Developing Infrastructure-Relevant Guidelines for Preliminary Conceptual Planning of a New Light Rail Transit System

Lyndon Henry
Transportation Consultant
Online Columnist
Railway Age
Austin, Texas
17 November 2015

Background

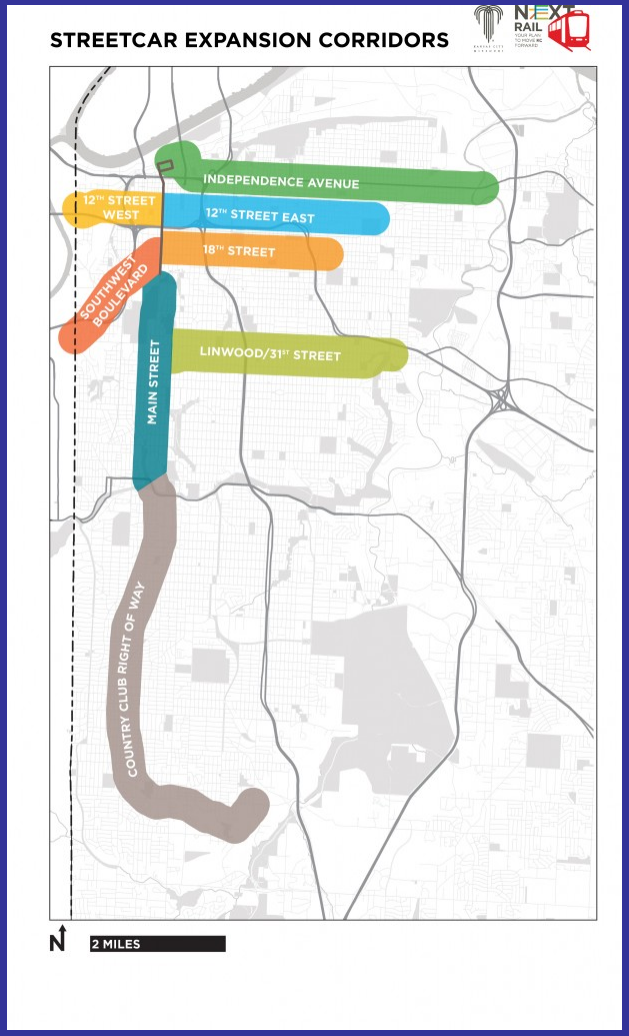
- Light rail transit (LRT) systems ("full-size" and "streetcar") continue to generate interest in cities across North America
- Local planners, transit agency personnel, other professionals, civic leaders, and community stakeholders need guidelines resource
- Project aim: Initiate development of such a resource

Approach

- Prep work toward conceptual design manual for systems-level "view from 30,000 feet"
- Occasional drill-down details where useful
- This presentation — overview with highlights from full paper
- Full paper on **LightRailNow.Wordpress.com**

