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Transport for Future, the jo-jo Concept

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Abstract

This theoretical study is useful for the build of a new separate railway system. We call it the Jo-Jo-concept. It is based upon the idea of shuttles (railcars) docking and undocking with trains in full speed, combined with a railway switch without moving parts. Such a switch is always in correct state and the wish for a single shuttle to take the side branch is implemented within the shuttle itself. The infrastructure is completely passive. The train on the main track runs at constant speed (245 km/h) non-stop and shuttles for passengers or goods go via connection tracks to/from stations. With a communication-based control train we can have moving adjustable blocks. We can have the main track, above highways, outside of dense populated areas and as many stations we want. An extra station will not prolong travel times for others. Each train can be for both goods and people. Direct shuttles (for people and/or goods) in front of a Control shuttle in the train. Behind the C-shuttle we have P shuttles that dock with gangways for free passenger movements. As such a P-shuttle dock at the end of the train, passengers move forward, and those bound for the next station enters this last P-shuttle. Approaching the switch the shuttle undocks. Its extra wheel axles are lowered and thus it takes the side branch. All passengers travel non-stop. All stations deliver passengers to all trains. To ensure redundancy we can have a three track system, up track, down track and in between a spare track. With aid of the static switch we can avoid total stop of the system by use of this spare track. C-shuttles have large energy storages to use in case of overhead line failures.

Keywords: railway, docking, shuttle, static switch, high way, goods, people and infrastructure

1 Introduction

The practical implication/use of this theoretical study will be for the build of new railways. The combination of two old ideas (plus a little thinking) leads to surprisingly many good results. We call it the Jo-Jo-concept.

1. Shuttles (railcars) dock and undock to a train at full speed [2 - 8]
2. Railway switches without moving parts [9 - 13]

High speed trains, of several shuttles, runs continuously (non-stop) at a constant speed (245 km/h) on a main railway track located outside of population centres, like highways for cars. Shuttles run at maximum 249 km/h. Connection tracks, join stations to the main track. Shuttles not within a train run with power from batteries. In the train is a Control shuttle controlling the train and distributing power from overhead power lines (or hydrogen).

Trains are simultaneously both for people and goods
In front of the C-shuttle there are Direct shuttles. These contain goods or people, or a mix thereof, that go directly from its station of origin to its final station. However, in low traffic time, or to/from stations with low traffic, an intermediate station for the rearrange of goods is used. D-shuttles enter the main track in front of the train and docks at its front. Approaching a railway switch, shuttles with destination to associated station/stations are undocked from the train. Each such shuttle then lowers its extra axels and in the switch they follow the side track. Having passed the switch the extra axes are raised. As the train has passed straight on in the switch it reunites with its shuttles on the main track. Note that the C-shuttle keeps its constant speed.
Behind the C-shuttle in the train are shuttles for people. These P-shuttles are connected with gang ways so people can walk freely between shuttles. Docking P shuttles dock at the end of the train. P-shuttles mostly undock from the end of the train. At very high traffic or high traffic from adjacent stations then P-shuttles can be undocked from within the train.

Low cost railway
Speed less than 250 km/h => we can build the track on pillars/poles (viaduct/bridge) above existing highways. Rapid build and low investment and running cost.

Direct connection
All passengers travels non-stop. The Jo-Jo concept allows unlimited number of stations. Addition of one more station does not prolong the travel time for others

2 Methods

Docking at full speed
Everything is relative. Space centre ISS moves with 30 000 km/h. For 50 years space crafts have docked and undocked vacuum leak tight; and there are 12 degrees of spatial freedom to control (X Y Z plus rotational angles). Aeroplanes refuel in the air without spill. Platooning for trucks in common traffic is technically doable. Modern

cars have automatic speed control. Approaching another car and the speed drops and a constant, adjustable, distance is maintained. Docking for railway vehicles is just a simple one dimensional activity and there are no surrounding activities. Automatic couplers are compulsory in USA since 100 years and are common practise in most countries. However, docking at full speed is not. The conservative say would be – to what use - and if the train in front suddenly derails, just in front of the approaching shuttle, then there would be an unavoidable collision. More people would be involved in the accident. But what about longer trains, if it derails, then more people would be in the accident. Should we forbid longer trains? Docking to a train can be vertical [2, 3, 4], parallel [5, 6] or linear [7, 8]. The Jo-Jo concept is linear.

Static railway switch

Here described is one version of how a static railway switch can operate. Each shuttle has an extra axle at both ends. Each axle has four wheels, (fig 1). The two outer wheels are double flanged, guide wheels. The two inner wheels have a flat circumference broad enough to bridge the gap where rails are crossing. A shuttle to take the side branch is separated from other shuttles. For a right turn switch, there is an extra rail to the right of the ordinary rails. The extra rails gradually get higher. The wheels on the lowered extra axles now reach down and raise the shuttle up above the ordinary rails.

