FORTBEWEGUNG & ZUKUNFT

Hängebahn

„Einschienenbahn

Übersetzung

Einschienenbahn

Eine **Einschienenbahn** ist eine dem Passagier- oder Gütertransport dienende Bahn, die auf oder unter einem einzelnen schmalen Fahrweg („Schiene“, „Fahrbalken“) fährt. Dieser kann unterschiedliche Formen annehmen und aus verschiedenen Materialien gefertigt sein. Er ist meistens aufgeständert, kann aber auch ebenerdig oder in Tunneln verlaufen. Der Antrieb von Einschienenbahnen erfolgt meist mit Hilfe von Elektromotoren, obwohl auch mit dem Dampfantrieb und Verbrennungsmotoren experimentiert wurde. Die Schwebebahn Dresden wird als Seilbahn durch ein Seil von einer stationären Maschine angetrieben.

Alle Einschienenbahnen, die eine Bedeutung erlangt haben, fahren in stabilem Gleichgewicht auf oder unter ihrer Schiene. Dies wird beispielsweise damit erreicht, dass eine Reihe von Zwillingsreifen auf der Oberseite des Fahrbalkens und auf den Seiten je eine hohe und eine tiefe Reihe von Führungsreifen laufen.

Inhaltsverzeichnis

Frühe Entwicklungen

Im Jahre 1821 ließ sich Henry Robinson Palmer ein Patent auf eine Einschienenbahn ausstellen. Nach diesem Patent wurde in Cheshunt, England, eine Bahn für den Ziegeltransport gebaut und am 25. Juni 1825 in Betrieb genommen. Die Wagen hingen unterhalb einer Schiene und wurden von einem Pferd gezogen.

Kreiselstabilisierte Einschienenbahn von Brennan (1907)

Um 1880 wurde in Algerien von dem französischen Ingenieur Charles Lartigue eine frühe Einschienenbahn über eine Strecke von 90 Kilometern errichtet. Die Wagen dieser Bahn hatten ein Fahrgestell, an dem beiderseits Tragbehälter zum Transport von Espartogras befestigt waren. Weitere Strecken dieser Lartigue-Einschienenbahn wurden auf einer Ausstellung 1886 in London und 1888 zwischen Listowel und Ballybunion im süd-östlichen Irland mit speziellen Dampflokomotiven errichtet. Diese Bahn war 36 Jahre bis 1924 in Betrieb und wird seit 2001 nach den alten Vorlagen wieder zum neuen Betrieb aufgebaut.

1907 entwickelte der irisch-australische Ingenieur Louis Brennan (1852–1932) eine Einschienenbahn, die auf Stahlrädern mit Doppelspurkränzen auf einer einzelnen Vignolschiene fuhr und über Kreiselsysteme aktiv stabilisiert wurde. Davon gab es ein Modell im verkleinerten Maßstab sowie 1910 auch eine Demonstrationsanlage in voller Größe in Whitecity / London. Es gab auch einen Versuch, diese Bahn in Deutschland einzuführen, wofür sich der bekannte Berliner Verleger August Scherl und der Landrat des Obertaunuskreises, Ritter von Marx, einsetzten. Das Projekt Einschienenbahn am Taunusrand wurde jedoch noch vor einer Entscheidung abgebrochen, und weitere

Projekte gab es nicht. Bernhard Kellermann verewigte eine solche Bahn in seinem Science-Fiction-Roman „Der Tunnel“ (1913).

Vorteile

Die Wuppertaler Schwebebahn ist die ältestenoch heute fahrende Einschienenbahnen

Als Hauptvorteil für Einschienenbahnen wird generell angeführt, dass die Fahrzeuge normalerweise aufgeständert und damit völlig planfrei verkehren. Dies verhindert Unfälle mit dem Straßenverkehr vollständig, erlaubt starke Automatisierung und ermöglicht eine Zuverlässigkeit, wie sie sonst nur bei U-Bahnen erreicht wird, allerdings zu einem Bruchteil des Preises und mit der gewissen futuristischen Faszination und der Aussichtswirkung, wie sie nur Einschienenbahnen zu eigen ist.

Bauvorhaben lassen sich, da die Fahrwege aus vorgefertigten Fertigteilen montiert werden, recht schnell und unproblematisch verwirklichen; die Fahrbalken gliedern sich relativ gut in städtische Szenerien ein und die Bahnen können sogar in Gebäude eingeführt werden. Die Baukosten von Einschienenbahnen liegen zwischen 25 und über 60 Millionen Euro pro Streckenkilometer. Dies ist gegenüber den Kosten von U- oder S-Bahnen allerdings verhältnismäßig günstig. Der Schattenwurf ist durch die schmalen, recht weit spannenden Träger geringer als beim Aufständern herkömmlicher Bahnen oder mehrspuriger nichtkonventioneller Spurfahrzeugsysteme.

Die Laufwerke sind, vor allem beim SAFEGE-System, aber auch bei Sattelbahnen, vergleichsweise mit konventionellen Eisenbahnen sehr gut vor Wettereinflüssen geschützt. Der Schneeräumaufwand ist bei Sattelbahnen sehr niedrig, bei SAFEGE entfällt das Schneeräumen ganz (daher auch die Anwendungsbeispiele in kälteren Gegenden Japans). Beschleunigungs- und Bremsvermögen der meist elektrisch betriebenen und luftbereiften Fahrzeuge sind zumal bei recht geringer Geräuschentwicklung recht gut (vergleichbar mit luftbereiften Leicht-U-Bahnen etc.); das gute Steigvermögen durch große Adhäsion der Gummireifen und die geringen Kurvenradien durch das unkompliziert mögliche, starke Überhöhen von Bögen erlauben Trassierungen in sehr schwierigen Umgebungen.

Zug der Tama-Monorail (Japan)

Nachteile

Fahrweg und Fahrzeug von Einschienenbahnen stammen im Normalfall von einem Hersteller und sind nicht standardisiert. Damit ist der Aufbau von echtem Wettbewerb in Netzwerken (vgl. Bundesnetzagentur), in denen Fahrzeuge und Netzwerkinfrastruktur unterschiedlicher Hersteller und Betreiber nebeneinander existieren, nicht möglich. Neben der mangelnden Standardisierung der Systeme untereinander ist keine Übergangsmöglichkeit von und zur herkömmlichen Schiene (wie bei Tram-Train, Cargotram) oder zur Straße (wie beim Spurbus) gegeben. Der Einsatzbereich von Einschienenbahnen liegt deswegen vor allem im Bereich der Punkt-zu-Punkt-Verbindungen, insbesondere wenn größere Bereiche aufgeständert zu überqueren sind (Messe, Parks, Flughäfen).

Ein wirtschaftlicher Güterverkehr (jenseits von Kurierware oder Luftverkehrscontainern) ist bei den tatsächlich implementierten Systemen unmöglich, da diese wegen der zahlreichen, zumeist luft- oder vollgummibereiften Räder einen ausschließlichen Betrieb mit Triebwagen verlangen, besonders, wenn große Steigungen und/oder Überhöhungen vorliegen.

Weichen sind verhältnismäßig komplex und teuer. Es gibt verschiedene, unterschiedlich praktikable Biegeweichen- und Wechselweichenbauarten; erstere verbiegen den Fahrbalken, letztere tauschen durch Verschieben oder Rotieren einer Plattform einen starren geraden Fahrstrang gegen einen starren gekrümmten Strang aus. Auffahrbare Weichen sind in keinem Fall möglich.

Die Höchstgeschwindigkeiten sind bei den gummibereiften Bauarten relativ begrenzt. Der Schattenwurf, obwohl nicht so groß wie bei herkömmlichen Hochbahnen, ist nicht zu vernachlässigen. Die flexible Trassierbarkeit und das futuristische Design haben eine sehr starke optische Wirkung und führen je nach Standpunkt zu einer erheblichen Beeinträchtigung bzw. Bereicherung von Stadt- und Landschaftsbild.

Bedeutung und Marktsegment

Die enge (proprietäre) Verbindung zwischen Fahrweg und Fahrzeug, im Regelfall von einem Hersteller, erlaubt im Einzelfall spezielle Verbesserungen gegenüber standardisierten Rad-Schiene-Netzen, verringert aber die Erneuerungsfähigkeit bei realisierten Systemen und kann Zuliefferermonopole bewirken.

Sowohl mit der seinerzeitigen Alweg-Bahn seit 1957 wie auch mit dem Transrapid war der Einstieg in den schnellen Fernverkehr geplant, bereits bei der Schwebebahn-Technologie wie später beim Aerobus war und ist die standardisierte Anwendung im Stadtbereich geplant.

Die entsprechenden Formatkrieg-ähnlichen Auseinandersetzungen im Netzwerkbereich gingen aber bislang alle unter großer Medienwirksamkeit und Anteilnahme der Öffentlichkeit zugunsten klassischer Rad-Schiene-Systeme aus. Selbst die längsten realisierten Einschienenbahnsysteme sind nicht mehr als Nischen und Insellösungen für Spezialfälle. Wichtig und herausragend sind auch (manchmal nur kurzfristige) Anwendungen für Weltausstellungen und Messen oder in Vergnügungsparks.

Trotzdem ist das Vorurteil, das die Einschienenbahn als Aussichts-Gondelbahn abstempelt, unberechtigt. Neben den zahllosen mehr oder weniger komplizierten Bahnen, mit denen in Handwerks- und Industriebetrieben jeder Größenordnung sowie im Steillagenweinbau Güter aller Art transportiert werden, gibt es zahlreiche gut eingeführte öffentliche Einschienenbahnen auf der Welt (Parkbahnen u.ä. sind nicht erwähnt); viele weitere sind geplant. Das längste geplante System in Tama, Japan, soll einmal eine Netzlänge von etwa 100 km erreichen.

Bauarten

Intamin-Monorail in Moskau

Stehende Bahnen (Sattelbahnen)

- System ALWEG: Fahrbalken aus Beton oder Stahlprofil, mit rechteckigem Querschnitt (oft seitlich leicht sanduhrförmig eingezogen); eine Reihe Trageräder, insgesamt vier Reihen Führungsräder (alle luftbereift); Stromversorgung über seitlich bestrichene Stromschiene (Gleichstrom)
    - Bauart Alwegbahn: Fahrbalken 51–90 cm breit und 88−220 cm hoch; Drehgestelle; Trageräder unterhalb oder in der Kabine und zwillingsbereift; Fahrspannung 600 V

  - Bauart Monorail Malaysia: Balkenbreite 80 cm, Fahrspannung 750 oder 1500 V
  - Bauart Hitachi: Fahrbalkenbreite 85 cm, zwei statt nur einem Paar Tragreifen pro Drehgestell, neuere Bauserien mit hohem Fahrzeugboden, so dass die Tragräder den Fahrgastraum nicht zerklüften; Fahrspannung 1500 V
  - Bauart Disney/Bombardier: Balkenbreite 66 cm; keine Drehgestelle, Tragräder stattdessen vor und hinter den Kabinen fest montiert (kein freier Durchgang zwischen den Fahrzeugen) und nur einzeln bereift; Fahrspannung: 600 V oder 750 V
  - Bauart Bombardier: wie Disney/Bombardier, aber vollautomatisch
- Kastenträger-Systeme: Fahrbalken aus rechteckigem Stahlprofil (selten Beton) mit

mindestens einem überstehenden Flansch; Führungsräder greifen den Flansch von unten und die Balkenseiten von außen

- Bauart Bombardier UM: Fahrbalken aus Stahl oder Beton
- Bauart Intamin: Fahrbalken 60 cm breit und 100 cm hoch
- Bauart Severn-Lamb: Fahrbalken aus Stahl oder Spannbeton
- Bauart Von Roll (mittlerweile via Adtranz an Bombardier übergegangen): Fahrbalkenbreite 70 cm, mit beidseitig je 12 cm überstehendem Flansch, Balkenhöhe 83,2 cm; jedem Paar Tragräder sind zwei von unten und je zwei von links und rechts greifende Führungsräder beigegeben; Fahrstrom 500 V Wechselstrom (zwei von unten bestrichene Stromschienen)

- T-Träger-Systeme: Fahrbalken mit umgekehrtem T-Profil, das heißt mit breitem

Flansch unten (evtl. mit schmalem Flansch oben); das Fahrzeuggewicht ruht auf dem breiten unterem Flansch, nicht auf der Schmalseite

- Bauart Eurotren Monoviga: Fahrbalken 190 cm breit und 130 cm hoch, Gelenkfahrzeuge mit 2 Tragrad- und 2 Führungsradpaaren pro Sektion; für Hochgeschwindigkeit Option, Stahl- statt Luftreifen und Linearmotor- statt Radantrieb zu verwenden
- Bauart Urbanaut: Betonbalken von 100 cm Breite mit einer speziellen profilierten Stahlführschiene; diagonal statt waagerecht angeordnete Führungsreifen; skalierbar vom langsamen Fahrzeug auf Vollgummireifen bis hin zur Magnetschwebebahn
- High-Speed Monorail: einzeln aufgehängte Stahlräder, Linearmotorantrieb, hohe Geschwindigkeiten

Hängende Bauarten (Hängebahnen)

H-Bahn Dortmund

- System SAFEGE: vierrädrige Drehgestelle laufen im Innern eines unten geschlitzten Kastenträgers; durch den Schlitz hindurch sind die Wagenkästen an den Gestellen aufgehängt; Fahrstrom aus Stromschienen im Innern des Trägers
    - Bauart Aerorail: Drehgestelle laufen im Träger auf konventionellen, meter-

spurigen Eisenbahnschienen; Fahrspannung 750 V Gleichstrom
    - Bauart Mitsubishi: Fahrträgerquerschnitt 186 cm x 189 cm, luftbereifte Drehgestelle; Fahrspannung 1500 V Gleichstrom
    - Bauart Siemens SIPEM: sehr schmaler Träger, Hartgummireifen; Fahrspannung 380 V Drehstrom (Beispiele: H-Bahn in Dortmund, Skytrain am Flughafen Düsseldorf)
- Doppel-T-Träger-Systeme: der Fahrbalken ist ein konventioneller vertikaler Doppel-T-Träger aus Stahl oder Beton
    - die meisten Werkstatt- und Industriehängebahnen
    - Bauart Titan Global Systems: Hartgummi-Tragrollen auf dem unteren Flansch, Führungsrollen greifen den Steg von außen und den unteren Flansch von unten; Linearmotoran-

trieb, der auch Hubkraft erbringt und die Tragrollen damit stark entlastet

- Doppelspurkranz-Systeme: Stahlräder mit einem doppelten Spurkranz laufen auf einer einzelnen Stahlschiene
    - Bauart Langen (Wuppertaler Schwebebahn, Schwebebahn Dresden, Ueno-Zoo Monorail): Fahrstrom 600 V Gleichstrom
- System Aerobus: Aluminiumschienen, die nach Hängebrückenart an Kabelkonstruktionen aufgehängt sind (Pylonenabstände bis 600 m), werden von den Drehgestellen von außen umgriffen; zwei Reihen Tragräder

Hybridbauarten

Fahrzeuge sind einseitig so an den Fahrbalken gehängt, dass ein Balken beidseitig befahren werden kann

- System Futrex: Fahrbalken mit dreieckigem Querschnitt (Basisbreite etwa 215 cm, Höhe etwa 168 cm) trägt beiderseits oben und unten je eine speziell profilierte Vignolschiene; auf den unteren Schienen laufen diagonal von oben außen Stahlräder mit konkaven Laufflächen, auf den oberen Schienen von innen her greifende Vierergruppen von Laufrollen

- System OTG HighRoad: massiver, umgekehrt T-förmiger Fahrbalken (etwa 198 cm breit und 183 cm hoch) mit nach am Rand nach unten gekröpftem Flansch über dem Steg; spurkranzlose Stahlräder laufen auf der Basis (tragend), an der Balkenseite (das Fahrzeug abstützend) und an der Innenseite des Oberflanschs (führend); das Fahrzeug ist durch Ausleger, die unter dem Oberflansch heraus führen, seitlich an die Fahrwerke gehängt; die Oberseite des Oberflanschs bleibt frei für Dienstfahrzeuge o.Ä.

Einschienen-Schwebebahnen

Land	Stadt	Artikel	Eröffnung	Gesamtlänge	Hersteller
Deutschland	Dortmund	H-Bahn	1984	3,6 km	Siemens
	Dresden	Schwebebahn Dresden	1901	0,274 km	
	Düsseldorf	SkyTrain am Flughafen	2002	2,5 km	Siemens
	Magdeburg	Panoramabahn von Intamin	1999	2,8 km	Intamin
	Rust	Europa-Park Express	1995	2,5 km	Von Roll
	Rust	Europa-Park Monorail	1990		Mack Rides
	Soltau	Heide-Park Monorail	1986	1,5 km	

	Soltau	Heide-Park Panoramabahn	1978		Mack Rides	
	Wuppertal	Wuppertaler Schwebebahn	1901	13,3 km		
Russland	Moskau	Monorail Moskau	2003	5 km	Intamin	

Aérotrain 02 (Prototyp) im Technik Museum Speyer

Als Schwebebahnen werden Systeme bezeichnet, die während der Fahrt die Schiene prinzipiell nicht berühren, wie die Magnetschwebebahn

(Transrapid, M-Bahn Berlin) und die Luftkissen-schwebebahn (Aérotrain)

Liste einzelner Bahnen

Bestehende Systeme in Europa

Bestehende Systeme in Asien

Land	Stadt	Artikel	Eröffnung	Gesamtlänge	Hersteller
VR China	Chongqing	Hochbahn Chongqing	2005	17,4 km	Alweg
	Shanghai	Transrapid Shanghai	2002	30 km	Siemens AG
	Shenzhen		1998	4,4 km	Intamin
	Weihai		2006	4,2 km	Aerobus
	Peking	Verbindungsbahn der Terminalhälften am Flughafen Peking	2008		

In-donesien	Ja-karta		???	27 km	Hitachi
Ja-pan	Chi-ba	Chiba Monorail	1988	15,5 km	SAFEGE
	Hi-roshima	Einschie-nenbahn Hi-roshima	1998	1,3 km	*Seil-bahnsystem*
	Inuyama	Inuyama Monorail	1962	1,1 km	Alweg
	Ka-makura	Shonan Monorail	1970	6,6 km	SAFEGE
	Kita-ta-kyūshū	Kita-kyūshū Mo-norail	1985	8,8 km	Hitachi
	Na-ha	Einschie-nenbahn Na-ha	2003	12,8 km	Hitachi
	Ōsaka	Osaka Monorail	1990	23,8 km	Hitachi
	Ta-ma	Einschie-nenbahn Ta-ma	1997	16 km	Hitachi
	To-	Haneda	196	16,9 k	Alweg

	kio		4	m	
	To- kio	Ueno-Zoo Monorail	195 8	0,3 km	Bauart Langen
	Uray asu	Disney Resort Line	200 1	4,8 km	Hitachi
Ka- sachstan	Al- maty		200 9	40 km (?)	
Ma- laysia	Kua- la Lum- pur	Kuala Lumpur Mo- norail	200 3	8,6 km	Monorail Malaysia
	Putr ajaya	Baube- ginn 2004 - Baustopp 200?	18 k m	Mono- rail Malay- sia	
Sin- gapur	Insel Sentosa	Sentosa Express	200 7	2,1 km	Hitachi Small
Sin- gapur	Sin- gapur	Flughafen	?	? km	?

Osaka hat das derzeit längste System der Welt mit 23,8 km. Transrapid in Shanghai siehe unter dem separaten Eintrag Transrapid Shanghai.

Bestehende Systeme in Amerika und Australien

Sydney Monorail, Australien.

Land	Stadt	Artikel	Eröff-nung	Gesamt-länge	Hersteller
Australien	Sydney	Sydney Monorail	1988	3,6 km	Von Roll Typ III
Brasilien	Poços de Caldas	Ferreira	1990	6 km	
USA	Jacksonville	Skyway	1997	7,0 km	Matra
	Las Vegas	Las Vegas Monorail	1995, 2004 er-weitert	6,3 km	Bombardier
	Newark	AirTrain	1995	4,8 km	Von Roll

		Newark			
	Tampa		1991	1 km	Bombardier
	Anaheim	Disneyland Resort	1959	ca. 4 km	Bombardier
	Seattle	Monorail	1962	ca. 1,6 km	Alweg
	Orlando	Walt Disney World Resort	1971	ca. 8 km	Bombardier
USA	Orlando	Flughafen	?	? km	?

Die Liste enthält auch Einschienenbahnen in Bau und in Planung, sofern die Projekte definitiv beschlossen sind.

Wieder abgebaute Systeme

Einschienenbahn bei der IGA 93 im Höhenpark Killesberg in Stuttgart

- Europa:
  - Basel: Grün 80, Ausstellung für Garten- und Landschaftsbau 1980
  - Gelsenkirchen: Bundesgartenschau 1997
  - Groß-Gerau Wallerstädten: Safariland (1971–1985), Hersteller: Schwingel-Parkeisenbahnen
  - Köln-Fühlingen: Alwegbahn Versuchsanlage (1957–1960)
  - Lausanne: Anlage anlässlich der Expo64, Schweizerische Landesausstellung 1964[1]
  - London: Kabinenbahn am Flughafen London-Gatwick
  - Mannheim: Aerobus während der Bundesgartenschau 1975
  - Stuttgart: Einschienenbahn während der IGA 1993 (Panoramabahn)
  - Turin: Einschienenbahn Turin

  - Wien: Einschienenbahn auf WIG 74 (Wiener internationale Gartenschau 1974), heute Kurpark Oberlaa
  - Brühl: Phantasialand Jet (1974-2008), Hersteller: Anton Schwarzkopf
  - Russland: Einschienen-Parkbahn(?) (1898-?)
  - Moskau: Pferdegezogene (!) Monorail vor Moskau (1820)

(zu ergänzen)

- Japan:
  - Nara Dreamland (1961–2006), System Alweg
  - Yomiuri Land, Tokio (1964–1988), System Hitachi-Alweg
  - Higashiyama Park, Nagoya (1964–1974), System Safege
  - Mukogaoka-Yuen, Kawasaki (1965–2001), System Lockheed
  - Himeji (1965–1974), System Lockheed

    - Yokohama Dreamland (1966–1967)

(zu ergänzen)

- USA:
    - New York: New York World's Fair (1964-1965), System AMF

(zu ergänzen)

Systeme in Planung bzw. im Bau

- Dubai (Vereinigte Arabische Emirate): Dubai Monorail (Alwegbahn)

ein Ergänzungs- und Zubringersystem zur ebenso fahrerlosen Dubai Metro

Siehe auch

- Einschienenbahn am Taunusrand
- Lartigue-Einschienenbahn
- Transrapid

Weblinks

- The Monorail Society
- Maglev Monorail IMB
- Monorackbahn

- "One-Track Wonders: Early Monorails" - Website mit Bilder von vorgestellten und wirklichen Einschienenbahnen

Einzelnachweise

1. ↑ zeit.de - 17.01.1964: "Expo 64 in Lausanne"

Wikimedia Foundation.

- Einschienenbahen Kitakyushu
- Einschienenbahn Hiroshima

Schlagen Sie auch in anderen Wörterbüchern nach:

- **Einschienenbahn** — Einschienenbahn, s. Eisenbahnsystem, auch Hängebahn … *Meyers Großes Konversations-Lexikon*

- **Einschienenbahn** — f однорельсовая железная дорога; монорельсовая дорога; однорельсовый путь …   *Большой немецко-русский и русско-немецкий словарь*
- **Einschienenbahn Tama** — Einschienenbahn Tama, im Hintergrund die Station Takamatsu in Tachikawa Die Einschienenbahn Tama (jap. 多摩都市モノレール線, Tama toshi monorēru sen, dt. Stadteinschienenbahnlinie Tama), meist Tama Monorail (多摩モノレール, Tama monorēru) genannt, ist Teil des… …   *Deutsch Wikipedia*
- **Einschienenbahn Kitakyūshū** — Ein Zug der Einschienenbahn Kitakyūshū verlässt die Station Kokura Die Einschienenbahn Kitakyūshū ist Teil des ÖPNV der japanischen Stadt Kitakyūshū auf der Insel Kyūshū. Sie wurde am 9. Januar 1985 in Betrieb ge-

nommen und besteht aus nur aus der … *Deutsch Wikipedia*

- **Einschienenbahn Hiroshima** — Kabine der Einschienenbahn Hiroshima Die Einschienenbahn Hiroshima (jap. 広島短距離交通瀬野線, Hiroshima tankyori kōtsū Seno sen, dt. Hiroshima Nahverkehrs Seno Linie) ist seit dem 28. August 1998 Teil des ÖPNV im Stadtteil Seno, des Stadtbezirks Aki der… …   *Deutsch Wikipedia*
- **Einschienenbahn Ueno** — Die Einschienenbahn Ueno Zoo Die Einschienenbahn Ueno Zoo (jap. 上野動物園モノレール, Ueno dōbutsuen monorēru), offiziell: Tōkyō to kōtsū kyoku Ueno kensui sen (東京都交通局上野懸垂線, dt. Ueno Hängebahnlinie des Städtischen Verkehrsamtes von Tokio), auch:… …   *Deutsch Wikipedia*
- **Einschienenbahn Ueno-Park** — Die Einschienenbahn Ueno Zoo Die Einschienen-

bahn Ueno Zoo (jap. 上野動物園モノレール, Ueno dōbutsuen monorēru), offiziell: Tōkyō to kōtsū kyoku Ueno kensui sen (東京都交通局上野懸垂線, dt. Ueno Hängebahnlinie des Städtischen Verkehrsamtes von Tokio), auch:… …   *Deutsch Wikipedia*

- **Einschienenbahn Ueno-Zoo** — Die Einschienenbahn Ueno Zoo Die Einschienenbahn Ueno Zoo (jap. 上野動物園モノレール, Ueno dōbutsuen monorēru), offiziell: Tōkyō to kōtsū kyoku Ueno kensui sen (東京都交通局上野懸垂線, dt. Ueno Hängebahnlinie des Städtischen Verkehrsamtes von Tokio), auch:… …   *Deutsch Wikipedia*
- **Einschienenbahn Naha** — Yui Rail, 19. Juli 2004 Die Einschienenbahn Naha ist Teil des ÖPNV der japanischen Stadt Naha auf der Insel Okinawa. Sie wurde am 10. August 2003 von der Okinawa toshi monorēru Kabushiki gaisha (jap.

沖縄都市モノレール株式会社) in Betrieb genommen und … *Deutsch Wikipedia*

- **Einschienenbahn am Taunusrand** — Kreiselstabilisierte Einschienenbahn von Brennan (1907) Die Einschienenbahn am Taunusrand war ein Anfang des 20. Jahrhunderts geplantes, aber nie verwirklichtes Verkehrsprojekt im Obertaunuskreis in Hessen. Das vor allem von dem Berliner… “[1]

Aerorail

„Aerorail is a suspended rail concept that is similar in many ways to the Siemens SIPEM system. It is still in the conceptual stage as no test track or operating scale model has been built so far. The Aerorail Development Corporation is located in Dallas, Texas. It was incorporated in 1992 for the purpose of consolidating and formalizing some six years of research and deve-

[1] Academic dictionaries and encyclopedias: Einschienenbahn, abgerufen am 30. 1. 2011, in: < http://de.academic.ru/dic.nsf/dewiki/379792 >.

lopment on the Aerorail susended rail mass transit concept.

During the early 1980's, Bryant Trenary, a principal in ADC, conducted engineering research intended to design a rail mass transit system which could be constructed without committing huge public resources and would not require large continuing public subsidies for its operation. While conducting this research, the suspended rail system evolved and several entrepreneurial companies involved in transportation-related industries provided, on a voluntary basis, professional support and assistance in the refinement of the concept.

Several design objectives were adopted. They are as follows:

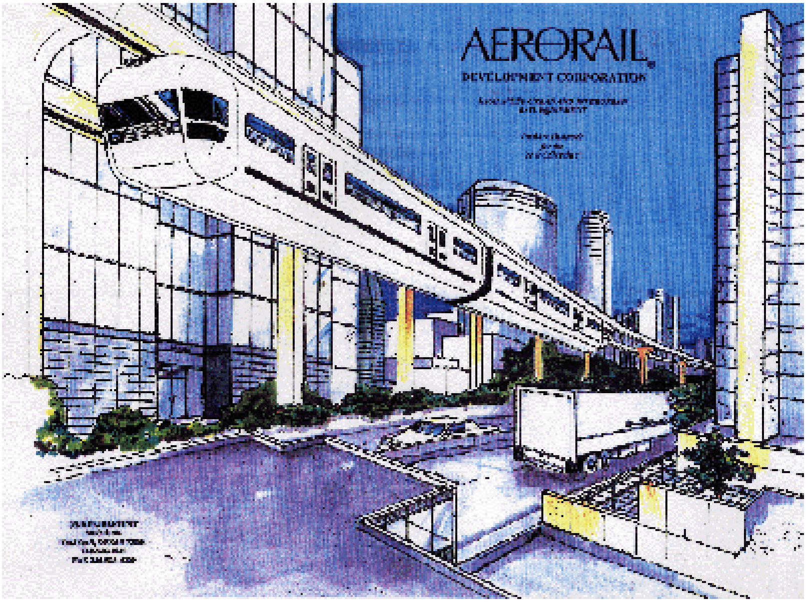
1. Improve operating safety through provision of an exclusive right-of-way, reduction of on-board fire hazards and smoothing of the passenger vehicle's movements.

2. Reduce operating costs through light weight vehicles, high acceleration rates, high crusing speed, reduction of the number of vehicles required and automated control - to reduce or eliminate the public subsidy requirements of operating the system
3. Obtain sufficient ridership and farebox revenue through moving people and goods quickly from their orgins to their desired destinations.
4. Reduce the environmental impact of the system to reduce EIS costs and delays and to gain public acceptance by reducing noise and providing a high level of vehicle and guideway aesthetics.
5. Minimize capital costs of construction through the use of existing technology, use of public rights-of-way and reduction of surface and subsurface disruption during construction.
6. Satisfy the needs of 21st century markets for high speed intercity surface transit systems.
Through Aerorail's suspended, elevated configuration and high power-to-weight ratio, all of these

design goals have been achieved, according to the ADC. Generally, the cost to operate per seat-mile is expected to be less than 50% that of existing surface LRT system and the cost to construct is expected to be less than 75% of conventional LRT systems.

The Aerorail vehicle would be suspended from two rails and thus is not technically a monorail like the SIPEM system. It is completely protected from de-railment and would generate little noise from its steel wheels on steel rails that are muffled inside the guideway beam. Two types of applications are envisaged, intra-urban and inter-city. Smaller ve-hicles could be used for the intra-urban system.

An artist's sketch of a possible Aerorail installation is shown below:



More detailed information can be obtained from the [Aerorail website](http://faculty.washington.edu/jbs/itrans/aerorail.htm) or by contacting ADC at the following address:
Pete Trenary, Principal, Aerorail Development Corporation, 3310 Fairmount, Suite 9E, Dallas, Texas 75201"[1]

[1] Trenary, Pete: Aerorail, Dallas, Last modified: December 29, 2000, in: < http://faculty.washington.edu/jbs/itrans/aerorail.htm >.

„AERORAIL […]

[…]

Due to the configuration of the Aerorail system, it can be readily implemented in communities with congestion and pollution problems with minimal requirements for right-of-way and no interference with surface traffic. Its all-weather capabilities allow it to be used in areas where severe weather conditions limit or completely shut down other surface systems.

The patented, unique suspension of Aerorail vehicles prevent derailing while allowing the vehicles to climb and descend grades well in excess of grades common for other rail systems. The suspension system also allows for passenger vehicle to gently swing out as it goes around a curve, similar to banking of an aircraft in a turn. The ability to swing allows for higher speeds around curves and more comfort for the passengers. Longitudinal movement of the passenger compartment is provided to reduce or eliminate sudden jerks during starts and stops. The wheels are standard light rail steel wheels with rubber inserts to absorb noise and vibration. A fast, smooth, quite, controlled ride is the key to an enjoyable experience for passengers.

Aerorail has been developed with extensive study of the other systems noted above, and with the idea of producing a transit system that would be economically self sufficient. Enough revenue will be generated by riders to operate and retire the construction debt only from fare box proceeds. The economy of operation comes from its speed. The over-riding concern is to have a fail-safe system in every respect.

All-weather capability and security of the running gear are design requirements. The running rails, power rail, automated controls and safety systems are all enclosed in the horizontal guideway beam. The guideway beam is supported by T-shaped columns spaced approximately 100' apart. The obvious next step in the development of Aerorail will be to build a prototype. The project will consist of building an Express Vehicle, 1 to 1 ½ miles of guideway with switches, and a final assembly and service building with offices. The cost of the project is estimated at $70 million. A $100 million total budget has been established to allow the Aerorail organization to pursue contracts after the prototype project is completed. The project can be accomplished in phases, with the first phase being for design work. The acquisition of the site, proceeding with construction on the site, and manufacturing of the Express vehicle would only commence as funds become available. We would look for a site that would be along a plausible route for a permanent installation, thereby being able to eventually recoup the cost of the prototype project with fare paying riders.“[1]

„AERORAIL […]

[…]

„A major objective in the design of the Aerorail system is to drastically increase operation efficiency compared to traditional mass transit systems. The vehicles are designed to reduce energy costs (usually more than 25% of the operating cost of a system) through the use of high voltage ☐ high efficiency motors, regenerative braking, and solar power generation. By operating the vehicles at higher speeds than can be done with sur-

[1] AeroRail: Projekt Plan, abgerufen am 3. 2. 2011, in: < http://www.aerorail.com/projectplan.html >.

face trains, more people can be moved with fewer vehicles. Aerorail is designed to reduce labor costs (usually more than 50% of operating costs of a system) through automation. AeroRail is designed to eliminate the continuous taxpayer operating subsidies required in other rail transit systems. Of equal importance, is the value of passenger's time that is saved by reducing waiting and travel time. The Aerorail team has been analyzing possibilities for its application since 1993. Two significant opportunities presented themselves that year which brought AeroRail into the public arena. The first event was to be invited to make a presentation to the Transportation Subcommittee of the Ways and Means committee for the US Congress as an emerging technology. Later that year, we responded to a Request for Proposal, and were picked as one of three finalists, for a transit system between Aspen and Snow Mass, Colorado. Even though we weren☐ t selected, it gave us the opportunity to prepare a presentation to a specific community. Most of the Aerorail illustrations and engineering work appearing in this presentation were created for the Aspen to Snow Mass RFP. Our work on the Aspen to Snow Mass RFP also gave us the template to prepare detailed analysis for several other communities around the country.“[1]

[...]

„Pete Trenary

The Aerorail concept was created by Bryant “Pete” Trenary, a mechanical engineer. Since earning his Mechanical Engineering degree from Purdue Uni-

[1] AeroRail: Mission, abgerufen am 3. 2. 2011, in: < http://www.aerorail.com/mission.html >.

versity, Pete's career has spanned nearly 60 years of mechanical and electrical design with General Electric, Powtech, and as an independant general consultant. In Pete's career with General Electric, he led design teams on diesel-electric locomotives, oil drilling equipment, and mining vehicles. Pete has since retired from full time work, but he will be involved as the chief design consultant while the Aerorail prototype is built."[1]

„**SwedeTrack System Inc.** is a public Swedish company which has designed the most technically advanced system for automatically controlled beamcarried traffic, for transportation of people and goods. This transport system is called **"Fly-Way"®.**

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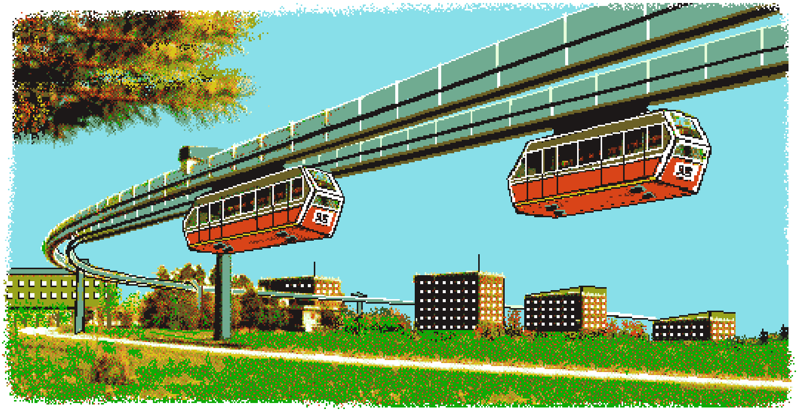
[1] AeroRail: Expertise, abgerufen am 3. 2. 2011, in: < http://www.aerorail.com/expertise.html >.

SwedeTrack System Inc. is, since February 2004, a public company, and offers shares to interested parties! **Information in Swedish!**

[…]



[…]

„Copyright © 1997, SwedeTrack System. Last Updated: 2008-09-14. This website is maintained by Johnson Consulting. Kerstin Olsson-Gronvik and the company Visulogik have contributed il-lustrations to this website.“[1]

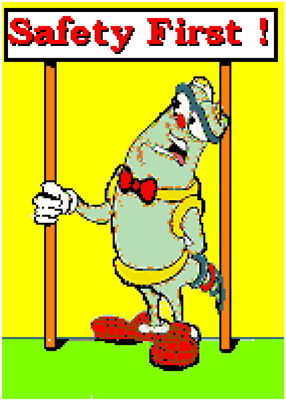
[1] Johnson Consulting / Kerstin Olsson-Gronvik: FlyWay, Copyright © 1997, SwedeTrack System, Last Updated: 2008-09-14, in: < http://www.swedetrack.com/ >.

