

# GUIDELINES FOR IMPROVING INDIA'S RAIL-ROADS TO ENSURE “CLOSE-TO-ZERO” FATAL DERAILMENT DISASTERS, AND FOR NEARLY ACCIDENT FREE RAIL-TRAVEL

By Dr. F.A. Wingler, December 2017



Vision of a sound and healthy Rail-Road **matching the Traffic Load**

## **PREFACE:**

*It can never be ethically acceptable that people are killed or seriously injured when moving within a transport system!*

*Rail-Track Engineering and Technology is not difficult to understand. However, it is difficult to make it comprehensible for Politicians, Decision-Bearers and Upper Echelons how a rail-track behaves under traffic load and what can be done in order to reduce the risks of Derailment-Disasters killing and injuring train passengers (“risk” is the product of probability of a bad incident to occur, the impact it has and the harm it produces).*

*Indian leadership wants to give Indian Railways the semblance of a world-class technology driven organization. But Trains derail on poor quality and rapid aging rail-tracks not matching the increasing traffic load, killing and injuring train-passengers.*

## **SUMMARY:**

Indian Railways show two faces, a “**brilliant**” and an “**ugly**” face. With the “brilliant” face IR can look on outstanding engineering results with new Railway Lines, Gauge-Conversion Projects, Bridge and Tunnel Constructions and with Introduction of new comfortable and faster running Trains. With the “**ugly**” face IR look on the spate of unwanted and nasty Train Derailment-Disasters killing and injuring Train-Passengers, on account of not optimised

Wheel-Rail Systems, rapid aging rail-tracks and on account of Track-Quality not matching the increased traffic load/volume.

India is ready to go for **High-Speed Train-Services**, but is not in a position to keep all its rail-roads in sound and healthy condition by proper repair, maintenance, rehabilitation, enhancement and renewal for “**Close-To-ZERO**” **Derailment Risks ensuring nearly Accident free Rail-Travel. Several routes age faster than they can be rehabilitated or renewed.**

People want to use a safe railway. Rail-tracks are an area presenting a great opportunity to achieve safety benefits. It is the obligation of the Indian Government to provide rail-tracks assuring close-to-zero fatal derailment-disasters and ensuring accident free rail-travel.

A railway-organization is only as good as the condition of its track-infrastructure. Therefore, it is in its original interest to optimize it and to keep it always on a high quality standard, which serves both the interests of its customers and business as well the operational safety.

World countries, whose economy can afford 300 kmph high-speed train services, have faced in the past decade **ZERO** killed or injured train-passenger due to a Derailment on account of an in-service failure of rail-tracks. They maintain, rehabilitate and renew all rail-roads in order to keep them in sound and healthy condition, fit for the traffic load/volume they have to carry.

It is not possible to achieve a **HIGH QUALITY** rail-track with short 13 m Indian rails with AT welds requiring to be bandaged with joggle-fishplates.

An underlying factor for the spate of fatal Derailment-Disasters in India, killing and injuring train passengers, are the aging long-welded (LWR) and continuous-welded (CWR) rail-panels consisting of poorly AT welded 13 meter short rails of sometimes inferior steel-alloy quality and in need to be bandaged with joggle-fishplates. Those panels age faster than they can be replaced or renewed by long milled rails of high steel-alloy quality and welded by modern robotic flash-butt welding methodology. It needs long-term strategies and high capital investment schemes to renew the aging LWR/CRW tracks.

To keep the quality of all rail-roads in India in compliance with the increased traffic load/volume, massive capital investment schemes of long-term certainty in Safety related infrastructure-works, especially in high quality of rail-tracks on all routes, are needed. And “**long-term**” in Railways means really long, covering a period of 5 to 15 years ahead for planning, organisation, logistics and procurements. Enough skilled and well trained manpower, materials, tools, **Monitoring/Inspection Technology** and **Heavy-Duty and High- Performance On-Track Machineries** are needed. High track quality means low track-deterioration rate, resp. slow aging under given traffic load/volume and hence low overall

life cycle maintenance costs.

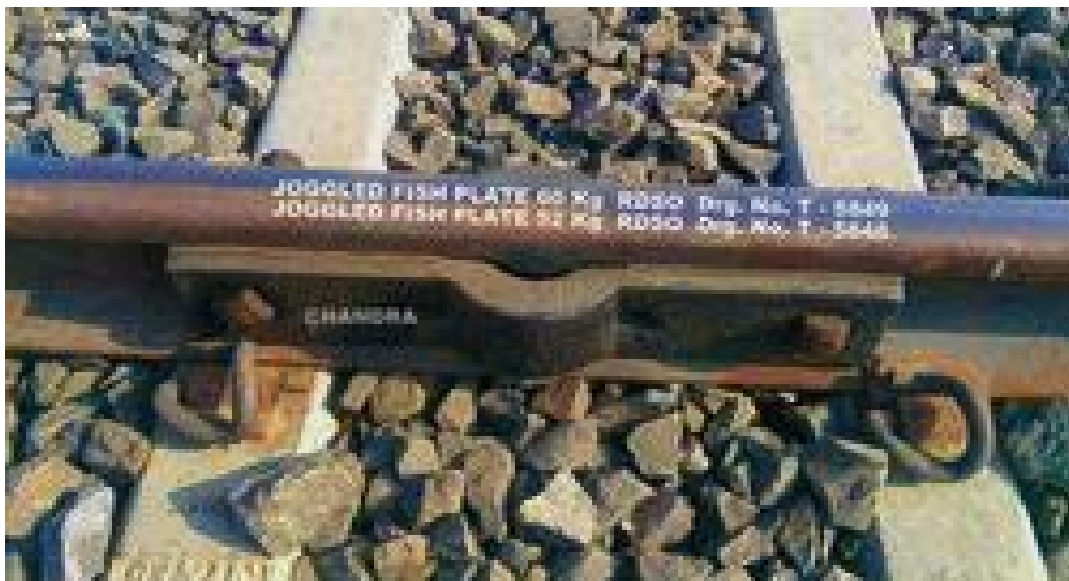
The lower the Track-Quality, the more frequent Track-Inspections and Monitoring are appropriate. A **low Quality Track** deteriorates faster than a **high Quality Track** and hence needs more maintenance expenditures causing higher costs.

Strong commitment and skilful execution of all people involved from the top to the bottom are prerequisites of paramount importance in order to reach the ultimate goal of **“Close-To-Zero Fatal Train Accidents”** by improving all India`s Rail-Roads up-to world class standards; see ANNEXURE I.

One Indian expert has quoted: **“The problem in India is not of safety standards but the execution of standards”**, see ANNEXURE II.

### **MESSAGE:**

Invest in bringing all Indian Railway-Tracks in sound and healthy condition, fit to carry the increased Traffic-Load/Volume, and then there will be **NO** Derailment-Disaster on account of rail-track failures, killing and injuring Train-Passengers. Indian Railways should get rid of its short 13 m rails poorly AT-welded to Long Welded (LWR) or Continuous Welded Rail (CWR) Panels, which need to be bandaged with Joggle-Fishplates. Indian Railways have to overcome the need for spot/patch track repairs, the so-called **“Fire-Brigade”** repairs, by investing in **High Initial Track Quality**.



