

STRATEGIC ROAD MAP OF CIVIL ENGINEERING DIVISION COUNCIL OF BIS

EXECUTIVE SUMMARY

As a developing country, India has embarked upon large scale measures for accelerating the overall development, be it related to industry, education, housing, healthcare, transportation, hospitality, commerce or defence. A common requirement for all these, however, is of world-class buildings and infrastructure development.

For the requisite quality of ongoing development and rapid urbanization, it is imperative to ensure availability of matching standards on all relevant areas.

In the area of Civil Engineering, so far around 1,800 Indian Standards have been formulated under the aegis of the Civil Engineering Division Council (CEDC) covering areas such as planning and functional requirements; building materials and construction technologies; structural design and disaster resilience of structures and developments; fire safety; good and safe construction practices; and various building and plumbing services. There has also been focus on waste utilization, energy conservation, low income housing, sustainability and accessibility to ensure harmonious and inclusive development. Apart from the standards, a number of Special Publications (SPs) such as Handbooks, Explanatory Handbooks and Design Aids including the National Building Code of India (NBC) have been published. All these standardization efforts have been made since last many decades through various Sectional Committees constituted under the Division Council. These standards have been extensively used by the buildings' regulatory bodies; government construction departments and agencies; including PWDs and housing boards, private construction agencies like builders, developers and contractors, building material manufacturers and suppliers; building professionals and consultants like architects, civil and structural engineers, town planners, landscape architects, building services engineers, fire personnel, and accessibility and sustainability consultants. These have also been used by R&D institutions in their research and development activities and testing laboratories engaged in testing of various building materials and components. Also, these standards, specially the Concrete Codes, Steel Design Code, Timber Design Code and NBC have been an integral part of education in engineering and architecture.

This strategic Road Map document reflects the vision of national standardization in civil engineering and provides a broad standardization road map with a five-year perspective. It covers an up-to-date overview of the Division Council's work that would form the basis for the Sectional Committees working under the Council. It intends to form the basis for the Sectional Committees functioning under the Division Council to in turn develop their respective Standardization Plan which can be shared with all

interested stakeholders. The objective is, thus, to provide a structured guiding document for standardization to facilitate seamlessly working towards development of national standards to meet the challenges and give a push to world-class development and construction activities which promotes orderly, safe, accessible and sustainable development and improved quality of life.

1. INTRODUCTION

The Bureau of Indian Standards (BIS), as the National Standards Body (NSB) of the country is engaged in harmonious development of standards at national level, apart from conformity assessment, laboratory services, etc. BIS is engaged in standards formulation in almost all sectors of economy and technology. In the area of civil engineering, the standardization is done through its Civil Engineering Division Council, CEDC. The CEDC achieves these objectives through various Sectional Committees functioning under it. At present, there are 38 Sectional Committees catering to various sub-domains under civil engineering. These are listed at Annex A.

During the last around seven decades, the Council has been able to bring out over 1,800 Indian Standards in the following broad areas:

- a)** Planning and functional requirements
- b)** Building materials and components including their testing and test equipment
- c)** Geo-technical engineering
- d)** Structural design and disaster resilient structures and development, including safety against natural disasters like earthquake, landslide and cyclone
- e)** Fire fighting and fire safety
- f)** Good construction practices including safety during construction
- g)** Construction project management
- h)** Building services, like lighting, ventilation and acoustics
- i)** Public health engineering including plumbing services, such as water supply drainage and sanitation
- j)** Measurement of works
- k)** Special structures like composite structures, tall buildings, broadcasting/transmission line towers, cooling towers, water tanks, bins, silos, ports and harbours, off-shore installations, etc.

The country is on the path of rapid development and urbanization. There is a changing priority where large scale buildings and world-class infrastructure has to be put in place to support the current development push being given in the country. This cannot be done without adhering to highest level of quality standards. Further, all developments have to be inclusive, accessible and sustainable. It is, therefore, imperative to revise

the work under the Division Council and plan and reset the scope, priorities and pace after understanding the national and stakeholder needs.