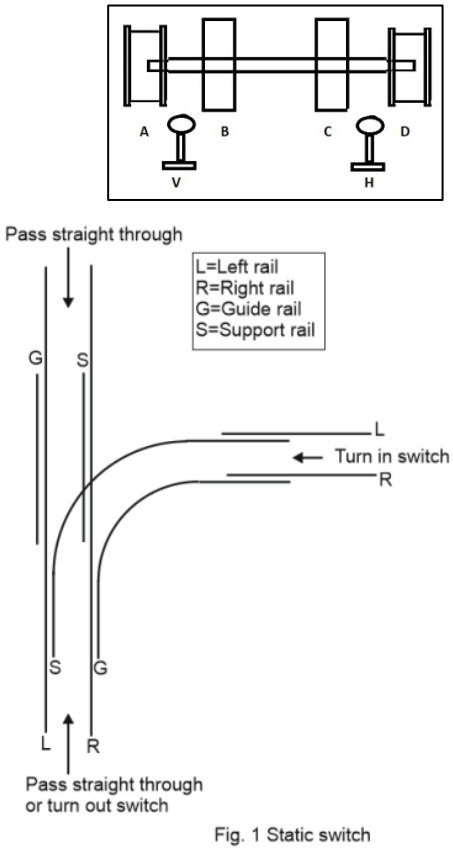

Fig. 1 Static switch

Failure
Standard switches must be in correct position, else the train might derail. Thus train approaching must know that the switch is in correct position in good enough time to stop. A static switch is always in correct position.

Train speed through switch
Standard switches have a limited maximum speed. In Sweden the switch EVR-60-2500 allow straight forward 250 km/h and 130 km/h for the side branch. A static switch does not have that limitation. The train or single shuttle can have 250 km/h in either direction

3 Results

People transport We can have as many stations we like and yet not increase transport time for other passengers. All passengers travel direct from station of origin to their final station of destination. All stations deliver and receive passengers from all trains. Traffic density can be high even when there are few travellers since each train can contain shuttles not only for persons but also shuttles for goods.

Goods transport
We can have direct high speed transport from station of origin to station of final destination. All trains can have shuttles for goods. We can have as many terminals for goods as we like. Some terminals for the rearrange of goods are needed to support smaller countryside stations. Goods should be light weight and loaded on standard Euro-pallets

Infrastructure
With tracks built on pillars/poles (viaduct/bridge) then we have a complete static infrastructure. Inspection of rails on a regular basis, but other maintenance is only on rolling stock and can be done off line in smaller cities. We need communication based train control, like ERTMS3 with adjustable floating/moving blocks.

Shuttles
Shuttles for people take 50 seated persons, disabled persons, bicycles etc. A shuttle is 24 m long, weighs fully loaded 24 tons and it has an axle load of 6 tons. Load shuttles can take 10 tons and 200 m3of goods. Shuttles can accelerate with 1 m/s 2 and is a light weight construction.

Stations
Stations are very small. Platforms are quite short, not much longer than a shuttle. As a comparison, platforms for high speed trains (HST) are 400 m long. Shuttles can on connection tracks to stations in populated areas run significantly slower to avoid disturbance.

Transport capacity
Since the length of the Jo-Jo-train is not predetermined it is easy to scale up or down the its capacity, just change the number of shuttles in the train.

Energy saving
At non-stop train, that yet service all stations, consumes considerably less energy. In a study [14] for totally nine stations on a 169 km long track and a HST they found at 250 km/h that the full stop train consumes almost double the amount of energy.

Time saving
In Sweden a HST with top speed 320 km/h (under discussion) with non-stop will take 2 hours 30 minutes for 600 km distance. The Jo-Jo-train use the same time with only 245 km/h and yet it service all (many) stations in between.

4 Conclusions and Contributions

The Jo-Jo-concept influence on society, environment and future With frequent departures and short travel time it is possible on a daily basis to commute for:

- Work
- Culture
- Sports
- Schools
- Health care

With lots of stations we can optimise: ·

- Business location
- Municipality planning
- Society service
- Use of present infrastructure like roads, houses, schools etc.

With the Jo-Jo-concept we can:

- Slow down or break the urbanization process
- Transfer transport for people and goods to trains
- Help save the environment by less energy consumption and less emissions
- Have many stations and thus have an unbeatable large traffic area
- Get good and swift both national and international travel
- Have improved over all social functions, military defence, police, emergency service etc.
- Enjoy life in the city as well as in the country side

Before realization of the Jo-Jo-concept we need to perform practical experiments on docking and on the switch without moving parts. That will consume time and money and need skilled people. We hope the Jo-Jo Tåg foundation together with others can be a part of that future.

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