RDSO designed Joggle Fishplate Bandage for Indian AT Welds

### **I. FUNDAMENTAL CONSIDERATIONS:**

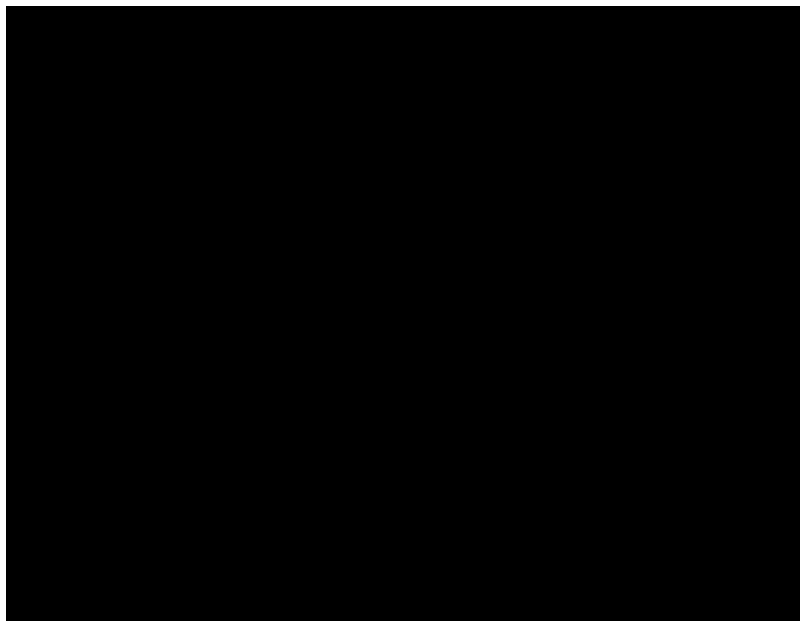
With each train goes, a Railway Track is subjected to changes; the track is not anymore the same, as it had been before a train-run. Every running train leaves by its dynamic load a marginal trace in the track adding to the **Rate of Deterioration** = the differential Loss of Stability and Alignment Parameters with the time under given Traffic Load/Volume. With every train goes, a track is subjected to aging like **“every water-drop adds to the hole in the stone”**.

After a certain Traffic Load, by cyclic **Maintenance**, the track has to be brought back near to what it has been before. However, the original initial high **Track Quality** cannot be reached any more unless by complete **Rehabilitation** or **Renewal**. After a certain number of repeated maintenance operations the end of the life-span will be reached. If one waits too long, a threshold will be reached, from which onward it becomes risky to render the rail-service without drastically reducing the speed, the traffic load and volume. A track has always to be kept sound and healthy, fit to carry the dedicated traffic load/volume for which it is meant.

People want to use a safe railway. Rail-tracks are an area presenting a great opportunity to achieve safety benefits. It is the obligation of the Indian Government to provide rail-tracks assuring close-to-Zero fatal Derailment-Disasters.

To keep the quality of a rail-road in compliance with the traffic load/volume, it has to carry, massive investment schemes of long-term certainty are needed. And “**long-term**” in Railways means really long, covering a period of 5 to 15 years ahead for planning, organisation, logistics and procurements. Proper current working manuals, enough well trained and skilled manpower, material, tools, **Monitoring/Inspection Technology** and **Heavy-Duty/High-Performance On-Track Machineries** are needed.

Strong commitment and skilful execution of all people involved from the top to the bottom are prerequisites of paramount importance. In order to meet the required quality, a rail track, fit for 80 to 160 kmph, cannot be any more maintained by conventional manual labourer’s work. Maintenance has to be mechanised:



Outdated manual Labour Work **unsuitable** for high Quality Tracks

## II. ACHIEVING RAIL-TRACK QUALITY THROUGH MODERN RAIL-TRACK TECHNOLOGY

**- FUNDAMENTAL QUOTATIONS FOR QUALITY, INNOVATIONS IN MAINTENANCE MANAGEMENT, FOR SUSTAINABLE TRACK AND FOR ECONOMICAL MODELLING OF PREVENTIVE MAINTENANCE**

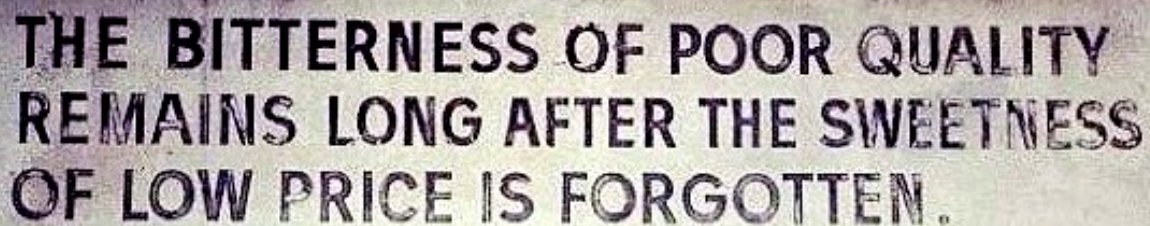
Under Overall Life-Cycle Considerations **Quality is no Luxury; it is a Must.** In order to make it cheaper, it is jugglery to hope that through appeals to the ingenuity of the Track-Men technical and physical laws, rules and connections can be overruled. At the end, jugglery short-cut works will turn out to be far more costly and to bring train-passenger's freedom from bodily harm and injury at risk.

University Professor **JOHN RUSKIN**, Oxford, UK, 1819-1900, gave a quotation, which can be evaluated as a summing-up for this economical proof on basis of **QUALITY, LIFE CYCLE COSTS** and **LIFE CYCLE COSTS CONSIDERATIONS**:

***“There is hardly anything in the world, that some man cannot make a little worse and sell a little cheaper. And the people who consider price only are this man's lawful prey.***

***It is unwise to pay too much, but it is worse to pay too little. If you pay too much, you sometimes lose some money on the long run. On the other hand, if you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do. The common law of business balance prohibits paying a little and getting a lot – it can't be done. If you deal with the lower bidder, it is well to add something for the risk you run. And if you do that, you will have enough to pay for something better!”***

***“Quality is always the result of high intention, sincere effort, intelligent direction and skilful execution. It represents the wise choice of many alternatives”.***



