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Hitachi Monorail Technology Presentation

September 3, 2013

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Contents

1.1 Introduction : Hitachi Overview

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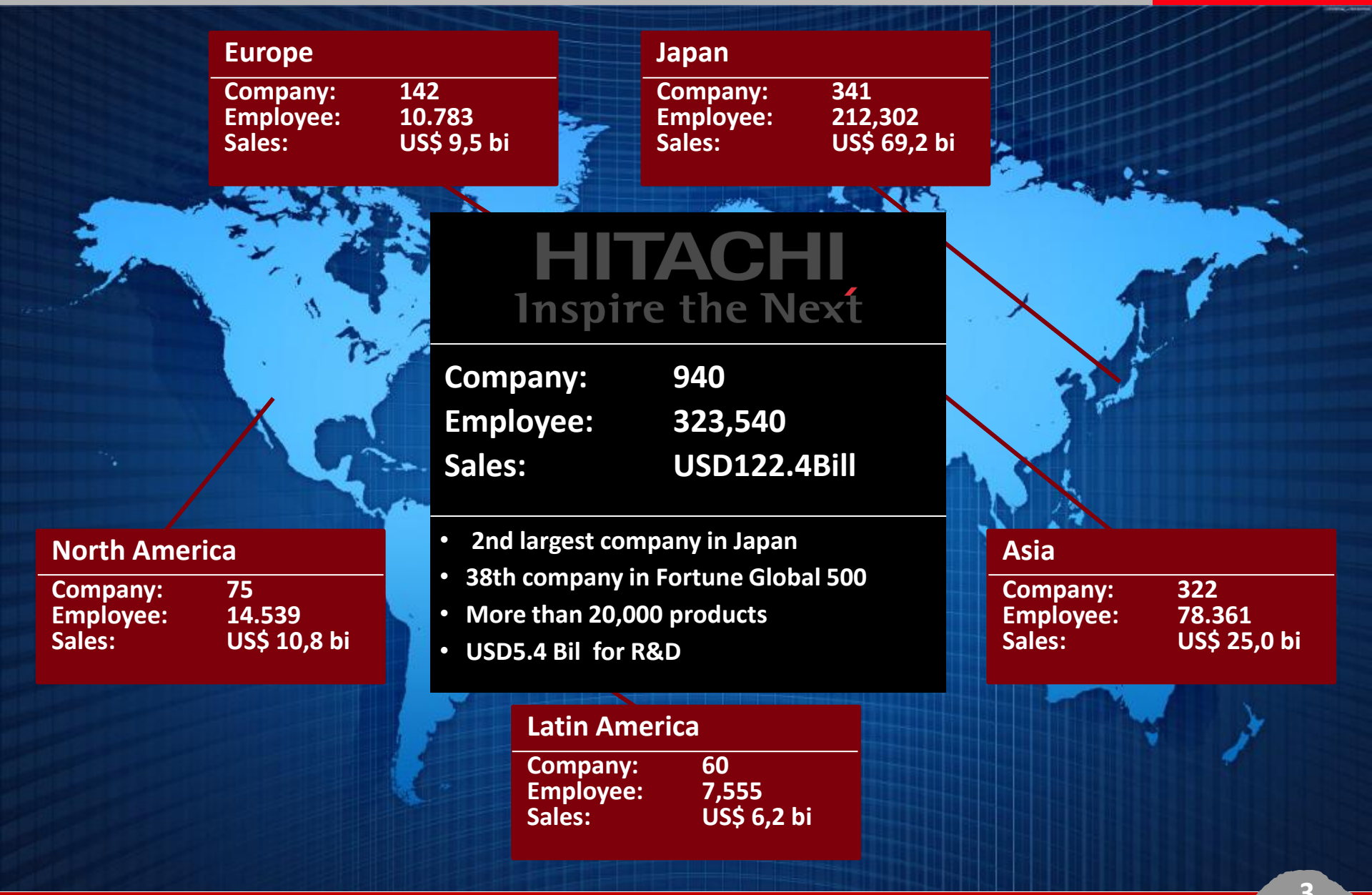

Europe

Company:	142
Employee:	10.783
Sales:	US$ 9,5 bi

Japan

Company:	341
Employee:	212,302
Sales:	US$ 69,2 bi

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Company:	940
Employee:	323,540
Sales:	USD122.4Bill

- 2nd largest company in Japan
- 38th company in Fortune Global 500
- More than 20,000 products
- USD5.4 Bil for R&D

North America

Company:	75
Employee:	14.539
Sales:	US$ 10,8 bi

Asia

Company:	322
Employee:	78.361
Sales:	US$ 25,0 bi

Latin America

Company:	60
Employee:	7,555
Sales:	US$ 6,2 bi

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The sole total rail system integrator in Japan

- ✓Full range of railway related products and systems
- ✓Strategic focus on Europe, China and emerging markets (Brazil, India and Southeast Asia)

1.3 Introduction : Hitachi Rolling Stock

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Supplied over 7,000 Electric Cars

