COLOMBO SUBURBAN RAILWAY PROJECT (CSRP); PART II - Learning technical Solutions from advanced Railways

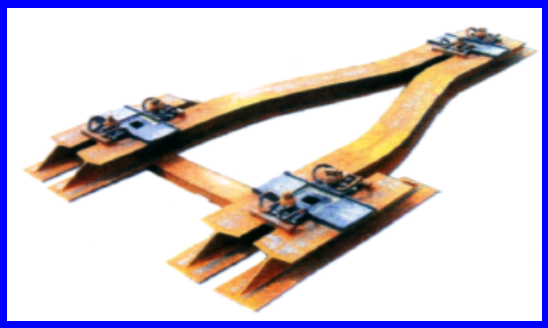
Regional Suburban Commuter Rail Service on Meter-Gauge Track of tight Curvatures with Y ThyssenKrupp Steel-Sleepers in Switzerland, Canton Aargau, Line S 17, Bremgarten-Dietikon

By Dr. Frank Wingler, September 2018

SYNOPSIS

Whereas Part I deals with the technologies and the difficulties of reengineering the existing tracks to become sound, healthy and fit to cater a modern high capacity Urban and Suburban Rail Transport System, Part II deals with technical solutions for the KV-Line and the Main-Line from Colombo to Kandy, especially for the Balana Incline between Rambukkana and Katuganawa, that can be learned from other advanced railways.

In order to increase the geometry stability in the tight curvatures with troublesome and narrow top-formation of the KV-Line and the Balana Incline, the author suggest making use of Thyssen/Krupp Schulte GmbH **Y-SHAPED STEEL-SLEEPERS** with Pandrol Fast Clip rail-fastenings and long welded rails. This track system is used in Italy, Switzerland and Germany for mountain and hill railways with tight curves and steep ruling gradients. Y steel-sleepers are advantageous on shallow ballast beds and narrow top-of-formation width and allow long-welded rails in tight curves. In curves, those sleepers provide the rail-grid with an excellent geometry stability.



ThyssenKrupp Schulte GmbH
Y-shaped Steel-Sleeper

A conversion of the KV rail-track to **METER GAUGE** would provide many advantages, especially allowing higher speed in tight curvatures on narrow formation. **METRE GAUGE CONVERSION** should be possible, since the KV ends at Maradana/Fort and carries no long-distance trains proceeding on other broad-gauge lines.

As **ROLLING STOCKS** the author suggests to make use of modern Light Weight Rail Cars of Swiss Stadler technology propelled by Diesel-electric power packs rating 2 x 800 KW in a middle traction van/module with a free gangway for the commuters, as the author has designed and envisaged for the **LANKA ECONO RAIL PROJECT**, initiated by L. Perera of Micro Cars Pvt. Ltd. Those Rail-Cars with middle traction run in Lithuania, Germany, Switzerland, Italy and Greece.

1 in 87 model of Light Weight Rail Car with middle Module Traction, System Stadler

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Case Study I: The Kelani Valley (KV) Railway Line