„Safe berthings at stops […]

Safety at stop sites can be a tricky business with vehicles that do not have human drivers. Although the **computer controlled safety systems** go a long way to reduce personal hazards, additional measures should be taken. **FLYWAY®** has 2 alternative systems for safe landings. The **FLYWAY** "cubicles" are dealt with on **this** page, while the **obstacle detection system** is described on another page.

Contents of this page:

8. Time to lower the elevator (table)



1. General

The FLYWAY® carriages can berth to load/unload people and cargo in **4 ways:**

1. Not using the elevator; berthing horizontally in a protected area

2. Not using the elevator; berthing horizontally in an unprotected area

3. **U**sing the elevator to berth vertically into a **FLYWAY®** cubicle
4. **U**sing the elevator to berth vertically at an **unprotected** place, or a place that has other kinds of protection.

The word **"protected"** means that:

- People, animals and objects are reasonable well protected from being hit by the beamcar´s maneuverings
- The beamcars are reasonable well protected from rough landings and from bumping into objects.

Figure 1:1 gives an example of berthing **without** using any elevator. The figure shows a **protected** beamcar platform (above a railway platform), protected insofar as people on the platform are **separated** from the beamcars by low walls. These walls have automatic doors that work in concert with the vehicle doors. If these walls were removed (and nothing similar, such as hedges or fences were put in their place) the beamcars could change beams more freely, and berth anywhere. But there would be no safety to either the cars or to other objects in the area.

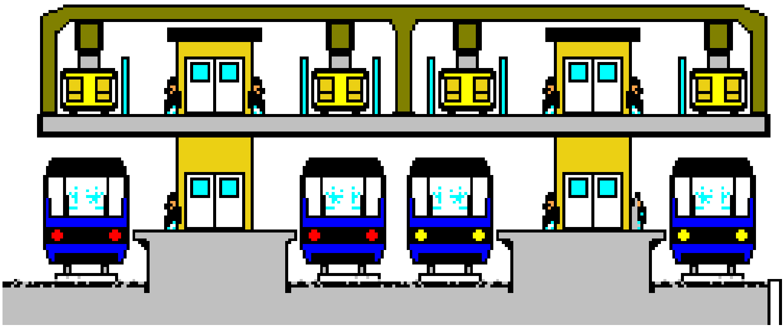


Figure 1:1

When using the elevator, the same type of protection (or even better!) can be obtained with the cubicles, which like wise have automatic doors that work in concert with the vehicle doors. But these cubicles are only practical for passenger service. In most other instances, one would have to take other measures, such as cordoning off cargo areas or using guards. There are of course instances where cubicles for passengers are not desired, such as:

1. there are **no space** on the ground for such cubicles
2. the operator chooses to **not** make that investment, but implements other solutions instead
3. the cubicles are **not practical**, for instance when loading groceries and the like in a booked beamcar
4. the operator prefers to allow the beamcars to **berth anywhere** along certain beams.

SwedeTrack System has given due consideration to all of these instances. We have designed an obstacle detection system for "unprotected" situations. And we have designed the "cubicles". And these are dealth with on this page.

2. The FLYWAY Cubicles

The main problem with automatically controlled cars that are supposed to "land" in the open street, like the **FLYWAY** system, is that the car could conceivably land upon a sleeping dog or some object lying in the street.

The **FLYWAY** beamcars will have **sensors** underneath the floor of the cabins, that are contact-sensitive. As soon as something presses on the bottom of the cabin or carriage, the lowering of the cabin stops, and the beamcar checks with its stored information that this is indeed the level where the ground should be.

The beamcar´s computer has information stored about how far down the ground is, for **each indi-**

vidual stop site in the network. In this way, the lowering of the cabin would be optimally speed-regulated, so it does not land with a "bump!" Now, if the sensor underneath the cabin registers ground contact higher up than expected, the cabin would stop lowering, **then alight again**. Likewise, if ground contact is not registered where it **should** be, the cabin will alight. Attendants at the control center would be automatically alerted, and on-board cameras would enable them to check on the situation. They would also be able to manually direct the car to another berth to land.

Figure 2:3

One system, with the idea taken from the subway of **Singapore,** is to use small landing areas that are shielded off from the milling crowd by plexiglass cubicles as shown in **figure 2:1**. The system is called "Platform Screen Doors" (PSD), and is used in for instance the Metros of Singapore, Paris and Copenhagen to prevent travellers from falling (or jumping) onto the track. In **FlyWay®,** this idea is used in the form of free-standing cubicles underneath the beams, cubicles that have doors that only slide open when a beamcar is in position on the ground or platform inside the cubicle. This cubicle would have only enough space to harbor the biggest vehicles that will use it. The illustration shows approximate measurements (in meters) for the cubicle intended for a 4-seat beamcar.

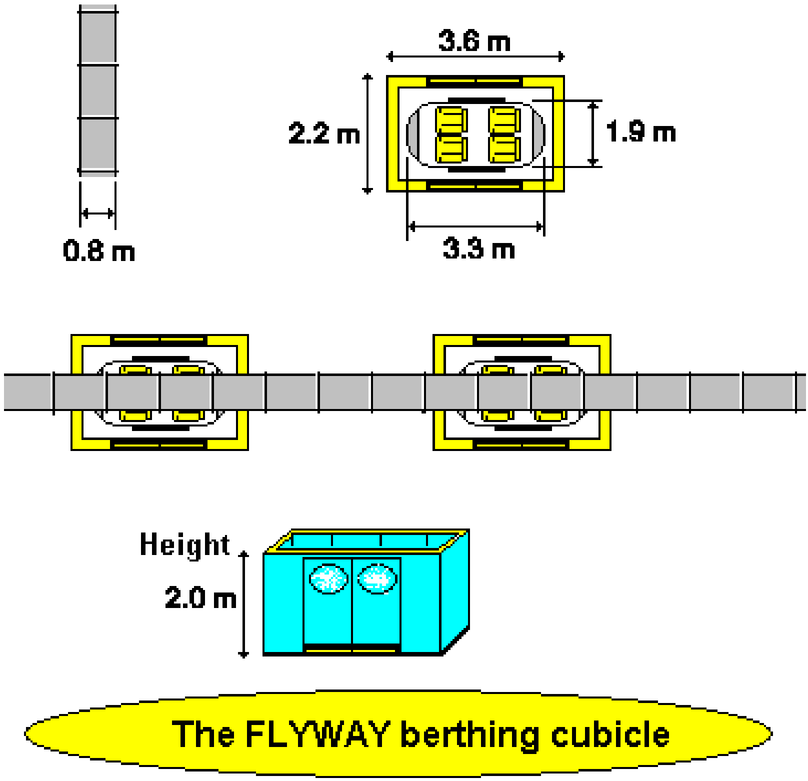


Figure 2:1

How this plexiglass cubicle could look in a street served by cars that **don´t use lifts** is shown in **figure 2:2** below. This long booth covers the whole stop area and also has to include the lower part of the sloping beams (so that the descending cars won´t hit the walls of the booth).

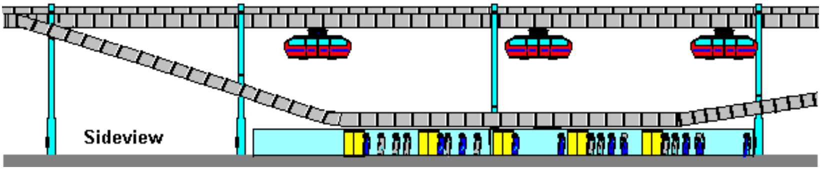
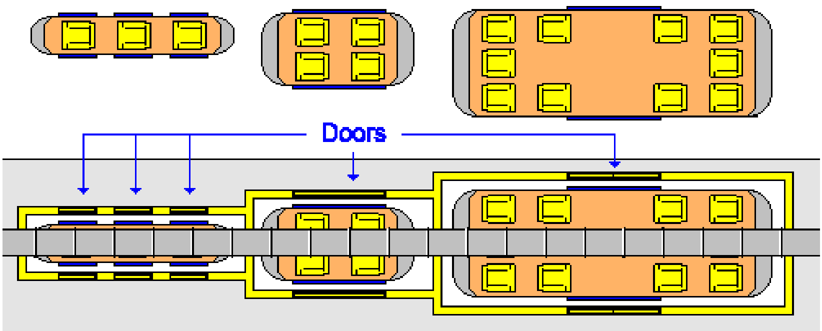


Figure 2:2

3. Handling vehicles of different sizes

For safety reasons, it should not be possible for persons to squeeze in between the cubicle doors and the vehicle doors. For this reason, stops that are used by vehicles of varying sizes would need cubicles for each **width** of those vehicles.

The **length** of the cubicles would be such as to accomodate the longest vehicles for each width, while the width would be suited to the vehicles, as illustrated in the birds-eye view of **figure 3:1** below. The various sizes of berths for **FlyWay´s** cabins have been dealth with on this page.



Station Cubicles match their sizes to that of Vehicles

Figure 3:1

4. Protecting the berth from snow

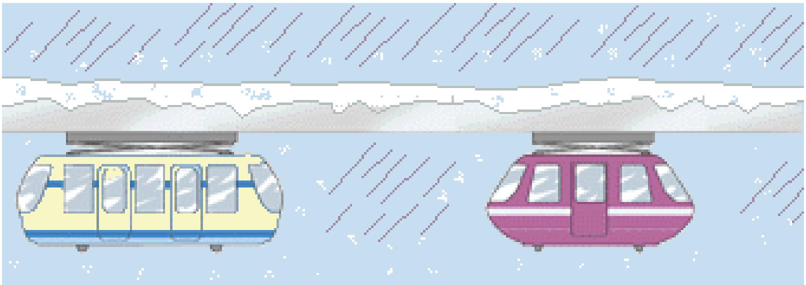


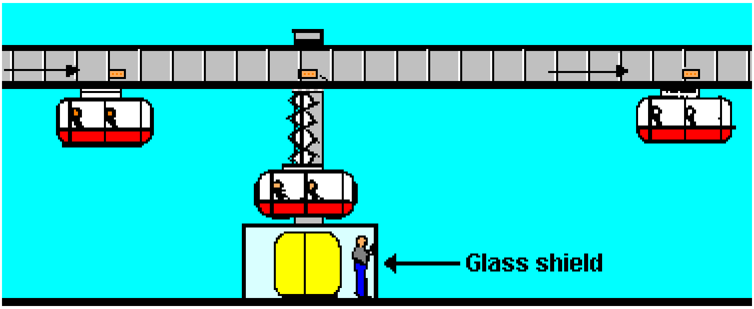
Figure 4:3

The **roof** on the cubicle in **figure 4:2** gives good protection from rain. If the sidewalls are high enough, it would also give reasonably good protection from **snow.** But a roofless berth with low walls, as in **figure 4:1** gives no protection from any weather. We are not talking about the waiting passengers here; providing waiting rooms from them should not be anything but (maybe) a space problem. But having snow collect within the berth cubicle could be a problem in some climates. It does not work well to have the beamcar land on top of two feet of snow!

FLYWAY has **2** alternative solutions for this:

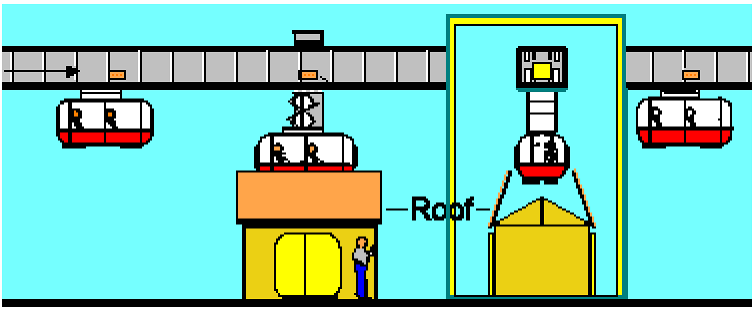
Providing heating in the ground to melt the snow as it falls
Providing an automatically removable roof over the cubicle.

This latter option is readily solved by mounting a roof above the cubicle which is hinged at the sides, as is illustrated in **figure 4:2** at right. This roof opens automatically when a beamcar stops above it, and closes again when the beamcar takes off. **Figure 4:1** shows a sideview and shortend view with the roof raised. These roofs would be manually closed when it snows, otherwise they would normally be in the open position, even when it rains.



Sideview of station for one car

Figure 4:1



Sideview and shortend view of cubicle with roof

Figure 4:2

5. Operating the doors

In the cubicle design described here, we have a double set of doors, where the cubicle doors operate in conjunction with the cabin doors, as is illustrated in **figure 5:1** at right. These kind of doors at station platforms are increasingly being used in underground train stations around the world, such as in the new, automatic Metro line in Paris. It is called "Platform Screen Doors" (PSD), as mentioned above.

Both sets of doors have to be properly closed before the beamcar can take of, so if **both** the beamcar doors **and** the cubicle doors are equipped with the the kind of contact lists described under the next heading, we get double safety against a malfunction in these contact lists.

How would the beamcar control the cubicle doors? Well, it could probably be done with some kind of mechanical device. But the solution favored by **FLYWAY®** would be to use the beamcar cabin´s Bluetooth-based passenger interface for this purpose. The cabin unit (operating as a piconet master) would establish contact with the Bluetooth-unit on the cubicle, and regulate the cubicle door via this link.

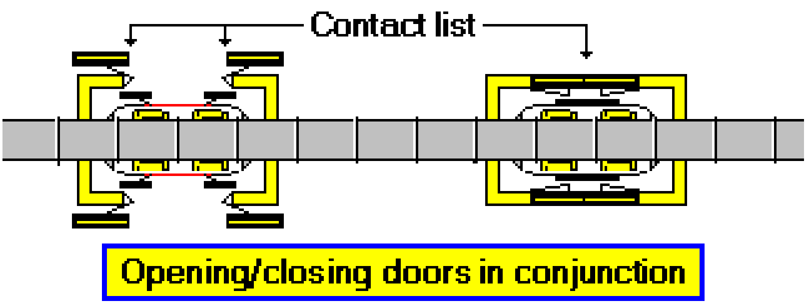


Figure 5:1

6. Handling the safety at the doors

Regular underground trains occasionally squeeze their passengers in the doors. The doors are of course equipped to handle this automatically. The principle of the most common protective design is illustrated in **figure 6:1** at right. The closing edges of the doors have a rubber coating that prevents damage to the squeezed object (or person). Inside this rubber coating are two electrical contact lists, **A and B**, that are normally separated by an air gap. But the list denoted by **B** is elastic, and a squeezed object will thus bring it into contact with **A**, whereupon the train is electronically prevented from starting. The details are better seen in **figure 6:2.** This system would of course also be implemented with the **FLYWAY®** cabins.

In the **FLYWAY®** system; should the doors of either cubicles or beamcabins detect squeezed objects in this manner, the doors would automatically open again. Then, after about 5 seconds, close. Should the squeezed object still be in place after about 4 (or so) closing attempts, an alert would go to the system control center, and appropriate information would be displayed to the passengers in the car, maybe also a recorded message would come over the loudspeakers.

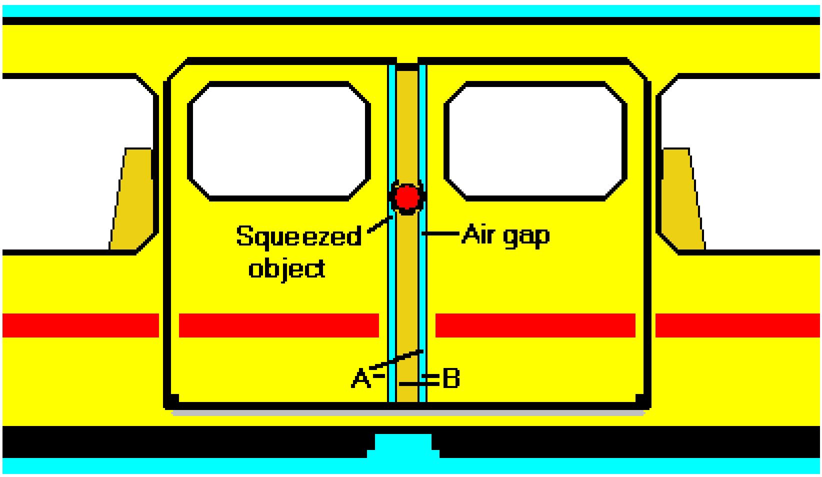


Figure 6:1

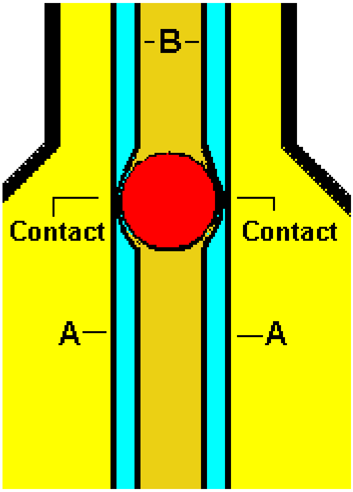


Figure 6:2

7. Speed and Safety at Berthings

The **FLYWAY®** system elevators require special attention at the berthing. The safest and easiest way for an approaching vehicle would be to stop above the berth, and then lower itself, as

illustrated in **A in figure 6**. But to save time, the vehicles could also lower themselves as they slow down to a halt, and then raise themselves as they accelerate, as illustrated in **B in figure 6**. If one choses the **B**-solution, the obstacle detection radar must scan vertically as well as horizontally, when approaching a stop where the vehicle is about to berth. This is shown in **figure 7**. The **B**-solution has one slight drawback, and is therefore not recommended by SwedeTrack:
It will put an additional strain on the elevator assembly.

Let´s make some simple calculations as to the time-lapse in the 2 alternatives.

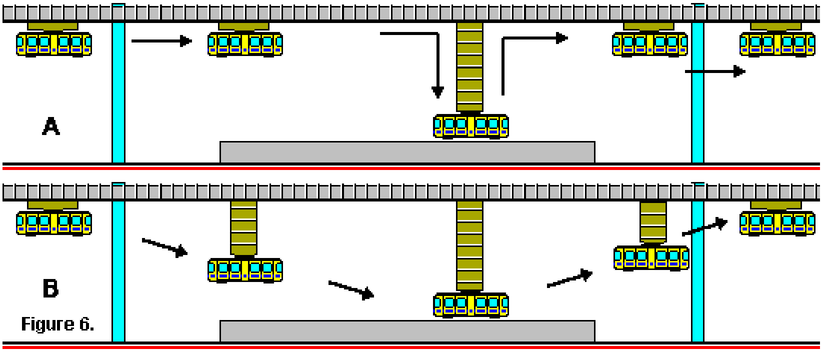


Figure 6.

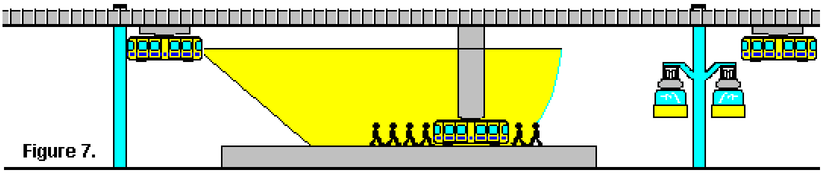


Figure 7.

Case A: The car is brought to a halt from full speed, lowers the cabin, exchange passengers, lifts the cabin and accelerates to full speed.

Case B: The car is brought to a halt from full speed. At the speed of 10.8 km/hour (which corresponds to 3 meters/second), the car lowers its cabin. When the cabin is on the ground, the exchange of passengers take place. The car then lifts the cabin during acceleration. Before the car reaches 10.8 km/hour, the cabin will be all up. The car then goes up to full speed.

Considerations for case B:

1. **T**he car must be stationary before the cabin hits the ground.
2. **T**he cabin has to clear the top of the cubicle at the berth, which would be at least 1.5 meters in height at the short ends (where the cabin enters and leaves).

Assumptions for both cases:

1. **W**e will calculate the time **(T)** from where the car starts slowing down, to the point where it´s up to full speed again.
2. The deceleration/acceleration **(a)** is put to 0.2*g (which is about **2 m/s^{2}**). It is not uniform; the "jerk-factor" **(j)** plays a small role in the equati-

on. It represents the change in the rate of retardation, and is arbitrarily set to **12 m/s^3.**

3. **W**e will use half that deceleration/acceleration for the lift, i.e. **a_l = 1 m/s^2,** but use the same jerk-factor as for the beamcar in this example, putting the maximum speed for the lift to **v_l**.
4. **"Full speed" (v)** is here assumed to be **72 km/hour** (= 20 m/s.)
5. **L**et´s put the height above ground from the bottom of the cabin **(d)** to **4 meters.**
6. **W**e will assume that the car stays one minute at the stop.

Regarding the lift, we use the following calculations:

$$d/2 = (v_l^2)/(2 * a) + (v * a)/(2 * j)$$

The distance is put to **d/2** because we accelerate the lift to maximum speed (= **v_l**), which is reached at mid-point (= 2 meters above the ground), after which we slow down at the same rate, and using the same jerk-factor. Thus, putting the time for the lift to lower itself to the ground (and the same time to go up again) to $\mathbf{T_l}$, we get:

$T_l = (2/v_l)*\ (d/2) = d/v_l = v_l/2*a + a/2*j$
$d = 4$ m => $v_l = 1{,}959$ m/s^2 => $T_l = 2.04$ seconds.

For **case A** the calculations are rather straightforward:

Retardation and Acceleration: $T_r = T_a = v/2*a + a/2*j$

$T_r = 20/2*2 + 2/2*12 = 5 + 0.083 =$ about **5 seconds**. At this low deceleration, the jerk-factor is negligible. So, stopping at a station in case A would take:

$T = T_r + T_l + 60$ sec:s $+ T_l + T_a = 5 + 2.0 + 60 + 2.0 + 5 = 74$ seconds.

So, stopping at a station in case B would take:

$T = T_3 + T_l + 60$ sec:s $+ T_l + T_3 = 4.33 + 2.0 + 60 + 2.0 + 4.33 = 72.67$ seconds.

Suppose we put the speed for starting to lower the lift at **10 m/s** instead of 3 m/s. Then,

$T_3 = 10/(2*2) + 2/(2*12) = 2.50 + 0.083 = 2.58$ seconds.

As can be seen, then, the saving in time is quite negligible.

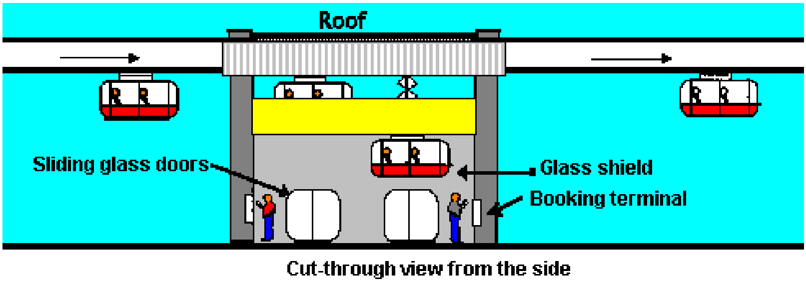


Figure 31

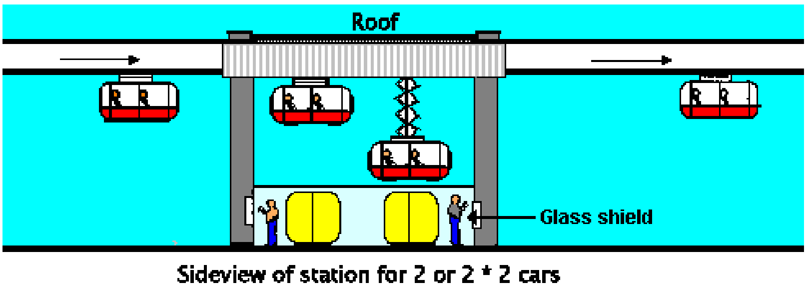
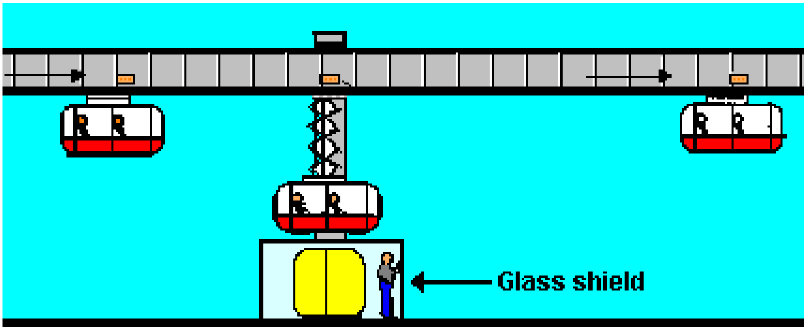


Figure 32.

A medium-size station for 2 cars in each direction or for 2 cars in one direction could look like **figure 31** at left. The sliding doors would **only** be open when there is a car in position behind them. The roof would be necessary in places where snow can be expected. In other areas, the roof could be dispensed with, and the walls of the cubicle lowered to a hight of about 1.80 to 2 meters (i.e. 6 feet). This would make the station cheaper and less intrusive in the city landscape. It could thus look like in **figure 32** (this one with a roof for rainprotection).

The sideview picture in **figure 33** shows a station for only **one** beamcar at a time. The station cubicle should not take up more space than an ordinary parking place for motorcars. These small stations could be placed in the streets in crowded downtown areas, one cubicle at each side of the street, and at least one in each direction at every block.



Sideview of station for one car

Figure 33.

Figure 34 shows what it could look like along a couple of city blocks. The cubicles are the yellow rectangles. It might seem awkward to have them placed in the middle of the street, but one should then remember that the purpose of the beams are to replace practically **all** private motor vehicles in those streets where the beams are erected, so the traffic in the streets should be just a fraction of what it used to be. An alternative is, of course, to erect the beams along the sidewalks.

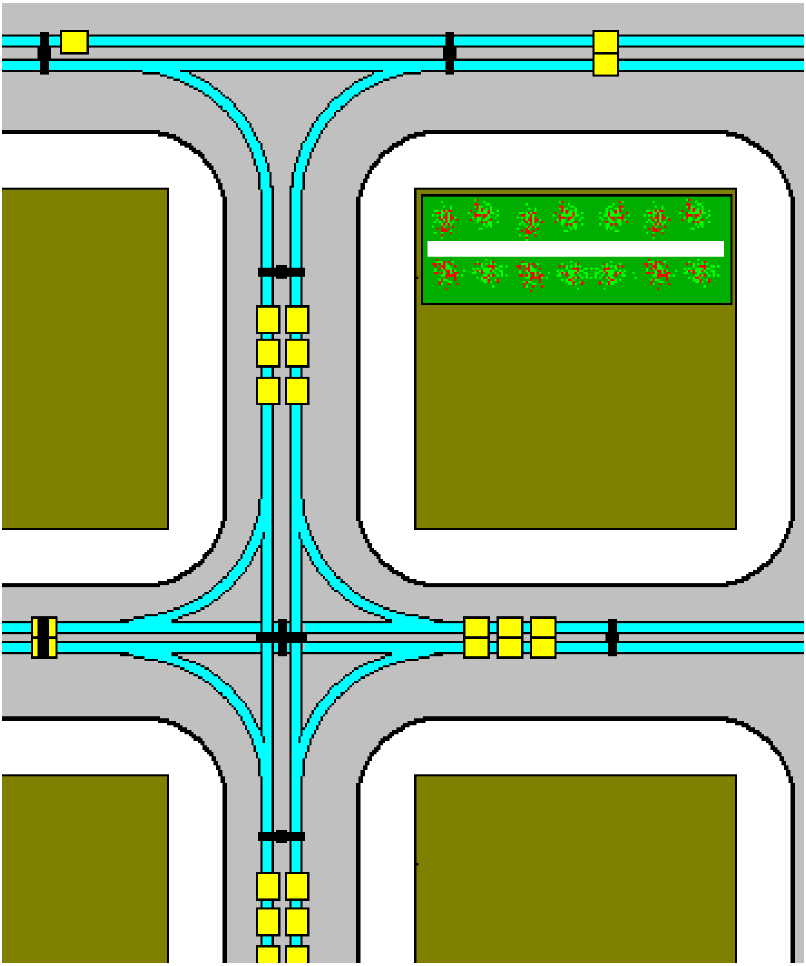


Figure 34.

8. Time to lower the elevator (in seconds) as a function of acceleration/deceleration.

It is rather interesting to note how the **jerk-factor** comes increasingly into play when the acceleration and deceleration increases. The table at right shows the time it takes to lower the cabin, for a range of allowable accelerations/decelerations. The second column shows maximum speed attained (halfway down) in m/sec:s, before the lift decelerates again. The 3:rd column is the sum of columns 4 and 5, and the fifth column contains the term with the jerk-factor, as shown in the calculations to the left.

In this table, the jerk-factor is set to 12 m/s.^{3} and height to 4 meters.

For safety reasons, every berth would probably have to be fenced in, using the **FLYWAY cubicles,** and maybe monitored by surveillance cameras as well, considering that the vehicle has no human driver. But, as stated above, the control staff can always take manual control over any beam vehicle.

Acc/ Dec.	Max. speed	Time (se-conds)	Term 1	Term 2
1,0	1,959	2,042	1,959	0,083
2,0	2,667	1,500	1,333	0,167
3,0	3,109	1,286	1,036	0,250
4,0	3,389	1,180	0,847	0,333

5,0	3,550	1,127	0,710	0,417
6,0	3,623	1,104	0,604	0,500
7,0	3,630	1,102	0,519	0,583
8,0	3,587	1,115	0,448	0,667
9,0	3,509	1,140	0,390	0,750
10,0	3,407	1,174	0,341	0,833
11,0	3,290	1,216	0,299	0,917
12,0	3,165	1,264	0,264	1,000
13,0	3,037	1,317	0,234	1,083
14,0	2,910	1,375	0,208	1,167
15,0	2,786	1,436	0,186	1,250
16,0	2,667	1,500	0,167	1,333
17,0	2,553	1,567	0,150	1,417

18,0	2,445	1,636	0,136	1,500
19,0	2,344	1,707	0,123	1,583
20,0	2,248	1,779	0,112	1,667

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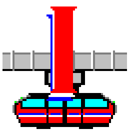
„FlyWay® and Road Traffic

[...]



n the page "Cooperation with the Road-traffic", we showed some examples of how a developed beam traffic system could be of great assistance to the road traffic. In the page "How Weaving Nodes handle

[1] Johnson Consulting / Kerstin Olsson-Gronvik: FlyWay, Copyright © 2004, SwedeTrack System, Last Updated: 2007-05-20, in: < http://www.swedetrack.com/e41safe.htm >.

Traffic" we discussed how **FlyWay´s** "intelligent nodes" will direct the beamcarried traffic.
At the cross roads of these two is the interesting problem of how to quickly and efficiently transport motorcars between two traffic places by using beams instead of tying those places together with a highway. That´s what we are going to look at here.
This is a fairly technical page, but it can nevertheless be read by anyone.

Note: this page is still under construction!

Contents of this page:

1. General

Let´s look at the art of transporting motor vehicles the **FlyWay®** way!

The task

Figure **1:1** shows a typical example: 2 highways which connect densely populated areas (shown in orange) need to be connected in-between, perhaps across a recreational area, approximately along the dotted grey line. The traditional solution: a 6-lane highway right across!

Suppose we instead erect beams along this line, and loading terminals for road vehicles at each end (**A** and **B** resp.). For this to be a viable idea, we would need a traffic handling capacity of this connection at least around 75% of the expected traffic flow. When building highways, one usually dimension these well above the anti-

cipated traffic flow, expecting the traffic volume to grow in the years to come. Let´s do the same for this beam connection, for good measure!
If each lane can handle a through-flow of 50 vehicles a minute, we need to dimension this beam connection for **6 * 50 = 300** vehicles per minute, for both directions taken together. If we assume that:
Lowering a beam-carried flatcar takes 15 seconds.
Off-loading the motor vehicle takes 15 seconds.
Loading a new vehicle takes likewise 15 seconds.
Raising the flatcar to the beam takes15 seconds.

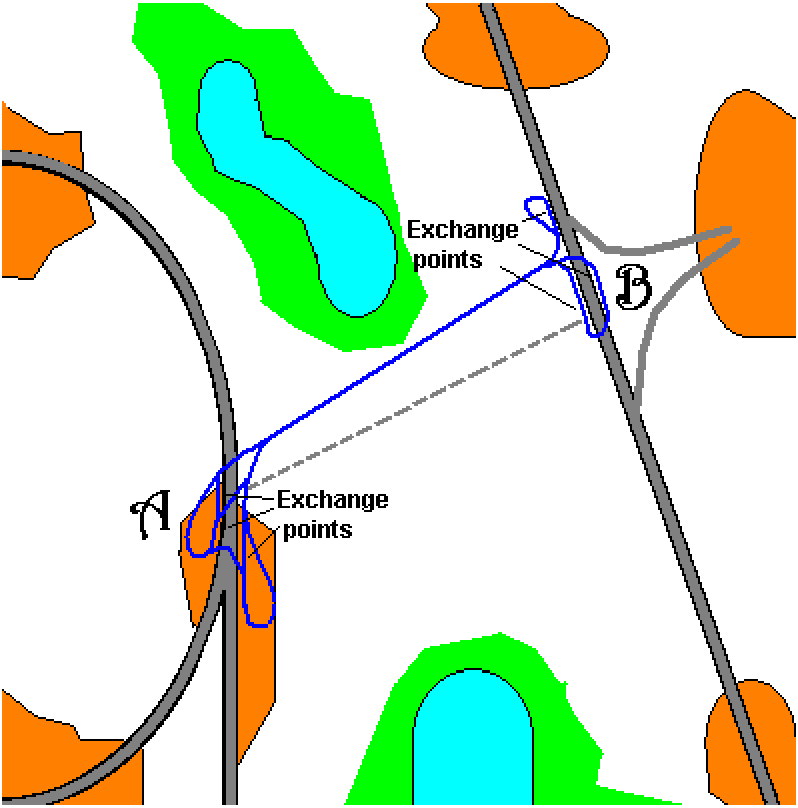


Figure 1:1

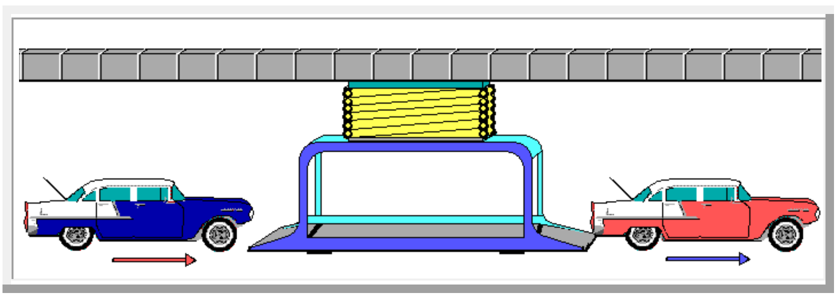


Figure 1:2

Then, this whole procedure will take **1 minute**. Locking and unlocking of braces around the wheels, to hold the motorcar during transport, is done automatically, and is performed during the setting down resp. raising of the flatcar.

Those who have observed the loading/offloading of car ferries will realize that this simple operation could be done even faster than 1 minute, especially considering the fact that car ferries have to off-load all their cars before they can take on the next bunch of cars, going back. The **FlyWay** flatcars, by contrast, can release a motorcar in one direction and load another from the opposite side, as shown in **figure 1:2**.

It is true that the speed of loading/unloading cars depends on how confident the drivers are of the procedure. This is just a matter of experience.

When you have done this 10 times, as a driver, it´s no big deal anymore.

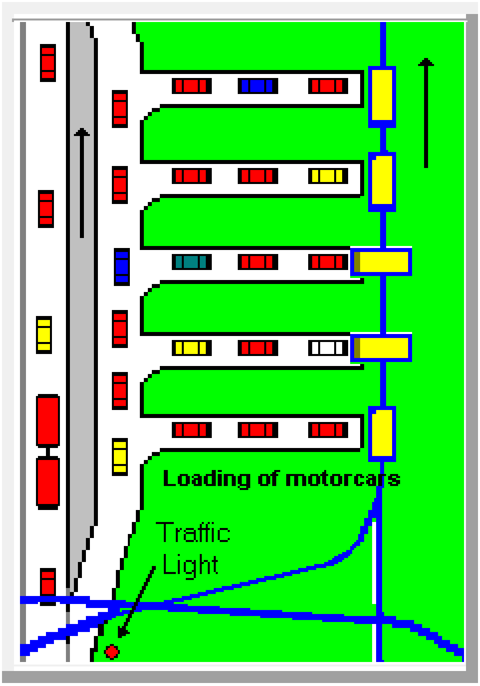


Figure 1:3

If you have read the page [“Cooperation with the road-traffic”](), you will recognize **figure 1:3**. This solution requires the flatcar to turn 90 degrees before and after loading, which of course could be arranged. But that is an extra procedure, which increase the time for offloading and loading, and also slightly increases the risk of malfunction. In addition, such car (with a swiveling capability) would inevitably be more expensive.

