018 – Hardened concrete – Methods of Test Part 5 Non destructive testing of concrete Section 1 Ultrasonic Pulse velocity testing [Superseding IS 13311 (Part 1): 1992]

b) IS 516 (Part 5/Sec 4): 2020 – Hardened concrete – Methods of Test Part 5 Non destructive testing of concrete Section 4 Rebound hammer test [Superseding IS 13311 (Part 2): 1992]

Lime and Gypsum

Building lime and gypsum are two building materials used in construction. Lime is derived from calcium carbonate having chemical composition as $Ca(OH)_2$ (Calcium hydroxide) and has applications in mortar, plaster, concrete and water treatment. Gypsum is a soft sulphate mineral having chemical composition as $CaSO_4$ (Calcium sulphate) used in drywall, plaster and manufacturing of cement.

Indian Standards for Lime and Gypsum specifications are:

IS 712:1984 Specification for building limes (*third revision*)

IS 12679:2023 By-product gypsum for construction – Specification (*second revision*)

Indian Standards regarding various tests performed on lime and gypsum and their products are tabulated below:

SI. No.	IS No.	Title
1	IS 1624:1986	Methods of field testing of building lime (*second revision)*
2	IS 6932 (Part 1):1973	Methods of tests for building limes: Part 1 Determination of insoluble residue, loss on ignition, insoluble matter, silicone dioxide, ferric and aluminium oxide, calcium oxide and magnesium oxide
3	IS 6932 (Part 2):1973	Methods of tests for building limes: Part 2 Determination of carbon dioxide content
4	IS 6932 (Part 3):1973	Methods of tests for building limes: Part 3 Determination of residue on slaking of quicklime
5	IS 6932 (Part 4):1973	Methods of tests for building limes: Part 4 Determination of fineness of hydrated lime
6	IS 6932 (Part 5):1973	Methods of tests for building limes: Part 5 Determination of unhydrated oxide
7	IS 6932 (Part 6):1973	Methods of tests for building limes: Part 6 Determination of volume yield of quicklime
8	IS 6932 (Part 7):1973	Methods of tests for building limes: Part 7 Determination of compressive and transverse strength
9	IS 6932 (Part 8):1973	Methods of tests for building limes: Part 8 Determination of workability
10	IS 6932 (Part 9):1973	Methods of tests for building limes: Part 9 Determination of soundness
11	IS 6932 (Part 10):1973	Methods of tests for building limes: Part 10 Determination of popping and pitting of hydrated lime
12	IS 6932 (Part 11):1983	Methods of tests for building limes: Part 11 Determination of setting time of hydrated lime
13	IS 2542 (Part 1/Sec 1) : 2023	Gypsum Plaster, Concrete and Products — Methods of Test Part 1 Plaster and concrete Section 1 Determination of normal consistency of gypsum plaster (second revision)
14	IS 2542 (Part 1/Sec 2) : 2023	Gypsum Plaster, Concrete and Products — Methods of test Part 1 Plaster and concrete Section 2 Determination of normal consistency of gypsum concrete (second revision)
15	IS 2542 (Part 1/Sec 3) : 2023	Gypsum Plaster, Concrete and Products — Methods of Test Part 1 Plaster and Concrete Section 3 Determination of setting time of plaster and concrete (second revision)
16	IS 2542 (Part 1/Sec 4) : 2023	Gypsum Plaster, Concrete and Products — Methods of test Part 1 Plaster and concrete Section 4 Determination of transverse strength of gypsum plaster (second revision)
17	IS 2542 (Part 1/Sec 5) : 2023	Gypsum Plaster, Concrete and Products — Methods of test Part 1 Plaster and concrete Section 5 Determination of compressive strength and dry set density of gypsum plaster (second revision)

18	IS 2542 (Part 1/Sec 6) : 2023	Gypsum Plaster, Concrete and Products — Methods of test Part 1 Plaster and concrete Section 6 Determination of soundness of gypsum plaster (*second revision*)
19	IS 2542 (Part 1/Sec 7) : 2023	Gypsum Plaster, Concrete and Products — Methods of test Part 1 Plaster and concrete Section 7 Determination of impact resistance of gypsum plaster by dropping ball test (*second revision*)
20	IS 2542 (Part 1/Sec 8) : 2023	Gypsum plaster, concrete and products — Methods of Test Part 1 Plaster and Concrete Section 8 Determination of mass of coarse particles (*second revision*)
21	IS 2542 (Part 1/Sec 9) : 2023	Gypsum plaster, concrete and products — Methods of test Part 1 Plaster and concrete Section 9 Determination of expansion of gypsum plaster (*second revision*)
22	IS 2542 (Part 1/Sec 10) : 2023	Gypsum plaster, concrete and products — Methods of test Part 1 Plaster and concrete Section 10 Determination of sand in set gypsum plaster (*second revision*)
23	IS 2542 (Part 1/Sec 11) : 2023	Gypsum plaster, concrete and products — Methods of Test Part 1 Plaster and Concrete Section 11 Determination of wood fibre content in wood fibre gypsum plaster (*second revision*)
24	IS 2542 (Part 1/Sec 12) : 2023	Gypsum plaster, concrete and products — Methods of test Part 1 Plaster and concrete Section 12 Determination of dry bulk density (*second revision*)
25	IS 2542 (Part 1/Sec 13) : 2023	Gypsum plaster, concrete and products — Methods of test Part 1 Plaster and concrete Section 14 Determination of free water (*second revision*)
26	IS 2542 (Part 1/Sec 14) : 2023	Gypsum plaster, concrete and products — Methods of test Part 1 Plaster and concrete Section 14 Determination of fineness (*second revision*)

Bricks and Blocks

Bricks are the building block of any building or structure. They are generally manufactured from earthen clay. They are one of the cheapest building materials used in the construction industry. Bricks are manufactured in kilns. These are used to build walls, pavements and other masonry construction.