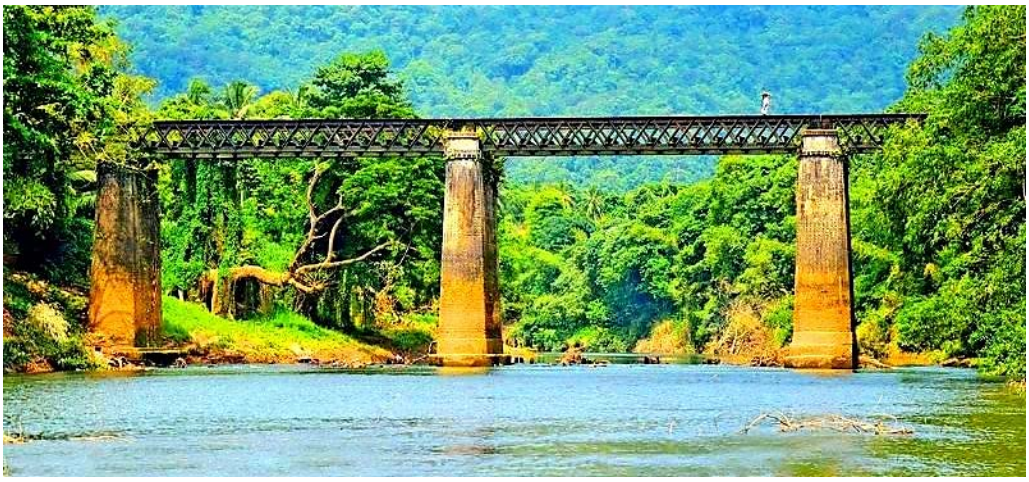
The upgrading of the KV Line is in the focus of the CSRP. The Kelani Valley line runs southeast from Colombo Maradana Station, through much of the city and outskirts of Colombo. It runs through major business centers, like Nugegoda and Maharagama, before turning eastwards. It crosses the Southern Expressway near Homagama and continues east towards Avissawella, the current terminus of the line. The trace runs through an increasingly urbanising community, and if transformed to a modern Mass Rapid Transport Rail System it would ease off road traffic congestions in Malapalla, Horana and Avissawella corridors and serve as a fedder rail system between city center and the intermodal Southern Expressway hub at Malapalla.

The KV line was originally laid as a 2 ½ feet Narrow-Gauge (NG) on a narrow and winding trace with tight curvatures up to 22 Degree (80 m radius). The laying of the narrow gauge railway commenced about 1900 from Maradana to Yatiyantota as the original Kelani Valley Railway through Baseline Road, Cotta Road, Manning Town, Nugegoda, Nawinna, Pannipitiya, Kottawa, Homagama, Migoda, Padukka, Waga, Kosgama, Puwakpitiya, Avissawella, Dehiowita, Karawanella covering a distance of 77 km (48 miles) and reaching Yatiyantota in 1903. The line titled the Pelmadulla Extension (part of the Kelani Valley & Sabaragamuwa Light Railway) from Avissawella reached Ratnapura in 1912 and Opanayaka in 1919 covering a total distance of 142 km (89 miles) and lifting the line to 140 meters above mean sea level. Although the whole of the narrow gauge railway network is mistakenly referred to as Kelani Valley, strictly the Kelani Valley was the section up to Yatiyantota. This narrow gauge line, spaced at 2 feet 6 inches with their quaint ‘baby’ trains, was initiated for transporting rubber and low/mid grown tea as well as raw graphite from the Bogala Mine. In the early days there was also high patronage of passengers especially during the Adam’s Peak pilgrim season.

However, the transport capacity and train-speed on the winding NG trace had been low and therefore, could not compete with road-traffic

In 1992, a project was started to convert the line to Broad-Gauge, 1,676 mm (5 ft 6 in), on the old NG trace without any formation, drainage and nearly no ballasting works. The project was finally completed up to Avissawella (58 km

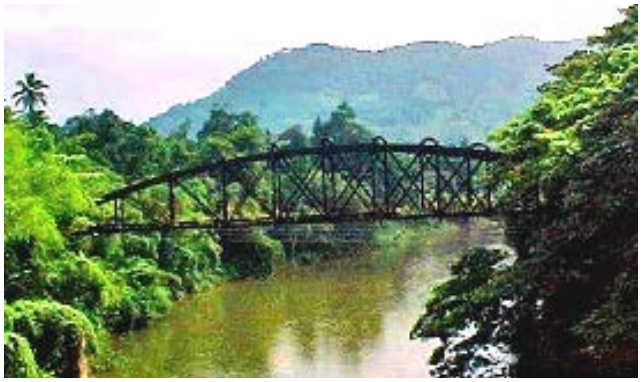
or 36 mi) in 1996. The tracks beyond were completely dismantled leaving only ruined stations, bridges, and bunds.



Down the **M**emory Line, Seetawaka Oya Bridge

Hunslet “Big KV” J1b Class, 4-6-4 T Tank, No. 292, Steam Locomotive, build 1929, on the winding NG KV Line, in Service up to 1990

Rehabilitated Class V1 Chain driven Steam Railcar build 1927 by Sentinel, on the gauntlet BG/NG Track



Old Railway Bridge at Ratnapura

Wey Ganga Bridge at Opanayaka; now used for a Road

Down the Memory Line: Ratnapura Railway Station 1974; now serving as Bus Stand; Pict. by Les Nixon

Current operating speeds on the converted BG single line are limited due to the tight curves of up to 17 Degree and the poor quality rail-track.

