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REPORT OF THE WORKING GROUP



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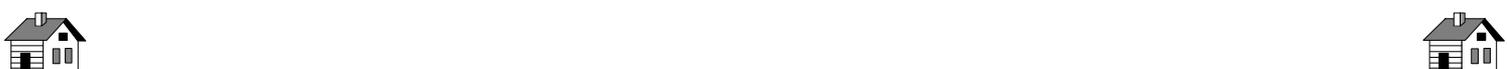
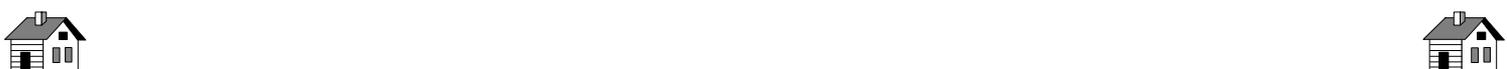
R&D FOR CONSTRUCTION SECTOR



12th PLAN



(2012-2017)



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1.0 Preface

In the context of the formulation of the Twelfth Five Year Plan, Planning Commission has set up a Steering Committee on Construction to study and analyze the Indian Construction Industry to suggest policy framework and to recommend the measures for self regulation for the constituents of the Construction Industry along with the mechanism for implementation of the recommendations.

For facilitating work by the Steering Committee, a working group on Research and Development for the Construction Sector has been constituted as per CIDC Letter No.2253/12th-National Plan/WG2011 dated 23rd September, 2011 (Annexure-1). Composition of the Working Group is as below:

1. Shri A.K. Purwaha, C&MKD, EIL - Co-Chairman
2. Dr.Shailesh Kumar Agrawal, ED, BMTPC - Co-Chairman
3. Shri Sunil Mahajan, Director, CIDC - Convenor
4. Shri V.M. Chariar, Assistant Professor, IIT, New Delhi
5. Prof. S.N. Naik, IIT, New Delhi
6. Dr. Manika Negi, Fellow, Human Settlement Management Institute, New Delhi
7. Shri A.K. Upadhyay, IAS, Chairman, National Highways Authority of India,
8. Shri S.P.S. Bakshi, Chairman cum Managing Director, EPIL
9. Shri V.P. Das, Chairman & Managing Director, NBCC
10. Shri S. Kanappan, EVP & Head – Heavy Civil Infrastructure SBG, L&T, Chennai
11. Dr. PS Rana, Director, Continental Construction Project Ltd., New Delhi
12. Shri Siddharth Singh, Secretary General, Construction Federation of India (CFI),
13. Shri Lalit Kumar Jain, President, CREDAI
14. Shri B.K. Jha, General Manager, SAIL, Ranchi
15. Shri Sanjay Pant, Jt.Director/Scientist D(Civil Engg.), BIS, New Delhi
16. Shri Mohan Tiwari, Managing Director, IRCON
17. Dr.Akshaya Kumar Sen, AGM, HUDCO

This report of the Working Group has been prepared based on the discussions held during the working group meetings, Planning Commission document – Approach to 12th Plan and the study of similar initiatives being undertaken globally.

2.0 Overview

- Construction Sector is an integral part of India's economy. The realization of Indian Vision 2025 to emerge as a major economic power requires rapid growth in Infrastructure. Construction industry plays a pivotal role in developing country's infrastructure and accounts for nearly 45% of the total investment in the Infrastructure. Construction sector is also the second largest employer after the agriculture sector.
- The pace of urbanization is now set to accelerate and massive investments are planned in the Infrastructure sector during the 12th Plan period which will benefit as well as pose challenges for the construction Industry.
- Demand for key services such as water, transportation, sewage treatment, low income housing is expected to increase five to seven-fold with a focus on inclusive cities.
- Innovation in construction sector is essential for competitiveness and effectiveness. R&D, being a driver of innovation, is important to construction sector as to any other.
- As per UNESCO Science Report 2010, India's R&D intensity – Ratio of Gross Expenditure on R&D (GERD) to GDP – was about 0.88% in the year 2008 while China had an R&D intensity of about 1.4%. However, there has been a significant increase in the R&D intensity in the country.