**THE BITTERNESS OF POOR QUALITY  
REMAINS LONG AFTER THE SWEETNESS  
OF LOW PRICE IS FORGOTTEN.**

Quotation by Benjamin Franklin, 1706-1790, USA





Modern High Quality heavy Haul Rail-Track in Australia

## **QUOTATIONS FOR FUNDAMENTALS OF RAILWAY-TRACK ENGINEERING AND TECHNOLOGY:**

***“A TRACK IS ONLY AS GOOD AS WHAT IS UNDERNEATH”;***  
***“A TRACK IS ONLY AS GOOD AS ITS WEAKEST SPOT, BECAUSE A TRAIN MIGHT  
DERAIL ON SUCH A SPOT”;***  
***“WITHOUT PROPER WELL BEARING AND WELL DRAINED SUBSTRUCTURE:  
SUBSOIL, SUBGRADE, FORMATION AND BLANKET, NO STABLE RAIL-ROAD”;***  
***“THE LONGIVITY DEPENDS ON DRAINAGE AND IF THE WATER CAN BE TAKEN  
OUT AND KEPT AWAY FROM THE TRACK BED”;***  
***“WATER IS THE ENEMY OF THE RAIL TRACK”;***  
***“CLEAN AND UNFOULDED BALLAST IS THE BLOOD OF THE RAIL TRACK”;***  
***”TRACK QUALITY IS NO LUXURY”;***  
***”A LOWER QUALITY TRACK DETERIORATES FASTER THAN A HIGHER QUALITY  
TRACK”;***  
***THE LOWER THE TRACK-QUALITY, THE MORE FREQUENTLY TRACK-  
INSPECTIONS/MONITORING ARE APPROPRIATE;***  
***“ONE HAS TO MANAGE EFFECTIVELY THE ALL-IMPORTANT WHEEL - RAIL  
SYSTEM”;***  
***“WITHOUT SOUND AND HEALTHY RAIL-TRACKS OF HIGH QUALITY, MATCHING  
THE TRAFFIC-LOAD/VOLUME, NO MODERN RAILWAY SERVICE WITH CLOSE-TO-  
ZERO MORTALITY RATE IS POSSIBLE!!!”***

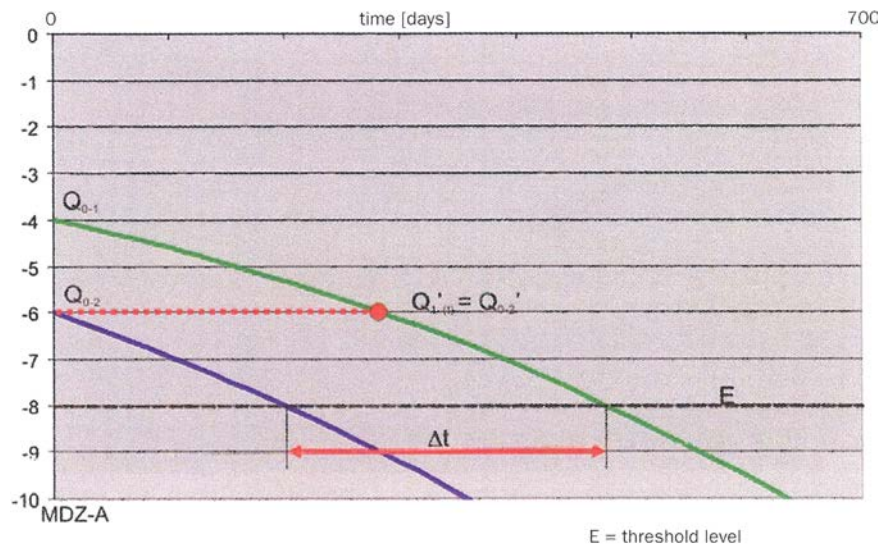
Professor Dr. Peter Veit from the Technical University of Graz, Austria, who is one of the leading top Railway-Track Experts from around the globe, teaches in his lecturing's:

Heavy Traffic Load/Volume causes high wear leading to high maintenance demands and hence to high maintenance expenditures.

A healthy and sound rail-track with a high **Inherent Quality** keeps its properties under given traffic load/volume longer than a less healthy and sound rail-track. Hence, a low quality track deteriorates faster than a high quality track (Prof. Dr. Peter Veit: **TRACK QUALITY – LUXURY OR NECESSITY**, RTR Special: **Maintenance & Renewal**, July 2007, DVV Media Group, Hamburg, Germany, ISBN: 0079-3-7771-0367-9; see also R. Pinjani, IRICEN, PUNE, INDIA: **“Important Track Design-Parameters to**

**cater Semi High-Speed & heavy Axle-Load Trains**", Technical Paper No. 2, presented on the International IPWE Seminar, held 12/13 Jan. 2017 at Mumbai).

In other words: A high quality rail-track ages slower and has a longer service life than a low quality track. A moderate reduction in Initial Quality results in the track condition reaching the threshold for maintenance-intervention much earlier: (Prof. Dr. P. Veit and Dr. B. Lichtberger, ETR Special, **MAINTENANCE AND RENEWAL**, July 2007, ISBN 978-3-7771-0367-9, DVV Media Group GmbH, Hamburg, Germany):



Influence of Initial Track Quality on Threshold for needed Maintenance

The **Inherent Quality** is governed by what is underneath of the superstructure-components (superstructure-components; consisting of Sub-Ballast (Blanket), Sleepers, Rail-Fastening Systems, Rails), and by the bearing quality and property of the sub-structure components consisting of Sub-Soil, Sub-Grade, Formation (Strata):



Cross-Section of a deformed Rail-Track with Strata/Sub-Grade, Subsoil, Formation protective Geo-Textile, Sub-Ballast Blanket, Ballast, Sleeper, Rail-Fastening System, Rail

In cases, where the sub-structure is unhealthy and unsound, **Optimising the Rail-Track** is not possible. For a rail-track with lower inherent quality the maintenance intervals become shorter on account of unhealthy, unsound and poor bearing sub-structure as well on account of poor drainage, than for a rail-track of higher inherent quality.

**Track Quality** can be defined by the **Track Deterioration-Rate**, the differential loss of track-parameters under given traffic load/volume over the time. The loss of Quality can be described by the 'e' function:

$$Q_t = Q_n \times e^{-bt}; \text{ whereas}$$

$Q_t$  presents the actual Track-Quality and  $Q_n$  the **Initial Track-Quality** after Renewal;  $b$  = Deterioration-Rate;  $t$  = Time passed since initial Construction or Renewal.

Investment delivers just **Initial Quality**, not service life. Maintenance transforms this initial quality into service life. Thus, neglected Maintenance devalues the investment done.

Obviously, **HIGH QUALITY STRATEGIES** can form a stable and thus cheap track. The better the **Initial Quality** the less is the maintenance demand.

The bearing quality of the **Sub-Structure Components** in their entity, the cleanness, resp. fouling-degree of the **Ballast** and as well the drainage, all have a great influence on “ $b$ ”.

Regular **Ballast-Cleaning** and as well as **Formation-Rehabilitation** by **Heavy-Duty and High-Performance On-Track Machineries** are essential for a sound and healthy Rail-Track assuring **close-to-Zero Risks for Trains to derail**.