Normally, bricks contain the following ingredients:

1. Silica (sand) – 50% to 60% by weight
2. Alumina (clay) – 20% to 30% by weight
3. Lime – 2 to 5% by weight
4. Iron oxide – < 7% by weight
5. Magnesia – less than 1% by weight

Indian Standards regarding various tests performed on bricks are tabulated below:

SI. No.	IS No.	Title
1	IS 3495 (Parts 1):2019	Burnt clay building bricks - Methods of tests: Part 1 Determination of compressive strength (*fourth revision*)
2	IS 3495 (Parts 2):2019	Burnt clay building bricks - Methods of tests: Part 2 Determination of water absorption (*fourth revision*)
3	IS 3495 (Parts 3):2019	Burnt clay building bricks - Methods of tests: Part 3 Determination of efflorescence (*fourth revision*)
4	IS 3495 (Parts 4):2019	Burnt clay building bricks - Methods of tests: Part 4 Determination of warpage (*fourth revision*)
5	IS 3495 (Parts 5):2021	Burnt clay building bricks - Methods of test: Part 5 Determination of initial rate of absorption
6	IS 3495 (Parts 6):2022	Burnt clay building bricks — Method of test: Part 6 Determination of modulus of rupture

In India, bricks are manufactured in Bull's trench kilns. Manufacturing of bricks involves the following steps:

1) Preparation of earthen clay
2) Moulding of clay – can be hand moulded or machine moulded
3) Drying of raw bricks
4) Burning of bricks

Different types of bricks used in the construction industry are:

a) Solid bricks
b) Paving bricks
c) Hollow bricks
d) Refractory bricks
e) Autoclaved bricks
f) Sand lime bricks
g) Light weight bricks
h) Heavy duty bricks

SI. No.	IS No.	Title
1	IS 1077:1992	Common burnt clay building bricks – Specification (*fifth revision*)
2	IS 2180:1988	Specification for heavy duty burnt clay building bricks (*third revision*)
3	IS 2222:1991	Specification for burnt clay perforated building bricks (*fourth revision*)
4	IS 2691:2017	Burnt clay facing bricks – Specification (*third revision*)

5	IS 3583:1988 IS 3583:1988 (B) IS 3583:1988 (H)	Specification for burnt clay paving bricks (*second revision*)
6	IS 3952:2013	Specification for burnt clay hollow bricks and blocks for walls and partitions (*third revision*)
7	IS 4885:1988	Specification for sewer bricks (*first revision*)
8	IS 5779:1986	Specification for burnt clay soling bricks (*first revision*)
9	IS 13757:1993	Specification for burnt clay fly ash building bricks
10	IS 1725 : 2023	Stabilized Soil Blocks Used in General Building Construction — Specification (Third Revision)
11	IS 12894:2002	Pulverized fuel ash-lime bricks – Specification (*first revision*)
12	IS 16720:2018	Pulverized fuel ash-cement bricks – Specification
13	IS 15658:2021	Concrete blocks for paving – Specification (*first revision*)

Tiles

Tiles are most often made of ceramic, typically glazed for internal uses and unglazed for roofing, but other materials are also commonly used, such as glass, cork, concrete and other composite materials, and stone.

Tile manufacturing process involves four major steps:

1) Preparation of clay,
2) Moulding,
3) Drying, and
4) Burning.

Indian Standards on tiles are listed below:

SI. No.	**IS No.**	**Title**
1	IS 2690 (Part 1) : 2023	Burnt clay flat terracing tiles — Specification: Part 1 Machine made (*third revision*)
2	IS 2690 (Part 2) : 2023	Burnt clay flat terracing tiles — Specification: Part 2 Hand made (*third revision*)
3	IS 2691:2017	Burnt clay facing bricks – Specification (*third revision*)
4	IS 3367:2023	Burnt clay tiles for use in lining irrigation and drainage works — Specification (*third revision*)
5	IS 3951 (Part 1):2023	Hollow clay tiles for floors and roofs — Specification Part 1 Filler type (*third revision*)
6	IS 3951 (Part 2):2023	Hollow clay tiles for floors and roofs — Specification: Part 2 Structural type (*third revision*)

7	IS 6250:1981	Specification for roofing slate tiles (*first revision*)
8	IS 13317:2023	Clay roofing country tiles, half round and flat tiles — Specification (*first revision*)
9	IS 13630 (Parts 1):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 1 Determination of dimensions and surface quality (*second revision)*
10	IS 13630 (Part 2):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 2 Determination of water absorption and bulk density (*second revision)*
11	IS 13630 (Part 3):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 3 Determination of moisture expansion using boiling water (*second revision)*
12	IS 13630 (Part 4):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 4 Determination of linear thermal expansion (*second revision)*
13	IS 13630 (Part 5):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 5 Determination of resistance to thermal shock (*second revision)*
14	IS 13630 (Part 6):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 6 Determination of modulus of rupture and breaking strength (*second revision)*
15	IS 13630 (Part 7):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 7 Determination of chemical resistance unglazed tiles (*second revision)*
16	IS 13630 (Part 8):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 8 Determination of chemical resistance glazed tiles (*second revision)*
17	IS 13630 (Part 9):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 9 Determination of crazing resistance - glazed tiles (*second revision)*
18	IS 13630 (Part 10):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 10 Determination of frost resistance (*second revision)*
19	IS 13630 (Part 11):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 11 Determination of resistance of surface abrasion - Glazed tiles (*second revision)*
20	IS 13630 (Part 12):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 12 Determination of resistance to deep abrasion - Unglazed tiles (*second revision)*
21	IS 13630 (Part 13):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 13 Determination of scratch hardness of surface according to Mohs' scale (*second revision)*

