TRACK QUALITY AND MAINTENANCE DEMANDS FOR INTRODUCING 160 KMPH SEMI HIGH-SPEED (SHS) PASSENGER TRAINS ON INDIAN RAILWAYS

- SAFETY ISSUES –

Introduction of T 18 Semi High-Speed (SHS) Rail-Car Train in India with Traction/Aggregate Distribution;

- India`s Pride –

By Dr. Frank August Wingler, Germany
http://www.drwingler.com

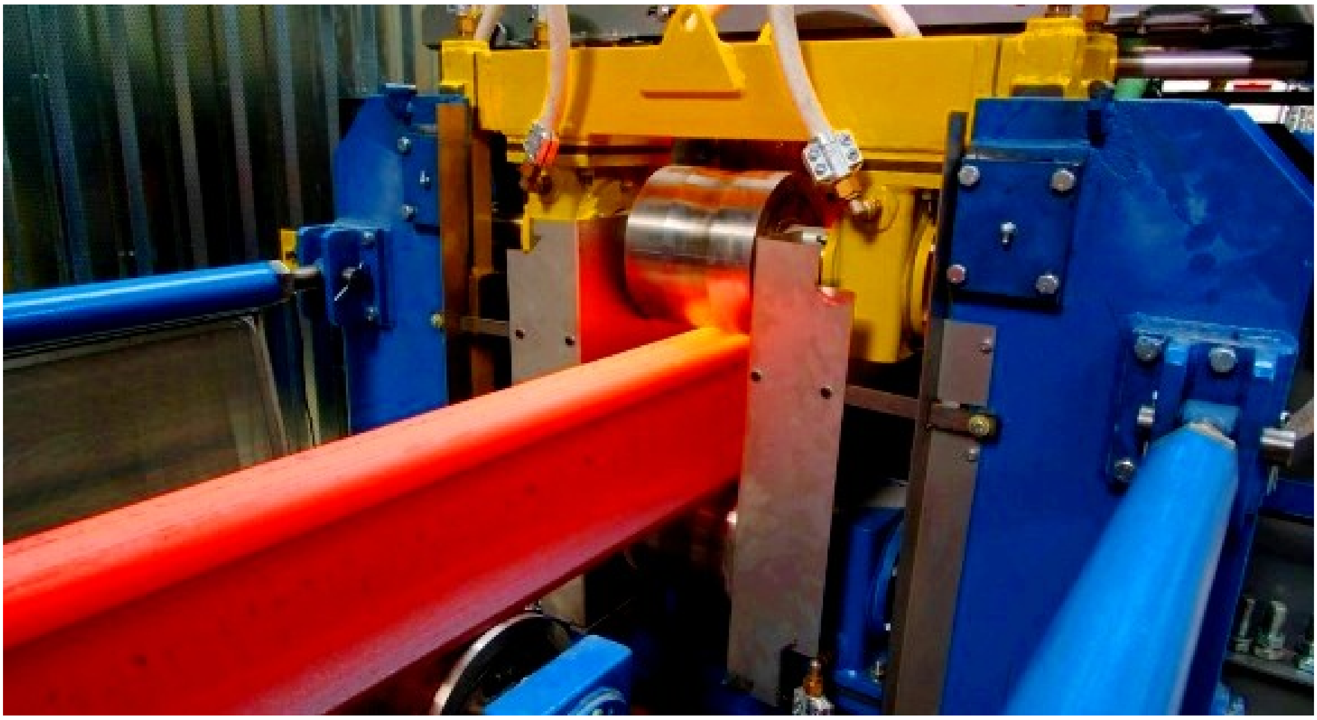
January 2019

FOREWORD

The Challenge in Introducing Speeds of 160 kmph for passenger trains on IR is to meet the Demands for Initial and Inherent Quality of Track, modern Infrastructure Management and modern best Practices of mechanised Maintenances and of Permanent Work Procedures.

Prerequisites for 160 kmph are:

- Well bearing and well drained formation.
- Long rolled rails of high steel-alloy quality.
- High performance turnouts with condition monitoring sensors.
- High standard robotic rail flash-but welding or digital controlled AT welding under supervision of well trained and skilled gangs.
- Under sleeper pads for concrete sleepers and a fit-and-forget replacement rail-fastening system for the current MarkIII ERC fastening.
- Well planned, condition based and predictive modern maintenance practises and procedures executed with appropriated tools and heavy duty & high performance on-track machinery; mechanised track maintenance.
- Regular preventive and target rail-grinding.
- Deployment of automatic train protection/control.



Heat Treatment of long rolled high Quality Rail; British Steel

TRACK QUALITY AND MAINTENANCE DEMANDS FOR INTRODUCING 160 KMPH SEMI HIGH-SPEED (SHS), PASSENGER TRAINS ON INDIAN RAILWAYS - SAFETY ISSUES –

Papers have been asked for the forthcoming International Technical Seminar of I.P.W.E (India) on 22nd and 23rd Feb. 2019 at Hyderabad on ***Challenges in Introducing Speeds of 160 kmph for Passenger Trains on IR***. One point should deal with **Track Maintenance Practices** and its **Effect on Safety**.

On the way to increase the throughput of the system by introducing 160 kmph running passenger trains certain demands on quality and maintenance of infrastructure and track have to be fulfilled, which have an effect on **Overall Life Cycle Costs** and **Safety.**

Fatal Train Derailments on account of track defects are frequent in India. The last occurred on 10th October 2018 when the New Farakka Express on its way to Delhi derailed near Harchandpur/Rae Bareli in Uttar Pradesh at around 6.05 am killing 8 passengers and injuring over 30:

Fatal New Farakka Express Derailment near Harchandpur/ Rae Bareli in Uttar Pradesh on 10-10-2018

The cause had been presumably a defective turnout. The train-driver had been given clear with a green signal to pass at permissible speed.

This unwanted bad event reminds, what can happen when quality of infrastructure and rail-track are not in compliance with train-speed. **Poor quality of infrastructure and rail-tracks as well as inefficient maintenance/working methods cannot go together with SEMI HIGH-SPEED (SHS)!**

I. High Initial and Inherent Quality of Track – a Demand for Semi High-Speed (SHS) Routes:

Most of the demands on infrastructure and rail-track for 160 kmph train speed have been already covered by the presentations on the International Technical IPWE Seminar held 12th & 13th January 2017 at Mumbai with the topic: **"Challenges in Design and Maintenance of Track under Mixed Traffic Regime of Semi High-Speed and heavy Axle-Load"; see also: F.A. Wingler** ***Some Demands for running on one-and-the-same Route higher Axle-Load (25 t) Freight Trains under a mixed Traffic Scheme plus Passenger Trains of different Speed-Profiles: 80 to 110 kmph Speed-Band with ICF Coach Trains and 130 to 160 kmph Speed-Band with LHB Coach Semi High-Speed Trains; Part I and Part II,*** and ***Challenge to increase Route Transport-Capacity and to cut Journey-Time on Indian Railways…*** **–** free for download from http://www.drwingler.com.

