A Review on
"Sky Bus Technology: A Mass Transportation System"

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Abstract—India is one of the leading developing countries in the world community today. But, the main obstacle it is facing is its large population and mass transportation. One of the most important aspects where our country is concentrating to work on, for its development is mass transportation. Mass transportation plays a vital role as we always have to think about moving of a large population in very denser area. That's why our Government is planning to implement the new technologies in mass public transportation. There are many new technologies in mass transportation such as Metro rail, Mono Rail, Underground railway, Sky bus Technology, Bus Rapid Transit System (BRTS) etc. In this seminar, we aim to explore Sky Bus Technology.

Key words: modern transportation, sky bus, safety, Advantages of sky bus

I. INTRODUCTION

Sky bus technology is developed by Mr. B. Rajaram. He was involved with the Konkan railway project from the beginning of construction (1990) as a Chief Engineer, Director (Projects) and finally as the Managing Director (1998 to January 2005).Sky Bus Metro concept first presented in Bologna University Italy, by him in 1989.

Heavy 52/60 kg/m rails placed at standard gauge floating in elastic medium and damped by inertia of measured mass held in a 8 m x 2 m box enclosure, supported over a 1m dia. Column spaced at 15 m and located at 15 m distance from each other, in the divider space in between lanes on a roadway, at a height of 8m above road surface – provides the support and guidance for powered bogies which can run at 100 Kmph, with the coach shells suspended below, carry passengers in air conditioned comfort, can follow existing road routes, while existing traffic on roads continue. The fixed structure at 8 m height above road level is aesthetically pleasing and there is no concern of claustrophobic feeling for road users. Mass-transit system, which can be put up within two years in any crowded & congested city.

Fig. 1: Sky bus train

Sky bus metro falls under tramway category, under Art 366(20) of constitution of India, since it operates along existing roadways and within municipal limits, hence excluded from Indian railway act.

Well proven rail guided system commonly used for normal railway system. Proven 3 phase asynchronous AS electrical motive unit-well proven and widely adopted abroad as well as in India. Light weight coaches called "Sky Buses" which are suspended from Bogies and Travel below rail guides.

Pre-fabricated latest Construction Technologies, which save time and money resulting in easy execution of the project in busy urban areas without disturbing the existing traffic pattern. These structural engineering methods are well proven which do not have any project execution risk attached.

Information technology tools for economic communications and control. The project will be of world class standard and will place India in the forefront of providing the much needed alternative transport solution, which is a financially viable, environmental friendly, synergizing well proven existing cutting edge technology.

II. COMPONENT OF SKYBUS

The system Sky bus metro consists of several conventional and some new proven technologies, which makes the sky bus more efficient. These are designed so that to keep the sky bus moving without any defect and to give the passengers the ultimate comfort along with other luxurious facilities which they cannot get in the local buses or in trains.

The various important components of this system are given below with their real views:

A. The sky way

In the middle of roadway, pile foundation support 1 m diameter column approximately 8 m high, and space at 15 m all along the roadway. The sky way consists of a concrete box structure carried over a series of piers above existing road level. Two rails fixed with appropriate fastening within the concrete box support and guide the sky bogie. There are no points & crossings.

B. Sky bogies

Standard two axle bogies used in metros for speed of 100 kmph, are used (but can have higher speed, if required, up to 160 kmph) of standard gauge. Linear induction motor technology is incorporated with 4th rail driving which is above the bogie/or 3 Phase AC motors with regenerative power capability. Third rail is used for current collection. Emergency mechanical brakes are also provided.

C. Sky coaches

Double walled light shells with wide large windows are suspended from the sky bogies, Controlled banking on

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curves – even 100 m radius curves can be handled, Air conditioned and with automatic doors, Audio & visual information to passengers with Special 4m wide sliding doors for quick entry and exit of passengers. It carries 300 persons.

D. Sky stations

Unlike conventional mass transit systems, sky bus needs smaller stations. Service is every 2 minutes that is virtually no waiting time for passengers. Totally automated without drivers or guards and access control is also electronic by prepaid cards being swiped in. Station act as only access facility, and not as passenger holding area.

E. Traverser arrangements

There are no points and crossings. The traverser is the system which automatically shifts the sky bus units for balancing the loads/changing routes too as well as shift units to depot lines etc. Proven technologies and a very simple solution by merely re-engineering.

III. FEATURES OF SKY BUS

Standard gauge rail tracks

60 kg rails fitted with double elastic fastening, with standard gauge on sleepers designed & tested for 20 tone axle load norms forming maintenance free tracks.

Driving bogies

100Kmph standard gauge 12 ton/14 ton axle load powered bogies – same as used in metro rails with 4x110/115 Kw asynchronous 3 Phase AC motors with power-regeneration and capable of peak 1.3 m/sec acceleration.

Braking

Electrical re-generative braking, coupled with compressed air disk mechanical brakes and emergency/idling mechanical brakes for stabling.

Crushing load for under frame

Under frame - fit to take crushing loads of regular main line coaches- more than 70 tone.

Train unit

Each train unit 20m long with two driving bogies- the coach divided into 2x9.5 m long buses connected through vestibule door.