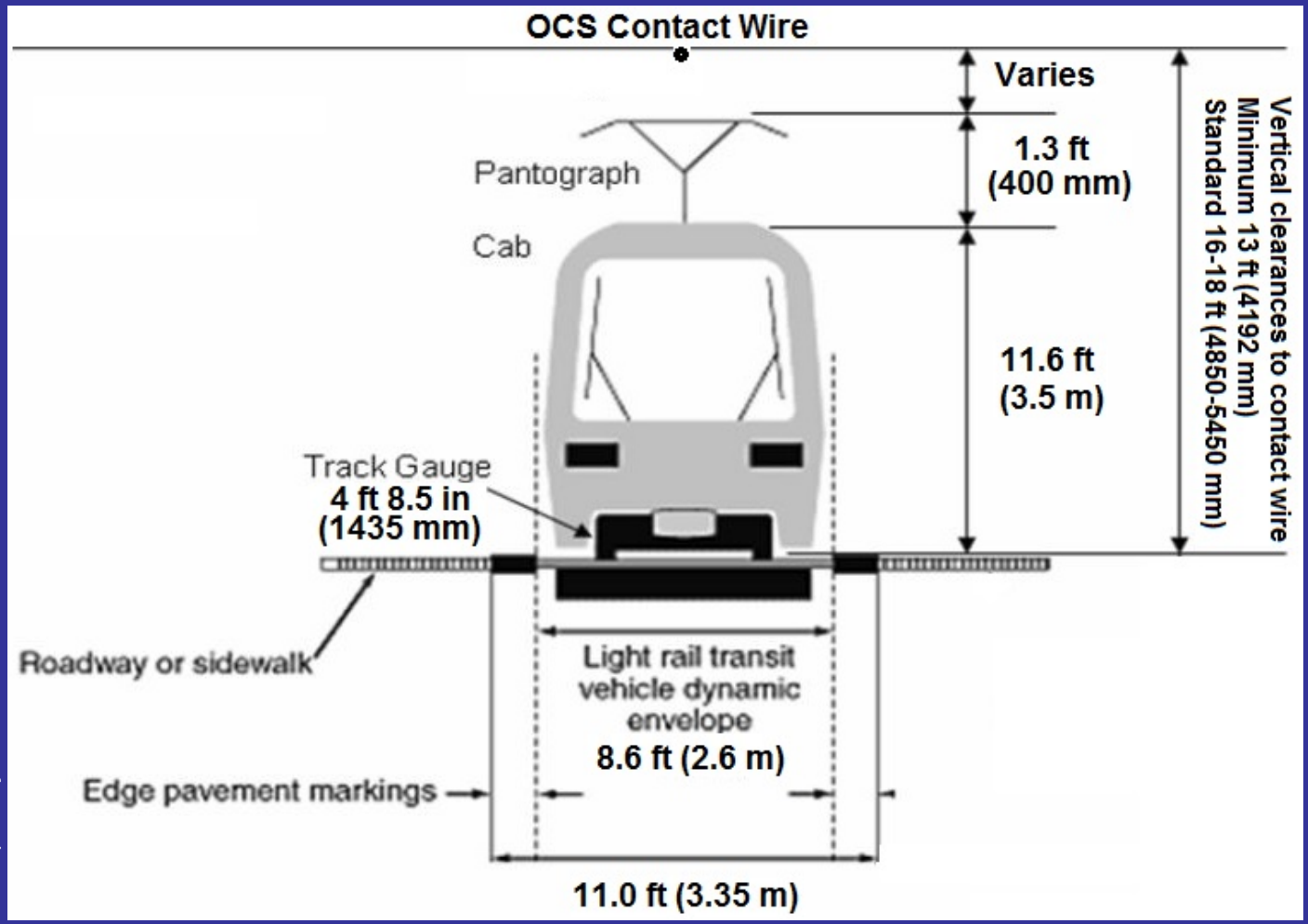
Route Selection: Corridors

NCHRP/TRB definition: "Normally, a corridor is considered to be a 'travel shed,' an area where trips tend to cluster in a general linear pattern ..."



Map: NextRail-KC

Vehicle Clearances Profile



Adapted by LH from Hamilton Public Works

Clearance Profiles: Curvature

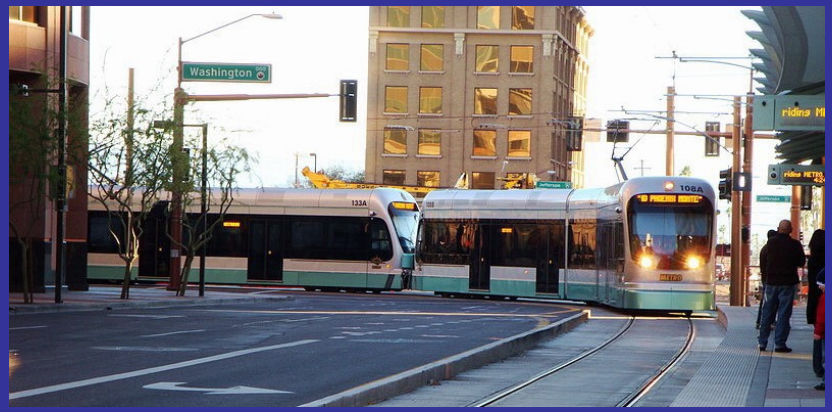


Photo: Salaam Allah/NYCSubway.org

- Standard minimum curve radius = 82 ft. (25 m), sharper turning capability possible
- Tight curves limit train speed, cause "wheel squeal" and wear on both wheels and rails
- Recommended curve radii range from 100 feet (30 m) (streets) to 300 feet (91 m) or more (exclusive alignments)