Countries which have increased their GERD/GDP between 1997 and 2005

	1997	2005	Ratio
Pakistan	0.16	0.44	2.81
Tunisia	0.43	1.02	2.40
Thailand	0.10	0.23	2.31
China	0.64	1.33	2.07
Turkey	0.36	0.69	1.69
Singapore	1.48	2.30	1.65
South Africa	0.60	0.92	1.54
Iceland	1.83	2.78	1.52
Israel	3.03	4.51	1.49
Mexico	0.34	0.50	1.46
Austria	1.69	2.44	1.44
Latvia	0.39	0.56	1.43
Spain	0.80	1.13	1.41
Lithuania	0.54	0.76	1.40
Mongolia	0.19	0.26	1.38
Portugal	0.29	0.41	1.37
Czech Republic	1.08	1.41	1.31
Hungary	0.72	0.94	1.30
Mauritius	0.29	0.38	1.29
Finland	2.70	3.48	1.29
Greece	0.39	0.51	1.28
Denmark	1.92	2.45	1.27
Egypt	0.20	0.25	1.25
Canada	1.66	2.05	1.24
Republic of Korea	2.48	2.98	1.20
Japan	2.87	3.33	1.16
India	0.69	0.80	1.16
Armenia	0.19	0.21	1.15
Cuba	0.44	0.51	1.14
Slovenia	1.29	1.46	1.13
Germany	2.24	2.49	1.11
Argentina	0.42	0.46	1.10
New Zealand	1.09	1.17	1.07
Italy	1.03	1.10	1.07
Sweden	3.52	3.69	1.05
Trinidad and Tobago	0.12	0.12	1.05
Kyrgyzstan	0.19	0.20	1.02
Russian Federation	1.04	1.07	1.02
Belgium	1.83	1.86	1.01
United States	2.58	2.61	1.01

Countries whose GERD/GDP has declined in 2005 compared to 1997

	1997	2005	Ratio
Ireland	1.27	1.26	0.99
United Kingdom	1.81	1.77	0.98
Kazakhstan	0.29	0.28	0.97
France	2.19	2.11	0.96
Bulgaria	0.51	0.49	0.96
Burkina Faso	0.18	0.17	0.95
Norway	1.63	1.52	0.94
Belarus	0.73	0.68	0.93
Netherlands	1.99	1.75	0.88
Poland	0.65	0.57	0.87
Ukraine	1.19	1.03	0.86
Madagascar	0.22	0.18	0.80
Panama	0.32	0.25	0.77
Romania	0.58	0.41	0.71
Colombia	0.27	0.18	0.67
Macedonia	0.38	0.25	0.65
Azerbaijan	0.37	0.22	0.60
Georgia	0.34	0.18	0.52
Republic of Moldova	0.81	0.40	0.49
Serbia	0.85	0.42	0.49
Slovakia	1.07	0.51	0.48
Kuwait	0.21	0.10	0.47

- As per the Global Innovation Index 2011 published by INSEAD in partnership with CII amongst others, India ranks at 87th place in a list of 125 countries globally and at 1st rank in South Asia.
- Significant changes are taking place in the global innovation landscape which are related to geography, understanding of its complex nature and the need for collaboration and openness.
- Recognising the vital role of innovation in India's development and economic growth, President of India has declared this decade as the 'decade of innovation' with a focus on inclusive growth.
- Approach to 12th Plan, underlines the following approach to innovation in Indian context:
 - Finding affordable solutions for the needs of people without compromising quality.
 - Optimum framework that delivers to people the benefits of technology that may be developed in scientific laboratories.
 - Innovations in the process of innovation itself to reduce the cost of developing the innovations.

- The new paradigm of innovation, focuses on producing 'frugal' cost solutions with 'frugal' cost of innovation; innovations that benefit people, especially the poor.
- A modern and efficient infrastructure encourages increase in productivity of any organisation as well as of an individual. Innovation in construction industry thus is crucial for delivering a cost effective built environment covering residential, commercial, industrial, institutional and public works.
- The built environment also has a major impact on sustainability, viz.:
 - Rate at which we use resources
 - Carbon footprint
 - Water consumption
 - Generation of waste
 - Raw material usage

Construction industry offers a vast potential for innovation both for sustained and sustainable growth.

- Construction industry cannot be visualized as a single industry in view of the wide range of types and sizes of construction works. It covers a spectrum of activities carried out by a group of linked organisations providing design and engineering, supplying materials and equipment, carrying out construction work and providing operation and maintenance services.
- Construction industry can be broadly classified into two sectors i.e. organized and unorganized. The organized sector includes more than 30,000 organisations whereas the standalone contractors in the unorganized sector number more than 120,000.
- Given such a diverse nature, the general perception is that the construction sector is not research oriented. While it is true that small organisations may not have adequate funds to create their own infrastructure, the real success lies unseen since construction R&D lacks a structured framework for capturing and sharing of learnings.
- R&D in construction sector needs to be built around a vision of delivering inclusive growth supported by collaboration between the research providers and the research users. There are many enterprises across the country which deliver benefits through innovation. Scaling of the impact of such innovations continuously and consistently requires a robust mechanism for information sharing and dissemination.