**If one waits too long with Overhaul, Rehabilitation and/or Renewal it becomes not only risky for the Train-Service. The future Maintenance-Expenditures will rise up by up-to 4 fold!! On the other side, too early Rehabilitation and/or Renewal are un-economical. Therefore, under economical as well under safety considerations, an optimum point in time for the Maintenance, Rehabilitation and Renewal has to be found.**

Prof. Dr. P. Veit quotes: **“A Rail-Track behaves like an Elephant”!** A track can tolerate a lengthy period of overuse, carelessness, neglect and ill-treatment until it will react. Like an Elephant, a Track has a memory for neglected care and ill-treatment. But be sure, suddenly the track remembers missing care and runs like an Elephant berserk throwing off the train:





Photo: A. Bhattacharya

NG Rail-Track of Darjeeling Hill Railway remembered on 10<sup>th</sup> Jan. 2017 near Mahanadi the Negligence and it run berserk throwing off the Train from the Track



The BG Track at Manikpur remembered on 24<sup>th</sup> November 2017 the Negligence, and it run berserk throwing off the Vasco-Patna Express 12741 from the Track

When the track reacts, service live is already gone. Thus, when the track takes revenge like an elephant, it is already too late for maintenance. Unfortunately this happens too often in India ending in nasty and unwanted **Train-Derailment Disasters, killing and injuring Train Passengers**, so also at the Howrah-Jabalpur Shaktipunji Express Derailment Site near Obra Dam, at 7<sup>th</sup> September 2017 or at the Vasco-Patna Express 12741 Derailment Site near Manikpur, UP, on 24<sup>th</sup> November 2017:



Fatigue Rail-Crack on Account of missing Intervention through Maintenance (preventive Rail-Grinding), leading to the 07<sup>th</sup> September 2017 Derailment-Disaster near Obra Dam

For the guidelines of Prof. P. Veit see: **“SUSTAINABLE TRACK”**,  
[www.mavkfv.hu/download/Sustainability\\_ProfDrPeterVeit.pdf](http://www.mavkfv.hu/download/Sustainability_ProfDrPeterVeit.pdf);  
 and **“LIFE CYCLE MANAGEMENT OF TRACK – Economic Modelling for preventive Maintenance”**; paper presented on 17.06.2015 at Paris, France;  
[https://online.tugraz.at/tug\\_online/voe\\_main2.getVollText?...](https://online.tugraz.at/tug_online/voe_main2.getVollText?...)

Indian Railways show not only a brilliant but also an ugly face on account of neglected rail-tracks:



But first we want to deal with the improvements of the last decades, with the happy face of Indian Railways.

### III. INDIAN RAILWAYS – A MODERN RAILWAY WITH OUTSTANDING ACHIEVEMENTS - THE BRILLIANT IMAGES

India wants to become modern, with a railway service up to global standards, as revealed in the ***National Railway Plans, Vision 2020 and 2030***.



The **2020 Vision from 2009** proposes to add 25.000 km of **New Lines** by 2020, supported by government funding and a major increase in Public Private Partnerships (PPPs). Of this, at least 10.000 km would be socially desirable lines regardless of their economic viability in the short run as well of national interest. This will, of course, include the completion of the backlog of 11.985 km of lines already sanctioned.

This programme would specifically aim at improving the connectivity to India's far-flung areas such as Uttarakhand, Himachal Pradesh, Jammu & Kashmir and all the States in the North-East, namely Arunachal Pradesh, Assam, Nagaland, Mizoram, Tripura, Manipur, Meghalaya and Sikkim. The vision also not forgets smaller States and Union Territories and large districts unconnected by the railways up-to 2009.

The **National Rail Plan 2030** has been prepared in order to provide long-term perspective to planning for augmenting the railway network. The Minister of Railways has decided to develop the **"National Rail Plan 2030" (NRP-2030)** in consultation with all the stakeholders including State Governments, public representatives and other relevant Central Ministries. **NRP-2030** will endeavour to harmonise and integrate the rail network with other modes of transport, and it will create synergy for achieving seamless multi-modal transportation network across the country. This will also achieve the Hon'ble Prime Minister's vision of integrated planning and cost optimization of the transportation network by laying the new railway lines and new highways together in tunnels and over mega-bridges."



Indian Railway's latest Proud: Tejas Humsafar Express LHB Coaches for 160 kmph

In respect to new Railway Lines and Gauge-Conversions up to 2017, a lot has been achieved. In 2015, the length of the IR network has reached 66.030 track-km. Meter-Gauge has nearly disappeared from the rail-road map of India. Only the scenic heritage hill railways will not be gauge converted: Ooty

Nilgiri Railway on Meter-Gauge, Kalka-Shimla and Joginder Nagar-Pathankot (Kangra-Valley Railway) on 2 ½ ft. Narrow-Gauge, Darjeeling and Matheran Railways on 2 ft. Narrow-Gauge.

The days of the Gwalior–Sheopur Kalan 2 ft Narrow-Gauge section, former Scindia State Railway, are already counted. This once longest operating 2 ft. NG Railway around the globe with 199 km will come soon under conversion to Broad-Gauge. The same fate to fade away into history will also soon reach the picturesque Shakuntala 2 ½ ft. Railway in Amravati District:

### 1. Picture Gallery; Narrow-Gauge:



Gwalior 2 ft. NG Light Railway will soon go down the Memory Line



Picturesque 2 ½ ft. Shakuntal Railway will soon fade away into History





Nilgiri Ooty MG Rack-Railway, System Abt



Kalka-Shimla 2 ½ ft. NG Railway





Kangra-Valley 2 ½ ft. NG Railway



Darjeeling 2 ft. NG Railway at Batasia Loop



Neral-Matheran 2 ft. NG Toy Train chuckling around Panorama Point



## 2. Picture Gallery; Broad-Gauge:



Konkan Railway Line – an outstanding Engineering Achievement

After full opening in 1998 the 741 km long Konkan Railway Line from Madgao to Roha – an outstanding engineering achievement - , the viable line for the north-south connection is already over-used beyond its capacity. The line is aging faster than it can be rehabilitated or renewed. The rails are larded with patch-repair works. Each and everywhere one can make out short rail-pieces welded in the panels by low quality AT welding, bandaged with joggle fish-plates:



AT weld, bandaged with Joggle Fish-Plate, Konkan Railway, October 2017

Line duplication has already become an urgent need. Availability of traffic blocks for repair and maintenance has become a severe problem.





Animation of the Chenab-River Bridge, with 359 m the highest Railway Bridge around the Globe, on the Katra-Banihal Link to Kashmir



Chenab-River Bridge under Construction





4.94 km long combined Road-Rail Bogibeel Bridge over the Brahmaputra-River under Construction

The Bogibeel Bridge will become a combined road-cum-rail bridge over the Brahmaputra River in between Dhemaji district and Dibrugarh district of the north eastern Indian state of Assam. Upon its expected completion in 2018, the 4.94 kilometer long bridge, work on which was started in 2002, will become the longest bridge of its kind in India.



Building a new Railway Line from Jiribam, Assam, to Imphal, the Capital of Manipur



Meter to Broad-Gauge Conversion in the Cachar Hills on the Lumding-Silchar Route, Assam



First Broad-Gauge Train reaches Agartala in Tripura on 13<sup>th</sup> Jan. 2016



The 43 km long Broad-Gauge section from Agartala southwards to Udaipur, Tripura, was completed in 2016 and became operational on 23. January 2017. The remaining 70 km long track to Sabroom at the bank of the Feni River at the Bangladesh border is expected to be completed by 2020.