Clearance Profiles: Gradients

Photo: Peter Ehrlich/NYCSubway.org

- 6% gradient = desired maximum, but grades of 9% and greater are possible

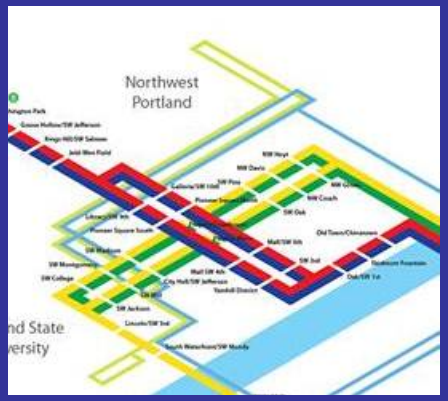
Typical Surface Alignment Options

Photo: YouTube

Double-track

Bi-directional single track

Photo: Eric Haas/NYCSubway.org



Graphic: Taylor Gibson

Paired directional tracks on parallel streets

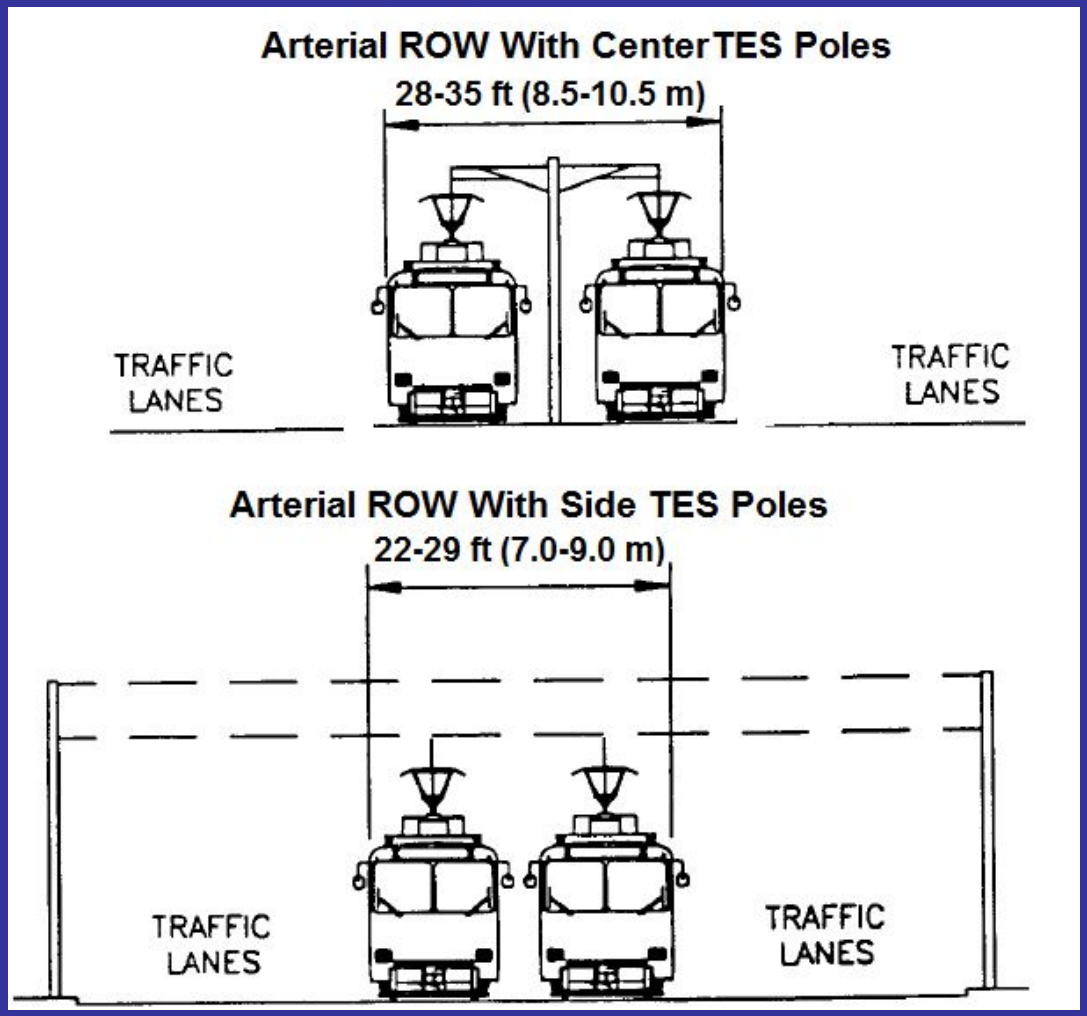
Interlaced (gauntlet) track

Photo: Stefan Baguette

LRT Alignment Considerations

- Abandoned railway lines and public arterials usually preferred
- Sharing tracks/ROW with "heavy" railroad is technically possible ... but problematic
- Freeway alignments often present serious challenges
- Subway/elevated alignments more expensive