3.0 R&D Infrastructure

In the field of construction sector in India, the institutions doing continuous and significant amount of developmental work include Construction Industry Development Council (CIDC), Central Building Research Institute (CBRI), Building Materials and Technology Promotion Council (BMTPC), Institute of Steel Development & Growth (INSDAG), Central Institute of Plastics Engineering & Technology (CIPET), National Council for Cement and Building Materials (NCB), Central Road Research Institute (CRRI) and Research Designs and Standards Organisation (RDSO) amongst others.

3.1 Construction Industry Development Council (CIDC)

The Planning Commission jointly with the Indian construction industry has set up Construction Industry Development Council (CIDC) in 1996 to take up activities for the development of the Indian construction industry.

The Council provides the impetus and the organisational infrastructure to raise quality levels across the industry. This helps to secure wider appreciation of the interests of construction business by the government, industry and poor groups in society.

The Council has taken several initiatives for the development of the industry such as:

- Advice the Government on policy formulation related to construction industry.
- Standardization of construction contracts and procedures.
- Training manpower at skilled worker level and construction management level.
- Grading of construction entities
- Devise mechanisms for workers' welfare.
- Create an environment that ensures equality of opportunity for all Indian contractors.
- Help evolve policies for financing.
- Help the industry move from the current state of rule-bound, lowest-price-based contracting to a more quality-conscious, time-bound & technology-driven one.
- Dispute Resolution in Construction Contracts.
- Establishing construction equipment bank.
- Interaction and networking with international organisations to promote emerging technologies and best practices.

3.2 Central Building Research Institute (CBRI)

The Central Building Research Institute, Roorkee, has been vested with the responsibility of generating, cultivating and promoting building science and technology in the service of the country.

Since its inception in 1947, the Institute has been assisting the building construction and building material industries in finding timely, appropriate and economical solutions to the problems of materials, rural and urban housing, energy conservation, efficiency, fire hazards, structural and foundation problems and disaster mitigation.

CBRI carries out applied and basic research in all areas of building science to solve problems confronting the country in:

- Shelter planning
- Building materials
- Structures and Foundations
- Disaster mitigation including Fire Engineering
- To develop new technologies for the promotion of building materials and systems
- To disseminate the results of results of research far and wide for the good of community
- To transfer the developed technologies to the industry for further commercialization

3.3 Building Materials and Technology Promotion Council (BMTPC)

In order to bridge the gap between research and development and large scale application of new building material technologies, the erstwhile Ministry of Urban Development, Government of India, had established the BMTPC in July 1990.

The Council strives to package proven innovative technologies for the benefit of entrepreneurs interested in setting up manufacturing units in tiny, small, medium and large scale sectors.

There has been a demand for setting up such an apex institution in order to provide an inter-disciplinary platform to various agencies under Central and State Governments and the private sector for scaling up proven technologies to enhance their wide-spread use and for assisting commercial production as well as systematic dissemination of appropriate technology for the benefit of the

construction of appropriate technology for the benefit of the construction agencies and different sections of the population.

The Council is structured to undertake the task of the extension and application of technologies and materials developed by research institutions on the ground with the backing of financial institutions and enabling regulatory environment. To draw upon the experience and expertise in the area of building materials technology, eminent technologists, professionals of the public sector construction agencies, the corporate sector, R & D and standardisation organisations are also associated with BMTPC.

BMTPC strives:

- To promote development, production, standardisation and large-scale application of cost-effective innovative building materials and construction technologies in housing and building sector.
- To promote new waste-based building materials and components through technical support and encouraging entrepreneurs to set up production units in urban and rural regions.
- To develop and promote methodologies and technologies for natural disaster mitigation & management and retrofitting/ reconstruction of buildings including disaster resistant design and planning practices in human settlements.
- To provide S & T services to professionals, construction agencies and entrepreneurs in selection, evaluation, upscaling, design engineering, skill-upgradation, and marketing for technology transfer, from lab to land, in the area of building materials and construction.

3.4 Institute of Steel Development & Growth (INSDAG)

INSDAG has been established with a view to popularize steel construction in India. The institute is a nonprofit organization having more than 600 members comprising organization, institution, associations and professionals.