Accordingly, this Strategic Road Map has been developed to reflect the vision of national standardization in Civil Engineering and provide a broad standardization road map with a five-year perspective. It covers up-to-date overview of the Division Council's work that would form the basis for the Sectional Committees working under the Council, to in turn develop their respective Standardization Plan, which can be shared with all interested stakeholders.

The aim is to align the work programme of all Sectional Committees under the Council with the business environment needs and trends and encourage the committees to plan their work, priorities among different projects, identify the benefits expected from the availability of national standards, and to ensure adequate expertise for the projects for their development.

The Road Map covers main objectives and current strategies taking into consideration the economic, social and environment aspects, as applicable to all Sectional Committees under the Council.

Today, the building materials have proliferated with diverse features, finishes and applications, needing more emphasis on performance based approach over the prescription based. Lots of new and innovative building materials, ready-to-use materials, ready-to-assemble articles, etc have come up, needing different approach for their standardization. The prefabricated and pre-engineered construction through mechanization needs to be promoted for better quality and increased pace of construction. Use of various softwares and expert systems/tools like Building Information Modeling (BIM) and Building Management System (BMS) should be promoted for better and faster and systemized planning, design, construction and their management, specially as more and more complexities are setting in today's construction projects. Today, there is in-depth knowledge of behavior of structures and the loads, forces and effects to be withstood by them. All such knowledge acquired needs to be brought under the fold of standardization for more efficient, comfortable and safe constructions. The national priorities to promote industrial development, investment and trade including exports also need to be facilitated. The Strategic Road Map captures all these important inputs to standardization.

Then, there are 17 Sustainable Development Goals (SDGs) set forth by the United Nations to be achieved by 2030. India is signatory to the document. The Road Map identifies the potential areas under different SDGs where we can play a role by formulating or aligning Indian Standards in consonance with SDG Objectives. This

Road Map addresses these aspects too including the relevance of smart and sustainable development of habitats in addressing them.

2. BUSINESS ENVIRONMENT, GOVERNMENT PRIORITIES TECHNOLOGICAL DEVELOPMENTS AND INNOVATIONS, AND STAKEHOLDER CONCENS

The various broad areas in Civil Engineering, on objective reveal that there are various areas which need a renewed focus of standardization to promote right materials or technologies or systems. Following are such areas which are enlisted along with the benefits expected through standardization, the challenges in implementation and the involvement of expertise necessary for developing the standards.

a) Building Materials and Technologies

Over the years, building materials have undergone large scale transformation including their strength, durability, performance and absorbing wastes/by-products. For example, concrete can be now made with very high strength that was unimaginable earlier through suitable mix proportioning using mineral and chemical admixtures including very fine materials as part of the blends. Various composite materials with varied combinations of materials out of cement, wood or other lignocellulosic materials, stone waste, polymers, etc can now be made successfully including the wastes/by-products like fly ash from thermal power plants, iron slag and steel slag from iron and steel industries phoso-gypsum from phosphoric acid, manufacturing fluoro-gypsum from hydrofluoric acid manufacturing from common salt manufacturing, sulpho-gypsum (FGD gypsum) from desulphurization of flue gases in power plants, red mud from aluminium industry, stone waste pieces/powder, wood and agro-wastes, etc. Research and development has realized the true potential of these materials. Continuous programme of standardization, characterizing these materials and the finished products using these needs to be taken up.

Water continues to be a scarce resource. The existing standards need to be reviewed for bringing innovative requirements to save water. This can be achieved for example, by use of sensor based taps, use of aerators and other water saving devices, water efficient design of fittings and sanitary appliances, etc.

Use of alternative building materials and components where timber, steel, glass, plastics and composite materials can be used with equal efficiency and performance, needs to be explored in all cases so as to promote competing technologies. This development is a continuous process and cannot sustain unless duly supported by standards.