Common Alignment Profiles/Costs
Arterial Alignments



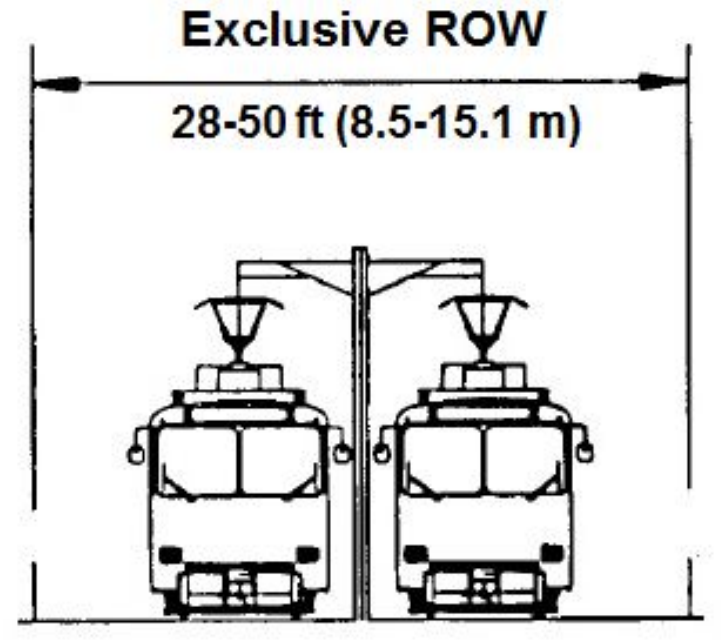
Graphics adapted by LH from originals of Robert. R. Clark

Typical Total System Costs

Street/arterial lane:
$63 million/mile
($39 million/km)

Roadway median:
$32 million/mile
($20 million/km)

Common Alignment Profiles/Costs
Exclusive Alignment



Abandoned railway alignment:
$24 million/mile ($15 million/km)

Shared use of active railway line:
$35 million/mile ($22 million/km)

Common Fare Collection Methods

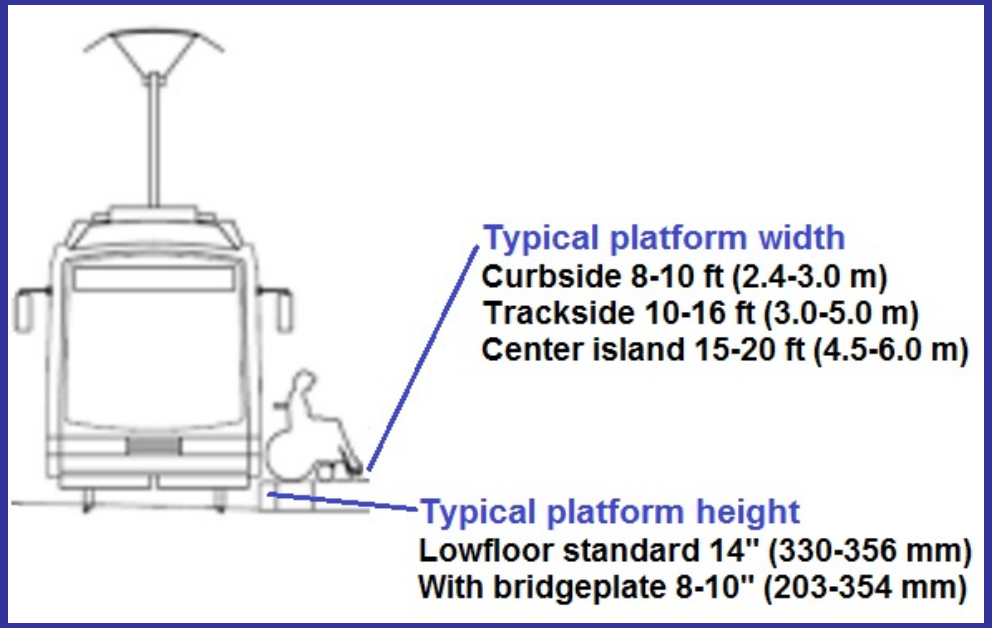
Operator collects fares

Turnstiles

Passenger self-service (recommended)