The Institute primarily works towards the development of technology in steel usage and market for the steel fraternity.

Some of its roles are:

- Creating awareness amongst potential users about affordability and benefits of steel.

- Providing prompt advisory service on materials, construction practices, interpretation of codes etc. and creating an environment for better usage of steel by acquiring and disseminating knowledge about the best practices.
- Upgrading the skills of the work force by organizing refresher courses/ training programmers and offering better technical know-how, design aids and teaching aids.
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- Communicating the benefits of steel vis-a-vis other competitive materials, through life cycle cost studies, where required.

3.5 Central Institute of Plastics Engineering & Technology (CIPET)

Central Institute of Plastics Engineering & Technology (CIPET), Chennai, Tamil Nadu is a premier institution devoted to manpower training and technical services to the plastics and allied industries.

R&D Projects undertaken by CIPET include:

- Development of mechanically and thermally stable biodegradable plastic composites.
- Development of High Performance Thermoplastics & Thermosetting Nano-composites.
- Development of polyolefin based Nano-composites.

3.6 National Council for Cement and Building Materials (NCB)

Established in 1962, as Cement Research Institute of India and redesignated as National Council for Cement and Building Materials in April 1985, NCB is an apex body dedicated to continuous research, technology development and transfer, education and industrial services for the cement and building material industries. The entire range of services of NCB is delivered through its units in Ballabgarh and Hyderabad. The main laboratories of the Council are located at Ballabgarh.

National Council for Cement and Building Materials (NCB) supports Cement, Building Materials and Allied Areas and covers:

- Research
- Technology Development and Transfer
- Education
- Industrial Services

NCB strives:

- To enhance quality, productivity and cost-effectiveness
- To improve the management of materials, energy and environmental resources.
- To develop competency and productivity in human resources.
- To develop technologies for durable infrastructure and affordable housing

3.7 Central Road Research Institute (CRRI)

Central Road Research Institute (CRRI), a premier national laboratory established in 1948, a constituent of Council of Scientific and Industrial Research (CSIR) is engaged in carrying out research and development projects on design, construction and maintenance of roads and runways, traffic and transportation planning of mega and medium cities, management of roads in different terrains, improvement of marginal materials, utilization of industrial waste in road construction, landslide control, ground improvements environmental pollution, road traffic safety and analysis & design, wind, fatigue, corrosion studies, performance monitoring/evaluation, service life assessment and rehabilitation of highway & railway bridges. The institute provides technical and consultancy services to various user organizations in India and abroad.

For capacity building of human resources in the area of highway engineering to undertake and execute roads and runway projects, Institute has the competence to organize National & International Training Programmes continuing education courses since 1962 to disseminate the R&D finding to the masses. R&D areas include:

- Traffic Engineering & Transportation Planning (Traffic Engineering & Safety, Transportation Planning and Transport Environment).
- Pavement Engineering and Materials (Flexible Pavement, Rigid Payment and Pavement Evaluation).
- Geotechnical Engineering (Ground Improvement and Landslide Investigations).
- Road Development Planning and Management (GIS based network planning, master plan for rural roads).
- Bridges and Structures (Bridge design, investigation, instrumentation and rehabilitation measures).

3.8 Research Designs and Standards Organisation (RDSO)

With increased demand of rail transportation, erstwhile Central Standards Office (CSO) and the Railway Testing and Research Centre (RTRC) were integrated into a single unit named Research Designs and Standards Organisation (RDSO) in 1957, under Ministry of Railways at Lucknow.

RDSO functions as the technical advisor to Railway Board/Zonal Railways and Production Units and performs the following important functions:

- Development of new and improved designs
- Development, adoption, absorption of new technology for use on Indian Railways.
- Development of standards for materials and products specially needed by Indian Railways.
- Technical investigation, statutory clearances, testing and providing consultancy services.
- Inspection of critical and safety items of rolling stock, locomotives, signaling & telecommunication equipment and track components.
- RDSO multifarious activities have also attracted attention of railway and non-railway organisations in India and abroad.

RDSO has a number of laboratories which are well equipped with research and testing facilities for development, testing and design evaluation of various railway related equipments and materials.

Board of Board of Railway Research (CBRR) consist of Railway officials and Non- Railways members - eminent scientists, technologists, engineers and senior executives of other research organizations, academic institutions and industrial units related to railway technology and materials. Functions of CBRR are:

- To consider and recommend the programme of research on Indian Railways.
- To review the research programme from time to time.
- To ensure coordination and assistance from other research laboratories.
- To review the ongoing projects from the technical angle.