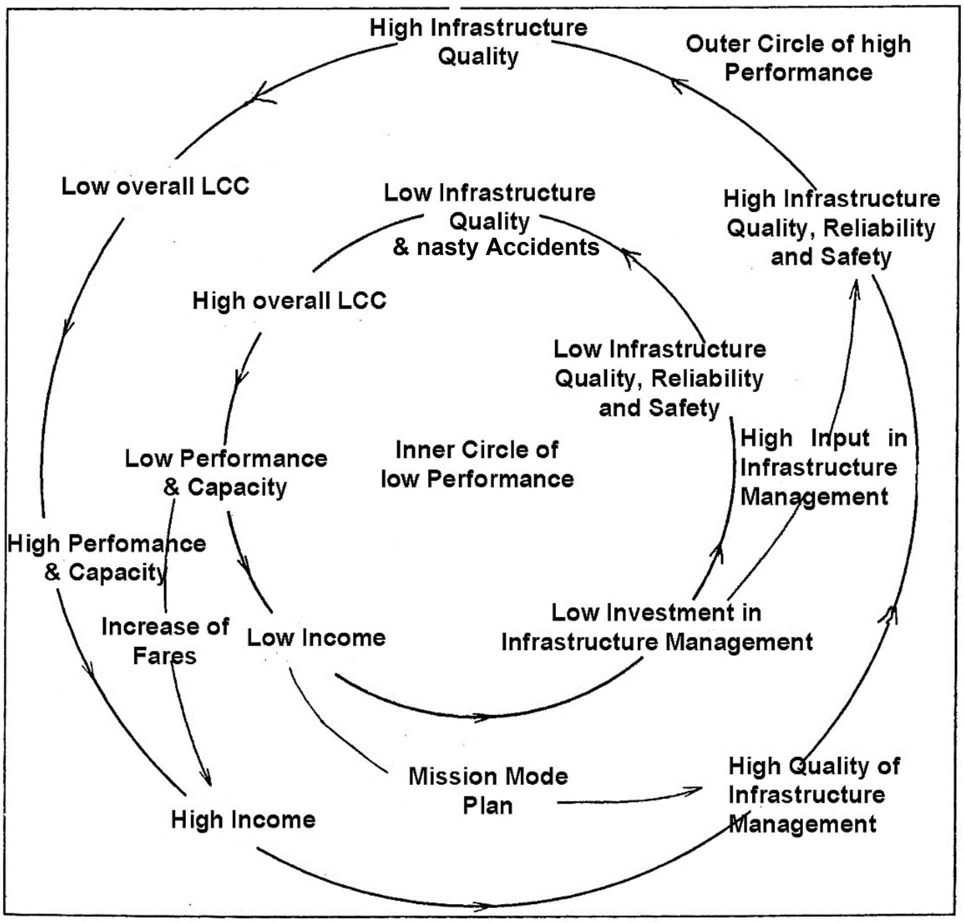
In his paper presented at the 2017 Mumbai IPWE Seminar, Prof. R. Pinjani, IRICEN, PUNE, had pointed out the importance of the **INHERENT TRACK-QUALITY (INHERENT QUALITY OF THE TRACK, TRACK INHERENT QUALITY**). The paper deals with considerations of important track design parameters, i.e. static vertical load intensity, dynamic augment, rate of track geometry deterioration, target defect wave length for track geometry correction, implications of specific locations such as curved track, abrupt change in sub-grade stiffness to cater semi high-speed trains, including proposed actions to deal with.

HIGH INITIAL and INHERENT QUALITY OF TRACK are no Luxury; they are a MUST under LIFE CYCLE and SAFETY CONSIDERATIONS.

The mutual INTERACTION of RAIL-TRACK and RAIL-VEHICLE is governed by Newton`s Laws of Mechanics; see Dr. Arnold D. Kerr, ***FUNDAMENTALS OF RAILWAY TRACK ENGINEERING,*** Simmon-Boardman Books Inc., Omaha, USA, ISBN: 0911382-40-2, 2003, page 252ff.

Indian Railways is locked in a **vicious Circle** of insufficient investment in quality infrastructure-, asset- and rail track-management, low maintenance performance, low safety and high repair- and maintenance-expenditures with the obvious result of high overall Life Cycle Costs (LCC) and **frequent fatal ACCIDENTS** on track account, represented by inner vicious circle of low performance. To reach the outer circle, that of advanced railways,

HIGH INPUT IN INFRASTRUCTUR MANAGEMENT is needed. This is upmost essential for operating Semi High-Speed (SHS) Trains on the IR network.



Inner and outer vicious Circle of Performances representing high and low overall Life Cycle Costs

The Technical University at Graz, Austria, is worldwide the forerunner in pushing up **Track Quality** under overall **LIFE CYCLE COSTS (LCC) CONSIDERATIONS**. In European countries, the aggregated **HINDRANCE COSTS**, the costs/expenditures emerging when the trains cannot run or run only at lower speed and capacity, are included in the overall cost considerations/evaluations/calculations. In India, one is not much concerned about the incurred costs and financial losses, when the trains cannot run or can run only at lower speed or with lower capacity. To keep trains running on a low or **poor quality track** is not only more risky but also more cost intensive.

A **poor or low quality rail-track** needs more frequent surveillance than a high quality track. The lower the track-quality, the more frequent track-inspection and monitoring are appropriate.

A **low quality track** deteriorates faster than a **high quality track**, and hence it needs more maintenance expenditures causing higher costs.

Under overall Life-Cycle Considerations, Quality of Track is a MUST and no Luxury. Life Cycle Costs Considerations are tools for economical track strategies. Under such considerations modern track-technologies have been pushed up; see relevant papers in RTR Special, ***MAINTENANCE & RENEWEAL***, ISBN 978-3-7771-0367-9, DVV Media Group, eurailpress, Hamburg Germany, 2007.