Capacity of 20m long train unit

Each Sky Bus unit having two compartments (3.25m x 9.5m) can carry almost 400 persons at 7persons/sq. m. density peak. The 20m units can be attached to form a 3 unit, 60m long train of 1200 person capacity.

Signal & train control

Simple three aspect signal system driven by line of sight by motorman, with additional unique safety layer of RAKSHAKAVACH, capable of providing 40 sec headway- but planned 60 sec.

Route capacity

A Sky Bus route can thus be designed at 60 sec headway, to carry 20000 to 70000 passengers per hour per direction in peak period.

Security and safety

Continuous computerized central monitoring & control with provision of audio/visual access for each coach for security. Distributed intelligence systems with redundancy to provide protection against swinging under wind loads/emergency localized control/prevent over-loading/ emergency evacuation guidance.

Track changes and reversals at terminals

The reversal for the sky buses at terminal points, to change tracks or go to depots happens through traversers- mechanical auto driven systems capable of handling 60m consists of sky bus units.

Stations-elegant and small

Stations are 60m long to handle three units of sky bus, covering next 25 years of requirements-though initially only 20m length is needed.

Easy access

Access is from existing footpaths, climb limited to 6m for passengers- within 500 to 600m from wherever you are on the road having sky bus route.

Turning radius & gradient

It can be designed for 20m turning radius, and vertical lift, if needed- thus we can avoid totally demolition of any built up urban property, if needed.

On Line maintenance of rolling stock and tracks

Maintenance is through continuous monitoring of vibration signatures, and directed by need automatically by computerized only and periodic checks. All the sub-systems/ elements are to existing UIC/Indian Railway code practices applicable to railway transport.

Cargo handling capability

Cargo of standard containers are automatically delivered and cleared into and out of city.

Safety Certification for Public carriage

It will carry international class safety certification by renowned world class safety certifiers.

Terminal concept

Current concept of a railway terminal replaced in this "grid" system, by a multi-point distributed discharge and access- almost eliminating intermodal transfer. Each station designed for handling whatever commuters can arrive on a 4m wide footpath – with waiting time less than one minute.

Land requirement for route, stations and at depots

All along the route the alignment is typically located on the median (1.2m diameter columns at about 15m spacing) of the road, needing right of way at 6.5m above the road, the fixed structure carrying railway tracks located at about 11m – thus avoiding effect to road users. Typical road widths normally of 10m all along and at station locations 20m width for 60m length desirable. Depots will be outside the urban areas, needing about 25 hectares land for services for every 10 km route. Stations are located with access from existing footpaths, and over and above existing roadways, none of them longer than 60m to cater to next 100 years of requirements of city- practically requiring little land.

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Power requirements

Typically for tropical climate conditions, for a module of 10 km route, 15 MW power needed covering traction and all services including comfort air-conditioning loads at stations.

Quality of service and pricing

With access within 500 to 700m walking distance, air-condition travel at 100 kmph, service available at less than a minute during peak hours, priced at Rs 1.5 per KM falling to Rs 1for regular travels with lead of more than 7 km can be provided.

Typical costing (year 2005-06)

For typical installation to handle 40,000 passengers peak load per hour, on a double line, the cost on turnkey basis will be Rs. 55 to 60 Cr. Per Km, and construction period less than 3 years, for a minimum module of 10 km route.

IV. ADVANTAGES OF SKY BUS

The various advantages of sky bus technology are Fast transportation, No Land Acquisition Problems, No demolition, Fire Protection, No Capsizing, No Deaths, Deep Penetration, Low Capital Cost, Lowest Operational Cost, No interference with normal road Traffic, Fast Clearance, Capacity, Flyover, Fast Execution, No Pollution, No Force Major, No Traffic Jams, No Waiting, Low Travel Cost, Comfort, Tourism, Easy Access, Amenity, Luxury.

V. SAFETY IN SKY BUS SYSTEM

Compared to conventional railways systems, the center of gravity of the mass being carried on the wheels is brought down to be closer to the wheel support – Hence dynamic safety is many time improved. In conventional railway wind can topple the trains. In Sky Bus wind cannot topple – there is positive link between the rail guidance system and the Bus Coaches – with 400 % safety factor built into multiple suspenders. The railway bogies in conventional system have propensity to lose control on derailment, but additional safety in sky bus bogie is that we have derailment arresters, which prevents the wheel from jumping off the rails. So we are ensuring that there is no derailment. In normal railway systems, when collision takes place, derailment also occurs, and carriages capsize killing people. But in sky bus no collision can take place between the coaches – even after the 3 levels of braking fail and the sky bus units hit each other in a collision, the sky Coaches in which people are travelling, will only swing to and fro – but will not collide with each other nor capsize.

But, if there will be any problem occurs in the Sky Bus during its running and it has to be stopped between two sky station, then there are the safety air bags provided with each coaches for emergency exit of the passengers in the mid-way.

VI. CONCLUSION

- The Sky bus is the technological breakthrough that India has achieved. Sky bus is an improved railway technology, eliminating the problems of existing metro rail systems, like - derailment collisions and capsizing crushing people – which have been suffered by country for decades.
- Financially Sky bus metro makes urban transport dream come true for administrators and people.
- The sky bus metro is one single technology which can change the face of our cities, take out almost 10 million road vehicles in the cities and make the cities live able, improving quality of life and attract and sustain economic activity to generate wealth.

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