22	IS 13630 (Part 14):2019	Ceramic tiles - Methods of Test, sampling and basis for acceptance: Part 14 Determination of impact resistance by measurement of coefficient of restitution (*first revision*)
23	IS 13630 (Part 15):2019	Ceramic tiles — Methods of Test, sampling and basis for acceptance: Part 15 Ceramic tiles sampling and basis for acceptance (*first revision*)
24	IS 13630 (Part 16):2019	Ceramic tiles — Methods of Test, sampling and basis for acceptance: Part 16 Determination of Lead and Cadmium Given off by glazed tiles
25	IS 13712:2019	Ceramic tiles — Definitions, classifications, characteristics and marking (*second revision)*
26	IS 13801:2013	Chequered cement concrete tiles — Specification (*first revision*)
27	IS 15477:2019	Adhesives for use with ceramic, mosaic and stone tiles — Specification (*first revision*)
28	IS 15622:2017	Pressed ceramic tiles — Specification (*first revision*)
29	IS 17190:2020	Grouts for filling of joints of tiles and stones — Specification
30	IS 17897 : 2022	Stone-polymer composite flooring tiles and planks — Specification

Following are the Indian Standards for adhesives for use with tiles and grouts for filling the joints of tiles and stones:

SI. No.	**IS No.**	**Title**
1	IS 15477:2019	Adhesives for use with ceramic, mosaic and stone tiles — Specification (*first revision*)
2	IS 17190:2020	Grouts for filling of joints of tiles and stones — Specification

Reinforcing and Prestressing Steel

The reinforcement bars (or rebars) are provided to impart ductility in concrete structures along with increasing its tensile strength. It comes in the form of bars (or rods) and wires. It is widely used in buildings, skyscrapers, bridges, warehouses, foundations, etc.

Steel is mainly used in two forms:

a) **Reinforcing steel:** This is mainly used in reinforced concrete elements like beams, columns, slabs, foundations etc. It is available in two forms – mild steel and HYSD bars. Example: Fe 250, Fe 415, Fe 500, Fe 550, etc.

b) **Prestressing Steel:** This is mainly used in prestressed or precast concrete structures like bridges, railway sleepers, electric poles, etc. This type of steel generally comes in the form of cables, tendons or strands. This has a high value of tensile strength in the range of 800 – 1200 MPa due to large amount of losses in pre-tensioning/ post-tensioning methods.

Indian Standards on reinforcing steel are listed below:

SI. No.	IS No.	Title
1	IS 432 (Part 1):1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars (*third revision*)
2	IS 432 (Part 2):1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 2 Hard-drawn steel wire (*third revision*)
3	IS 1566:1982	Specification for hard-drawn steel wire fabric for concrete reinforcement (*second revision*)
4	IS 1786:2008	High strength deformed steel bars and wires for concrete reinforcement – Specification (*fourth revision*) (superseding IS 1139:1966)
5	IS 16651:2017	High strength deformed stainless steel bars and wires for concrete reinforcement – Specification

Indian Standards on prestressing steel are list below:

SI. No.	IS No.	Title
1	IS 1785 (Part 1):1983	Specification for plain hard-drawn steel wire for prestressed concrete: Part 1 Cold-drawn stress relieved wire (*second revision*)
2	IS 1785 (Part 2):1983	Specification for plain hard-drawn steel wire for prestressed concrete: Part 2 As-drawn wire (*first revision*)
3	IS 2090:1983	Specification for high tensile steel bars used in prestressed concrete (*first revision*)
4	IS 6003:2010	Indented wire for prestressed concrete – Specification
5	IS 6006:2014	Uncoated stress relieved strand for prestressed concrete – Specification (*second revision*)
6	IS 16644:2018	Stress-relieved low relaxation steel wire for prestressed concrete – Specification
7	IS 14268:2022	Uncoated stress relieved low relaxation seven wire (ply) strand for prestressed concrete – Specification (*second revision*)

All the above mentioned standards on mild steel, HYSD steel and prestressed steel give details about the manufacturing, physical and chemical composition of the rebars, and test requirements of the bars.

Steel bars are manufactured in the plant in standard sizes and length. For increasing the length of the rebars, either welding or mechanical couplers are used.

- **IS 16172: 2014** – Reinforcement couplers for mechanical splices of bars in concrete – Specification
- **IS 9417: 2018** – Welding of high strength steel bars for reinforced concrete construction – Recommendations (*second revision*)

Various mechanical properties of reinforcement steel are:

1. Physical properties which includes Ultimate tensile strength, yield strength, percentage elongation, 0.2 percent proof stress (in case of HYSD bar), UTS/YS ratio.
2. Tensile tests
3. Bend/ Rebend test
4. Chemical composition test
5. Free from Defects

Provisions for mechanical properties of wires and bars are given in IS 432 (Parts 1 and 2 respectively; for HYSD bars are given in IS 1786.

