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

Route Segregation by Grade-Seperator to keep Rail Traffic flowing at Zurich Main Station, Switzerland

A Feature Article by
Dr. Frank Wingler, March 2017
With the topic of the International Technical IPWE Seminar, held 12&13th January 2017 at Mumbai:

“Challenges in Design and Maintenance of Track under Mixed Traffic Regime of Semi High-Speed and heavy Axle-Load”

an invitation to the ingenuity of Indian`s Track Experts had been launched to come forward with technical solutions, how the different track-structure requirements for Freight-Train Axle-Load Increase and Passenger-Train Speed Increase can be compiled, and how this ambiguous programme can be technically achieved on India`s busy rail-corridors.

Between the lines of some presented Technical Papers, one can read that some experts are NOT so happy with the ambiguous concept of a compiled programme to increase the Axle-Load of Freight-Trains up to 25 t under a “Mixed Traffic-Regime” on one-and-the-same-route of Indian Railway`s conventional track structures simultaneously with the deployment of higher Speed Passenger-Trains running up to 160 kmph.

No doubts, the growing economy in India has led to an increasing need for mobility. India has to improve conveniences by connecting the cities with passenger trains of shorter journey times and by increasing the route transport-capacity for freight-trains. The growing economy puts pressure on rail-transport to increase the volumes of rail-traffic, to speed up intercity-journey and simultaneously to increase freight transport-capacity.

What are scheduled train-speeds of express-trains with 160 kmph around the globe of advanced modern Railways falls now in India under a new category called “Semi High-Speed” or “semi-high Speed”.

The Indian ICF passenger coaching stocks are commissioned to run 110 kmph. With the introduction of the new better damped and track friendlier trailing Linke-Hoffmann-Busch, LHB, coaches with so-called pivot- or centre-pin less “Fiat-Bogie” of the Flexicoil type, a commissioned coach-speed of up to 180 kmph has become possible.

The Technical Papers, presented on the last IPWE Seminar, describe how increased Axle-Load and Train-Speed exert higher stress and strain on Tracks and hence on the Track-Components/Constituents.

What counts are not so much the static stress/strain-increase by increased Axle-Load and Train-Speed, but the higher Dynamic Forces (Dynamic Loadings) exerted by rail-vehicles on the rails and hence on the track structure with its components/constituents, governed at the wheel-rail-interface by the Newton’s Laws Mechanisms; see Technical Paper HOW
Political masters and strategic decision makers are mostly not aware, that energy increases by square of the velocity:

\[ E_{\text{kin}} = \frac{1}{2} MV^2. \]

**Newton`s FIRST LAW** suggests that any change of velocity of a body under consideration is associated with the counter-action of a resultant force, which acts on this body. This in turn suggests a relationship between the resultant force and the acceleration of the body. Newton assumed by his **SECOND LAW** the very simple relation that the resultant force, which acts on the body and causes acceleration, is linear related. The **THIRD LAW** is the **“LAW OF ACTION AND REACTION”**. It states that to every action or force there is an equal and opposite reaction or force. In other words, when a body (rail-vehicle) exerts a force on a second body (rail-track), in consequence the second body (rail-track) exerts a numerically equal but opposite force on the first body (rail-vehicle). The laws are useful to analyse mutual track-vehicle interactions and to determine track irregularities and track defects by vehicle mounted **ACCELEROMETERS**; see also Dr. Arnold D. Kerr, **FUNDAMENTALS OF RAILWAY TRACK ENGINEERING**, Simon-Boardman Books Inc., Omaha, USA, ISBN: 0911382-40-2, 2003; **Chapter VIII: DYNAMICS OF TRACK-TRAIN INTERACTIONS AND RELATED PROBLEMS**, page 250-286.

Under a higher Axle-Load and Train-Speed Regime

Wheel-Flats, ovalized Wheels, Overloads, latter reducing the play of suspensions, and Rail-Vehicle Oscillation

will create an over-linear additional speed dependant input of dynamic energy in the track-structure. Horizontal and vertical misalignments/geometrical defects excite additional wheel/rolling-stocks accelerations resulting according Newton`s-Law Mechanism in additional back-slashing over-linear speed dependent energy input in the track structure. The track responds to such ill-treatments, accumulated over the time, with loss of geometrical stability, with track-defects and in-service failures of track-components. Rolling stocks answer track alignment irregularities and geometrical defects with Oscillation. Oscillating rolling stocks ruin the tracks further. Hence, it comes to a **devastating mutual interactive self-destroying process**. The elder ICF coaching stocks are prone to oscillate. They are the culprits for many emerging track-defects.
A Railway Track behaves according Prof. Peter Veith, Austria, like an elephant. It can tolerate for a longer period ill-treatment and negligence without significant signs. But suddenly, like an elephant, the track takes revenge and runs berserk throwing a train off the track.

During a period of inadequate maintenance, it is a relatively long time before a track shows signs of stress. To a lengthy period of inadequate maintenance a track reacts badly like an elephant with a memory for its ill-treatment and with an irreversible shortening of its period of geometrical stability (Prof. P. Veith, Technical University Graz, Austria).