Tunnel under Construction on the Aizwal, Mizoram, Rail Project, Section Bhairabi to Sairang



2 ½ ft Narrow to Broad-Gauge Conversion under Progress on the Satpura Narrow-Gauge Network with the focal Point at Nainpur of the once over 1000 km Bengal Nagpur Railway





Upgrading the Kannara 13-Arch Bridge on the Kollam-Sengottai Branch-Line from Meter- to Broad-Gauge Conversion

## IV. INDIAN RAILWAYS - THE UGLY IMAGES

### 1. INDIAN RAILWAYS “INCREDIBLE” SAFETY RECORDS

On the other side of its coin, Indian Railways reveal ugly images:

Worldwide, the Indian Government promotes tourism in India with the slogan:

***“INCREDIBLE INDIA!”***

In Indian Railway’s Visions, in regard of **Train-Passenger’s freedom of bodily harm and injury**, the gap between claim and reality is really “incredible”. The question is, what is the **value of a killed or injured train passenger** caught in one of the frequent **fatal Derailment Disasters** on account of rail-track in-service failures and wheel defects?

**There is no other country around the world other than India, from where so many nasty Train-Accident Disasters can be reported!**

According latest released figures, Derailments contribute in India with 53% to the numbers of train accidents. Some other sources speak of a 85 % share



(see: <http://www.railnews.in> under the category Accidents, Rail-Fractures, Mishaps and Causalities in Railway Area).

World countries, the economy of which can afford 300 kmph High-Speed Train services, have faced in the past decade **ZERO** killed or injured train-passenger in a Derailment on account of an in-service failure of wheels and rail-tracks. They maintain, rehabilitate and renew all rail-roads in order to keep them in sound and healthy condition, fit for the traffic load/volume they have to carry.



“Enhanced Passenger Experience”, showing IR’s ugly Face

To keep the quality of all rail-roads in India in compliance with the increased traffic load/volume, massive capital investment schemes of long-term certainty are needed. And “**long-term**” in Railways means really long, covering a period of 5 to 15 years ahead for planning, organisation, logistics and procurements. Enough well trained and skilled manpower, materials, tools, **Monitoring/Inspection Technology** and **Heavy-Duty and High- Performance On-Track Machineries** are needed.

Strong commitment and skilful execution of all people involved from the top to the bottom are prerequisites of paramount importance in order to reach the ultimate goal of “**Close-To-Zero Fatal Train Accidents**” by improving all India`s Rail-Roads up-to world class standards.

## **2. INDIAN RAILWAYS COUGHT IN A VICIOUS CIRCLE – NEARLY NO HOPE FOR BETTERMENT!**

With its poor Quality Rail-Tracks not matching the strain and stress exerted by the increased traffic-load/volume, and with its limited financial resources for maintenance, rehabilitation and renewal to adopt **GLOBAL TRACK QUALITY STANDARTS BY MODERN RAILWAY-TRACK ENGINEERING AND TECHNOLOGY** on all routes, Indian Railways is caught in vicious circle of **HIGH RISK** and **HIGH EXPENDITURES**.

The present track-renewal capacity for only approx. 4.500 km per annum is totally insufficient to catch-up with the backlog and to bring within the next 10 years all rail-tracks of the network in a sound and healthy condition assuring **CLOSE-TO-ZERO** fatal Derailments killing and injuring Train-Passengers. Several tracks are aging faster than they can be rehabilitated or renewed.

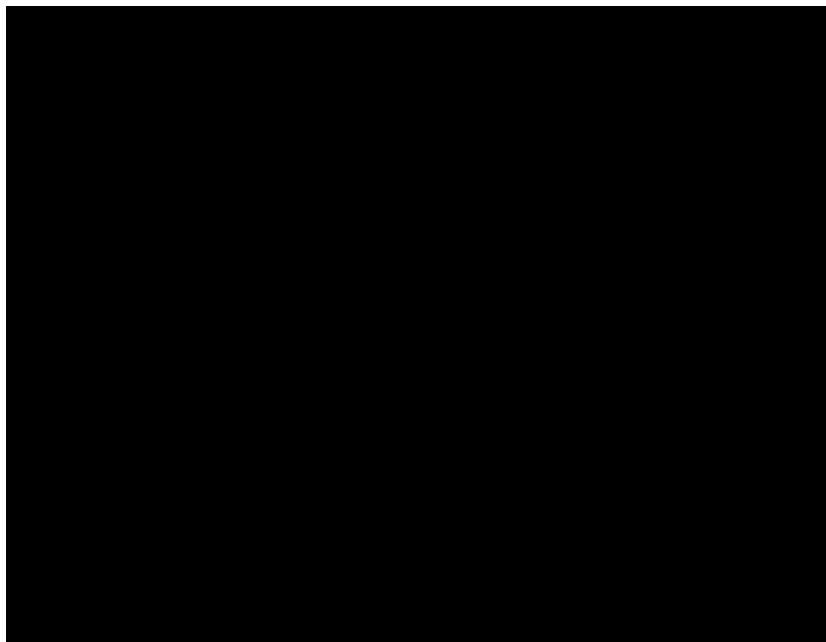
On several routes, to keep the trains on poor quality rail-tracks running, just near the threshold of the **next Derailment-Disaster**, nearly daily surveillance, patrolling and spot or patch repairs/maintenance under a so-called “**FIRE-BRIGADE MAINTENANCE-STRATEGY**” are needed. Modern proactive and preventive Maintenance, Rehabilitation and Renewal Strategies are not applicable for such tracks. Indian Railways have to overcome the need for “**Fire-Brigade**” spot/patch repairs by achieving **High Initial Track Quality**. A **HIGH QUALITY RAIL-TRACK** needs no “**Fire-Brigade**” spot/patch repair strategies. A track in need of the so-called “**FIRE-BRIGADE MAINTENANCE-STRATEGY**” is of no possibility for optimisation (quotation by Prof. Dr. Peter Veit).

The lower the **Track-Quality**, the more frequent Track-Inspections and Monitoring are appropriate. A **low Quality Track** deteriorates faster than a **high Quality Track** and hence needs more maintenance expenditures causing higher costs.



Rail-Fracture on a poor Quality Rail-Track in Need of “Fire-Brigade” Track Spot/Patch-Repair

Freedom from Bodily Harm and Injury of Train Passengers are left to the mercy of the commitment, skill and reliability of low rank railway men. The Puri-Haridwar Uthkal Express Derailment-Disaster of 19<sup>th</sup> August 2017, killing over 23 and injuring over 200 Train-Passengers, demonstrates, what can happen, if something goes terrible wrong on the level of those railway-men in the environment of such a **poor Quality Rail-Track** in need of “**FIRE-BRIGADE**” REPAIR and PATCH MAINTENANCE STRATEGY”:



19<sup>th</sup> August 2017 Uthkal Express fatal Derailment-Disaster killing over 23 and injuring over 200 Train-Passengers

With the background of an overused rail track with a track quality not matching the traffic load, ailing faster than it can be rehabilitated or renewed, and with a rail-track, that needs patch repairs under a so-called “**Fire-Brigade Maintenance Strategy**” in order to keep the traffic flowing, **all safety barriers had been breached** – or in words of the J. Reason Doctrines: The **HAZARD-TRAJECTORY** with its sharp end had penetrated the holes of all swiss cheese slices (defence layers); see also Dr. F. Wingler,



**RISK AND HUMAN ERROR MANAGEMENT**, free for download from <http://www.drwingler.com>.

The prevailing **HAZARD** is manifested by the poor quality rail-tracks not matching the traffic load and aging faster than they can be maintained, rehabilitated or renewed.