4.0 R&D Vision and Strategy

- Keeping in view the diverse and fragmented nature of Construction Industry, a holistic approach is essential in developing a long term vision and implementation of R&D projects for the Construction Industry. The research strategy needs to be credible and coherent both for the research providers and research users to ensure adequate flow of funds.
- Assets that will be built a few years into the future may be radically different in their design and construction in view of the sustainability concerns. At the same time, the existing buildings and infrastructure assets would still be in use and shall require refurbishment. Accordingly, R&D works may focus on immediate goals of cost reduction, resource conservation, improvement in quality and safety along with the pioneering innovations which can bring about paradigm shift in material and processes. Key improvements are expected in areas relating to energy, water, biodiversity and waste management. R&D focus thus would galvanize and accelerate imbibing good practices and new technologies.
- R&D vision shall motivate towards an innovative sustainable and productive construction industry and shall ensure collaboration and alignment amongst policy makers and all sections of the construction industry supply chain. A clear objective and identification of well defined research projects would accelerate development of an innovative mind-set and in time should cause users to demand change.
- Comprehensive approach to Research and Development shall cover:
 - User requirements.
 - Design and engineering of better assets which are sustainable and environmental-friendly.
 - Construction of assets which conserve energy and water resources and are easy to operate, maintain and deconstruct.
 - Improved materials with optimum use of raw materials and with emphasis on recycling of resources.
 - Construction techniques and methodologies which promote safety and biodiversity.
 - Minimizing waste generation and environmental friendly waste management.
 - Effective communication and validation procedures.

- Innovations in Economics and Management of Construction Sector.
- Processes and systems to ensure wide reach of benefits for urban as well as rural sectors.
- Integrate the research in construction of infrastructure development with the national employment programmes such as National Rural Employment Guarantee Act (NREGA) and Sampoorna Grameen Rozgar Yojna (SGRY).
- Promoting collaboration amongst policy makers, research institutions, academic institutions and construction industry.

5.0 Thrust Areas

- The challenge for the construction industry in the coming years is to establish a framework which supports innovation, research, development, demonstration and use of knowledge for benefits to society at large. Such a framework would be built around:
 - Integration of various technologies into viable assets.
 - Develop designs and practices for meeting the needs of climate control.
 - Develop new materials and construction techniques.
 - Asset management deploying ICT right from conceptualization to deconstruction.
 - Automation in design, construction and operation.
 - Risk reduction/mitigation.
- Designers, constructors, suppliers and asset users are required to work as a team in a collaborative environment to improve the overall delivery process which will lead to innovation and learning.

5.1 Design and Engineering

- Infrastructure design in principle should support the triple bottom line i.e. environmental, social and economic sustainability. Enhanced usage of design tools and software supported by proper standards and specifications is essential to meet the demands of rapid growth.
- Energy efficiency, safety, resource conservation and waste control measures are key parameters both for existing assets as well as assets to be built in future.
- Design engineers' focus would be:
 - Reduction in overall construction time and cost.
 - Reduction in operation, maintenance and energy costs.
 - Increase in productivity and comfort.
 - Less waste and pollution
 - Health and safety of construction workers
 - Fewer user/occupant related illnesses/injuries
 - Longer life and flexibility in usage

- Analytical models to assess effects of fire, wind, rain and earthquakes and build safety measures as required
- Use of locally available/environment friendly materials

- Life cycle assessment of resources
- Technologies to collect, reuse or recycle construction materials
- Standardisation and simplification of designs.

5.2 Construction Materials

- Materials used in the construction sector are not equal in terms of their impact on environment since these:
 - Are derived from different raw materials (ores, wood, oil or plant origin)
 - Have different energy requirement for transformation, processing, transportation and usage.
 - Have varying recycling/degradability options.

The research and development for materials need to address all above aspects in addition to their availability close to the construction sites/regions.

- Major construction materials are: asphalt, concrete, steel, composites, roofing, coatings, wood, aluminium, masonry, glass.
- Both steel and aluminium have a high potential for recycling. Steel has become the material of choice in building construction, compared to concrete and timber. Steel building designs are more flexible, durable and adaptable.
- One of the major challenges before construction industry is energy efficient construction materials. In the last 30 years, the steel industry has reduced its energy consumption per ton of steel produced by 50%. For improvements in future, it will be necessary to identify and introduce breakthrough steel making technologies that are viable.
- Versatile properties of aluminium as a building/construction material need to be propagated for its extensive use. The environmental advantages of aluminium being an endlessly recyclable material consuming far less energy and substituting wood in the CDM efforts of the country need to be widely publicized.