Highspeed Train
Over 200 km/h

Classe 395
UK
225 Km/h

Classe E954
Japan
360 Km/h

Classe 500
Japan
300 Km/h

Classe E5
Japan
300 Km/h

Inter City, Commuter Train
Between 100 and 200 Km/h

TE-1000
Taiwan
130 Km/h

Series 683
Japan
160 Km/h

Rockhampton
Australia
160 Km/h

Series 885
Japan
150 Km/h

Urban Transport

Monorail

Urban train

Metro

1.4 Introduction : Global Network

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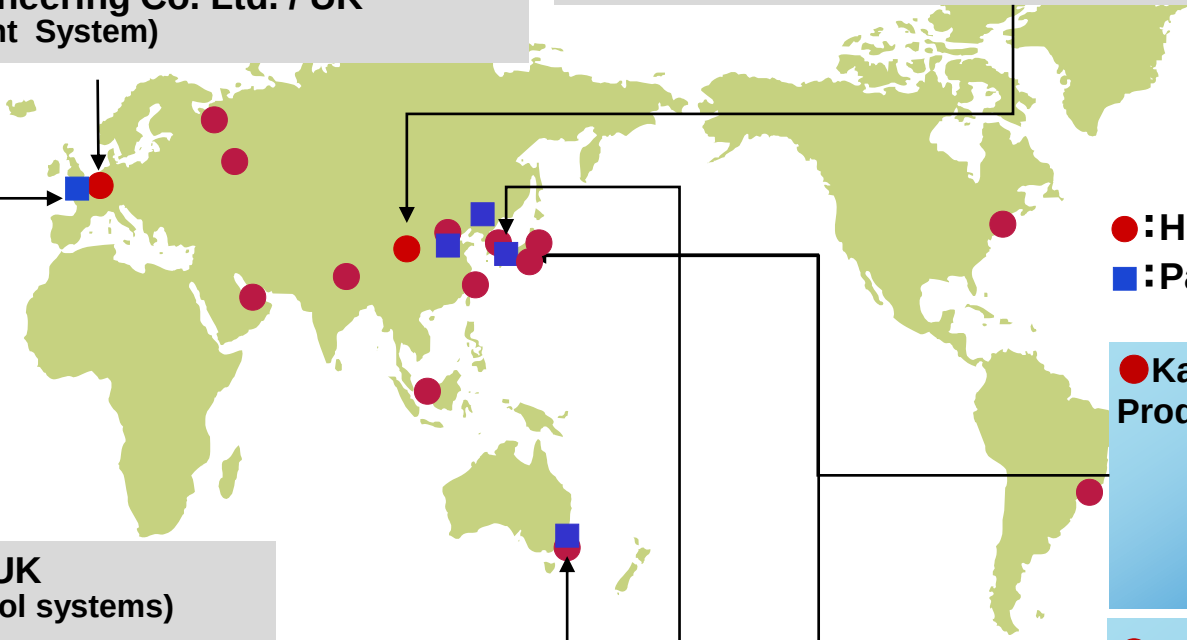
● **Hitachi Rail Europe Ltd. / UK**
London head office, Ashford Depot, Newton Aycliffe Works
(Sales & Marketing, engineering, and maintenance service)

Ashford Depot

● **The Railway Engineering Co. Ltd. / UK**
(Traffic Management System)

● **Hitachi Yonge Electric Equipment (Xi'an) Co., Ltd./China**
(Manufacture of electrical component)



●：Hitachi Sites
■：Partners

■ **Network Rail Ltd./UK**
(Signaling/Train control systems)

● **Kasado Rail Systems Product Div.** (Rolling stock)

● **Mito Rail System Product Div.**


(Electrical Components)


(Signaling System)

■ **Downer EDI Rail Ltd./ Australia**
(Electrical components)

■ **Woojin Industrial Systems Co., Ltd./Korea**
(Monorail, Electrical components)

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Simple
Suitable
Safe

2.1.1 Simple: Beam Structure

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Simple and Light – Various Routing Possibilities

[Over Road Medians]

[Over the Rivers & Canals]

[Along Existing Roads]

[On Hills & Slopes]

[Along the Shoreline]

[Over Road Flyovers]

2.1.2 Simple: Low Construction Costs

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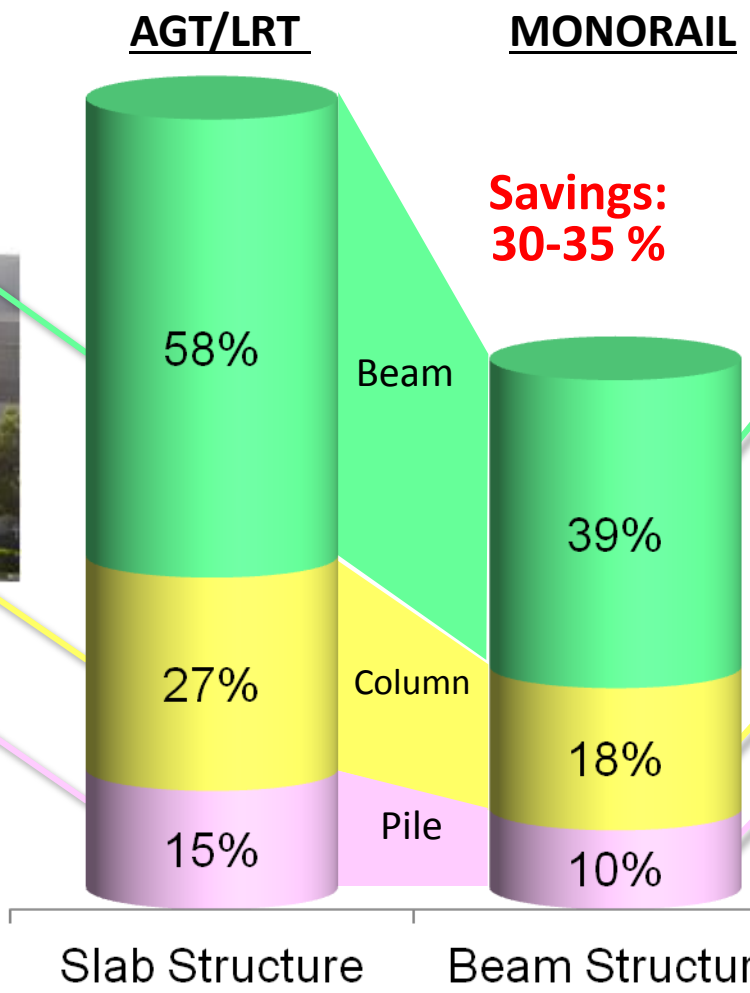
Simple and Light – Lower Cost in Track Construction