Let´s keep this operation as simple and quick as possible. As you
might guess from the figures given, our arrangement must have the capability to move quite a lot of motorcars. **FlyWay** proposes a procedure which is safe and quick and can be a real, viable option to more highways.

2. Looking at the Example

With a one-minute reloading time at each berth, there would theoretically be a need of **1 * 300 = 300** reloading berths at each end (points **A** and **B** in **figure 1:1**). This is, of course, quite a lot of reloading berths. But each berth won´t take much more space than the length of **two** motor vehicles. 150 such places in

a row, on each side of the road, maybe somewhat at an angle, each 5 meters sideways to its neighbor, would occupy a stretch of road equal to about **5 * 150 = 750** meters. How close they actually can come to each other is a matter of beam design, which will be described further down.
This is the **theoretical** side. The **practical** side is of course a bit trickier. If this arrangement is to going to function as smooth as in this outline, then every new motorcar would have to arrive at a flatcar the very moment it arrives, and just possibly is in the process of unloading another motorcar. That would of course rarely be the case in practice. Rather, at high traffic times there will be queues of, at most, 4 motorcars at each berth. If every reloading takes 1 minute, then the queueing time will be at the most 4 minutes. The average queueing time should be less than 2 minutes. That is not so hard for most drivers to put up with.
There are two other matters to consider:

Traffic flow is rarely at a maximum for more than one hour in the morning, and maybe 2 hours in the afternoon. If it was more than **that**, the original highway would have been provided with more lanes.

Traffic is as a rule un-equally divided during the day; there is often more traffic in one direction than in the other. Most berth will thus be unused most of the time.

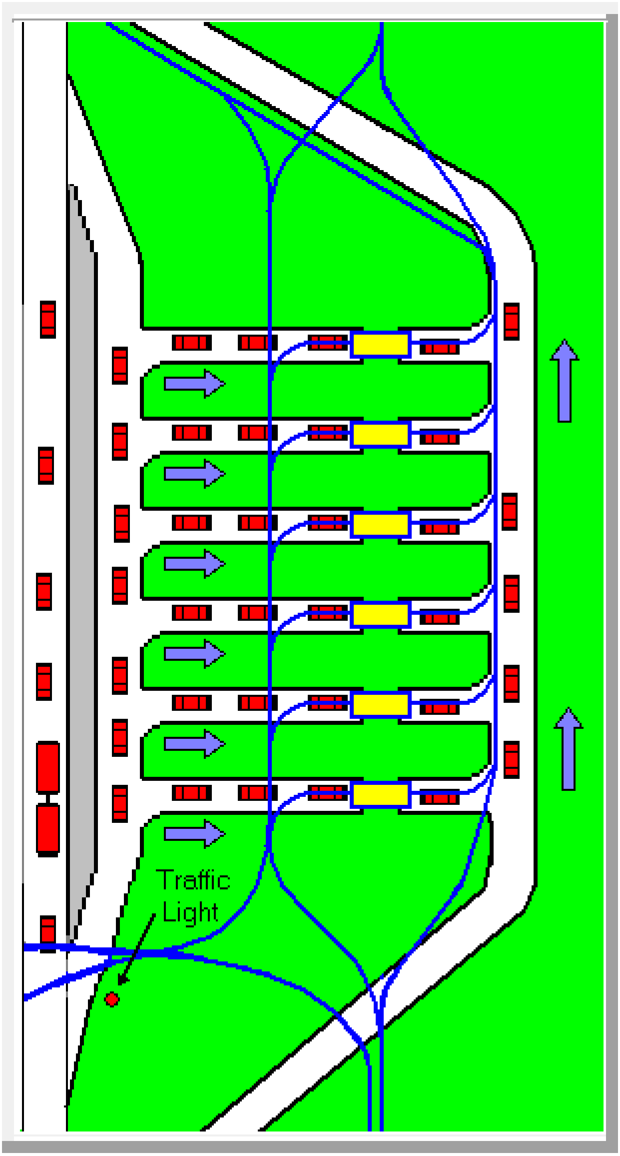


Figure 2:1

Now, compare **figure 1:3** with **figure 2:1** to the left. The blue lines are of course the beams, some 4-5 meters above the ground. You will note that a 90-degree twist in every beam segment before and after the berth, which will allow the flatcars to land and load/unload road vehicles without needing the swiveling function. This calls for real smooth handling of the beam cars, because there are 2 shunts for every such berth.

In **figure 2:2**, we have emphasized the beams. All traffic, both on the beams and on the access-roads, move from right to left. Beamcars with vehicles to unload enter on the beam marked **1**. Buffered beamcars are kept in readiness at right on beam **2**. Loaded cars travel off on beam **2** to the left, and empty cars are shunted off to the left on beam **1**.

A node computer is in charge of this traffic flow. It directs all traffic in a synchronous manner, allotting a time slot to each moving car. At times when all these berths are in operation, this node control will be rather busy. It will constantly monitor all berths. Its tasks:

As soon as a beamcar announces that it´s leaving, an incoming car will be directed toward that berth.

If no beamcar is coming, a car from the buffer will be directed to that berth, by way of beam **3**.

An incoming beamcar has to be directed to a berth at once, as soon as it passes the Booking point, without having to stop. A berth that will (hopefully) be empty by the time the car gets there.

Loaded cars that wants to leave will get slot allotments right away, without having to wait.

Platooning might have to be implemented now and then.

Could this really be made to work that smoothly? Yes, it could. But it takes a computer to manage it all.

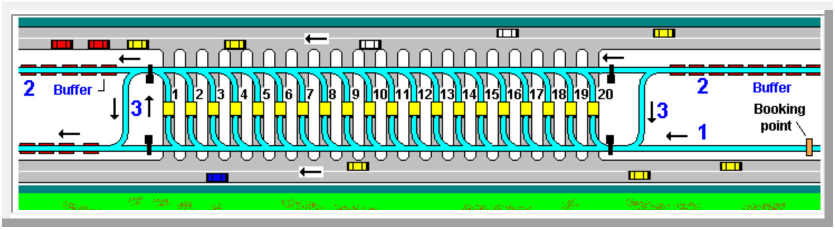


Figure 2:2

3. How the Node Computer does it

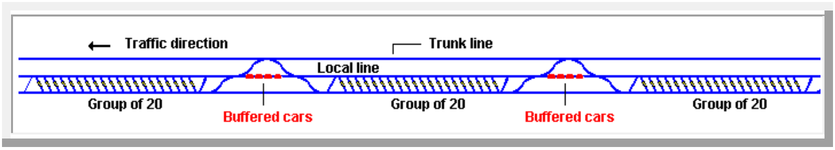


Figure 3:1

The node uses timeslots to control the traffic around these berths, to prevent cars from getting in each others´ way. But these timeslots cannot move very fast in the arrangement in **figure 2:2**, since beamcars entering and leaving the berths need a few seconds to slow down, and then pick up speed again, when leaving the berth.

A typical slot frequency here would be about 3 seconds. If a beamcar takes one minute to load/unload, and slightly less time if it arrives or leaves empty, then a berth would "generate" a new, leaving car every 60 seconds. 20 berths in a row would generate a beamcar every 60/20 = 3:rd second, which is the reason why we have limited the number of berths to 20 in this group. The next group of 20 berths could then be placed about 100 meters further down the road, but they would have to be joined by trunk lines, so that beamcars have time to accelerate and decelerate (this is illustrated in **figure 3:1**.).
How many such groups of 20 berths (in this example) could we have in a row? That depends entirely on the traffic capacity of the trunk beam. If this capacity is infinite, then we could also have an infinite number of berths, arranged in groups like this.
Well, then, the capacity of the trunk is clearly not infinite. At one point, if traffic demands grow, the

capacity of the trunk will hamper traffic, right? No, not quite. Trunk beams are like highways, insofar as you can have several beams in parallel, just as you can have parallel traffic lanes. A properly designed beam network can swallow as much traffic as there is room for new beams.

How would it work?
These beamcars could of course operate around the clock. But let´s say, for the sake of argument, that a group of 20 berths have been closed for the night (maybe for maintenance?). As daybreak comes, and the station goes into service, the node would start directing incoming beamcars to the berth which is furtherst away first (i.e. number **1** in **figure 2:2**. Then it would fill berth number **2**, then number **3** and so on, supplementing with buffered cars if loaded beamcars are not arriving in sufficient numbers. Sending off a new car every 3 seconds, as the first minute is up, **all** the berths would be filled.

The beamcars will then start leaving in an entirely random fashion, some of them will have to wait several minutes before a motorcar arrives. Every time a departing beamcar asks for (and gets assigned) a timeslot, a new beamcar is sent out, to fill the berth. Two (or more) beamcars requesting a slot at the same time will be processed one at a time; real simultaneous does not exist in this context. If the beamcars use Bluetooth communication, call collision is automatically avoided.
Traffic direction and control is shown in the overview in **figure 3:2**, where the trunkbeam has been included. Arriving beamcars with vehicles to unload leave the trunk by way of beams **6** and **3**. Empty, arriving beamcars join the buffer by way of beam **5**. Departing cars with cargo (or which have been assigned a destination) use beam **4** to join the trunk. These connecting beams (4, 5 and 6) are long and smooth enough to allow cars to join and leave the trunk beam at full speed.
How are motorists handled?

The **first** question is: How do motorists select the "best" berth, to avoid queueing? Well, one could have visual aids, like a clearly visible digit on a high-placed sign at each berth. "Zero" would indicate "no cars queueing", "2" would indicate "two cars queueing", "4" would indicate "four cars queueing, go to another berth".

The **second** question is: How do motorists pay for the trip? A convenient way would be a magnetic card in the windshield, coupled to a bank account. A scanner at the berth would automatically read this card as the motorcar enters the berth.

An alternative would be a "smart" card reader, to be used while queueing. One could also let the driver use the same kind of Bluetooth interface as is envisioned for ordinary passengers.

The **third** question is: How are passengers in the motorcar handled? No bif deal, they travel free of charge.

The **fourth** question is: How do we deal with "freeloaders"? If a driver does not use any of these methods to pay the fare, he gets a "free" ride to the nearest manual control station, where he can pay in cash, or at least get identified.

The **fifth** question is: How does the driver inform the beamcar where he wants to go? An easy method would be a button panel on the flatcar; one button, or combination of buttons, for each destination. He could also use his Bluetooth unit to communicate with the booking system, that directs the flatcar where he wants to go.

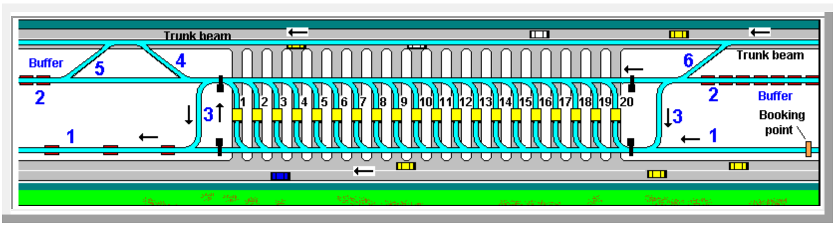
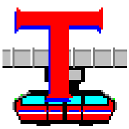


Figure 3:2

he "intelligent" node control could handle the traffic more **efficiently** by taking into account the actual distances between the berths. Cars that leave berths 1, 6, 11 and 16 could for instance leave almost simultaneously, and fall in behind each other.

Provided, of course, that any (or all) of them are ready to leave at about the same moment. Likewise could cars 2, 7, 12 and 17 leave at the same time, and so on. But, when directing the traffic in this manner, the node control has to take care that these "subgroups" are kept separa-te from other subgroups.

This is an example of successive weaving, which normally is handled by **one** node for each wea-ving point. The difference here is that we cannot have booking points in a row for beamcars that have already left their berths, just because they happen to pass other berths. That would generate too much communication overhead. But, by trim-ming its parameters, **one** node could handle **all** the weaving for these berths.

Last Updated: 2007-01-17

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„3. Service Categories

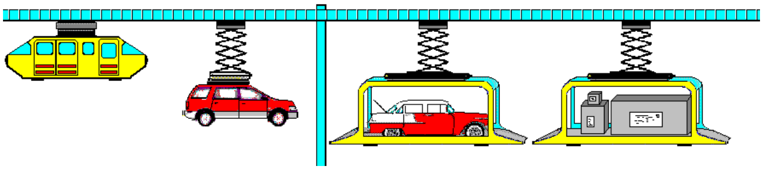

Figure 3:2

While taxi-cab service is the first that comes to mind when talking about beam-carried traffic systems, the other 3 services might be even more important during the long building phase of the network. Before the network reaches practically "everywhere", taxi-cab service will be of limited use. Rather, the dual-mode vehicle carrier service will be more attractive.

[1] Johnson Consulting / Kerstin Olsson-Gronvik: FlyWay Booking System, Copyright © 2004, SwedeTrack System, Last Updated: 2007-01-17, in: < http://www.swedetrack.com/flybook.htm >.

As time goes by, the network will most likely be expanded so as to provide cargo-carrier service with flatcars and container movers.

Important information that the booking system will need in this respect is:

1. Time and place of pickup
2. Time and place of delivery
3. Type of cargo
4. Size and weight of cargo
5. Regular, time-scheduled service or one-time.

Container sizes are standardized, and **FlyWay´s** vehicles are of course adapted to those standard. One important consideration, though, is that **all** beams that are available for container-moving vehicles need to be sturdy enough to carry the heaviest containers.

Private vehicles

Travellers which use their own vehicles will pay for the traffic control services that the network provides. The vehicles need to be previously registered with the network, so that network control is familiar with all relevant parameters with the vehicle, such as size, weight, etc.

Private vehicles need not have all facilities that **FlyWay´s** vehicles have, such as lifts and on-board routing information. The only requirement is that they are compatible with beams and communication modes of the network, and that they do not pose safety hazards for themselves, their passengers or the network in general. Thus, some network services are **optional** for private beam vehicles, such as preventive maintenance notifications.

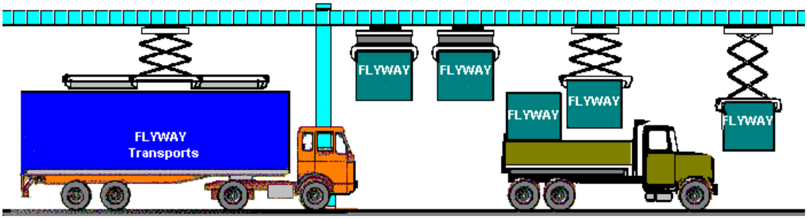

Figure 3:3: Container movers

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„Maneuvering the Beamcars

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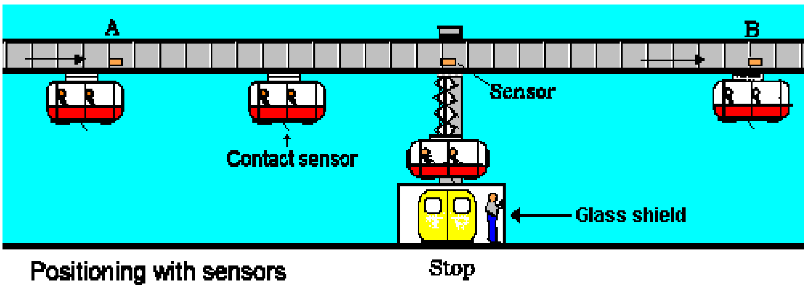


[1] Johnson Consulting / Kerstin Olsson-Gronvik: **Maneuvering the Beamcars**, Copyright © 2004, SwedeTrack System, Last Updated: 2007-05-20, in: < http://www.swedetrack.com/e50mobil.htm >.

Figure 1:2

[...]

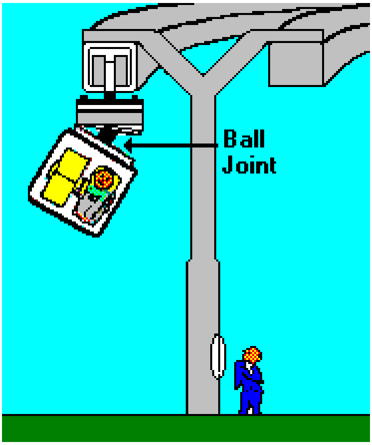


Figure 4:1

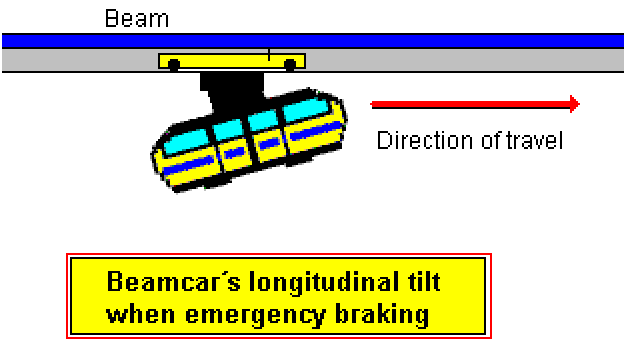


Figure 4:2“[1]

„The FlyWay Positioning System

[...]

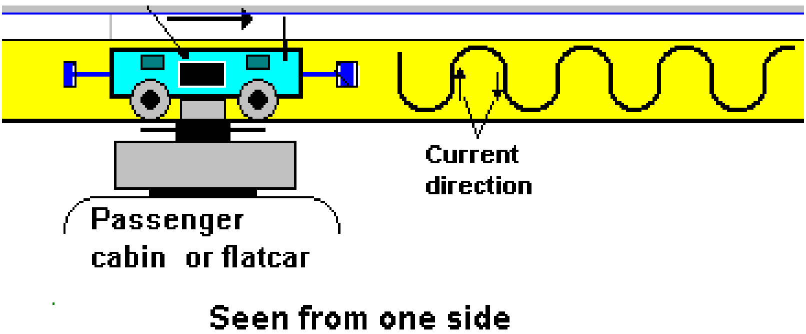


Figure 1:1

[1] Johnson Consulting / Kerstin Olsson-Gronvik: Maneuvering the Beam-cars, Copyright © 2004, SwedeTrack System, Last Updated: 2007-05-20, in: < http://www.swedetrack.com/e50mobil.htm >.

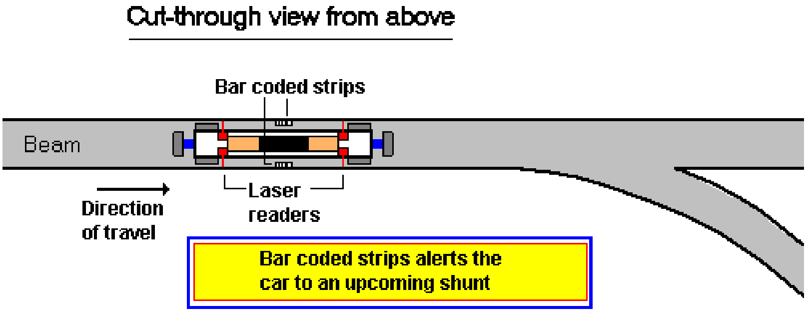


Figure 1:2“[1]

„The FlyWay Shunting

[...]

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FlyWay Positioning System, Copyright © 2004, SwedeTrack System, Last Updated: 2007-01-17, in: < http://www.swedetrack.com/flypos.htm >.

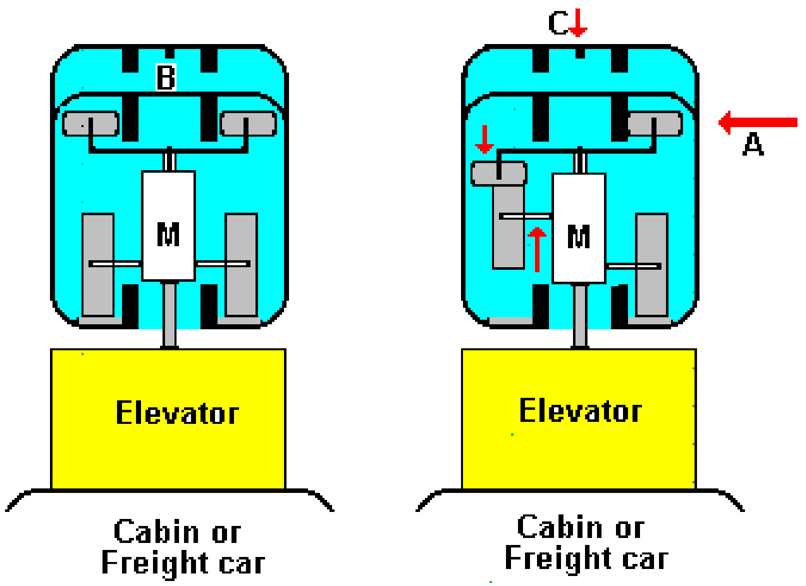


Figure 12. Figure 13.

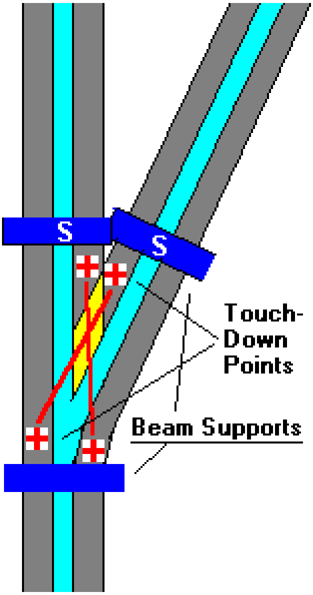


Figure 14."[1]

„The Elevator and Swiveling Functions

[…]

1. General

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FlyWay Shunting, Copyright © 2004, SwedeTrack System, Last Updated: 2007-01-17, in: < http://www.swedetrack.com/flyshunt.htm >.

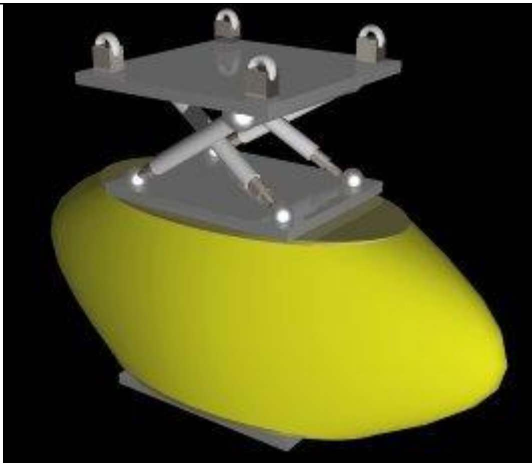


Figure 1:3

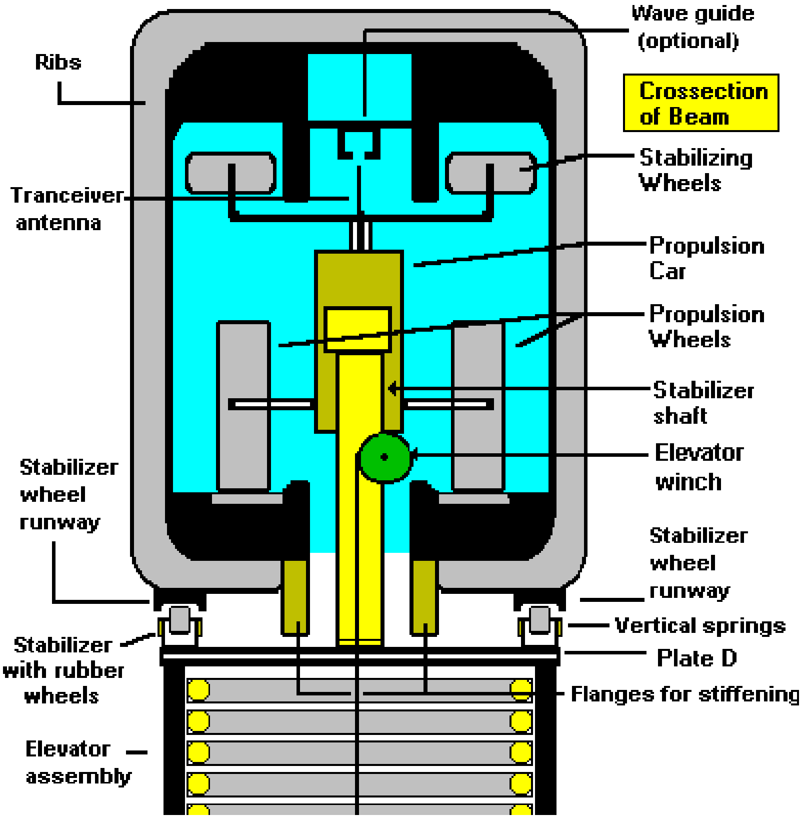
T**he FLYWAY®** beam cars have
5 exciting, potential features:

The carriages can be lowered to the ground
The carriages can be twisted sideways in either direction
They adapt intelligently to side forces during travel
They can negotiate sloping beams
They can handle dual-mode vehicles.

Figure 1:1 shows a cut-through view of the beam and the propulsion car. It shows the "scissors"-arrangement and is quite schematic. Also, all details are not shown, for patent-reasons. But **two functions** should be kept separate, to avoid confusion. The "stabilizing wheels" near the top of **figure 1:1** are for stabilizing the propulsion car when it switches beams. This function is detailed elsewhere.

The stabilizers on the elevator assembly, on the other hand, are for keeping the **carriage** (and the elevator assembly) underneath the beam stable as it is being raised or lowered, and also during travel. These four wheels run along tracks on the underside of the beams (as shown in figure **figure 1:1**), and are more easily seen in **figure 1:3** above, where they are mounted on the plate above the carriage.

Figure 1:1


Wave guide (optional)
Crossection of Beam
Ribs
Stabilizing Wheels
Tranceiver antenna
Propulsion Car
Propulsion Wheels
Stabilizer shaft
Elevator winch
Stabilizer wheel runway
Stabilizer wheel runway
Vertical springs
Plate D
Stabilizer with rubber wheels
Flanges for stiffening
Elevator assembly

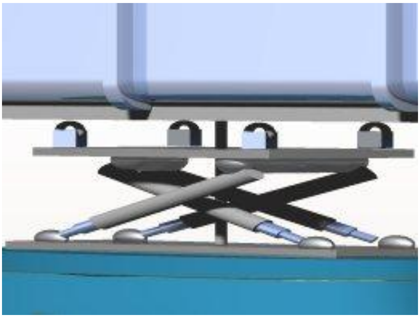
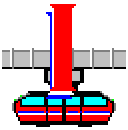


Figure 1:4



In the **FLYWAY®** concept, the propulsion car inside the beam carry the carriage underneath by way of an elevator. **Figure 1:2** shows the beam and the elevator assembly. As mentioned above, this is just **one** alternative design.

The left of this figure shows a cross-sectional view through the beam, the right drawing shows a sideview. As shown in **figure 1:2**, the elevator is operated by means of steel cables (one ordinary cable **(A)** and one for emergency use **(B)**), and the cabin or flatcar beneath is steadied by some suitable arrangement, such as the "scissors" construction shown here.

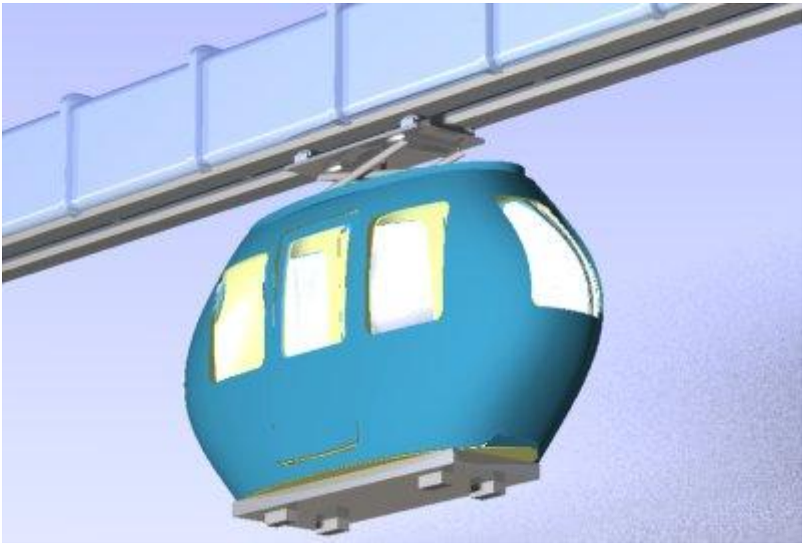
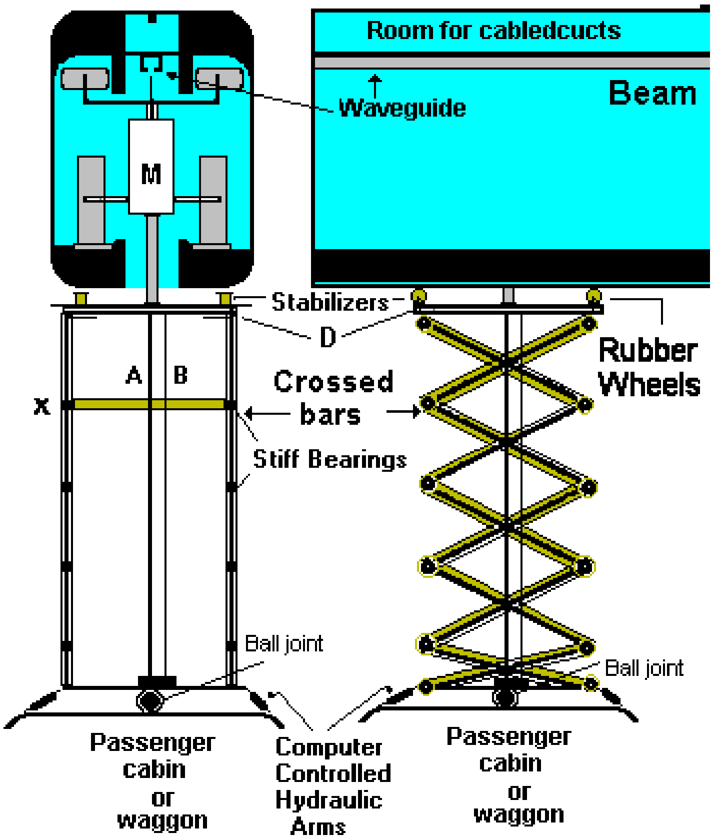


Figure 1:5

One proposed solution is to use a "scissors" arrangement, to stabilize the carriage. These scissors beams would consist of steelgirders. This construction must be stable; it cannot be allowed to swing sideways. Consequently, when the car is stationary and the carriage beneath is being lowered, **stabilizers** on the top of the scissors construction will press against the underside of the beam (**see figures 1:1 and 1:2)**. The horisontal crossbars (indicated by **X** in **figure 1:2**) would add some stability to the scissors arrangement, but they might not really be necessary.



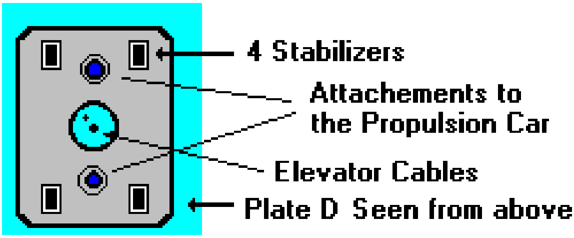
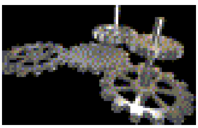


Figure 1:2

The Elevator Assem



The elevator is of the conventional type, with a winch and a motor on the propulsion car. The winchmotor would be controlled by the car's computer. It might be advisable to have **2 wires**. In **addition** to the elevator wire (indicated by **A** in **figure 2:2**), there is a **safety wire** (**B**) which automatically locks the carriage in the air, should the carriage's weight be transferred to this wire. This would happen, for instance, if the ordinary elevator wire were to break apart. Ordinary safety belts in motorcars function according to the same principle. This emergency wire would go to a separate winch drum.

One disadvantage as compared to ordinary elevators in buildings is the fact that the **FlyWay®** elevator will have to make do **without a counterweight**. This lack of counterweight would normally require an elevator motor with about twice the strength that would otherwise have been necessary. Alternatively the winch could be equipped with some kind of a **spring** (mechanical or hydraulic) to balance the weight of the load. Just like the air springs in a car hatch.

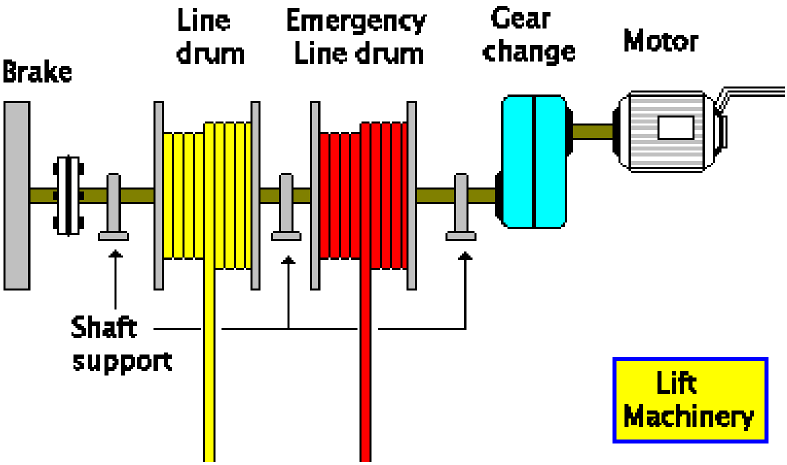


Figure 2:4

3. Stabilizing the Carriage during Raising/Lowering

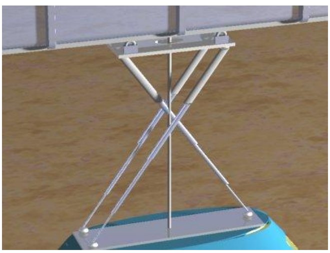


Figure 3:1

Figure 3:2

Another disadvantage (apart from the lack of a counter-weight) as compared to ordinary elevators (i.e. elevators in buildings, that run in shafts) is that **FLYWAY´s®** elevators are not automatically **stabilized** sideways by being mounted in a **shaft.** We have to use other solutions to compensate for this.

During travel, the upward pressure of plate **D** (in **figure 1:2**) against the underside of the beam when the carriage is being raised or lowered (and while standing on the ground) would be supplied by a retraction mechanism in the propulsion car, which pulls the small shaft holding plate **D** upwards, against the beam.

The top surface of these stabilizers would be equipped with rubber **wheels**, running along the underside of the beam, thus allowing the rest of the lift assembly to steady the carriage both when the carriage is being raised and lowered during travel and, of course, during normal travel.

These wheels would have the added benefit of helping to stabilize the carriage when it is moving and subjected to strong sidewinds and to centrifugal force in the curves. With this arrangement, the carriage could be kept at an adequate distance from the underside of the beam, so that it won't scrape into the beam when the beam is sloping (as in **figure 6:10** below).

With the "scissors" arrangement, the crossed girders are too rigid to respond to centrifugal force when the vehicle passes through curves (**figure 3:3**). The ball joint between the carriage and the elevator assembly will, however, allow the carriage to adapt to external forces during travel, working in conjunction with the hydraulic arms. Thus, the car **should** bend with the centrifugal force, but not be pushed askew from sidewinds.

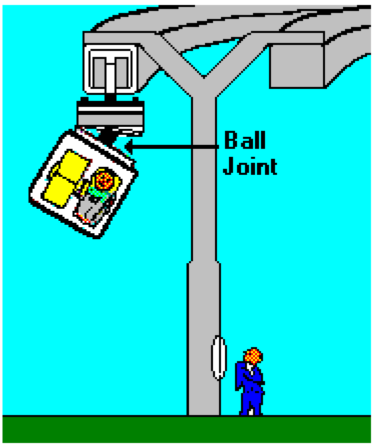


Figure 3:5

4. The Ball-joint Arrangement

This joint is only used with the "scissors" arrangement. The main advantage of the ball-joint arrangement (see **figure 1:2** above) is that the cars can negotiate sloping beam sections without the carriages **tipping** in the direction of travel. This provides better comfort for the passengers, and might be necessary in order to carry certain goods, like that being carried on flatcars. The ability to keep the carriage level at all times and compensate for shifting loads (such as people that move about in a passenger cabin) requires that the hydraulic pistons are automatically regulated so that independently of the centre of gravity the floor in the cabin is kept horizontal.

The hydraulic pistons thus fill **5 functions:**

They **swivel** the carriage

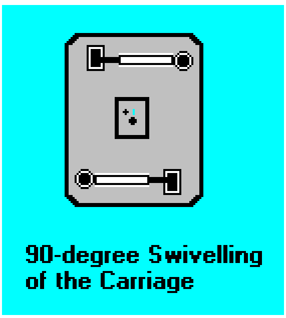
They keep the carriage **level** despite shifting lo-ads

They permit the carriage to **adapt to centrifugal forces** during travel

They **prevent** the carriage from **swinging** due to other forces during travel

They serve as **shock absorbers**, if necessary, when touching the ground

5. Swiveling the Carriage



90-degree Swivelling of the Carriage

Figure 5:1

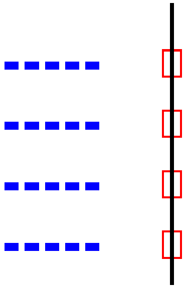


Figure 5:2

The ability to rotate around the swiveling-axis is an option that could come in very handy in many situations. It could be performed using the ball-joint shown in **figure 1:2** above. If we use the girders described above, this swiveling could be done **also** when the girders are in the folded-up position, since the stabilizers will only be needed when the carriage is lowered. The girders in the scissors construction are always oriented in parallel to the direction of travel, as is shown in **figure 1:2**.