The construction technologies have enormous scope for innovation. From the conventional timber, stone, brick and mud-based construction, research and innovation paved the way for steel and concrete based construction. Bricks and stone blocks are being increasingly replaced by concrete blocks and fly ash based bricks and blocks. Advantages, such as light-weight, factory-made quality and fly ash utilization encouraged use of such materials. Similarly, use of soil based technologies with cement as binding material has shown potential. Use of cold-formed light gauge steel structural members for pre-engineered buildings and glass fibre reinforced gypsum (GFRG) panel building technologies have potential yet to be fully realized.

Also, for quite some time the prefabricated concrete construction technology has been tried in the country but the same has not yet reached the desired level of implementation. There are number of Indian Standards on prefabricated building elements including partial prefab concrete components, already developed along with the main code of practice for design and construction encompassing safety features such as prevention of progressive collapse.

While Indian Standards have been formulated on most of the above areas to promote waste utilization, and newer materials and technologies, it is to be borne in mind that innovation is an ongoing development. There are lot of research going on in the country and abroad in continuous manner, and unless these are absorbed into the standards, the real fruits of R&D cannot be effectively passed on to the masses. The Sectional Committees have to be, therefore, vigilant and remain keen responsive to all these development.

b) Prescription Versus Performance Based Approach

Traditionally standardization in the country largely adopted the prescription route to characterize the materials using prescription of species of timber, size of sections, thicknesses, safety factors, etc and so has been the case with design of components of structures. Over the period, it was found that many of the quality parameters can better be explained through performance requirements. However, it is convenient to lay down certain requirements based on prescription as it remains as an easy tool for implementation. Hence, most of the standards during last few decades use a mix of prescriptive and performance approach. However, the materials and components are becoming proliferated due to increasing options of appropriate materials and designs, which can be used interchangeably. It is becoming increasingly difficult to prescribe each combination of materials or design requirements. The current approach has to

be, therefore, to encourage performance based standards to the extent desirable after studying each case. This allows material-independent products or designs, or permits more innovation within a set of materials used. It also obviates the pain involved in development of standards for each combination of materials/designs. The material or technology supplier is also able to improve designs more frequently paving the way for more innovative products and technologies. In performance approach, the ultimate application is kept in mind and ensured through the performance requirements for fitness for purpose, safety stability, durability, comfort, etc as the case may be.

c) Promotion of Industries//Vendors and Experts

Development of manufacturing industries is key to industrial development, employment generation and export promotion. This entails development of need based standards that help improve quality of products and thus their marketing and acceptance. Each such case for which standards are yet to be developed needs to be identified and quickly brought under the fold of standardization. Further, to bring economies of scale, it is imperative to encourage vendor development who could specialize in manufacture of certain components and supply to the main manufacturer. This will ensure quality of the components within strict tolerances along with cost reduction. The main manufacturer can concentrate on overall quality and production of cheaper goods. This will make him competitive and help promote his exports. All this could be facilitated through development of separate component-wise standards and BIS Certification against the same. Also, efforts should be made to explore possibility of standards with international standards particularly in areas where there is substantial potential for export.

d) Accessibility in Built Environment

Accessibility deals with the requirements for barrier free access to, movement within and around buildings and in built environment, by the persons with disabilities and the elderly. This is particularly important in public buildings. The disabilities could be difficulty in walking, reliance on walking/mobility aids, blindness and visual impairments, speech and hearing impairments, incoordination of motor movements, etc. The goal of barrier free design is to provide an environment that supports the independent functioning of individuals so that they can participate without assistance, in everyday activities. It will be much better to rather pursue with the concept of universal design that promotes the usability of built environment by all without discrimination. *The Persons with*

Disabilities Act, 2016 mandates accessibility in public buildings and transportation system. In pursuance to all these, the National Building Code of India (2016) gives an exhaustive treatment to the provisions of accessibility. This needs to be complemented with standards on flooring with anti-skid properties, tactile ground surface indicator (TGSi) direction and warning tiles, door handles and knobs facilitating ease of operation, accessible installation of fittings and equipment such as water, sanitary and electrical fittings, sensor operated fittings, and doors, etc. Use of Braille, accessible marking on packaging, and use of addressable systems and IT tools facilitates easy access to information.