The mechanical properties of prestressing steel includes:

1. Physical properties which include breaking strength, elongation after fracture, relaxation, ductility and proof stress.
2. Tensile test
3. Reverse bend test
4. Chemical composition

Provisions for mechanical properties of wires and strands are given in IS 6003 and IS 14268 respectively.

Following standards relates to structural steel:

- **IS 811: 1987** – Specification for cold formed structural steel sections (*second revision*)
- **IS 2062: 2011** – Hot rolled medium and high tensile structural steel (*seventh revision*)

BIS has also formulated Special Publications for classification and details regarding steel sections used in the industry as listed below:

- SP (Part 4): 1969 – Handbook for structural engineers: Part 4 Use of high strength friction grip bolts
- SP (Part 5): 1980 – Handbook for structural engineers: Part 5 Cold-formed, light gauge steel structures (first revision)
- SP (Part 6): 1972 – Handbook for structural engineers: Part 6 Application of plastic theory in design of steel structures

Timber, Bamboo and Lignocellulosic Panel Products

Timber is a finished wood product which is obtained from deciduous trees and used for building houses, furniture products etc.

IS 399: 1963 deals with classification of timber based on different purposes such as:

a) Constructional purposes, including building construction, house-posts, beams, rafters, cart-building, bridges, piles, poles and railway sleepers.
b) Furniture land cabinet making.
c) Light packing cases.
d) Heavy packing cases (for machinery and similar stores)
e) Agricultural implements and tool handles.
f) Turnery articles and toys.
g) Veneers and plywood.

Seasoning of timber is a process of reducing the moisture content in timber to a desired level. A well-seasoned timber has more strength, stiffness, elasticity and is more durable. Seasoning of timber also prevents it from attack from insects and rodents. IS 1141: 1993 deals with seasoning of timber.

Preservation of timber is a method of reducing the deterioration and increasing the service life of timber. It prevents the timber from the attack of insects, worms, fungi, rodents etc. IS 401: 2001 deals with preservation of timber.

Different types of preservatives used for timber are as follows:

a) Oil type
b) Organic solvent type
c) Water soluble type
d) Water soluble (Leachable type)
e) Water soluble (Fixed type)

The standards dealing with preservation and types of preservatives are listed below:

Sl. No.	**IS No.**	**Title**
1	IS 401:2001	Preservation of timber - Code of practice (*fourth revision*)
2	IS 10013 (Part 1):1981	Specification for water soluble type wood preservatives: Part 1 Acid-copper-chrome (ACC) preservative
3	IS 10013 (Part 2):1981	Specification for water soluble type wood preservatives: Part 2 Copper-chrome-arsenic (CCA) wood preservative
4	IS 10013 (Part 3):1981	Specification for water soluble type wood preservatives: Part 3 Copper-chrome-boron (CCB) wood preservative
5	IS 10753:1983	Code of practice for preservation of wooden sleepers for railway track by pressure treatment
6	IS 9096:2006	Preservation of bamboo for structural purposes - Code of practice (*first revision*)

Various standards on timber, bamboo and lignocellulosic panel products are:

SI. No.	IS No.	Title
1	IS 190:1991	Coniferous sawn timber (Baulks and scantlings) – Specification (*fourth revision*)
2	IS 1003 (Part 1):2003	Timber panelled and glazed shutters – Specification: Part 1 Door shutters (*fourth revision*)
3	IS 1003 (Part 2):1994	Timber panelled and glazed shutters – Specification: Part 2 Window and ventilator shutters (*third revision*)
4	IS 1326:1992	Non-coniferous sawn timber (Baulks and scantling) – Specification (*second revision*)
5	IS 13622:1993	Indian timbers for furniture and cabinets - Classification
6	IS 4021:1995	Specification for timber door, window and ventilator frames (*third revision*)
7	IS 2191 (Part 1) : 2022	Wooden Flush Door Shutters (Cellular, Hollow and Tubular Core Type) — Specification Part 1 Plywood Face Panels (Fifth Revision)
8	IS 2191 (Part 2):2022	Wooden Flush Doors Shutters (Cellular, Hollo and Tubular Core Type) – Specification Part 2 Particle Board, High Density Fibre Board, Medium Density Fibre Board and Fibre Hardboard Face Panels (*Fourth revision*)
9	IS 2202 (Part 1):1999	Specification for wooden flush door shutters (solid core type): Part 1 Plywood face panels (*sixth revision*)
10	IS 2202 (Part 2) : 2022	Wooden Flush Door Shutters (Solid Core Type) — Specification Part 2 Particle Board, High Density Fibre Board, Medium Density Fibre Board and Fibre Hardboard Face Panels (*Fourth revision*)
11	IS 15380:2023	Moulded raised high density fibre (HDF) panelled doors – Specification (*first revision*)
12	IS 303:1989	Plywood for general purposes – Specification (*third revision*)
13	IS 652:1960	Specification for wooden separators for lead-acid storage batteries
14	IS 709:1974	Specification for medium strength aircraft plywood (*first revision*)
15	IS 710:2010	Marine plywood – Specification (*second revision*)
16	IS 1328:1996	Veneered decorative plywood – Specification (*third revision*)
17	IS 1658:2006	Fibre hardboards – Specification (*third revision*)
18	IS 1659:2004	Block boards – Specification (*fourth revision*)
19	IS 3087:2005	Particle boards of wood and other lignocellulosic materials (medium density) for general purposes – Specification (*second revision)*