The carriage is rotated in the horizontal plane around the ball joint, using active hydraulic arms. These would be two hydraulic piston devices that are controlled in an intelligent manner from the propulsion car, thus the label "active".

Using the "scissors" type of lift, he ball joint allows the carriage to be swiveled, using these arms, while the scissors assembly remains oriented along the beam. The control signal is transmitted to the carriage below by means of cable along the lift wire. This technology is really not new; it is well tested and widely used. Using this technique, the carriages could be swiveled a maximum of **90 degrees**, as illustrated in **figure 5:1** at left. We do not rule out the possibility of being able to swivel **180 degrees,** but that would have to be done in a different manner. **Figure 5:2** show, in a simplified animation, how motor vehicles wait on the ground to be loaded onto beamcarried flatcars. This technique of handling road vehicles is described elsewhere.

The alternative rig shown at right (**figure 5:3**) could also be used for swivelling, although maybe not as much as 90 degrees. This is a matter of design. The swivelling would be done by altering the length of the hydraulic arms, relative to each other.

Figure 5:3

6. Handling Sloping Beams

Figure 6:10 shows a sloping beam. These have to be allowed for in all city-wide beam networks.

Sloping beams would be used:

to change between different beam levels

to berth at a station, for cars not using elevators

to follow the contour of the ground.

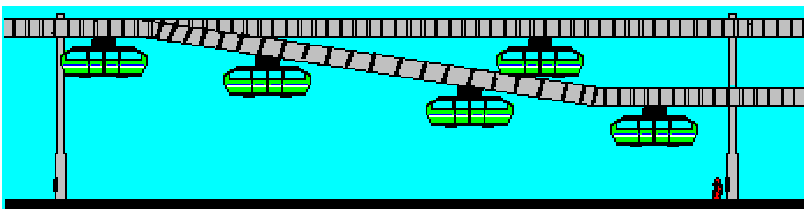


Figure 6:10

When hydraulic arms are used, **the ability to negotiate sloping beams** while keeping the carriage level requires that the lift machinery cooperates with these arms insofar as it would have to allow the plate (**D in figure 2:2**) to move vertically relative to the beam, whenever the beamcar passes over vertical knees on the beam. This is best accomplished with some spring mechanism on the lift wire. Consider **figure 6:12** below.

During horizontal travel (view 1) plate D is just pressed against the beam. This is done by the liftwire.

When beam tilts downwards (view 2), plate D needs some slack to be able to move away from the beam's underside. This is indicated by **A in figure 6:12**.

During travel along a slope (view 3) the hydraulic arms will regulate the carriage´s position relative to plate D.

When the beam bends upwards again (view 4) some slack is again needed to allow plate D to keep clear from the knee at **A.**

Thus, the hydraulic arms need to be computer controlled.

The beams must not slope too steep, either. Their inclination is limited by:

The size of plate D. It must be big enough to make a steady anchor point for the girders, but not so big that it will have trouble handling the beam knees and curvatures.
The traction of the wheels of the propulsion car. They should preferably have rubber tyres.
The strength of the traction motor relative to the load it must carry.

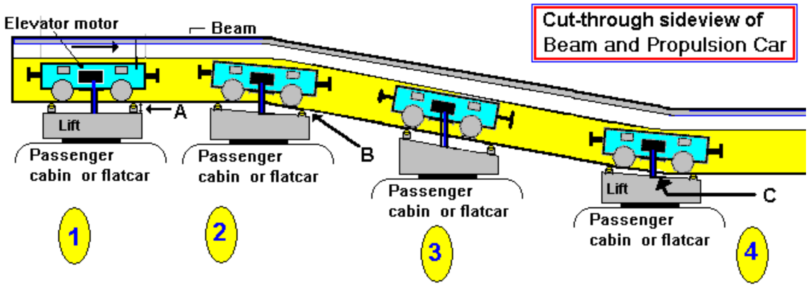


Figure 6:12

7. The Height above the Ground

From what height could the cars be lowered and reach the ground?

That would, of course, depend on:

The number of girders
The length of those girders, and
The maximum angle they could be stretched out.

Figure 7:14

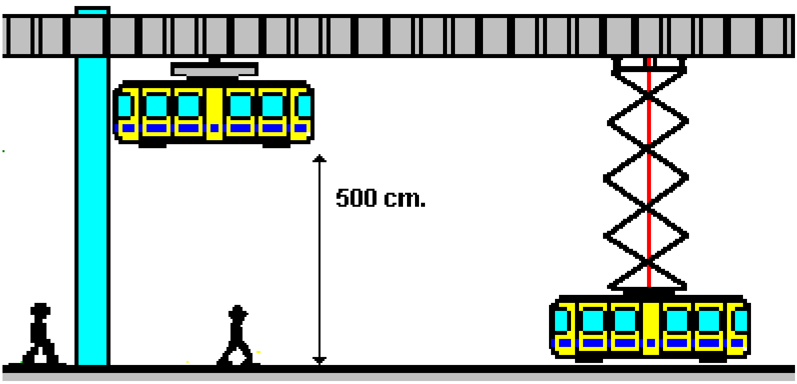
Assuming, of course, that **this** is the lift arrangement that will be used.

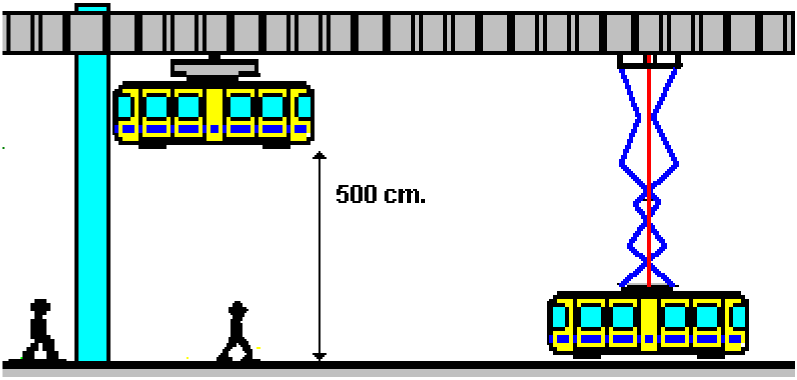
As an example, let us set the number of girders to **2 * 4 * 2 = 16.**This would result in **10 pivot points** on each side, indicated by the blue dots to the left in **figure 8:1**. Let us assume that the girders are 10 centimeters (= 4 inches) wide. This would result in a distance between the roof of the carriage and the underside of the beam of at least 50 centimeters during transport. Further, if those girders were **176 cm. long** between the pivots, and could be folded down to an angle of **45 degrees**, the resulting lowering would be approximately 4 * 176 * sinus 45° = **500 centimeters**. That is a vertical span of 5 meters, or almost 17 feet.

Figure 7:14 shows how the scissors unfold if the number of girders are **even.**

Figure 7:15 shows how the scissors unfold if the number of girders are **odd.**

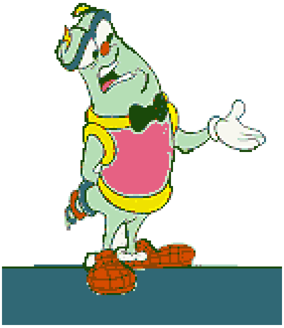
Figure 7:15





8. The Upper Girder Attachment

Figure 8:1 shows the upper attachment for the girders that constitute the "scissors" stabilization for the lift. It is a roughly squarish plate, not broader than the beam. It fills **3** functions:



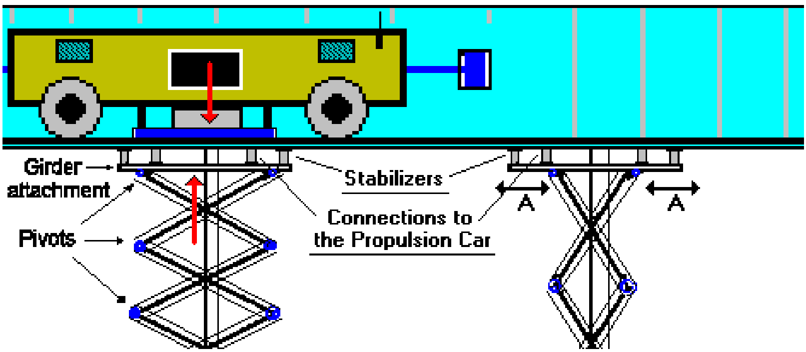


Figure 8:1

It stabilizes the elevator and carriage during lowering and raising of the lift (as mentioned)
It serves as a stable attachment for the cabin or carriage during the trip, insofar as it has small

rubber wheels (see **figure 1:2**) that touches against the beam if the going gets a bit rough. **It** serves as an extra emergency brake that, together with the propulsion car itself, clamps against the bottom of the beam (the **red** arrows in the left part of the figure).

Note that the pivot points have to **slide** in the upper and lower girder attachments as the scissors mechanism folds/unfolds (as indicated by **A** in **the figure at upper right**). The reason for this is that the pivot points will then come vertically under each other, maximizing the extension of the elevator and also even out the strain on the girders. An example of what would happen if the girders were **fixed** in the plates, and an **odd number** of girder-pairs were used, is shown in **figure 7:15** above.

When the beamcar travels, there is a space of about an inch (2.5 centimeters) between the rubber wheels and the floor of the beam. At sudden jerks and other uneven movements, these wheels will come in contact with the beam and help steadying the vehicle. When the car emergency brakes, these wheels are braked as well, and might come under considerable stress. But emergency braking should normally **not** be a daily occurence.

When the beamcar stops at a station or is queued on the beam, the upper girder attachment (together with the propulsion car inside the beam) will clamp onto the beam **after** the car has stopped, and the wheels of the propulsion car will be locked. This clamping to the beam will thus be used in **two** situations:

braking in an emergency and
as a parking brake when the car is stationary.

It will **not** be used for the **normal braking** of the car.

Figure 8:2 shows how this works. The left figure shows how only the stabilizer wheels have contact with the beam during travel. At right, the vehicle is stationary. As the girder plate is pressed up-wards, the clamps make contact with the beam. The stabilizer wheels rest on springs on their axis, and are pressed down by the beam, towards the girder plate.

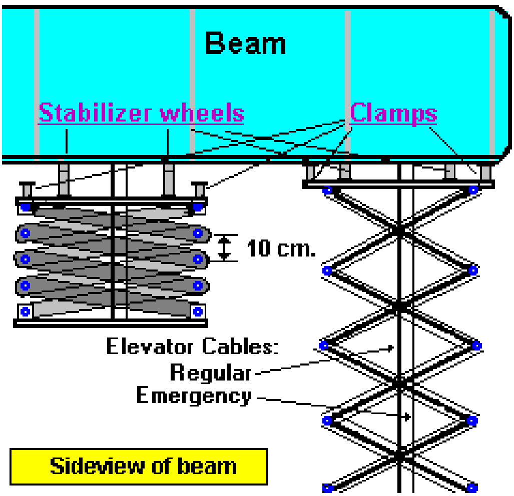


Figure 8:2

9. Long Beamcars need Two Elevators

Beamcars with 2 Elevators

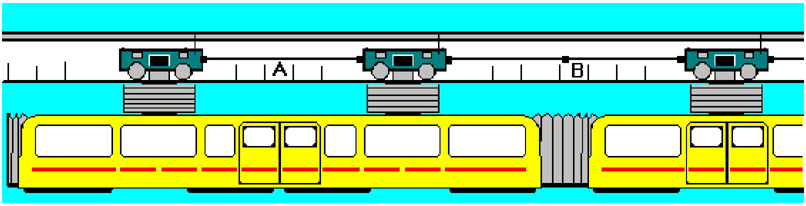


Figure 9:20

Sufficiently long beamcars might need **2** elevators, as shown i **figure 9:20.** This adds the requirement that the 2 elevators in the car will have to work in conjunction, to keep the carriage level during raising/lowering. A second consideration is; if there are more cars coupled together, the whole trainset would have to be kept level. A third consideration would be to what degree the carriages would be allowed to tilt in the direction of travel when negotiating a slope. Single carriages could be kept level by temporari-ly lowering the high end when the car is going through the vertical bend on the beam. For trainsets, however, this manuever would be tricky. But, yes, it could be accomplished for trainsets as well. **Figure 9:21** shows what it might look like.

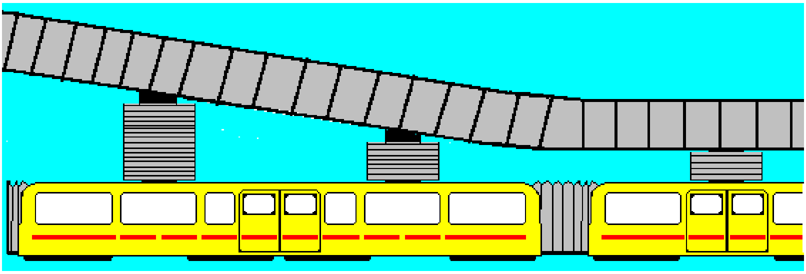


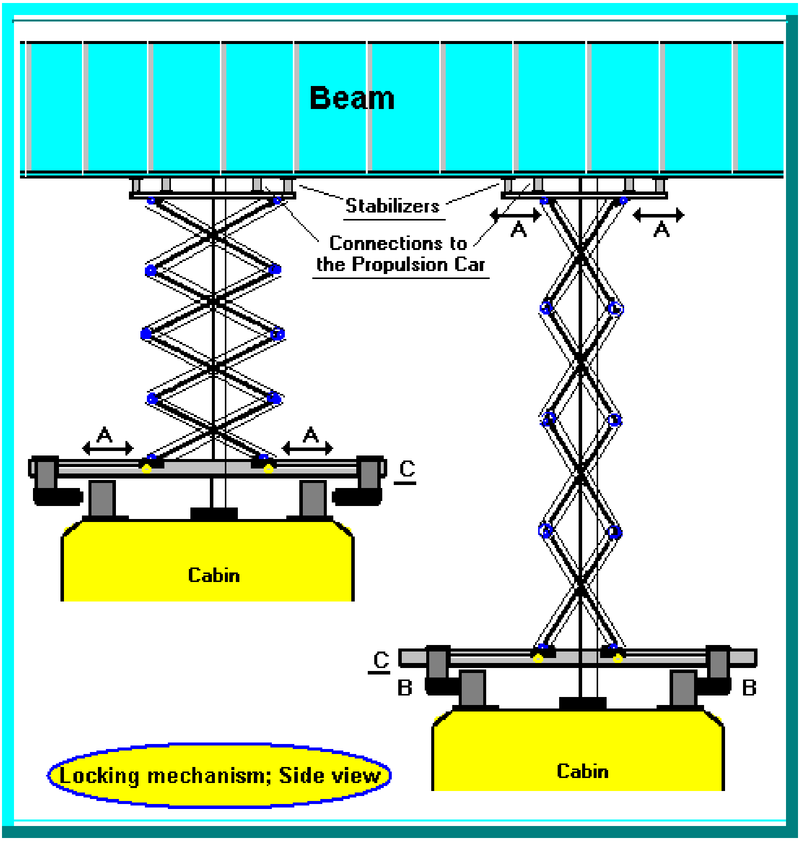
Figure 9:21

10. Steadying the Beamcar for Emergency Evacuation

Normally, the carriage will reach the ground, and stand steady on its feet while cargo is loaded/unloaded or when passengers are embarking/disembarking, as the case may be. One could, however, imagine a situation where a beamcar cannot be moved for some reason, and has to be evacuated where it is. It **could** happen, then, that it is positioned at a place where it won't reach the ground.

As detailed elsewhere, the carriage could be evacuated anyway, provided it stays steady and does not swing back and forth. This problem of steadying the car could be solved in a very elegant way, as shown in **figure 10:1** below. Normally, as the girders unfold during lowering of the carriage, the upper and lower attachments will slide (indicated by **A**) so as to stay vertically relative to the other joints in the scissors assembly.

Should the carriage be lowered further than the normal scissors angle of about 45 degrees, the lower attachment will pull 2 blocks, mounted on a sliding beam (**C**), inwards. This beam is mounted atop the carriage by way of the ball joint mentioned. As these blocks move inwards, they will fit neatly between other blocks on the roof of the carriage (indicated by **B**), thus preventing the carriage from swinging sideways.



11. Dual-mode Capability

The dual-mode concept means that people and freight can be transported in the same vehicle, that travels both on the road and connected to a beam propulsion vehicle, alternately. This is an important feature, if the beam network is to gain enough popularity to grow and ultimately cover the whole urban area. If dual-mode capability is not included in the network it will not gain the acceptance and ridership necessary to finance its growth. It will just be another public transport system, albeit more sophisticated than today´s. You can read more about dual-mode transportation on this page.

The **FlyWay®** system goes further than that. SwedeTrack System has designed a lift interface that would enable all kinds of loads to quickly and automatically be connected and disconnected to a beam propulsion vehicle. This capability has several advantages:

1. **R**epair and maintenance of both propulsion vehicles and carriages can be performed separate from each other. This means for instance that if a propulsion vehicle has to be brought out of service, its carriage can still be in traffic, connected to another propulsion vehicle, and vice versa. This enhances the system´s economy and flexibility.
2. **A** certain carriage of any kind can be connected to a lift arrangement of any kind, if there are several lift arrangements being used, maybe from different manufacturers.
3. **P**eople can have their own, private passenger cabins or other types of carriages, just as they own motorcars today. When they want to go someplace, they just call for a

propulsion vehicle to come and fetch their carriage.

Figure 11:1 provides an idea how the **FlyWay®** interface would work. The cargo, equipped with the "Plate C" interface, stands on the ground, underneath the beam. It could be a passenger cabin, a flatcar, a container transport, or a genuine dual-mode vehicle. "Plate B" is part of the lift assembly.

As the propulsion vehicle approaches, it will have to locate the load. This is initially done by informing the prop. vehicle of the load´s whereabout and identity. At the specified location, it slows down and activates a laser (**1** in the figure). This laser would, in turn, perform three tasks:

1. **I**t locates and reads a strip-coded identity label on plate C (**2**).

2. **I**f the identy is correct, the prop. vehicle then proceeds until it is directly above the load. This is ascertained by the aid of a marker (**3**) on plate C. If required, the lift arms will also move plate B sideways and rotate it a bit, to get it aligned with plate C.
3. **A**s the lift lowers, the laser will monitor the distance to plate C.

As plates **B** and **C** meet up, the grip arms (**5**) move inwards to lock onto plate **C**. One could conceivably also use electro-magnets for this interlocking.

This procedure should not have to take longer than about 20 seconds. Releasing a load would be even quicker. But it is clear that the mobility of plate **C** needs to be greater than the lifts so far described on this page would allow. Plate **C** might need to be:

- moved sideways, maybe up to 40 cm in each direction
- twisted, preferably up to 90 degrees, as mentioned earlier
- slanted, not much, but one should not have to depend on the load being absolutely horizontal.

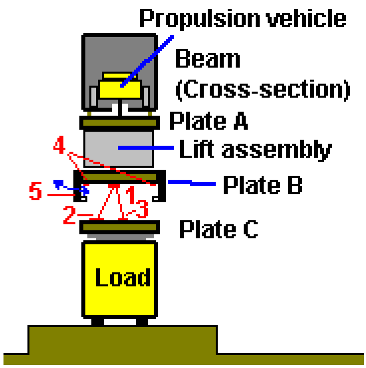


Figure 11:1

One relatively easy way to achieve this would be to use only **two** hydraulic arms, diametrically positioned as shown in **figure 11:2**, and where the upper arm attachments on plate **B** (indicated by **A**

in in **figure 11:3**) can be independently rotated. This is how industrial robot arms move, so there is nothing special about this technique.

When plates **B** and **C** disengage on reaching the destination, the driver of a dual-mode vehicle would get a green light on his dashboard, possibly together with charging information. And he can drive off.

There are a few things that the **propulsion vehicle** needs to be informed about, regarding its new load.

1. **I**t needs to check that the load is not too heavy, and this could be measured by the lift as the lift (tries to) lift it off the ground.
2. **I**t also needs to know the length, height and width of the load. It might be too big to be allowed to travel certain routes. Such in-

formation could be conveyed from the system computers.

3. **I**nformation about the nature of the load could also be vital for various reasons, such as priority travel, choice of route and safety distance to the vehicle ahead (if the load cannot handle too quick emergency braking). Such information would have to be conveyed from the system computers.

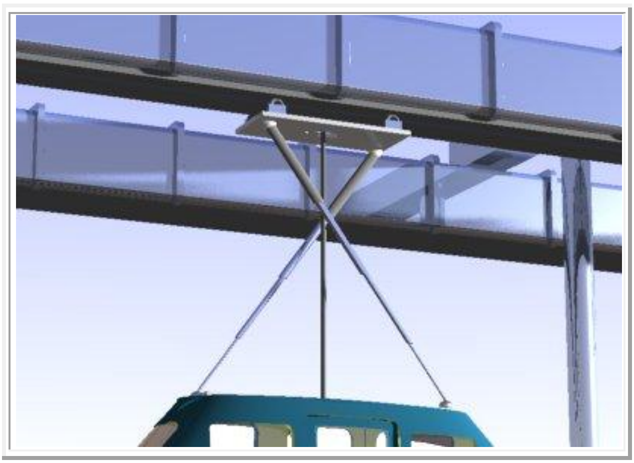


Figure 11:2

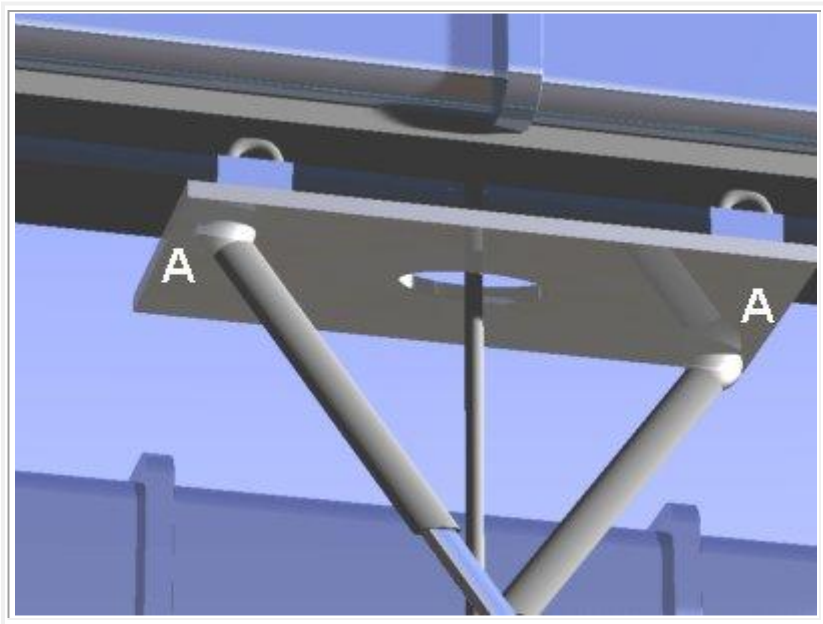


Figure 11:3

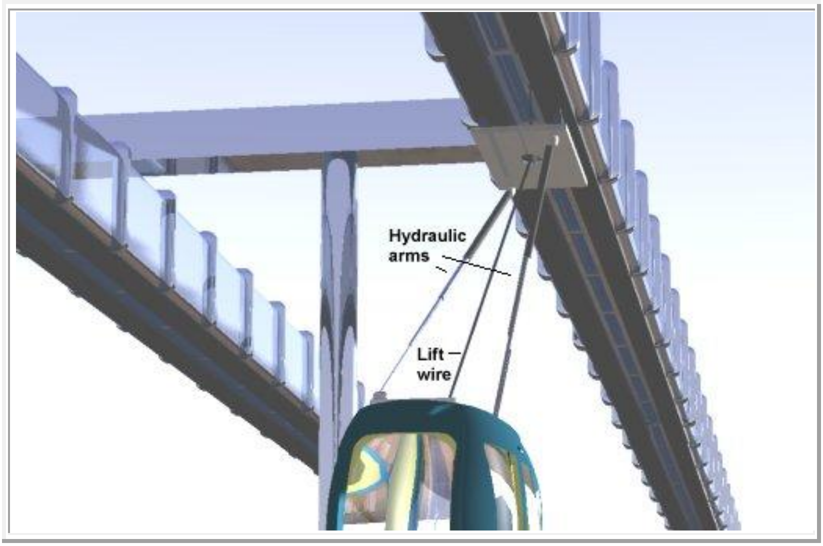


Figure 11:4

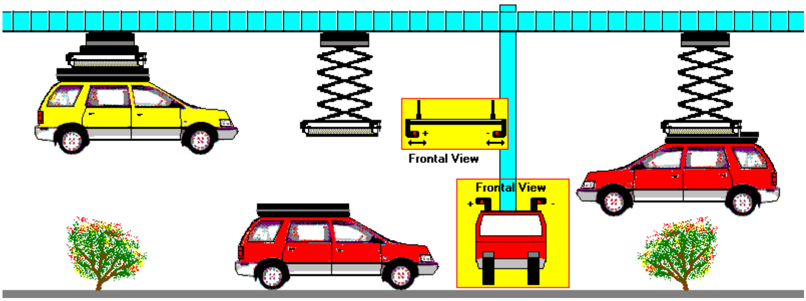


Figure 11:5"[1]

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The Elevator and Swiveling Functions, Copyright © 2004, SwedeTrack System, Last Updated: 2007-01-17, in: < http://www.swedetrack.com/e49hiss.htm >.

„The FLYWAY Stations […]

The **FLYWAY** implementation of the suspended automatic concept is as flexible as can be provided, with due regard for safety. The cubicles described below and on another page are not mandatory, but they are the best insurance against damage to life and property.

Figure 1:1

5. Queue-handling

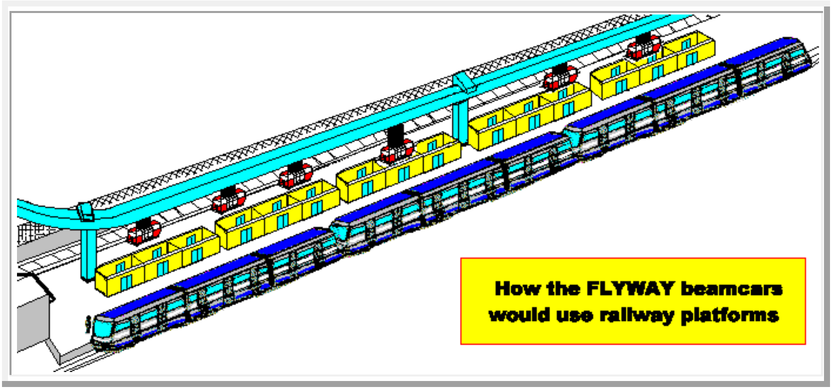


Figure 5:1

As shown in **figure 5:1** above, there are situations where berths have to be placed in a row along the same beam. A typical such situation is the one shown; a rail station platform. Clearly, these cars will be blocking each other during unloading and loading. Since this typically takes only 30 to 50 seconds, this waiting is no big deal. But if you consider the example shown in **figure 5:2**, you will appreciate the **real** problem. If the 8 berths in the example are successively filled, starting with berth number one, the cars in berts one and two would typically be empty again, by the time berths seven and eight get occupied. But the cars coming in at this point (depicted in red) will not be able to use these empty berths until **all** berths have been cleared. The only sensible way to handle this is to let the beamcars occupy the berths in groups. In this case the groups would be up to **8** cars each. If one accepts that an occupied berth will be free again within one minute, this means that a traffic intensity of about **8** cars every minute would result in forming of groups of 8 vehicles. The group as a whole moves forward as soon as **all** berths are available. If the group is not complete, then cars coming in later would of course be allowed to dock at the available (and accessible) berths. Cars coming in later than that (when berth number **8** is still occupied) would have to wait until all berths are empty again.

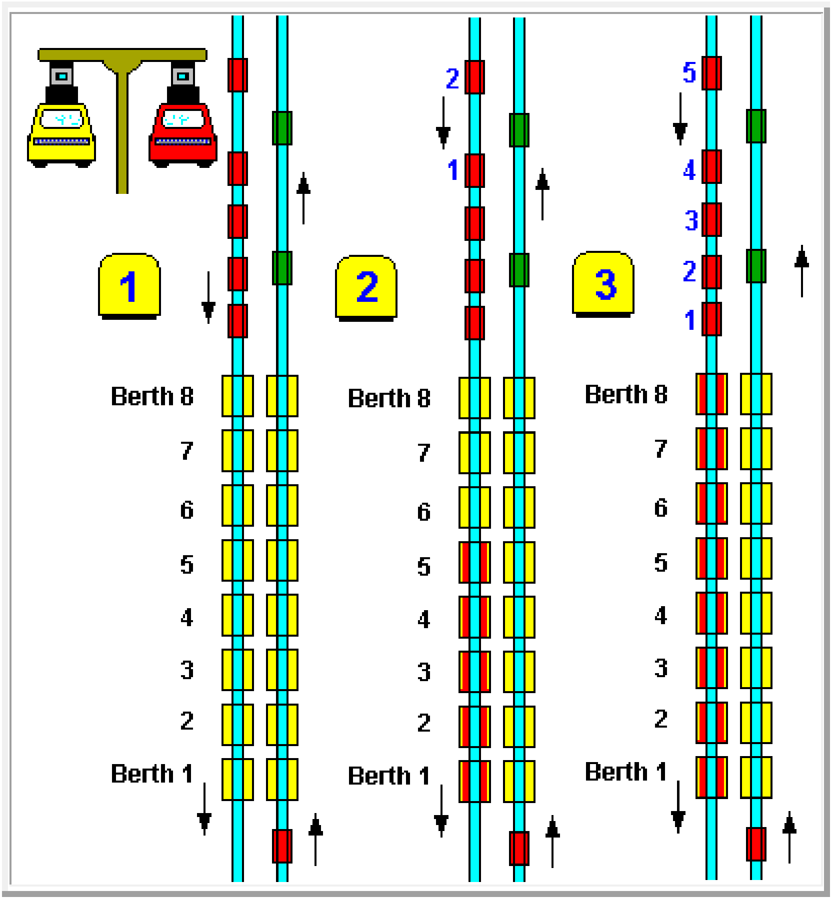


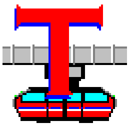
Figure 5:2 Queue-handling at stations

At times when traffic intensity is lower, the cars would in principle tend to use berths 1, 2 and so forth, leaving berths 7 and 8 mostly unused, if they were to follow this scheme. But since node computers monitors traffic, they could easily direct the cars to other berths, and necessarily fill the berths from nuber one and backwards, in order to provide for an evenly distributed use of berths.

Regarding efficiency: When traffic flow is so heavy that all berths are occupied practically all the time, (in other words; there are constant small queues), then the berths will be pretty efficiently used. The waiting time for each group would be commensurate with the slowest vehicle in the foregoing group. As the number of berths increase, the waiting time because of this will increase very marginally. At low traffic intensity, however, queues would tend to form even while there are empty berths. So, the number of "inline" berths should not be too great. A limit should be set to about 10 berths in a row.“[1]

„The FLYWAY Propulsion Cars

[...]



The **FLYWAY®** propulsion car (**figures 1 and 2**) can have the following attributes and equipment:

A small cross-sectional area relative to the beam, to minimize air-resistance while travelling.

Propulsion by means of an electrical motor, which feeds the energy back into the power conduits whenever it is slowing down on its own volition.

A mechanical emergency break, which clamps around the bottom flange of the beam.

It would be controlled automatically by the beam-car´s computer, from the Network Control Center

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FLYWAY Propulsion Cars, Copyright © 2004, SwedeTrack System, Last Updated: 2007-01-17, in: < http://www.swedetrack.com/flwprop.htm >.

and by the passengers by means of an on-board emergency brake.

An elevator motor.

A hydraulic or spring-loaded device for pressing the elevator assembly's upper girder attachment against the botttom of the beam.

Control mechanism for the twisting arms for those cars that can swivel the carriage horisontally 90 degrees in either direction.

A motor that raises and lowers the wheels of the propulsion carriage at the shunting points.

A transceiver antenna for communication with the next upcoming node and with the central computer by way of waveguides or (more likely) Bluetooth-technology inside the beam.

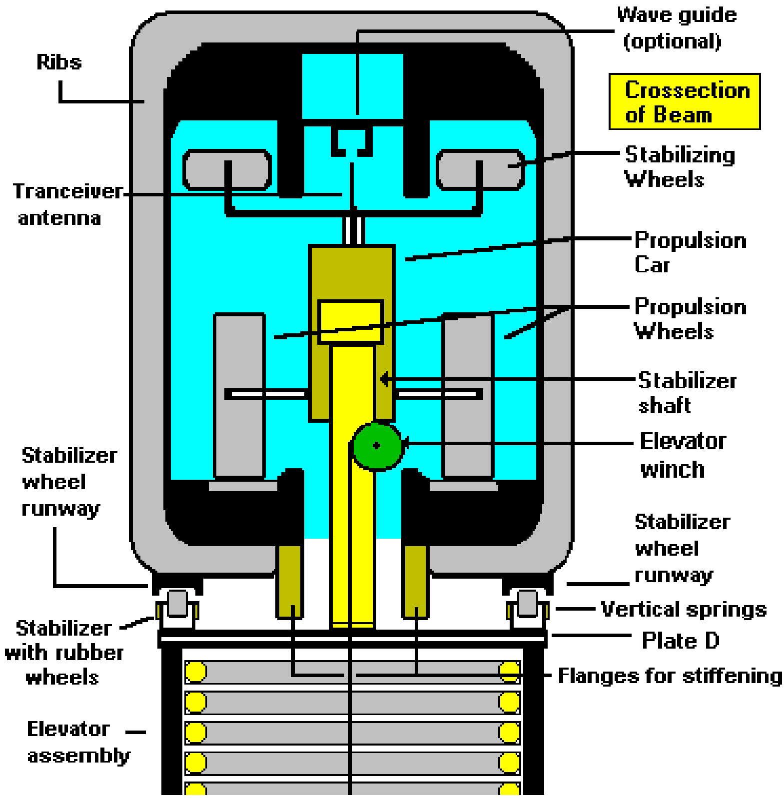


Figure 1:1: Cross-sectional view of beam and propulsion car

2 transponders to communicate with sensors in the beams.

An addressable computer which controls all the actions of the vehicle, including the automativ doors.

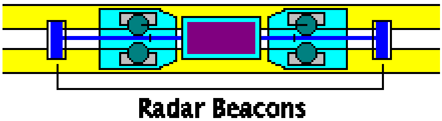


Figure 1:2

The **FLYWAY** propulsion car is **longer** than is strictly necessary, and has a slimmed waist (see figure 1:2 above) which is also flexibly jointed. The purpose is of course to:

better negotiate the twist and turns of the beam
better distribute the weight of the carriage.

The **FLYWAY®** propulsion cars rely on radar signals and on detectors in the beam to alert them about obstacles. The **FLYWAY** cabins for **PRT-operation** are not planned to be longer than **about 6 meters**. Cabins of 10 meters or more in length (for GRT-operation) might need **2 beam attachments** (and thus **2** propulsion cars) in order to keep the cabin properly balanced, as shown to the **left** in **figure 3:1** below. This arrangement makes it trickier to keep the cabin level when the beam slopes.

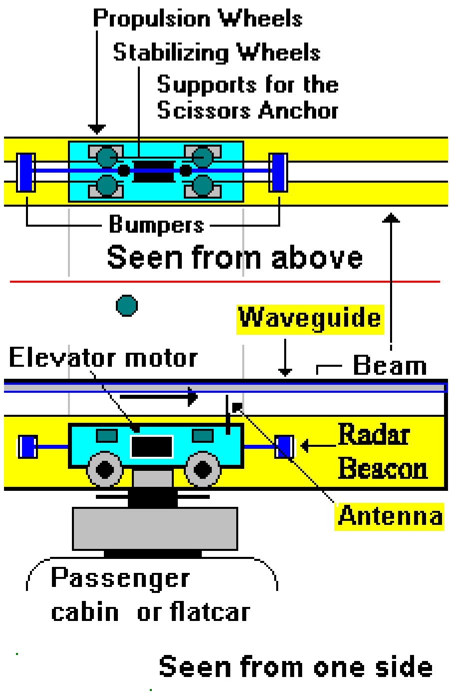


Figure 1:3

[...]

3. Connecting the propulsion cars

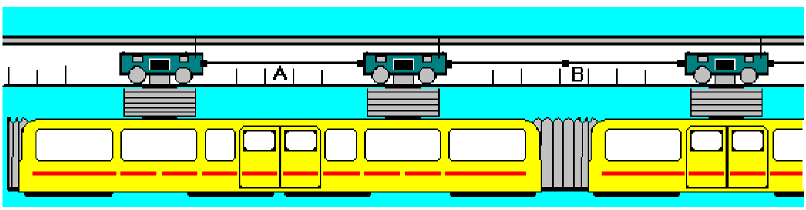


Figure 3:1

[...]