*Comparison based on average construction costs in Japan

2.1.3 Simple: Short Construction Time

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Simple Construction Process of Monorail Track Beam

- Production of **pre-casted concrete beams** at temporary casting yard
- Beam construction may be carried out at **Night Time** by lifting cranes

- **Minimal interruption and occupation of public roads during daytime**
- **Less impact on traffic throughout construction period**

2.1.4 Simple: Short Construction Time

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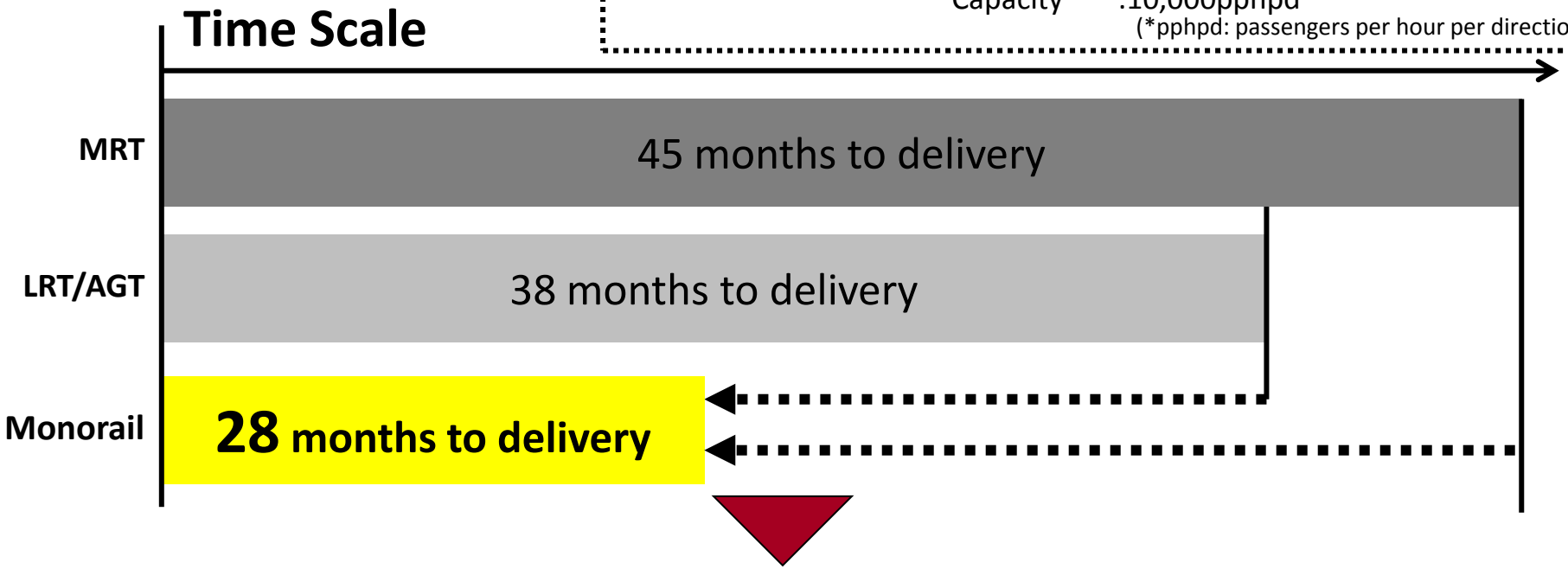
Sample Scenario: Line Length:10km (double track)
Stations :10
Capacity :10,000pphpd*
(*pphpd: passengers per hour per direction



Benefits of Short Lead Time Result in:

- Reduction in overall construction cost
- Increased opportunities in providing public service
- Early start of revenue collection
- Improvement of project viability

2.1.5 Simple: Comparison of Civil Works

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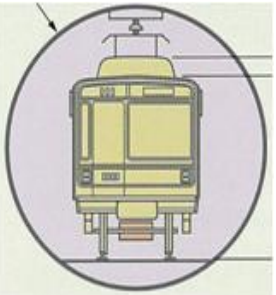
System (Capacity)	Image	Cost (10km length, 10 stations, 10,000pphpd)	Delivery
MRT (underground) (6,000-60,000 pphpd)		300%	45 month
LRT/AGT (2,000-12,000 pphpd)		130%	38 month
MONORAIL (2,500-48,000 pphpd)		100%	28 month