5.3 Construction Machinery and Techniques

- Construction equipment accounts for 21-23 % of the total project cost and as such, variations in equipment pricing have a huge impact on the project costs. The prices of construction equipment vary according to the product.

As per estimates by Off-Highway research, the sale of construction equipment is expected to reach 84,000 units by 2014, of which infrastructure and real estate sectors will account for 70%. This translates into a CAGR of about 20% over the next five years (2009-2014) in sales of construction equipment.

Over the years, the equipment used in construction has improved significantly to provide better productivity, safety and accuracy. Mechanization ensures greater efficiency and reduces the need for skilled labour. It also enables access to hazardous areas where manual intervention is not possible.

- Development areas include:
 - Deployment of sustainable construction practices
 - Enhanced usage of precast products
 - Close proximity radiography
 - Concrete production and placement
 - Earth moving and mining
 - Heavy lifting and material handling
 - Tunneling and underground
 - Crushers for aggregate and green sand preparation
 - Mechanized Reinforcement Steel bar Cutting and Bending
 - Auto/semiautomatic welding for piping and structures
 - Induction Pipe Bending
 - Primer Painting of Pipes and structures using auto-painting system
 - Building scaffolding replaced by mounting cranes for finishing works
 - Auto blasting of pipe, piping components and structural items
 - Automation to enhance productivity and safety
 - Facilitate availability and deployment of construction equipment through incentives/tax breaks
 - Penetration of good practices into rural construction sector and low cost housing

5.4 ICT in Construction

- India's technology and business services sector has flourished in the last decade with deployment of Information and Communication Technology (ICT). Construction sector is also expected to benefit with optimum use of ICT right from the design to O&M phase of a built environment.

- All the stakeholders in the construction sector need to work towards creating a collaborating environment to support asset development, project implementation and production of construction materials.
- ICT will lead to better project information exchange, communications, integrated processes and, therefore, more efficient collaborative working. ICT enabled work environment will overcome many of industry's inherent problems e.g. fragmented nature. Above all, ICT shall allow easy availability of knowledge in far flung areas of the country.
- ICT deployment in construction sector would cover:
 - Design tools e.g. CADD, CAE, 3D system
 - Computer based construction simulation
 - Creation of database covering materials, suppliers, contractors, construction machinery, skilled manpower, etc.
 - Facilitate training and retraining through e-learning and virtual classrooms
 - Optimized O&M
 - Collaborating Project planning and monitoring systems
 - Easy availability of applicable codes and regulations
 - Knowledge transfer and management
 - Material management during construction and O&M
 - Integration with the MIS for NREGA

5.5 Economics and Management of Construction Sector

- Along with the construction activity a number of economic processes are set in motions which have their implications and repercussions on a range of parameters. Research activities relating to the economic, financial and management of construction sector like economic modeling & analysis of various construction products, financing & marketing in construction sector, supply chain economics, networks economics, economies of scale in construction sector, cost-benefit analysis, etc. need a concerted effort.
- About 250 ancillary industries such as cement, steel, brick, timber and building material are dependent on the construction industry. A unit increase in expenditure in this sector has a multiplier effect and the capacity to generate income at much higher growth rates.
- The construction sector is fragmented. Every company is tending to solve their own problems alone, according to specific vision and interest. Modifying the cost chain without impacting the payment chain proves to be difficult.

Since numerous risks linked to construction sector, large-scale and costly experiments are thus required which involves risk analysis through economics and financial knowledge of the sector.

- In view of the above, various studies, research and analysis are required to understand and identify various implications relating to construction sector. The research issues are diverse and numerous, yet very important due to the large scale of decisions made in the construction industry. The key Research & Development activities in construction sector for 12th Plan should focus on economic, financial and management aspects in the following ways:

- **Allocation of a Research & Development Budget for Construction Sector:**

There is a need to have a special allocation of R & D Budget for construction sector so that proper, scientific and wide variety of research in all aspects including economic and financial aspects relating to constructions sector can be undertaken.

- **Research on Supply Chain from Systems perspective:**

Construction cannot be viewed in isolation from its surroundings, and from its industrial and service base. The supply chain for construction includes practically the entire economy. As construction cannot function without energy, services, etc., the economics analysis of construction has to include the sustainable environmental analysis of the corresponding energy, as well as the other sectors of the economy. The suppliers of construction may have a larger environmental impact than construction itself. R & D in construction economics would answer the questions like: Which alternatives have the lowest resource inputs and environmental emissions and wastes throughout their life-cycle? What are the reuse and recycling options, and do they make environmental and economic sense?