5. Methodes of Propulsion

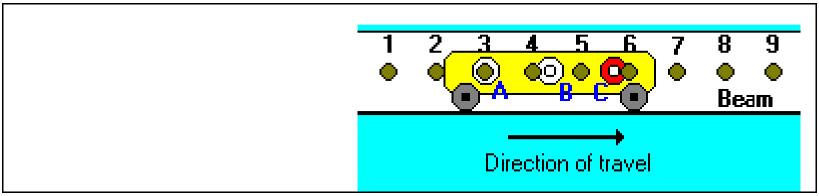
T he **FLYWAY** beamcars can be propelled by 3 alternative means:

Asynchronous electrical motors with variable-frequency control driving on 4 rubber-tire wheels, as outlined in the foregoing chapter

LIM, using magnets to propel the car. The propulsion car has 4 rubber-tire wheels, but they are not used for traction

LIM, in combination with **Magnetic Levitation,** where the propulsion car has no wheels for running. The shunting is in this case performed in a different manner than that outlined on this page.

FLYWAY´s propulsion cars use rubber wheels, as they provide for better traction and less noise than steel wheels. They have to negotiate sloping beams, and the steepness allowed for those beams is determined by motor strength and possibly traction.



Traction, then, is only a limiting factor in the **first** case, i.e. when asynchronous motors for propelling the wheels are used. In this case, the slope of the beams are limited to 5°. If linear motors (LIMs) are used, traction is not a limiting factor, and the slope could be increased to 10°, possibly more.

Magnetic Levitation is a technology which probably has a great future. It is as yet rather expensive. The **FLYWAY®** system will include MagLev if customers so desire. In this case, there are a couple of US patents that are quite promising, as regards performance and affordability.

[...]

7. Regulating the Speed

The following factors influence the speed of the beamcar:

The maximum allowable speed on the current beam section (info from local node).

Any restrictions that apply for **this** car during **this** journey (info from central computer and/or locally stored information in the car´s computer).

Whether it has to negotiate a shunt, with consequential changing of direction (info from beam sensor and from stored information regarding this trip).

Whether it goes through a sharp turn (info from beam sensor).

Whether it´s about to stop (info from beam sensor and from stored information regarding this trip).

If it receives an alert from local node, central computer or other vehicle that immediately influenses its speed (complementary stored information regarding this trip).

If the radar on the carriage notes an unexpected obstacle in its path.

If running in a timeslot; directives from the local node computer.

If the radar on the propulsion car detects a vehicle ahead (illustration at right).

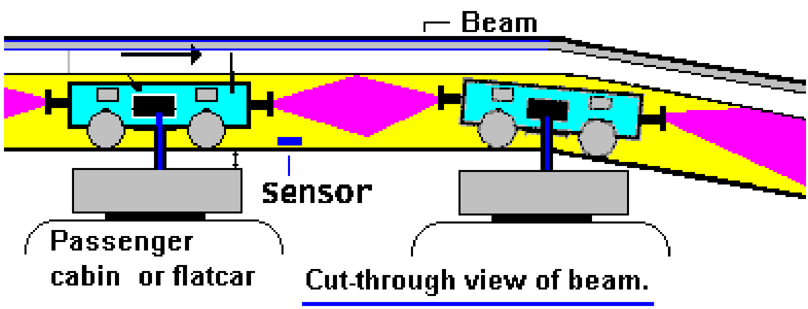


Figure 7:1

The internal radar inside the beam functions as an **electronic bumper.** It also has a **doppler function,** enabling the car to calculate the speed of an encountered car by **measuring** their relative speeds and **knowing** its own speed. The beamcar then behaves as a human driver; it regulates its own speed so that it keeps a safety distance commensurate with the current speed, i.e. the higher the speed, the longer the required distance to the car up ahead. The doppler function will in all likelihood be implemented by comparing successive measurements.

For trunkbeams, we calculate with speeds upwards of **140 km/hour** (corresponding to 90 miles/hour). Depending on how the obstacle detection is implemented, it has been calculated that the safety distance for that speed should be at least

120 meters. Generally, this internal radar should be able to see far enough. Long, straight beams should not present any impediment to these 120 meters.

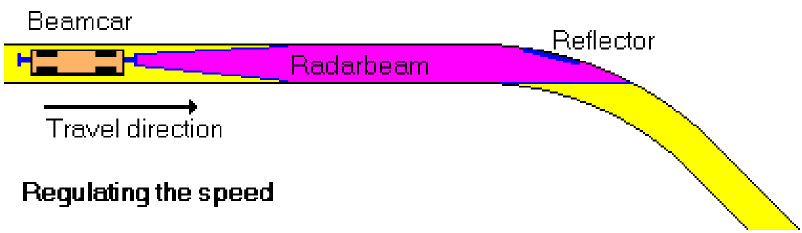
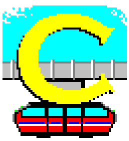


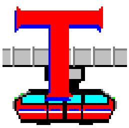
Figure 7:2

urving beams usually means that the speed will have to be reduced, thus lowe-ring the requirements as to how far the radar has to see. **Obstacle detection** for **FLYWAY** is examined more in detail on another page.

It could be that, as soon as the beam bends, the allowable maximum speed would be reduced to that commensurate with visibility inside the beam.

The beamcar could be told by sensors whenever this allowed speed is altered, or the inside of the outer wall of the bending beam segment could have reflectors, telling the car´s radar that the beam is bending, and how far away this is. This speed reduction is a policy matter, however, since there is also an obstacle detction system on the carriages themselves.

8. Braking the Car



The beamcar must (of course!) be able to **brake**, both in order to regulate speed and to stop at stations, and in emergency situations. There are situations such as:

When passing a booking point and being ordered by the node to regulate speed
Approaching a shunt
Going through a curve
Passing a downward-sloping beam

Stopping at a station
Handle an emergency.

At such times, the motor power is **reduced** or, in the case of an **VFD-controlled** Synchronous AC-motor, the **frequency** of the supplied power is reduced.

The ensuing mechanical torque is fed back to the power rail. The propulsion motor should be designed to generate enough braking torque to suffice in most cases. This not only conserves energy (by feeding it back into the power rails) but also saves on the wear of the mechanical brakes.

Under certain circumstances, however, the beam-car might be required to brake at maximum force to prevent a possible accident. This "maximum force" has to take due consideration to possible passengers; an empty car could brake even harder. It is stated above about the traction motor that "It should be dimensioned to handle the emergency braking required". This means that if the electrical power is cut altogether, the beamcar will breake at a rate of approximately **2g** (= 20 meters/second^2). To complement this, there is also a mechanical brake, functioning in principle like the illustration at right, and applied on all four wheels of the propulsion car.

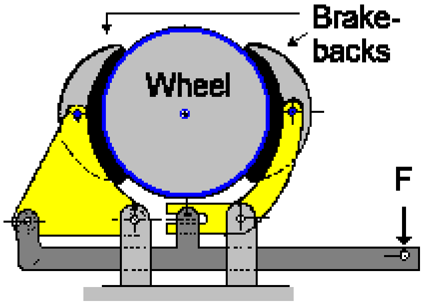


Figure 8:1: Mechanical brake assembly

When the beamcar has to emergency-brake, the slow-down speed is monitored. If it isn´t sufficiently quick, the **mechanical brakes** will be applied. The braking force would be applied at **F** in the above figure by means of, for instance, in electrical relay.

9. Design Considerations

The propulsion car cannot be designed as a rectangular wagon, with a wheel in each corner, as a regular railway bogey car.

Because the beam bends and slopes here and there,

- the front and back axis have to be **mobile** relative to each other
- the **"waist"** has to be a bit slimmer than a straight beam would allow

Were it not for the lift, the propulsion car could probably be short enough to be constructed with **one** pivot point. But with a lift machinery to carry, more space is needed. With **two** pivot points the car can be longer and thus carry a bigger load, while still allowing sharp turns in the beam, in all directions; vertically and horizontally.

One could make **3** general designs for the propulsion car.

1. **one-pivot** with a central platform (**figure 9:1**)
2. **one-pivot** with two platforms (**figure 9:2**)
3. **two-pivot** with one platform in between (**figure 9:3**)

The **one-pivot** design in **figure 9:1** is the cheapest and simplest, and it regulates itself so that the platform with the lift machinery (shown in orange) always stays in the **middle** of the beam (i.e. it is always positioned over the slit). This platform cannot be bigger than shown, since the beam bends both ways (i.e. both left and right). It takes some calculations to find the optimum size. The length of the shafts **A** relative the width of the beam $\mathbf{W_b}$ has an optimum where the width of the platform $\mathbf{W_p}$ is as it widest. Providing the platform with rounded corners would make it larger, but it still is not deemed possible to make it big enough.

The **one-pivot** design with **2** platforms, as shown in **figure 9:2** is better than the foregoing, since it provides more platform space. The lift machinery would then have to be placed on either one of these platforms.

The **two-pivot design,** as shown in **figure 9:3**, is an even better solution. The optimum length **L** of this platform would be the length that provides the largest area, and this length is limited by:

- its width relative to the **width** of the beam
- its width relative to the shortest radius of **curvature** of the beam.

The only problem with this design, compared to the one-pivot design, is that the center of the platform **x** does not stay over the beam´s slit in curves.

We want the Area $\mathbf{A = L * W_p}$ to be as large as possible. Let´s apply some trigonometric thinking and see how big we can make **A** as a function of bending radius $\mathbf{R_b}$ and beamwidth $\mathbf{W_b}$**.** The beam´s bending radius is properly calculated from the center of the beam, where the slit is.

From the triangle in **figure 9:3** we can see that:

$$\mathbf{(L_p)^2/4 + (2R_b - W_b + W_p)^2/4 = (2R_b)^2/4}$$

which comes to:

$$\mathbf{(L_p)^2 = 4R_bW_b - 4R_bW_p - W_b^2 - W_p^2 + 2W_bW_p}$$

Assuming a smallest bending radius of **6 meters** and one of the smallest **FLYWAY** beamwidths of **0.80 meters,** we get:

$$\mathbf{(L_p)^2 = 19.2 - 24*W_p - 0.64 - W_p^2 + 1.6*W_p}$$

$$\mathbf{\Rightarrow (L_p)^2 = 18.56 - 22.4*W_p - W_p^2}$$

deriving $\mathbf{dA/dW_p = 0}$**,** one gets $\mathbf{W_p = 0.54}$ **meters** as an optimal platform width.

From the equations above we get the otimum dimensions as:

$\mathbf{L_p = 2.48}$ **m,** $\mathbf{W_p = 0.54}$ **m and** $\mathbf{A = 2.48 * 0.54 = 1.34\ m^2}$

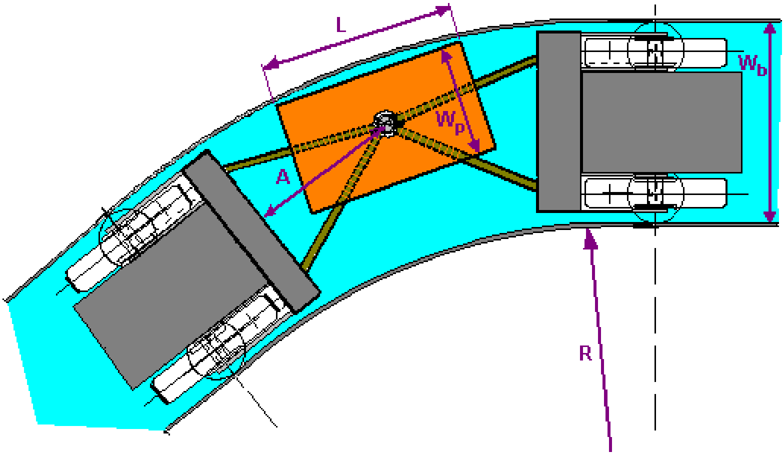


Figure 9:1: One pivot point, one platform

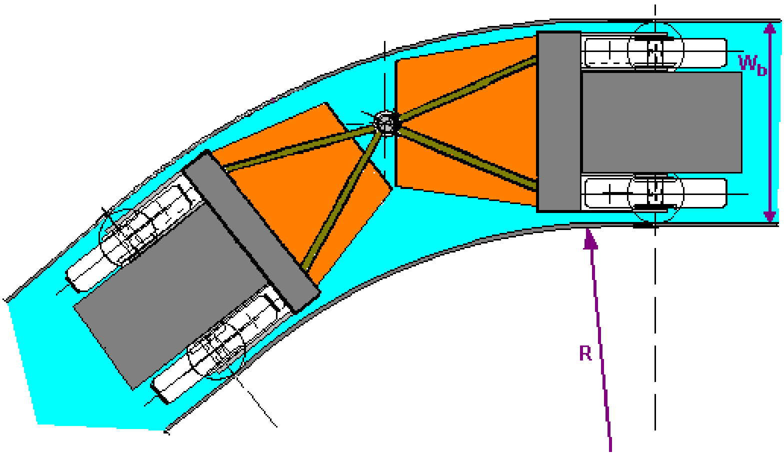


Figure 9:2: One pivot point, two platforms

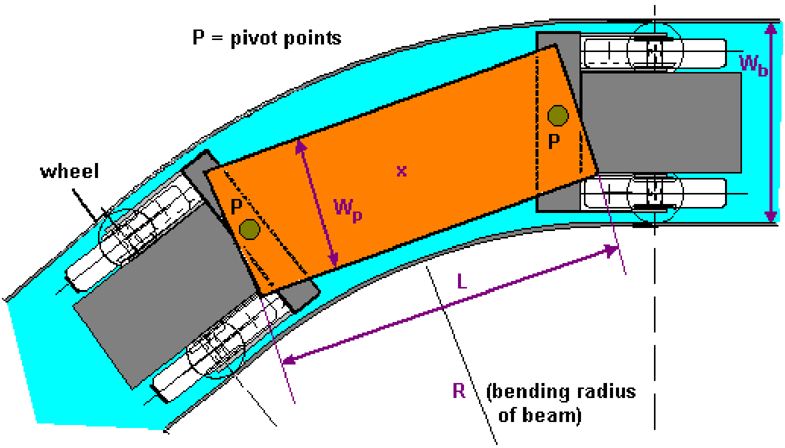


Figure 9:3: Two pivot points, one platform

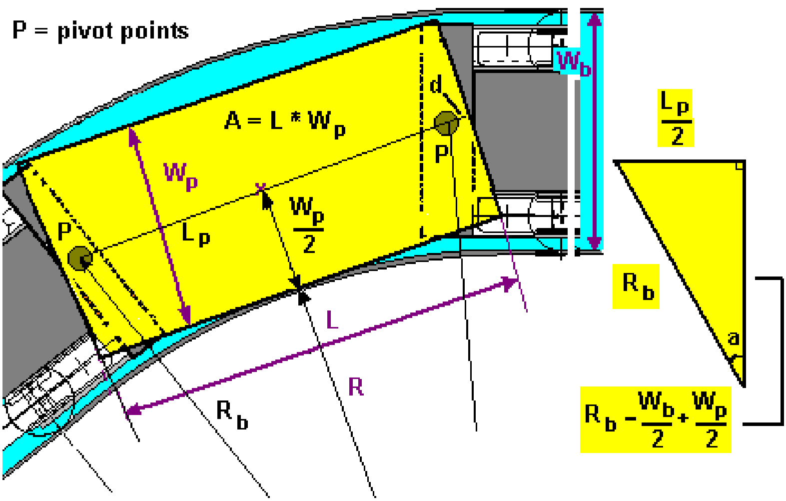
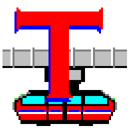


Figure 9:4: Trigonometry

Now, $\mathbf{W_p}$ has to take account for the fact that the beamsdes has some **thickness** which we disregarded here. But **0.54 m** is sufficiently small to a handle that. Another matter is that **L** is larger than $\mathbf{L_p}$, since the pivot points are **overlapped** by the platform. How much that overlap is depends in part on whether the platform has rounded corners (which seems like a good idea), but if we add 0.26 m at each end, we would get **L = 2*0.26 + 2.48 = 3 meters**, and the Area comes to about **1.5 m^2**.

Slit in the Platform



The platform center in **figure 9:2** does not stay centered over the beam slit when going through curves. **If** only **one** vertical suspender is used for carrying the carriage below, this has to be compensated for by a **transverse slit** in the platform, to allow the elevator cables to hold on to the cabin or carriage without undue strain, as shown in **figure 9:4.** If **two** vertcal suspenders are used (each positioned near the wheel axis) then this slit will of course not be required.

If the free length of the elevator cables inside the beam is sufficient, they can move of their own volition, back and forth, and need only be protected from abrasive forces from the slit linings by a round holder underneath the propulsion car. If the free cable length is not sufficient for this, the round holder has to move the cables be following the slit as it moves back and forth relative the car. This can be achieved mechanically by letting the holder travel on its own wheels underneath the car (but still inside the beam.

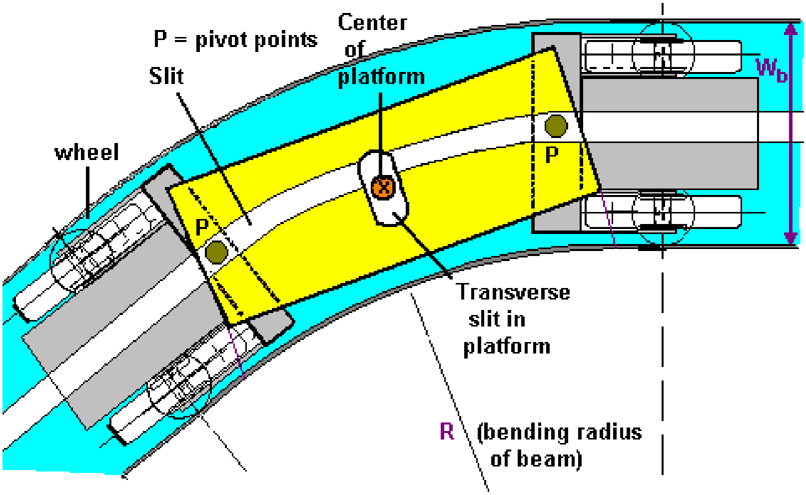
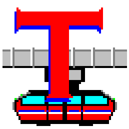


Figure 9:5: The slit in the Platform“[1]

„The FLYWAY Beams

[...]



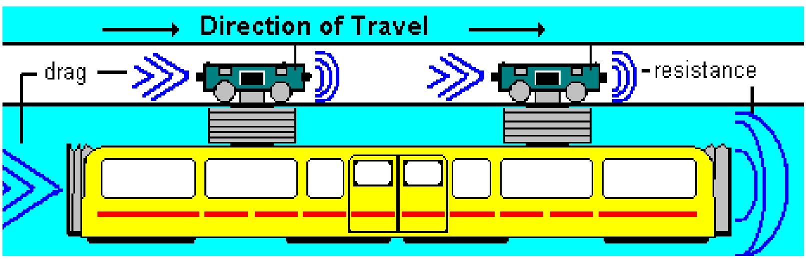
The beams are the arteries of the system, in a manner of speaking. The **general theory** of designing beams (from SwedeTracks point of view) has been detailed on a [separate page.](#) This page will be devoted to the

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FlyWay Stations, Copyright © 2004, SwedeTrack System, Last Updated: 2007-04-26, in: < http://www.swedetrack.com/flwstat.htm >.

FLYWAY® beam design. The **FLYWAY®** design will mainly follow the commonly accepted pattern, with a view to either **establish** or **adopt** a **common interface standard** for beam design.

As stated elsewhere, it would be highly desirable if, in the future, beam networks from different manufacturers had common interfaces, so that they could be interconnected, and beamcars thus being able to travel from one network to another, as is possible with regular railway services.[…]

1. General considerations



There is no rule that says that beams for this kind of purpose have to have a **rectangular** cross-section. Other shapes have been proposed. But as long as other shapes are not strongly motivated by some special circumstance, the rectangular cross-section is the most straight-forward design.

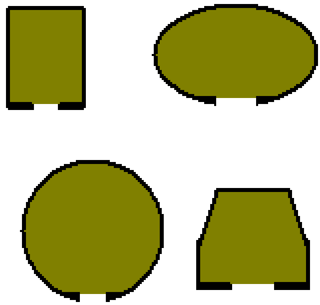


Figure 1:3

What, then, about **material** for the beams? One could use straight steel, alloyed steel, alloyed aluminum, glass-fiber and even glass, if one wants to. The important criteria for **SwedeTrack** when choosing a suitable beam-material are that it should be:

Strong, in relation to its cost
Durable and maintenance-free
Resilient against weather, fire, earthquakes and willful damage
Unpenetrable for electro-magnetic waves.

The last condition alone mandated that we had to choose steel or aluminum. Comparing those 2, steel won out. With proper painting and/or zinc plating for corrosion protection, steel would be the material of choice. By roll forming sheet metal during the manufacturing process, one gets the desired shape of the parts, which are then welded together.

Air Compression and Aerodynamic Drag

The propulsion car inside the beam would be subjected to air compression in front and aerodynamic drag behind it, when moving. The compressed air in front and the thin air behind both the cabin and the propulsion car (as illustrated above) have a braking effect on the vehicle. This effect only increases with speed. The solutions are, of course, to:

Giving the propulsion car as small cross-sectional area as possible
Making the cabin small, and giving it an aerodynamic design
Giving the air inside the beam as much chance as possible to move out of the way.

Addressing the third issue here, the **slit** at the bottom of the beam should be rather **broad.** **FLYWAY,** as opposed to most other PRT-systems, proposes to use **elevators** on its vehicles, which might require broader slits than would otherwise be needed. In addition, beam segments will need space for lateral movements, and this will be provided for with a few centimeters´ gap between beam segments. This gap will be covered with casings (se illustration further down) wich will be so designed that they lets air out and in through both sides when a vehicle passes by. [...]

3. Manufacture and Assembly of Straight Beams

The pre-fabrication of straight beam elements should be quite straight-forward. The top, the sides and the runways are manufactured in 10 meter length segments (or thereabouts). In addition, som lenths would have to be custom-made to meet specific requirements. These parts are then welded together, as shown to the right. For strength, "ribs" would then have to be added at regular intervals. This is further described on a separate page.

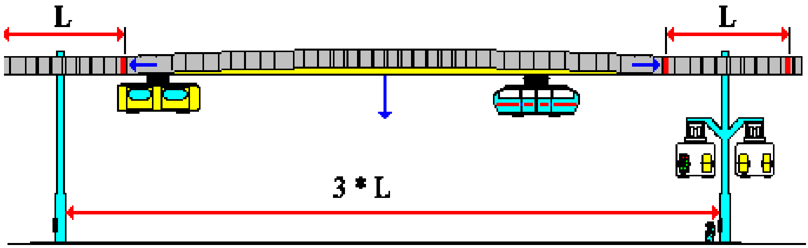


Figure 3:1

The beams should be prefabricated with an **up-ward bent** (so-called "camber", which is shown exaggerated in the figure above), to compensate for the beam´s own weight and for the downward stress of passing beamcars. One or two **flanges** near the bottom slit would fill the same function; to stiffen the beam. Some sort of **casing** or inner **lap,** welded onto the end of one of the beam segments, might also be needed where beam segments are joined, both to take up movements due to heat expansion, and to allow the beams to move **laterally** in conjunction with moving vertically when beamcars pass through. This lap, shown at right, would protect the beams´ interiors, but would at the same time let some air pass out and in (as noted above, under "general considerations").

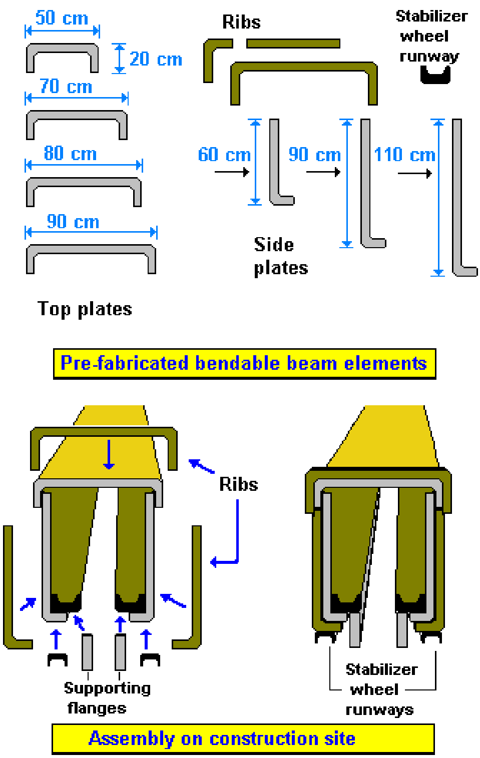
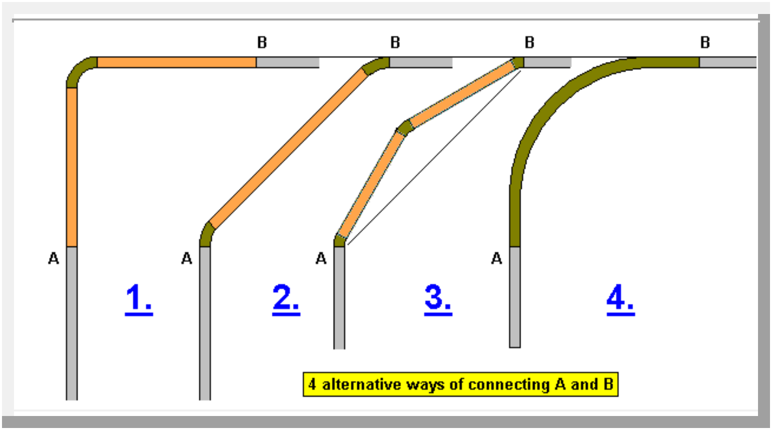


Figure 3:3

4. Manufacture and Assembly of Curved Beams


B
B
B
B
A
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A
A
1.
2.
3.
4.
4 alternative ways of connecting A and B

Figure 4.1 […]

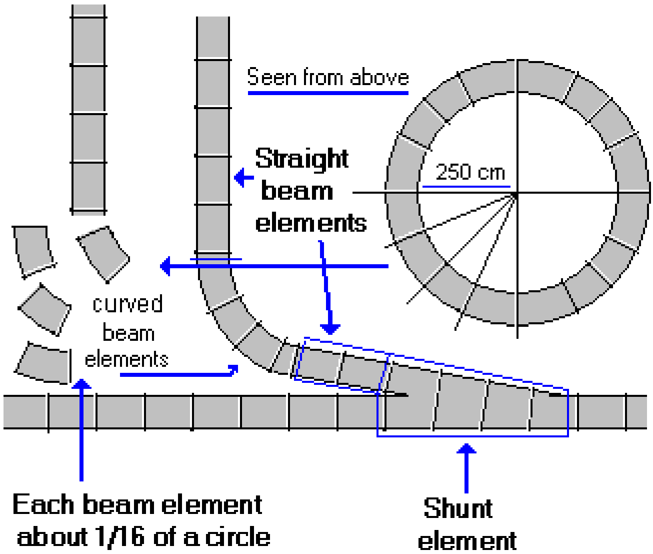

Seen from above
Straight beam elements
250 cm
curved beam elements
Each beam element about 1/16 of a circle
Shunt element

Figure 6.2"[1]

„The FlyWay® Beamcars

[…]

[…]

5. 3 kinds of freight carriers

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FlyWay Stations, Copyright © 2004, SwedeTrack System, Last Updated: 2007-04-26, in: < http://www.swedetrack.com/flwstat.htm >.

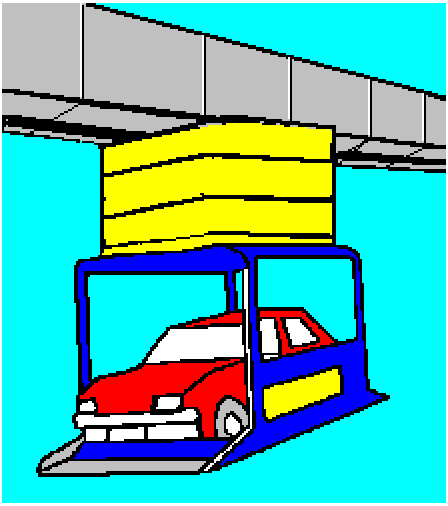


Figure 5:1

The **"FLYWAY®"** concept includes 3 models of beamcars for handling of goods:

Flatcars for transport of motor vehicles, but also other kinds of goods.

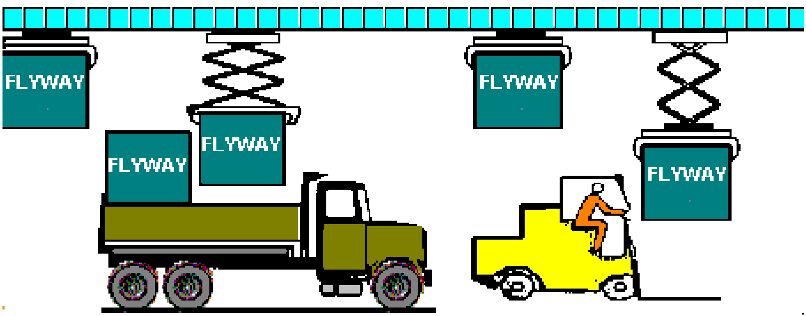


Figure 5:2

Grappling hooks for carrying containers. These have to be in 3 classes for varying sizes and weights of the containers to be moved, so that the weight- and width-restrictions of various beam routes are not exceeded.

Attachments for specially adapted road vehicles. The cars are carried by way of their roofs, and in the case of electrical road vehicles, power outlets for recharging of the vehicle´s battery during transport would be available.

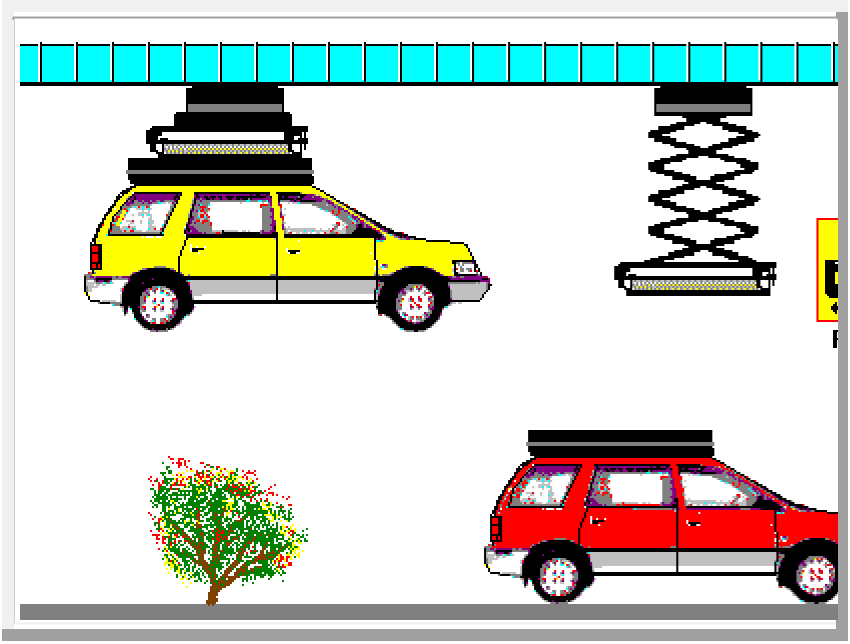


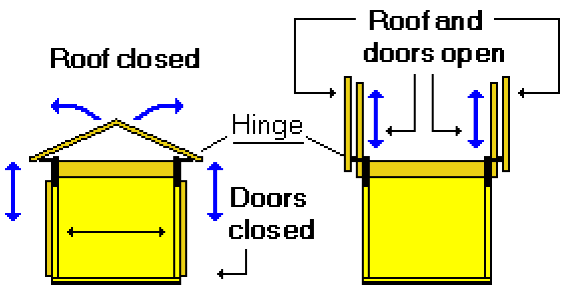
Figure 5:3

6. 4 sizes of stops

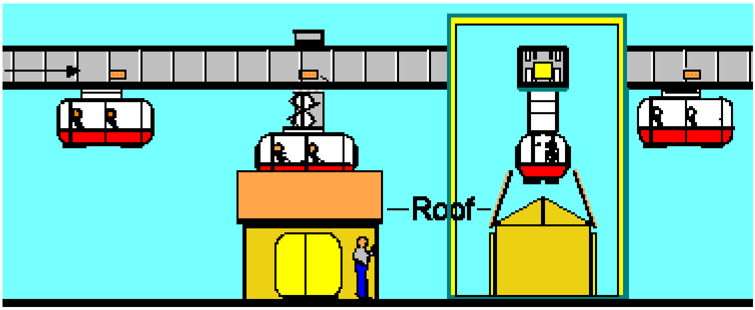
[…]

One problem that has to be solved is cubicles with **roofs,** which fold up when a cabin is about to be lowered, as is shown on the illustration at lower right. These roofs are only really needed in places that can expect huge amounts of snow at times.

The best solution to this is to hinge the roof at both ends on protruding attachments, which reach outside the doors, as **shown below.** When the roof is raised, the path is free for the doors to go up. When the beamcar is about to leave, the cubicle doors go down, the cabin is raised, and finally the roof folds back down, in that order.



Shortend views of station cubicles with foldable roof and raisable doors



Sideview and shortend view of cubicle with roof

Station cubicle with foldable roof.

[...]

"FLYWAY´s®" vehicles are meant for high speeds, and have to be designed accordingly. To travel at **120** km/hour instead of **40** km/hour, for instance, requires 27 times as much power, just to overcome air resistance. **27 times?** Yes, because power requirements increase in proportion to the cube of the speed ratio. Tripple the speed, and the air resistance becomes **3*3*3 = 27** times as big.

Air resistance consumes a lot of motive power from moving vehicles. This is why aircrafts on long flights travel on high altitudes, where the air is thinner, despite the fact that:

thinner air cannot carry the plane as good
it requires a lot of power to **climb** to higher altitudes.

You can read more about aerodynamic resistance on this linked page.

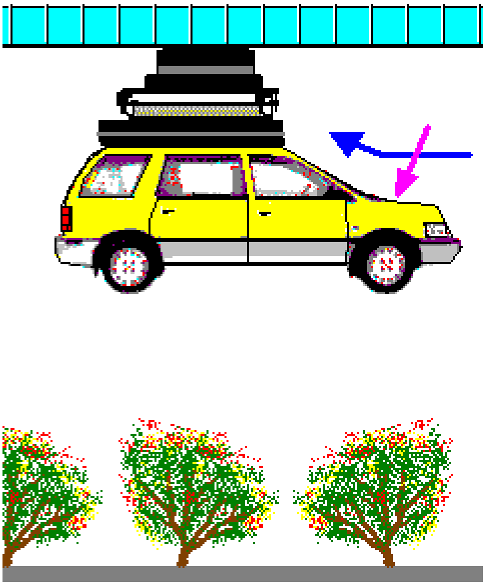
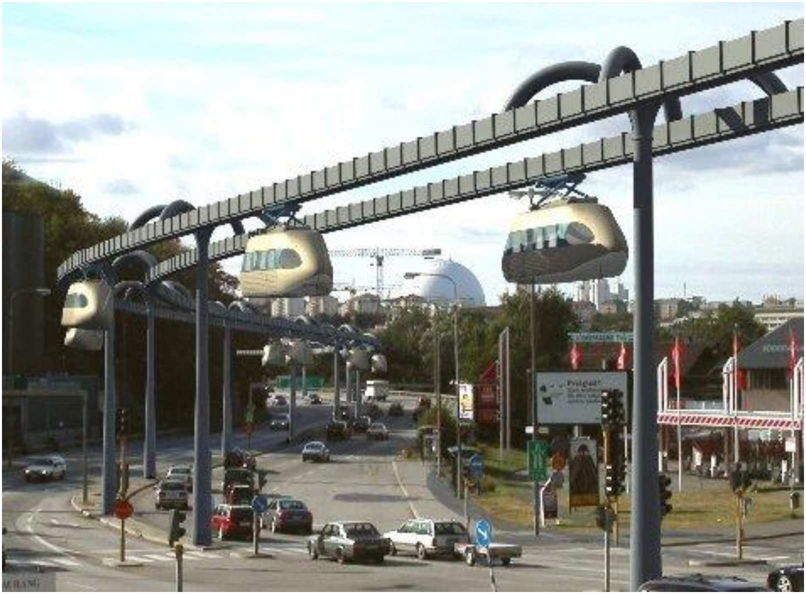


Figure 7:3"[1]

„The FLYWAY® Components

[...]



[...]

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FlyWay® Beamcars, Copyright © 2004, SwedeTrack System, Last Updated: 2007-01-17, in: < http://www.swedetrack.com/flyway2.htm >.

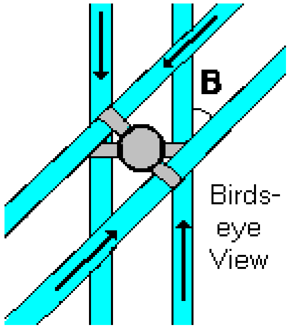


Figure 3:2"[1]

Aerobus

„Das von dem Schweizer Gerhard Müller erfundene Nahverkehrssystem **Aerobus**, das inzwischen von der Firma *Aerobus International, Inc.* vermarktet wird, ist eine Einschienenbahn, deren elektrisch betriebene Fahrzeuge ähnlich wie die Wuppertaler Schwebebahn hängend verkehren. Im Unterschied zur dortigen Konstruktion handelt

[1] Johnson Consulting / Kerstin Olsson-Gronvik: The FLYWAY® Components, Copyright © 2004, SwedeTrack System, Last Updated: 2009-11-14, in: < http://www.swedetrack.com/flyway1.htm >.

es sich bei den Fahrwegen aber nicht um starre Stahlschienen, sondern um Aluminiumschienen, die nach Hängebrückenart an Kabelkonstruktionen aufgehängt sind.