After dismantling the track, the railway-land via Ratnapura to Opanayaka have been used for widening of roads and some used as lanes by local authorities. But the majority of railway land fell under land-grab and encroachments. The land for a modern and advanced suburban rail-service it is now lost forever.

It had been a big mistake to convert from NG to BG on the same winding and narrow trace and to give up the trace and railway-land to Ratnapura. Since the line ends at Maradana/Fort, and since there is no through traffic for long-distance trains, the line could have been converted up to Ratnapura to Meter-Gauge under some easements of tight curvatures and after formation and drainage upgrading. This would have made things easier, and it would have

saved the trace to build a **Mass Rapid Transit Suburban Rail System up to Ratnapura.**

Warped KV Broad-Gauge Rail-Track on Narrow Gauge Trace**, Baseline Road Station** – unfit for a high Capacity Urban and Suburban Commuter Rail Service

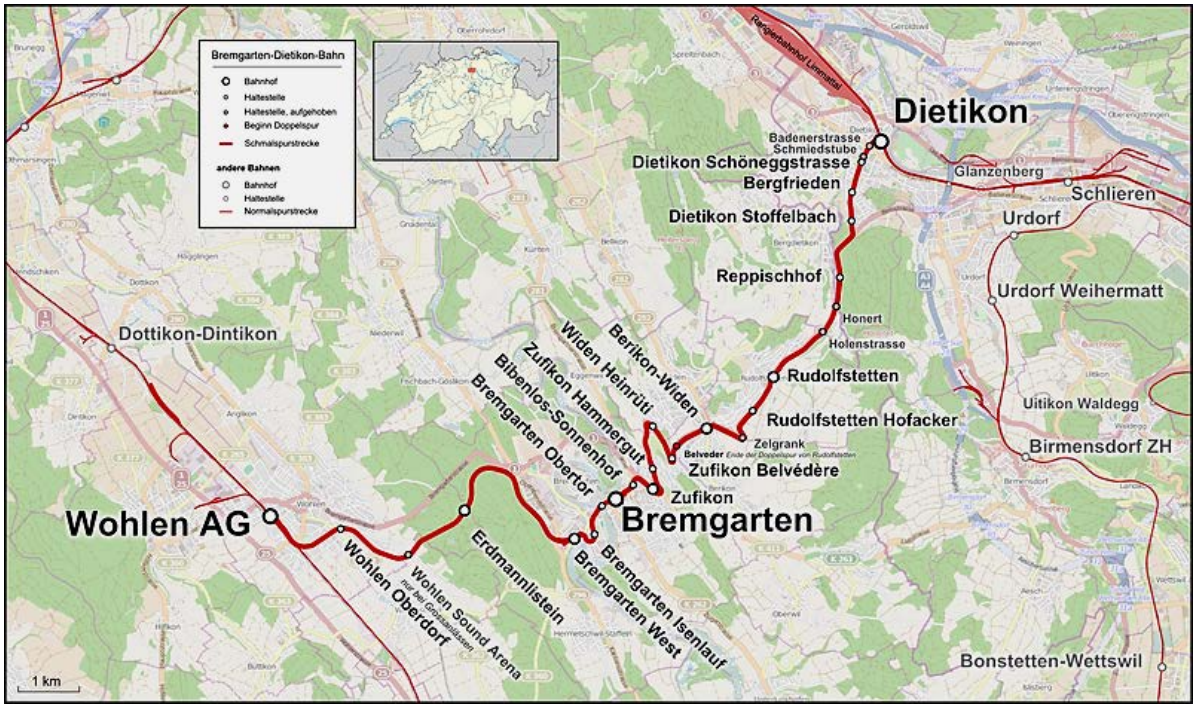
On Meter Gauge track, it would have been nowadays possible to run a high capacity and fast commuter service with modern Light Weight Rail Cars, powered by so-called Diesel power packs, over tight curvatures laid on ThyssenKrupp Y-shaped steel-sleepers with 60 to 80 kmph instead presently with max. 35 kmph on Broad Gauge with heavy power-sets; see: F. A. Wingler ***DESIGNING A LIGHT WEIGHT MODEL RAIL CAR FOR THE "LANKA ECONO RAIL" PROJECT***; *published on: July 15, 2016 August 23, 2016,* free to download from http://drwingler.com ; and ***COLOMBO SUBURBAN RAILWAY PROJECT (PARTI)*** ibid..