2.2.1 Suitable: Symbol of the city

Dubai Palm Jumeirah Monorail, UAE

Okinawa Monorail, Japan

Sentosa Monorail, Singapore

Daegu Monorail, Korea

2.2.2 Suitable: Flexible Route Alignment

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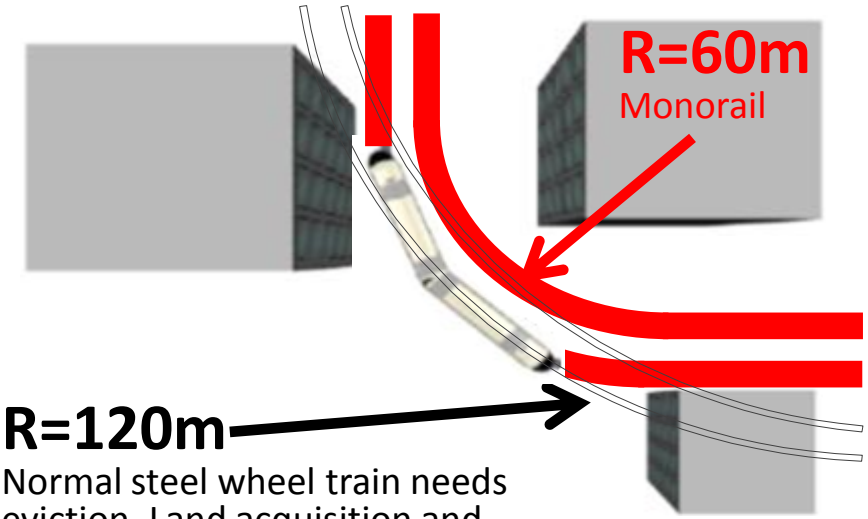
- Minimum Curve Radius : **60m at main line (50m at depot)**
- Maximum Gradient : **6% at main line (6% at depot)**

Fits urban environment, avoids constraints of existing buildings and

Minimizes Civil Work and Cost Less eviction, less removal of existing buildings and less land acquisition



Normal steel wheel train needs eviction, Land acquisition and removal of existing buildings

2.2.3 Suitable: Environmental Impact

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Low visual impact compared to conventional elevated tracks (slab)

2.2.4 Suitable: Low Noise and Good Ride

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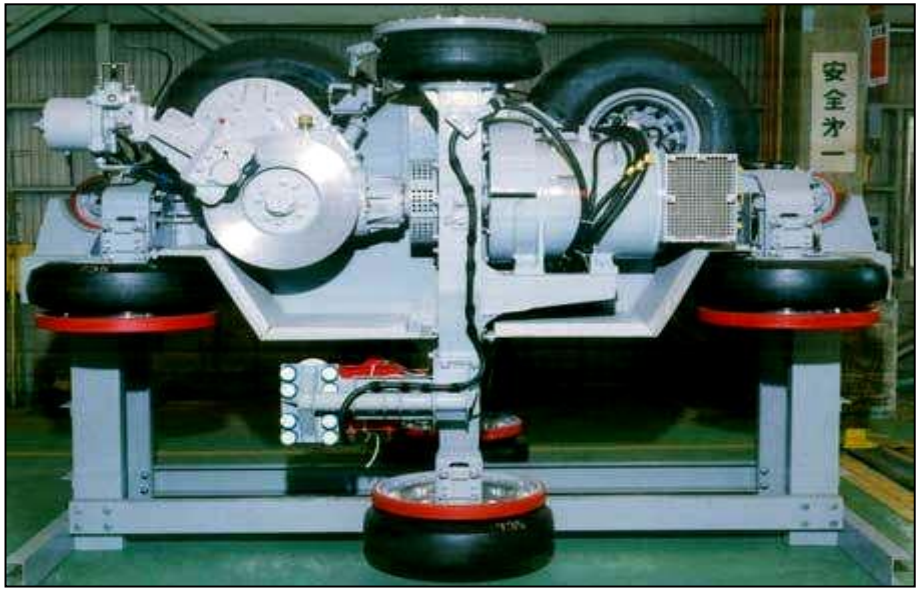
- **Aluminum body** ⇒ *Light weight, recyclable*
- **Bogie**
  - ***Tandem Axle*** ⇒ *Better Ride comfort*
  - ***Rubber Tire*** ⇒ *Less noise and vibration*