1974: Testanlage in Dietlikon

Prinzip [Bearbeiten]

Ein Hauptvorteil des Aerobus sind die langen Abstände zwischen jeweils zwei Trägern (Pylonen), die bis zu 600 Meter betragen können und dadurch den Aufwand für Bauarbeiten am Boden und auf der Straße auf ein Minimum reduzieren. Im Gegensatz zu traditionellen Verkehrsmitteln im Öffentlichen Personennahverkehr wie etwa der Straßenbahn oder dem Omnibus fährt der Aerobus ungehindert von anderen Verkehrsteilnehmern und weitestgehend geräuscharm.

Als hauptsächliche Nachteile gelten die vergleichsweise aufwändige Konstruktion von Kurven und Weichen sowie die mühsame Evakuation der Fahrgäste im Notfall.

Geschichte [Bearbeiten]

1970 erfolgte in der Schweiz die erste probeweise Installation einer Aerobus-Anlage, sie befand sich in Schmerikon am Zürichsee. 1975 verkaufte man diese nach Ste. Anne in Kanada, wo sie noch bis 1992 in Betrieb stand.

1974 erbaute man im Schweizer Dietlikon eine zweite Teststrecke.

Zur Bundesgartenschau 1975 in Mannheim wurde zwischen den beiden Ausstellungsteilen Luisenpark und Herzogenriedpark eine 2,8 Kilometer lange Strecke errichtet. Bei einer der ersten Probefahrten musste der damalige Mannheimer Bürgermeister Ludwig Ratzel wegen eines technischen Defekts mühsam mit einer Drehleiter aus einer stehengebliebenen Bahn befreit werden. Der Betrieb während der Bundesgartenschau verlief danach jedoch reibungslos, nicht zuletzt auch wegen täglicher Testfahrten vor Betriebsbeginn. Die acht Wagen transportierten in der Zeit vom 18. April bis 19. Oktober 1975 insgesamt 2,2 Millionen Besucher.[1] Längster freitragender Abschnitt war die Neckarquerung unmittelbar östlich der Kurpfalzbrücke. Die Strecke wurde nur während dieser Ausstellung befahren, und nach Beendigung der Betriebserlaubnis 1976 bis auf ein 600 Meter langes Teilstück abgebaut. Das verbleibende Teilstück diente der damaligen Studiengesellschaft „Hochbahn Mannheim“, an der auch die Mannheimer Verkehrsbetriebe MVV beteiligt waren, als einbahnige Versuchsstrecke. Hierzu wurde die Trasse für rund 1,2 Millionen Deutsche Mark (circa 600.000 Euro) umgebaut. Das Tragkabel wurde durch Aluminiumschienen ersetzt, die einen ruhigeren Lauf gewährleisten sollten. Bei möglicher Finanzierung und einer Bewährung des Systems war die Erschließung weiterer Stadtteile mit diesem verbesserten Aerobus-System geplant. Da sich die Hoffnungen jedoch zerschlugen, wurde der nichtöffentliche Testbetrieb 1979 eingestellt und die restliche Trasse 1987 komplett demontiert und verschrottet.

2000 schloss man mit der Stadt Chongqing in der Volksrepublik China ein Abkommen über eine 2,6

Kilometer lange Installation. Zu einer Verwirklichung kam es bisher jedoch nicht.
2004 folgte ein Abkommen mit der ebenfalls chinesischen Stadt Weihai über eine 4,2 Kilometer lange Installation. Diese führt überwiegend über Wasser und soll an neun bis zu 100 Meter hohen Pylonen aufgehängt werden. Die Wagen selbst sollen in einer Höhe von 50 Metern verkehren, um auch großen Meeresschiffen die Passage zu ermöglichen.[2] Die Finanzierung des Projekts in Weihai ist seit 2006 gesichert, die Inbetriebnahme war ursprünglich für 2008 vorgesehen."[1]

„Aerobus Mannheim Buga 1975

[1] Wikipedia: Seite „Aerobus". In: Wikipedia, Die freie Enzyklopädie. Bearbeitungsstand: 14. November 2010, 12:10 UTC. URL: http://de.wikipedia.org/w/index.php?title=Aerobus&oldid=81494658 (Abgerufen: 5. Februar 2011, 18:12 UTC) Versions-ID der Seite: 81494658.

Während der Bundesgartenschau 1975 verband der Aerobus die beiden Ausstellungsgelände Luisenpark am südlichen Neckarufer und Herzogenriedpark nördlich des Neckars. Die 8 Fahrzeuge transportierten in der Zeit vom 18.4.1975 bis 19.10.1975 insgesamt 2,2 Millionen Besucher. Das Tragseil war nach oben gespannt und senkte sich unter Last in die Waagrechte. Auf nebenstehender Aufnahme (OEG Bahnhof Kurpfalzbrücke) sind die beiden Fahrdrähte zur Antriebsstromversorgung oberhalb der Tragbahn zu erkennen.


BUNDESGARTENSCHAU
MANNHEIM
© Klaus Rothenhöfer 2003

Am alten Meßplatz - heute Alte Feuerwache - mit Tw 347

Übergang Kurpfalzbrücke Alter Meßplatz

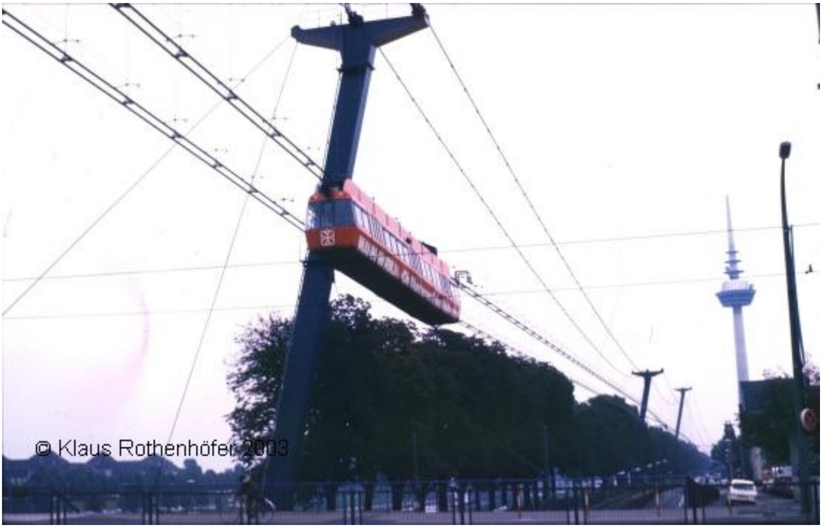
Max-Joseph-Straße

Max-Joseph-Straße

Südliches Neckarufer - OEG Strecke Mhm Kurpfalzbrücke – Heidelberg


Mannheim
Mannheim
© Klaus Rothenhöfer 2003


© Klaus Rothenhöfer 2003



Südliches Neckarufer - OEG Strecke Mhm Kur-pfalzbrücke – Heidelberg

Inzwischen in amerikanischen Händen erlebt der Aerobus in China eine Renaissance. In der chinesischen Stadt Weihei wird der Aerobus ab 2008 die Stadt mit einer vorgelagerten Insel verbinden. Mehr

Düwags in der Metropolregion Rhein-Neckar - 100 Straßenbahnbetriebe - Veröffentlichungen und Pressestimmen“[1]

„IM FERNEN OSTEN

Schweben in Japan und China

Bei japanischen Schwebebahnbetrieben planen Ingenieure neue Wagen und in China interessiert man sich für ein Schweizer System.

FREIE SICHT IN CHIBA

[1] Rothenhöfer, Klaus: Aerobus Mannheim Buga 1975, abgerufen am 5. 2. 2011, in: < http://www.rothenhoefer-wiesloch.de/bahn/Aerobus.html >.

In Japan „schwebt" die längste Bahn seit 1988 in der Stadt Chiba. Diese heißt übersetzt „Tausend Blätter" und liegt gut 20 Kilometer von Tokio entfernt. Dort gibt es inzwischen eine zweite Monorailstrecke, die das System auf insgesamt 15,5 Kilometer und 21 Haltestellen verlängert. Eine Erweiterung des Netzes auf 40 Kilometer ist geplant. Angesichts hoher Fahrgastzahlen und auch älter werdender Fahrzeuge präsentierte jetzt das Unternehmen Mitsubishi Pläne für eine neue Wagengeneration. Der „O-Typ" verspricht einige Besonderheiten für die Kunden im Land der aufgehenden Sonne. Die seitlich versetzte Fahrerkabine erlaubt den Reisenden einen freien Blick, im Fußboden eingelassene Fenster lassen einen neuen Fahrspaß wie in einem Glasbodenboot erwarten. Die ersten neuen Wagen sollen ab 2009 in Betrieb gehen.

CRYSTAL FLYER

Zusätzlich zeigt Mitsubishi einen zweiten Wagentyp namens „Crystal Flyer". Die ebenfalls mit einem Gelenk versehenen Wagen entsprechen der bekannten Konzeption der vorhandenen Züge von Chiba und Shonan. Aber auch hier legten die Entwickler ein futuristisches Design vor. Die Shonan-Bahn fährt in der Stadt Kamakura seit 1970. Bei einer Länge von 6,6 Kilometern erreichen die Züge bis zu 75 km/h.

ÜBER DEN WELLEN

Der Schweizer Gerhard Miller baute erstmals 1970 sein „Aerobus"-System als Teststrecke in Schmerikon am Zürichsee auf. Anders als in Wuppertal gibt es kein starres stählernes Gerüst, sondern einen Fahrweg aus Aluminium, der wie eine Hängebrücke an Pylonen aufgehängt ist. 1975 konnten die Besucher der Bundesgartenschau in Mannheim mit dem Aerobus über das Areal schweben. Nach einer langen Pause meldet sich die heutige Firma Aerobus International mit Sitz in Houston, Texas, zurück. Sie baut in der Stadt Weihai (Volksrepublik China) eine 4,2 Kilometer lange Bahn, die über eine Bucht führt und an insgesamt neun Pylonen aufgehängt ist, die bis zu einer Höhe von 100 Metern in den Himmel ragen. Die Wagen schweben bis zu 50 Meter über dem Ozean, damit auch große Schiffe darunter verkehren können! Die Konstrukteure haben eine Kapazität von 5000 Fahrgästen stündlich je Richtung vorgesehen – am Tag rechnet man mit bis zu 24.000 Kunden, die bei einer Höchstgeschwindigkeit von 80 Kilometern in der Stunde in nur 15 Minuten hin- und zurückfahren könnten. Drei Stationen sind vorgesehen, die mittlere davon heißt Weihai Star. Per Aufzug kann man hier eine Aussichtsplattform in 208 Metern Höhe erreichen. Die Inbetriebnahme der neuen Schwebebahn soll Anfang Juli 2008 erfolgen – rechtzeitig zu den Olympischen Spielen in China!

In 50 Metern Höhe über

der Bucht von Weihai

schweben – das soll für

die Besucher der Olympischen

Spiele im nächsten

Jahr Wirklichkeit werden.

wsw information Ausgabe 130 September 2007“[1]

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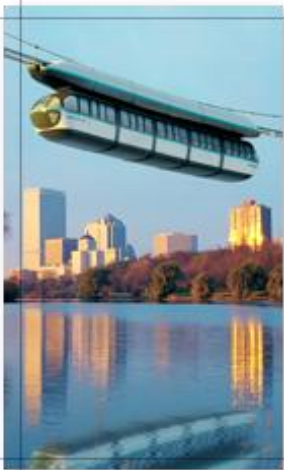
[1] WSW: **Probeausbau am Hardtufer**, abgerufen am 5. 2. 2011, in: **wsw** information Ausgabe 130 September 2007 < http://www.wsw-online.de/unternehmen/Download/wsw-Info/130 >.



„A self-propelled vehicle speeds silently through the sky carrying 300 passengers. Riding high above congested freeway or gliding over rivers and other impassable barriers, it is the last word in transit technology.

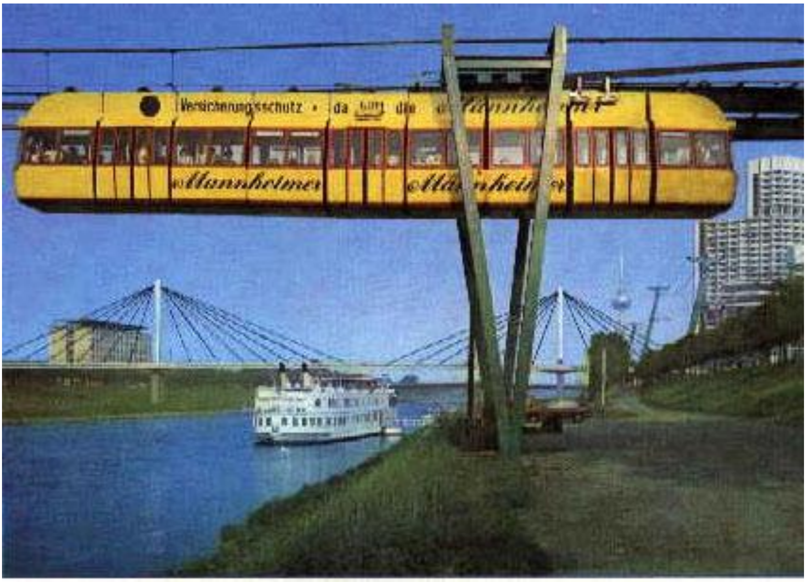
Called Aerobus, this proven system is economical to install, environmentally friendly, and pollution-free.

Utilizing a patented cable suspension concept, Aerobus is the only solution for certain difficult alignments. And Aerobus may be configured to move people or cargo.

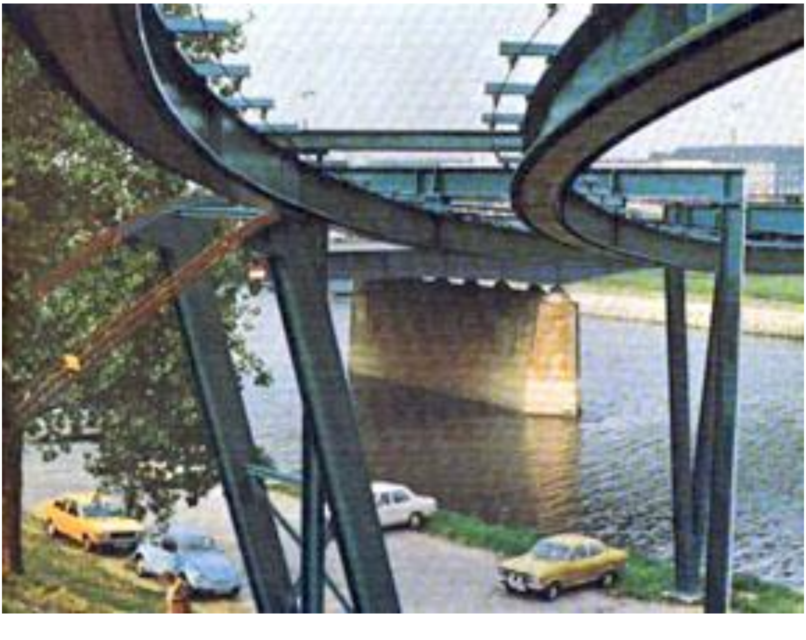
Aerobus installations have operated safely and reliably for millions of passenger miles and have been favorably evaluated by specialists working for the U.S. Department of Transportation.“[1]

„These photos were printed originally in the *Aerobus-Revue*, #2, the official publication of the International Aerobus Association (IAA) in January, 1976. Shown below are six photos taken in of an Aerobus installation in Mannheim, Germany. Four additional photos are also available, two of an installation in Quebec and two more from Mannheim.

[1] **Aerobus: Riding high above ist all. Aerobus, abgerufen am 5. 2. 2011, in: < http://www.aerobus.com/ >.**


Versicherungsschutz
Mannheimer


Mannheimer
BUNDESGARTENSCHA
MANNHEIM 1975



HOME

Last modified: March 24, 1999“[1]

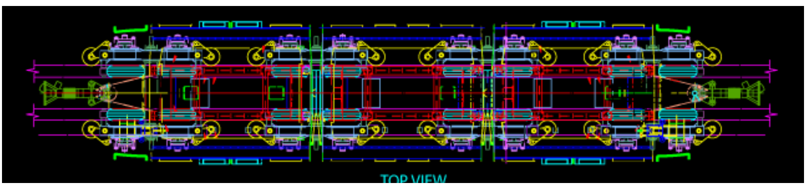
„In many ways the quality of a company may be juded by the quality of the business parnters associated with that company. Aerobus is proud of

[1] washington.edu: Gallery of Aerobus Photos, **Last modified: March 24, 1999**, in: < http://faculty.washington.edu/jbs/itrans/aerob1.htm >.

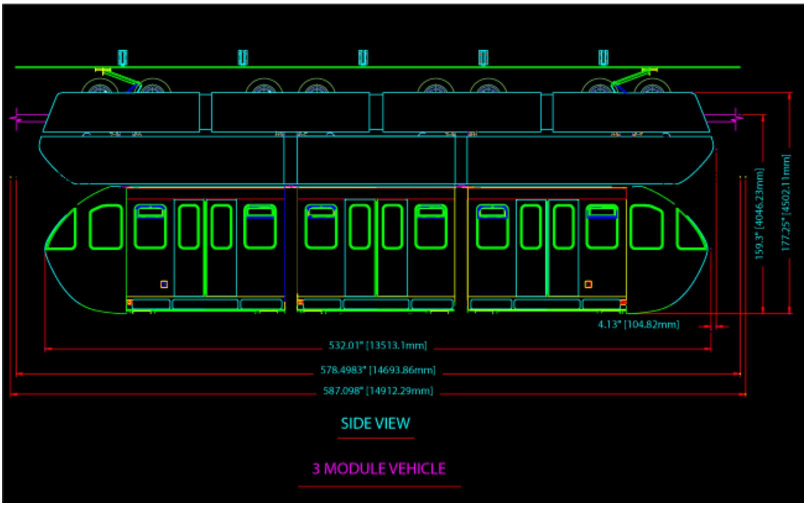
its affiliations with these outsdanding individuals and organizations:

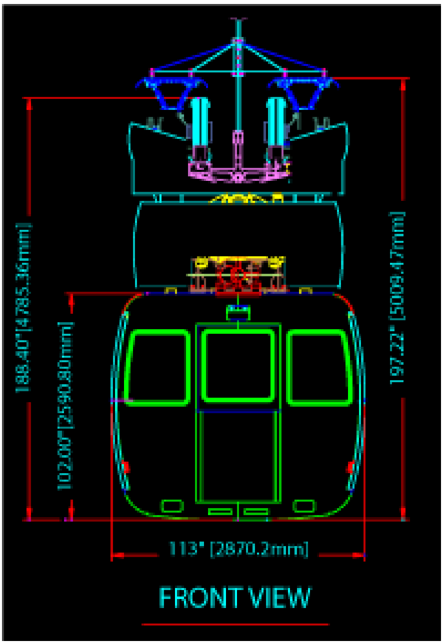
POL-X West – POL-X West is the engineering design group which design the support guideway system and the bogeys for the Aerobus system. This group has extensive experience in tramway design as well as cable supported bridges.

TPI Composites Inc. – TPI is a high technology specialty group which builds the composite vehicle bodies for the Aerobus system. TPI’s transportation group has built several composite body vehicles for monorails and light rail systems. The use of composites allows for great strength and weight savings.“[1]



[1] **Aerobus: Aerobus ist proud of it affiliation, abgerufen am 5. 2. 2011, in: < http://www.aerobus.com/partners.html >.**


159.3" [4046.23mm]
177.25" [4502.11mm]
4.13" [104.82mm]
532.01" [13513.1mm]
578.4983" [14693.86mm]
587.098" [14912.29mm]
SIDE VIEW
3 MODULE VEHICLE


188.40"[4785.36mm]
102.00"[2590.80mm]
197.22" [5009.47mm]
113" [2870.2mm]
FRONT VIEW

Look inside.

The following schematics are provided to allow visualization of selected Aerobus system components[1].

„Aerobus technology throughout the world.
Aerobus technology is recognized and respected throughout the world. Today's Aerobus is the result of a consistent, ongoing engineering and research activity.

The following provides a timeline of Aerobus installations. Currently, Aerobus has projects in va-

[1] **Aerobus: Look inside, abgerufen am 5. 2. 2011, in: < http://www.aerobus.com/engineering.html >.**

rious stages of development in the United States, China and South Korea.

Swerikon, Switzerland / 1970 ~ 1974

Serving as a people mover on an ecological reserve, this first Aerobus installation tested long spans and the feasibility of a portable pylon floating on a lake. After a series of successes, the entire system was sold and moved to a ski resort in Canada.“[1]

Swerikon, Switzerland / 1970 ~ 1974

Serving as a people mover on an ecological reserve, this first Aerobus installation tested long spans and the feasibility of a portable pylon floating on a lake. After a series of successes, the entire system was sold and moved to a ski resort

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[1] **Aerobus: Look inside, abgerufen am 5. 2. 2011, in: < http://www.aerobus.com/engineering.html >.**

in Canada.

Ste. Anne, Quebec, Canada / 1975 ~ 1992

Expanded to a suspended guideway length of 820 meters, about one-half mile, the system carried patrons of a ski area from their lodges to the lifts in all weather conditions. In May 1981, the Urban Mass Transportation Administration (UMTA), part of the U.S. Department of Transportation, inspected the operation and produced a most favorable report on the system.

Dietlikon, Switzerland / 1974

A 500-meter circular track was designed to perfect an upgraded, articulated vehicle. Trials resulted in the design used for the Mannheim, Germany, installation.

Mannheim, Germany / 1975

The 2.8 kilometer Aerobus guideway crossed the Neckar River, linking two parking sites of the Bundesgartenschau, or Federal Garden Show, in Mannheim, Germany. During a six-month period between April 1 and October 19, when the show ended, more than 2.5 million passengers rode the system without incident.

US Government system evaluation / 1975

The Urban Mass Trans- portation Administration (UMTA), an agency of the U.S. Department of Transportation, sent an independent engineering firm to Mannheim, Germany, for the purpose of evaluating the Aerobus system. Their highly favorable assessment, called the UMTA report, was released later that same year.

Dietlikon, Switzerland / 1980 ~ 1983

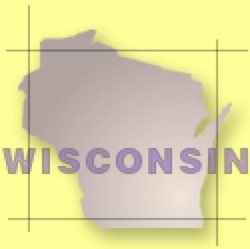
An 8.3 kilometer development track with a 12% grade to further refine the Mannheim system, was planned and constructed. This guideway was the first to use aluminum rails fitted over the cables to provide a smoother ride. The first all-wheel-drive vehicle was also developed and improved.

US Government system evaluation / 1981

In May 1981, the Urban Mass Transportation Administration (UMTA), inspected the Ste. Anne, Quebec, Canada, operation and produced another very favorable report on the system.

United States / 1989

Aerobus was named a winning technology in the U.S. Government-sponsored competition for a light rail system to be constructed in the city of Milwaukee, Wisconsin, USA. Long-term financing commitments are now being sought.



United States / 1990

Aerobus management committed necessary funding for a multi-stage product enhancement project. This continuing effort has expanded the Aerobus design envelope and assures that Aerobus engineering takes full advantage of all advances in the field.

SEE "In the news" FOR LATEST INFORMATION[1]

„Read all abaut Aerobus.

Final approval given to complete Weihai Project

Aerobus Intenational announces commencement of major transit project in China

[1] Aerobus: Look inside, abgerufen am 5. 2. 2011, in: < http://www.aerobus.com/engineering.html >.

Weihai, Liugong Island, Aerobus Transit Project[1]

[1] Aerobus: Read all abaut Aerobus, abgerufen am 5. 2. 2011, ©2006 Aerobus International, Inc., in: < http://www.aerobus.com/weihai-news.html >.

„Chaotic traffic, potholed streets, and a chronic lack of parking space are all challenges to making urban life more pleasant and appealing. Some form of mass transit, to move people from one point to another, is a vital ingredient in our efforts to overcome these serious problems.

Decades ago, transportation authorities in some major population centers decided to reduce surface traffic by burying rail systems beneath the ground. This proved to be a very expensive solution. New York City, for example, has nearly 650 miles of subterranean track, built at a cost, in today's dollars, of $150 million per mile!

Subways, for the most part, are no longer affordable.

As an alternative, metropolitan areas have returned to horse and buggy days by reintroducing what amounts to modernized streetcars. Under the euphemistic name of "light rail," these lines perform worse today than in the 1920s in terms of clogging traffic at intersections and hogging valuable lanes of downtown streets.

The other conventional answer, monorail, lifts vehicles above the ground by using archaic steel tracks laid atop endless rows of concrete or steel pillars spaced 60 or so feet apart. These massive, unsightly supports require an entire lane of major thoroughfares, preclude installations along existing right-of-ways, and are expensive. Monorails typically cost $100 million or more per mile.

We at Aerobus think modern transit should not interfere with surface activities. We concur with the concept of rising above grade. We also believe a system must be environmentally sound, relatively inexpensive to install, economical to operate, and fun to ride.

Aerobus technology fulfills these criteria and offers three substantial advantages over ordinary monorails. **The first is cost.**

Aerobus Cost Comparison

Mass Transit Option	**Cost Per Mile**
Subway	$300 million+
Heavy Rail	$150 million+
Light Rail	$100-150 million+
Monorail	$75-100 million+
Aerobus	**$15-30 million**

Aerobus spans up to 2,000 feet (600+ meters) between thin steel or concrete pylons which require only a small footprint. Compared to standard monorail supports, these pylons cost less, and fewer are required for a given line. This makes it possible to construct a route capable of carrying from 3,000 to 20,000 passengers per hour per direction for a price as much as 60 percent less than regular monorail systems.

Long, straight runs, possible because Aerobus passes over obstructions, can have as much as an 8 percent grade and deliver speeds in excess of 50 miles per hour. Gentle turns of two or three degrees may be made at each pylon. Sharper turns are easily handled by transitioning from cable-suspended track to a fixed steel rail and then back to suspended track. These capabilities allow for selecting the shortest, most efficient route from one point to another. Which again lowers costs.

Additional savings are possible during construction. Erecting typical elevated guideways frequently requires relocation of existing underground utilities. Aerobus installations do away with this expensive problem. And with Aerobus, street closures are minimized.

All of this gives Aerobus a significant cost advantage.

The second Aerobus advantage also stems from its long-span feature.

An Aerobus line may cross wide rivers, bridge ravines, run up mountain sides, or traverse swamp land. In fact, for some installations, Aerobus is the only practical mass transit option.

The final Aerobus advantage is related to costs but centers on grade-level disruption during construction and the use of existing right-of-ways.

An Aerobus route can be erected above or along-side freeways, bridges, and heavy rail lines. Thin-ner pylons, fewer supports per mile, and smaller pylon footprints allow construction with little or no interruption of normal traffic flows.

These advantages, along with better aesthetics, the fun factor, faster passages, and operational economies, make Aerobus the outstanding mass transit solution for almost every situation.“[1]

„The tested and proven Aerobus technology lo-wers system installation costs and provides grea-ter route flexibility.

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[1] Aerobus: Consider these three substatial advantages, abgerufen am 5. 2. 2011, ©2006 Aerobus International, Inc., in: < http://www.aerobus.com/advantages.html >.

In place of a conventional monorail's massive, un-sightly concrete support pillars, Aerobus utilizes slender steel pylons to elevate suspension cables, similar to those used in the Golden Gate Bridge.

These cables, in turn, support dedicated, very lightweight, fixed cable guideways that allow electric, self-propelled vehicles to operate at any desired height above surrounding terrain.

Using patented Aerobus technology, the pylons may be placed as far as 2,000 feet (600+ meters) apart. This distance between supports is more than 15 times greater than other elevated systems.

Why is this important?

Simple. The fewer the support points, the lower the cost of construction. Which substantially reduces the price of an entire project. Lowering the number of support points also means less visual clutter and a reduced number of ground-level obstructions.

Further savings are realized by the fact that fabricating and erecting Aerobus pylons are less expensive, unit for unit, than constructing and installing traditional concrete or steel support posts.

Aerobus offers the only tested, proven solution for many difficult transit applications.

Perhaps the most important benefit derived from widely-spaced pylons, though, is unparalleled flexibility. Aerobus guideways can span lakes, rivers, wetlands, and deep canyons. Those same guideways may be elevated to any specified height. So Aerobus can be routed over freeways, buildings, rail yards, power lines, and impediments that block the path of other transit options. This allows designers to plan the shortest, most efficient routes, reducing total project costs even more.

No other transit technology can match this unique Aerobus capability

Aerobus provides a proven, reliable technology. Aerobus installations have operated safely and reliably for millions of passenger miles. On two separate occasions, operating Aerobus systems were evaluated by transit specialists working for the U.S. Department of Transportation, Urban Mass Transportation Administration. Both glowing reports recognized the advantages and value inherent in Aerobus technology.

The Aerobus construction of the Weihai Project in China brings to light these unique aspects that will soon be realized by millions.“[1]

„Aerobus is a suspended light rail transit system.

Aerobus moves people or cargo in both urban and suburban settings. The proven Aerobus technolo-

[1] Aerobus: It’s what you don‘t see!, abgerufen am 5. 2. 2011, ©2006 Aerobus International, Inc., in: < http://www.aerobus.com/features.html >.

gy, which does not congest streets or contaminate the air, is a dramatic advancement of the conventional monorail concept. Based on engineering principles which have withstood the test of time, Aerobus is the mass transit mode for the next century.

Aerobus is:

- Elevated and unobtrusive
- Quiet and pollution-free
- Safe and comfortable
- Reliable
- Low maintenance
- Flexible in terms of passenger capacity
- and a proven mass transit system

The heart of the Aerobus system is an elevated aluminum track or guideway. This is hung from a prestressed cable by a suspension system like the one used to support the Golden Gate Bridge. Thin pylons of any desired height lift the cable into the air to form a pathway in the sky which can go over obstacles that stop conventional monorails.

Aerobus vehicles are modular. From two to eight modules may be linked, providing a carrying capacity between 80 and 320 passengers. Top-suspended, Aerobus vehicles run on rubber tires which roll quietly on the aluminum tracks to deliver a ride of unparalleled smoothness.

Each vehicle is self-propelled by safe, environmentally clean electric motors. Where needed, articulated vehicles may be used to permit tight turns in crowded or space-cramped settings.

Because of its unique design, Aerobus offers significant cost savings over other technologies. Only Aerobus can span distances up to 2,000 feet between pylons. So in place of 60 to 100 traditional concrete or steel supports per mile, Aerobus uses between 5 and 10 to hold up either a single or double lane layout. Fewer supports equal lower installation expense as well as less visual clutter and reduced right of way requirements.

And Aerobus rises above congestion. An Aerobus line may cross over highway interchanges, run down the center of existing freeways without impeding normal traffic flow, or bridge a river. Which means the shortest distance between two points is Aerobus. And the shorter the route, the lower the price.

Best of all, Aerobus delivers a high level of user satisfaction. The practical, secure ride is also fun, which encourages people to use mass transportation.

Each Aerobus installation is custom-designed to meet individual community requirements. The number of stations, station size, the use of single or double lanes, car configuration, and fully automated or manual control are only a few of the options which can be tailored to fit specific operating conditions.

In short, Aerobus offers flexible, clean, and unobtrusive transit for the 21st century. Compared to other alternatives, Aerobus requires less initial investment and operates at a lower cost. So when you think monorail, think of Aerobus."[1]

„Gerhard Mueller – the dreator of Aerobus

[1] Aerobus: Aerobus is a suspended light rail transit system, abgerufen am 5. 2. 2011, ©2006 Aerobus International, Inc., in: < http://www.aerobus.com/about.html >.

The Aerobus' alternative to traditional modes of transportation had its origin during the early 1970's in Switzerland.

Since then, Aerobus has undergone major patented engineering advances. This multi-million dollar modernization resulted in a sophisticated technology which exceeds its inventor's most optimistic dreams.

Aerobus emerged from the genius of Gerhard Mueller, whose company designed and manufactured conventional aerial ropeway systems. His restless creative mind led to experimenting with a new cable suspended transport system which he called Aerobus.

The initial successful testing of Mueller's Aerobus occurred in Zurich. So impressive was the environmentally safe demonstration that the Swiss government allowed the system to run through an ecological reserve.

Subsequently, an installation was sold in Canada where Aerobus operated at a ski resort. Later a two mile system was installed at the horticulture exposition in Mannheim, Germany, where 2.5 million passengers enjoyed a scenic Aerobus' ride through the city center and across the Neckar River. After six months of uninterrupted performance, as previously planned, the system was dismantled.

The Mannheim experience provided valuable data to support Mueller's constant drive to perfect his new technology, utilizing a test track in Switzerland, he moved Aerobus into a higher stage of development and acceptance.

His instincts and engineering improvements established a technology which became attractive to Vevey Engineering Works, Ltd., an internationally known manufacturer of railway cars and trams. Vevey acquired Aerobus from Mueller.

Vevey's marketing activities exposed Aerobus technology worldwide. For example, construction of a system in Kuala Lumpur, Malaysia, was commenced but discontinued when final financing failed. Contemporaneously, a highly successful Houston businessman, became interested in the uniqueness of the Aerobus system. In 1987, and acquired Vevey's rights to Aerobus technology and patents, including the engineering studies, drawings and other materials supporting Aerobus development and marketing.

It was not, however, until Aerobus received an invitation in 1992 to participate in a U.S. Government program involving suspended light rail transit, that it was decided to move Aerobus into a final stage of development.

Based upon consultations with knowledgeable U.S. and European transit industry engineers, Aerobus committed the necessary financial resources to organize and sustain an exhaustive final design and engineering effort to bring Aerobus technology up to the highest standards of the international transit community. This determination and investment produced an Aerobus system with phenomenal capabilities.

During this process, the fundamental distinguishing characteristics of Mueller's innovative technology were retained and improved. New patents were applied for, particularly on guideway features, and most importantly, Aerobus' cost-effectiveness, was assured.

Two highly favorable reports on Aerobus deserve to be mentioned. The first was an assessment of Mueller's technology by the U.S. Department of Transportation's Urban Mass Transportation Administration ("UMTA") (later named Federal Transit Administration). UMTA's report, based upon the successful use of Aerobus in Mannheim during 1975, assessed the innovative technology and how its characteristics related to improved forms of urban transportation.

UMTA's conclusion was that Aerobus offered a viable solution to urban transit problems.

In 1992, the Federal Transit Administration originated a $30 million competition to evaluate new transit technologies. A total of 17 local governments in various states participated by examining different concepts and submitting plans for an installation in their respective areas.

Among others, Milwaukee County selected Aerobus as the favored suspended light rail technology. Milwaukee was then awarded part of a $1 million grant to develop a definitive transit program. The two-volume Aerobus-Milwaukee report was selected as one of three finalist proposals.

To date Congress has not yet funded the $30 million award. Of the final three, however, Aerobus is the only tested and proven technology. The other two remain in an untried, conceptual state.

Aerobus development from Mueller's earliest concepts to the important advanced engineering period of the current ownership, has produced a transportation technology which meets the most demanding requirements of the 21st Century.“[1]

„SISTEM TRANSIT AERO REL MELAKA

[1] Aerobus: Gerhard Mueller – the dreator of Aerobus, abgerufen am 5. 2. 2011, ©2006 Aerobus International, Inc., in: < http://www.aerobus.com/history.html >.

Aerorail Melaka Station Model

Illustration of Aerobus Train On The Road Median

COMING SOON TO MELAKA HISTORICAL CITY, MALAYSIA"[1]

„**Have your say on aerorail project**

By CHEN PELF YEEN [...]

MALACCA: Members of the public have three months to give their views or raise objections over the proposed RM1.5bil aerorail project that connects Ayer Keroh to Melaka Sentral.

Chief Minister Datuk Seri Mohd Ali Rustam said details of the proposed project have been on display at the Malacca Historic City Council's Graha Makmur foyer in Ayer Keroh since June 23.

"The display will be up until Sept 23 and members of the public will have the opportunity to give

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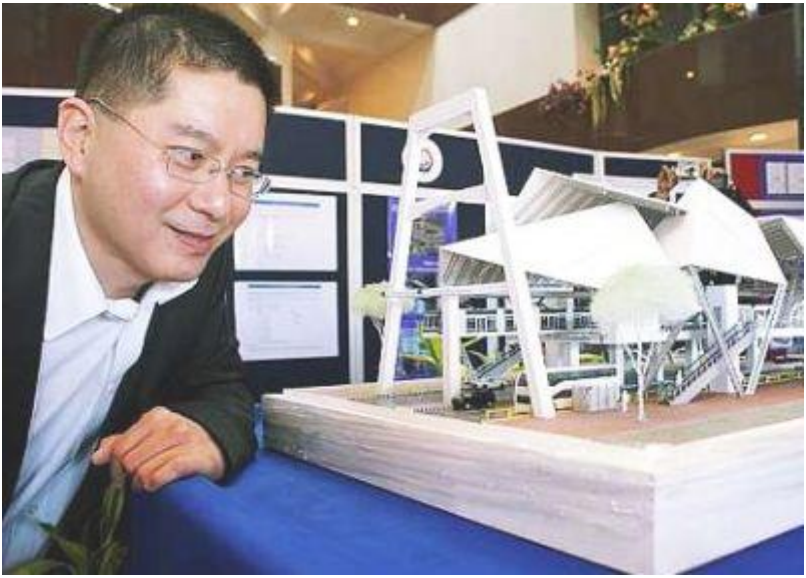
[1] SMILE: Illustration of Aerobus Train On The Road Median, Friday, July 17, 2009, POSTED BY SMILE AT 4:00 AM, in: < http://jee2ice.blogspot.com/2009_07_01_archive.html >.

feedback on the proposed project during the period," he said after visiting the display of the proposed aerorail project here recently.