- **R&D in economic analysis of construction products from Life-cycle perspective:**

Infrastructure should properly be viewed from a life-cycle perspective. For example, design decisions at the beginning of a project have significant long-term effects. In terms of individual life-cycle stages, operation and maintenance and end-of-life environmental costs of facilities may outweigh all other costs. Hence Civil engineers, architects, construction engineers and managers have a crucial role in identifying right kind of technologies in such cases. To put in economic terms there may be considerable variation

between benefit from construction activity and social cost of it. A cost benefit analysis approach is needed in many cases to determine such aspects. Models could be developed to ascertain benefits vis-a-vis costs for similar type of projects. Therefore, proper and scientific research is needed to determine the engineering and management options, and economic costs of end-of-life treatment of constructed facilities. The research may solve may issue like: For what period should facilities be designed? How do we predict the rate of obsolescence for our facilities? What is the planning period for the economic analysis of construction products?

- **Economics and Financing aspects in Construction design:**

The research and development activities in construction economics would enable the stakeholders involved in the sector to find answers to questions such as: How do we effectively communicate to construction professionals the environmental implications of material selection, design, facility siting, construction method, etc. choices? How do environmental issues get balanced with engineering, economic, quality and safety criteria? How do construction designs get optimized with the triple bottom line (engineering, economics and environment) in mind?

- **R&D research in operation and maintenance (O&M) aspects:**

From viability point of view, projects need to be analysed from the operation and maintenance (O&M) aspects. The O&M costs should be such so that the project may run smoothly throughout its life period. In funding construction projects, thus, many financial engineering and innovations are required to make it financially sustainable over the entire project life. More innovative research required in this field in order to reduce the O & M cost of construction projects.

- **Incorporation of Construction Economics and Management modules into existing courses in Educational Institutions:**

Traditional construction design and engineering education has focused on providing instruction in achieving and maintaining the highest standards in engineering, safety and quality of the built infrastructure at the lowest possible economic costs. Construction design and engineering education needs to incorporate economic, financial, management and environmental issues into education in a systematic way. The objectives of incorporating such modules in education are: (i) to provide every civil engineering student with a notion that economic, financial and environmental management issues are

increasingly important in construction, in addition to the engineering and design aspects, and that construction activities have large economic, financial environmental impacts; and (ii) to teach students in construction engineering and management the practical methods and tools to lower the environmental footprint of construction design and engineering through economic, financial and management tools.

5.6 Supporting national Re-employment schemes

- Construction sector being the second largest employer in the country has enormous potential to support the national employment schemes such as Sampoorna Grameen Rozgar Yojana (SGRY) with NREGA being in place. With job creation being the primary objective, challenge lies in creating useful and productive job opportunities.
- NREGA has given ample opportunities for infrastructure development at the community level. Schemes include:
 - Ponds/Earthen Bunds
 - Wells
 - Masonry Check Dams
 - Mitti Murram Roads
 - Land Leveling
 - Guard Wells
 - Water conservation and Water Harvesting
 - Irrigational canals including micro and minor irrigation works.

These schemes require innovative technical support relating to feasibility studies, innovative design, surveying and cost estimation, prevention of soil erosion, conservation of water, availability of better tools for the workers etc.

- Optimally conceptualized schemes can stimulate investment, employment opportunities and livelihood creation which provide benefits to the community. Focus of such programmes would be on skill building and productivity improvement rather than on unskilled manual work to create an avenue for sustained livelihood and increase in income.

6.0 Way Forward

- Technology innovations for productivity improvement are basically of two kinds, viz. hardware and software focused. In context of construction industry, hardware implies construction material, construction equipment/machinery, construction techniques etc. whereas software includes design and engineering, project planning, control and management, quality control system, HSE practices etc. It is also very important to harmonize hardware and software for proper asset building.
- Obviously, such a vast slate of technologies can not be addressed by a single enterprise or institution and requires focused initiatives by the government in coordination with all the constituents of construction industry. Suppliers of materials, products and systems together with contractors have to jointly identify areas for innovation and decide on their priorities for accomplishment.
- Industrially advanced countries too depend on collaboration amongst all stakeholders to decide on policies and their implementation framework. Similar studies carried out in UK provide specific examples:
 - Rethinking Construction (1998), Sir John Egan
 - Rethinking Construction Innovation and Research (2002), Sir John Fairclough
 - Strategy for Sustainable Construction (2008), Strategic Forum for Construction
- It is suggested that a nodal agency be set up with participation of policy makers, various research organisations, associations, academic institutions and industry to spearhead the collaborative effort needed to drive the R&D initiatives in Construction Industry. The nodal agency would:
 - Articulate its Vision and Mission
 - Draw out the policy framework including incentives and tax breaks for promoting innovations
 - Identify the funding arrangement for research
 - Define user requirements for R&D
 - Address issues relating to economics and management of construction sector