The CSRP Management Team can learn from the high Capacity Meter-Gauge Networks and Regional Train Services in Switzerland.

A shining teaching sample amongst other Meter Gauge Railways is the regional **Dietikon-Bremgarten Railway** in Canton Aargau, Switzerland, negotiating curvatures as tight as 72 Degree (25 m radius) with Stadler build articulated and electric propelled rail cars, climbing over a gradient of 1 in 17.5. The curve long-welded rails are laid on ThyssenKrupp Y steel-sleepers.

The headway on the single track section is 15 minutes. After moderisation, this railway had been incorporated into the Suburban Rapid Transit Railway Network of Zurich as City Railway Line S 17. The ridership is now high.

Bremgarten-Dietigon Regional Rail-Service S 17 on MG with long-welded Rails on ThyssenKrupp Y Steel-Sleepers, Canton Aargau, Switzerland



Another success-story with **Light Weight Rail Cars** (Diesel propelled) on traces with tight curvatures, ruling gradient of 1 in 35 and with ThyssenKrupp Y steel-sleepers is the rehabilitation of the Regional Standard Gauge **Vinschgau Railway** in North Italy. The rehabilitated and 2005 reopened railway runs from Meran to Mals. Originally the trace should be extended as an alpine traverse over the Ofen-Pass to Graubünden in Switzerland and Reschen-Pass to the Inn Valley in Austria. But the projects did not realize.

After modernization, the passenger volume exceeded all expectations. The railway serves in this region local population and as well holiday makers. The

rehabilitation and upgrading has boosted the local economy. Electrification is now envisaged.

Leaving Mals for a 1 in 35 down-gradient Run with 60 to 70 kmph on Y Steel-Sleeper Track

Winding Trace of Vinschgau Railway, North Italy

ThyssenKrupp Y Steel-Sleepers at Mals, Vinschgau, North Italy

Stadler, Switzerland, build Light Weight Rail-Car with Middle Module Diesel-electric Traction

Rail-Track rehabilitated with long welded Rails on Y Steel-Sleepers

Case Study II: The Balana Incline on the Route from Rambukkana to Kandy

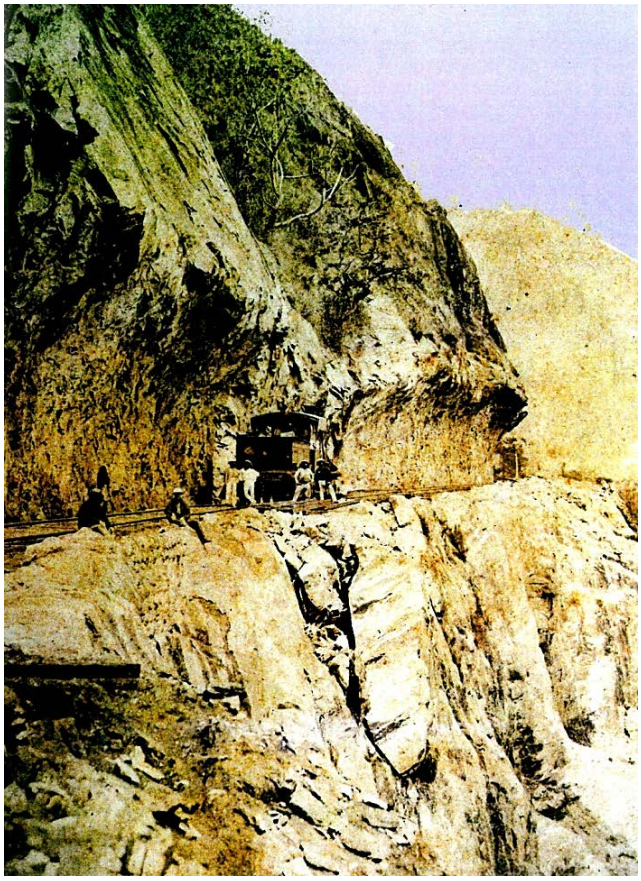
To travel by train from Colombo to Kandy on the Main-Line over a distance of 120 km takes 2 hours and 31 minutes with the fastest intercity train and with an average speed of 48 kmph. This low speed is owed to the poor track