He said the response has been encouraging with 60 people giving positive comments two days after the display was put up.



A beauty: Lim taking a closer look at the aerorail model in the Malacca Historic City Council Graha Makmur's foyer recently.

The aerorail project, tipped to be the first of its kind in South East Asia, will have 10 stations and cover 18.4km of routes.

Development of the project covers two phases, with Phase I covering 9.6km from Jalan Tun Ali to Melaka Mall while Phase II covers 8.8km from Multimedia University to the Malacca Zoo.

Meanwhile, Pyramid Express Sdn Bhd managing director Datuk Lim Sue Beng said work on the aerorail would commence once the company obtains necessary approval from the Transport Ministry.

“Phase 1, involving seven stations, is scheduled for completion in 2013 while three more stations under Phase II is set for completion in 2016,” he said, adding that the aerorail would be able to transport between 2,000 and 4,500 passengers per hour per direction.

Each train, he said, would be able to accommodate 40-seated passengers to a maximum of 200 passengers while travelling at 40km an hour from station to station.

Lim said upon completion, there would be service apartments, hotels and restaurants including levelled parking at each station.“[1]

„A closer look at the Aerorail site reveals the following technical drawings of the Aerorail train, a section of the suspension tower, and various cross sections of the routes. All images are from Aerorail.net.

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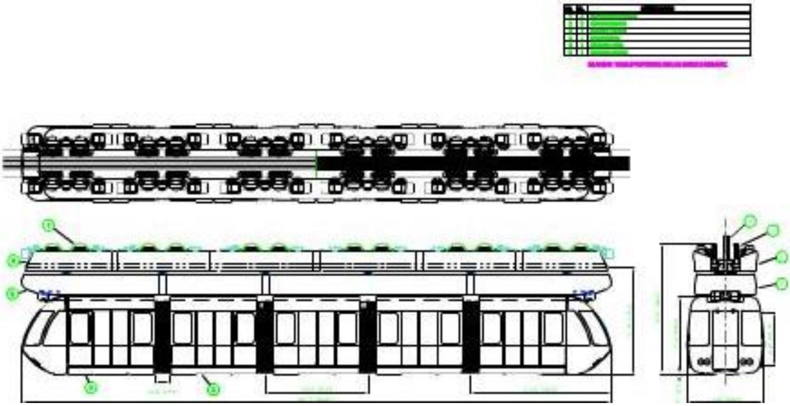
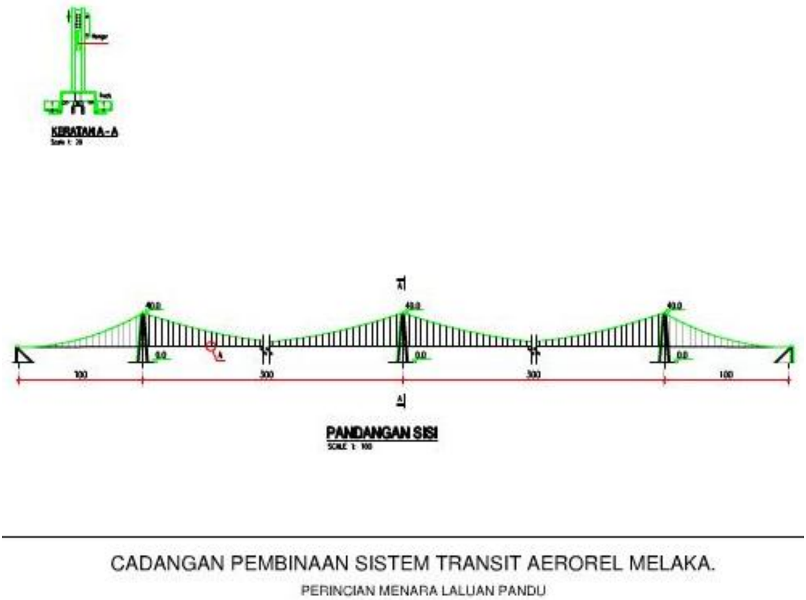
[1] CHEN PELF YEEN: Have your say on aerorail project, Friday July 3, 2009, in: < http://thestar.com.my/metro/story.asp?file=/2009/7/3/southneast/4221243&sec=southneast >.



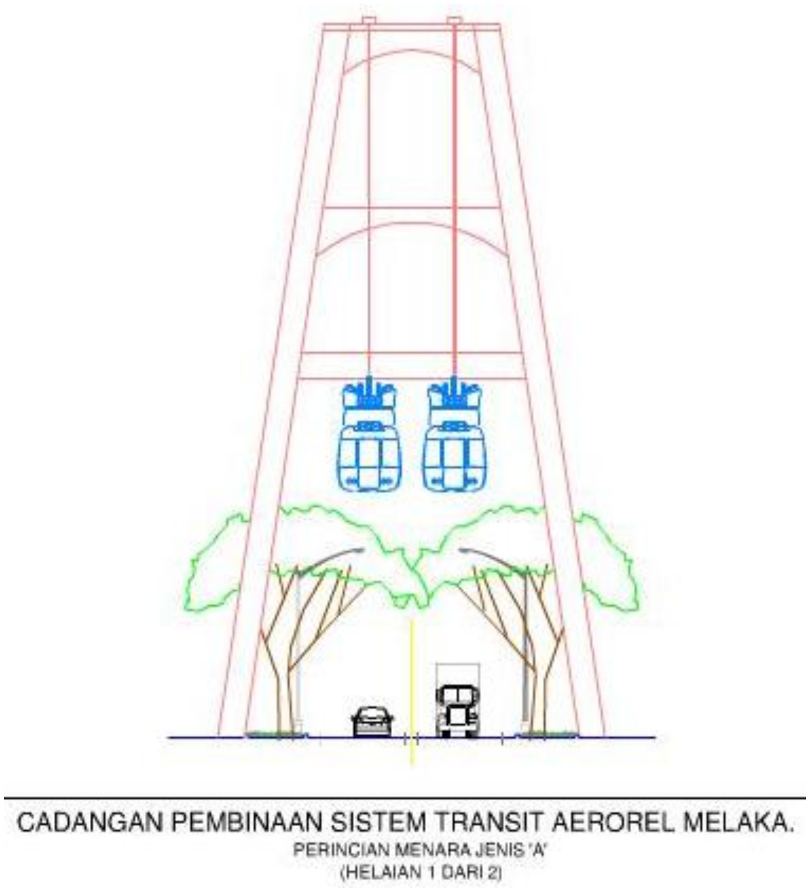
CADANGAN PEMBINAAN SISTEM TRANSIT AERORAIL MELAKA

LUKSAN TERPERNCI

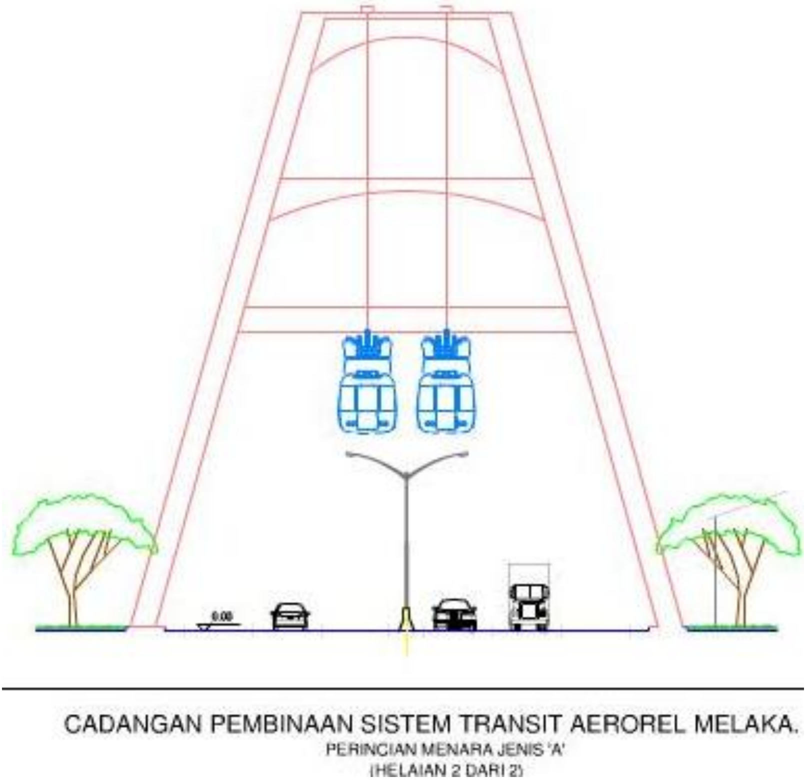
Aerorail Design



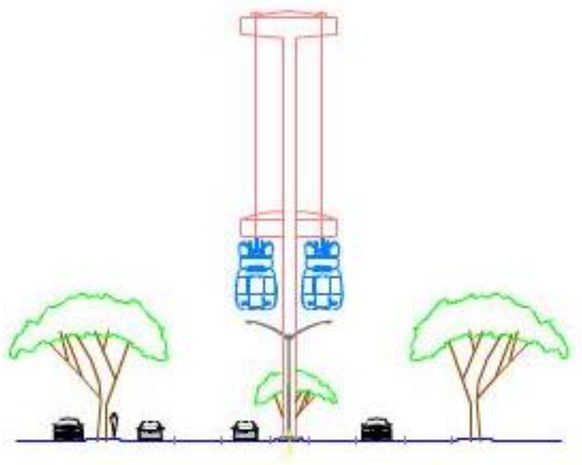
A diagram showing a section of Aerorail suspension structure – like a suspension bridge over land.



One type of “A” Frame tower – used for travel over narrower roads (e.g. in Ayer Keroh, Peringgit)



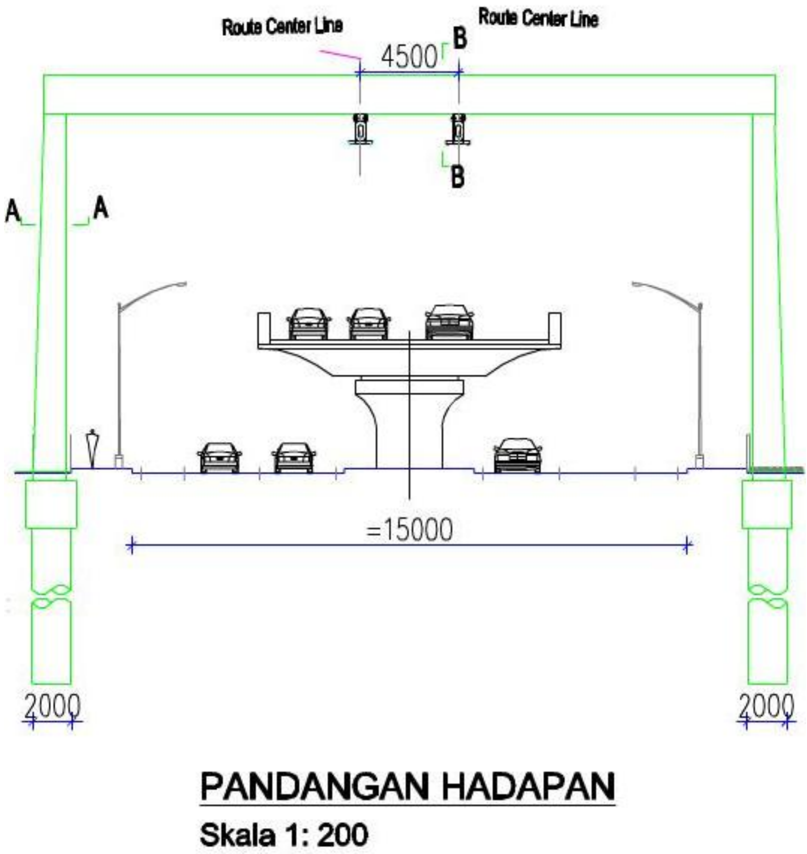
Second type of “A” Frame tower – for use on wider roads



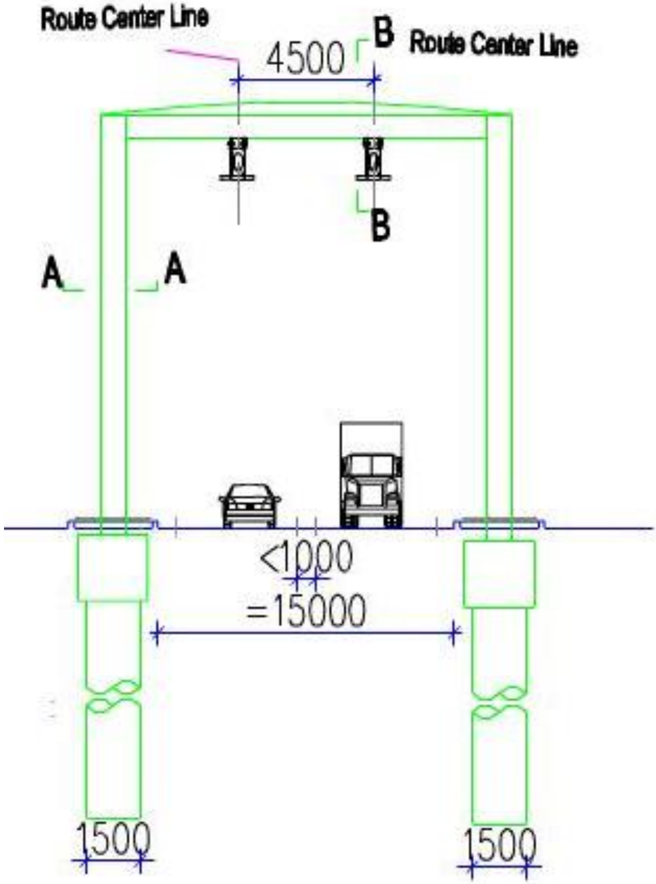
CADANGAN PEMBINAAN SISTEM TRANSIT AERORAIL MELAKA.

PERINCIAN MENARA JENIS 'T'

“T” Frame tower for use on wide roads (e.g. Jalan Tun Razak)



Inverted “U” Frame over a flyover (at Jalan Tun Razak?)



PANDANGAN HADAPAN

Skala 1: 200

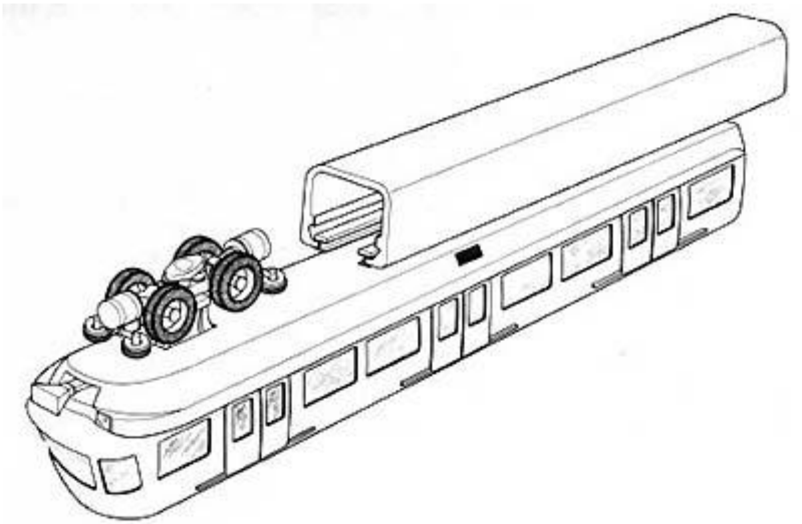
Inverted “U” Frame over a narrow road“ [1]

Safege

„S.A.F.E.G.E. is an acronym and a genre. It stands for **S**ociété **A**nonyme **F**rançaise d'**E**tude de **G**estion et d'**E**ntreprises, and translated to English it means "French Limited Company for the Study of Management and Business." It was a consortium of 25 very impressive companies, including Michelin and Renault. The system was considered as an extension of the subway line to connect Chalenton to Créteil near Paris. Construction of the test track started in April 1959 and lasted un-

[1] transitmy: Malacca Aerorail – Technical Dravings, Posted on June 27, 2009, in: < http://transitmy.org/2009/06/27/malacca-aerorail-technical-drawings/ >.

til April 1960. The exploratory phase lasted until 1967, and demolition took place in 1970-71.“[1]



„The essence of the system was the conversion of the rubber-tired bogie developed for the Paris Metro into a bogie from which the coaches could be suspended to make an aerial railway. The bogie ran inside a hollow box girder on the lower

[1] Monorails: Suspended – SAFEGE, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPSafege.html >.

face of which was a slot through which the suspension gear passed. The system enjoyed the same type of quiet, rapid acceleration and braking as did the Metro and the SAFEGE's ALWEG cousins. The cars were hung on a pendulum type suspension with pneumatic springs, giving stability and comfort even at high speeds.

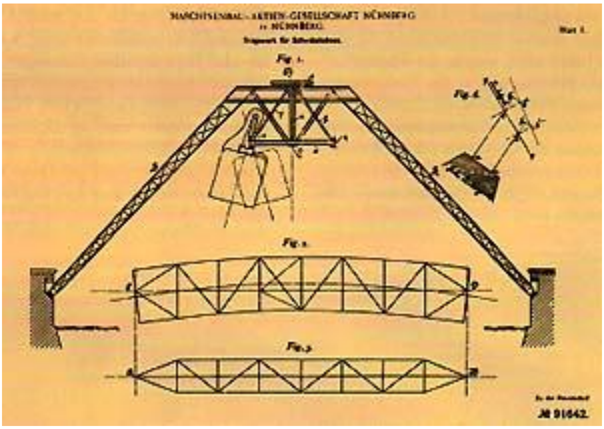
The complete enclosure of the bogies inside the box protected them from the weather, so the system was unaffected by rain, frost or snow. Operation was electric from a third rail also enclosed in the box, preventing accidental electrocution. As on the Paris Metro, steel "emergency" wheels come into play if the tire is accidentally deflated.“ [1]

„Suspended - Double Flanged

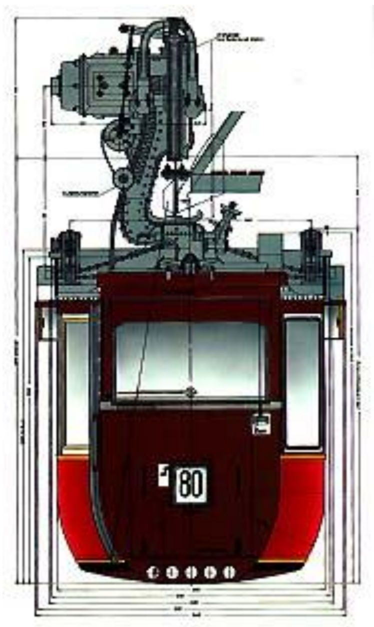
[1] Monorails: Suspended – SAFEGE, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPSafege.html >.

The first successful use of monorail technology in urban transportation was the Schwebebahn (suspended or floating railway) of Wuppertal, Germany. It has been in operation since 1901. Carl Eugene Langen gets credit for the concept, though Albert Charlier had built the "schwebe bicycle" in 1895.

The Wupper River in northern Germany flows though a narrow valley, which was becoming urbanized and congested. Originally, an elevated railway was planned with the support pylons in the middle of the river, but public objections (NIMBYs!) and concerns about flooding scuttled that plan. Since the support for Langen's system would be on the banks and not in the river, and the fact that the cars could swing up to 15 degrees like a pendulum, the system was approved. The first part of the system opened in 1901 and the full 8.3 miles (13.3 km) with 20 stations opened in 1903. The original two car trains weighed 34 (31 metric) tons loaded with 97 passengers. 19,000 tons of iron were used to build the railway framework. The rails are supported by a total of 472 girders.



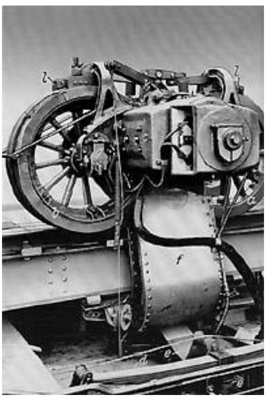
There are two dual-wheeled bogies per car. The double flanged steel wheels run on a single steel rail laid on a girder. Bogies on the original cars had a single motor using a chain to drive both wheels. Current cars use a single motor driving both wheels with worm gears. Reversing at each end of the line is by loop, and a turntable has been installed for short turns. In 1993, between 45,000 and 50,000 people used the Schwebebahn every day. Not bad for a system that's been around for nearly 100 years!



Then.

Now.

The Schwebebahn had a perfect safety record until 1999. On April 12th, 1999, one of the Wuppertal trains fell off its track and plunged into the river below. For the first time in the 98 year history of the Schwebebahn, five people died and 47 were injured. The accident was caused when a contractor that was working on the guideway accidentally left a metal clamp on it. This was not a defect in equipment nor normal operating procedures. Countless people have lost their lives in the last 100 years in train and light rail accidents. Monorail still enjoys an enviable safety record!



The Track:	
Length over the Wupper River	10km
Length above the street in Vohwinkel	3.3km
Minimum radius of curvature	75m
Height above river (normal water level)	12m
Minimum headroom (street to bottom of car)	4.5m
Maximum gradient	4%
Distance between tracks	4m
The Vehicles:	
End-to-end length	24.06m
Length of main cabins	9.7m
Width	2.2m
Height of car (to roof)	2.7m
Internal height	2.1m
Distance between bogies	7.6m
Axle-to-axle length of bogies	1.3m
Diameter of wheels (current)	800mm

Weight-loaded	33.5 metric tons
Weight-empty	22.2 metric tons
Total seats	48
Total SRO	156
Total passenger capacity	204
Width of doors (four per unit)	1.3m
Maximum tilt angle	15 degrees
Running Gear:	
Voltage of traction power supply	600VDC
Interior power supply	24V
Continuous DC control for motion and braking	
Traction motors 4 DC motors/train	4DC motors/train
Traction motor power	50kW
Maximum speed	60km/h (37 mph)
Maximum acceleration rate	1.1m/s
Maximum deceleration rate	1.2m/s

[back to Technical Home Page / back to the Monorail Society Home Page]"[1]

„Suspended - I-Beam

[1] Monorails: Suspended – Double Flanged, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPdoub.html >.

AMF I-Beam monorail at New York World's Fair.

The I-Beam suspended monorail is the most common monorail in the world. If you think that I-beam transit monorails are everywhere because of that statement, you are mistaken. We are referring to the I-Beam industrial monorail. The simplicity of the design, a guideway the shape of a common steel I-Beam with a traveling conveyance suspended below, is used for everything from butcher shops to commercial laundries to move various items efficiently.

Transit I-Beam monorails would seem to be a logical extension of the industrial monorail. However, the history of this type of monorail has been relegated to amusement centers and fairs. It's an I-Beam monorail that carries miniature guests in pirate ships "floating through the air" of Peter Pan's ride at the Disney parks. Busch Gardens once had Arrow Company-built I-Beam monorails at parks in Van Nuys, California and up until recently, Tampa, Florida. I-Beam monorails operated for years at the Los Angeles County Fairgrounds. Perhaps the most famous I-Beam monorail operated for only two years at the New York World's

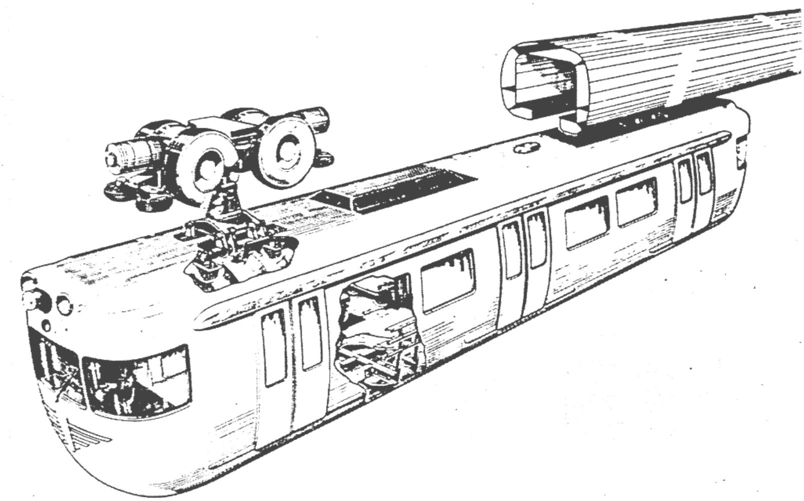
Fair of 1964-65. Arrow supplied the Luxor Hotel in Las Vegas with a suspended I-Beam monorail for a short unsuccessful trouble-plagued run in the early 1990's.

Today we know of only one company still active in the promotion of the I-Beam monorail, Titan Global Systems. Their design for a LIM-powered I-Beam monorail has been around for many years, but unfortunately there are no transit I-Beam systems in existence currently." [1]

„After eight years into the design of the Sky Train concept, a contact with Wilfred Sergeant, Transit Consultant - Karl the originator and web writer, no master here - was informed; that although using steel wheels, that Sky Train had similarities

[1] Monorails: Suspended – I-Beam, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPIbeam.html >.

to the above French prototype, who's technology has been used in both Japan & Germany." [1]



Monorail Safege 1958[2]

„First Monorail

Constructed in 1825 at Cheshunt England

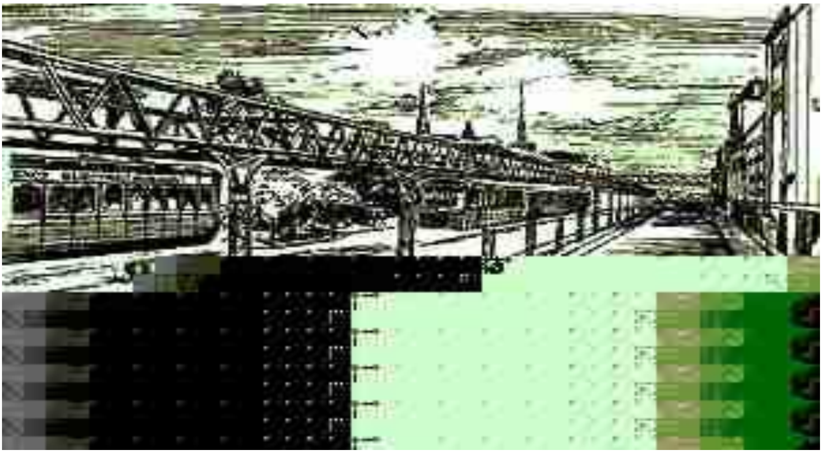
[1] Sky Train: Monorail – Safege 1958, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Duorail 1958 < http://www.skytraincorp.com/ >.
[2] Sky Train: Monorail – Safege 1958, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Duorail 1958 < http://www.skytraincorp.com/ >.

Based on a 1821 patent of Henry Palmer and put into service in 1825 it was designed to carry bricks. For the grand opening they attached a carriage making monorail history in also carrying freight and people.

This is a great example of the low force required to carry weight on steel wheels and rails. It requires 4 pounds (lb) to move 2000lb on steel; 40lb to move it on rubber tires, and 8lb to move it through flight!

It was the oldest monorail listed by "The Monorail Society" and appropriately powered by a real hay eating one horsepower horse!" [1]

„1887 USA



Build on the grounds of the Enos Electric Company in Greenville New Jersey, called the Enos Electric Railway. Build out of light steel construction. It

[1] Sky Train: First Monorail, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Monorail 1825 < http://www.skytraincorp.com/ >.

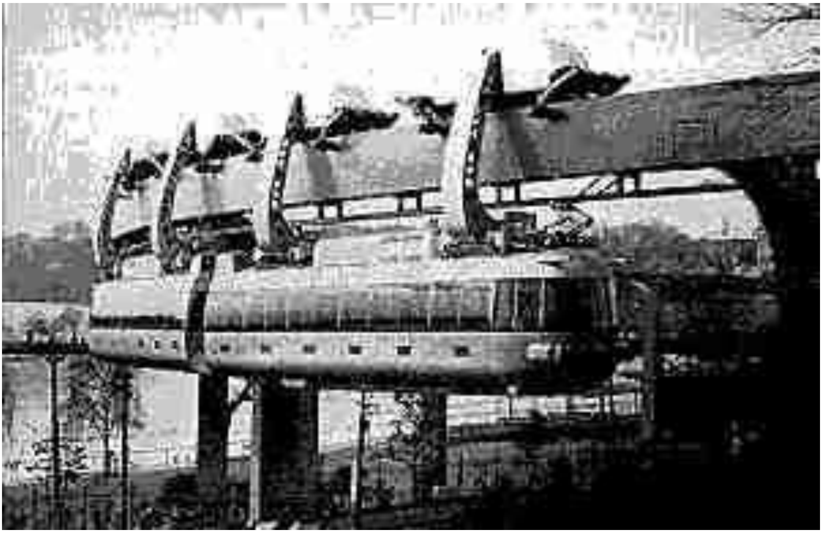
beat the Wuppertal in performance but was never expanded.“[1]

„Wuppertal, the first true monorail. Built in Germany, 1901.“[2]

[1] Sky Train: 1997 USA, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Monorail 1887 < http://www.skytraincorp.com/ >.

[2] Sky Train: Wuppertal, the first true monorail. Built in Germany, 1901, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Monorail 1901 < http://www.skytraincorp.com/ >.

„1957 Japan



Japan in an all-out effort to improve its transportation infrastructure - presented their first monorail in the Ueno Zoo in Tokyo. It is a modernized version of Wuppertal's System. Feeling they could cut costs, they used rubber tire components."[1]

[1] Sky Train: 1957 Japan, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Monorail 1957 < http://www.skytraincorp.com/ >.

„After the purchase of the Safege technology, in the year 1970 in Shonan Japan, this air conditioned system with 7 minute headways was opened to the public. The following are comments **by Hiroshi Naito***.

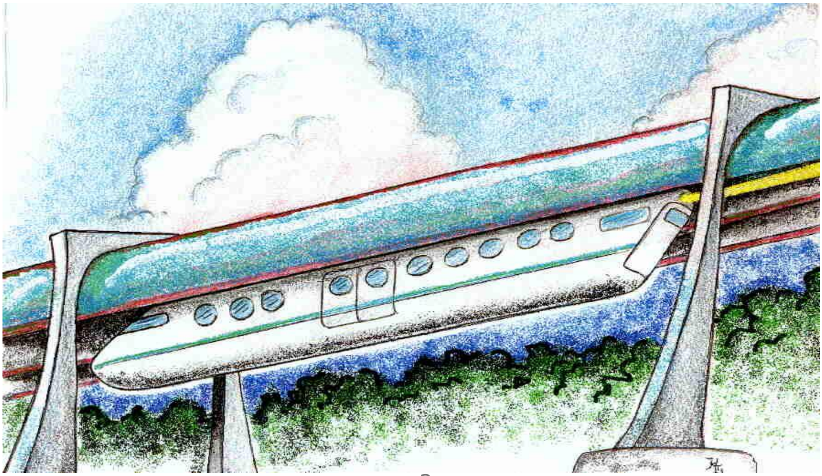
"Since the train runs up in the air about 10 meters high, visibility out of the train windows is quite nice, and rather spectacular. The scenery is filled with green trees along the hillsides, although the areas have been fully developed."

"The train slowly pulled into the home track, and sure enough, there was the opposing movement of a train entering the station along the opposite home track. After the train stopped at the platform, the conductor was busy collecting tickets from the passengers getting off. All stations are unmanned except at either end."

"After passing Shonan Fukazawa, scenery along the track turned somewhat rugged, like in the mountains. Soon, our train entered a short tunnel. A monorail running through a tunnel is quite a unique feature."

*** The Japanese Railway Society (JRS) was founded in 1991 in London, England, to promote the knowledge of the railways of Japan**

in England and other non-Japanese-speaking parts of the world. Contact the JRS via e-mail: [Mark Kavanagh,] coordinator for the USA."[1]



Artist's Rendition of Skytrain, 1987.[2]

[1] Sky Train: 1970 in Shonan Japan, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / Duorail 1970 < http://www.skytraincorp.com/ >.
[2] Sky Train: Artist's Rendition of Skytrain, 1987, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / STC vision 1987 < http://www.skytraincorp.com/ >.

A "Lego" Sky Train, demonstration model 1996.[1]

Urban High Speed Monorail[2]

[1] Sky Train: **A "Lego" Sky *Train, demonstration model 1996***, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Pidtures / STC demo 1996 < http://www.skytraincorp.com/ >.
[2] Sky Train: **Urban High Speed Monorail**, abgerufen am 6. 2. 2011, in: Sky Train Corporation / Corporata / MAIN < http://www.skytraincorp.com/ >.

Sky Train: **Universal Transit Solutions**[1]

„Sky Train Corporations (STC) robust Overhead-Suspended Light Rail (OSLR) system fits admirably into the scheme of most transit projects. Overhead-suspension brings benefits that existing or light rail technology cannot offer whether elevated at grade, or underground. These innovations represent the first major change in rearranged light-rail technology in 50 years. Operating cost savings due to automation are 40%, with

[1] Sky Train: **Universal Transit Solutions**, abgerufen am 6. 2. 2011, in: Sky Train Corporation < http://www.skytraincorp.com/energydevelopement/brochure.pdf >.

energy reclamation of 40% to 70%. Construction cost is also reduced by automation. Our system will rule future transportation for both high-speed, security, and Smart Growth. The service for passengers, combined freight and containers to intermodal destinations is greatly improved.

We have been asked to build a “Ride-able Interactive Energy System” at a science museum. Information at:
http://home1.gte.net/stco/usgte.htm Florida’s budget has $2,000,000 waiting for matching funding, see movies at:
www.stpt.usf.edu/brownbag/09-08-06-growth.asp showing our presentation and computerized model in operation at Fox 13 TV movie clip .

Sky Train Corporation is a premier developer and technologist of rail and monorail systems, offering to operate; with listed and other partners in joint ventures or Public/Private partnerships. STC engineers have experience in container handling (design, build, operate) and in manufacturing of automation equipment. We have devoted some 20-man years to our innovations. STC concepts use standard off the shelf components from modern light rail, improving performance, allowing utilization of existing trained rail personnel workforces.

Simply, we re-engineer into an overhead-suspended system that incorporates solutions to natures and mans extremes. Sky Train offers full transportation capacity from single vehicles up to full subway. We provide the next level of solutions for most railroad and monorail needs.

OUR MISSION

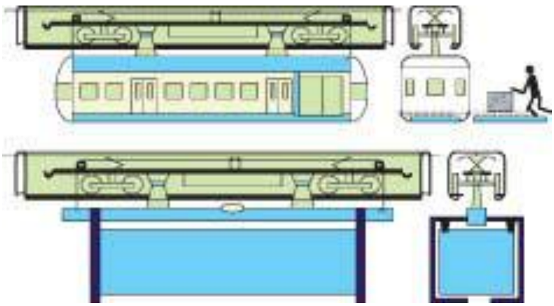
Sky Train Corporation funded in part by Florida's Technological Research Development Authority (TRDA). We are presently designing with NASA and have proposed a planetary system. STC products, peer reviewed by the National Science Foundation has gained international recognition. We are a private company with 23 stockholders. Our Patent protection with 63 claims covers three advanced systems protecting our concepts; also an additional three patents are pending.

This is a best fit for Smart Growth, offering enhancing technologies. We focus on conservation and efficiency, and embrace sound growth principles. This alternative transit mode helps control sprawl, improves economic competitiveness, mitigates pollution and fits the 21st Century model to revitalize our cities. It will allow connecting with low ridership rural communities.

In short - Sky Train provides a new format of versatile Overhead Light Rail System, with increased passenger comfort, efficiency, high average speeds, and automated freight loading for added revenue. STC structures use about 4% of the ground space with semi-automated offsite manufacturing; they are erected quickly with minimum disruption and relocation of utilities.