Tandem Axle Bogie



2.2.5 Suitable: Structure of Bogie

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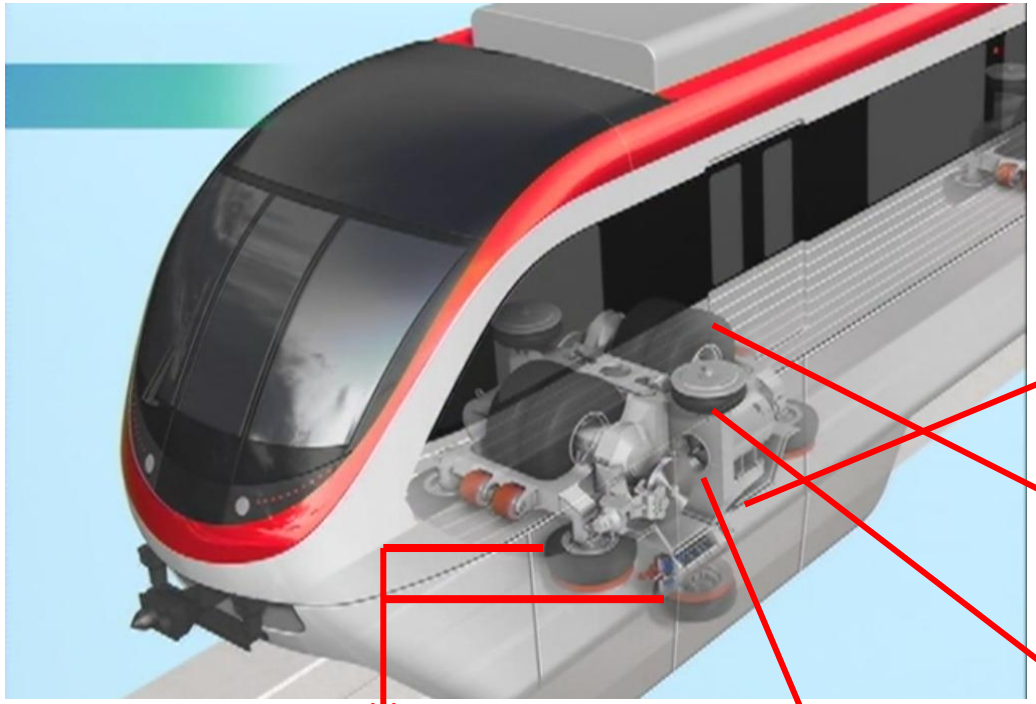
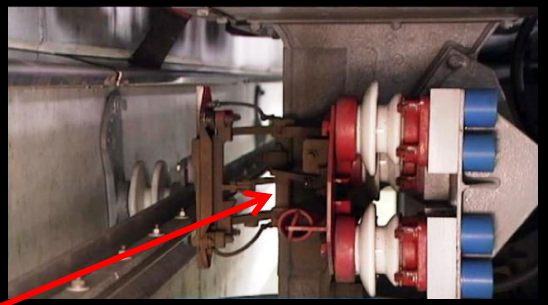
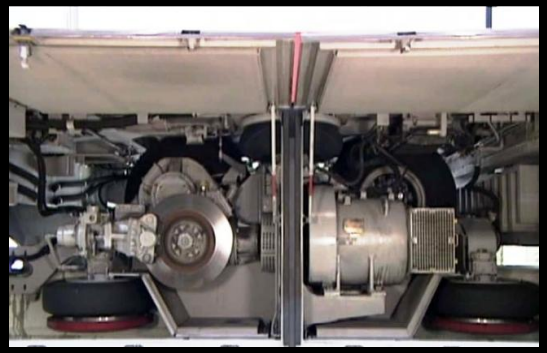




Current collector

Rubber Running Tire

Stabling tire



Eletric Motor

Air suspention

2.2.6 Suitable: Propulsion System

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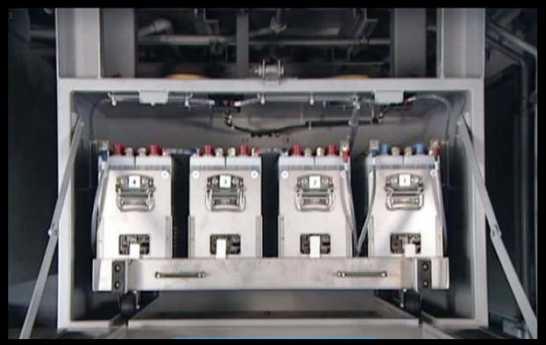