Photos: PhiladelphiaPlaneto.com, Los Angeles Times, Portland Tribune

Station Platform Profile



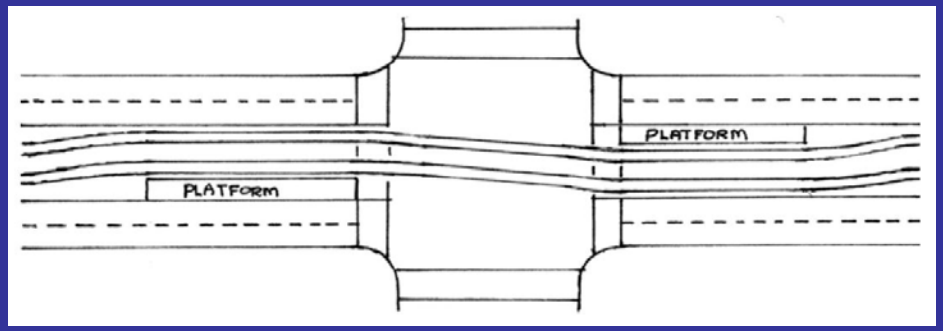
Dimensions

Photo: APTA Streetcar Subcommittee

Bridgeplate

Common Station Configurations

Center island platform: width 15-20 ft (4.5-6.0 m)



Side platform: width 10-16 ft (3.0-5.0 m) — often staggered across intersections

Curbside platform: often includes 8-10-ft (2.4-3.0-m) "bulgeout" of sidewalk

Photos: Bob Vogel, L. Henry. Graphic: Robert R. Clark

Station Park & Ride Facilities

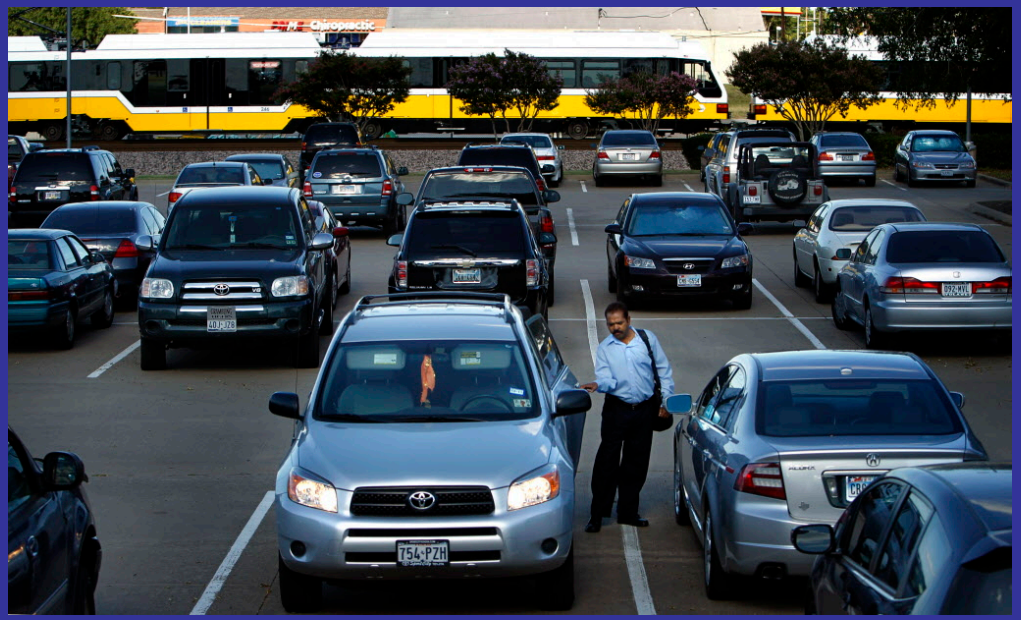
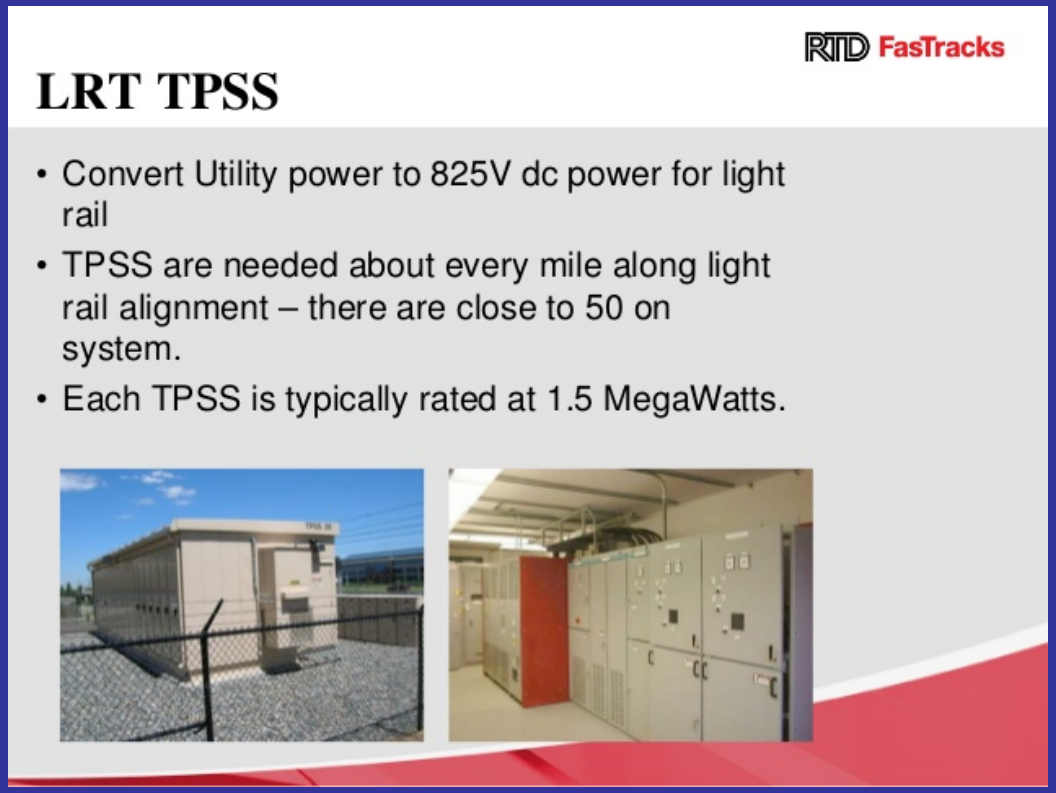