In order to make it cheaper, it is jugglery to hope that through appeals to the ingenuity of the Track-Men technical and physical laws, rules and correlations can be overruled. At the end, jugglery short-cut works will turn out to be far more costly and to bring train-passenger`s freedom from bodily harm and injury at risk.

Heavy Traffic Load/Volume/Speed causes high wear leading to high maintenance demands and hence to high maintenance expenditures, especially on poor quality tracks not matching the traffic load/speed. The relation is over-linear.

A healthy and sound rail-track with a high **Inherent Quality** keeps its properties under given traffic load/volume/speed longer than a less healthy and sound rail-track. Hence, a low quality track deteriorates under given traffic load/volume and speed faster than a high quality track. The rate of deterioration (degradation) is governed by Newton`s Laws Mechanics.

A **high quality rail-track** ages slower and has a longer service live than a **low quality track**. A moderate reduction in **Initial Quality** results in the track condition reaching the threshold for maintenance-intervention much earlier. For a rail-track with **low Inherent Quality** the maintenance intervals become shorter on account of unhealthy, unsound and poor bearing sub-structure and as well on account of poor drainage, than for a rail-track of **higher Inherent Quality.**

Investment delivers just **Initial Quality**, not service life. Maintenance transforms this initial quality into service life. Thus, neglected maintenance devalues the investment done. When the track reacts, service live is already gone. See: F. Wingler, ***Fundamentals of Railway-Track Engineering and Technology; Quotations for achieving sound and healthy Railway-Tracks of high Quality fit for modern "World-Class" Railway-Service***, published April 01, 2018 on http://www.drwingler.com**;** see also ibid: F. Wingler**;** ***INSTRUMENTS MOUNTED ON SCHEDULED RUNNING COMMERCIAL TRAINS (INSTRUMENTED REVENUE VEHICLES, IRV) MAKE USE OF NEWTON`S LAWS OF MECHANICS FOR TRAIN BASED AND IN-SERVICE TRACK-CONDITION MONITORING IN TARGET PLANING OF MAINTENANCE***", published on April 22, 2018. by Chaminda Weerawarna, Category: Rail Track Engineering.

Track maintenance and renewal require a high input of financial resources. About 50% of the renewals budget is spent on the permanent way. Therefore, it is essential that transparency of the permanent way decisions is not only ensured but also continually developed. Digitalization offers a wide range of applications.

Generally, engineering structures display a linear quality and condition behavior (see **Fig. 1**):

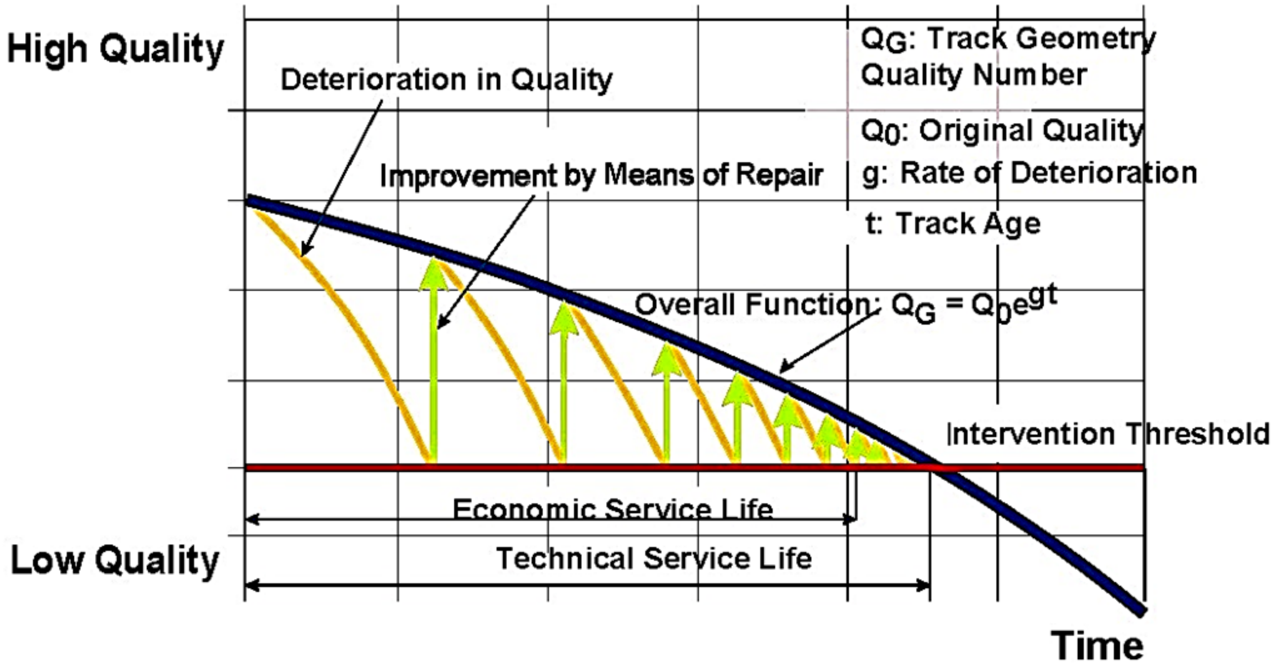


Fig. 1: Quality Behavior of Engineering Structures
[Diagram based on F. Auer, „***Ein Prognosemodell zur Abschätzung der Nutzungsdauer des Oberbaus unter Berücksichtigung der Eingriffsschwelle“***, Thesis, Graz Technical University, Institute of Railways and Transport, Austria, 2002, p. 59.]

The following correlations can be deduced from that: The higher the quality and the better the condition of a system the lower the corresponding deterioration rate and wear of the material. Consequently, the added value of high-quality maintenance becomes obvious. The opposite also applies: An inferior condition of the system will result in a higher deterioration rate and quicker wear of the material.

The asset condition is improved through repair measures. However, it is usually not possible to achieve the level of the system's initial quality with these measures. **The more the material has worn at the time of repair the less sustainable the repair measures will be**.

Fig. 2 shows the difference between technical and economic service life. The economic service life has been reached, when the additional cost from increased maintenance coupled with reduced availability of the track exceeds the reduced amortisation costs. This results in higher life cycle costs. It would be technically possible to extend the service life through excessive maintenance, but this is not economically efficient.