20	IS 3097:2006	Veneered particle boards – Specification (*second revision)*
21	IS 3129:1985	Specification for low density particle boards (*first revision*)
22	IS 3308:1981	Specification for wood wool building slabs (*first revision*)
23	IS 3348:1965	Specification for fibre insulation boards
24	IS 3478:1966	Specification for high density wood particle boards
25	IS 3513 (Part 1):1989	Specification for resin treated compressed wood laminates (compregs): Part 1 For electrical purposes (*first revision*)
26	IS 3513 (Part 2):1989	Specification for resin treated compressed wood laminates (compregs): Part 2 For chemical purposes (*first revision*)
27	IS 3513 (Part 3):1989	Specification for resin treated compressed wood laminates (compregs): Part 3 For general purposes (*first revision*)
28	IS 3513 (Part 4):1966	Specification for resin treated compressed wood laminates (compreg): Part 4 Sampling and tests
29	IS 4834:1968	Specification for veneered-wood boards for packing cases
30	IS 4835:1979	Specification for polyvinyl acetate dispersion based adhesives for wood (*first revision*)
31	IS 4859:1968	Specification for high strength aircraft plywood
32	IS 4990:2011	Plywood for concrete shuttering works – Specification (*third revision*)
33	IS 5509:2021	Fire retardant plywood – Specification (*third revision*)
34	IS 5539:1969	Specification for preservative treated plywood
35	IS 7316:1974	Specification for decorative plywood using plurality of veneers for decorative faces
36	IS 10701:2012	Structural plywood – Specification (*first revision*)
37	IS 12406:2021	Medium density fibre boards for general purpose – Specification (*second revision)*
38	IS 12823:2015	Prelaminated particle boards from wood and other Iignocellulosic material – Specification (*first revision)*
39	IS 13957:1994	Metal faced plywood – Specification
40	IS 13958:1994	Bamboo mat board for general purposes – Specification
41	IS 14276:2016	Cement bonded particle boards – Specification (*first revision*)
42	IS 14315:1995	Commercial veneers – Specification
43	IS 14587:2023	Prelaminated medium density fibre board – Specification (*first revision*)
44	IS 14588:1999	Bamboo mat-veneer composite for general purposes – Specification
45	IS 14616:1999	Laminated veneer lumber – Specification

46	IS 14842:2000	Coir veneer board for general purposes – Specification
47	IS 15476:2004	Bamboo mat corrugated sheets – Specification
48	IS 15491:2004	Medium density coirboards for general purposes – Specification
49	IS 15786:2008	Prelaminated cement bonded particle board – Specification
50	IS 15791:2007	Museum plywood – Specification
51	IS 15877:2010	Coir faced block boards – Specification
52	IS 15878:2010	Coir hardboard for general purposes – Specification
53	IS 15972:2012	Bamboo-Jute corrugated and semi-corrugated sheets – Specification
54	IS 16171:2014	Veneer laminated lumber – Specification
55	IS 17571:2021	Flattened bamboo board – Specification
56	IS 17572:2022	BWP grade bamboo mat-veneer composite board — Specification
57	IS 17573:2021	BWP grade bamboo mat board – Specification

Stones

Stones are obtained from rocks which forms part of the earth's crust and composed of two or more minerals. These are used in building construction works such as foundation of structures, stone masonry, coarse aggregates for concrete mix, etc.

Indian Standards providing specifications for various types of stones are as follows:

SI. No.	**IS No.**	**Title**
1	IS 1128:1974	Specification for limestone (slab and tiles) (*first revision*)
2	IS 1130:1969	Specification for marble (blocks, slabs and tiles)
3	IS 3316:1974	Specification for structural granite (*first revision*)
4	IS 3620:1979	Specification for laterite stone block for masonry (*first revision*)
5	IS 3622:1977	Specification for sandstone (slabs and tiles) (*first revision*)
6	IS 6250:1981	Specification for roofing slate tiles (*first revision*)
7	IS 6579:1981	Specification for coarse aggregate for water bound macadam (*first revision*)
8	IS 9394:1979	Specification for stone lintels
9	IS 14223 (Part 1):2023	Polished building stones – Specification: Part 1 Granite and Similar Stones (*first revision*)

Following tests are performed on stones for testing their quality and strength:

a) Compressive strength
b) Tensile strength
c) Transverse strength

d) Shear strength
e) True specific gravity
f) Water absorption and porosity
g) Weathering
h) Durability
i) Abrasion resistance
j) Water transmission rate by capillary action
k) Surface softening by exposure to acidic atmospheres
l) Permeability
m) Toughness

Glass

Glass is a solid material formed by rapid cooling of molten silica (sand). It is a transparent, hard, brittle and impervious material. It is widely used for aesthetic or decorative looks like in building construction, housewares and telecommunications.

IS 14900 : 2018 specifies the requirements of transparent float glass.

IS 2553 (Part 1) : 2018 covers the specification for safety glass for architectural building and general uses.

IS 16231 deals with the use of glass in buildings. Its various parts are:

Part 1: 2019 – General methodology for selection (*first revision*)
Part 2: 2019 – Energy and light (*first revision*)
Part 3: 2019 – Fire and loading (*first revision*)
Part 4: 2019 – Safety related to human impact (*first revision*)

Innovative Materials for use in building construction

1. Geosynthetics and Geopolymers

These are the synthetic materials which are mainly used in soil stabilization due to their high durability. They have a large number of civil engineering applications such as roads, embankments, dams, retaining walls, canals, reservoirs, etc.