Photo: Dallas Morning News

- 300-350 SF/space, 100 spaces/AC (250-270/hectare)
- Average $3500/space

Traction Electric Power: Substations



- Provide nominal 750 VDC to power trains
- Small cabinets or buildings, typically ~ 100-200 SF (9-20 m^2)
- ~ 0.5 MW to 3.0 MW
- Spaced ~ 0.5-2.0 miles (800-3200 m)

OCS: Simple Trolley Wire vs Catenary

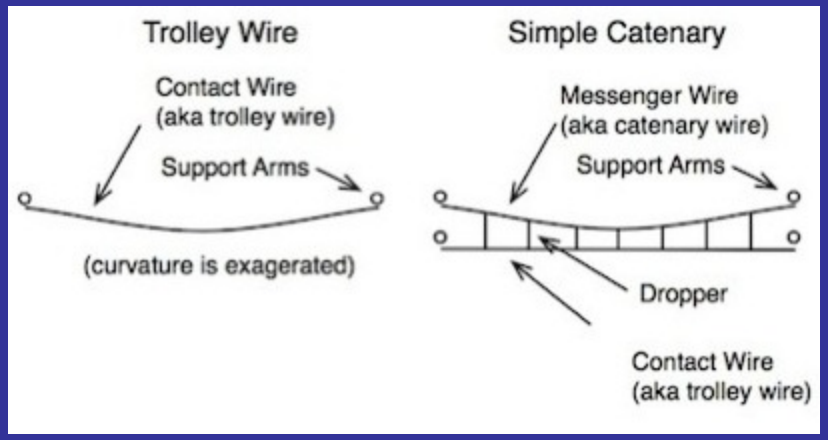


Diagram: Sumida Crossing
Photos: Flickr, Houston Chronicle

Common Signal Systems

Railway-type systems: Typically automatic block signals (ABS), but may include cab signals, ATS, ASC, ATO, CBTC, PTC

Street operation systems: Integrated with traffic signal system, special signals control train movements; may involve signal prioritization

