

Building LRT Urban Track Structures Considerations on Vertical Gradients

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Special Trackwork – an Essential System Operation Element

- Definition of special trackwork?
- Can special trackwork be located on slope and are we pushing design envelope too far?
- Where are the optimal special trackwork locations?
- What are the criteria and design considerations?

Considerations for Installing Special Trackwork on Vertical Gradients

1. Track alignment optimization
2. Track supporting structures
3. Special trackwork installation and constructability
4. Track-train dynamic (Ref. to Railroad Engineering by Dr. Hay)
5. Climate and maintenance considerations (Edmonton +/-40°C)



Considerations for Installing Special Trackwork on Vertical Gradients:

6. Track alignment design controls and constraints on linear design:

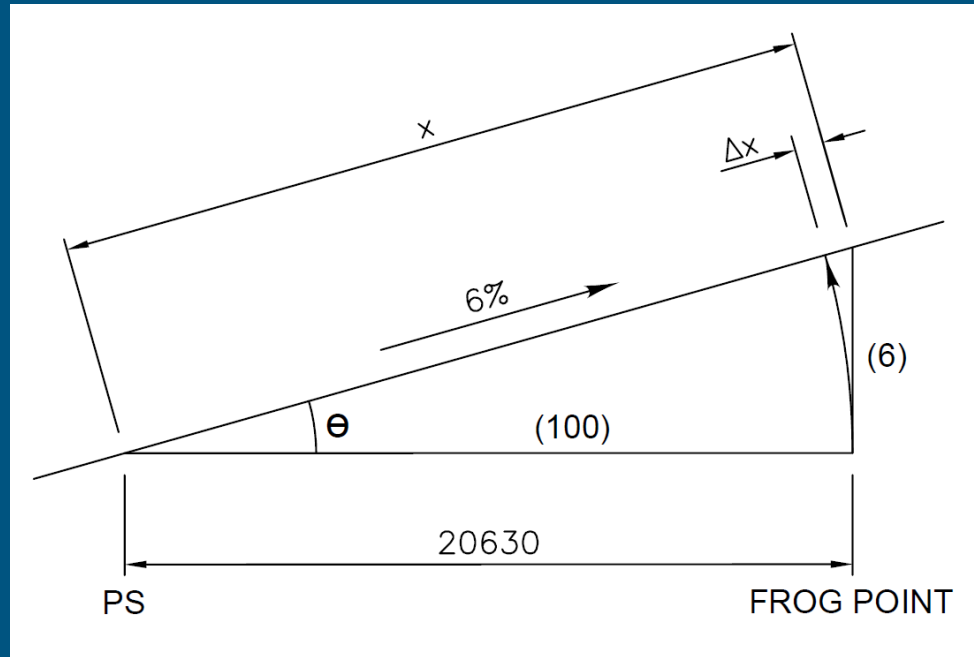
- **Design layouts** are normally done in accordance with an established coordinate system of x, y and z in linear design.
- Effects of **survey control network** on special trackwork:

Grid coordinate Vs ground coordinate systems (special trackwork are measured in **true ground distances**)