quality of the double track main-line from Colombo to Rambukkana, the bottleneck of the single track on the Balana Incline and the inferior quality single line track from Kadugannawa via Peradeniya to Kandy. An upgrade making use of modern state-to-the-art Rail-Track Engineering and Technology would allow a speed between Colombo and Rambukkana of 110 to 120 kmph, on the Balana Incline of about 60 kmph and on the Kadugannawa-Kandy section of 80 kmph.

The economy in the Kandy region is rapidly developing. There is an increasing demand for daily journey.

On the 13 miles from Rambukkana to Kadugannawa over the Balana Pass the single track main-line rises 426 m with a ruling gradient of 1 in 45 (2.22 %). There are 12 tunnels and several tight 6 to 9 Degree curves. The line to Kandy had been opened 1867.

The track structure is nearly the same as 1867, only that instead of of-spiked timber sleepers there are now concrete sleepers with Pandrol Clips and heavier rails, however less ballast than in the 1870-ties.



Balana Incline Track under Construction in the 1860-ties at Sensation`s Rock (left) and Lion`s Mouth (right); Pict. from ***CEYLON RAILWAY HERITAGE***, by K.A.D. Nandasena and V. Wickremeratne; see also R.L. Dissanayake ***FASCINATION OF RAILWAYS***

Current State of Affairs on Balana Incline; Concrete Sleepers laid without any Formation Works, without boxing up with Ballast and on plain and narrow Strata

Viceroy Special at Tunnel near next to Lion`s Mouth on "*ballastless"* Rail Track; Pict. with curtsey by B. Seiler from ***TALES OF ASIAN STEAM***

As already pointed out in the previous papers, on the Main-Line over its full length from Maradana up to Kandy there is an urgent need of comprehensive embankment widening, substructure/formation and drainage reengineering, provision of formation protective layer and state-to-the-art of ballasting for a continuous welded modern rail-track. The outdated turnouts with the short straight tongue rails have to be replaced by modern turnouts with curved tongue rails on sets of sleepers with sufficient length as can be found nowadays on the IRCON rehabilitated and rebuild tracks. **What are rail-track standards in the backward countries Ethiopia and Kenya in East Africa should also be possible in the advanced country Sri Lanka:**

Modern well ballasted and drained Rail-Track in Ethiopia, East Africa

Construction of a World Class Standard High Quality Track for 120 kmph in Kenya

The weak track structure on the Balana Incline allows only a max. permissible speed of 35 kmph hampering the route capacity. Ideal would be ThyssenKrupp Y steel-sleepers, which tolerate a shallow ballast cushion, narrow top-formation width, and which retain the geometry of the curve rail-grid in an excellent way. They are laid nowadays on many winding mountain railway lines in Central Europe. As fastening system the author proposes Pandrol Fast-Clips, as already used in Sri Lanka on recently laid Indian trough steel-sleepers of the Uva-line from Nawalapitiya to Pattipola and on some trial concrete sleepers on the KV-line.