Photos: L. Henry

Elements of Typical Communications Systems

- Radio communications
- PA system
- Variable message board (VMB) links (aka PIDs)
- CCTV
- Automated fare collection
- Automatic vehicle location (AVL)
- Supervisory Control and Data Acquisition (SCADA) system

Typical Rolling Stock Assumptions

Full-performance LRT car, 90-100 ft. (27.3-30.3 m) — 150 passengers

Full-performance LRT car, 75-85 ft. (22.7-25.8 m) — 125 passengers

Streetcar, 65-70 ft. (19.7-21.2 m) — 110 passengers

Photos: GoMetroRail.org, Siemens, OldTrails.com

Plausible Average Speed Assumptions

LRT in urban arterial: 15 mph (24 km/h)

LRT in railway: 20 mph (32 km/h)

Streetcar in urban arterial: 12 mph (19 km/h)

Streetcar circulator: 9 mph (14 km/h)

Photos: L. Henry, Peter Ehrlich

Example: Estimating Fleet Size

- Assume 8-mile route, urban arterial, projected ridership 25,000
- Peak-hour/peak-direction ridership = 10% of total = 2,500
- Average speed 15 mph = >30 min end-to-end, implies 20 "short" (125-pax) cars needed
- With 15% spares, fleet size = 23 railcars

Storage and Maintenance Facility

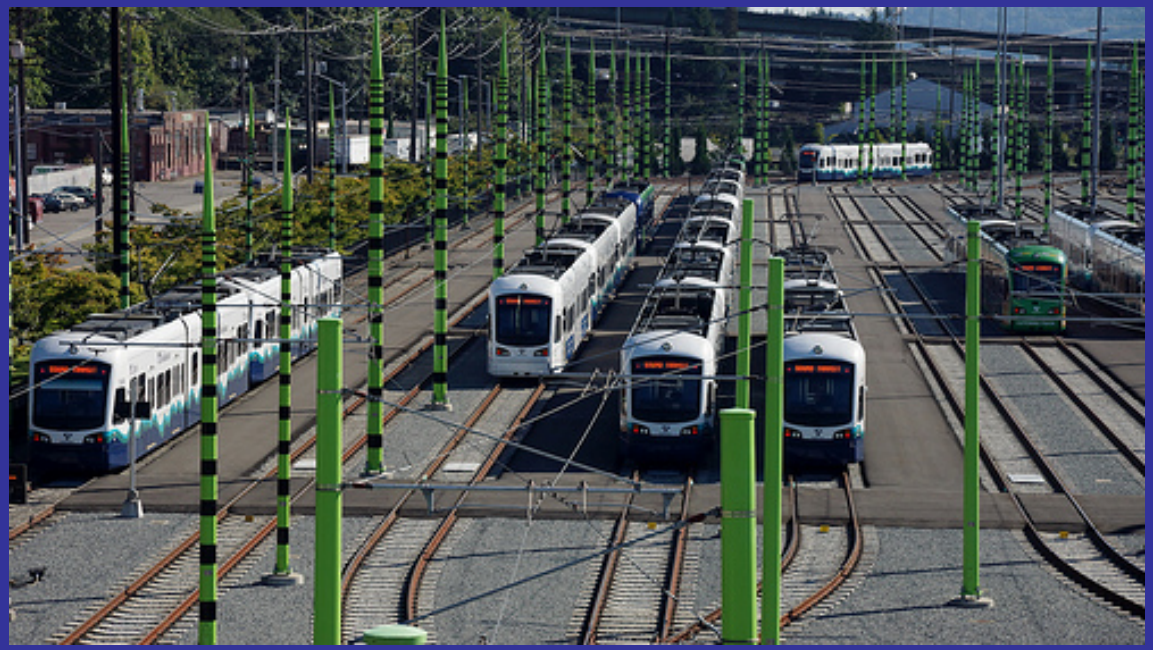


Photo: Flickr

- Space per railcar: 770- 2760 SF (71-253 m²)
- Cost per car-space: $416,000-$1,546,000

Summation

- Hopefully helpful to North American communities in considering, evaluating, and conceptualizing new LRT systems
- Guidelines could be useful for planners, civic leaders, decisionmakers, and community stakeholders to give a general understanding of LRT design and technical issues
- Comprehensive manual could elaborate and expand on many of the topics discussed

Further Information

Copy of paper:

LightRailNow.Wordpress.com

Contact author:

Lyndon Henry

Nawdry@gmail.com

Phone 512.441-3014