To pin “culprits” to be blamed and interdicted, will not bring alleviations in India’s **“INCREDIBLE”** Railway Safety Records. To blame Human Error has nearly **NO** or only a marginal effect. Human beings are so ingenious to fail and to make the next mistakes. A technical organisation of high risk potential has to be made resistant against **HUMAN MALFUNCTIONS** and **LAPSES** by **searching for HUMAN ERROR PRODUCING FACTORS** and **PREVAILING LATENT UNSAFE CONDITIONS IN THE SYSTEM AND ORGANISATION**.

The Indian Steel Industry runs short in producing and delivering enough new long milled rails of high quality for new rail projects and for replacing the risky rail panels consisting of poor AT welded 13 m short rails of often insufficient quality – an underlying factor, why India faces so many fatal Train-Derailment Disasters on account of in-service rail failures. India has called for international tenders for the procurement of high quality, world-class standard rails:



Typical in-Service Failure of a low Quality AT-Weld bandaged with Joggle Fishplates;  
Central Railway, Asangaon, 20<sup>th</sup> September 2015



Now Indian Railways has to call for worldwide tender for high quality rails as THE HINDU published in his 26<sup>th</sup> October 2017 edition. Modern Rail-Tracks demand well-handled rails milled to a length of at least 120 m length.

Indian Railways possesses not enough modern **Monitoring Technology and Heavy-Duty and High-Performance On-Track Machineries** to make vintage manual track works obsolete.

Inadequate upgrading of track-infrastructure and congestions reduce headways and eat into the time available for maintenance, rehabilitation and renewal. The denial of urgent needed traffic blocks can drive track engineers into risky adventurers.

Sufficient length of urgent needed traffic blocks are often refused by Divisional Railway Managers (DRMs)

The increasing traffic takes place in narrower windows, and necessary traffic block pauses are shorter. For this reason, the requirements for effective rail construction site long-term logistics are also increasing.

The **AVAILABILITY** of Traffic Blocks of sufficient time-length for urgent needed Maintenance, Rehabilitation and Renewal on overused routes has become for many railways, so also in India, a severe unsolved problem; see Professor Dr. P. Veit **TRAFFIC-BLOCKS IN THE CONFLICT-ZONE BETWEEN COSTS AND AVAILABILITY**, Special Edition of **Der Eisenbahn Ingenieur**, EI, November 2017, DVV Media Group, Hamburg, Germany; and relevant papers presented on the International Conventions of the Working Committee on Railway Technology of the Österreichische Verkehrswissenschaftliche Gesellschaft, ÖVG, Austria, held on 15-17<sup>th</sup> September 2015 at Salzburg and 25-26<sup>th</sup> 2017 September at Graz, Austria.

Professor Dr. P. Veit quotes:

***“Infrastructure measurements are generally more cost-effective if a longer traffic block is available, as the fixed costs of the construction site can be split up to a greater track length. However, this reduces the availability of the infrastructure in the short term. Track strategies must therefore be formulated from a system viewpoint and from a compromise between cost-effective maintenance and ensuring sufficient availability. The costs of measures can be calculated for different construction section lengths. These costs are compared with the operational follow-up costs of the temporary capacity restrictions for the identification of the system section lengths to be striven for from a system perspective.”***

Train dispatching Authorities have to understand, that if not sufficient **Time for Traffic Block** is provided, the track itself will enforce the block in an unpredictable manner by derailing trains.

Politicians want to convert Indian Railways to a Modern Railway with Global Standards, but in reality they seem to be in their Visions so remote from the daily reality on the tracks.

**WITHOUT SOUND AND HEALTHY RAIL-TRACKS OF HIGH QUALITY MATCHING THE TRAFFIC-LOAD/VOLUME NO MODERN RAILWAY SERVICE WITH CLOSE-TO-ZERO MORTALITY RATE IS POSSIBLE!!!**



Massive Capital-Investment in Track Quality optimising the Wheel-Rail System is no Luxury. It not only cuts overall Life-Cycle Costs but also prevents that Train-Passengers are killed or injured in unwanted nasty Derailment-Disasters!

The costs of improving SAFETY all arise immediately, but the benefits emerge only in long-term. And "long-term" in railways is really a long time and will cover the next 15 years.

Train-Passenger`s Freedom from bodily Harm and Injury matters!

It can never be ethically acceptable that people are killed or seriously injured when moving within a transport system!

For more Guidelines see the Technical Railway Papers on "HOW SAFE ARE INDIAN RAILWAYS?", how to achieve "TRACK-QUALITY" and how to "OPTIMISE THE WHEEL-RAIL SYSTEM". The relevant articles are free for download on <http://www.drwingler.com>.