Considerations for Installing Special Trackwork on Vertical Gradients

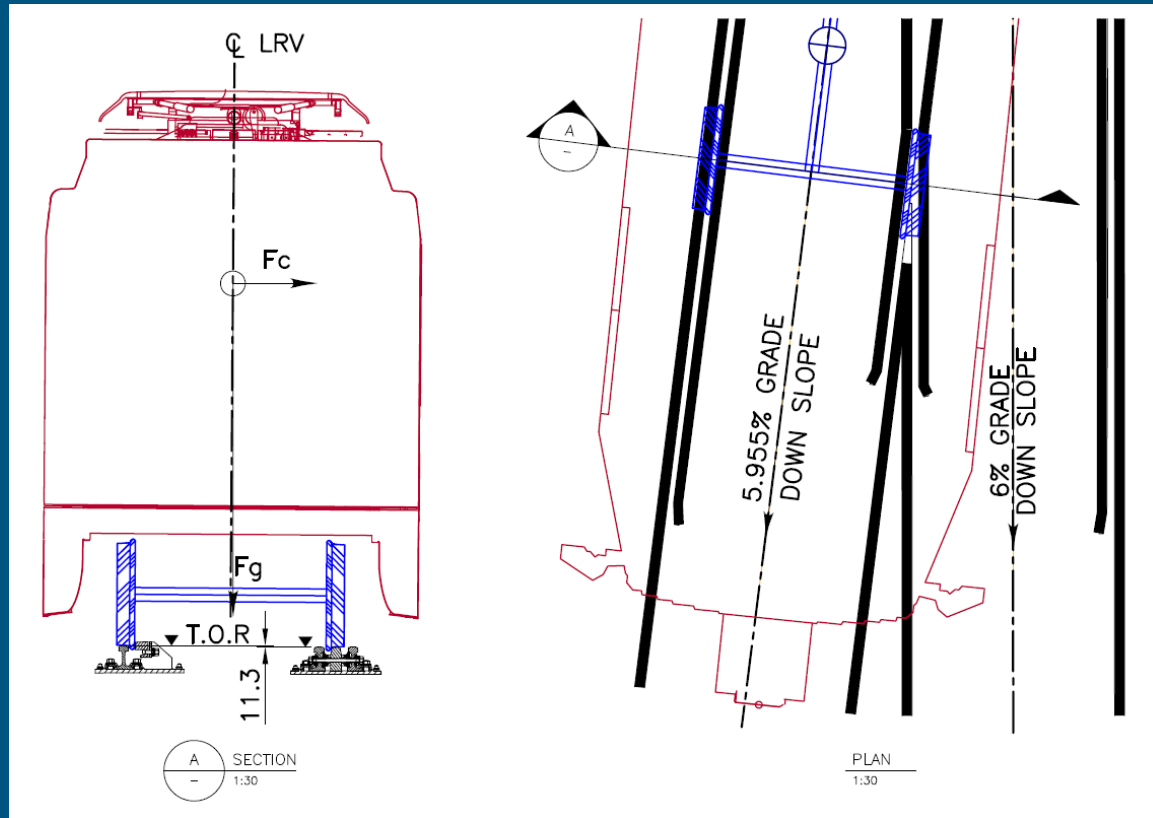
- The significance of the 3rd dimension (z) on a **tilted plane** that impacts on special trackwork:



- Length Adjustments for tilted plane and coordinate system are required for construction layout.

Considerations for Installing Special Trackwork on Vertical Gradients

7. Induced negative superelevation:



- Wheel tends to bear against the frog point


Considerations for Installing Special Trackwork on Vertical Gradients:

8. Why a good understanding of special trackwork fabrication and how it operates is absolutely essential for trackwork/alignment designer ?

- Areas that are subject to the highest impact forces and susceptible to train derailment.
- A good understanding of special trackwork could mean a safer design and ultimately, a safer operating system