OVERHEAD-SUSPENDED LIGHT RAIL (OSLR)

Combination car adapted for automated container handling at right



Major development in freight container movement - the grapple is substituted for the car shown above

REWARDS AND BENEFITS

The Sky Train System:

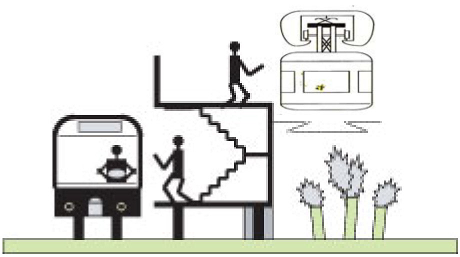
- Descends to ground level if necessary
- Safety: Vehicles are locked in the supporting structure
- “Double Super-elevation” gives high speed to vehicles, reducing size of fleet, gaining superior service
- Swings on curves for passenger comfort allowing greater speeds
- Providing bottom and side access gains safer passenger and freight interchange
- Operates above congestion insuring scheduling and fast-unimpeded service
- Designed to continue operating in high winds and flooding
- Suspended, passes above all traffic and land uses, allows low stations which reduces costs

- High speed, high capacity transit service, no imposed speed limits
- Can climb twice the rate of the maximum suggested for highways to (13 degrees)
- Uses standard light rail components, performance-tested in existing services
- Preferred, electric operation ensures good air quality
- Components mostly standard off the shelf; results in low cost due to competitive bidding
- One Sky Train OSLR track transports the equivalent of nine automobile lanes
- Sky Train uses 80% less power than rubber-tired systems that most monorails use
- Can be totally automated, lowering cost, using railway or elevator control systems
- Can also be designed for heavy container freight or lighter airports and theme parks

About Sky Train Car Designs:

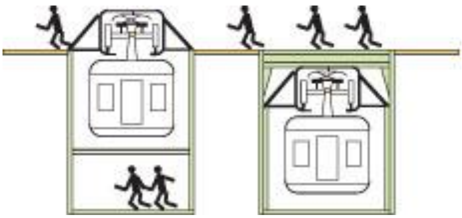
- Cars can be 10ft (3.0m) wide, 40ft to 80ft (12.2m to 24.3m) long for high capacity and comfort
- Single cars up to full-length trains offer transportation capacities equaling modern subways
- Wide-door level access for handicapped, bi-cycles, baggage trolleys and containers
- Level access-offers double passenger loa-ding rates compared with steps
- Cars and stations can be air conditioned for comfort

About Intermodal Stations:



Platform levels at any height Safety net protects anyone falling from Sky Train platform

An architect's dream; an economical suspended mode, helping dot the "**I**" in intermodal



For Malls, Airports, Parks using Corridors, Cuts or Tunnels

LONG TERM EFFECT

- Creates a new "icon" for the system locati-on
- Enhances the shopping transportation image

- Attracts investor money and commerce
- Convenient and fast relaxed transit; more time for businesses and tourists
- Increasing economic Smart Growth and Transit Oriented Development (TOD)
- Transit can reduce parking requirements, especially for employees
- Coordinates best with improved land use planning and rearranged bus service

SKY TRAIN CORPORATION, SYSTEM DETAIL:

STC100 has been successfully peer reviewed and included on prestigious short lists of solutions, the STC150 with slight revision can handle the movement of freight even containers, while the STC300 designed for low cost structure and high efficiency is a solution for low ridership locations. We as technical consultants provide custom solutions for each client; creating partnerships, developing OSLR service. Specifically we define routes, capacity, sizes and speed, station locations, and perform design of transferable tooling, team, and vendor selection.

Sky Train favors elevated systems that are mass-produced serving the international market. We can design to carry automated containerized freight as a revenue bonus. We own tooling to start the next job, movable to the next qualified existing manufacturing partner.

Sky Train's suspended designs, allow the elimination of many devices such as: rubber tired stabilizing wheel sets, energy intensive steering systems, and complex tilt mechanisms. We are designing to use renewable energy, eliminate power lines at ½ to 2 million per mile; resulting in smaller sub-stations and reduced mechanical complexity - all reduce weight and cost.

This suspended design gives passengers closer proximity to the ground by:

- Directing the rider's viewing out and downward to enhance: security, retail sales, and fits within the Smart Growth and Livable Community model.

Our main features exploit the mechanical ability to:

- Utilize Air Rights over community right of way on roads, rivers, tollroads or railroads.
- Our Icon at left depicts batteries or capacitor flash charging units, using a computerized buss that monitors vehicle functions; exchanging kinetic and potential energy, constantly monitoring safety for every start/stop

cycle. Examples: Tesla Motors, GE, Siemens, Honda, Mitsubishi and others. STC, is the first patented duo-rail system with major enhancements in the suspended mode.

Energy Savings are of model STC100 to 40%; STC200 & STC300 of 40% to 70%. STC300 is designed to reduce structure cost up to 40%, which is 60% to 80% of overall cost.

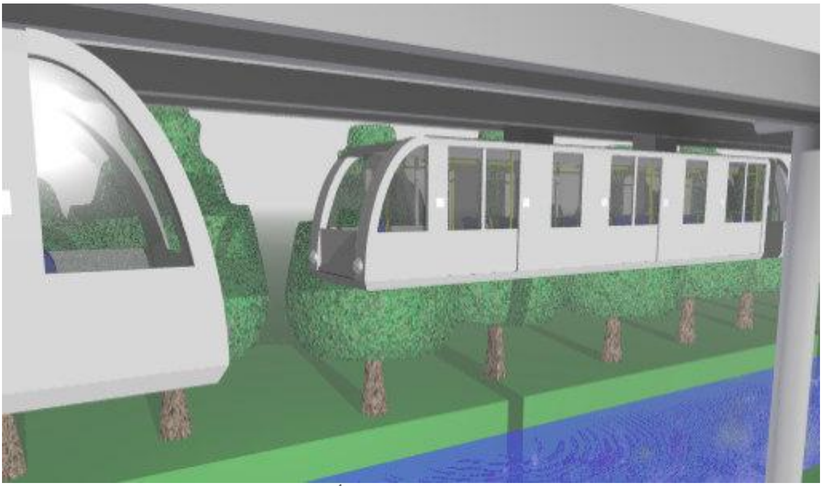
STC's elevated structure reduces passenger transfer distance, utility relocation costs, traffic impact, length of construction time, eliminates corridors and drainage dividing communities and land use. The designs also protect against lightning strikes, houses fiber optics, CCTV, other conduits, and street light installations. The structure reduces impact of terrorism, earthquakes, sand storms or floods. It allows rescue after a catastrophe." [1]

„Imagine futuristic transport in your city.

Sailing past congested traffic.

[1] Sky Train: **Universal Transit Solutions**, abgerufen am 6. 2. 2011, in: Sky Train Corporation < http://www.skytraincorp.com/energydevelopement/brochure.pdf >.

Fully integrated with other transit modes.



Imagine Sky Rail.“[1]

[1] Sky Rail: **Sky Rail - Photographs**, abgerufen am 6. 2. 2011, in: Sky Rail UK Ltd < http://www.plater.karoo.net/skyrail/pictures.htm >.

„**19th Century - Horse-drawn trams:** Trams run on rails to avoid the mud in the unpaved streets. The first affordable Public Transport.
Early 20th Century - Electric Trams: The catalyst for the growth of many cities in the days before widespread car ownership. Now looked on with nostalgia. Note the complete lack of traffic in this picture from Hull.

Late 20th Century - "Super" Trams: The new generation of trams, in many cases segregated from other traffic and pedestrians. Where trams do enter the domain of the car (or the pedestrian) the potential for accidents is considerable - witness the frequent accidents in Sheffield and Croydon.

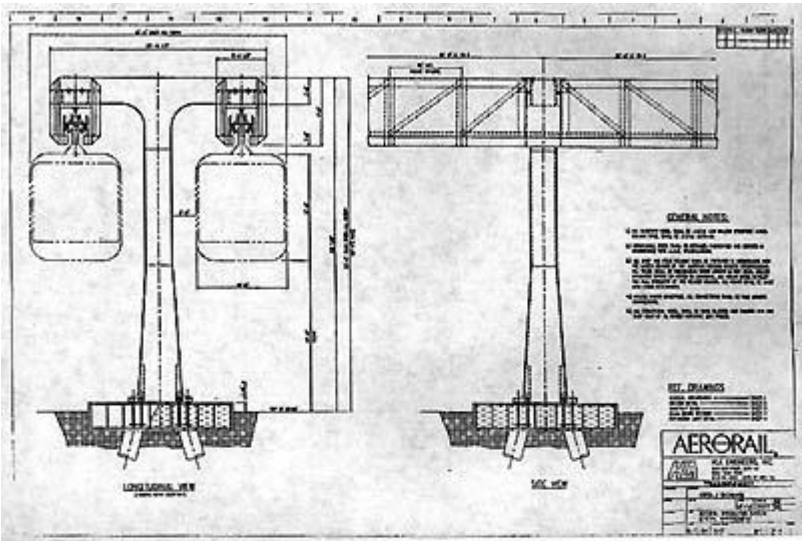
21st Century - Sky Rail: Fully segregated by design. Offering a renaissance for Public Transport by providing a quality alternative to the car. Premium Public Transport for your city. Sky Rail, the solution to traffic congestion.“[1]

„Aerorail - Footprint

[1] Sky Rail: **Sky Rail – Light Rail History**, abgerufen am 6. 2. 2011, in: Sky Rail UK Ltd < http://www.plater.karoo.net/skyrail/history.htm >.

Aerorail on river-crossing bridge.

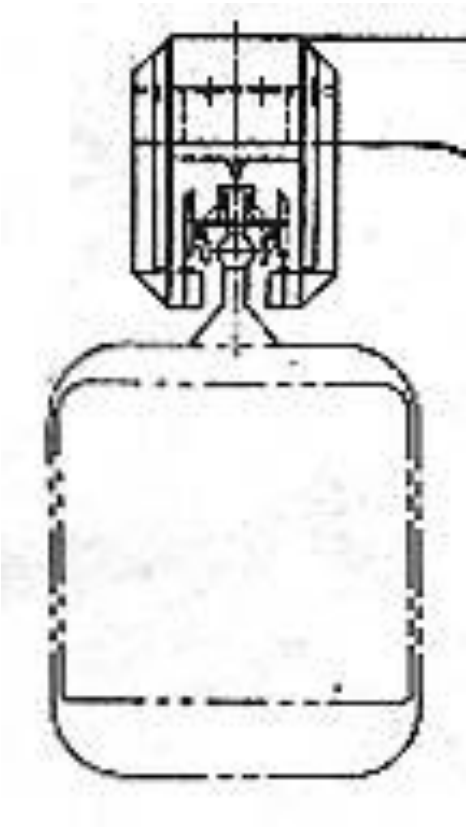
The typical guideway section is 5' 6 1/2" wide by 7' 6" tall. It is usually a dual beam configuration. The beam is elevated approximately 29 feet above the ground. The composition is ductile carbon steel, designed for a minimum of vertical or horizontal deflection. Teflon or elastomeric pads are used to keep the rails isolated from the frame and allow for expansion and contraction.



[back to Technical Home Page / back to the Monorail Society Home Page]“[1]

„Aerorail - Suspension and Propulsion

[1] Monorails: Aerorail – Footprint, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPAerofo.html >.



The Aerorail guideway rails are two #115 standard railroad rails with a 1m gauge. Wheels are 30" in diameter. As in other state-of-the-art transit systems, propulsion is by VVVF (Variable Voltage, Variable Frequency) 3-phase AC traction motors, rectified from a 750 VDC power rail that runs inside of the guideway. Braking is also regenerative. Emergency stopping will include mechanical braking. Horsepower is over 2000 per car.

The vertical support for the vehicle's passenger compartment is by two tubular steel hangars with a pair of hydraulic springs that are used to dampen the oscillation and permit banking in curves. All electrical and HVAC systems are located above the passenger compartment (as they are in the Mitsubishi's systems.) Compare this to the ALWEG systems, where equipment is below the passenger compartment.

Minimum turning radius is 50 feet, about a third of what is required in a conventional light rail system."[1]

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[1] Monorails: Aerorail – Suspension and Propulsion, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPAerosu.html >.

„Mitsubishi

Shonan Monorail.

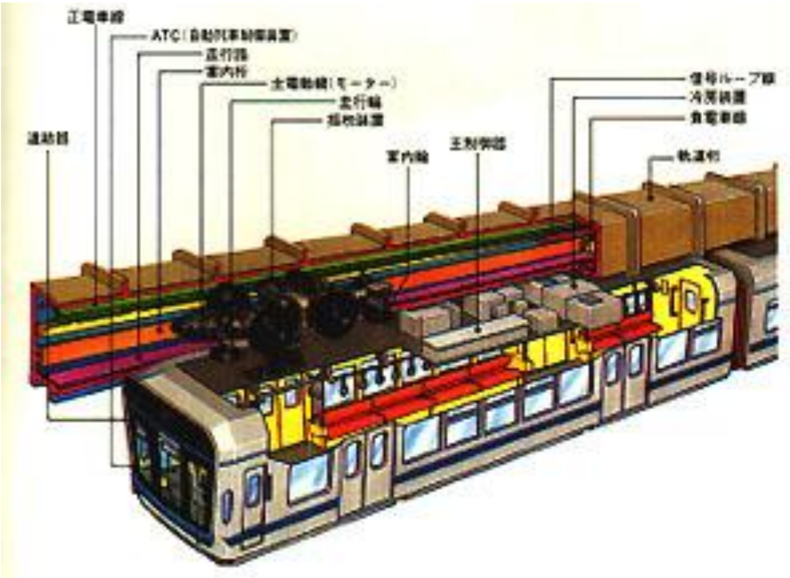
Chiba City.

The modern-day incarnation of the SAFEGE mono-rail is in Japan. One system is in Chiba City (near

Tokyo) and the other is the Shonan system. The Shonan system was opened in 1970 and is a single beam system with passing lanes located at several stations. We will discuss the Chiba City system here.

The Chiba City "Townliner" is currently the longest suspended monorail system in the world, and it is getting longer. Since it opened in 1988, the system has never stopped growing. Long term plans are for the monorail to be over 40 km in length, and this will most likely be surpassed. Building upon the knowledge and experience of the Shonan Monorail, the Mitsubishi Company built this dual-tracked system to connect suburbs in the Chiba Prefecture with Chiba's main rail station downtown. It is currently the world's only dual-beamed SAFEGE-type system. It also has a spur line off the main line, another example that monorail switches work fine. One of the reasons Chiba officials selected SAFEGE was because of the occasional inclement weather of the area. With SAFEGE, the running surfaces and train bogies are protected from the elements inside the beams. ALWEG-type monorails need heaters in the beamway or shovels on the train fronts during heavy snow or ice conditions.

The dual beams are hollow steel boxes about 1.86m (6.09') x 1.89m (6.18') in size. Note that this is much larger than the 2'2" x 4'0" Disney/Bombardier beam. Trains are two cars long, each car 15.4m long and 2.65m wide. Each car has two four rubber-tired bogies. There are 2 motors per bogie for a total of 4 per train. Power comes from a third rail inside the beam. On each bogie are four rubber guide wheels. The gauge of the load/drive tires is about .87m (2.85'). Electrical equipment and HVAC equipment are above the cabin. This helps lessen the risks of fire, as well as making it easy to maintain. The suspension system allows the cars to swing several degrees, like a pendulum, which makes it easier on standing passengers in curves.



- Weight 21.5 metric tons
- Max. speed 65km/h (40 mph)
- Acceleration 3.5 km/h/sec (2 mph/sec)
- Normal Deceleration 3.5 km/h/sec
- Emergency Deceleration 4.5 km/h/sec (2.8 mph/sec)

- Main power 1500V "[1]

„Siemens H-Bahn (SIPEM)

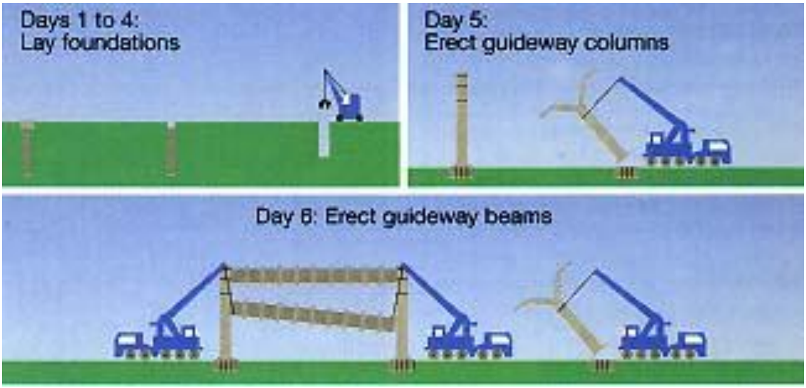
Dortmund University H-Bahn.

The Siemens H-Bahn (also known as SIPEM for SIemens PEople Mover) has been around since

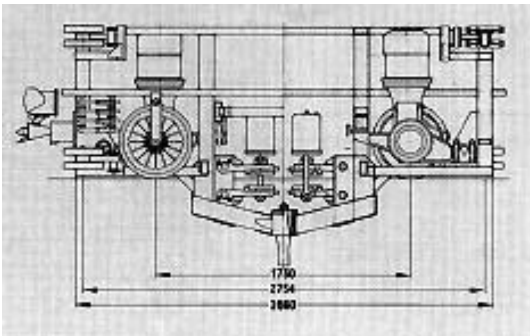
[1] Monorails: Mitsubishi, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPMitsu.html >.

the early 70s. A test track was built at a Siemens-DUEWAG facility and the first operational installation was at Dortmund University in Germany in 1984. The latest opened at the Düsseldorf International Airport. The SIPEM system is designed as a medium-capacity transit system, carrying up to 15,000 passengers per hour per direction (pphpd).

The system in Dortmund was the first automatically controlled urban transit system in Germany. Two cars carrying 42 passengers each traverse a 1-km long main line which links two university campuses. Several track extensions have been added since it opened, which include several switches and a spur line. The Düsseldorf Airport SkyTrain, the second Siemens H-Bahn system, opened a 2.5km double guideway line in 2002.



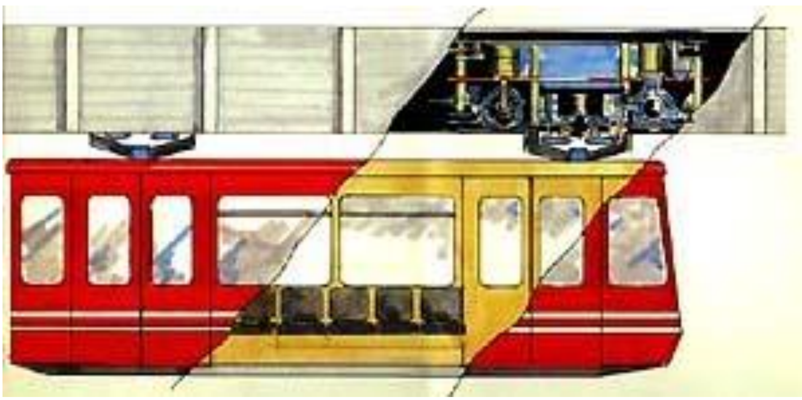
Quick track installation is a great advantage of Siemens H-Bahn."[1]



Bogies are simple and small[2].

[1] Monorails: Siemens H-Bahn (SIPEM), abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPSiem.html >.
[2] Monorails: Siemens H-Bahn (SIPEM) – Suspension & Propulsion, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPSiem.html >.

„The running gear sets are dual axle and the wheels have hard rubber tires which travel on the two lower sections of the guideway. Side mounted wheels are used to guide the running gear. The rubber tires permit very low noise levels (65 dB-(A) measured at 50 km/h and 7.5m distance.) Two air brakes are used on each rolling gear as the safety and parking brake. 8 DC traction motors are supplied with 380 VAC (50Hz) via thyristor converters. Maximum speed is 60 km/h. The main braking is a combined regenerative/rheostatic brake. […]

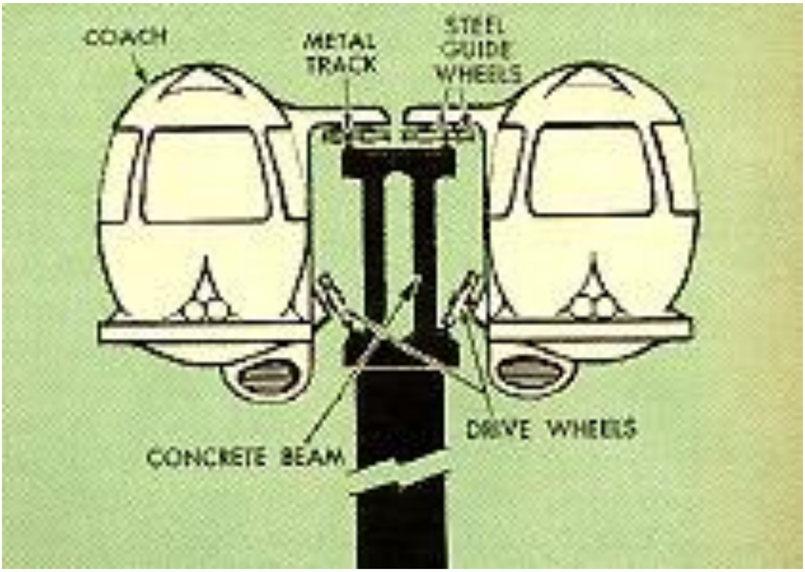


[…]/ back to Technical Home Page“[1]

Monorails

„Monorails are touted for many reasons, but narrow guideway is one item at the top of the list. That said, there are companies proposing to do better than monorail. Imagine bi-directional travel of transit vehicles on one beam, not two. That is the chief characteristic feature of the monobeam system. While monobeam may seem to be a new idea, it has been around for some time. The Scherer Monobeam was promoted without success in the 1960's. Still, the concept remains today and at least two companies are promoting very different versions of the concept.

[1] Monorails: Siemens H-Bahn (SIPEM) – Suspension & Propulsion, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPSiem.html >.



Scherer Monobeam, as illustrated in December 1963 Popular Mechanics"[1]

„*System 21* ® Monobeam Technology

[1] Monorails: Cantilevered, abgerufen am 6. 2. 2011, in: < http://www.monorails.org/tmspages/TPmbeam.html >.

[...]

- **The Name "*System 21*" -** Derived from the technology's primary feature: ***2-***direction traffic on ***1*** slender, triangular "monobeam". The system is a major breakthrough which should significantly influence the transit market in the ***21***st century.
- **Affordability & Creative Financing -** Conservatively estimated at $30-$35 million per mile, including guideway, stations, power substations, vehicles, maintenance facility and train control , *System 21* compares very favorably with the capital costs of competing systems , normally ranging between $40-$200 million per

mile. Operating cost will be comparable or superior to other fixed guideway systems carrying comparable passenger volumes. *System 21*'s portability may allow it to be the first fully leasable transit system, making it affordable to communities that heretofore could not assemble the large up-front capital payment required for expensive transit infrastructure projects.

- **Elevated Guideway** - *System 21*'s slender triangular steel, concrete or composite guideway design is normally 7 feet wide at the base and 6 feet high, is supported on 16-foot columns, but it can be higher or lower as required. It does not require significant dislocation of homes and businesses and does not partition communities. Life goes on uninterrupted underneath, and the guideway profile does not block out sunlight. It's ideal for installation above roadway medians. *System 21* guideway will be designed to International seismic standards.

- **Modular Construction** **-** *System 21* beams, columns and wayside components are pre-fabricated in a factory setting and shipped to the site for installation. The community experiences no prolonged disruption during installation. Because the system is modular, and essentially "portable", it can be relocated to meet changing demand, and expanded into networks.

- **Branching -** With an innovative switch design based on a standard rail-road switch with few moving parts, *System 21* provides grade separated, tight turn branching, and the ability to form efficient transit networks.
- **Minimum Curve Radius -** Minimum turning radius is 90 feet horizontal, 300 feet vertical.
- **Average Foundations -** 7' x 7' x 2' precast concrete foundations below the surface are anchored to four pilings of varying depth, depending on soil conditions. Foundations support a 4' x 6' pedestal which protrudes 18 inches out of the ground, serving as the anchorage for columns.

- **Average Beam Span And Column Spacing -** 84 feet. Longer (100+ feet) and shorter spans are possible.
- **Stations -** A typical four-car station requires a 12' x 120' landing at grade. Stations are modular and pre-fabricated off-site, or can be built on-site to client specifications. Island platform loading is standard through inboard (beam side) vehicle doors, and loading through outboard vehicle doors to side platforms can be accommodated. Stations are accessed by stairs and elevator, and can vary in length to accommodate the longest trains operated.

- **Accessibility To The Disabled -***System 21* is fully accessible to the disabled.
- **Vehicle Capacity** - Each 28-foot vehicle has nominal design load of 52 passengers - 24 seated and 28 standing. Vehicle interiors can be reconfigured to suit client needs (i.e. greater standee capacity, luggage racks, etc.)
- **Train Length And System Capacity -** Train length can consist of one to as many as ten vehicles, depending on available berthing space at station platforms. *System 21* can accommodate potentially more than 20,000 passengers per hour per direc-

tion, and trains may be able to operate at headways of as little as 90 seconds.

- **Vehicle Suspension System -** Side-mounted, cantilevered vehicle suspension places majority of the weight on steel drive wheels (2 per vehicle at 18-foot separation) which ride directly atop a steel rail at either side of the base of the triangular beam. To add upright stability, upper outrigger mechanisms (2 per vehicle mounted over the drive wheels) capture and ride along a steel rail located on either side of the top of the beam.
- **Vehicle Design Weight -** Approximately 11,500 lbs. empty, 20,000 lbs. fully loaded with 52 passengers.

- **Maximum Grade** **-***System 21* vehicles are designed to negotiate 10% grades. The unique vehicle suspension configuration will provide sufficient traction from a standing start to accomplish this in all weather conditions.
- **Maximum Vehicle Speed** **-** Initially 70 mph; later versions may reach 100+ mph.
- **Vehicle Operation And Train Control** **-** Using proven, state-of-the-art train control technology, *System 21* will safely operate in either a fully automated or manual control mode. Central control will monitor all operations, activities and passenger handling.

- **Vehicle Evacuation** - A number of train evacuation methods are offered, including vehicle-borne stairways and emergency slides, and a cantilevered, guideway-mounted walkway with deployable handrail. Passengers will also be able to move from car to car to flee a hazardous or uncomfortable situation. Over waterways and busy highways, or at exceptionally high elevations, FUTREX offers an open truss guideway configuration which incorporates an emergency walkway within the beam.
- **Traction Power And Propulsion -** 750v DC wayside power is distributed along a contact rail moun-

ted under the outrigger rail on either side of the beam. A power substation will be installed approximately every three miles. Wayside power is drawn into the vehicles through outrigger-mounted contact shoes. DC power is converted on-board to drive two independent three-phase, brushless AC motors.The segmented system power grid will be monitored and operated by Central Control.

- **All-Weather Operation** - *System 21* is well suited for all weather conditions. Weather tested vehicle and guideway components are specified to function in ambient temperature ranges between -40F and +120F, and under high precipitation and humidity conditions. The triangular shaped beam and weather guards will prevent the accumulation of snow and ice. Design wind load, with vehicles mounted on the guideway, is 150 mph. "[1]

2-Direction Traffic on ***1*** "Monobeam"[2]

„Gegenstand der Überlegungen ist der Entwurf eines neuen Verkehrssystems im Öffentlichen Per-

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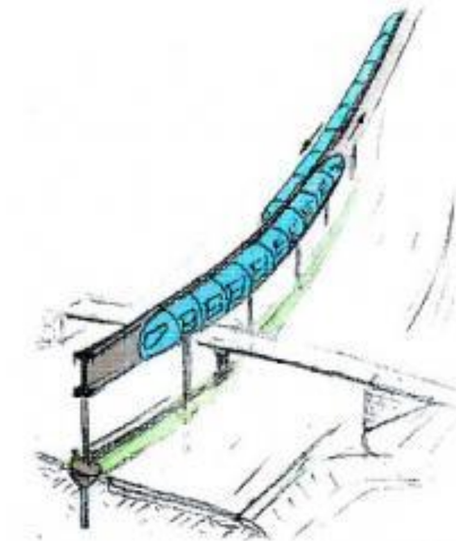
[1] Futrex: System 21® Monobeam Technology, abgerufen am 6. 2. 2011, in: < http://www.futrexinc.com/features.htm >.

[2] Futrex: System 21® Monobeam Technology, abgerufen am 6. 2. 2011, in: < http://www.futrexinc.com/features.htm >.

sonennah- und Fernverkehr unter besonderer Berücksichtigung der Anbindung an den Verbundbetrieb bestehender Park- & Ride-Systeme.

Wesentliches Merkmal des „People Cargo Movers" (PCM) ist die mögliche Linienführung über dem Mittelstreifen bereits vorhandener Hauptverkehrswege (innerstädtische Straßen, Autobahnen). Ein optionales Shuttlesystem ergänzt den Betrieb im regionalen Bereich. Die Erweiterung des Systems auf Cargo-Transporte ermöglicht eine Entlastung der Fernstraßen vom LKW-Verkehr.

Transrapid und Metrorapid markieren den Anfang einer innovativen technischen Entwicklung für den öffentlichen Verkehr. Eine mögliche Erweiterung dieser Innovation ist der People Cargo Mover. Der Unterschied zum Transrapid oder zum Metrorapid wird im direkten Vergleich augenfällig:



Die heutige Bautechnik für die bekannte „Magnet-schwebebahn" sieht eine jeweils nur einspurig nutzbare Verkehrstrasse auf balkenartigen Stahl-betonbauteilen vor, die auf Stahlbetonrahmen aufgelegt sind. Der not-wendige Grunderwerb ist dabei unerlässlich.

Ein Wechsel zwischen unterschiedlichen Verkehrssystemen ist hinsichtlich der Akzeptanz potenzieller Nutzer generell problematisch. Schließlich geht es um die Frage des be- quemsten Weges zwischen zwei Orten unter Beachtung der dabei entstehenden Kosten und der dafür aufzuwendenden Zeit.

Die gegenüber dem öffentlichen Verkehrsmittel bevorzugte Nutzung des privaten PKW weist auf die ungebrochene Beliebtheit des eigenen Fahrzeugs hin. Angesichts verstopfter Hauptverkehrsadern mit nicht mehr vorhersagbaren Ankunftszeiten suchen wir immer wieder nach geeigneten Alternativen. Vermeintliche „Rechenexempel" („… was geht schneller?") führen zu individuellen Entscheidungen – meist zugunsten des eigenen Autos.

Ausgehend von diesen tradierten Verhaltensweisen können in logischer Konsequenz die Vorteile des individuellen PKW-Gebrauchs mit denen des ÖPNV und ÖPFV mit dem People Cargo Mover zweckdienlich kombiniert werden.“[1]

„Lösung verkehrstechnischer Probleme

Zu den Aufgaben unserer Zeit zählt die Lösung der verkehrstechnischen Probleme. Welcher volkswirtschaftliche Schaden entsteht täglich, wenn man nur an die Staumeldungen auf unseren Autobahnen denkt? Von vermeid-baren Umwelt-belastungen ganz zu schweigen. Der von dem re-nommierten Zukunftsforscher Prof. Frederik Vester (1925–2003) prog-nostizierte Verkehrskol-laps zeichnet sich mehr und mehr ab. Selbst der ehemalige Ford-Manager Daniel Goudevert sprach es offen und ehrlich aus:

„Wer Straßen sät, wird Verkehr ernten“.

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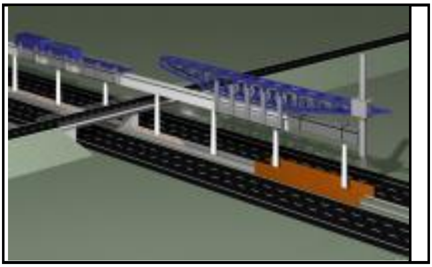
[1] Wörzberger, Ralf: People Cargo Mover (PCM), Überblick, © Copyright 1999-2006, in: < http://mwvi.de/pcm/index.php?de_intro_overview >.

Das sagt ein Autobauer, der erkannt hat, dass es keinen Sinn ergibt, einfach so weiter zu machen wie bisher.

Wir – die Generation der zur Zeit Verantwortlichen – sollten solche Mahnungen ernst nehmen. „Wir", das sind: Wir Ingenieure, Architekten und Entscheidungsträger in Politik und Wirtschaft, die gemeinsam mit Investoren dazu beitragen können, das Ganze voraus-schauend auf den Weg zu bringen.

Innovationsschub für Industriebereiche



Nur durch gemeinsames Handeln kann ein solches Vorhaben als Innovationsschub für zahlreiche Industriebereiche gelingen. Die dargestellten Baumaßnahmen könnten dazu beitragen, neue Bau-Verfahrenstechniken zu entwickeln. Der beteiligten Bauindustrie könnte das zu einem Exportschub verhelfen.

In der Folge könnten auch neue, umweltschonende Wirtschaftszweige ent-wickelt und kultiviert werden.

In der Automobilbranche beispielsweise, wo intensiv über Anwendungen für Kleinwagen mit Elektro-Hybrid-Antrieb geforscht wird. In dem hier dargestellten Park&Ride-Betrieb wären diese, als sparsame „Minimobile“, sehr sinnvoll nutzbar. Auch hängen etliche Dienstleistungsanbieter (Car-Rent, CarSharing) von solchen Vorhaben ab.

Prüfung und Weiterentwicklung

Es bedarf sicherlich einiger Vorstellungskraft, die Tragweite solcher Innovationen zutreffend abzuschätzen. Dazu dient das Mittel der Planung.

Ziel einer ersten Planungsstufe muss sein, den Beleg für die Funktionstüchtigkeit der vorgeschlagenen Konzeption unter allen Aspekten – nicht nur der Kosten – zu führen.“[1]

„Im Fernverkehr gleitet der Personenzug über die Autobahnen …

Die Anbindung an den Öffentlichen Personen- fernverkehr (ÖPVF) erfolgt an Hochbahn-stationen über der Autobahn. Das ermöglicht einen fließenden Übergang zwischen den unterschiedlichen Verkehrsmitteln ohne nennenswerten Zeitverlust.

Ein System zeitlich dicht aufeinander folgender Bahnen und Shuttles ermöglicht eine bequeme Weiterfahrt, wobei die Fahrtzeit individuell genutzt werden kann. An einer dem Reiseziel nächstgelegenen Station stehen Angebote für die Weiterbe-

[1] Wörzberger, Ralf: People Cargo Mover (PCM), Ziele, © Copyright 1999-2006, in: < http://mwvi.de/pcm/index.php?de_intro_goals >.

förderung bereit. Hierzu eignen sich insbesondere „Minimobile", die kosten- und raumsparend neben den konventionellen Möglichkeiten des ÖPNV (Taxi, Bus, Bahn) ein attraktives Angebot für die individuelle Weiterfahrt zum jeweiligen Zielort bieten.

… im Nahverkehr ergänzen Shuttle den Betrieb.

Für kurze Distanzen (ÖPNV) eignet sich insbesondere der Shuttle-Betrieb. Eine spezielle Weichenkonstruktion erlaubt hier die Kombination von ÖPNV und ÖPFV. Ein weiterer Vorteil, auf langen Strecken über der Stadt zu fahren und nicht im Dunkeln unter der Erde, liegt auf der Hand: Fahrgäste erleben ihre Stadt aus hervorragender Position, Orientierungen fallen leichter als im Untergrund.

Das allgemeine Wohlbefinden als wesent-licher

Garant für die Akzeptanz spricht dabei für sich. Die vorbeiziehende Landschaft beziehungsweise der Stadtraum kann unein-geschränkt betrachtet werden – zugege-benermaßen nur zu einer Seite; auf der Rück-fahrt wird dieser Mangel aber aus-geglichen. Über kurze Rampen ist ein Abtauchen für eine Weiterfahrt als U-Bahn ebenfalls möglich.

Selbstverständlich ist das System auch für den Gütertransport geeignet.

Hauptursache der kontinuierlich zuneh-menden Staus auf den Autobahnen ist der Gü-tertransport mittels LKWs. Eine direkte Verlagerung von Containern und Europaletten von der Straße auf die Schiene des PCM könnte Verkehrsprobleme auf unkompli-zierte Art lösen und gleichzeitig die Kosten der Spediteure senken. Auch aus ökologischer Sicht sind Alternativen zum LKW-Transport notwendig und geboten.

Die Anbindung an bereits bestehende Systeme der Güterbeförderung, aber auch gekoppelt an innovative Lösungen, wie beispielsweise an das CargoCap-Prinzip, (z. Zt. in der Entwicklung, Prof. Stein, Ruhr-Unversität Bochum), oder das Rail-Cab-System (Prof. Lückel, Neue Bahntechnik Paderborn), ließe sich umsetzen."[1]

„Wuppertaler Schwebebahn

Abwägen der Vor- und Nachteile:

[1] Wörzberger, Ralf: People Cargo Mover (PCM), Grundlagen, © Copyright 1999-2006, in: < http://mwvi.de/pcm/index.php?de_applications_basics >.

- Vorteil u. a. Querneigungen durch Fliehkräfte, d.h.: „natürliche Neigetechnik“ in Kurvenfahrten
- Nachteil u. a. sehr laute Fahrgeräusche durch Kontakt Stahl auf Stahl

Transrapid:



Abwägen der Vor- und Nachteile:

- Sehr Schnell (> 400 km/h), hoher Fahrkomfort, leise, High-Tech-Image u.v.a.m
- Gegenverkehr nur durch Ausweichstrecken oder durch zweite Stelzenbahn

- Reduzierte Durchschnittsgeschwindigkeit durch Stop in Zwischenstationen
- Trassenführungen zerstören wertvollen Landschafts- bzw. Stadtraum"[1]

[1] Wörzberger, Ralf: People Cargo Mover (PCM), Rückblick, © Copyright 1999-2006, in: < http://mwvi.de/pcm/index.php?de_applications-review >.