Battery

Inverter

APU

Filter Reactor

Breaker

2.2.7 Suitable: Route Flexibility by Track Switches

2.2.8 Suitable: Route Flexibility by Track Switches

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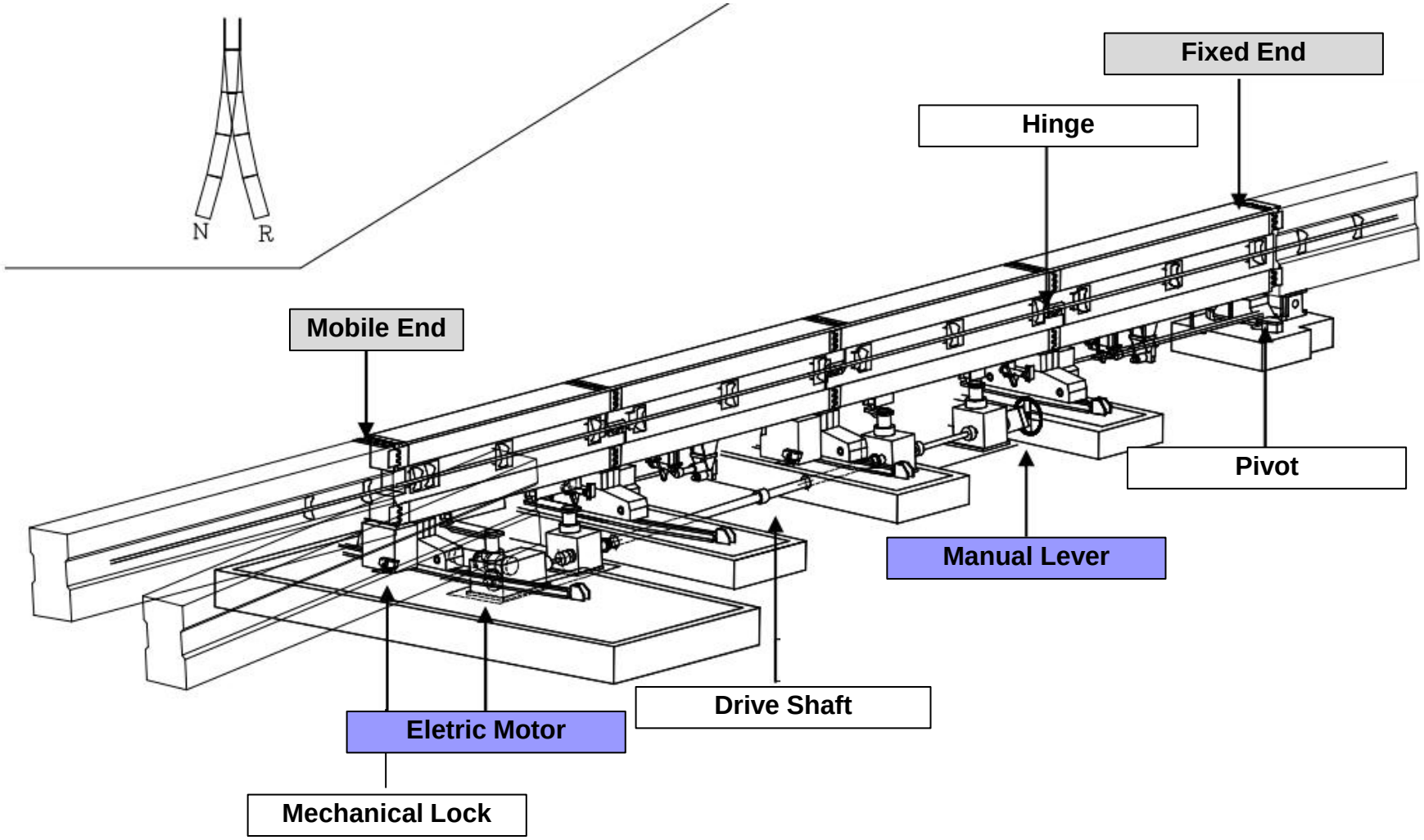
Structure



2.2.9 Suitable: Route Flexibility by Track Switches

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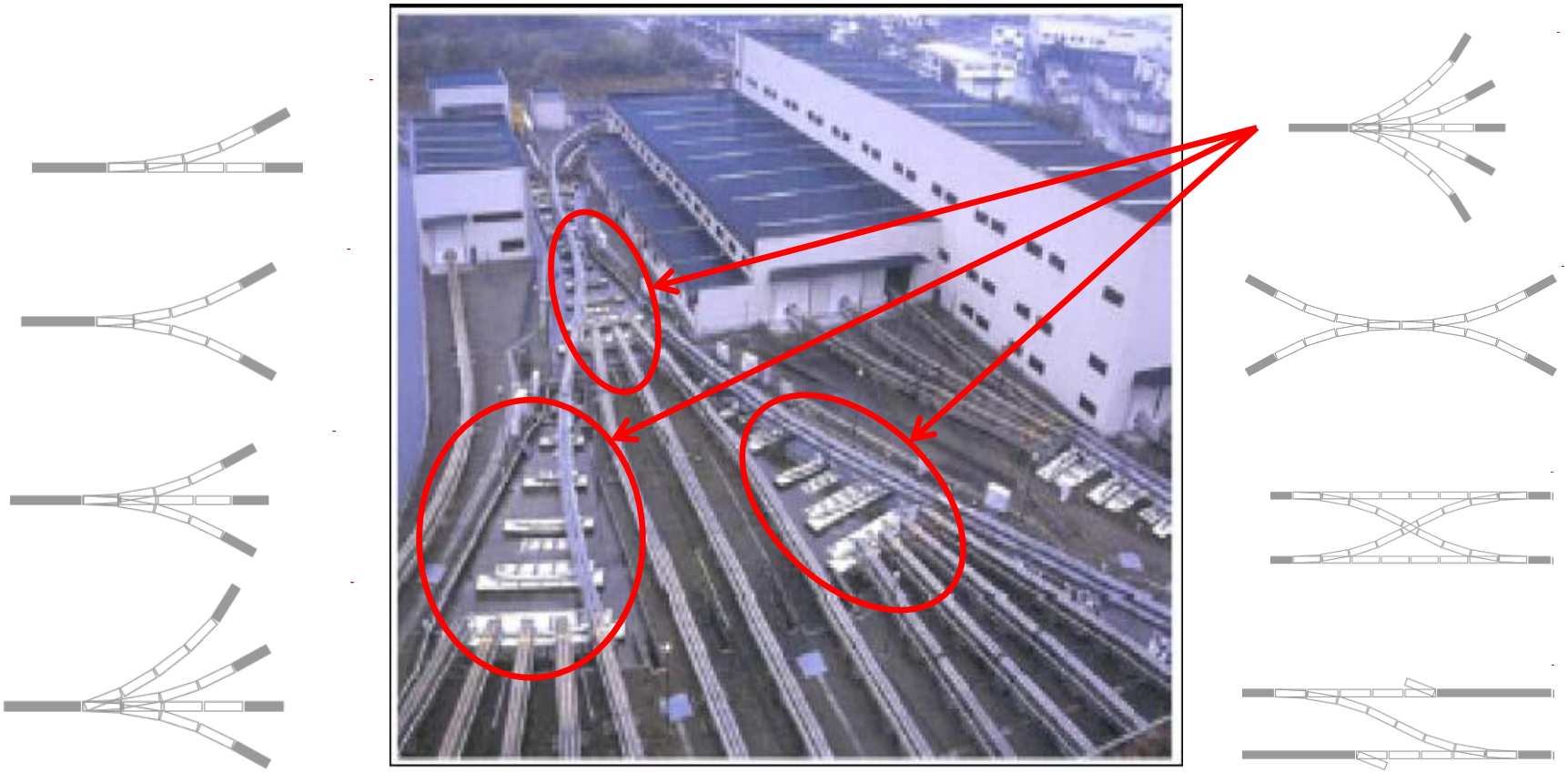
Various Type of Switches provide Vast Route Flexibility and Depot Space Saving