On the Balana incline the top formation width has to be widened, and where not possible, ballast retaining walls provided. The side-drains and the catch drains have to be reengineered. Here one can learn from the Kothavalasa–Kirandul (KK) hill Railway passing through the three states Andhra Pradesh, Odisha and Chhattisgarh in India; see: Dr. F.A. Wingler ***WATER THE ENEMY OF THE RAIL TRACK***, published on: September 4, 2016 on http://www.drwingler.com :

Ballast retaining cum Drainage Walls on the Kirandul-Koraput Hill Railway in India

This well ballasted and most scenic line climbs through the hill sections of the Eastern Ghats through the Araku Valley. This is the highest climbing broad gauge line in India. The line has a total of 58 tunnels and 84 major bridges, and some tunnels are as long as 520 metres:

Well maintained and serviced modern **Diesel power-pack powered Light Weight Rail Cars** would negotiate on a Y steel-sleeper track the Balana Incline up and down with about 60 kmph increasing the route capacity and cutting the journey time. The Author had designed for the ***"Lanka Econo Rail"*** Project (initiated by Micro Cars Pvt., Dr. Lawrence Perera)) on basis of Swiss Stadler technology a crashworthy (according European Crash Norms) Rail Car with a B0`B0`middle traction module and a free gangway for passengers through the module or power-van, latter can be used also as a "mini-loco"; see: F. A. Wingler ***DESIGNING A LIGHT WEIGHT MODEL RAIL CAR FOR THE "LANKA ECONO RAIL" PROJECT*****;** *published on: July 15, 2016 August 23, 2016,* free to download from http://drwingler.com :

Design Study in 1 in 87 Scale of a B0`B0`Module powered Light Weight Rail Car for the *"Lanka Econo Rail Project"* based on Swiss Stadler Traction-Module Design; designed by Dr. F. A. Wingler

A modern track-structure with Y steel-sleepers would allow using the Balana Incline with higher speed, if there is not the indigenous problem of Sri Lanka Railway with the improper maintained, serviced, repaired, tested, examined and certificated train-brake systems. **Defective train brake systems** are often addressed only when they appear during train run and not before. Vacuum and compressed air brake tests and certifications before commencing a train run, as prescribed and compulsory in India, are in Sri Lanka either unknown or unused.

There had been several run-away incidents with narrow escape on the incline. The worst run-away disaster happened in January 2002 due to brake-system failure and wrong-handling by train driver and guard of the Kandy-Colombo Intercity Train. On the last right-hand curve before entering the straight line to Rambukkana the coaches left the weak un-ballasted track together with the rail-grid at an estimated speed of over 110 kmph and tumbled into a soft paddy field. How many passengers got killed had been never exactly revealed. Not confirmed reports speak about 40 killed passengers. The Author had been that time called to render his contributions to the investigation committee:


Rambukkana Train Accident due to faulty Train Brake, January 2002;
Pict. by F. Wingler (left) and The Island (right)

RESUME OF TECHNICAL SOLUTIONS:

