Feature

An Overview of the R&D Center of Indian Railways

Gopal Krishan Wadhwa

Historic Background

The first railways in India were built in 1853 and their subsequent continent-wide development saw the appearance of various private railway companies and state-owned railway systems. To enforce standardization and coordination between these sometimes-disparate systems, the Central Standard Office (CSO) was established in 1930 to prepare designs, standards and specifications. However, before Indian independence in 1947, most of the design and manufacturing of rolling stock and infrastructure was entrusted to foreign consultants. With the subsequent phenomenal increase in the nation's industrial and economic activity and rising demand for railway transport, a new organization called the Railway Testing and Research Centre (RTRC) was set up in 1952 at Lucknow to test and conduct applied research for development of railway rolling stock, permanent way etc. In 1957, the CSO and RTRC were integrated as the Research Design and Standards Organisation (RDSO) under the Ministry of Railways at Lucknow.

Functions

RDSO is the sole R&D organization of Indian Railways and functions as the technical advisor and consultant to the Indian Railway Board, regional railways and rolling stock works.

Basically, its activities involve:

- Development of new and improved designs
- Development and adoption of new technologies for use on Indian Railways
- Development of standards for materials and products especially needed by Indian Railways
- Technical investigation, statutory clearance, testing and provision of consulting services
- Inspection of critical and safety items for rolling stock, locomotives, signals, telecommunications equipment, and track

RDSO also offers international consultancy services on design, testing and inspection of railway equipment as well as surveys for construction of new lines. Consultancy services have been provided to various countries such as Iraq, Sri Lanka, South Korea, Zambia, Egypt, Nigeria, Saudi Arabia, etc. The organizational structure of RDSO is shown in Table 1.

Identification of Research Areas

RDSO derives its policy direction from a governing council comprised of a chairman and board, director general, and board members of Indian Railways representing the civil, mechanical and electrical engineering, finance, personnel, traffic and planning wings.

The governing council identifies and approves R&D projects for Indian Railways. It reviews the progress of projects and determines the amount of direct funding.

To keep abreast with the latest technological developments, close liaison is maintained with industry and academic institutions through the Central Board of Railway Research (CBRR), consisting of well-known scientists, technologists, engineers and executives of other research organizations, universities and industrial units related to railways and materials. The CBBR considers, recommends and reviews research while also ensuring coordination and assistance from non-railway laboratories.

Collaboration with Research and Academic Institutions

RDSO recognizes the imperative to generate basic knowledge through advanced academic research to enable a truly self-reliant technology improvement programme for the nation's railways. As a result, strong links have been forged with other institutions and organizations, such as the Indian Institutes of Technology (IIT) at Kanpur, Roorkee, New Delhi and Chennai, the Defense Research and Development Organisation (DRDO) in New Delhi, and the Central Scientific Research Organisation (CSIR).

IIT Kanpur has a Railway Technology Cell to handle projects related to development of a detector for wheel flats, finite element method (FEM) analysis of wheels and geo-technical problems such as field validation of design methodologies for rehabilitation of unstable structures and strengthening of existing structures for heavier axle loads.

Two professorial chairs have been established at IIT Roorkee in the fields of bridge engineering and the dynamics of rail–vehicle systems. The research covers revision of fatigue provisions in codes for steel bridges, formulation of design guidelines for rational assessment of temperature gradient in PRC box girders, reduction of scour around bridge piers, optimization of rail–wheel profiles for longer life, and representation of track irregularities by photo-spectral density. IIT Chennai also has a project on development of knowledge-based expert systems for integrated design of bridges.

IIT Delhi has projects on reduction of diesel engine noise and analysis of rail stress by FEM. RDSO also has a joint project with CSIO Chandigarh to develop an oscillation monitoring system based on microprocessor technology.

International Union of Railways (UIC) Projects

RDSO is active in global research projects through its participation in the following two UIC joint research projects.

Research Design and Standards Organization at Lucknow (RDSO)

Table 1 RDSO Directorates

• Bridges and Structures	• Psycho-technical
• Carriages	• Quality Assurance
• Civil	• Research
• Defense Research	• Signalling
• Electric Loco	• Telecommunications
• EMU and Power Supply	• Track
• Engine Development	• Testing
• Finance and Accounts	• Track Machines and Monitoring
• Geo-technical Engineering	• Traction Installation
• Metallurgical and Chemical	• Traffic
• Motive Power	• Wagons

UIC Project on Rail Defect Management (JRP-I)

RDSO was entrusted with laboratory testing under simulated load conditions of various rail samples received from railways in Japan, America, South Africa and India. A test rig was built in the RDSO Track Laboratory and the tests were completed in December 2002. A report on the growth of flaws in rails has been submitted to UIC for future discussions.

UIC Project on Rail–Wheel Interaction (JRP-2)

RDSO has been assigned the work of 'defining/describing/cataloguing the Rail–Wheel interaction phenomenon and mechanisms with respect to vertical and lateral discontinuities' at welded rail joints.

RDSO Laboratories

RDSO has well-equipped laboratories for testing and developing railway-related equipment and materials. The 14 most important are listed in Table 2.

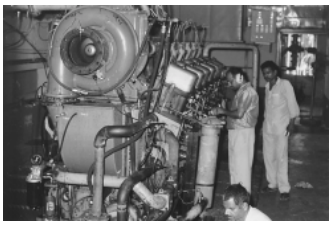
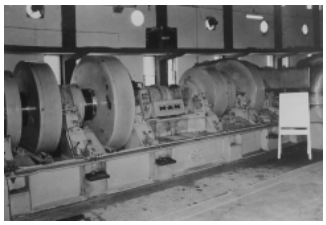
Table 2 Laboratories at RDSO

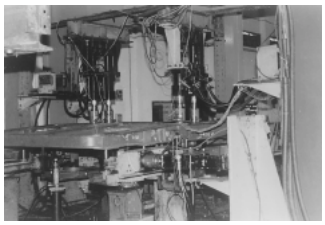
Air Brake Laboratory	Simulating operation of air brakes on freight and passenger trains
Brake Dynamometer Laboratory	Developing and testing friction materials for brakes of locomotives, carriages, wagons and aircraft
Bridge and Structures Laboratory	Testing full-scale models of beams, slabs, columns, towers, shells and other concrete and steel components under static and dynamic loads
Diesel Engine Development Laboratory	Testing diesel engines ranging from 100 to 6000 hp with recording of over 128 test parameters on four fully computerized test beds
Fatigue Testing Laboratory	Testing prototype locomotives and rolling stock bogies, springs and other components to ascertain service life
Geo-technical Engineering Laboratory	Surveying using latest sub-surface interface radar (SIR) system, laser based soil particle analyzer, computerized consolidation test and tri-axial shear apparatus
Metallurgical and Chemical Laboratory	Destructive and non-destructive testing of metals, polymers, composites, petroleum products, and paints using scanning electron microscopy (SEM), direct reading spectrometry, ultrasonic flaw detection, etc.
Psycho-technical Laboratory	Assessing critical psycho-technical attributes of operations staff, such as drivers, stationmasters, etc., using skin galvanometer, etc.
Signal Testing Laboratory	Environmental testing of signal equipment using programmable heat, humidity, mould growth, dust and rain chambers
Track Laboratory	Testing full-scale track panels under realistic dynamic loads and fatigue testing of welded rail joints
Mobile Test Facilities	Evaluating track–vehicle interaction by recording track parameters, locomotive power, etc. Recently developed Network of Electrification, Testing, Recording Apparatus (NETRA) for scanning of overhead equipment
Vehicle Characterization Laboratory	Conducting rolling stock characterization tests to study behaviour of suspension systems
Test Track	Planned 12-km single-line test track and 8-km closed loop for rolling stock braking trials, rating and performance trials, accelerated fatigue testing of track and rolling stock, derailment studies, wheel–rail interaction and other studies
Library	170,000 books, reports, periodicals, specifications, etc., on science, engineering, technology and management RDSO also publishes *Indian Railway Technical Bulletin*, a quarterly journal on railway technology.

Main Research Projects

To meet the growing technological challenges posed by railways in India, RDSO is actively conducting research in the following major areas:

- **Monitoring strength of railway bridges**
  To plan cost effective rehabilitation of aged bridges, acoustic emission (AE) techniques are being evaluated in the laboratory and field to study crack growth under static and dynamic loads.
- **Modular toilet for passenger carriages**
  The design emphasis is on better maintainability. Development of modular lightweight, corrosion resistant toilets with concealed plumbing and non-slip flooring has been completed. Implementation on carriages has been highly successful and appreciated by the travelling public.
- **Improving ride comfort**
  To provide a smoother ride for suburban passengers, air springs have been developed and implemented. Field trials on prototype swing nose



From left: Diesel Engine Development, Brake Dynamometer Laboratory, Fatigue Testing Laboratory, Air Brake Laboratory (RDSO)

crosslinks to reduce impact at frog gaps are in progress.

- **LHB Carriages**
  A project to design 10 variants of the LHB carriage is nearing completion. The variants will permit higher payloads compared to conventional carriages.
- **Development of special wagons**
  Ongoing projects to increase traffic include design of special wagons for steel coils, low tare weight coal wagons, and low-load container bogies, etc.
- **Rail welding technology**
  To eliminate human error when welding rails, global leaders in rail welding have been invited to participate in this project.
- **Track-friendly bogies**
  RDSO has developed a new track-friendly bogie with redesigned spring suspension, side frames and other major components. Prototypes are undergoing field trials.
- **Microprocessor-based control system for diesel locomotives**
  The system permits programming for different types of traction alternators, traction motors and range of engine horsepower. It eliminates relay logic for propulsion control, provides optimum use of engine horsepower and better rail adhesion and has an online fault diagnostic system.
- **Crash-worthiness of carriages**
  Carriages with a vastly improved buffer design to reduce head stock damage and improve crash worthiness are in field trials.
- **New locomotive wheel**
  To meet the need for future increases in axle load, the present straight plate design has been redesigned as a new S-shaped web with low stress curve plate. It is suitable for 24-tonne axle loads and will shortly be in field trials.
- **Modified AC EMU driving cab**
  The cab of AC EMUs has been redesigned for ergonomic layout of equipment and instruments and to improve the driver's field of vision.
- **Improvements to Mumbai suburban services**
  RDSO has developed the specifications to build a corrosion-free and energy efficient train with regenerative braking, light stainless-steel carriages with a design life of 40 years, air suspension bogies, microprocessor controlled EP braking, fault diagnosis and passenger information and communication systems.
- **Trial of thermoplastic elastomer rail pads**
  The specifications for thermoplastic elastomer rail pads have been finalized and field trials are commencing shortly.
- **Rail–wheel interaction and management of rolling contact fatigue**
  This is being studied jointly with IIT Roorkee.
- **Wheel flat detection system**
  Field studies on a domestically developed system for detecting wheel flats are in progress. The system generates two alarms depending on the severity of the impact force and can detect overloaded wagons.
- **Train actuated level crossing warning system**
  The system is designed to warn road users of an approaching train using audible and visible alarms. Ten installations are in field trials.
- **FRP Sleepers**
  Fibre-reinforced plastic sleepers have been developed as an alternative to wooden sleepers and are being put into revenue service.
- **Digital axle counters (DAC)**
  The aim of this project is to replace the present analog design with a digital system for improved reliability and economy.
- **Development of biodiesel**
  Biodiesel is a clean alternative fuel that can be produced from domestic, renewable resources. Biodiesel has been used as the fuel on a successful test run of the Delhi–Amritsar *Shatabdi Express*. ■

Further Reading

Information about RDSO and its major activities is available on the RDSO website at http://www.rdso.gov.in

Gopal Krishan Wadhwa

Mr Wadhwa is Director General of RDSO. He is a graduate in mechanical engineering and holds an MBA. He has 35 years experience with Indian Railways in project planning, management and manufacturing.