**Simultaneous Axle-Load and Speed Increase**, not appropriately accompanied by capital investment schemes of long-term certainty, is risky. The demand for long-term capital investment, in order to meet with the technical requirements making the tracks fit for the increased strain and stress, grows over-linear with Axle-Load and Train-Speed.

The reader of the Paper 22, Session II, of Vipul Kumar and Ajay Kumar, RDSO, dealing with the strain and stress caused in Track – Vehicle Interactions

**Challenges in Design and Maintenance of Track Structure for mixed Traffic Regime on IR**

learn: To avoid unwanted bad events requires strict maintenance regimes both by fixed infrastructure and rolling stocks owners to keep the dynamic loading low within the permissible limits. **Until then, the introduction of**
Heavy Axle-Load Regime simultaneously with Semi High-Speed can only be done on IR assuming considerable RISKS.

Risk is the product of probability that an incident will occur and the impact that it will have. It is impossible to have a zero probability. Effective and efficient risk management must include the proactive mitigation of the impact that incidents will have; see 1) in Annexure.

The spate of recent year’s increased numbers of killed and injured train-passengers in unwanted nasty IR Train-Disasters speak a clear language that Indian Railway is already on a RISKY COURSE,

and that Indian Railways will have to do a lot in catching up, when it comes to the backlog in safety related rectifying works, in order to keep passenger-trains moving safely; see Technical Paper: INDIAN RAILWAYS ON A RISKY COURSE?; free for download from the website: http://www.drwinger.com.

Presently there is no other Railway around the globe, from where so many nasty and fatal Train Accidents with such frequent high mortality rates can be reported than from India!

Measurements to improve operational flexibility without simultaneous Axle-Load and Train-Speed Increase are not yet fully out-bidden. There is still room on IR to increase the transport-capacity and to reduce the journey-time of passenger-trains between major cities, resp. to speed up intercity-links, before IR has to push ahead for a MIXED TRAFFIC-REGIME with higher Axle-Load simultaneously with Semi High-Speed - a costly SIMULTANEOUS PROGRAMME, the implementation of it will become long-term highly
Capital-Investment intensive. In his first budget speech Railway Minister Suresh Prabhu had singled out “CHRONIC UNDERINVESTMENT” as a major factor behind IR’s problems.

Political Masters have to be made understood, that with the deployment of modern Signalling cum Automatic Train Protection, as for example with European Train Control System (ETCS) Level 1 / Level 2, headways can be cut, and hence route capacity and volume of train-transport can be increased. There are still many not fully exploited possibilities to increase route- and transport-capacity and to reduce journey-times by improvements of Logistics, Infrastructures, Assets, Realigning Track-Layouts, Route-Modernisations, Triple/Quadruple-Tracking and by deployment of faster accelerating track friendlier Rolling Stocks.

In order to minister increased volumes of rail-traffic, to ease the traffic flow and to keep the trains running at congested sections and bottlenecks, the trains could be segregated by speed and priority with fly-over/over-bridge/grade-separator/over- and under-pass/by-pass/viaducts. This can help that valuable gain in journey-time will get less squandered due to bottle-necks and constraints of infrastructures and track-layouts. Enhanced traffic-management can also help to improve the rail-traffic flow, to optimize the head-ways and to cut journey-times. In this respect IR can learn from the Railways in Switzerland:

![Line Segregation on different Levels to keep Rail Traffic flowing at Zurich Main Station, Switzerland](image-url)

The question, Semi High-Speed YES or NOT on India`s busy corridors, is not under dispute. It is disputed, if it is prudent to combine on India`s busy rail-
corridors Freight-Train Axle-Load Increase with the Passenger-Train Speed Increase. The message is to increase Train-Speed gradually without simultaneous Axle-Load Increase.

“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”

could be the topic of one of the forthcoming IPWE Seminars.
ANNEXURE

1) ZERO FATALITY VISION in Transport environment cannot be achieved. Recent developments in Safety-Management tend to use PREDICTIVE RISK BASED STRATEGIES. In the RISK-BALANCE MODEL, the strategy is to find an economical balance between minimizing the probability that an unwanted bad incident will occur and mitigating the impact, that the incident will have. With the background of “CHRONIC UNDERINVESTMENT”, available money must be spend in the best way; see: Dr. Ing. Willem Sprong, Technical Executive, GIPP (PTY) Ltd., South Africa, in his paper: “Does 'Zero Incident' really exist in the Transport Environment?”, presented for the forthcoming World Conference THE FUTURE OF TRANSPORTATION, held 5-6th July 2017 at Cologne, Germany. See also: Dr. Ing. Willem Sprong, GIBB (PTY) Ltd., PREDICTIVE RISK-BASED STRATEGIES TO MANAGE SAFETY;

https://www.rssb.co.uk/irsc/.../IRSC2015%20Full%20Paper%20Willem%20Sprong.pdf...