A thesis at Graz Technical University, Austria, showed that a higher threshold of intervention through maintenance has a positive effect on the service life of the systems (see **Fig. 2**); [Diagram based on F. Auer, "***Ein Prognosemodell zur Abschätzung der Nutzungsdauer des Oberbaus unter Berücksichtigung der Eingriffsschwelle"***, Thesis, Graz Technical University, Institute of Railways and Transport, Austria, 2002, p. 82.]:

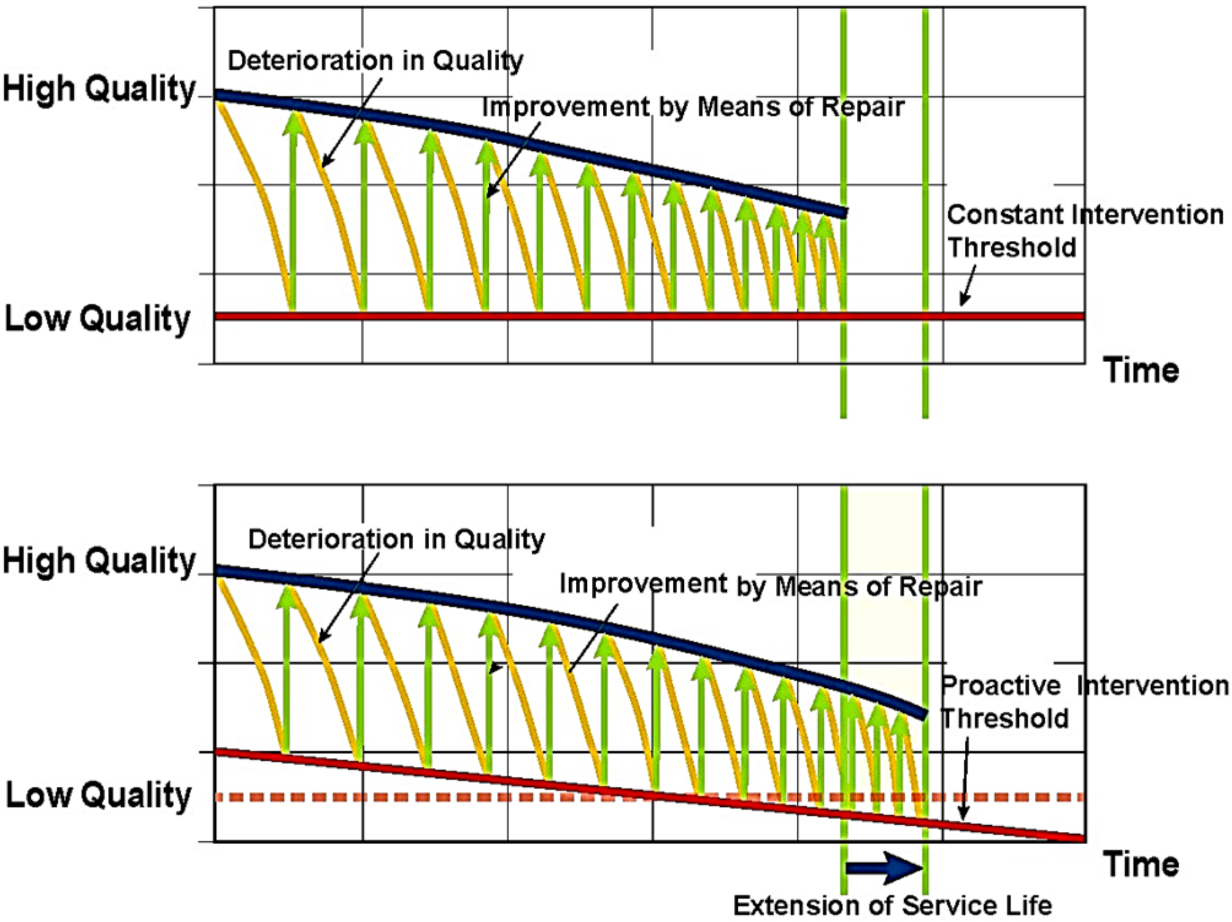


Fig. 2: In Permanent Way Systems the Implementation of a proactive Intervention Threshold results in extended Service-Life of the Assets. – Note: The effect is enhanced in the Diagram.

Guidelines for Infrastructure Management and best Practice in Track Maintenance are summarised in the new edited book of Florian Auer, ***INFRASTRUCTURE MANAGEMENT***, 2018 PMC Media House GmbH, ISBN: 978-3-96245.155-4, Bingen, Germany.

In his new book, Dr. Florian Auer points out:

"Needs-based and reliable rail infrastructure requires all processes associated with the sustainable preservation of the condition of the existing network to be considered and structurally planned over a period of several years ahead. **Continually updated multi-year plans** assist in making efficient use of scarce financial resources".

From this basic behavior, the following principles can be deduced for the permanent way:

- **Provide the highest possible initial quality!** This is to be aimed in the production of track systems. The quality of the initial construction has a massive impact on the service life. The better the initial quality the longer the service life.

- **Level of maintenance quality.** At the beginning of the service life a high level of quality has a highly positive impact on the overall deterioration function. Therefore, repair works carried out in the early stages of a service life should be of a high quality. This will ensure that the required condition can be maintained at a high level as long as possible; this will extend the systems' service life.

- **Transparency of overall system quality.** Infrastructure managers must continually strive to improve the transparency of the system quality. They should combine "transparent system behavior" with the motto "the right measure at the right time".

The two strategic objectives of German Federal Railway, DB Netz AG, are: "High operational quality" and "systems kept in top condition" conform to these principles.

A quality specification must meet the requirements of different viewpoints. A global quality parameter alone cannot cover the different aspects of system behavior. From a **Life Cycle Management Point of View (LCMPV)** it is necessary to shape the quality specification in such a way that separate quality values, which reflect the needs of maintenance processes, are derived for each maintenance process. In this context, it is recommended to subsume the following elements under quality:

"Quality = [Technical] Safety + Functionality + Condition + Material-Properties".

The different aspects of quality are systemically interlinked. To put it simply: Technical safety, functionality, condition and the maintenance of materials behave like **communicating tubes**; see **Fig. 3**:

Fig. 3: Proactive Life Cycle Management means to control the Condition of an Asset sustainably and according to Requirements [Diagram based on F. Auer, "***Ein Prognosemodell zur Abschätzung der Nutzungsdauer des Oberbaus unter Berücksichtigung der Eingriffsschwelle"***, Thesis, Graz Technical University, Institute of Railways and Transport, Austria, 2002].

Of these four quality features only the condition can be actively improved through appropriate repair measures. The level of the quality features technical safety, functionality and material maintenance is a reaction to the repair measures taken.