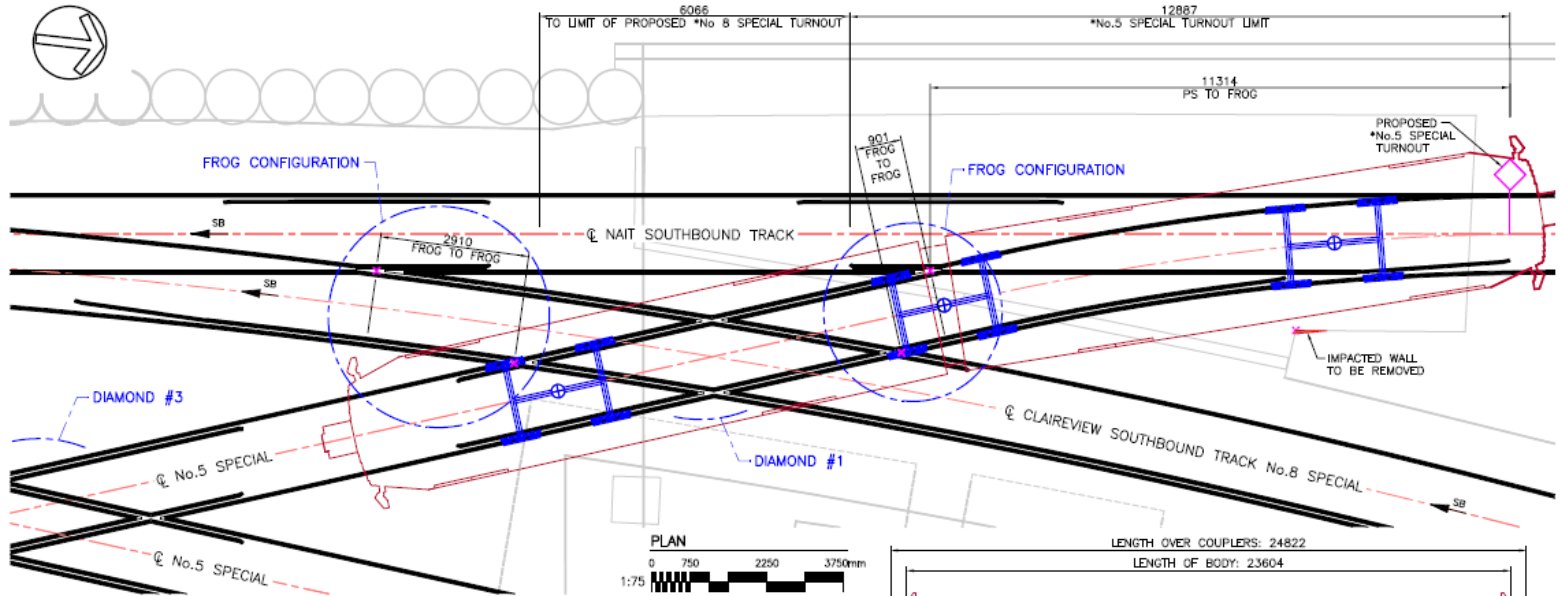


Considerations for Installing Special Trackwork on Vertical Gradients

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- The diagram shows a vertical track layout with four parallel vertical lines representing the rails. Two curved lines represent the turnout frog, crossing between the rails. Small diamond symbols are placed at the points where the frog crosses the rails, indicating the switch entry points. The frog is positioned such that it overlaps with the diamond symbols.
- **Turnout geometry** - angle of attack at the switch entry point.
 - **Frog configuration** – turnout frog overlapping distance with diamond:

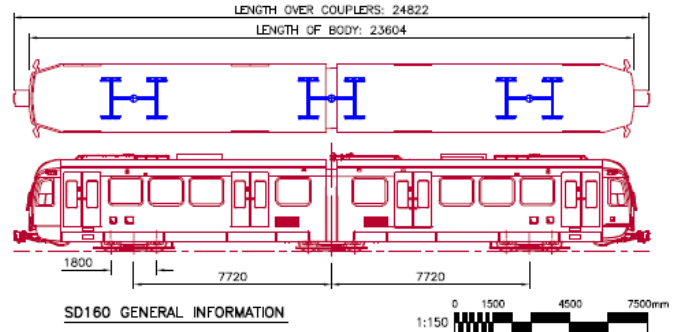
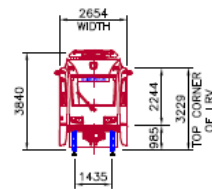
Overlapping distance must be sufficient to avoid wheels of the same wheel set to cross the “gap” at the same time.

Considerations for Installing Special Trackwork on Vertical Gradients



NOTE:
 LRV SD160
 BASED ON TANGENTIAL TURNOUT GEOMETRY:
 *No.5 SPECIAL TURNOUT (4.5)
 T/O RADIUS = 50,000 m
 T/O SPEED = 20 km/hr
 *No.8 SPECIAL TURNOUT (CURVED)
 T/O RADIUS = 180,000 m
 T/O SPEED = 39 km/hr