Aerial view of Tama Monorail Depot

2.3.1 Safe : Proven Track Record

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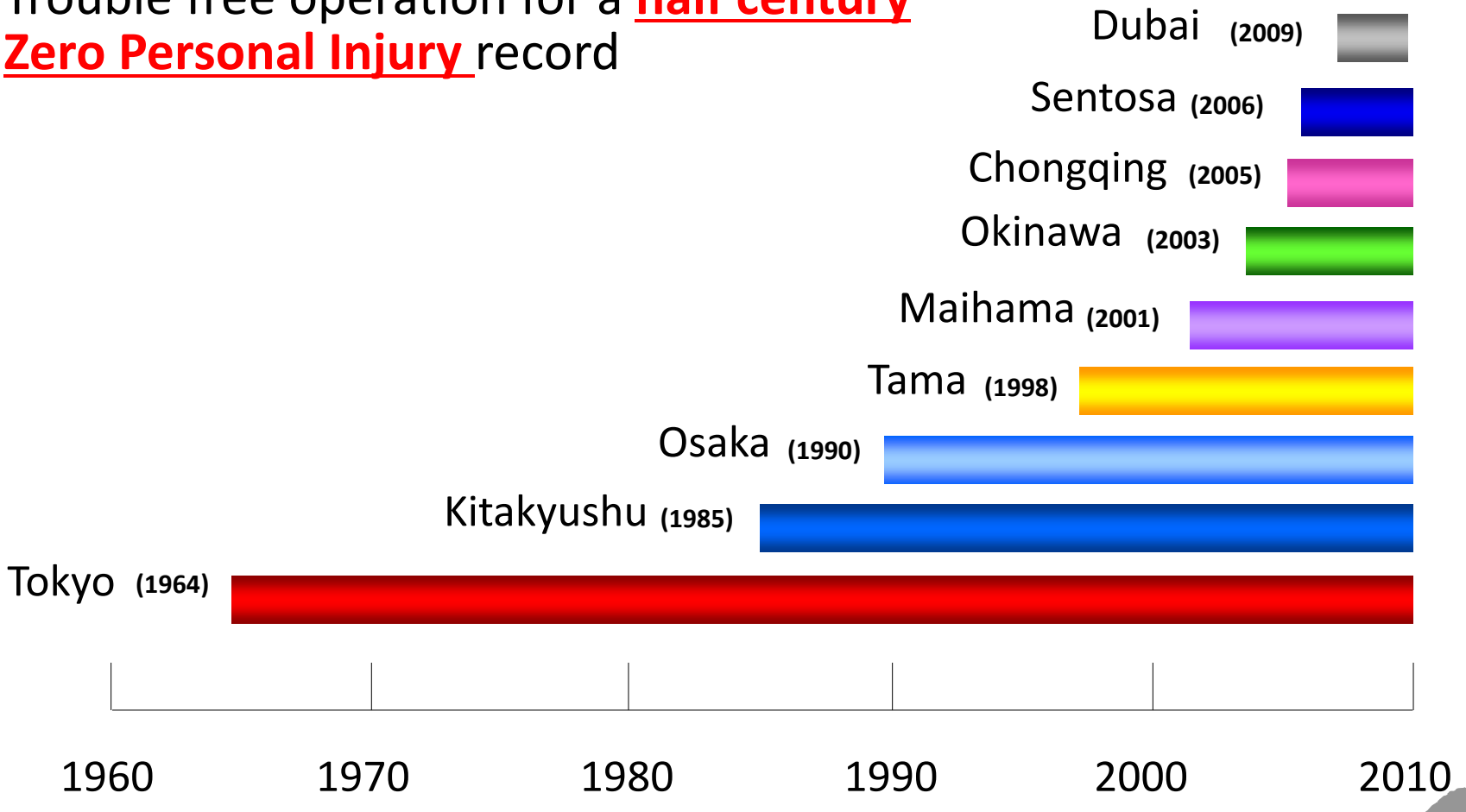
Thanks to the very strict safety standards for urban transit in Japan, Hitachi Monorail Systems have achieved:
- Trouble free operation for a **half century**
- **Zero Personal Injury** record



2.3.2 Safe : Safety Features

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Suitable Interior Arrangement

A walkthrough can be provided between the cars so that passengers may move freely to other cars, especially effective during train to train evacuation in the event of an emergency.