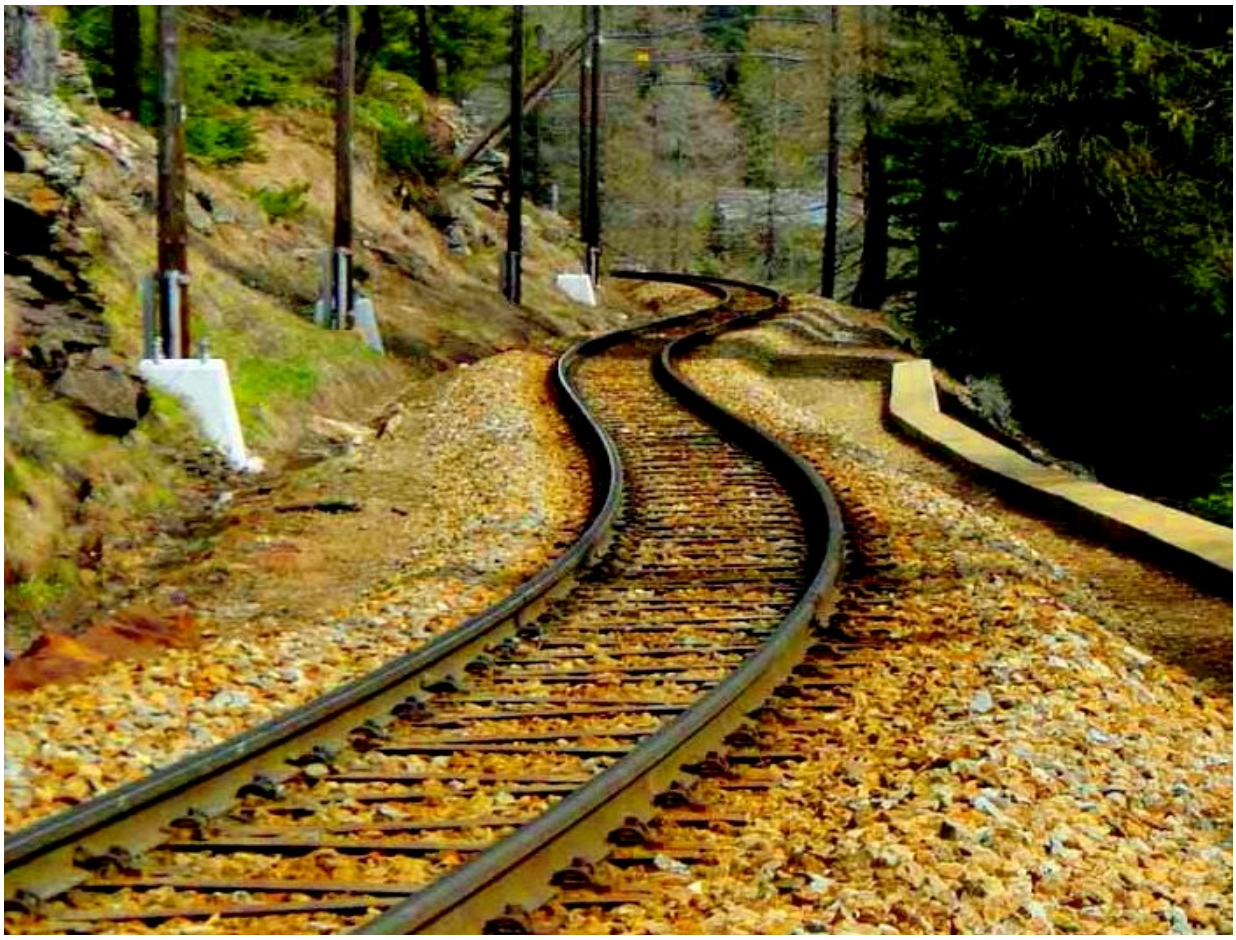
For KV-Line:

- Conversion to Meter Gauge.
- Broadening of Trace.
- Easement of Curves tighter than 6-7 Degree.
- Comprehensive Subgrade/Formation and Drainage Re-engineering, Top-Formation Width Broadening.
- Provision of Formation Protective Layer (FPL)/Subballast/Blanket.
- Full Profile Ballasting.
- ThyssenKrupp Y Steel-Sleepers with Pandrol Fast-Clips on Curves.
- Modern Points/Turnouts with curved Tongue Rails on Sets of Point-Sleepers.
- Long welded Rail Track (LWR).
- Communication based Train Control (CBTC).
- Light Weight Rail Cars powered by Power-Packs of Swiss Stadler Traction-Module Design.

For Main-Line up to Kandy:

- Broadening of Trace.
- Comprehensive Embankment Broadening, Subgrade/Formation and Drainage Re-engineering, Top Formation-Width Broadening.
- Provision of Formation Protective Layer (FPL)/Subballast/Blanket.
- Full Profile Ballasting.
- ThyssenKrupp Y Steel-Sleepers with Pandrol Fast-Clips on Balana Incline.
- Modern Points/Turnouts with curved Tongue Rails on Sets of Point-Sleepers.
- Long Welded/Continuous Welded Rail Track (LWR/CWR).
- Deployment of Automatic Train Protection System.
- Strict Supervision and Control of Train-Brake System: –Repair, -Maintenance, -Examination, -Testing, strict to follow and compulsory Schedules/Procedures for Brake-Examination, -Testing and Issue of

Brake-Certificate before dispatching for Train Run through Train-Driver, Head-Guard and Brake-Examiner (as stipulated and compulsory in India).



Y-shaped Steel-Sleepers on winding Bernina Railway Meter-Gauge Track with 45 m Radius Curves and Long Welded Rails

Last not Least; SLR Main-Line, Upcountry Section

OUTLOOK

Bird`s View on Malapalla Hub under Construction; KV-Line