An improved condition of the system leads to better technical safety, better functionality and reduced wear of the materials. **Proactive Life Cycle Management** means to control the condition of the system sustainably and according to requirements in order to achieve overall optimization of quality, cost and availability.

Most of the Central European Railways have their own infrastructure management providers/cooperation, with own budged and long-term funding agreements with the government, ensuring infrastructure management planning far ahead, which takes into account the actual condition of the network. They generate value through engineering as a service for rail transport in the countries.

Basis for planning are **Status-Reports or Audits** on the condition/status of the countries' full network with regard to their assets-behaviour in order to provide correlations with output quantities and the required financial recourses for re-investment in assets and infrastructures, and as well for maintenance-strategies and planning's.

II. High Initial and Inherent Quality of Track through Heavy Duty and High Performance On-Track Machinery instead of Hammer, Spanner, Shovel or Craw-Bar; Formation Strengthening and comprehensive Drainage Management are crucible for 160 kmph Routes

A track is as good as what is underneath: Subsoil, Subgrade, Formation and Formation Protective Layer (FPL). And Water is the Enemy of a Rail-Track; see F.A. Wingler, ***Ballast, Formation and Drainage, Part I with the Amendment: Water the Enemy of the Rail Track, Part II*,** published free for download on September 18, 2016, on http://www.drwingler.com; and ibid.: ***WITHOUT WELL BEARING FORMATION AND CLEAN BALLAST-BED NO STABLE RAILROAD,*** published on August 13, 2018, by Chaminda Weerawarna, Category: Rail Track Engineering.

Heavy Duty and High Performance On-Track Machinery for Formation Rehabilitation and Ballast Cleaning, AHM 802 R (above) and RM 802 (below) from Plasser&Theurer

The eminent Indian Consultant and Book Author, Mr. J.S. Mundrey pointet out:

For Indian Railways, to move to higher speed, it is necessary to carry out the formation treatment on war footing.

Chinese Railway, appreciating the importance of formation treatment for higher speed, has set up their own factory to manufacture the formation rehabilitation machines AHM-800 R, after purchasing a number of them from Austria.

Indian Railways shall also have to acquire a fleet of formation treatment machines to rehabilitate their tracks.

Apart from general treatment of poor formation, effective measures will have to be taken to have easy track stiffness gradients/transitions. All places, where abrupt changes in track stiffness occur – as on bridge approaches/abutments, tunnels etc. - would need special design inputs in the form of approach slabs, approach sleepers, sand piling, increased sleeper density etc..

To achieve the desired quality standards on Indian Railways, the track construction and track relaying work need to be fully mechanised. The policy frame work for that system needs to be created at Railway Board level. The minimum level of mechanical equipment, needed to be deployed, shall have to be clearly indicated in the contract conditions of track laying contractors. Once such a framework is created, small and big contractors will emerge to handle the track work in the most appropriate manner, deploying the right equipment, producing quality track, comparable with the tracks of advanced railways.

Poor Track Quality trough Manual Track Works with simple Tools in India

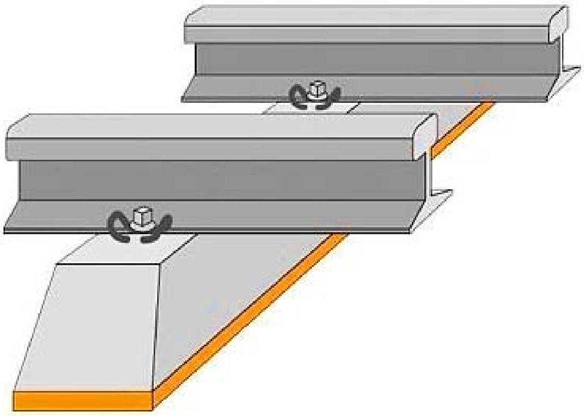
Unprotected manual Track Works in India with simple Tools

Frequent preventive and target **Rail Grinding** with On-Track Machinery extends the service live and reduces in-service failures of rails. Rail-head defects have to be removed before cracks will penetrate into the rail ending in rail-fractures. This will become essential for IR`s 160 kmph tracks.

VOSSLOH High-Speed Rail Grinder HSG-2

German DB NETZ AG could prolong the service life of rails drastically by ***RAIL HEAD MANAGEMENT TECHNOLOGY*** (grinding, milling) under their ***PREVENTIVE MAINTENANCE PROGRAMME.***

Under-Sleeper-Pads (USP) reduce ballast deterioration and extend the intervals for tamping, ballast cleaning and ballast renewing:



GETZNER Under-Sleeper Pad (USP) advisable for IR High Quality Tracks

III. Long rolled Rails of High Steel-Alloy Quality and modern Digital controlled Rail-Welding – a Prerequisite for 160 kmph Rail-Tracks

A prerequisite for high quality tracks catering 160 kmph trains are strings of long rolled rails of high steel-alloy quality, which are factory welded to longer panels (300 to 500 m) and delivered/unloaded on the track by the manufacturer and welded on the track by robotic flash-but welding machines. Alumino Thermic (AT) Rail-Welding on160 kmph rail-tracks have to be performed under strict supervision by well trained operators. Th. Goldschmidt offers computer controlled “Smart Weld”.

Long rolled Rails provided by JINDAL, India, are a Prerequisite for 160 kmph Tracks

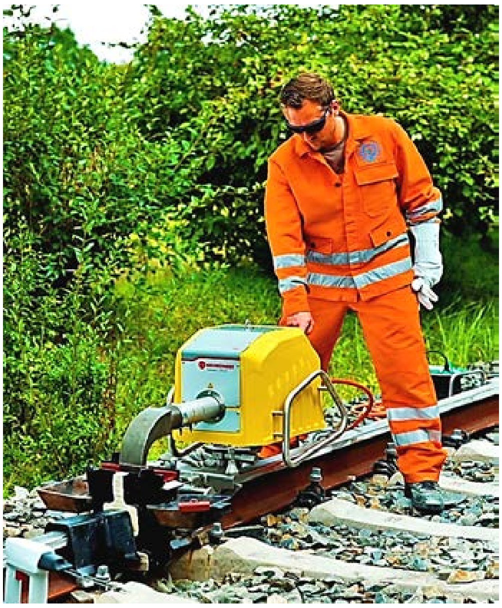
Transport of long rolled Rails on "Robel *Spaghetti* Trailer"

Mechanised Unloading of **long r**olled Rails

Rail-Weld Failures and Rail-Fractures due to poor welding, poor steel-quality and rail-head defects (RCF) have led to a series of fatal Derailment Disasters in India. Tracks composed of short 13 m rails, poorly AT welded to Long Welded or Continuous Welded Rail-Tracks (LWR/CWR) and in need of joggle fish-plates and therefore are prohibitive for 160 kmph train services. On 160 kmph tracks rails have to be regularly freed from rail-head defects by rail-grinding and/or milling befor cracks might grow into the rail causing fractures.