Indian Standards dealing with geosynthetics and geopolymers are listed below:

SI. No.	IS No.	Title
1.	IS 17369 (Part 1) : 2020 (Part 2) : 2020	Geotextiles and geotextile related products – Strength of internal structural junctions Geo composites Geocells
2.	IS 14716 : 2021	Geosynthetics - Test method for the determination of mass per unit area of geotextiles and geotextile-related products
3.	IS 14714 : 1999	Geotextiles – Determination of abrasion resistance

4.	IS 14706 : 1999	Geotextiles – Sampling and preparation of test specimens
5.	IS 14293 : 1995	Geotextiles – Method of test for trapezoid tearing strength
6.	IS 14715 (Part 1) : 2016	Jute geotextiles - Part 1 Strengthening of sub-grade in roads – Specification second revision
7.	IS 14715 (Part 2) : 2016	Jute geotextiles - Part 2 Control of bank erosion in rivers and waterways – Specification second revision
8.	IS 14986 : 2001	Guidelines for application of jute geotextile for rain water erosion control in road and railway embankments and hill slopes
9.	IS 15869 : 2020	Textiles Open weave coir Bhoovastra – Specification (*first revision*)
10.	IS 15910 : 2010	Geosynthetics - for highways – Specification
11.	IS 16090 : 2013	Geo-synthetics - Geo-textiles used as protection or cushioning materials – Specification
12.	IS 16352 : 2020	Geosynthetics High density polyethylene HDPE geomembranes for lining – Specification first revision
13.	IS 16362 : 2020	Geosynthetics - Geotextiles used in subgrade stabilization in pavement structures – Specification first revision
14.	IS 16391 : 2015	Geosynthetics - Geotextiles used in sub-grade separation in pavement structures – Specification
15.	IS 16392 : 2015	Geosynthetics - Geotextiles for permanent erosion control in hard armor systems – Specification
16.	IS 16393 : 2015	Geosynthetics - Geotextiles used in subsurface drainage application – Specification
17.	IS 16653 : 2017	Geosynthetics - Needle punched nonwoven geobags for coastal and waterways protection – Specification
18.	IS 16654 : 2017	Geosynthetics - Polypropylene multifilament woven geobags for coastal and waterways protection – Specification
19.	IS 17371 : 2020	Geosynthetics Geogrids for flexible pavements – Specification
20.	IS 17372 : 2020	Geosynthetics Polymeric strip geostrip used as soil reinforcement in retaining structures – Specification
21.	IS 17373 : 2020	Geosynthetics - Geogrids used in reinforced soil retaining structures – Specification
22.	IS 17374 : 2020	Geosynthetics Reinforced HDPE membrane for effluents and chemical resistance lining – Specification
23.	IS 17483 (Part 1) : 2020	Geosynthetics - Geocells – Specification Part 1 Load Bearing Application
24.	IS 17483 (Part 2) : 2020	Geosynthetics - Geocells – Specification Part 2 Slope Erosion Protection Application

25.	IS 17880 : 2022	Geosynthetics Polymer Gabions for Coastal and Waterways Protection – Specification
26.	IS 18309 : 2023	Geosynthetics- Prefabricated Vertical Drains for Quick Consolidation for Very Soft Plastic Soil – Specification

2. Fiber Reinforced Composites

These are the composite materials reinforced with fibers of synthetic or natural materials. They offer not only high strength to weight ratio but also exhibit exceptional properties such as high durability, stiffness, damping property, flexural strength, resistance to corrosion, wear, impact and fire etc. Due to these diverse features, FRCs has find wide range of applications in construction, automation, mechanical, aerospace, biomedical, marine and many other industries.

Fiber reinforced concrete and fiber based cement are the recent advancements in the concrete technology which possess lot of advantages over the conventional concrete. Few relevant standards are :

IS 14862: 2000 – Fibre cement flat sheets – Specification

IS 14871: 2000 – Products in fibre reinforced cement – Long corrugated or asymmetrical section sheets and fittings for roofing and cladding – Specification

IS 17161: **2020** – Flexural strength and toughness parameters of fibre reinforced concrete – Method of test

Recently Developed Indian Standards on Building Materials

SI. No.	IS No.	Title
1.	IS 17650 (Part 1):2021	Water efficient plumbing products - Requirements: Part 1 Sanitaryware
2.	IS 17650 (Part 2):2021	Water efficient plumbing products - Requirements: Part 2 Sanitary fittings
3.	IS 17400:2021	Glass fibre reinforced gypsum panels – Specification
4.	IS 17682: 2021	Aluminium composite panel – Specification
5.	IS 17953 : 2023	UPVC profiles for windows and doors — Specification
6.	IS 17296:2020	Stainless steel door stoppers – Specification
7.	IS 17706:2022	Pull handles – Specification
8.	IS 17544:2022	Multilayer (PE-AL-PE) plastic piping system for indoor gas installations with a maximum operating pressure up to and including 500 KPA (5 Bar) – Specification
9.	IS 17546:2021	Chlorinated polyvinyl chloride (CPVC) fittings for potable hot and cold water distribution supplies – Specification
10.	IS 17452:2020	Use of alkali activated concrete for precast products – Guidelines
11.	IS 17725:2022	Precast concrete circular manhole – Specification

12.	IS 18255:2023	Fibre-reinforced polymer (FRP) bars for concrete reinforcement – Methods of tests
13.	IS 18256:2023	Solid round glass fibre reinforced polymer (GFRP) bars for concrete reinforcement – Specification

Aspects from National Building Code of India 2016

The National Building Code of India is a single document in which, like a network, the information contained in various Indian Standards is woven into a pattern of continuity and cogency with the interdependent requirements of Parts/Sections carefully analyzed and fitted in to make the whole document a cogent continuous volume. The first version of the Code was published in 1970 and revised in 1983 and in 2005. A vigorous implementation drive was launched by the then Indian Standards Institution and now by Bureau of Indian Standards to propagate the contents and use of the Code among all concerned in the field of planning, designing and construction activities. Two amendments were issued to the 2005 version of the Code in 2015; first to include a new chapter relating to sustainability namely, Part 11 'Approach to Sustainability', and the second to modify/include certain provisions in Part 4 'Fire and Life Safety'.