2.3.3 Safe : Safety Measures

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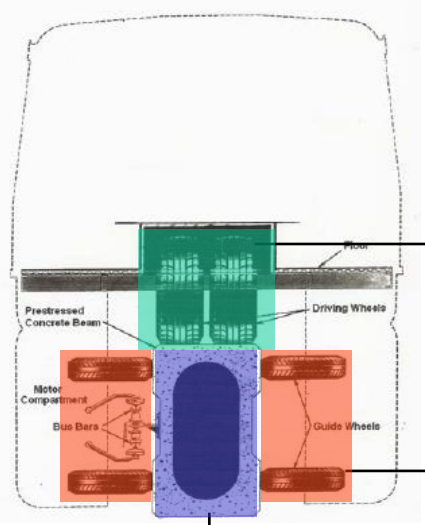
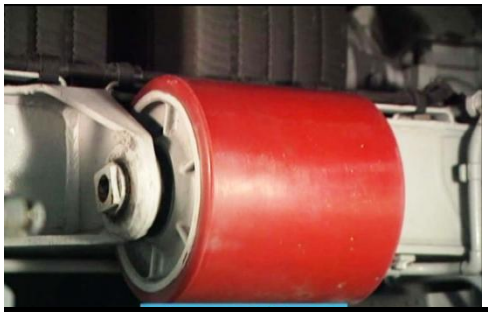
In emergencies, the following methods are approved by urban transit authorities in Japan.

2.3.4 Safe : Safety Measures

- **Safety tire is equipped for the unlikely event of rubber tire blowout**



Running Tire →



Safety tire

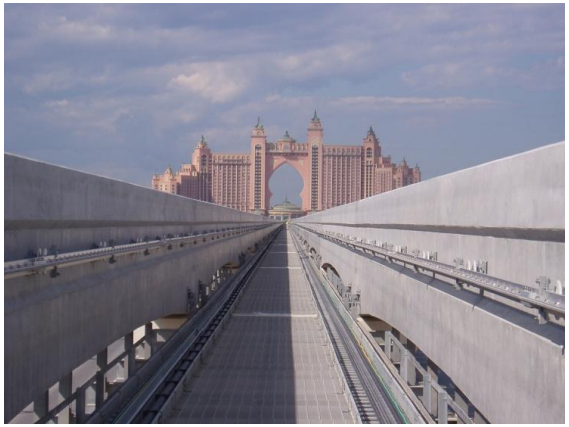
Support Tire →

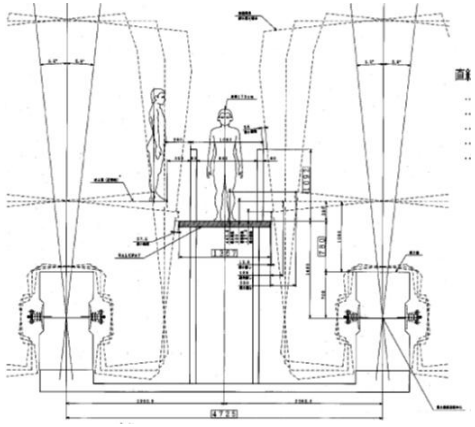
Safety tire

Rail

2.3.5 Safe : Safety Measures

- In certain cities, local regulations require the adoption of emergency walkways (ex Dubai)





- An alternative solution adopted is the installation of Diesel Generators that allow trains to reach the nearest station at reduced speed (15 km / h) in case of a power outage (ex Sentosa).

Proven Delivery Record(Japan)

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	Tokyo	KitaKyushu	Osaka	Tama	Okinawa
					
Year of inauguration	1964	1985	1990	1998	2003
Line Length	17.8 Km	8.8 Km	28.0 Km	16.0 Km	12.9 Km
Number of Station	10	13	18	19	15
Design PPHPD	33,300	48,000	48,000	48,000	9,300
Number of Train	20 trains 6 cars / train 1.100 pass. / train	10 trains 4 cars / train 810 pass. / train	20 trains 4 cars / train 770 pass. / train	16 trains 4 cars / train 770 pass. / train	12 trains 2 cars / train 310 pass. / train
Maximum Speed	80 Km/h	65 Km/h	70 Km/h	60 Km/h	60 Km/h
Notes	First monorail for public transportation in Japan		Withstood major earthquake in 1995	Effective use of VVVF inverter	Operated in tropical climate

Proven Delivery Record(Overseas)

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	Chongqing (CHN)	Sentosa (SIN)	Palm (UAE)	Daegu (KOR)
				
Year of inauguration	2005	2006	2008	(2014)
Line Length	19.2 Km	2.1 Km	5.1 Km	24.0 Km
Number of Station	18	4	5	30
Design PPHPD	48,000	4,000	4,000	(25,000)
Number of Train	21 trains 4 cars / train	4 trains 2 cars / train	4 trains 3 cars / train	28 trains 3 cars / train
Maximum Speed	60 Km/h	60 Km/h	60 Km/h	80 Km/h
Notes		Operated in tropical climate	✓Operated in extreme temperatures ✓Driverless operation with attendant	✓Fully unattended operation

Tomorrow’s Railway, Delivered Today

Hitachi Railway Systems
Rail Systems Company, Hitachi, Ltd.