3. UNITED NATION'S SUSTAINABLE DEVELOPMENT GOALS

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a blueprint for peace and prosperity of people and the planet, now and in the future. Under this, it sets forth the following 17 Sustainable Development Goals (SDGs):

1. No poverty
2. Zero hunger
3. Good health and well-being
4. Quality education
5. Gender equality
6. Clean Water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure
10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice and strong institutions
17. Partnership for the goals

Building and construction sector directly or indirectly can help achieve many of these goals. This Division Council can have particular interest in SDG 5, 6, 7, 10, 11 and 13. There are number of standards available on recycling and waste utilization. However, there is potential to improve upon the same as well as bring more such materials into the mainstream.

The NBC 2016 in its Part 11 'Approach to Sustainability' deals with overall approach towards achieving sustainability in built environment by addressing the siting, form and design; external development, and landscape; envelope optimization; materials; water and waste management; building services optimization, construction practices; and commissioning, operation, maintenance and building performance tracking. NBC 2016 and the corresponding Indian Standards also extensively deals with accessibility issues, habitat and welfare requirements for construction workers, low income housing, etc. However, in pursuance with concerned SDGs, many of these standards and provisions may need updation as well as formulation of new standards to reflect improved and holistic provisions based on the state-of-the-art. The Sectional Committees should map the SDGs against the scope of work of their committee and review the relevant standards formulated so far and identify and address the gaps.

4. STAKEHOLDER REPRESENTATION

The work of standardization is a collaborative work through the members of the Sectional Committees and the Subcommittees/Panels/Working Groups functioning thereunder. These members represent diverse interest like manufacturers or industry; users or consumers; technologists such as R&D Institutions, academic institutions, testing laboratories, professional bodies and experts in their personal capacity; and Government regulatory departments. The effectiveness of participants is important as the same influences the quality of the standards formulated. It is thus imperative that right organization and experts who are most relevant and knowledgeable on the subject matter are represented on the committees. The committee composition should be reviewed from time to time and updated so that the latest organization/representative are on board and new members having exposure to and expertise in the latest in the technology and domain areas, are co-opted from time to time. Those who have failed to contribute should give way to the new members having fresh ideas and zeal to contribute. It is to be kept in mind that the extensive standardization programme could only be achieved with the support of right and motivated experts on the committee. All encouragement and opportunities should be given to younger members and experts, to serve on the committees and help in expediting the standards development.

5. SPECIAL PUBLICATIONS

Apart from Indian Standards, BIS is also engaged in bringing out Special Publications (SPs) in the form of explanatory handbooks, design aids, compilations, etc. A series of Special Publications have been brought out under the Division Council. However, the formulation and revision of standards always take precedence over SPs. It is acknowledged that the Special Publications brought out in the past have been of immense value.

Particularly, the explanatory handbooks have served well in the explanation of intricate codal provisions to the professionals and faculty members and students alike. It would be most appropriate to prepare clause-wise commentary/explanatory document as the design codes are developed. This will help in understanding the basis of the clause/provision and help in its implementation, and assist in future revision of the publications too.

6. PROMOTION OF STANDARDS

Standards are formulated based on extensive contribution by the members of the committees and wide consultation among the stakeholders, and reflect the consensus opinion of the experts and the state-of-the-art. Unless the standards so developed are copiously referred and implemented, the benefits of standardization are not fully realized in influencing quality, safety and industrial economic development in the country. It is, therefore, imperative that a strong publicity, promotion, training and capacity building programme is charted out by the committees for extensive dissemination and implementation of the standards by all concerned stake holder segments.