The Code contains regulations which can be immediately adopted or enacted for use by various departments, municipal administrations and public bodies. It lays down a set of minimum provisions designed to protect the safety of the public with regard to structural sufficiency, fire hazards and health aspects of buildings; so long as these basic requirements are met, the choice of materials and methods of design and construction are left to the ingenuity of the building professionals. The Code also covers aspects of administrative provisions, development control rules and general building requirements; fire safety requirements; stipulations regarding materials and structural design; rules for design of electrical installations, lighting, air conditioning and heating, installation of lifts; provisions for ventilation, acoustics and plumbing services, such as water supply, drainage, sanitation and gas supply; measures to ensure safety of workers and public during construction; and rules for erection of signs and outdoor display structures. The Code today also covers provisions relating to structural use of glass; escalators and moving walks; information and communications enabled installations; solid waste management; landscape planning and design; and asset and facility management.

NBC 2016 comprises of two volumes, i.e. Volume 1 and 2 which are divided into 13 Parts from 0 to 12. Part 5 'Building Materials' of NBC 2016 (*see* Volume 1) covers the requirements of building materials and components, and criteria for accepting new or alternative building materials and components.

New or Alternative Materials

For the purpose of selecting new or alternative building materials, following parameters shall be taken into account:

a) Requirements of the material specified/expected in terms of the provisions given in the standards on its usage, including its applicability in geo-climatic condition;

b) General appearance;
c) Dimension and dimensional stability;
d) Structural stability including strength properties;
e) Fire safety;
f) Durability;
g) Thermal properties;
h) Mechanical properties;

j) Acoustical properties;
k) Optical properties;
m) Biological effect;
n) Environmental aspects;
p) Working characteristics;
q) Ease of handling;
r) Consistency and workability;
s) UV resistance; and
t) Toxicity.

Some of such new/alternative materials may be ferrocement, decorative concrete, polymer concrete, micro-concrete repair materials, dry-mix mortar, non-shrink grout, optical fibres, special materials for bunkers/blast resistant structures, artificial stones used in restoration of heritage structures, nanotechnology based advanced materials, vermiculite based boards, exfoliated perlite, pervious concrete, stainless steel insulated water tanks, etc.

Sustainability Aspects

Part 11 'Approach to Sustainability' of NBC 2016 covers the parameters required to be considered for planning, design, construction, operation and maintenance of buildings and those relating to land development, from sustainability point of view.

Various Approach to Achieve Sustainability

- Need for Sustainable Development
- Elements of Sustainability
- Life Cycle Sustenance
- Energy Efficient Design and Processes
- Technology Options
- Reduced Embodied and Operational Energy
- Integrated Water Management
- Operation and Maintenance of Services
- Monitoring Compliances
- Corporate Governance
- Disaster Preparedness

This chapter of NBC 2016 also covers provisions on sustainable building materials.

How to Download Indigenous Indian Standards

To download your own copy of indigenous Indian Standards free of cost, visit the link given below:

https://standardsbis.bsbedge.com/

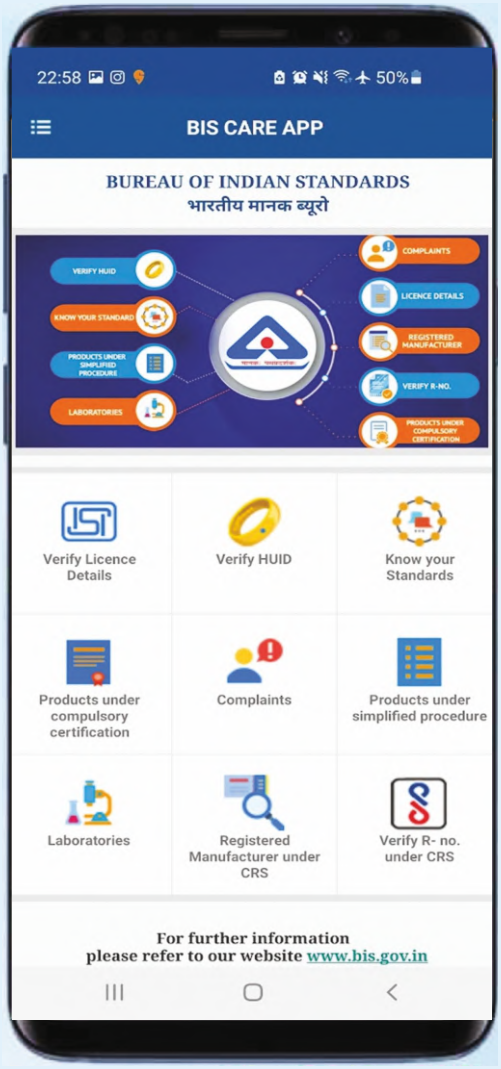
For further information and details, please write to:

Head (Civil Engg)
Bureau of Indian Standards
Manak Bhavan
9 Bahadur Shah Zafar Marg
NEW DELHI 110 002