Rail-Weld and Rail-Head Defects leading to fatal and nasty Derailment Disasters on IR

High Quality Rail-Welds by Th. Goldschmidt`s Digital controlled AT "SmartWeld"



High Quality Rail Welding with mobile Robotic Plasser&Theurer Flash-But Welding Machine

IV. Turnouts are Main Cost-Drivers and Trouble-Spots inviting for Derailments; Demands for High Performance Turnouts with Diagnosis Sensors for IR Semi High-Speed (SHS) Routes

Turnouts – frequent Trouble Spots on IR

Modern Turnouts by Vossloh for Heavy Haul

Main Cost Drivers in Maintenance are Curvatures and Turnouts/Crossings. Heat Hardened/Bainitic Low Fatigue (BLF) Rails are asked for curvatures, turnouts and crossings. Turnouts/Crossings should be installed with a diagnosis system; see relevant presented papers at the IPWE ***International Seminar on leveraging Developments in Monitoring Technology for Optimising Track, Bridges and Tunnels Maintenance,*** held 23/24th February at Guwahati, India. A Derailment at 160 kmph on a turnout can lead to a disastrous catastrophe; see above: Fatal **New Farakka Express Derailment.** Optimising Turnouts and providing Turnouts with Diagnosis Sensors for Failure Diagnosis and Predictive Maintenance Strategies will become essential on IR 160 kmph routes.

German Federal Railway (DB) works together with Munich-based Internet of Things (IoT) startup ***KONUX*** to improve the availability of high-speed turnouts through predictive maintenance.

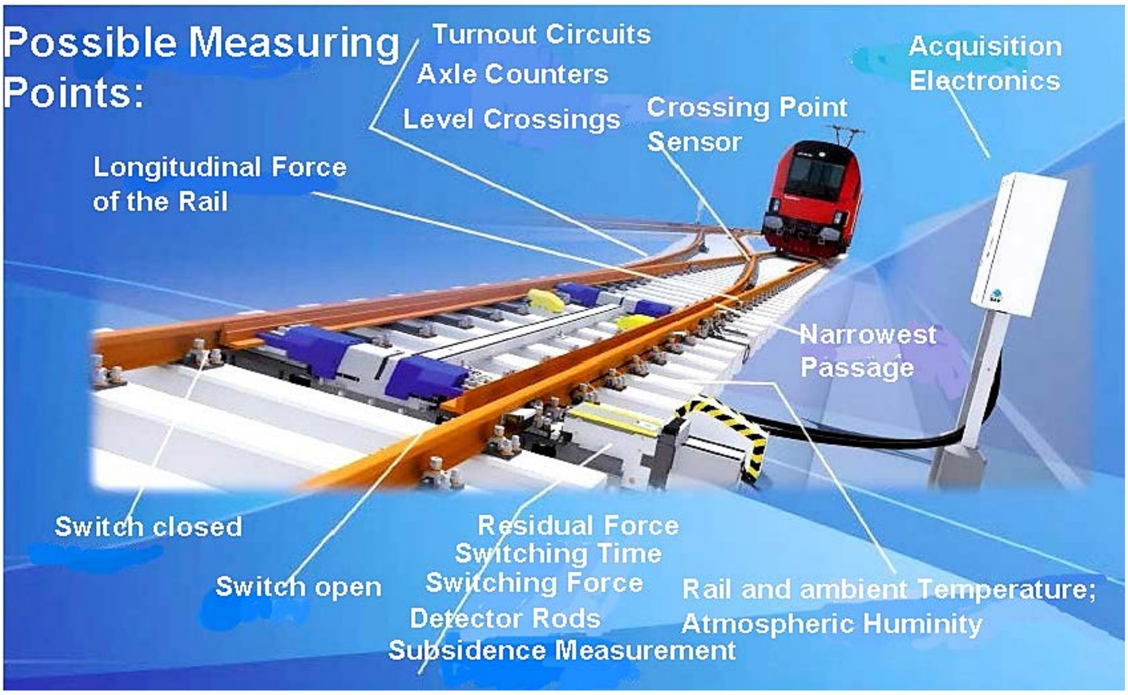
The ***KONUX*** sensors detect vertical movement in sleepers as a train passes over a turnout. Data collected by the sensors is transmitted to DB's ***DIANA*** diagnosis and analysis platform, which already monitors more than 15,700 point motors across the network; see F. Wingler ***LEVERAGING DEVELOPMENTS IN MONITORING TECHNOLOGY FOR OPTIMISING TRACK MAINTENANCE – Switch Monitoring and Diagnosis Systems,*** published on http://www.drwingler.com on January 11, 2018 by Chaminda Weerawarna; Category: Rail Track Engineering.

DB says, complementary applications such as ***KONUX*** enable a holistic digital image of a turnout to be created.

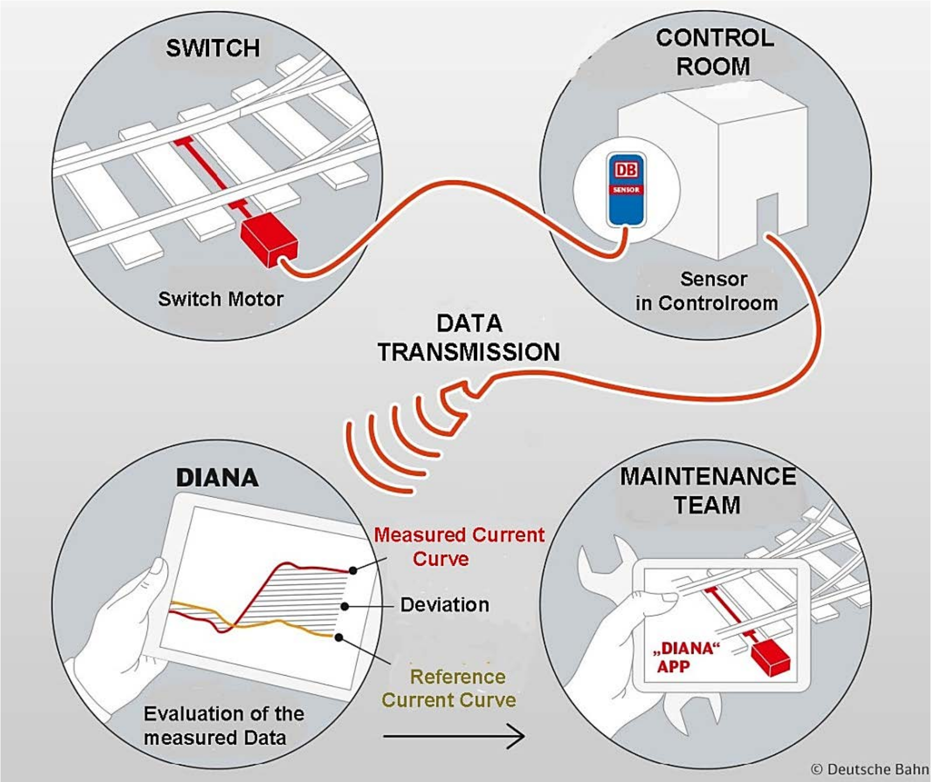
The trial phase involved equipping 100 turnouts with the technology. With the conclusion of the contract, DB and ***KONUX*** have agreed to investigate other areas, where the system could be used to predict damage before it occurs.