7. IMPLEMENTATION OF STRATEGIC ROAD MAP

From the foregoing, it is clear that the following should largely form the basis for standardization activity during the next five years:

- a) Promoting recycling and waste utilization
- b) Promoting new/innovative building materials and technologies
- c) Development of standards with a view to promote industrial development, vendor development and exports
- d) Promoting sustainable development in tandem with UN Sustainable Development Goals for inclusive growth of all sections including persons with disabilities, women and economically weaker sections
- e) Promoting accessibility in buildings and built environment progressively leading to universal design.
- f) Ensuring right stakeholder participation
- g) Development of commentaries/explanatory handbooks
- h) Promoting published standards through communications, seminars and webinars.

A suggestive list of subjects to be taken up under standardization and accomplished in the next five years is given in Annex B. The Sectional Committees should chart out their Standardization Plan for the next five years to meet the above objectives in formulation of new standards and revision of existing standards including the Special Publications.

8. REVIEW OF PLAN

The Division Council shall review the Strategic Road Map periodically and guide and direct the Sectional Committees from time to time.

Annex A

List of Sectional Committees under CEDC of BIS

SI 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	Waterproofing 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

Annex B

New Area/Topic to be developed under CEDC in the next Five Years

New Area/Topic	Relevant Technical Committee
1) Planning Standards [Urban planning; Environmental design (CPTED)]	CED 51
2) Construction management (Building information modeling, Construction procurement & tender conditions)	CED 29
3) Development Control Rules	CED 51
4) Assessment, Rehabilitation and Maintenance (Structural Health Monitoring) of existing Masonry, Concrete, Steel, Buildings and Structures	CED 02
5) Climate resilience - Urban flooding due to cloud bursts/ Good practices for stormwater management	CED 13 or WRD
6) Vibration control in buildings; Protocols for Wind tunnels; Structural health monitoring	CED 37
7) Tunneling & Tunnel construction (Measurement; H&S in construction; Design of segmental lining)	CED 48
8) Trenchless technology; Construction technology; Mechanization	CED 13
9) Pre-engineered buildings, precast systems and their safety (including 3D printing)	CED 32
10) Rehabilitation of existing water supply and sewerage systems	CED 24
11) Recycling waste water & reuse of water - On site systems	CED 24
12) Green/net zero buildings - with emphasis on minimum embodied energy	CED 58
13) Mechanization in construction - Methodology and processes	CED 13
14) New building materials and hardware (Steel Wire for bridge suspension; FRP bars, Damping devices; Mechatronic door furniture; Binders & Sealing materials; Engineered stones)	CED 54, CED 39, CED 15, CED 13, CED 06
15) Waterway and Dyke construction (Design of quay walls, jetties & geotechnical design); Offshore installation related	CED 47
16) Stainless steel water tanks	CED 03
17) Laying of ceramic tiles; installation of ACP sheets	CED 05

18) Chain of custody of wood products	CED 09
19) Performance based test methods for aluminium and UPVC windows	CED 11
20) Ventilation aspects in buildings	CED 12
21) Disposable type fire extinguisher	CED 22
22) Bamboo furniture	CED 35
23) Fire dampers; smoke & heat control system	CED 36
24) Steel composite tall building	CED 38
25) Water proofing system specifications	CED 41
26) Demolition and Safety related	CED 45
27) Polypropylene pipe for soil and waste discharge; PVC lay flat hoses	CED 50
28) Precast concrete boundary wall	CED 53
29) Crib retaining wall; Gabion retaining wall	CED 56
30) Safety of external building fabric impacted by wind borne debris; Habitat protection post cyclones/warning	CED 57
31) Handbook and tunneling	CED 48
32) Handbook on lime	CED 04
33) Revision of existing important standards and handbooks (SPs)	CED 02, CED 39
34) Revision of standards in A5 size	All relevant TCs
35) Revision of standards published prior to year 2000	All relevant TCs
36) Emerging subjects/technologies	All relevant TCs