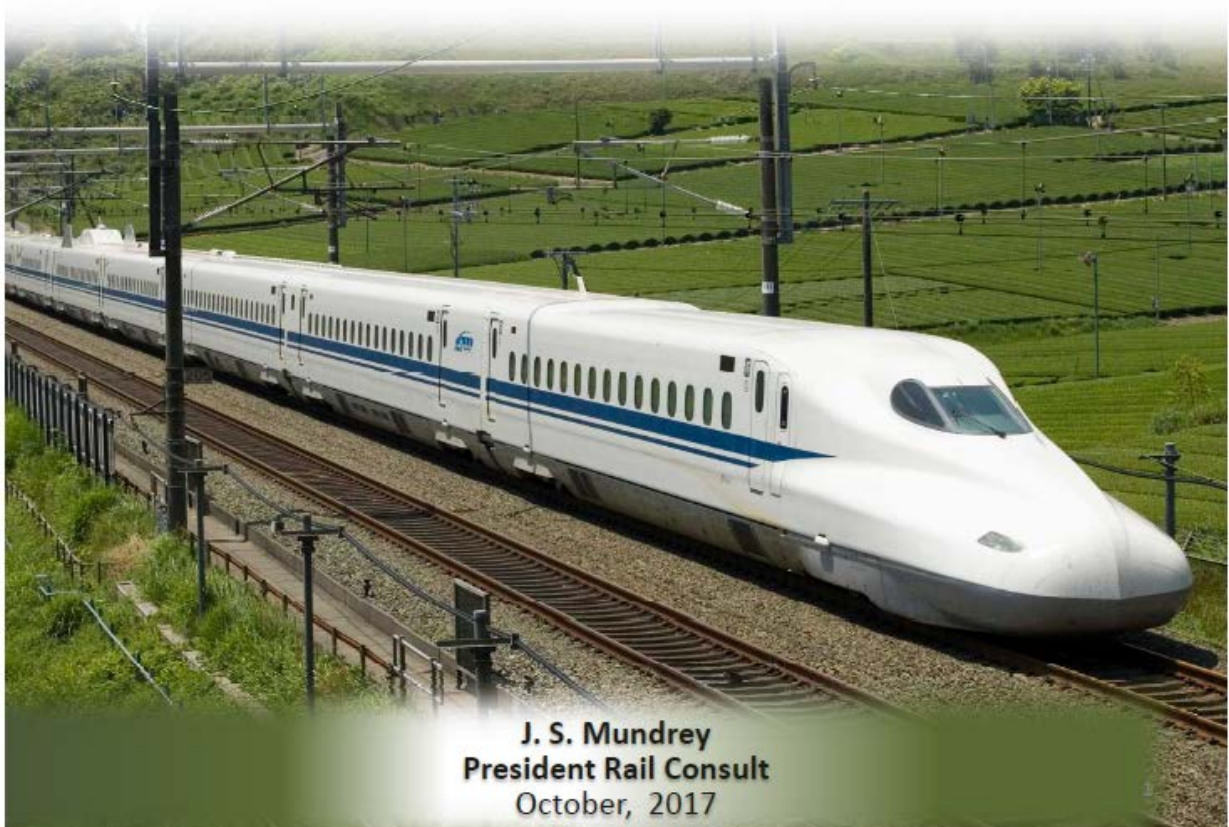


# ANNEXURE I

Power Point Presentation of J.S. Mundrey, Rail Consult India, on the

**INTERNATIONAL CONFERENCE  
TECHNOLOGICAL ADVANCEMENTS IN  
RAIL & METRO PROJECTS 2017 (IC-TRAM 2017)  
6/7<sup>th</sup> October 2017, Manekshaw Centre New Delhi, India**

**ZERO DERAILEMENT:** Track Technology can make this happen

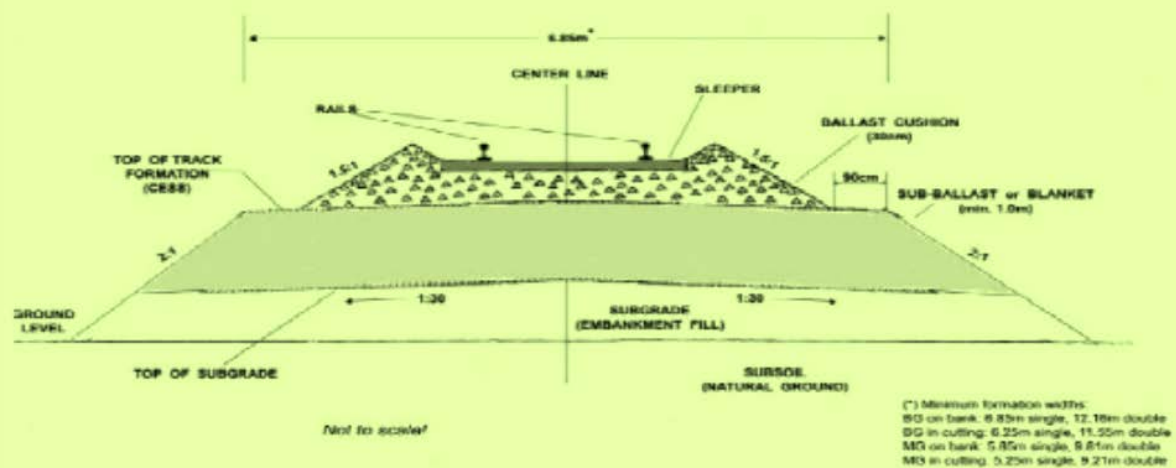


J. S. Mundrey  
President Rail Consult  
October, 2017

# Rail: Safest Mode of Transport

- With an assured right of way, it is the safest mode of Transport, world over.
- On German Railways, on their mixed traffic routes, there has been NO fatal Derailment on track account in the last 10 years.
- In Japan ,on their high speed lines ,there has been NO fatal accident in their 50 years of existence.
- On Indian Railways ,there have been far too many Derailments, recently in quick succession, causing a big dent to the image of Indian Railways.
- Can Indian Railways achieve the Safety Standard of German Railways? The answer Is YES. How ? What is needed.
- A firm commitment to the cause of ZERO DERAILMENT followed by a time bound programme of action.
- Indian Railway engineers have all the capabilities and competence to adopt those technologies .

## Our Track Standards conform to Global Standards



### MODERN TECHNOLOGY IN TRACK PROCUREMENT

#### The Difference?

- Exercising necessary quality control in procurement and construction.
- Purchase of substandard jointed rails not conforming to I.R. specifications from State owned Plant..

#### Overlooking superior Alternatives

JSPSL is offering high quality long rails from their new Rail Rolling Mill – at a competitive price..



## Quality during Procurement is Key

Manual



On I.R. maximum damage to rails occurs in its **initial stage**, causing a permanent liability in track.



German Railways have made the Rail Supplier responsible, for its transport and delivery at construction sites, thus a **single point responsibility**.

## Manual laying causes irreparable Damage to Track



**Latest technology** should be used in track laying and track welding.



Glued Insulated Joints, Switch Expansion Joints, should have a service life equal to the Rails.



**Digital Thermit Welding**



**Modern Flash Butt Welding Plant**



**Modern Turnouts, as are being used on DFCC should be a standard on IR**

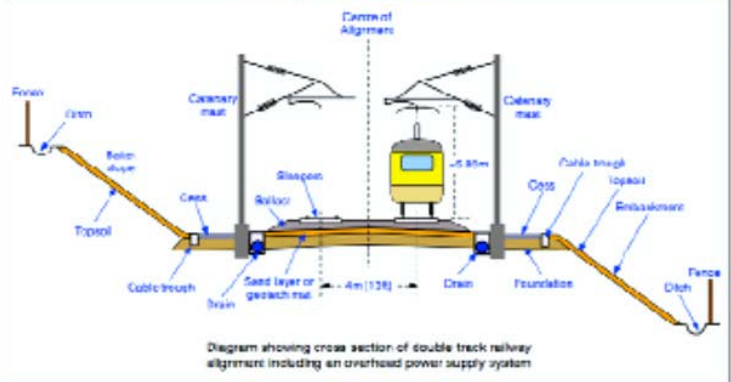


**Railways "RIGHT OF WAY" has to be assured**





Track rests on earth formation, and its strengths gets badly depleted under poor drainage conditions.



1. *Journal of the American Medical Association*, 2000; 283: 2689-2695.



Track Recording Cars, fitted with cameras, should record Track Geometry, Riding Indices and an exception Report on Track Components.



Deployment of mobile, fully equipped Track Maintenance Units, which would carry out the rectification of Track Defects under complete Traffic Block and under full weather protection.

## Significant Benefits of Automation



No manual Track Patrolling.

At sensitive locations sensors should be installed to provide information about flood level, embankment slippage etc.

Sensitivity indices for vulnerable sections are worked out to take effective measures under extreme weather conditions.

Once Track is completely fenced, DRONES can be deployed to monitor any suspicious movement on the Track and timely action taken.

