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TILTING TRAIN

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Abstract

The roads of the rail called wagon-ways were comparatively similar in Europe from 1500 through 1800. The first mechanised rail transformation system issued in England in 1820's transportation use steam locomotive to industrial revolution and development of expert finance across the world they transfer bulk material such as coal, grain, stone, sand etc. via rail roads. Because of rigid wheel rolling on rigid rail tracks requires less energy per ton-miles than the road transport railroads are intensely. Lower frictional resistance encounters in rail transport system road vehicles, so that freight and passenger wagons can be linked into longer train. This operation is carried out by railways providing transport between stations on freight customers convenience. The power provided to locomotive by the application of electric power from railways electrification system and diesel. As the production of no. of trains and the freight trains is increased to fulfil the passengers expectations and for convenience. The railway system introduce signalling system on most of the tracks, so it becomes more safe transport than other transport, but it required more amount than road transport traffic level are presume. In 19th century the first steam locomotive were developed in U.K by "George Stephenson" and his son Robert Stephenson & company. To carry passengers on a public rail line the first steam locomotive "Locomotive no.1" is introduced. Electrified trains were introduced in 1880s and most countries replace their steam locomotive by diesel engines. To reduce the CO₂ emission in favour about global warming concern, in 1960s Japan introduce electrified high speed railway system with traditional Railway such as monorail and maglev.

Index Terms: Tilt Revolution, Pendolino, Technology, Pendolino Sustainability, Tilting Trains Around The World etc.

1. TILT REVOLUTION

The train run quickly along straight tracks and then get slowed down while came to a bend i.e. they didn't tilt. The sensation of slowdown of train at the bend was experienced by 'Switzerland', 'china' and 'japan'. To overcome that problem technology enabling trains to tilt as they introduced to bend using sensors and hydraulic jack lift developed in U.K. and were introduced in 1981 to increase the speed and reduce journey time Switzerland and the Great Britain. As the joining the tilt train that they can bring to 'classic lines' than the dedicated high speed lines. The first early proponent of tilting technology in the 1960's developed it throughout 1970 was Italy. A Train has mechanism that enabling increased speed on regular tracks object experiences inertia as a train rounds a curve at speed. Tiling train are designed to overcome the loss balance by passenger due to the application of centrifugal force. If in a curve to left the train tilt to left to make up for the gravitational push to the right and vice-versa. The train constructed in such a way that inertia force cause by the tilting. The first tilting trains were introduced to public service are 381 series electric multiple unit train which they were operated "JAPANESE NATIONAL RAILWAYS" this train were not fully worked worldwide. The first implement active tilt by the computer power control

mechanism was given by British advanced passenger train that empower significantly increased speed on tight rail curves. This active tilt mechanism most frequently used today.

1.1 Pendolino

The pendolino is the high speed tilting train that introduced by 'ALSTOM FERROVIARIA'. It can gain 250 km/hr speed on conventional tracks and dismissed the need for special laying tracks. The name pendolino means pendulam in Italian by mechanism tilt at bends. They have been in operation for more than 40 years. This technology was developed by Fiat ferroviaria. 11 countries across Europe including Italy, Portugal, Slovenia, Finland, Russia, U.K., Switzerland, China, Germany, Romania are with 400 Pendolino trains serviced. The length of the train is 26.2 meter and width 2.83 meter the weight of the train is 387 ton and total weight under normal load is 421 ton. The 1st prototype launched by Fiat Ferroviaria in 1969.

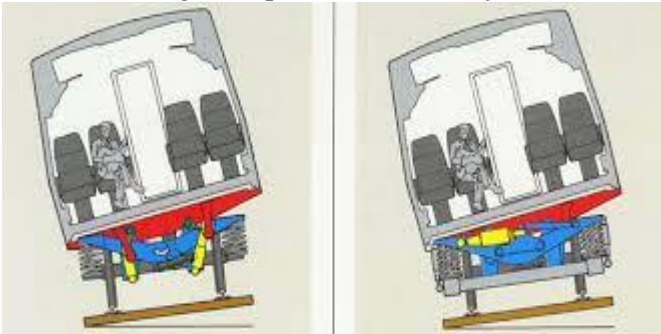
The first fully working unit was launched for public services in 1976 on Rome-Ancona route conducted by ITALIAN STATE RAILWAYS. The second fully working unit was administrated to Spanish rail operator to move on its wide gauge. The ETR-401 had four cars and can run at aspeed up to 295 km/hr. Advanced passenger train (APT) was not successful which is

developed by British rail. The several improvements on technology were made by Fiat and introduced a blooming first generation ETR-450 on Rome-Milan route. This train was the first Pendolino tilting train introduced in regular services the specification of the first Pendolino that it was nine car train with configuration of restaurant coach. It ran at a top speed 250 km/hr and it can tilt at an angle 13 degree.



1.2 Technology

Pendolino trains use Tiltronix technology and feature hydraulic tilting bogies. The second unit of Pendolino-ETR-460 was entered in 1993 it has some several modifications over first generation A.C. Asynchronous motor and installation of anti-tilting action piston in coach & bogie-to-coach connection. The tilt angle reduced to 8 degree to provide more safety.



It keeps low axial load of 14.5 ton per axle that use permission to train to run 35% faster on curves as to the convention tracks. The tilting roads installed in the bogies. The trains wheel forces have been reduced by decreasing suspended mass. The coach seats centred with the use of active air suspension system. They get

also modified by tilting pantographs fixed on roof of the coach. As the train tilt the carriage slides along aside due to an active translation hydraulic system which gives permission to the pantograph to remain centred.



2. PENDOLINO SUSTAINABILITY

The new Pendolino trains are 95% recyclable. The electric break system saved 8% of energy consumed. Alstom gives statement that 97% of the power is recycle and feedback into catenary wire system. The sound insulation phenomenon under the body and improved aerodynamic design to decrease sound entrance through the rough of coach. A shock absorber dumping system vibration the wheels also grants to reduce noise pollution



Table-1: Tilting Train Around The World

Sr. No.	Country Name	Train Name	Speed (Km/hr)
1	JAPAN	381-EMU	120
2	ITALY	ELETTO-TRENO	280-250
3	SPAIN	TALGO-350	350-330
4	U.K.	APT (ADVANCED PASSENGER TRAIN)	249-201

- In Japan, EMU-381 series can ride at a speed of 120 Km/hr.
- In Italy, Elettro-Treno series can ride at speed of 280-250 Km/hr.

- In Spain, Talgo series can ride at a speed of 350-330 Km/hr.
- The ATP (Advanced Passenger Train) provided a smooth ride at a speed at high as 249-201 Km/hr

3. CONCLUSION

Importing common tilting trains from Europe is not the solution when looking at curvy tracks. The majority of main lines trains will not pass through existing curves without improvements. Although tilting mechanisms are expensive as the other technology are absent. Thus, tilting trains have an important role in safe railway transport system and high speed transport system. And hopes that tilting train mechanism will be a part of 'INDIAN RAILWAYS SERVICES' in coming years.

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