Phone: 011 – 2323 5529
Mob: 9355898266
e-mail: ced@bis.gov.in
Website: www.bis.gov.in

Other Useful References

BIS Talks on Civil Engineering	
BIS Talks on Ready Mixed Concrete (RMC)	
Guide for Using National Building Code of India 2016	
Guide for Homeowners Series 1 Building Permit Process Series 2 Constructing your Independent House Series 3 Buying an Apartment from a Developer/ Builder	



Download BIS CARE APP

From Play Store/Apple Store

BIS CARE APP

A tool for Consumer Empowerment

Main features of the App

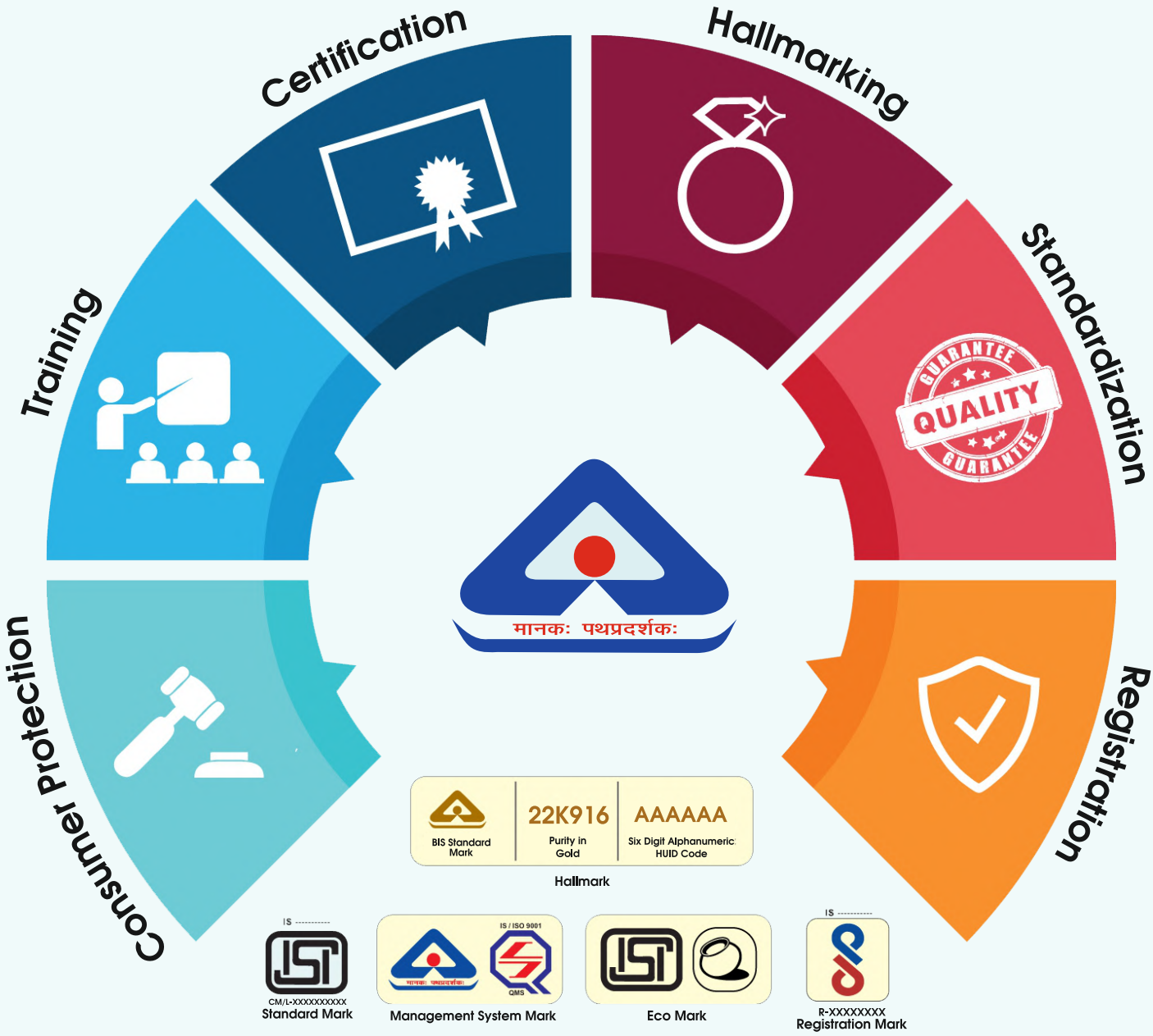
- Check the authenticity of the product with Standard mark by using 'Verify Licence Details'.
- Check the authenticity of Hallmarked Jewellery items with HUID number by using 'verify HUID'.
- Select 'Know your Standards' for information on any Indian Standard, licenses against it and laboratories for this product.
- Check the authenticity of electronic products with R-number by using 'Verify R-number' under CRS.
- Register complaints regarding quality of product or misuse of mark by using 'Complaints'.

मानकः पथप्रदर्शकः

Bureau of Indian Standards

www.bis.gov.in

76 years of serving the Nation



BUREAU OF INDIAN STANDARDS

Civil Engineering Department

Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi-110 002

Email: ced@bis.gov.in

Phone No: 011-2323 5529

Download **BIS Care app**

GET IT ON Google Play | Download on the App Store

www.bis.gov.in

www.manakonline.in

Indigenous Indian Standards can be downloaded free of cost by visiting the URL: **https://standardsbis.bsbedge.com**

/ @IndianStandards

/ Bureau of Indian Standards

Scan this QR Code to download e-book