## Urgent need for a new Track Maintenance Manual

The new manual must cover:

- Action for the protection of Track and imposition of Speed Restrictions for every track work.
- Traffic block needed for the rectification of defects.
- Machines and Manpower deployment.
- Level of supervision and the responsibility for train safety during the operation will be adequately covered for each type of defect.
- Manual will need revision ever 5 Years as new technologies emerge.



**The present IR Manual is more than 30 years old!!**



## In sum:

Modern Track Technology can assure **Zero Derailment** on Track Account

- ❖ Exercising proper quality control in the procurement of RAILS and Track Components.
- ❖ Adopting Mechanised Track Laying and latest technology in Rail Welds.
- ❖ Impregnable Fencing of Track.
- ❖ Fool proof Drainage System.
- ❖ Deployment of modern track monitoring system, such as: Track Recording Cars, Ground Penetrating Radars, Ultrasonic/Eddy Current Rail testing equipment.
- ❖ Creating Mobile Maintenance Gangs, fully equipped to carry out, track repair work of high quality standards in a safe stress free environment.
- ❖ An up-to date Track Maintenance Manual, describing methodologies of Rectification of each conceivable Track Defect in a safe and secure manner.



## ANNEXURE II

### **India's Train Accidents are not even Accidents, but High-Probability Events caused by systemic Problems!**

**12 Sep 2017 in Category(ies):** Posted on 12/09/2017 12/09/2017 Categories Derailments, Accidents, Rail Fractures, Mishaps and Casualties in Railway Areas, Indian Railways, Railway Board/Ministry, Union Minister of Railways

### ***The Dear Lives India lost in Rail Mishaps is a matter of serious Concern – Can new Rail Minister has Guts to shake the System to bring about a Change?***

India has had four train derailment accidents in the last few weeks. One of the accidents, in Uttar Pradesh on August 19, killed 23 people and injured more than 150 people. This series of serious accidents led to the resignations of Minister of Railways Suresh Prabhu and Chairman of the Railway Board A.K. Mittal.

Since last many decades railway up-gradation was not keeping pace with time technology. Unions in railways rule the roots, efficiency and safety are the last things on their mind. Accountability is passing the buck and generally the blame is put on human error. However, we are supposed to follow rules. Shoddy maintenance of railways across India is the main cause for major accidents – particularly on the Northern India. Railways are also looting passengers by imposing safety surcharge. People started thinking that all the false promises were given from behind the veils of power mongers. God knows how the tough rakes are maintained or not but prone to more major mishaps.

India was one of the first countries in the world to build a large railway system. Its 21-mile railway from Mumbai to Tana was built in 1853, under British colonial rule. At the time of independence in 1947, the Indian railway network covered more than 55,000 kilometers, behind only the US, the former Soviet Union and Canada. The surge in India's population and its rapid urbanization meant that the trains, which were relatively affordable, became the most important means of transport for most people. But the explosion in passenger numbers severely burdened the aging railway system, which had been constructed to a fairly low standard. As a result, accidents have not been uncommon.

As in the past the blame on the derailment near Muzaffarnagar in Uttar Pradesh is caused by negligence and the blame is passed on human error. The locals in UP expose lapses and it is very clear that accident could have been averted. The victims narrate their ordeal and that is pathetic. Just by giving compensation we will not be able to make up the human loss. Eyewitnesses recount the horror and how the victims were struggling for help. Medical facilities reached the accident spot late and that shows the apathy and the lethargic approach of the officials.

By suspending or by transferring officials is not the solution. More and more care should be taken on passenger safety and the railway budget should allot more funds to reduce the accident cases to a negligible level. The approach after the tragedy by the government does not augur well and the railway passengers are feeling lack of relief during such major accidents. It should not be out of context to mention here that the system is controlled by the Railway Ministry through the state-owned Indian Railways having more than 1.5 million employees and is India's largest state-owned enterprise too. However, it is also probably the most inefficient Company in the world, in the state sector. Coupled with the



government's policy of low-cost train transport and high salaries for railway employees, the Indian Railways simply cannot accumulate enough funds to update its railway system.

The train accident near Khatauli saw tragedy struck killing of more than 23 people and injuring over 100 and that jolts the nation. It could have been averted if the track fractures had been taken care in time and a close watch carried on the train tracks. The derailment created fear among the passengers. Strange are the ways of train accidents in the Indian history. In the past we heard about bomb blasts, head on collision, wrong signal, smoke inside coaches and snatching of fish plates caused trouble and discomfiture to the travelers and caused major casualties at late night. A panel will be set up for a probe. But the dear lives were lost in a major mishap. Time tested methods are to be carried out regularly on all rail routes periodically.

The past governments have not given enough attention to vital infrastructure like railways. At the same time, India's domestic manufacturing industry has fallen behind, unable to provide technical and equipment support for railway upgrading.

It could be said that India's train accidents are not even accidents, but high-probability events caused by systemic problems. For decades, the situation has not improved. According to the statistics, in 2016 more than 500 train accidents took place in India. This problem cannot be solved by the resignation of the minister of railways. The minister himself to be serious on various corrupt practices in Railway system right from the Railway Board level to the Zonal and Divisional levels in the Engineering, Safety, Operations, Electrical, Signal & Telecom wings. Most of the Indian Railway officials are corrupt and past Governments have not taken sufficient steps to correct the system. At least Suresh Prabhu, former Railway Minister was too serious on such malpractices, as he has taken aggressive stand on corruption under the Prime Minister Mr. Modi's regime.

The slow speed and frequent accidents on India's railways have become symbolic of the backwardness of the country's infrastructure. In the international media coverage of India, the train-related problems also give a negative impression of the country to the international community. Not only do foreign tourists feel insecure about traveling there, but foreign investors also have little confidence in India's infrastructure, which has hindered the development of India's economy and modernization.

Over the past decade, the government has recognized the importance of railways for economic development and it has proposed a series of railway construction plans. After Modi came to power, he expressed ambitions not only to reconstruct the original railways but also to form a "diamond quadrilateral" of railways connecting Delhi, Mumbai, Chennai and Calcutta, the Delhi-Chennai high-speed railway corridor and the Mysore-Bangalore Chennai high-speed rail lines. At the same time, India also becomes more welcoming to the participation of foreign funds and enterprises. In September 2014, when Chinese leaders visited India, the two countries signed an agreement to invite Chinese enterprises to participate in a project to upgrade the railway from Bangalore to Mysore. India also announced in 2015 that it would invest more than \$13 billion over five years to modernize and expand the railway system. In February 2016, India and Japan signed a \$12 billion agreement to build a high-speed railway from Mumbai to Ahmedabad.

The Modi government's railway construction plan is exciting, but will not be easy to achieve. First, the huge funds required have not yet been mobilized, partly because private capital hasn't been properly involved, but also because there are still concerns regarding foreign investment. Second, long-term constraints in the institutional infrastructure in India have not been resolved, such as problems related to land expropriation.

Even if Modi can create a miracle and successfully complete his plan, it only involves the enhancement of the main Indian Railways, which account for just a small part of the entire Indian railway system. A comprehensive upgrade of the whole system will need a huge

amount of money, and will take several decades to achieve. Therefore, news about Indian train accidents is not likely to fade away.