- Develop framework to support integration with NREGA and SGRY
- Set-up priorities and performance monitoring systems for R&D initiatives
- Generate awareness for quality, safety, pro-diversity and environment
- Develop programs for training and retraining of human resources
- Define mechanism for institutional financing of asset building including micro-financing in rural construction.
- Oversee conversion of R&D initiatives to benefits for all section of society.

F.No.18/5/2011-Tpt.
Government of India
PLANNING COMMISSION
(Transport Division)

Yojana Bhavan, Sansad Marg
New Delhi, dated 22-09-2011

Subject: Constitution of Working Group on Construction Sector (Research & Development) in the Twelfth Five -Year Plan (2012 - 2017)

In the context of the formulation of the Twelfth Five Year Plan, it has been decided to set up a Working Group on Construction. The composition of the Working Group will be as follows:

1.	CMD, EIL	Joint Chair
2.	DG, BMTPC	Joint Chair
3.	Members - to be nominated by the Chair	
4.	Shri. Sunil Mahajan, Director, CIDC	Convenor

II. Terms of the Reference for the Working Group.

1. To study and analyze the Indian Construction Industry, keeping in view the focus on creation of a world class infrastructure and rebuilding rural India through schemes such as Bharat Nirman and MNREGA. To make an assessment of qualitative and quantitative capabilities of the Indian Construction Industry in the background of category-wise projections for construction and allied supporting activities in the 12th Plan with a view to evolve strategies for overcoming deficiencies and bottlenecks and achieve time bound targets, by suggesting measures for better coordination among the stake holders.
2. To review the regulatory framework governing the sector including fiscal and other regulations and suggest any changes required to make the sector more efficient and productive.
3. To focus on R&D activities in the construction sector and suggest measures for greater use of modern technologies and equipment and speedy adaptation of new methods.
4. To review the quality and safety aspects in construction and to suggest necessary measures, and to recommend measures for evolving a Techno-legal regime.

5. To study the impact of this industry on environment and suggest measures to make it more environmental friendly and sustainable; to also review the present regulatory framework for environmental clearance with a view to making it more business friendly.

6. To review the status of data base in the construction sector and to suggest ways and mean to upgrade, augment and effectively maintain the same on institutional basis.

7. To study the best practices adopted worldwide and draw lessons for the Indian Construction Industry.

8. To suggest a policy framework for the increase productivity and reducing construction costs, in order to ensure the healthy development of the construction sector after examining/ reviewing of the above mentioned areas and the existing regulating from work.

9. To recommend the measures for self-regulation for the constituents of the Construction Industry.

10. To evolve suitable mechanisms to ensure implementation of the recommendations of this group during the 12th plan period.

11. To examine any other matter considered important by the Working Group.

III. The Chair of the Working Group may co-opt officials or non-officials as Members. Representatives nominated, if any, by the Central Ministries/ Organization should not be below the level of Joint Secretary.

IV. The non-official Members of the Working Group will be paid TA/DA at the rates applicable for Grade-I officers of the Central Government for attending meetings of the Working Group.

V. The Working Group will submit its final report to the Planning Commission by 15th October and an interim report by 1st October


Dr. Manoj Singh
Advisor (Transport)

Copy to:

- a. Chairman, all Members and Convenor of the Working Group.
- b. PS to Deputy Chairman, Planning Commission

- c. PS to Minister of State (Planning)
- d. PS to all Members, Planning Commission
- e. PS to Member-Secretary, Planning Commission
- f. All Principal Advisor/Sr. Advisors/Advisors/HODs, Planning Commission
- g. Director (PCMD), Planning Commission
- h. General Branch I and II, Planning Commission
- i. Accounts-I Branch, Planning Commission
- j. Information Officer, Planning Commission
- k. Library, Planning Commission


Dr. Manoj Singh
Advisor (Transport)