KONUX Diagnose Sensor on DB Turnout

Voest Alpine, Austria offers its Turnout Diagnosis System ***ROADMASTER*** and German Railway (DB) developed the system ***DIANA*:**

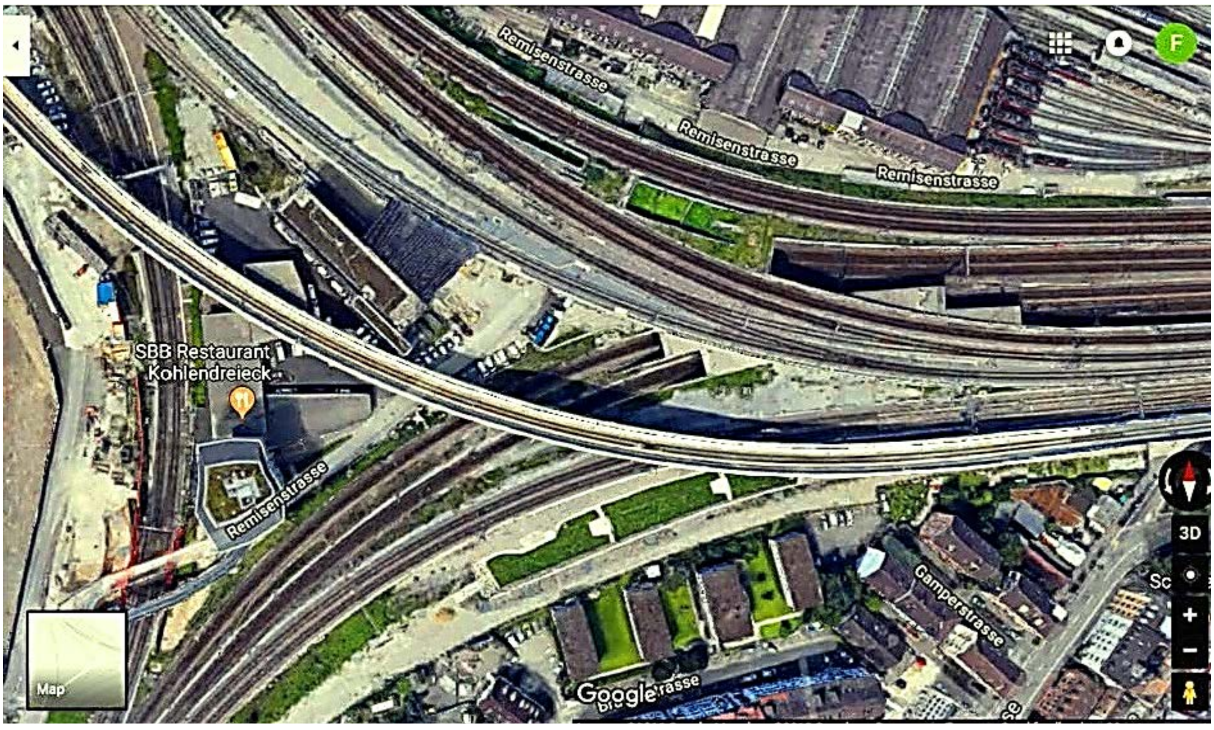


Voest Alpine ROADMASTER Turnout Diagnosis System



German Railway's Turnout Diagnosis System *DIANA*

To minimize the number of turnouts and crossings and to increase the route capacity resp. to cut the journey times, IR should go for grade-separation as road highway engineers do; see F. Wingler on http://www.drwingler.com: ***Challenge to increase Route Transport-Capacity and to cut Journey-Time on Indian Railways without the Need of a Mixed Traffic-Regime/Scheme with higher Axle-Load for Freight-Trains combined with Semi High-Speed for Passenger-Trains;*** published March 25, 2017**:**



Google Map of Rail-Track Grade-Separation at Zurich Main Station, Switzerland
- Rail-Track Grade-Separations cut Journey Time -

V. 160 kmph Rail-Tracks need Attendance free ***"Fit-AND-FORGET"*** Rail-Fastening System

For a 160 kmph track, when it comes to a sleeper renewal, the MARK III ERC rail fastening system should be changed for a ***"FIT-AND-FORGET"*** System. The present Indian MARK III ERC Fastening, which needs attendance ***"nearly as every train goes",*** is by far NOT ***"FIT-AND-FORGET***"!!!!

Indian Tracks with Mark III ERC Fastening need constant Surveillance and patrolling Key-Men to drive loose or fallen-off ERCs back into the Housing - a Practice, which becomes prohibitive at Train-Speeds of 160 kmph

On IR Rail-Tracks per year about 100 to 120 Track-Men are losing their lives on duty.

On a high quality rail-track, a speed of 160 kmph makes it prohibitive to send a key-man regularly on patrol to hammer loose or fallen-off ERC`s back into the housing/tunnel; see F.A. Wingler: ***Demand for Attendance-free "fit-and-forget" Rail-Fastening on envisaged Indian Railway`s "Semi High-Speed" Routes;*** published on: February 25, 2017 by Chaminda Weerawarna**:**

Although the indirect Pandrol Fast-Clip fastening systems are superseding worldwide the e and 401 Series Pandrol Type ERCs, the **Dowel-Bolt Type** direct fastenings with SKL tension-clamps from VOSSLOH/SCHWIHAG will be more advisable for India. Repair in case of corrosion will be easier. Such direct fastening systems have also the advantage, that elasticity and clamping force can be adjusted, especially on transits of abutments to bridges.