FOR DISCUSSION ONLY

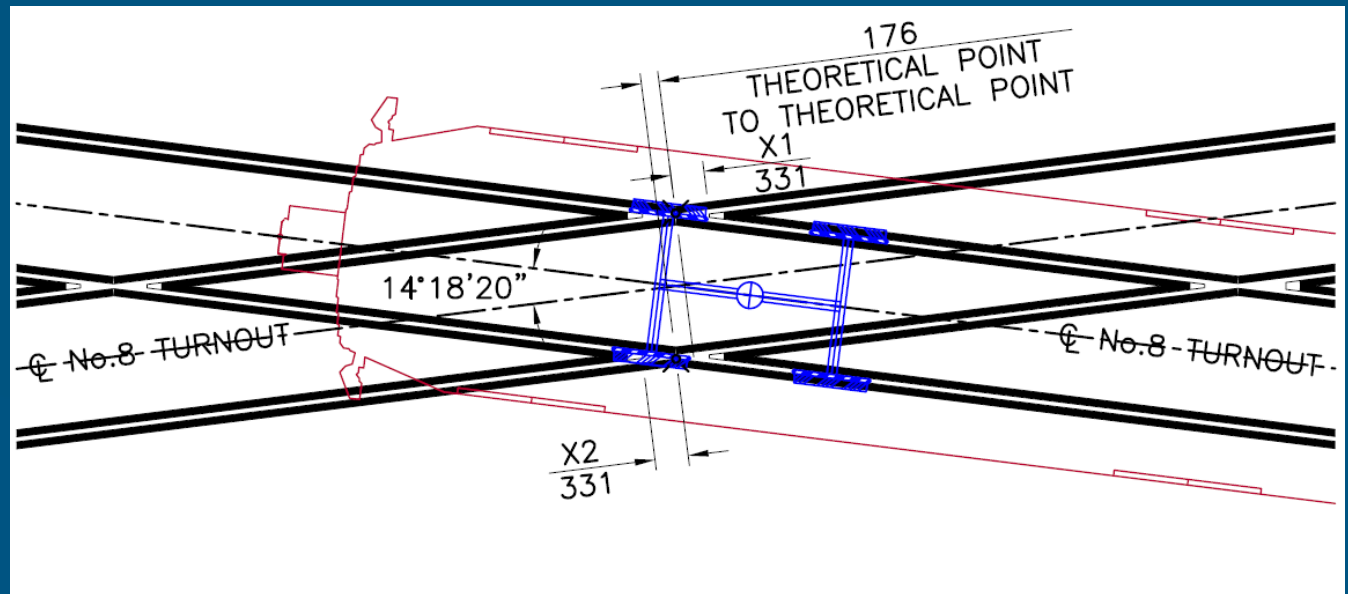


Edmonton CAPITAL CONSTRUCTION
NORTH LRT EXTENSION
 EDMONTON, AB
 Drawn By: A. BONDA
 Designed By: F. LAM
 Checked By: F. LAM
 Date: 06-APR-09
 Title: CHURCHILL TO NAIT No.5 SPECIAL TURNOUT FROG CONFIGURATION
 Draw No: SK-PM-T-08

Considerations for Installing Special Trackwork on Vertical Gradients

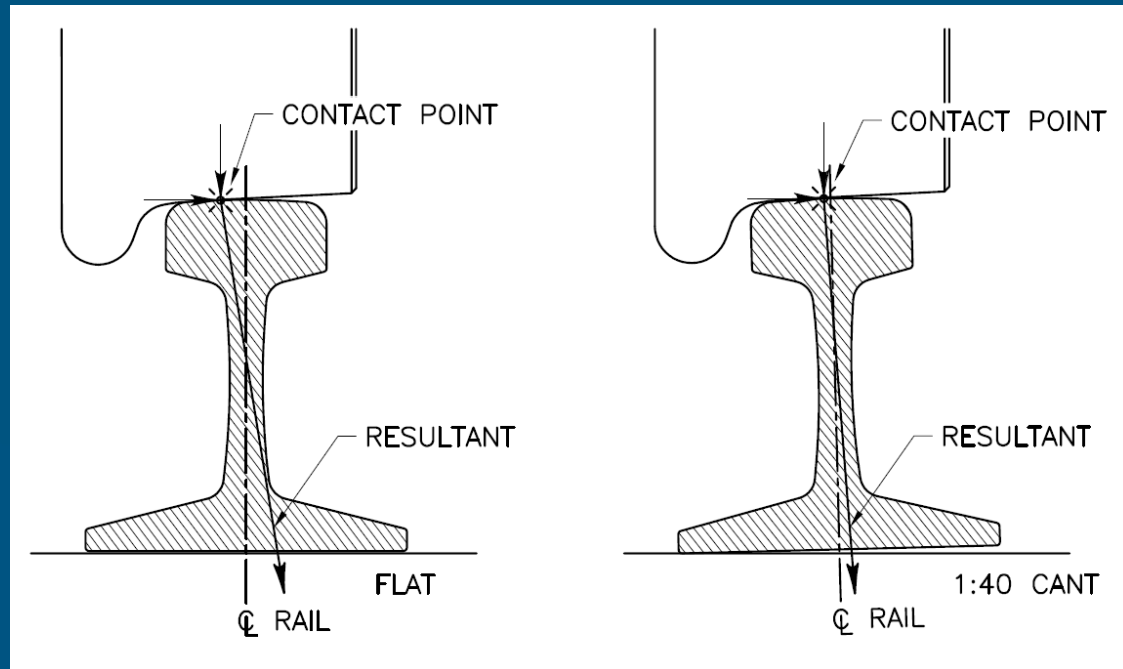
- **Frog spacing** - close proximity of frog spacing at diamond crossing:

TCRP 57, The Track Design Handbook for Light Rail Transit, Chapter 6.4.7 - Diamond crossing flatter than No. 6 frog angle is not recommended.



Considerations for Installing Special Trackwork on Vertical Gradients

- The significance of the 4th dimension, **operating speed** (v) that impacts on special trackwork and;
- Effect of **rail-wheel interface** on special trackwork.



Considerations for Installing Special Trackwork on Vertical Gradients

- Precautionary Measures if special trackwork are installed on steep vertical gradients:
 - Operating speed and limitation through Special Trackwork;
 - Switch point protector for facing point movement for mainline operation;
 - Rail anchor or anti-creep devices to prevent misalignment of switches.



Considerations for Installing Special Trackwork on Vertical Gradients

- Conclusions:
 - Criteria for locating special trackwork are **system specific**.
 - The designer **must** have a good understanding of:
 - Special trackwork fabrication;
 - Characteristics of rolling stock;
 - Track structures and;
 - Alignment design and optimization.
 - Operational safety is the **top priority**.



Considerations for Installing Special Trackwork on Vertical Gradients

- Acknowledgments:

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- The City of Edmonton
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- Edmonton Transit System
- AECOM Management