Pandrol Fast Clips are superseding worldwide the e-Series and 401 Series ERC`s

Mechanised Laying of new Sleepers and Rails with direct Screw/Dowel *VOSSLOH* SKL Tension-Clamp Fastening

On Central European rail-tracks one can **NOT** detect patrolling key-men refastening or retightening the fastening systems, as in India. The dowel/SKL direct systems are favoured by the Central European Railways of the ***DACH*** working Groups (DB, ÖBB, SBB-CFF-FFS) and nowadays also in China.

VI. Rail-Tracks for 160 kmph Semi High-Sped (SHS) need constant Condition Monitoring for Target Planning of Maintenance

The author has published free for download on http://www.drwingler.com three technical railways papers covering recent developments and worldwide trends in leveraging developments in Track-Monitoring Technologies, that will be of importance for IR`s 160 kmph rail-tracks:

I. ***LEVERAGING DEVELOPMENTS IN MONITORING TECHNOLOGY HELP TO ACHIEVE SOUND AND HEALTHY RAIL-TRACKS FOR A MODERN "WORLD-CLASS" RAIL-SERVICE;*** published on: February 25, 2018/March 11, 2018;

II. ***LEVERAGING STATUS-REPORT/AUDIT ON TRACK-CONDITION OF THE WHOLE NETWORK OF INDIAN RAILWAYS – A TOOL FOR LONG-TERM CAPITAL INVESTMENT-SCHEMES AND MAINTENANCE- STRATEGIES*****;** published on: December 25, 2017/January 11, 2018;

III. ***DYNAMICS OF TRACK-TRAIN INTERACTIONS; MAKING USE OF NEWTON`S LAWS OF MECHANICS WITH MONITORING INSTRUMENTS MOUNTED ON SCHEDULED RUNNING COMMERCIAL TRAINS (INSTRUMENTED REVENUE VEHICLES, IRV) IN TRAIN BASED IN-SERVICE MONITORING FOR TARGET PLANING OF MAINTENANCE;*** published on: April 22, 2018/May 18, 2018.

The worldwide trend in track monitoring is to capture data on track condition by sensors mounted on bodies or bogies of scheduled running trains.

Automatic in-service track-condition monitoring through data acquisition by means of Instrumented scheduled running commercial Revenue Vehicles (IRV), making use of **NEWTON`S LAWS OF MECHANICS,** drive track maintenance efficiency; see Ravi Ravitharan, Director, Institute of Railway Technology Monash University, Australia; paper presented on the Permanent Way Institution NSW Annual Convention 27th Oct. 2017 at Sydney, Australia (see ANNEXURE I); Railway Gazette International, March 2018, page 34.

The Economic Times, Railways; Mar 24, 2018, informs: "**Railways to install Coach Defect Monitoring Systems for Safety":**

SHIMLA: In a move to create a "Zero Accident" network, the Indian Railways has decided to install **"Coach-Defect Monitoring Systems"** on 65 rail sections across the country.

Officials said these include 25 sections on Central and Western Railway, both of which have an extensive rail network in Maharashtra.

"The sections on WR and CR, where we plan to have these systems include Wardha-Nagpur and Bhusawal-Jalgaon on CR and Mumbai-Surat and Surat-Baroda on WR," a senior official of Northern Railway said.

It will cost Rs 115 crore to set up the system in these 25 sections, the official said.

Explaining the mechanism, Arun Arora, Principal Chief Mechanical Engineer, NR, said, "The Online Monitoring of Rolling Stock (OMRS) System involves the placing of microphones and sensors in such a way that they record any audible noise or measure forces generated while a wagon, coach or locomotive is in motion."

"The OMRS equipment is extremely sensitive and accurate and can detect the most minute of abnormal noises emanating from rolling stock (railway term for trains) and will alert the control room immediately", he said.

He informed that the trial of the OMRS on the busy Lucknow-Delhi stretch was successful following which it was installed on the Delhi-Panipat section.

"This system allows us is to do away with the current method, which involves the physical examination of rolling stock in workshops," Arora said.

Another official said that it would ensure faster maintenance of coaches and also allow coaches to be monitored using mobile communication facilities.

Data capturing Sensor mounted on Axle-Box of a HLB Coach

VII. Automatic Train Protection/Control is advisable for Semi High-Speed (SHS) Routes to avoid unwanted nasty and bad Mishaps – Safety Issues –

In the recent global history of High-Speed (HS) and Semi High-Speed (SHS) Trains there had been four fatal and nasty derailment disasters. All four accidents occurred at a transition from straight (tangent) to curved track. In all four incidents the Automatic Train Protection/Control had been either switched off or not yet installed, and the trains entered the curves too fast:

2013 Santiago de Compostela, Spain, HS fatal Train Disaster

2015 Philadelphia, USA, Amtrak SHS fatal Train Disaster

2015 Eckersheim, Alsace-France, TGV HS fatal Train Disaster

2017 Cascade, Dupont-Washington, USA SHS fatal Train Disaster

India could take a lesson and deploy on the envisaged 160 kmph Semi High-Speed (SHS) routes and trains an Automatic Train Protection/Control System, something like Positive Train Control (PTC, USA), European Train Control System (ETCS, Europe, China) or SmartTrain 4.0 (Switzerland) in order to safeguard the Semi High-Speed Trains (SHS) by speed control, especially on transitions of straight (tangent) to curved tracks.

With the T 18 160-180 kmph SHS Rail-Car Train with traction and aggregate distribution mounted on the passenger racks (without a locomotive) India got a world class standard train; the pride of India. The technology and design are based on the Siemens engineered German ICE 3.

The recent 2018 **FIRE** of the ICE 3 on its HS route from Cologne to Frankfurt near Montabaur has triggered of a discussion amongst experts of the risk to install the transformer/IGBT-converter with its cooling oil tank and devices under and on a passenger rack.

The passengers in the fire engulfed German HS ICE 3 coach hat a narrow escape:

Transformer/Converter cooling Oil Tank of German High Speed ICE 3 catches Fire near Montabaur; 7-12-2018, Germany

But what will happen, if India`s pride, the T 18 Semi High-Speed Rail-Car Train will catch fire due to a derailment on account of a track/turnout defect?:

India`s Pride the SHS T18 Rail-Car Train with Traction and Aggregate Distribution under and on the Passenger Racks

FIre Protection of Rolling Stocks is on the International Agenda: